

# EPA REFERRAL SUPPORTING DOCUMENT

CW01923 Walpole New Source Borefield Trial

AU213008632.001  
17 July 2023  
Rev 0

## REPORT

### Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Draft A	Draft for review	RebDaw	SteRol	NA	8/05/2023
Rev 0	Final for issue	RebDaw	SteRol	SteRol	13/07/2023

### Approval for issue

S. Rolls

17 July 2023

This report was prepared by RPS within the terms of RPS' engagement with its client and in direct response to a scope of services. This report is supplied for the sole and specific purpose for use by RPS' client. The report does not account for any changes relating the subject matter of the report, or any legislative or regulatory changes that have occurred since the report was produced and that may affect the report. RPS does not accept any responsibility or liability for loss whatsoever to any third party caused by, related to or arising out of any use or reliance on the report.

#### Prepared by:

#### RPS

Rebecca Dawson  
Managing Scientist

Level 3, 500 Hay Street  
Subiaco, WA 6008

T +61 8 9211 1111  
E rebecca.dawson@rpsgroup.com.au

#### Prepared for:

#### Water Corporation

Caitlin McLeod  
Senior Environmental Advisor

629 Newcastle Street  
Leederville WA 6007

T (08) 9420 2724  
E caitlin.mcleod@watercorporation.com.au

# Contents

<b>EXECUTIVE SUMMARY</b> .....	<b>1</b>
Proposal description .....	1
Summary of potential impacts, proposed mitigation and environmental outcomes .....	5
<b>1 INTRODUCTION</b> .....	<b>14</b>
1.1 Purpose and scope of this document .....	14
1.1.1 Purpose of this document .....	14
1.1.2 Structure of this document .....	14
Proponent details .....	14
<b>2 PROPOSAL</b> .....	<b>15</b>
2.1 Justification .....	15
2.2 Proposal content .....	15
2.3 Proposal alternatives .....	16
<b>3 LEGISLATIVE CONTEXT</b> .....	<b>22</b>
3.1 Environmental impact assessment process .....	22
3.1.1 <i>Environmental Protection Act 1986</i> .....	22
3.2 Other approvals and regulation .....	23
3.3 <i>Environmental Protection and Biodiversity Conservation Act 1999</i> .....	23
3.3.1 EPBC Act assessment context .....	24
<b>4 STAKEHOLDER ENGAGEMENT</b> .....	<b>25</b>
4.1 Key stakeholders .....	25
4.2 Stakeholder engagement process .....	25
4.3 Stakeholder consultation outcomes .....	25
<b>5 OBJECT AND PRINCIPLES OF THE EP ACT</b> .....	<b>28</b>
<b>6 ENVIRONMENTAL FACTORS AND OBJECTIVES</b> .....	<b>30</b>
<b>7 FLORA AND VEGETATION</b> .....	<b>32</b>
7.1 EPA objective .....	32
7.2 Policy and guidance .....	32
7.3 Environmental investigations .....	32
7.4 Receiving environment .....	34
7.4.1 Interim Biogeographical Regionalisation of Australia .....	34
7.4.2 Regional vegetation mapping .....	34
7.4.3 Surveyed vegetation units .....	36
7.4.4 Vegetation condition .....	38
7.4.5 Ecological communities .....	38
7.4.6 Conservation significant flora .....	43
7.4.7 Introduced species .....	46
7.5 Potential environmental impacts .....	46
7.5.1 Assessment of impacts .....	46
7.6 Mitigation .....	50
7.7 Assessment and significance of residual impact .....	52
7.8 Environmental outcomes .....	52
<b>8 SUBTERRANEAN FAUNA</b> .....	<b>53</b>
8.1 EPA objective .....	53
8.2 Policy and guidance .....	53
8.3 Environmental investigation .....	53
8.3.1 Desktop assessment .....	53
8.3.2 Stygofauna survey .....	54
8.3.3 Groundwater quality sampling .....	56

8.4	Receiving environment.....	56
8.4.1	Potential habitat .....	56
8.4.2	Stygofauna species .....	58
8.5	Potential environmental impacts .....	59
8.5.1	Assessment of impacts .....	59
8.6	Mitigation .....	60
8.7	Assessment and significance of residual impact .....	63
8.8	Environmental outcomes.....	63
<b>9</b>	<b>TERRESTRIAL ENVIRONMENTAL QUALITY .....</b>	<b>64</b>
9.1	EPA objective .....	64
9.2	Policy and guidance .....	64
9.3	Environmental investigation .....	64
9.3.1	Acid sulfate soil investigations .....	64
9.4	Receiving environment.....	66
9.4.1	Acid sulfate soils .....	66
9.4.2	Contaminated sites .....	68
9.5	Potential environmental impacts .....	71
9.5.1	Assessment of impacts .....	71
9.6	Mitigation .....	73
9.7	Assessment and significance of residual impact .....	75
9.8	Environmental outcomes.....	75
<b>10</b>	<b>TERRESTRIAL FAUNA.....</b>	<b>76</b>
10.1	EPA objective .....	76
10.2	Policy and guidance .....	76
10.3	Environmental investigation .....	76
10.3.1	Terrestrial vertebrate fauna surveys.....	76
10.3.2	Aquatic fauna surveys .....	76
10.3.3	Short range endemic surveys .....	79
10.4	Receiving environment.....	81
10.4.1	Fauna habitats .....	81
10.4.2	Significant fauna .....	84
10.4.3	Short range endemic species .....	93
10.5	Potential impacts .....	95
10.5.1	Assessment of impacts .....	96
10.6	Mitigation .....	103
10.7	Assessment and significance of residual impacts.....	106
10.8	Environmental outcomes.....	106
<b>11</b>	<b>INLAND WATERS .....</b>	<b>107</b>
11.1	EPA objective .....	107
11.2	Policy and guidance .....	107
11.3	Environmental investigation .....	107
11.3.1	Surface water investigations.....	107
11.3.2	Groundwater investigations .....	107
11.3.3	Groundwater Dependent Ecosystems .....	111
11.4	Receiving environment.....	111
11.4.1	Groundwater .....	111
11.4.2	Surface water.....	112
11.4.3	Groundwater Dependent Ecosystems .....	117
11.5	Potential impacts .....	121
11.5.1	Assessment of impacts .....	121
11.6	Mitigation .....	125
11.7	Assessment and significance of residual impact .....	128

11.8	Environmental outcomes.....	128
<b>12</b>	<b>SOCIAL SURROUNDINGS .....</b>	<b>129</b>
12.1	EPA objective.....	129
12.2	Policy and guidance .....	129
12.2.1	Aboriginal heritage and culture .....	129
12.2.2	Natural and historic heritage.....	129
12.2.3	Bushfire.....	129
12.3	Environmental investigations .....	129
12.3.1	Aboriginal heritage.....	129
12.4	Receiving environment.....	129
12.4.1	Aboriginal heritage.....	129
12.4.2	Natural heritage .....	130
12.4.3	Bushfire.....	130
12.4.4	Surrounding groundwater users .....	130
12.5	Potential impacts.....	133
12.6	Assessment of impacts .....	133
12.6.1	Impacts to Aboriginal heritage .....	133
12.6.2	Bushfire impacts .....	133
12.6.3	Groundwater drawdown impacts to other land users .....	133
12.7	Mitigation.....	133
12.8	Assessment and significance of residual impacts.....	135
12.9	Proposed environmental outcomes .....	135
<b>13</b>	<b>OTHER ENVIRONMENTAL FACTORS OR MATTERS .....</b>	<b>136</b>
<b>14</b>	<b>OFFSETS .....</b>	<b>137</b>
<b>15</b>	<b>MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE.....</b>	<b>138</b>
<b>16</b>	<b>HOLISTIC IMPACT ASSESSMENT .....</b>	<b>139</b>
<b>17</b>	<b>CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT .....</b>	<b>140</b>
17.1	Flora and vegetation .....	140
17.2	Subterranean fauna .....	140
17.3	Terrestrial fauna .....	141
17.4	Inland waters.....	141
<b>18</b>	<b>REFERENCES.....</b>	<b>142</b>

## Tables

Table 1:	Proposal overview.....	1
Table 2:	Location and proposed extent of physical and operational elements.....	2
Table 3:	Summary of the potential impacts, proposed mitigation and environmental outcomes.....	6
Table 4:	Proposal overview .....	15
Table 5:	Location and proposed extent of physical and operational elements.....	16
Table 6:	Water source alternatives currently being investigated. ....	17
Table 7:	Applicable EPA guidance and technical reports .....	22
Table 8:	Other approval requirements .....	23
Table 9:	Matters of national environmental significance .....	23
Table 10:	Stakeholder engagement process .....	25
Table 11:	Summary of consultation with state government agencies and regulators, local government and the local community .....	26
Table 12:	Summary of consultation with traditional owners.....	27
Table 13:	Object and principles of the EP Act .....	28

Table 14:	EPA key environmental factors and their relevance to the proposed borefield expansion .....	30
Table 15:	Pre-European vegetation associations, remnant extent and reservation status .....	34
Table 16:	Vegetation units .....	36
Table 17:	Vegetation condition.....	38
Table 18:	Ecological communities.....	38
Table 19:	Database search results .....	44
Table 20:	Introduced taxa in the study area.....	46
Table 21:	Potential impacts on flora and vegetation .....	46
Table 22:	Groundwater dependent native vegetation within the zone of influence .....	47
Table 23:	Application of mitigation hierarchy to flora and vegetation .....	50
Table 24:	Stygofauna sample locations .....	54
Table 25:	Aquifers within the zone of influence .....	56
Table 26:	Stygofauna species identified during surveys.....	58
Table 27:	Potential impacts on subterranean fauna .....	59
Table 28:	Application of mitigation hierarchy to subterranean fauna.....	61
Table 29:	Additional monitoring proposed.....	66
Table 30:	Summary of surface water physical parameters (RPS, 2023c).....	67
Table 31:	Potential impacts on terrestrial environmental quality .....	71
Table 32:	Application of mitigation hierarchy to Terrestrial Environmental Quality .....	74
Table 33:	Fauna habitat present within the fauna survey area and modelled zone of influence.....	81
Table 34:	Walpole River habitat assessment.....	83
Table 35:	Significant fauna species potentially occurring within vicinity of the proposal .....	86
Table 36:	Potential SRE species identified within the zone of influence .....	94
Table 37:	Potential impacts on Terrestrial Fauna .....	96
Table 38:	Risk of impact level and magnitude of permissible change for phreatophytic vegetation .....	97
Table 39:	Risk assessment of groundwater drawdown on significant fauna habitat .....	97
Table 40:	Summary of potential impacts to habitat suitable for significant terrestrial fauna species.....	100
Table 41:	Risk assessment of groundwater drawdown on SRE habitat .....	101
Table 42:	Application of mitigation hierarchy to Terrestrial Fauna.....	104
Table 43:	Monthly streamflow at the Walpole River Weir .....	114
Table 44:	Surface water levels at the Walpole River .....	116
Table 45:	Phreatophytic categories within the zone of influence .....	119
Table 46:	Potential impacts to Inland Waters .....	121
Table 47:	Risk of impact level and magnitude of permissible change for phreatophytic vegetation .....	122
Table 48:	Risk assessment of groundwater drawdown on GDEs.....	123
Table 49:	Application of mitigation hierarchy to Inland Waters.....	125
Table 50:	Potential impacts to Social Surroundings .....	133
Table 51:	Application of mitigation hierarchy to Social Surroundings.....	134
Table 52:	Overview of other environmental factors .....	136
Table 53:	Matters of national environmental significance summary .....	138

## Plates

Plate 1:	Aquatic habitat at the Plain Road upstream site (AQU01), March 2020. Left – woody debris visible in water column and along surface of water. Right – submerged macrophyte at the upstream end of the site (DWER 2020).....	78
Plate 2:	Aquatic habitat at the Plain Road downstream site (AQU02), March 2020. Left – woody debris visible in water column. Right – stream shading along river width, looking upstream (DWER, 2020).....	79
Plate 3:	Walpole River Weir (downstream) (DWER 2020).....	113

## Figures

Figure 1:	Physical elements: Groundwater abstraction bore locations .....	3
Figure 2:	Modelled groundwater drawdown area .....	4
Figure 3:	Alternative to the proposal – Chatley Road Dam .....	18
Figure 4:	Groundwater abstraction bore locations .....	19
Figure 5:	Properties within the zone of influence .....	21
Figure 6:	Ecological survey boundary (orange border) .....	33
Figure 7:	Vegetation complexes .....	35
Figure 8:	Vegetation units .....	40
Figure 9:	Vegetation condition .....	41
Figure 10:	Potential (future and currently unlisted) TEC – <i>Empodisma gracillimum</i> peatlands of south-west Western Australia .....	42
Figure 11:	<i>Aotus carinata</i> (P4) locations .....	45
Figure 12:	Depth to groundwater (MBGL) .....	49
Figure 13:	Stygofauna sampling locations .....	55
Figure 14:	Geology .....	57
Figure 15:	Groundwater, surface water and soil monitoring locations .....	65
Figure 16:	Acid sulfate soils .....	69
Figure 17:	Contaminated sites .....	70
Figure 18:	Soil net acidity within the zone of influence (RPS, 2023c) .....	72
Figure 19:	Stream fauna survey sites within and outside fauna study area (yellow boundary) .....	77
Figure 20:	Walpole Rivers Healthy Rivers program monitoring sites (DWER 2020) .....	78
Figure 21:	SRE survey sites .....	80
Figure 22:	Fauna habitat mapping and location of conservation significant fauna species recorded .....	85
Figure 23:	Potential black cockatoo habitat within the zone of influence .....	90
Figure 24:	Known distribution of the western mud minnow .....	91
Figure 25:	Known distribution of the pouched lamprey .....	93
Figure 26:	Risk impacts assessment of groundwater drawdown on significant fauna habitat .....	98
Figure 27:	Surface water and groundwater monitoring locations .....	109
Figure 28:	Coffey Environments’ groundwater monitoring locations .....	110
Figure 29:	Global Groundwater’s bore monitoring locations .....	110
Figure 30:	Groundwater contours .....	112
Figure 31:	Surface water .....	115
Figure 32:	Walpole River’s Healthy Rivers program monitoring sites (DWER 2020) .....	117
Figure 33:	Vegetation ecohydrological states on the Gngangara mound .....	118
Figure 34:	Potential Groundwater Dependent Ecosystems within the zone of influence .....	120
Figure 35:	Risk impacts assessment of groundwater drawdown on GDEs .....	124
Figure 36:	Mapped Aboriginal heritage sites (DPLH, 2023) .....	131
Figure 37:	Bushfire prone areas .....	132

## Graphs

Graph 1:	Walpole River at Walpole Weir mean daily discharge (ML/D) 2012 to 2022 (red and orange indicate data of a lower quality) (Water Corporation 2023) .....	114
----------	---	-----

## Appendices

Appendix A:	Flora and vegetation assessment, Swann Road borefield (RPS, 2023)
Appendix B:	Groundwater Dependent Ecosystem management plan (RPS, 2023b)
Appendix C:	Detailed Stygofauna Survey for the Swann Road Walpole EIA Project (Phoenix, 2023b)

## REPORT

---

Appendix D: Acid sulfate soil detailed site assessment; Swann Road Borefield, Walpole (RPS, 2023c)

Appendix E: Walpole Implementation and Monitoring Plan (Water Corporation, 2023a)

Appendix F: Fuel Storage in Drinking Water Catchments

Appendix G: Walpole Engineering Summary Report (Water Corporation, 2023c)

Appendix H: Terrestrial fauna assessment for the Swann Road borefield, Walpole EIA Project

Appendix I: Acid Sulfate Soil Investigation; Walpole Groundwater (Coffey Environments 2010)

Appendix J: Test pumping and groundwater investigation (Global Groundwater 2021)

Appendix K: Stream fauna assessment for the Swann Road borefield project (Phoenix Environmental Sciences,

Appendix L: Short-range endemic invertebrate survey for the Swann Road Walpole EIA Project (Phoenix Environmental Sciences, 2023d)

Appendix M: Walpole New Source Borefield; Aboriginal Heritage Study (Aboriginal Land Services, 2023)

Appendix N: Emergency preparedness and response procedure (Water Corporation, 2023g)

Appendix O: DWER correspondence regarding location and containment of fuel/gensets



# EXECUTIVE SUMMARY

## Proposal description

Walpole’s water is currently sourced from Butler’s Dam, which is a small 3.3 ML turkey nest dam with a daily recharge rate of 100–300 kL. The current yields do not meet peak summer demand and water needs to be supplemented by water carting from Denmark and / or Albany (Water Corporation, 2023e). Additionally, the catchment area of Butler’s Dam contains a permanent presence of livestock, necessitating an advanced treatment process to manage pathogen risks. The peak water source abstraction from Walpole is predicted to reach as high as 415 kL per day by 2050 (Water Corporation, 2023e). Therefore, water from Butler’s Dam is not a sustainable long-term source and Water Corporation requires a new source that can deliver a peak 415 kL/day (4.6 L/s).

Water Corporation needs to identify a new source as soon as possible to manage these risks and avoid carting, as carting of water during peak periods is not a sustainable or reliable water source. Carting during peak demand in summer is equivalent to an addition of ten trucks per day on the roads. Water Corporation aims to improve source reliability and improving safety of the community and its staff and contractors by reducing and removing unnecessary risks to safety and human health (Water Corporation, 2023e).

To meet future and peak demand for water in Walpole, Water Corporation has identified a potential groundwater source in the deep underlying fractured rock aquifer north of Walpole at Swann Road. To assess its potential as a long-term sustainable water source, Water Corporation is proposing to conduct a six-month groundwater abstraction trial from the deep fractured rock aquifer at the existing abstraction bores 5/09, 3/20, 5/20 (Figure 2 and Figure 4).

The proposed groundwater abstraction trial has been modelled by the Water Corporation, and a potential zone of drawdown influence identified (Figure 2). The groundwater drawdown model undertaken by Water Corporation provides the magnitude of drawdown at the end of the six-month trial period, not the rate of drawdown. Therefore, risk assessments undertaken to support this referral are based on the magnitude of drawdown alone. Implementation of the proposed trial will provide the data required to understand the rate of drawdown from the aquifer and to determine suitability has a long-term water source. The trial will also identify if there is a connection between aquifers and the degree of connectivity.

Ecological studies have been undertaken within the modelled zone of influence, plus a buffer area. This report describes and assesses the significance of the potential environmental impacts to the Environmental Protection Authority’s (EPA’s) environmental factors within the zone of influence from implementation of the proposed groundwater abstraction trial. As the abstraction bores 5/09, 3/20, 5/20 are existing, this report addresses the operational aspects of the trial only, as summarised in Table 1 and Table 2.

The groundwater abstraction zone of influence and buffer (groundwater abstraction modelling boundary) is approximately 50% farmland, and 50% native vegetation. The upper Walpole River flows through the site, with the Keystone State Forest to the west and partially within the modelled zone of influence.

Table 1 provides an overview of the proposal and Table 2 identifies the extent of the proposal’s physical and operational elements.

**Table 1: Proposal overview**

<b>Proposal title</b>	CW01923 Walpole New Source Borefield Trial
<b>Proponent name</b>	Water Corporation
<b>Short description</b>	<p>Water Corporation propose to conduct a six-month water source abstraction trial to assess the long-term viability of a new water source for Walpole, Western Australia. The trial will be conducted during the summer peak water demand period and will use existing infrastructure. The source comprises three existing deep fractured rock bores located within the following Water Corporation Lots:</p> <ul style="list-style-type: none"> <li>• Bore 5/09 is located within the Swan Road reserve</li> <li>• Bore 3/20 is located within part of Lot on Plan P209284 12737</li> <li>• Bore 5/20 is located within part of Lot on Plan P064982 86.</li> </ul> <p>The abstraction bores will be operated up to 24 hours, seven days a week to produce a total groundwater volume of up to 415 kilolitres (kL)/day at an abstraction rate of up to 4.6 L/s.</p>

**Table 2: Location and proposed extent of physical and operational elements**

<b>Proposal element</b>	<b>Location / description</b>	<b>Maximum extent, capacity or range</b>
<b>Physical elements</b>		
Groundwater abstraction bores	Figure 1	Existing abstraction bores 05/20, 03/20 and 05/09.
<b>Construction elements</b>		
Not applicable		
<b>Operational elements</b>		
Groundwater abstraction	Figures 1 and 2	Abstraction rate of up to 4.6 L/s to a maximum production capacity of up to 415 kL/day, 24 hours a day, seven days a week for six months.  The modelled zone of influence from the proposed groundwater abstraction is shown in Figure 2. This report addresses the proposed impacts to environmental values from the modelled groundwater drawdown within the zone of influence.
<b>Proposal elements with greenhouse gas emissions</b>		
<b>Construction elements</b>		
Not applicable		
<b>Operational elements</b>		
Not applicable – Estimated to be 24.5 tonnes carbon dioxide produced over the six-month trial (i.e. <100,000 tonnes per annum of CO <sub>2-e</sub> ).		
<b>Rehabilitation</b>		
Not applicable		
<b>Commissioning</b>		
Not applicable		
<b>Other elements which affect extent of effects on the environment</b>		
<b>Proposal time*</b>	<b>Maximum project life</b>	Six months
	<b>Construction phase</b>	Not applicable
	<b>Operations phase</b>	Six months
	<b>Decommissioning phase</b>	Not applicable

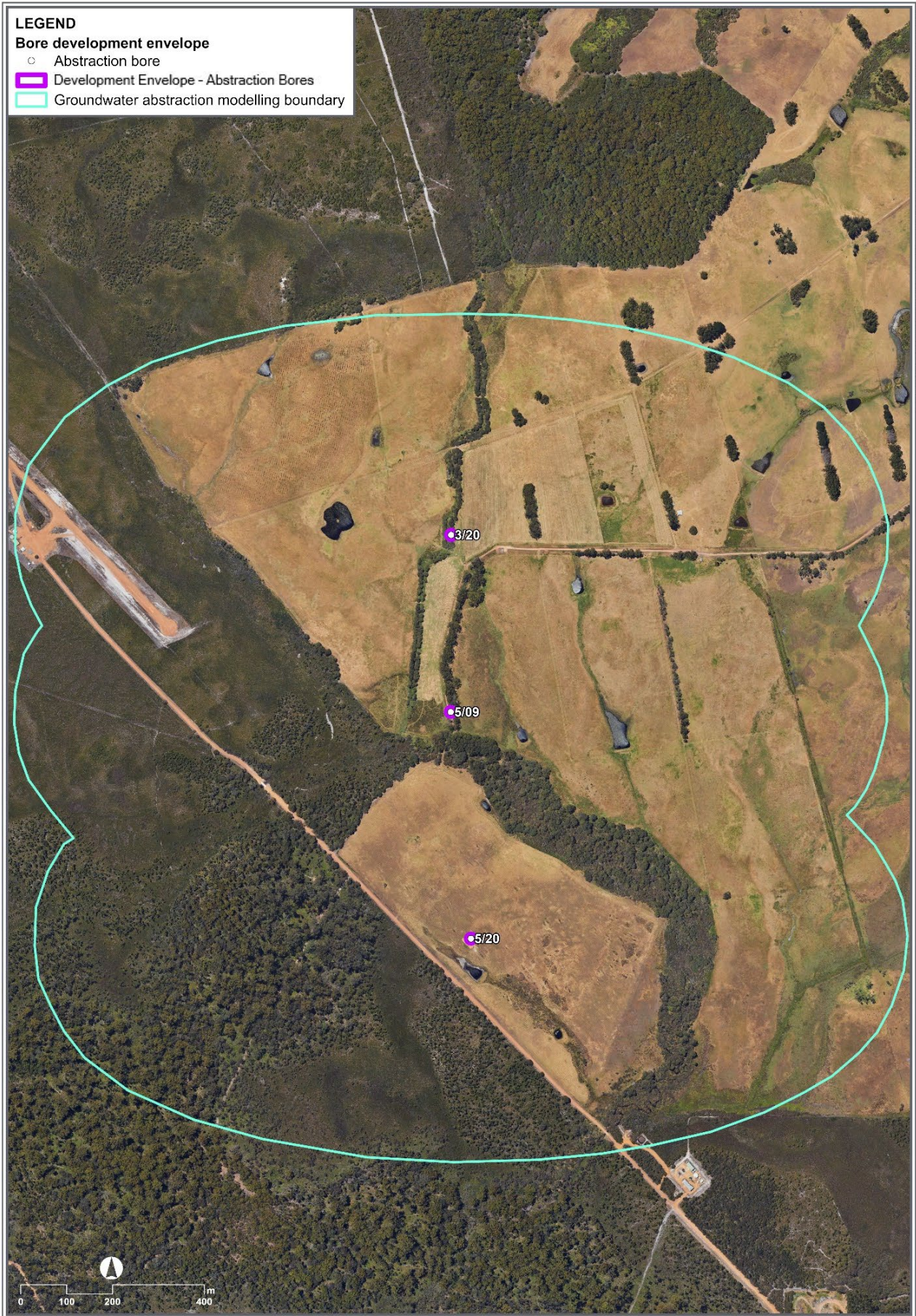


Figure 1: Physical elements: Groundwater abstraction bore locations

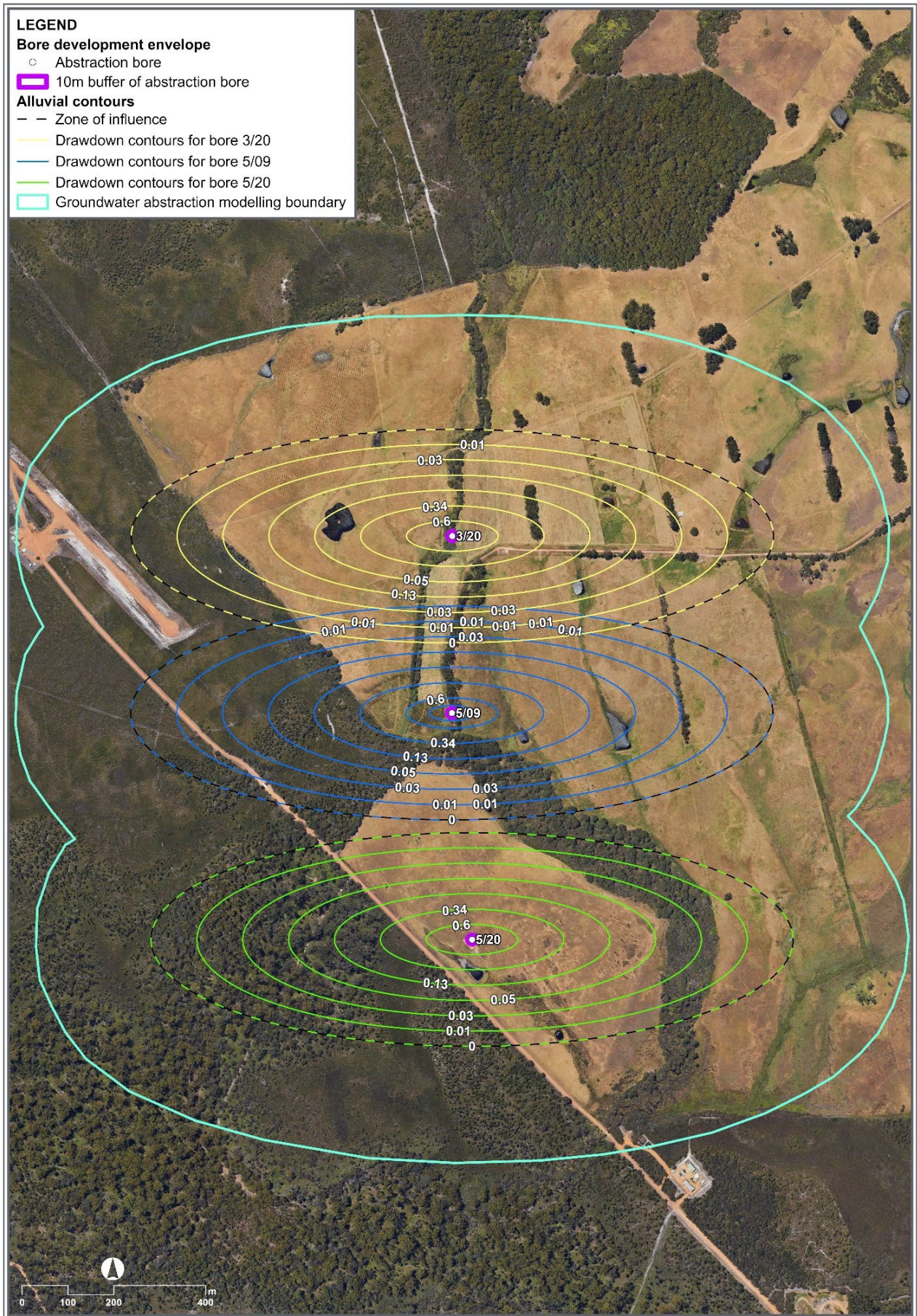


Figure 2: Modelled groundwater drawdown area

## Summary of potential impacts, proposed mitigation and environmental outcomes

This supporting document addresses the EPA's environmental factors, as outlined in the *Statement of Environmental Principles, Factors and Objectives* (EPA 2021a), of relevance to the proposal:

- Land factors
  - Flora and vegetation
  - Subterranean fauna
  - Terrestrial environmental quality
  - Terrestrial fauna
- Water factors
  - Inland waters
- People factors
  - Social surroundings.

Technical surveys, investigations and environmental impact assessments have been undertaken of these environmental factors to assess the potential and residual environmental impacts that may result from the proposal.

Table 3 summarises the results of this supporting document's assessment of the potential impacts, proposed mitigation measures and predicted outcomes (after the application of the EPA mitigation hierarchy) for each of the identified environmental factors from the implementation of the proposal.

Table 3: Summary of the potential impacts, proposed mitigation and environmental outcomes

Flora and vegetation	
<b>EPA objective</b>	To protect flora and vegetation so that biological diversity and ecological integrity are maintained (EPA, 2016a).
<b>Potential impacts</b>	<b>Direct</b> <ul style="list-style-type: none"> <li>As the groundwater abstraction bores are existing and no vegetation clearing is proposed, there will be no direct impacts to flora and vegetation from implementation of the proposed groundwater abstraction trial.</li> </ul>
	<b>Indirect</b> <ul style="list-style-type: none"> <li>Alteration of groundwater levels (drawdown) may reduce groundwater availability for groundwater dependent vegetation and flora.</li> <li>Alteration of groundwater levels may result in the exposure of acid sulfate soils, resulting in groundwater quality impacts to groundwater dependent vegetation.</li> <li>Introduction and / or distribution of weeds, pests and diseases.</li> <li>Disturbance to surrounding native vegetation through personnel accessing the bores for maintenance or monitoring activities.</li> </ul>
<b>Mitigation hierarchy</b>	<b>Avoid</b> <ul style="list-style-type: none"> <li>No flora or vegetation protected under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act) or <i>Biodiversity Conservation Act 2016</i> (BC Act) is located within the zone of influence (RPS, 2023) and therefore, no conservation significant flora or vegetation will be impacted by the proposal.</li> <li>The vegetation community <i>Empodisma gracillimum</i> peatlands of south-west Western Australia is currently under assessment by the Minister for listing under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act). Although not currently listed and protected as a TEC under the EPBC Act or BC Act, potential impacts to this vegetation have been considered as part of this impact assessment. 0.79 ha of vegetation that is likely to comprise this community (if listed) is located within the zone of influence.</li> <li>Ten individuals of the Priority species; <i>Aotus carinata</i> (P4) were recorded within the zone of influence. Based on the groundwater drawdown modelling, potential groundwater drawdown at the recorded locations of this species will range from 0.02 m and less than 0.01 m (Figure 11). This modelled drawdown is within the natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 metres below ground level (MBGL) in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021). Therefore, potential impacts to this species as a result of indirect impacts from the modelled groundwater drawdown are unlikely.</li> <li>The complete avoidance of potential impacts to flora and vegetation (including <i>Aotus carinata</i> and the potential TEC) from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of groundwater drawdown impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the Groundwater Dependent Ecosystem Management Plan (GDEMP) (RPS, 2023b) and the Walpole Groundwater Investigation Monitoring and Implementation Plan (WIMP) (Water Corporation, 2023a): <ul style="list-style-type: none"> <li>Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with operation of the bores will not be undertaken in or adjacent to native vegetation and the proposal will not result in indirect disturbance to surrounding vegetation or the introduction of weeds or disease to areas of native vegetation. No further management is considered necessary.</li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>
	<b>Minimise</b> <ul style="list-style-type: none"> <li>RPS has undertaken a risk assessment of the potential impacts of the proposed groundwater abstraction on phreatophytic vegetation within the zone of influence based on the framework developed by Froend &amp; Loomes (2004). This risk assessment is discussed in further detail in Sections 7.5.1.3 and 11.4.3 of this report. The risk assessment identified that impacts to groundwater dependent (phreatophytic) vegetation are unlikely to be significant as summarised below: <ul style="list-style-type: none"> <li>All terrestrial phreatophytic vegetation (Figure 34) has a low risk of being impacted from the six-month trial (23.1 ha, 15.5% of the zone of influence) and 43.7 ha of wetland phreatophytic vegetation has a low risk of being impacted from the six-month trial (29.25% of the zone of influence).</li> <li>4.21 ha (2.82% of the overall zone of influence) of wetland phreatophytic vegetation comprising vegetation types CcTBsLt, EpmCec and PJh has a moderate risk of being impacted from the modelled groundwater drawdown. As the majority of this vegetation is already Completely Degraded (RPS, 2023), only the 0.79 ha of CcTBsLt (18.76% of the 4.21 ha at a moderate risk of impacts) in Excellent condition is considered to be at risk from implementation of the proposal. The 0.79 ha of vegetation in excellent condition also comprises the potential (not yet listed) TEC <i>Empodisma gracillimum</i> peatlands of south-west Western Australia.</li> <li>1.93 ha (1.29% of the overall zone of influence) of wetland phreatophytic vegetation (Figure 34) comprising the EpmCec (0.16 ha) and PJh (1.78 ha) vegetation types has a high risk of being impacted from the six-month trial. However, as both of these vegetation types have been assessed as Completely Degraded, any potential impacts from groundwater drawdown are unlikely to be significant.</li> </ul> </li> <li>Based on assessments undertaken by Froend (2005), the possible response of phreatophytic vegetation within the moderate or high-risk categories are summarised below: <ul style="list-style-type: none"> <li>Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying.</li> <li>Some mortality of individuals may occur. However, the temporary and short term (six-month) nature of the groundwater drawdown means this is unlikely.</li> <li>Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).</li> </ul> </li> <li>Assessments of vegetation susceptibility and possible responses to groundwater drawdown undertaken by Froend (2005) indicate that it is unlikely that vegetation response to groundwater drawdown within the six-month trial period will be identifiable or measurable. However, the above responses may be observed after completion of the trial.</li> <li>A GDEMP (RPS, 2023b) has been prepared to minimise indirect impacts to groundwater dependent vegetation from groundwater drawdown. The GDEMP (RPS, 2023b) is provided in Appendix B of this report and includes the following measures to ensure impacts to vegetation are consistent with the EPA objective for flora and vegetation (EPA 2016): <ul style="list-style-type: none"> <li>Groundwater monitoring will be undertaken at the baseline bore (19/22) and the monitoring bores (1/22, 4/22, 8/22 and 14/22) to manage and monitor groundwater drawdown and ensure the following triggers established in consultation with the Department of Water and Environmental Regulation (DWER) are not exceeded: <ol style="list-style-type: none"> <li>Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m.</li> <li>Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m.</li> <li>Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m.</li> </ol> </li> <li>If these trigger levels are exceeded, then the management actions and corrective measures outlined in the GDE MP (RPS, 2023b) will be implemented as summarised below: <ol style="list-style-type: none"> <li>If the early response trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>If the threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore. Of the 0.79 ha of potential (not yet listed) TEC <i>Empodisma gracillimum</i> peatlands of south-west Western Australia, only 0.000165 ha is located within the 0.5 m groundwater drawdown contour.</li> <li>If the threshold criterion (of 0.5 m) is exceeded, contingency vegetation monitoring in accordance with the Groundwater Dependent Vegetation monitoring plan (provided in Appendix A of the GDE MP) will be undertaken.</li> </ol> </li> </ul> </li> <li>Impacts to groundwater water quality from the exposure of acid sulfate soils is discussed in the terrestrial environmental quality section of this table.</li> <li>Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year from completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>
	<b>Rehabilitate</b>

<b>Residual impacts</b>	<ul style="list-style-type: none"> <li>Based on the risk assessment undertaken, residual impacts are limited to the potential indirect impact from groundwater drawdown to 0.79 ha of CcTBsLt (18.76% of the 4.21 ha at a moderate risk of impacts in Excellent condition).</li> <li>The 0.79 ha of vegetation encompasses 0.53% of the overall zone of influence and has a moderate risk of being impacted by the modelled groundwater drawdown, with potential vegetation responses including:             <ul style="list-style-type: none"> <li>Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying.</li> <li>Some mortality of individuals may occur. However, the temporary and short term (six-month) nature of the groundwater drawdown means this is unlikely.</li> <li>Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).</li> </ul> </li> <li>The 0.79 ha of vegetation in excellent condition also comprises the potential (not yet listed) TEC <i>Empodisma gracillimum</i> peatlands of south-west Western Australia. Of this only 0.000165 ha is located within the 0.5 m groundwater drawdown contour (0.5 m threshold criteria).</li> </ul>
<b>Environmental outcomes</b>	<ul style="list-style-type: none"> <li>No vegetation will be cleared or directly impacted by the proposal.</li> <li>The GDEMP (RPS, 2023b) will be implemented to minimise indirect impacts to groundwater dependent vegetation from groundwater abstraction and outlines trigger and threshold criteria that provides an early warning to ensure impacts to vegetation are consistent with the EPA objective for flora and vegetation (EPA 2016).</li> <li>Groundwater and surface water monitoring will be undertaken in accordance with the following documents to determine whether trigger and threshold criteria have been exceeded:             <ul style="list-style-type: none"> <li>GDEMP (RPS, 2023b) provided in Appendix B</li> <li>Acid sulfate soil detailed site assessment (RPS, 2023c) provided in Appendix D.</li> <li>Walpole Implementation and Monitoring Plan (WIMP) (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> <li>In the event that monitoring undertaken in accordance with the above documents indicates an exceedance of the trigger or threshold criteria, Water Corporation will:             <ul style="list-style-type: none"> <li>Report the exceedance to DWER.</li> <li>Implement the appropriate response actions outlined in the GDEMP (RPS, 2023b).</li> <li>Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.</li> </ul> </li> </ul> <p>The environmental outcomes above are consistent with the EPA objective for flora and vegetation (EPA 2016), and are thereby not significant, as they to protect flora and vegetation so that biological diversity and ecological integrity are maintained. Environmental outcomes applicable to other groundwater dependent ecosystems are outlined in 'Inland Waters'.</p>
<b>Subterranean fauna</b>	
<b>EPA objective</b>	To protect subterranean fauna so that biological diversity and ecological integrity are maintained (EPA, 2016c).
<b>Potential impacts</b>	<p><b>Indirect</b></p> <ul style="list-style-type: none"> <li>No Threatened or Priority stygofauna species were identified within the stygofauna study area. However, <i>Bathynellidae</i> sp. 'Walpole 1', <i>Bathynellidae</i> sp. 'Walpole 2' and <i>Fibulacamptus</i> 'BHA346' are considered to be potentially significant as they represent new taxa that have only been found within the stygofauna study area (Phoenix, 2023b). Alteration of groundwater levels (drawdown) may reduce groundwater and habitat availability for these species within the zone of influence.</li> <li>Groundwater drawdown may result in the exposure of acid sulfate soils, resulting in water quality impacts to stygofauna habitat. Impacts to groundwater quality as a result of oxidisation of ASS is discussed in the terrestrial environmental quality section of this table.</li> </ul>
<b>Mitigation hierarchy</b>	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>No Threatened or Priority stygofauna were identified within the stygofauna study area (Phoenix, 2023b). Therefore, no conservation significant stygofauna species will be impacted by the proposal.</li> <li><i>Bathynellidae</i> sp. 'Walpole 1', <i>Bathynellidae</i> sp. 'Walpole 2' and <i>Fibulacamptus</i> 'BHA346' are new taxa which have only been found within the stygofauna study area (Phoenix, 2023b). The sampling bores within which these species were located are provided below (Figure 13):             <ul style="list-style-type: none"> <li><i>Bathynellidae</i> sp. 'Walpole 1' within sampling bores STY-04 and STY-08</li> <li><i>Bathynellidae</i> sp. 'Walpole 2' within sampling bore STY-08</li> <li><i>Fibulacamptus</i> 'BHA346' within sampling bore STY-10.</li> </ul> </li> <li>Only sampling bore STY-04 is located within the zone of influence. The other sampling bores are located outside the zone of influence and therefore impacts to the stygofauna species identified at these bores (<i>Bathynellidae</i> sp. 'Walpole 2' and <i>Fibulacamptus</i> 'BHA346') has been avoided.</li> <li>The complete avoidance of potential impacts to stygofauna species present within the zone of influence (including <i>Bathynellidae</i> sp. 'Walpole 1') from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b), ASS detailed site assessment (RPS, 2023c) and the WIMP (Water Corporation, 2023a):             <ul style="list-style-type: none"> <li>Interim groundwater level trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m)</li> <li>Groundwater trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m)</li> <li>Groundwater level threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m)</li> <li>Trigger criterion of an exceedance of field groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) over two consecutive weekly monitoring events</li> <li>Threshold criterion of an exceedance of laboratory groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) after one monitoring event.</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul> <p><b>Minimise</b></p> <ul style="list-style-type: none"> <li><i>Bathynellidae</i> sp. 'Walpole 1' was recorded within and outside the zone of influence (sampling bores STY-04 and STY-08). The fact that this species was sampled from both within and outside the zone of influence indicates physical and biological connectivity. Therefore, as the stygofauna community is not restricted to the zone of influence it is unlikely to be significantly impacted by the predicted groundwater drawdown. Furthermore, sampling bore STY-04 is located within the modelled 0.05 m drawdown contour of the zone of influence. This modelled drawdown is within the natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuations ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021).</li> <li>The GDEMP (RPS, 2023b) (Appendix B) outlines the trigger and threshold criteria listed above to minimise adverse impacts to potentially new stygofauna species identified during the stygofauna survey. If these trigger criteria are exceeded, Water Corporation will implement the following response actions in accordance with the GDEMP (RPS, 2023b) and ASS detailed site assessment (RPS, 2023c) to ensure impacts to stygofauna are consistent with the EPA objective for stygofauna (EPA, 2016c):             <ul style="list-style-type: none"> <li>If the early response groundwater level trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed and any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the groundwater level trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring.</li> <li>If the groundwater level threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> <li>Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul> <p><b>Rehabilitate</b></p> <ul style="list-style-type: none"> <li>N/A</li> </ul>

<b>Residual impacts</b>	<ul style="list-style-type: none"> <li>• There are no direct residual impacts to stygofauna resulting from the proposal.</li> <li>• Residual indirect impacts are limited to the modelled groundwater drawdown of 0.05 m at bore STY-04 (Figure 13), where the previously undescribed stygofauna species <i>Bathynellidae</i> sp. 'Walpole 1' was identified. This species was also identified outside the modelled zone of influence and is therefore not restricted to the modelled groundwater drawdown area.</li> </ul>						
<b>Environmental outcomes</b>	<ul style="list-style-type: none"> <li>• Potential impacts to water quality through the exposure of potential acid sulfate soils and water levels will be managed in accordance with the following documents:             <ul style="list-style-type: none"> <li>– GDEMP (RPS, 2023b) provided in Appendix B</li> <li>– ASS detailed site assessment (RPS, 2023c) provided in Appendix D</li> <li>– WIMP (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> <li>• In the event that monitoring undertaken in accordance with these management plans indicates an exceedance of threshold criteria specified in the plans, the Water Corporation shall implement the appropriate response actions outlined in the management plans, including:             <ul style="list-style-type: none"> <li>– Report the exceedance to DWER.</li> <li>– Implement the appropriate response actions outlined in the management plans.</li> <li>– Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.</li> </ul> </li> <li>• The environmental outcomes above are consistent with the EPA objective for Subterranean Fauna (EPA, 2016c) as they protect subterranean fauna so that biological diversity and ecological integrity are maintained</li> </ul>						
<b>Terrestrial environmental quality</b>							
<b>EPA objective</b>	To maintain the quality of land and soils so that environmental values are protected (EPA, 2016e).						
<b>Potential impacts</b>	<table border="0"> <tr> <td style="background-color: #e0e0e0;"><b>Indirect</b></td> <td> <ul style="list-style-type: none"> <li>• Exposure of potential acid sulfate soils resulting from groundwater drawdown</li> <li>• Potential hydrocarbon spills or leaks from generators and fuel tanks</li> <li>• Mobilisation of potentially contaminated groundwater from the nearby Walpole airstrip.</li> </ul> </td> </tr> </table>	<b>Indirect</b>	<ul style="list-style-type: none"> <li>• Exposure of potential acid sulfate soils resulting from groundwater drawdown</li> <li>• Potential hydrocarbon spills or leaks from generators and fuel tanks</li> <li>• Mobilisation of potentially contaminated groundwater from the nearby Walpole airstrip.</li> </ul>				
<b>Indirect</b>	<ul style="list-style-type: none"> <li>• Exposure of potential acid sulfate soils resulting from groundwater drawdown</li> <li>• Potential hydrocarbon spills or leaks from generators and fuel tanks</li> <li>• Mobilisation of potentially contaminated groundwater from the nearby Walpole airstrip.</li> </ul>						
<b>Mitigation hierarchy</b>	<table border="0"> <tr> <td style="background-color: #e0e0e0;"><b>Avoid</b></td> <td> <p><b>Acid sulfate soils</b></p> <ul style="list-style-type: none"> <li>• The modelled drawdown of up to 0.6 m will typically be within natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021). Soils above the existing groundwater level (November 2022) are characterised as potential acid sulfate soils (PASS) and will be naturally oxidising during seasonal groundwater fluctuations. However, as water demand will be greatest during the summer months when groundwater levels are typically lowest, there is the potential for soils not normally exposed to oxygen to be dewatered. The potential effects of ASS oxidation will be monitored through groundwater and surface water monitoring as discussed below.</li> </ul> <p><b>Contamination</b></p> <ul style="list-style-type: none"> <li>• RPS undertook a contaminated sites desktop assessment as part of this impact assessment to assess the risk for contamination to be present within or adjacent to the zone of influence. Based on the desktop assessment, RPS determined the risk of contamination within and adjacent to the zone of influence to be low.</li> <li>• The power source for the abstraction bores proposed will be diesel generators due to the temporary nature of the groundwater abstraction trial. Therefore, due to the nature of the proposal, it is not possible to completely avoid the risk for hydrocarbon spills.</li> </ul> </td> </tr> <tr> <td style="background-color: #e0e0e0;"><b>Minimise</b></td> <td> <p><b>Acid sulfate soils</b></p> <ul style="list-style-type: none"> <li>• Monitoring of surface water, groundwater and soils will be undertaken for assessment against relevant triggers. Should monitoring results exceed the triggers, appropriate contingency actions will be implemented to ensure that impacts resulting from exposure of ASS are not significant. The proposed monitoring, trigger criteria and threshold criteria and contingency measures are outlined in the following documents which will be implemented during the proposed trial:             <ul style="list-style-type: none"> <li>– An ASS detailed site assessment (RPS, 2023c) (Appendix D) to minimise impacts to flora, fauna and inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>– A GDEMP (RPS, 2023b) (Appendix B) to minimise and monitor for impacts to GDEs from potential changes to groundwater and surface water quality resulting from exposure of ASS. Relevant threshold levels and contingency actions are summarised below:                 <ol style="list-style-type: none"> <li>Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m. If the early response groundwater level trigger criterion is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m. If the groundwater level trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m. If the groundwater level threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>Trigger criterion of an exceedance of field groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) over two consecutive weekly monitoring events. If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>Threshold criterion of an exceedance of laboratory groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) after one monitoring event. If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>The surface water quality trigger criterion states; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events. If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>The surface water quality threshold criterion states; no exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event. If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.                 <ul style="list-style-type: none"> <li>– The WIMP (Water Corporation, 2023a) (Appendix E) to minimise and monitor for impacts to GDEs, and the environment generally, from potential changes to groundwater and surface water quality resulting from exposure of ASS. Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> </ol> </li> </ul> </li> </ul> <p><b>Contamination</b></p> <ul style="list-style-type: none"> <li>• As the airstrip is outside of the zone of influence, the risk of mobilisation of any potential contaminants due to the pumping from the confined abstraction bores during the trial is low. Pressure monitoring of the production and monitoring bores will also be used during the trial to confirm groundwater movement.</li> <li>• The following measures will be implemented to minimise the risk of spills and leaks, ensuring that the risk of a spill or leak impacting the surrounding environment is low:             <ul style="list-style-type: none"> <li>– The generator compounds, housing the generators and fuel tanks, are remote from the bore compounds and have pads raised 300 mm above the natural ground level to guard against flood levels. As the trial will be undertaken over the summer and autumn period, flooding is considered a low risk.</li> <li>– The diesel fuel tanks supplying the generators will comply with the Water Corporation document; Fuel Storage in Drinking Water Catchments (Appendix F), which summarises DWER guidance on best management practices for fuel stored near sensitive water resources.</li> <li>– Double skinned self-bunded fuel storage tanks will be used.</li> <li>– A temporary bund will be used for the generator, fuel tank and fuel lines, details are provided in the Engineering summary report (Appendix G). Operators will check the bunds after rain.</li> <li>– A fuel tank level alarm will identify if levels in the tank become too low, notifying occurrence of any major spill.</li> </ul> </li> </ul> </td> </tr> <tr> <td style="background-color: #e0e0e0;"><b>Rehabilitate</b></td> <td> <ul style="list-style-type: none"> <li>• If a spill occurs, it will be appropriately contained and remediated through removal of any contaminated materials and off-site disposal in accordance with the <i>Contaminated Sites Act 2003, Landfill Waste Classification and Waste Definitions 1996 (amended 2019)</i> (DWER 2019) and Water Corporation's Emergency preparedness and response procedure provided in Appendix N.</li> </ul> </td> </tr> </table>	<b>Avoid</b>	<p><b>Acid sulfate soils</b></p> <ul style="list-style-type: none"> <li>• The modelled drawdown of up to 0.6 m will typically be within natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021). Soils above the existing groundwater level (November 2022) are characterised as potential acid sulfate soils (PASS) and will be naturally oxidising during seasonal groundwater fluctuations. However, as water demand will be greatest during the summer months when groundwater levels are typically lowest, there is the potential for soils not normally exposed to oxygen to be dewatered. The potential effects of ASS oxidation will be monitored through groundwater and surface water monitoring as discussed below.</li> </ul> <p><b>Contamination</b></p> <ul style="list-style-type: none"> <li>• RPS undertook a contaminated sites desktop assessment as part of this impact assessment to assess the risk for contamination to be present within or adjacent to the zone of influence. Based on the desktop assessment, RPS determined the risk of contamination within and adjacent to the zone of influence to be low.</li> <li>• The power source for the abstraction bores proposed will be diesel generators due to the temporary nature of the groundwater abstraction trial. Therefore, due to the nature of the proposal, it is not possible to completely avoid the risk for hydrocarbon spills.</li> </ul>	<b>Minimise</b>	<p><b>Acid sulfate soils</b></p> <ul style="list-style-type: none"> <li>• Monitoring of surface water, groundwater and soils will be undertaken for assessment against relevant triggers. Should monitoring results exceed the triggers, appropriate contingency actions will be implemented to ensure that impacts resulting from exposure of ASS are not significant. The proposed monitoring, trigger criteria and threshold criteria and contingency measures are outlined in the following documents which will be implemented during the proposed trial:             <ul style="list-style-type: none"> <li>– An ASS detailed site assessment (RPS, 2023c) (Appendix D) to minimise impacts to flora, fauna and inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>– A GDEMP (RPS, 2023b) (Appendix B) to minimise and monitor for impacts to GDEs from potential changes to groundwater and surface water quality resulting from exposure of ASS. Relevant threshold levels and contingency actions are summarised below:                 <ol style="list-style-type: none"> <li>Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m. If the early response groundwater level trigger criterion is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m. If the groundwater level trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m. If the groundwater level threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>Trigger criterion of an exceedance of field groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) over two consecutive weekly monitoring events. If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>Threshold criterion of an exceedance of laboratory groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) after one monitoring event. If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>The surface water quality trigger criterion states; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events. If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>The surface water quality threshold criterion states; no exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event. If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.                 <ul style="list-style-type: none"> <li>– The WIMP (Water Corporation, 2023a) (Appendix E) to minimise and monitor for impacts to GDEs, and the environment generally, from potential changes to groundwater and surface water quality resulting from exposure of ASS. Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> </ol> </li> </ul> </li> </ul> <p><b>Contamination</b></p> <ul style="list-style-type: none"> <li>• As the airstrip is outside of the zone of influence, the risk of mobilisation of any potential contaminants due to the pumping from the confined abstraction bores during the trial is low. Pressure monitoring of the production and monitoring bores will also be used during the trial to confirm groundwater movement.</li> <li>• The following measures will be implemented to minimise the risk of spills and leaks, ensuring that the risk of a spill or leak impacting the surrounding environment is low:             <ul style="list-style-type: none"> <li>– The generator compounds, housing the generators and fuel tanks, are remote from the bore compounds and have pads raised 300 mm above the natural ground level to guard against flood levels. As the trial will be undertaken over the summer and autumn period, flooding is considered a low risk.</li> <li>– The diesel fuel tanks supplying the generators will comply with the Water Corporation document; Fuel Storage in Drinking Water Catchments (Appendix F), which summarises DWER guidance on best management practices for fuel stored near sensitive water resources.</li> <li>– Double skinned self-bunded fuel storage tanks will be used.</li> <li>– A temporary bund will be used for the generator, fuel tank and fuel lines, details are provided in the Engineering summary report (Appendix G). Operators will check the bunds after rain.</li> <li>– A fuel tank level alarm will identify if levels in the tank become too low, notifying occurrence of any major spill.</li> </ul> </li> </ul>	<b>Rehabilitate</b>	<ul style="list-style-type: none"> <li>• If a spill occurs, it will be appropriately contained and remediated through removal of any contaminated materials and off-site disposal in accordance with the <i>Contaminated Sites Act 2003, Landfill Waste Classification and Waste Definitions 1996 (amended 2019)</i> (DWER 2019) and Water Corporation's Emergency preparedness and response procedure provided in Appendix N.</li> </ul>
<b>Avoid</b>	<p><b>Acid sulfate soils</b></p> <ul style="list-style-type: none"> <li>• The modelled drawdown of up to 0.6 m will typically be within natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021). Soils above the existing groundwater level (November 2022) are characterised as potential acid sulfate soils (PASS) and will be naturally oxidising during seasonal groundwater fluctuations. However, as water demand will be greatest during the summer months when groundwater levels are typically lowest, there is the potential for soils not normally exposed to oxygen to be dewatered. The potential effects of ASS oxidation will be monitored through groundwater and surface water monitoring as discussed below.</li> </ul> <p><b>Contamination</b></p> <ul style="list-style-type: none"> <li>• RPS undertook a contaminated sites desktop assessment as part of this impact assessment to assess the risk for contamination to be present within or adjacent to the zone of influence. Based on the desktop assessment, RPS determined the risk of contamination within and adjacent to the zone of influence to be low.</li> <li>• The power source for the abstraction bores proposed will be diesel generators due to the temporary nature of the groundwater abstraction trial. Therefore, due to the nature of the proposal, it is not possible to completely avoid the risk for hydrocarbon spills.</li> </ul>						
<b>Minimise</b>	<p><b>Acid sulfate soils</b></p> <ul style="list-style-type: none"> <li>• Monitoring of surface water, groundwater and soils will be undertaken for assessment against relevant triggers. Should monitoring results exceed the triggers, appropriate contingency actions will be implemented to ensure that impacts resulting from exposure of ASS are not significant. The proposed monitoring, trigger criteria and threshold criteria and contingency measures are outlined in the following documents which will be implemented during the proposed trial:             <ul style="list-style-type: none"> <li>– An ASS detailed site assessment (RPS, 2023c) (Appendix D) to minimise impacts to flora, fauna and inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>– A GDEMP (RPS, 2023b) (Appendix B) to minimise and monitor for impacts to GDEs from potential changes to groundwater and surface water quality resulting from exposure of ASS. Relevant threshold levels and contingency actions are summarised below:                 <ol style="list-style-type: none"> <li>Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m. If the early response groundwater level trigger criterion is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m. If the groundwater level trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m. If the groundwater level threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>Trigger criterion of an exceedance of field groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) over two consecutive weekly monitoring events. If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>Threshold criterion of an exceedance of laboratory groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) after one monitoring event. If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>The surface water quality trigger criterion states; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events. If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>The surface water quality threshold criterion states; no exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event. If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.                 <ul style="list-style-type: none"> <li>– The WIMP (Water Corporation, 2023a) (Appendix E) to minimise and monitor for impacts to GDEs, and the environment generally, from potential changes to groundwater and surface water quality resulting from exposure of ASS. Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> </ol> </li> </ul> </li> </ul> <p><b>Contamination</b></p> <ul style="list-style-type: none"> <li>• As the airstrip is outside of the zone of influence, the risk of mobilisation of any potential contaminants due to the pumping from the confined abstraction bores during the trial is low. Pressure monitoring of the production and monitoring bores will also be used during the trial to confirm groundwater movement.</li> <li>• The following measures will be implemented to minimise the risk of spills and leaks, ensuring that the risk of a spill or leak impacting the surrounding environment is low:             <ul style="list-style-type: none"> <li>– The generator compounds, housing the generators and fuel tanks, are remote from the bore compounds and have pads raised 300 mm above the natural ground level to guard against flood levels. As the trial will be undertaken over the summer and autumn period, flooding is considered a low risk.</li> <li>– The diesel fuel tanks supplying the generators will comply with the Water Corporation document; Fuel Storage in Drinking Water Catchments (Appendix F), which summarises DWER guidance on best management practices for fuel stored near sensitive water resources.</li> <li>– Double skinned self-bunded fuel storage tanks will be used.</li> <li>– A temporary bund will be used for the generator, fuel tank and fuel lines, details are provided in the Engineering summary report (Appendix G). Operators will check the bunds after rain.</li> <li>– A fuel tank level alarm will identify if levels in the tank become too low, notifying occurrence of any major spill.</li> </ul> </li> </ul>						
<b>Rehabilitate</b>	<ul style="list-style-type: none"> <li>• If a spill occurs, it will be appropriately contained and remediated through removal of any contaminated materials and off-site disposal in accordance with the <i>Contaminated Sites Act 2003, Landfill Waste Classification and Waste Definitions 1996 (amended 2019)</i> (DWER 2019) and Water Corporation's Emergency preparedness and response procedure provided in Appendix N.</li> </ul>						



<b>Residual impacts</b>	<ul style="list-style-type: none"> <li>Due to the natural, seasonal fluctuations of groundwater levels and groundwater quality, quantifying the potential residual impacts to terrestrial environmental quality resulting from oxidisation of acid sulfate soils is not possible. However, implementation of the monitoring and contingency actions outlined in the ASS detailed site assessment (RPS, 2023c), GDEMP (RPS, 2023b) and WIMP (Water Corporation, 2023a) will that residual impacts to groundwater or surface water quality resulting from oxidisation of PASS are minimised and consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e).</li> </ul>
<b>Environmental outcomes</b>	<ul style="list-style-type: none"> <li>ASS to be managed in accordance with the following management plans.                             <ul style="list-style-type: none"> <li>GDEMP (RPS, 2023b) provided in Appendix B</li> <li>ASS detailed site assessment (RPS, 2023c) provided in Appendix D.</li> <li>WIMP (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> <li>In the event that monitoring undertaken in accordance with these management plans indicates an exceedance of threshold criteria for groundwater and surface water quality and groundwater levels (as specified in these plans and summarised in above), the Water Corporation shall implement the appropriate response actions outlined in the management plans, including:                             <ul style="list-style-type: none"> <li>Report the exceedance to DWER.</li> <li>Implement the appropriate response actions outlined in the GDEMP (RPS, 2023b), ASS detailed site assessment (RPS, 2023c) and WIMP (Water Corporation, 2023a).</li> <li>Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.</li> </ul> </li> <li>The environmental outcomes above are consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e) and thereby not significant, as they protect Terrestrial Environmental Quality to maintain the quality of land and soils so that environmental values.</li> </ul>

**Terrestrial fauna**

<b>EPA objective</b>	To protect terrestrial fauna so that biological diversity and ecological integrity are protected (EPA, 2016f).
<b>Potential impacts</b>	<p><b>Indirect</b></p> <ul style="list-style-type: none"> <li>Groundwater drawdown from the proposed trial may reduce ground water availability for terrestrial fauna habitat which supports conservation significant fauna species, including the peregrine falcon, Baudin's cockatoo, Carnaby's cockatoo, wambenger brush-tailed phascogale, quokka, Nornalup frog, quenda, rakali and western false pipistrelle (Table 35) (Phoenix, 2023a). Habitat within the zone of influence that is suitable for these species includes:                             <ul style="list-style-type: none"> <li>'Tall open forest', which covers 10.44 ha (6.98%) of the zone of influence</li> <li>'Riparian zone', which covers 8.63 ha (5.78%) of the zone of influence</li> <li>'Low woodlands / woodlands', which covers 13.51 ha (9.04%) of the zone of influence</li> <li>'Broad swampy plains', which covers 17.22 ha (11.52%) of the zone of influence</li> <li>'Isolated paddock remnants', which comprises 4.13 ha (2.77%) of the zone of influence</li> </ul> </li> <li>Groundwater drawdown from the proposed trial may reduce ground water availability for terrestrial fauna habitat, which supports short-range endemic (SRE) fauna species. None of the SRE species recorded by Phoenix (2023d) were conservation significant species, however the EPA (2016a) identifies species with restricted distributions as being significant fauna in the context of environmental impact assessments (Phoenix 2023d)</li> <li>Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially impacting aquatic fauna habitat. However, as the Walpole River naturally experiences no flow periods during the summer months, this impact is considered minimal. Significant aquatic fauna identified within the upper Walpole River by Phoenix (2023) includes the Walpole burrowing crayfish, blackstriped dwarf galaxias, mud minnow, Balston's pygmy perch, little pygmy perch, salamander fish and Carter's freshwater mussel</li> <li>Alteration of groundwater levels may expose acid sulfate soils, resulting in water quality impacts to the Walpole River. Impacts to water quality as a result of oxidisation of ASS is discussed in the terrestrial environmental quality section of this table</li> <li>Introduction and / or distribution of weeds, pests and diseases</li> <li>Disturbance to surrounding terrestrial fauna habitat</li> <li>Disturbance to fauna from generator noise emissions. With the acoustic enclosure installed around the generator, noise emissions at 1 m from the generators will be approximately 80 dB(A).</li> </ul>
<b>Mitigation hierarchy</b>	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>As the groundwater abstraction bores are existing and no fauna habitat is proposed to be cleared, direct impacts to fauna habitat have been avoided.</li> <li>The complete avoidance of indirect impacts to terrestrial and aquatic fauna habitat from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b) and the WIMP (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Impacts to groundwater dependent terrestrial fauna habitat will be avoided through the following threshold criteria:                                     <ol style="list-style-type: none"> <li>Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ol> </li> <li>Impacts to aquatic fauna habitat within the upper Walpole River will be avoided through the following threshold criteria:                                     <ol style="list-style-type: none"> <li>Trigger criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.30 m below the minimum baseline levels.</li> <li>Threshold criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.35 m below the minimum baseline levels.</li> <li>Trigger criterion for water quality within the Walpole River; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events.</li> <li>Threshold criterion for water quality within the Walpole River; an exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event.</li> <li>Trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir); Surface water flows exceed 63 consecutive days of no flow over the Walpole River Weir.</li> <li>Threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir); surface water flows exceed 85 consecutive days of no flow over Walpole River Weir.</li> </ol> </li> </ul> </li> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with operation of the bores will not be undertaken in or adjacent to fauna habitat and the proposal will not result in indirect disturbance to surrounding vegetation or the introduction of weeds or disease to areas of fauna habitat. No further management is considered necessary.</li> <li>The generator supplying bores 3/20 and 5/09 has been located in a cleared area approximately 380 m, away from significant fauna habitat. As it has been located away from fauna habitat, noise impacts to fauna from this generator have been avoided.</li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul> <p><b>Minimise</b></p> <ul style="list-style-type: none"> <li>Groundwater drawdown impacts are minimised through strategic placement of the abstraction bores within cleared agricultural areas, resulting in 95.49 ha (63.9%) of the zone of influence comprising cleared areas with no value as fauna habitat.</li> <li>RPS undertook a risk assessment of proposed groundwater abstraction on the fauna habitat within the zone of influence based on the framework developed by Froend &amp; Loomes (2004) as described in Section 10.5.1.3 and shown in Figure 26. A summary of the risk assessment is provided below:                             <ul style="list-style-type: none"> <li>52.86 ha (35.37%) of fauna habitat has been assessed as having a low risk of being impacted by the predicted groundwater drawdown and impacts to this fauna habitat from groundwater drawdown are considered unlikely.</li> <li>0.92 ha (0.62% of the zone of influence) has a medium risk of being impacted by the modelled groundwater drawdown.</li> <li>0.16 ha (0.1% of the zone of influence) has a high risk of being impacted.</li> </ul> </li> <li>Assessments of vegetation susceptibility and possible responses to groundwater drawdown undertaken by Froend (2005) indicate that it is unlikely that vegetation response to groundwater drawdown within a six-month period will be identifiable or measurable. Based on assessments undertaken by Froend, the possible response of phreatophytic vegetation associated with the habitat types within the moderate or high-risk categories are summarised below, however due to the lag in responses of vegetation to groundwater drawdown, these may occur after the trial is complete:                             <ul style="list-style-type: none"> <li>Moderate risk of groundwater drawdown impacts may result in the following possible responses:</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>a. Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying</li> <li>b. Some mortality of individuals may occur. However, considering the temporary nature of the groundwater drawdown, this is considered unlikely</li> <li>c. Some evidence of reduced growth, loss of height and loss of vigour</li> </ul> <ul style="list-style-type: none"> <li>– High risk of groundwater drawdown impacts may result in the following possible responses:             <ul style="list-style-type: none"> <li>a. Measurable reduction in rates of primary production in response to drying</li> <li>b. Mortalities, potentially resulting in greater than 15% reduction in abundance of dominant species</li> <li>c. Measurable crown dieback in overstorey species and/or reduction in cover of understorey</li> <li>d. Measurable reductions in height due to loss of canopy and/or reduced diameter of adult stems.</li> </ul> </li> </ul> <ul style="list-style-type: none"> <li>• A GDEMP (RPS, 2023b) has been prepared to minimise impacts to groundwater dependent vegetation comprising fauna habitat from indirect impacts associated with groundwater drawdown. The GDEMP (RPS, 2023b) is provided in Appendix B of this report and includes trigger values to ensure impacts to fauna habitat are consistent with the EPA objective for terrestrial fauna (EPA, 2016f). These trigger values are discussed in the avoidance section of this table. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:             <ul style="list-style-type: none"> <li>– If the early response groundwater level trigger criterion is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>– If the groundwater level trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>– If the groundwater level threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore. Contingency vegetation monitoring will also be undertaken in accordance with the GDEMP.</li> <li>– If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>– If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> <li>• The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels, flow and quality. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to aquatic fauna habitat within the upper Walpole River are consistent with the EPA objective for terrestrial fauna (EPA, 2016f). These trigger values are discussed in the avoidance section of this table. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:             <ul style="list-style-type: none"> <li>– If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>– If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>– If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>– If the threshold criterion for surface water levels is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. This data will be reviewed as well as an assessment of climatic data and surface water flows to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>– If the trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. Water Corporation will also review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water flows declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>– If the threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> </ul> </li> <li>• Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year of the trial completion that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> <li>• Water Corporation is proposing to install a soundproof canopy enclosure around both generators. With the acoustic enclosure installed, noise emissions at 1 m from the generators will be approximately 80dB(A).</li> </ul>
--	---

Rehabilitate • N/A

<b>Residual impacts</b>	<ul style="list-style-type: none"> <li>• Residual impacts are limited to the potential indirect impact to 1.08 ha (0.72% of the zone of influence) of potential fauna habitat that has a medium or high risk of being temporarily impacted by the modelled groundwater drawdown, as summarised below:             <ul style="list-style-type: none"> <li>– Moderate risk of groundwater drawdown impacts to 0.21 ha of riparian zone habitat, providing suitable habitat for conservation significant species such as Baudin's cockatoo, Carnaby's cockatoo and forest red-tail black-cockatoo, quokka, quenda, Nornalup frog, rakali, western false pipistrelle.</li> <li>– Moderate risk of groundwater drawdown impacts to 0.46 ha of broad swampy plains habitat, providing suitable habitat for conservation significant species such as Baudin's cockatoo, Carnaby's cockatoo and forest red-tail black-cockatoo, quokka, quenda, Nornalup frog.</li> <li>– Moderate risk of groundwater drawdown impacts to 0.26 ha and high risk of impacts to 0.16 ha of isolated paddock remnant (riparian) providing suitable habitat for conservation significant species such as rakali and Baudin's cockatoo, Carnaby's cockatoo and forest red-tail black-cockatoo.</li> </ul> </li> </ul>
-------------------------	---

<b>Environmental outcomes</b>	<ul style="list-style-type: none"> <li>• No fauna habitat will be cleared or directly impacted by the proposal.</li> <li>• Potential fauna habitat at risk from groundwater drawdown comprises 1.08 ha (0.72% of the zone of influence). The remainder of the fauna habitat within the zone of influence has been assessed as having a low risk of being impacted by the predicted groundwater drawdown.</li> <li>• The GDEMP (RPS, 2023b) will be implemented to ensure that:             <ul style="list-style-type: none"> <li>– The risk of impacts to habitat outside the 1.08 ha of fauna habitat (comprising habitat suitable for SRE fauna and conservation significant terrestrial fauna, including Baudin's cockatoo, Carnaby's cockatoo and forest red-tail black-cockatoo, quokka, quenda, Nornalup frog, rakali, western false pipistrelle) with a medium or high risk of impacts from groundwater drawdown is minimised, as summarised below. The GDEMP will outline trigger and threshold criteria that will provide an early warning to ensure that impacts greater than this are avoided.</li> <li>– Surface water levels, flows and quality within the Walpole River do not exceed the trigger thresholds outlined in the GDEMP and discussed in this table. The trigger and threshold criteria and response actions demonstrate that impacts to aquatic habitat within the upper Walpole River can be avoided or minimised.</li> </ul> </li> <li>• Groundwater and surface water monitoring will be undertaken in accordance with the following documents to determine whether trigger and threshold criteria have been exceeded:             <ul style="list-style-type: none"> <li>– GDEMP (RPS, 2023b) provided in Appendix B</li> <li>– ASS detailed site assessment (RPS, 2023c) provided in Appendix D.</li> <li>– Walpole Implementation and Monitoring Plan (WIMP) (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> <li>• In the event that groundwater and surface water monitoring undertaken in accordance with the above documents indicates an exceedance of the trigger or threshold criteria, Water Corporation will:             <ul style="list-style-type: none"> <li>– Report the exceedance to DWER.</li> <li>– implement the appropriate response actions outlined in the GDEMP.</li> <li>– Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.</li> </ul> </li> <li>• The environmental outcomes above are consistent with the EPA objective for Terrestrial fauna (EPA, 2016f), and thereby not significant, as they protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</li> </ul>
-------------------------------	---

## Inland waters

<b>EPA objective</b>	To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA, 2018a).	
<b>Potential impacts</b>	Indirect	<ul style="list-style-type: none"> <li>• There are no Ramsar or Wetlands of National Significance within the zone of influence.</li> <li>• The upper Walpole River is located within the zone of influence. Groundwater drawdown may result in oxidisation of PASS, which may indirectly impact water quality within the river. These impacts are discussed in the Terrestrial environmental quality section of this table.</li> <li>• Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially resulting in reduced water levels and stream flow. However, as discussed previously, due to the natural seasonal cessation of flows within the river during summer, impacts to flows from the proposal are unlikely to be significant.</li> <li>• An assessment of groundwater depths and vegetation types within the zone of influence was undertaken by RPS, in accordance with categories developed by Froend (2004) to identify potential terrestrial GDEs within the zone of influence. 72.96 ha (50.54% of the zone of influence) was mapped as a terrestrial GDE. Alteration of groundwater levels (drawdown) may reduce ground water availability for these GDEs. RPS undertook a risk assessment of proposed groundwater abstraction on the terrestrial GDEs within the zone of influence based on the framework developed by Froend &amp; Loomes (2004). A summary of the outcomes of the risk assessment is provided below: <ul style="list-style-type: none"> <li>– No terrestrial GDEs within the zone of influence have been assessed as having a severe risk of being impacted by the predicted groundwater drawdown.</li> <li>– 66.81 ha (44.71% of the zone of influence) of terrestrial GDEs have been assessed as having a low risk of being impacted by the predicted groundwater drawdown.</li> <li>– 4.21 ha (2.82% of the zone of influence) has a medium risk of being impacted by the modelled groundwater drawdown. Of this vegetation, 3.42 ha is already completely degraded and is unlikely to be impacted further. The remaining 0.79 ha is in Excellent condition is considered to be at risk from the proposal.</li> <li>– 1.93 ha (1.29% of the zone of influence) has a high risk of being impacted. This vegetation has been assessed as Completely Degraded and any potential impacts from groundwater drawdown are unlikely to be significant.</li> </ul> </li> <li>• Alteration of groundwater levels (drawdown) may reduce ground water quality, potentially impacting terrestrial GDEs. These impacts are discussed in the Terrestrial environmental quality section of this table.</li> </ul>
<b>Mitigation hierarchy</b>	Avoid	<ul style="list-style-type: none"> <li>• No phreatophytic vegetation associated with the GDEs within the zone of influence is protected under the EPBC Act or BC Act.</li> <li>• The complete avoidance of potential impacts to inland waters from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded: <ul style="list-style-type: none"> <li>– Groundwater level and quality criteria: <ol style="list-style-type: none"> <li>a. Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m)</li> <li>b. Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m)</li> <li>c. Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m)</li> </ol> </li> <li>– Surface water (Walpole River) criteria: <ol style="list-style-type: none"> <li>a. Trigger criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.30m below the minimum baseline levels</li> <li>b. Threshold criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.35m below the minimum baseline levels</li> <li>c. Trigger criterion for water quality within the Walpole River; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events</li> <li>d. Threshold criterion for water quality within the Walpole River; an exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event</li> <li>e. Trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir); Surface water flows exceed 63 consecutive days of no flow over the Walpole River Weir</li> <li>f. Threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir); surface water flows exceed 85 consecutive days of no flow over Walpole River Weir.</li> </ol> </li> </ul> </li> <li>• An ASS detailed site assessment (RPS, 2023c) (Appendix D) has been prepared to minimise impacts to inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>• The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and manage risk to the environment and ecosystems. The resultant data will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>
	Minimise	<ul style="list-style-type: none"> <li>• Impacts to terrestrial GDES have been minimised through strategic placement of the abstraction bores within cleared agricultural areas, resulting in 75.05 ha (50.22%) of the zone of influence comprising cleared areas.</li> <li>• Of the 72.96 ha (50.54% of the zone of influence) of terrestrial GDE within the zone of influence, only 0.79 ha will potentially be impacted by the modelled groundwater drawdown. Based on assessments undertaken by Froend (2005), the possible response of phreatophytic vegetation within the moderate or high-risk categories are summarised below: <ul style="list-style-type: none"> <li>– Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying</li> <li>– Some mortality of individuals may occur. However, the temporary and short term (6 month) nature of the groundwater drawdown means this is unlikely</li> <li>– Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).</li> </ul> </li> <li>• A GDEMP (RPS, 2023b) has been prepared to minimise and manage indirect impacts to the 0.79 ha of terrestrial GDEs in Excellent condition is at risk of being impacted by the groundwater drawdown. Groundwater monitoring will be undertaken at the baseline bore (19/22) and the monitoring bores (1/22, 4/22, 8/22 and 14/22) to manage and monitor groundwater drawdown and ensure the triggers discussed in the section above are not exceeded. If these trigger levels are exceeded, then the management actions and corrective measures outlined in the GDE MP (RPS, 2023b) will be implemented to ensure impacts to inland waters are consistent with the EPA objective (EPA, 2018a): <ul style="list-style-type: none"> <li>– If the early response groundwater level trigger criterion (of 0.2m) is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>– If the groundwater level trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>– If the groundwater level threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>– If the threshold criterion (of 0.5 m) is exceeded, contingency vegetation monitoring in accordance with the Groundwater Dependent Vegetation monitoring plan (provided in Appendix A of the GDE MP) will be undertaken.</li> <li>– If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>– If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> <li>• As surface water flows within the Walpole River naturally cease over the summer months (Water Corporation, 2023f), groundwater drawdown from the proposal will not impacts flows (or result in a reduction in flows) over this period.</li> <li>• The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels, flow and quality. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to the Walpole River are consistent with the EPA objective for inland waters. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:</li> </ul>

	<ul style="list-style-type: none"> <li>- If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>- If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>- If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>- If the threshold criterion for surface water levels is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. This data will be reviewed as well as an assessment of climatic data and surface water flows to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>- If the trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. Water Corporation will also review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water flows declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>- If the threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>• The Water Corporation will prepare and submit a Groundwater Dependent Ecosystems Performance Report within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown, any actions undertaken and contingencies.</li> <li>• Impacts to soils, groundwater and surface water from exposure of potential acid sulfate soils, and associated mitigation measures, are discussed 'Terrestrial environmental quality' above and in Section 9.5.</li> </ul>
	<p>Rehabilitate • N/A</p>
<p><b>Residual impacts</b></p>	<ul style="list-style-type: none"> <li>• Residual impacts are limited to the potential indirect groundwater drawdown impact to 0.79 ha (0.5% of the zone of influence) of terrestrial GDEs in Excellent condition that has a medium risk of being impacted by the modelled groundwater drawdown. Vegetation associated with the terrestrial GDEs within the zone of influence are not protected under the EPBC Act or BC Act.</li> <li>• Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially resulting in reduced water levels and stream flow. However, as discussed previously, due to the natural seasonal cessation of flows within the river during summer, impacts to flows from the proposal are unlikely to be significant.</li> </ul>
<p><b>Environmental outcomes</b></p>	<ul style="list-style-type: none"> <li>• No terrestrial GDEs will be cleared or directly impacted by the proposal.</li> <li>• No rivers or wetlands will be directly disturbed by the proposal.</li> <li>• The GDEMP (RPS, 2023b) will be implemented to ensure that:             <ul style="list-style-type: none"> <li>- No more than 0.79 ha of terrestrial GDEs will have at a medium of impacts from groundwater drawdown as summarised below. The GDEs that will be potentially impacted by groundwater drawdown do not comprise flora or vegetation protected under the EPBC Act or BC Act. The GDEMP will outline trigger and threshold criteria that will provide an early warning to ensure these areas and impacts are not exceed.</li> <li>- Surface water quality, levels and surface water flows within the upper Walpole River (measured at the Walpole Weir) do not exceed trigger levels outlined in the GDEMP (RPS, 2023b) and ASS detailed site assessment (RPS, 2023c).</li> </ul> </li> <li>• Groundwater and surface water monitoring will be undertaken in accordance with the following documents to determine whether trigger and threshold criteria have been exceeded:             <ul style="list-style-type: none"> <li>- GDEMP (RPS, 2023b) provided in Appendix B</li> <li>- ASS detailed site assessment (RPS, 2023c) provided in Appendix D</li> <li>- WIMP (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> <li>• In the event that monitoring undertaken in accordance with the above documents indicates an exceedance of the trigger or threshold criteria, Water Corporation will:             <ul style="list-style-type: none"> <li>- Report the exceedance to DWER.</li> <li>- implement the appropriate response actions outlined in the GDEMP (RPS, 2023b).</li> <li>- Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.</li> </ul> </li> <li>• The environmental outcomes above are consistent with the EPA objective for inland waters (EPA, 2018a) and thereby not significant, as they maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected..</li> </ul>
<p><b>Social surroundings</b></p>	
<p><b>EPA objective</b></p>	<p>To protect social surroundings from significant harm (EPA, 2023).</p>
<p><b>Potential impacts</b></p>	<p><b>Indirect</b></p> <ul style="list-style-type: none"> <li>• Groundwater drawdown impacts to the Walpole River, which although not a Registered or Other heritage site has been identified as being of potential ethnographic significance, may result in changes to surface water levels and flow. However, as flows naturally cease during the summer months, the trial is unlikely to significantly impact the riverine function and associated heritage values.</li> <li>• Impacts to domestic and agricultural users that may be reliant on groundwater, such as landowners with private bores.</li> <li>• Damage to property and/or infrastructure from fire.</li> </ul>
<p><b>Mitigation hierarchy</b></p>	<p><b>Avoid</b></p> <ul style="list-style-type: none"> <li>• No Registered or Other areas of Aboriginal heritage or cultural significance were identified within the zone of influence. Although the Walpole River, which has been identified as being of potential ethnographic significance (Aboriginal Land Services, 2023), is located within the zone of influence.</li> <li>• The complete avoidance of potential impacts from groundwater drawdown to the Walpole River is not considered an achievable outcome due to the nature of the proposal. However, as flows naturally cease during the summer months, the trial is unlikely to significantly impact the riverine function and associated heritage values.</li> <li>• Avoidance of impacts to the Walpole River greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded:             <ul style="list-style-type: none"> <li>- Trigger criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.30 m below the minimum baseline levels.</li> <li>- Threshold criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.35 m below the minimum baseline levels.</li> <li>- Trigger criterion for water quality within the Walpole River; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events.</li> <li>- Threshold criterion for water quality within the Walpole River; an exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event.</li> <li>- Trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir); Surface water flows exceed 63 consecutive days of no flow over the Walpole River Weir.</li> <li>- Threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir); surface water flows exceed 85 consecutive days of no flow over Walpole River Weir.</li> </ul> </li> <li>• Approximately 0.5 ha of the predicted zone of influence comprises private landholdings and therefore, impacts to surrounding groundwater users have been avoided as far as practicable. No further management or mitigation is considered necessary.</li> <li>• Although the bores are within a mapped bushfire prone area, they are located within existing agricultural land, approximately 200 m from the native vegetation located in the west of the zone of influence.</li> </ul>

	<p><b>Minimise</b></p> <ul style="list-style-type: none"> <li>• There are potential for impacts to domestic and agricultural users that may be reliant on groundwater. However, as stakeholder consultation as part of the proposal has not identified any potential surrounding groundwater users (Section 4), impacts to surrounding groundwater users is considered unlikely.</li> <li>• The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River, and any associated Aboriginal heritage values, from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels, flow and quality. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to the Walpole River are consistent with the EPA objective for social surroundings. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:             <ul style="list-style-type: none"> <li>– If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>– If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>– If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>– If the threshold criterion for surface water levels is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. This data will be reviewed as well as an assessment of climatic data and surface water flows to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>– If the trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. Water Corporation will also review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water flows declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>– If the threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> </ul> </li> <li>• Abstraction bores and associated infrastructure are either located within or adjacent to an area mapped as a Bushfire Prone Area (Figure 37). The current bore and generator layouts have the following clearance from existing vegetation (Water Corporation, 2023c) and potential risks are considered minimal.</li> <li>• Water Corporation shall prepare and submit a Groundwater Dependent Ecosystems Performance Report to DWER within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>
	<p><b>Rehabilitate</b></p> <ul style="list-style-type: none"> <li>• N/A</li> </ul>
<p><b>Residual impacts</b></p>	<ul style="list-style-type: none"> <li>• As there are no Registered or Other Aboriginal heritage sites within the zone of influence and values within the Walpole River will be protected through implementation of the following plans, there are no residual impacts to Aboriginal heritage:             <ul style="list-style-type: none"> <li>– GDEMP (RPS, 2023b) provided in Appendix B</li> <li>– ASS detailed site assessment (RPS, 2023c) provided in Appendix D</li> <li>– WIMP (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> </ul>
<p><b>Environmental outcomes</b></p>	<ul style="list-style-type: none"> <li>• There will be no direct impacts to Aboriginal heritage values.</li> <li>• There will be no impacts to surrounding groundwater users from the proposed trial.</li> <li>• Implementation of the below plans will ensure there are no residual, indirect impacts to Aboriginal heritage values within the zone of influence and therefore, the environmental outcomes are consistent with the EPA objective for Social Surroundings (EPA, 2023), and thereby not significant, as they protect social surroundings from significant harm.             <ul style="list-style-type: none"> <li>– GDEMP (RPS, 2023b) provided in Appendix B</li> <li>– ASS detailed site assessment (RPS, 2023c) provided in Appendix D</li> <li>– WIMP (Water Corporation, 2023a) provided in Appendix E.</li> </ul> </li> </ul>

# 1 INTRODUCTION

Water Corporation is planning for a new water source for the town of Walpole, Western Australia and has identified a potential groundwater source in the deep underlying fractured rock aquifer north of Walpole, at Swann Road. Water Corporation has previously installed the following three deep bores north of Walpole and is proposing to conduct a six-month groundwater abstraction trial during the summer peak water demand period from the aquifer to assess its potential as a long-term, sustainable water source:

- 3/20 located within lot on Plan P209284 12737, within the Shire of Manjimup
- 5/09 located within the Swann Road reserve
- 5/20 located within lot on Plan P064982 86, within the Shire of Manjimup.

During the proposed trial, to obtain an indication of the groundwater drawdown, abstraction at the bores would occur at the abstraction rates that would be implemented for the ongoing, long-term groundwater abstraction, if the trial is successful.

Water Corporation has undertaken modelling (Water Corporation, 2022b) to predict the groundwater drawdown based on the proposed groundwater abstraction volumes from the three bores, over a six-month period. Figure 2 shows the abstraction zone of influence (the site) for the bores, with a drawdown ranging from 0.6 m near the bores to 0.1 m approximately 700 m from the bore, at the extremity of the drawdown zone. The overall modelled zone of influence comprises 149.43 ha.

## 1.1 Purpose and scope of this document

The content and structure of this supporting document has been based on the Environment Protection Authority's (EPA) Instructions on how to prepare an Environmental Review Document (EPA, 2021).

### 1.1.1 Purpose of this document

The purpose of this supporting document is to describe and assess the significance of the environmental impacts to the EPA's environmental factors associated with the implementation of the proposal, with reference to specific technical investigations and detailed analysis that has been undertaken to assess the environmental factors.

This document has been prepared to support referral of the proposal to the EPA under Section 38 of the *Environment Protection Act 1986* (EP Act).

### 1.1.2 Structure of this document

This supporting document has been prepared to reflect the framework for environmental impact assessment under the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016* and the associated *Procedures Manual (Part IV Divisions 1 and 2)*.

The structure of the report follows the Template for an Environmental Review Document attached to EPA (2021).

## Proponent details

The proposal proponent is Water Corporation:

Name: CW01923 Walpole New Source Borefield Trial  
Postal address: PO Box 100, Leederville, WA 6902  
ABN: 28003434917

The key contact for the environmental approval component is:

Name: Caitlin McLeod  
Position: Senior Environment Advisor, Assets Planning and Delivery  
Phone: (08) 9420 2724  
Email: caitlin.mcleod@watercorporation.com.au

## 2 PROPOSAL

### 2.1 Justification

Walpole’s water is currently sourced from Butler’s Dam, which is a small 3.3 ML turkey nest dam with a daily recharge rate of 100–300 kL. The current yields do not meet peak summer demand and water needs to be supplemented by water carting from Denmark and / or Albany (Water Corporation, 2023e). Additionally, the catchment area of Butler’s Dam contains a permanent presence of livestock, necessitating an advanced treatment process to manage pathogen risks. The peak water source abstraction from Walpole is predicted to reach as high as 415 kL per day by 2050 (Water Corporation, 2023e). Therefore, water from Butler’s Dam is not a sustainable long-term source and Water Corporation requires a new source which can deliver a peak 415 kL/day (4.6 L/s).

Water Corporation needs to identify a new source as soon as possible as carting of water during peak periods is not a sustainable or reliable water source. Carting during peak demand in summer is equivalent to an addition of ten trucks per day on the roads. Water Corporation aims to improve source reliability and improving safety of the community and its staff and contractors by reducing and removing unnecessary risks to safety and human health. Additionally, the catchment area of Butler’s Dam contains a permanent presence of livestock, rendering the source risk level to be categorised as unsuitable from a pathogen perspective (Water Corporation, 2023e)

To meet future and peak demand for water in Walpole, Water Corporation is planning for a new long-term water source and have identified a potential groundwater source in the deep underlying fractured rock aquifer north of Walpole at Swann Road. To assess its potential as a long-term sustainable water source, Water Corporation is proposing to conduct a six-month groundwater abstraction trial from the deep fractured rock aquifer at the abstraction bores; 5/09, 3/20, 5/20 (Figure 4).

The pumping strategy during the trial has been designed to (Water Corporation, 2023a):

- Allow the Water Corporation to optimise the operation of the Walpole borefield and plan for augmentation of supply.
- Increase Water Corporation’s understanding of the groundwater response to pumping and provide quantitative data that can be applied to the Water Corporation’s current understanding of the groundwater model predictions to assess the effectiveness of the model and guide improvements if necessary.
- Refine the understanding of groundwater recession characteristics following rainfall recharge and drying events.
- Collect information about the behaviour of groundwater in the vicinity of Groundwater Dependent Ecosystems (GDEs) to help refine understanding of the relationship between groundwater and GDEs.

The production capacity of the trial (415 kL/d) is equivalent to 19% and 2% of Denmark and Albany's average day peak week flows (respectively).

### 2.2 Proposal content

**Table 4: Proposal overview**

<b>Proposal title</b>	CW01923 Walpole New Source Borefield Trial
<b>Proponent name</b>	Water Corporation
<b>Short description</b>	<p>Water Corporation proposes to conduct a six-month water source abstraction trial to assess the long-term viability of a new water source for Walpole, Western Australia. The trial will be conducted during the summer peak water demand period and will use existing infrastructure. The source comprises three existing deep fractured rock bores located within the following Water Corporation lots:</p> <ul style="list-style-type: none"> <li>• Bore 5/09 is located within the Swann Road reserve</li> <li>• Bore 3/20 is located within part of Lot on Plan P209284 12737</li> <li>• Bore 5/20 is located within part of Lot on Plan P064982 86</li> </ul> <p>The abstraction bores will be operated up to 24 hours, seven days a week to produce a total groundwater volume of up to 415 kilolitres (kL)/day at an abstraction rate of up to 4.6 L/s.</p>

**Table 5: Location and proposed extent of physical and operational elements**

Proposal element	Location / description	Maximum extent, capacity or range
<b>Physical elements</b>		
Groundwater abstraction bores	Figure 1	Existing abstraction bores 05/20, 03/20 and 05/09.
<b>Construction elements</b>		
Not applicable		
<b>Operational elements</b>		
Groundwater abstraction	Figures 1 and 2	Abstraction rate of up to 4.6 L/s to a maximum production capacity of up to 415 kL/day, 24 hours a day, seven days a week for six months.  The modelled zone of influence from the proposed groundwater abstraction is shown in Figure 2. This report addresses the proposed impacts to environmental values from the modelled groundwater drawdown within the zone of influence.
<b>Proposal elements with greenhouse gas emissions</b>		
<b>Construction elements</b>		
Not applicable		
<b>Operational elements</b>		
Not applicable – estimated to be 24.5 tonnes carbon dioxide produced over the six-month trial (i.e. <100,000 tonnes per annum of CO <sub>2-e</sub> ).		
<b>Rehabilitation</b>		
Not applicable		
<b>Commissioning</b>		
Not applicable		
<b>Other elements which affect extent of effects on the environment</b>		
Proposal time*	Maximum project life	Six months
	Construction phase	Not applicable
	Operations phase	Six months
	Decommissioning phase	Not applicable

## 2.3 Proposal alternatives

As discussed above, Walpole’s water is currently sourced from Butler’s Dam. Butler’s Dam is not a sustainable long-term source due to (Water Corporation, 2023e):

- The presence of livestock within the catchment, resulting in the water requiring treatment to an advanced standard
- Current yields do not meet Walpole town peak summer demand, requiring supplements via water carting from Denmark and / or Albany.

Several other water sources have historically been used by Water Corporation, including (Water Corporation, 2023e):

- Chatley Road Dam, which was not considered suitable due to dam safety concerns
- Two superficial Swann Road bores, which were not considered suitable due to inadequate yields
- The Walpole River, which was not considered suitable due to environmental and social values.

Water Corporation is currently investigating alternative water sources to these, to remove the need for regular summer water carting and secure the town supply into the future. These sources are described in Table 6.



**Table 6: Water source alternatives currently being investigated.**

Water source type	Description	Uncertainties and potential risks involved with the water source being investigated
Surface water	Construct a 100 ML replacement dam at the Chatley Road site (Figure 3).	<ul style="list-style-type: none"> <li>• Environmental approvals</li> <li>• Source risks and treatability</li> <li>• Cost and requirements for upgrading Walpole WTP</li> </ul>
Groundwater	Equip three production bores near Swann Road, targeting a fractured rock aquifer (this proposal is related to this option).	<ul style="list-style-type: none"> <li>• Reliability, drawdown and environmental impacts</li> <li>• Source risks and treatability</li> <li>• Costs and requirements for equipping bores and upgrading Walpole WTP</li> </ul>

(Water Corporation, 2023e)

The proposed six-month groundwater abstraction trial will assess the potential of the three production bores as a long-term sustainable water source. If the trial is successful, and no significant environmental impacts are identified, ongoing groundwater abstraction would provide a new long-term source and remove the need for regular summer water carting to Walpole.

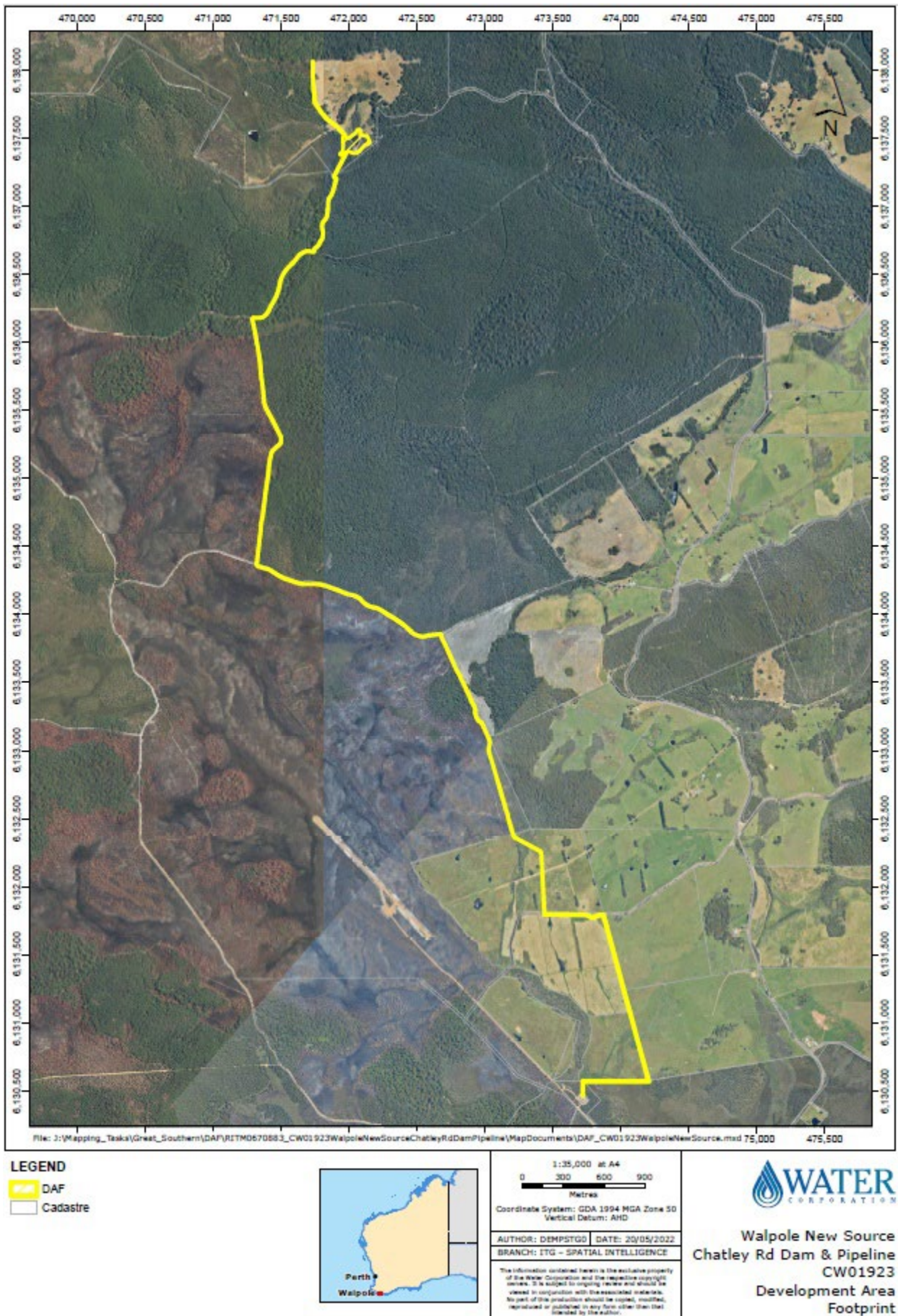


Figure 3: Alternative to the proposal – Chatley Road Dam

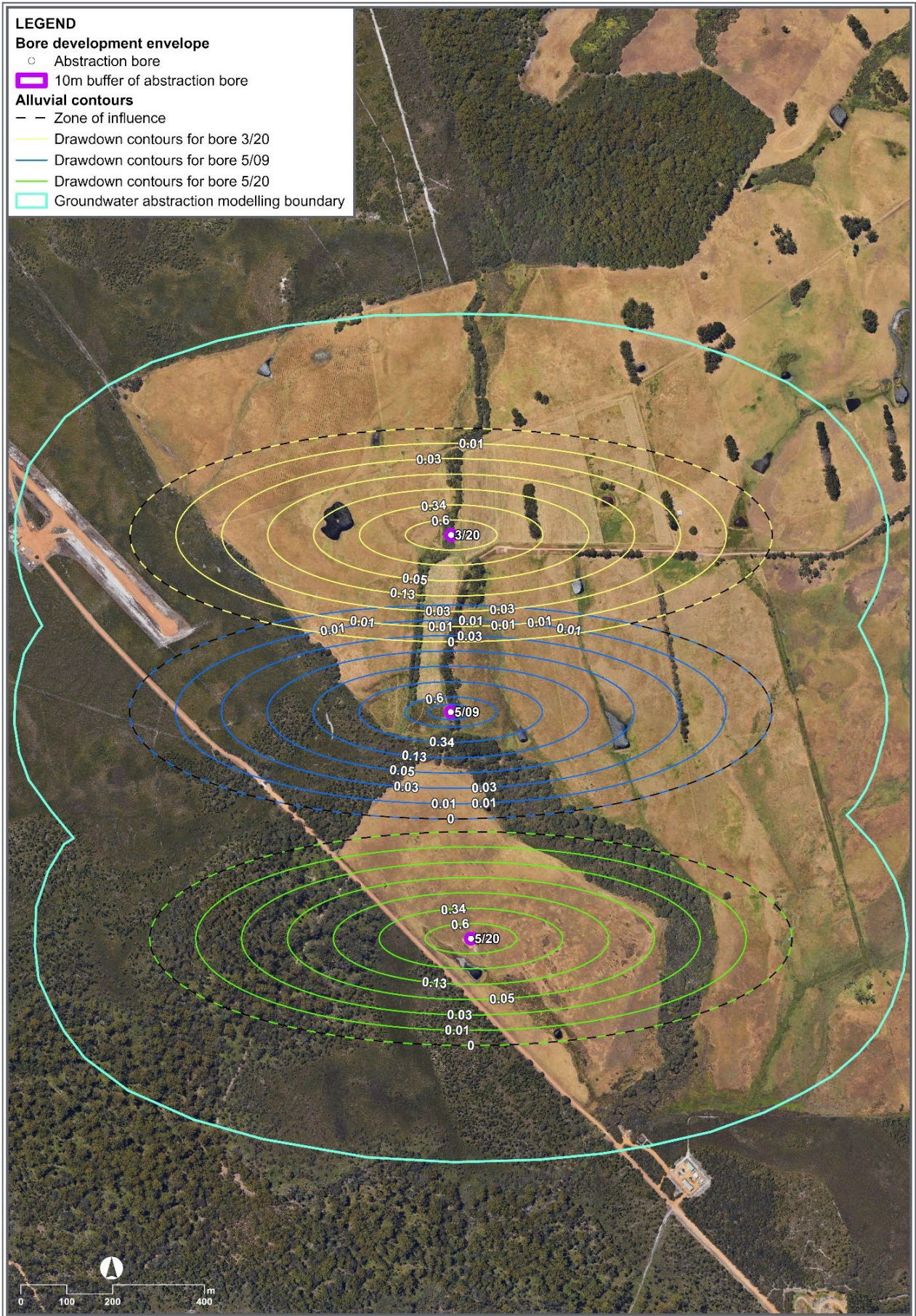


Figure 4: Groundwater abstraction bore locations

## REPORT

---

Land within the groundwater drawdown impact area is zoned as a combination of National Park (Keystone State Forest) and Other Conservation Reserves, Public Purposes: Water Service, General agriculture, Parks and Recreation Under the Shire of Manjimup Local Planning Scheme 4. The Special Control Area (SCA) – Butler’s Dam Catchment Area is mapped within the zone of influence.

The majority of the zone of influence comprises Water Corporation managed land or reserves, with approximately 0.5 ha comprising private property. The site boundary encompasses the following lots (Figure 5):

- Part lot on Plan F 48
- Part lot on Plan P219920 13076, R 31501
- Part lot on Plan P219960 13526
- Part R 31362
- Part lot on Plan P064982 86
- Part lot on Plan P064982 87, R 31501
- Part lot on Plan P167304 12554
- Part lot on Plan P167304 12386
- Part lot on Plan P208550 500, R 31501
- Part lot on Plan P209284 12737
- Part lot on Plan P166404 12385.

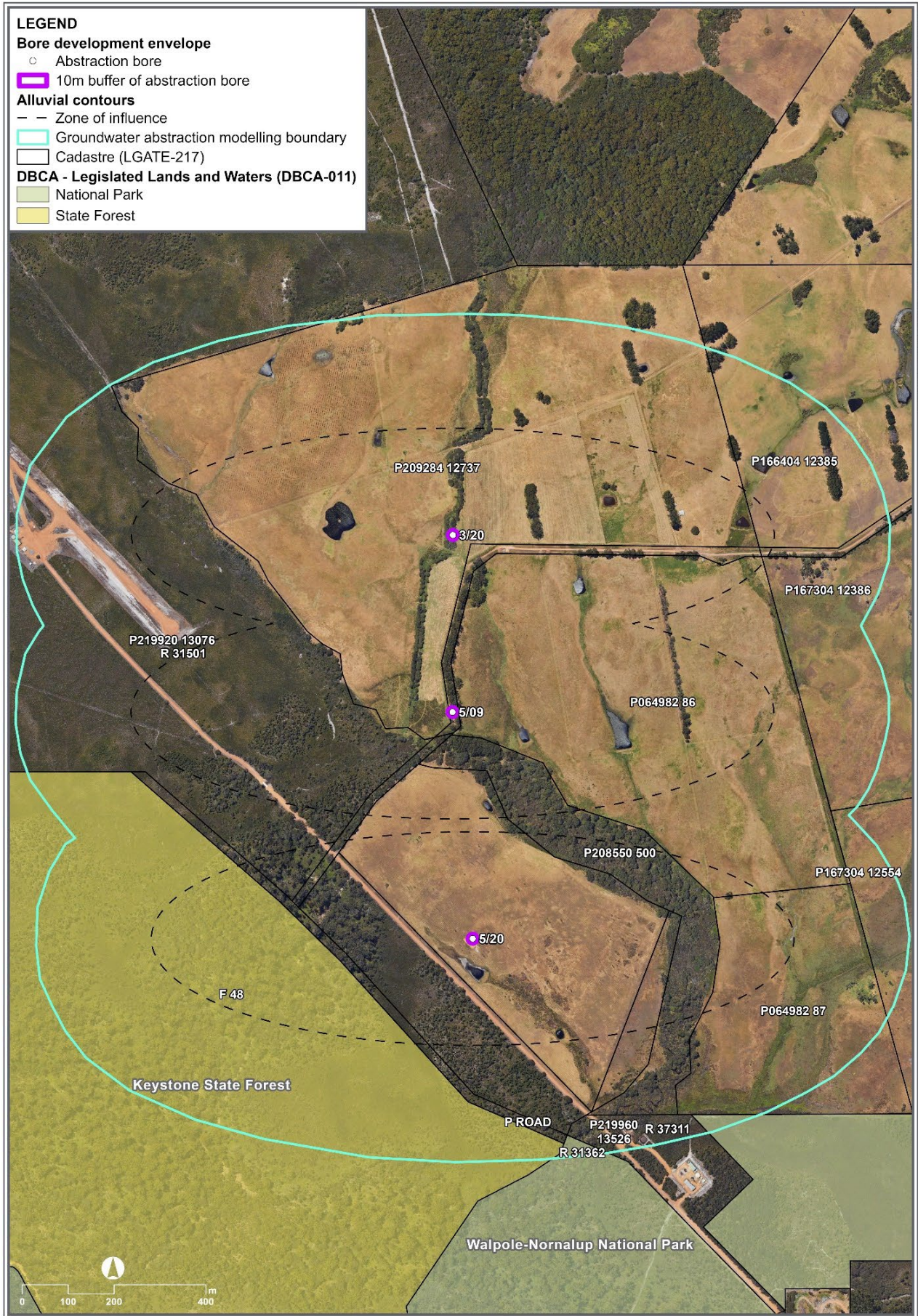


Figure 5: Properties within the zone of influence

## 3 LEGISLATIVE CONTEXT

### 3.1 Environmental impact assessment process

#### 3.1.1 *Environmental Protection Act 1986*

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in Western Australia. The EP Act provides for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment. The EP Act is administered by the EPA and the Minister for the Environment.

##### 3.1.1.1 Part IV of the Environmental Protection Act 1986

The environmental impact assessment process is regulated under Part IV of the EP Act, with Divisions 1 and 2 dealing with proposals and Divisions 3 and 4 dealing with planning schemes. The EP Act sets out the essential requirements of environmental impact assessment, while the specific practices of environmental impact assessment are covered in the Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures (2021) (the Administrative Procedures) (EPA, 2021c).

The Administrative Procedures provide the overarching framework for the EPA to undertake environmental impact assessment. The Administrative Procedures are grouped according to the following key stages:

- Stage 1: Referral of a proposal to the EPA
- Stage 2: EPA to decide whether or not to assess a referred proposal
- Stage 3: Assessment of proposals
- Stage 4: EPA report on the assessment of proposal
- Stage 5: Deciding if proposal may be implemented and implementation of proposals.

The referral of this supporting document and accompanying Section 38 referral form to the EPA under Section 38 of the EP Act allows for the EPA to determine if the referral is valid under the EPA's Administrative Procedures and decide whether or not to assess the proposal.

##### 3.1.1.2 EPA guidance and technical reports

The proposal is subject to compliance with applicable guidelines and technical reports that have been developed to assist proponents and the general public, in understanding the minimum requirements for the protection of the environment that the EPA expects to be met during the assessment process.

Table 7 details the EPA's environmental factors and technical guidelines relevant to the proposal.

**Table 7: Applicable EPA guidance and technical reports**

<b>EPA environmental factor guidelines</b>
Environmental Factor Guideline: Flora and Vegetation (EPA, 2016a)
Environmental Factor Guideline: Subterranean Fauna (EPA, 2016c)
Environmental Factor Guideline: Terrestrial Environmental Quality (EPA, 2016e)
Environmental Factor Guideline: Terrestrial Fauna (EPA, 2016f)
Environmental Factor Guideline: Inland Waters (EPA, 2018a)
Environmental Factor Guideline: Social Surroundings (EPA, 2023)
<b>EPA technical guidance</b>
Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b)
Technical Guidance – Subterranean fauna surveys for environmental impact assessment (EPA, 2021b)
Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020)
Technical Guidance: Sampling of short-range endemic invertebrate fauna (EPA, 2016i)

## 3.2 Other approvals and regulation

The proposal is required to comply with the requirements of other relevant pieces of state legislation, regulation and policy. Table 8 provides an overview of other potential key state-based approval requirements relevant to the proposal.

**Table 8: Other approval requirements**

Proposal activities	Type of approval	Legislation regulating the activity	Approval agency
Groundwater abstraction resulting in impacts to Aboriginal heritage.	<ul style="list-style-type: none"> <li>Authorisation under Part 6 of the <i>Aboriginal Cultural Heritage Act 2021</i>.</li> </ul>	<ul style="list-style-type: none"> <li><i>Aboriginal Cultural Heritage Act 2021</i>.</li> </ul>	<ul style="list-style-type: none"> <li>If there is a risk for harm to Aboriginal cultural heritage, then authorisation is required under Part 6 of the <i>Aboriginal Cultural Heritage Act 2021</i>.</li> </ul>

## 3.3 Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects Matters of National Environmental Significance (MNES) and is administered by the Commonwealth Minister of the Environment. If an action is likely to have a significant impact on any MNES a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCEEW) is required. A summary of MNES relevant to the proposed is provided in Table 9.

**Table 9: Matters of national environmental significance**

EPBC matter	Matters returned	Description	Relevant to the proposal
World Heritage Properties	None	There are no world heritage properties located within or near the site.	NA
National Heritage Places	None	There are no National Heritage properties within or near the site.	NA
Wetlands of International Significance	None	There are no Wetlands of International Significance within or near the site.	NA
Great Barrier Reef Marine Park (GBRMP)	None	Not relevant to the proposed action as the GBRMP is located off the east coast of Australia.	NA
Commonwealth Marine Area	One	Not relevant to the proposed action as it is not located in a marine environment.	NA
Listed Threatened Ecological Communities	One	Subtropical and temperate coastal saltmarsh	NA
Listed Threatened Species	39	Birds – 20 Crustacean – 1 Fish – 3 Mammals – 5 Mollusc – 1 Plants – 5 Reptiles – 3 Sharks – 1	Yes Species listed under the EPBC Act were recorded within the zone of influence as outlined in Section 10.
Listed Migratory Species	33	Migratory Marine Birds – 12 Migratory Marine Species – 11 Migratory Terrestrial Species – 1 Migratory Wetlands Species – 9	Yes There is potential habitat for migratory species within the zone of influence, as outlined in Section 10.
Nuclear Actions	None	The proposal does not relate to this MNES.	NA
Water resources in relation to Coal Seam Gas and large coal mining development	None	The proposal does not relate to this MNES.	NA

### 3.3.1 EPBC Act assessment context

#### 3.3.1.1 Accredited assessment

The intention to develop a bilateral agreement with Western Australia under Section 45 of the EP Act and EPBC Act was published in 2019. The draft bilateral agreement is intended to revoke and replace the current bilateral agreement (2014) between the Commonwealth of Australia and the State of Western Australia. Until the Agreement is amended, the assessment of any new proposals that would otherwise have been assessed by the EPA under the agreement will be individually accredited by the Commonwealth Government. If significant impacts to a MNES are identified because of the proposal, a separate EPBC Act referral will be submitted to the Commonwealth DCCEEW to 'turn on' the accredited assessment process.



## 4 STAKEHOLDER ENGAGEMENT

### 4.1 Key stakeholders

Key stakeholders for the proposal are summarised below:

- State government agencies and regulators
  - Department of Biodiversity, Conservation and Attractions (DBCA)
  - Department of Water and Environmental Regulation (DWER)
  - Department of Planning, Lands and Heritage (DPLH)
- Local government (Shire of Manjimup)
- Traditional owners
  - South West Aboriginal Land and Sea Council (SWALSC)
  - Wagyl Kaip Southern Noongar representatives
- Local community.

### 4.2 Stakeholder engagement process

Consultation has occurred with the key stakeholders listed in Section 4.1. Water Corporation has sought to engage on major issues through in-person briefings where possible, with written updates provided to support a timely flow of information to stakeholders.

The community stakeholder engagement process is summarised in Table 10. Engagement with government agencies and regulators and traditional owners will remain ongoing throughout the project, with further consultation planned with stakeholders when the trial is complete.

**Table 10: Stakeholder engagement process**

Issue for engagement	Level of engagement	Timing	Scope
The need for a new drinking water source.	Inform	Underway / ongoing	New sources are regularly required to keep up with demand and the impacts of climate change. The Walpole community is aware of the need for a new source, as they overwhelmingly dislike temporary carting.
Foster community advocacy for the project.	Inform	From March 2023	A trial of a borefield is being proposed, as bores are the most appropriate solution to Walpole's supply concerns.
Specifics of new source option/s chosen – borefield trial	Consult	April 2023 onwards	Two-way engagement to understand community expectations for the borefield trial e.g. aesthetics, managing construction and environmental impacts.
Environmental referrals to support the proposal.	Consult	May 2023	Input into our surveys and measures to ensure we are not unduly impacting the environment.

(Water Corporation, 2023d)

### 4.3 Stakeholder consultation outcomes

Table 11 and Table 12 presents a summary of the stakeholder consultation undertaken to date for the proposal.

**Table 11: Summary of consultation with state government agencies and regulators, local government and the local community**

Date	Stakeholder	Purpose of engagement/ questions/comments/issues raised	Outcome
02/09/2021	DWER	Briefing with DWER regarding Walpole new source options and the proposed borefield trial. Presentation DWER at Quarterly Liaison Meeting.	Introduced the planned borefield trial to DWER to gain in-principle support to progress with further planning.
07/12/2021	DWER, Sharon Stratico	Presentation to Sharon Stratico regarding Chatley Road Dam and Borefield options as well as environmental and community considerations and a project timeline.	Information was noted.
02/02/2022	DWER	Planning summary to DWER: detailed options analysis and next steps.	Information was noted.
02/05/2022	DWER	Presentation to DWER on progressing a borefield trial. Additional information provided to DWER: included hydrogeological report and proposed monitoring bore locations.	Information was noted. Feedback and advice on the trial (including hydrogeological modelling etc.) was received from DWER via a letter on 26/05/2022.
17/05/22	DWER	Email correspondence with DWER regarding advice on Groundwater Dependent Ecosystems (GDEs).	Interim advice received regarding GDEs prior to formal advice letter received from DWER on 26/05/2022.
15/09/2022	DWER	Email correspondence with DWER seeking further advice on GDE risk assessment and vegetation monitoring location placement.	Feedback and advice confirming proposed GDE assessment methodology 23/09/2022. Follow-up phone call with Adrian Goodreid 12/10/2022 confirming the approximate placement of vegetation monitoring quadrats was appropriate.
21/09/2022	Shire of Manjimup	Email to advise Shire of survey work and that we are putting a notice in the Walpole weekly.	Information was noted.
27/09/2022	DBCA, DWER, DPLH and private landowners	Notice of Entries issued for Heritage and Environmental Surveys.	Response from two private landowners. Private landowners of owns Lots 12386 and 12554 on P167304, opposite Water Corporation land. Water Corporation offered a meeting.
September 2022	Walpole residents	Notice in Walpole Weekly to advise community of upcoming heritage and environmental investigations and surveys.	Community was re-introduced to the Walpole new source investigations.
05/10/2022	Private landowners	Meeting held to discuss concerns of private landowners declining Water Corporation access to his property for the environmental survey. Also discussed additional items both related and unrelated to the borefield trial that were noted and passed on to the relevant Water Corporation team for follow up.	Private landowners advised they appreciated the opportunity to have a meeting. Water Corporation confirmed we would complete the environmental survey without accessing private landholdings.
13/10/2022	DBCA	Courtesy email to DBCA to drill monitoring bore near DBCA managed airstrip on DWER land.	DBCA responded on 04/11/2022 with no concerns of the bore location, with access to the bore provided during the trial.
19/10/2022	DWER	Request for approval to drill monitoring bores on DWER land.	DWER responded with approval and a list of conditions to follow on 31/10/2022 and further advice on 01/11/2022.
12/12/2022	Walpole residents	Letter and FAQs sent to residents, and a public notice published in the Walpole weekly to support summer carting. Included update and information about planning new source project in the FAQs to residents.	Residents updated about Walpole new source planning.
30/01/2023	DBCA, DWER, DPLH	Notice of Entries issued for surface water sampling.	No issues.
30/01/2023	DBCA, DWER, DPLH	Notice of Entries issued for additional environmental surveys.	No issues.
21/02/2023	DWER	Request for DWER acknowledgement of hydrocarbon storage within Priority 2 drinking water area for the borefield trial.	Confirmation received from DWER on 21/02/2023.
16/03/2023	DWER	Water Corporation attended DWER Quarterly Liaison Meeting. Update to DWER regarding progress of planning for borefield trial.	DWER requested additional briefing prior to borefield trial and EPA engagement.
21/03/2023	Shire Manjimup	Email update to arrange briefing ahead of community information sessions.	Meeting held on 12/04/2023. Shire was supportive of plans and offered to update the Shire council at meeting on 13/04/2023. Advised Water Corporation to contact Cr Jennifer Wilcox.
21/03/2023	DBCA	Email update to arrange briefing ahead of community information sessions.	Meeting held on 13/04/2023. DBCA was supportive of the borefield trial plans and offered advice and considerations.
27/03/2023	Walpole residents	EDM and Walpole weekly notices: Joint notice regarding Waterwise Towns offers and community information sessions.	Residents and community provided details of upcoming information sessions.
03/04/2023	DWER	Water Corporation project team met with DWER via Webex to update them on the borefield trial and discuss key messages ahead of the community information sessions.	DWER supported the proposed engagement and requested to see the marketing materials being used at the events. The materials were emailed through to DWER on Tue 18/04/2023.
11/04/2023	<ul style="list-style-type: none"> <li>• South Coast NRM</li> <li>• Green Skills Inc</li> <li>• Walpole, Nornalup and Districts Community Development Group</li> <li>• Walpole-Nornalup National Parks Association</li> <li>• Manuka Life</li> </ul>	Emailed FAQ sheet and information on community sessions.	Acknowledgement and thanks received from South Coast NRM.
14/04/2023	Private landowner WC met with in 2022	Emailed FAQ sheet and information on community sessions.	No response received.
14/04/2023	Private landowner WC met with in 2022	Emailed FAQ sheet and information on community sessions.	No response received.
14/04/2023	Cr Jennifer Wilcox	Phone conversation and email of FAQ sheet and information on community sessions.	Thanked Water Corporation for the update and offered to send information session details on directly to interested residents of which she is aware.
27/04/2023	Walpole residents	1. Community drop-in session held at Walpole Community Resource Centre.	The Water Corporation project team attended a community lunch at the Walpole Community Hall, and then hosted a drop-in session at the Walpole Community Resource Centre next door. A total of 16 Walpole community members were updated about the planned borefield trial throughout the day. Questions were asked about previous investigations and the community advised that the session provided clarity on why the borefield is currently the preferred option.
28/04/2023	Walpole residents	2. Community drop-in session held at Walpole Community Resource Centre.	No attendees this session.

**Table 12: Summary of consultation with traditional owners**

<b>Date</b>	<b>Group</b>	<b>Consultation details</b>	<b>Outcome</b>
12/10/2021	South West Aboriginal Land & Sea Council (SWALSC)	Activity Notice issued under clause 8.2 of the Noongar Standard Heritage Agreement	
02/11/2021	SWALSC	Activity Notice Response received	Site ID survey required
08/02/2022	Aboriginal Land Services Archae-Aus Brad Goode & Associates	Quotes requested from heritage consultants	
16/03/2022	Aboriginal Land Services	Aboriginal Land Services selected as successful consultant to conduct the survey	
28/09/2022	Aboriginal Land Services & Aboriginal Knowledge Holders: <ul style="list-style-type: none"> <li>• Samantha Williams</li> <li>• Shawn Colbung</li> <li>• Veronica Williams</li> <li>• Thomas Narkle</li> <li>• Glenn Colbung</li> </ul>	First day of Aboriginal Heritage Survey	
29/08/2022	Aboriginal Land Services & Aboriginal Knowledge Holders: <ul style="list-style-type: none"> <li>• Samantha Williams</li> <li>• Shawn Colbung</li> <li>• Veronica Williams</li> <li>• Thomas Narkle</li> <li>• Glenn Colbung</li> </ul>	Last day of Aboriginal Heritage Survey	Initial survey complete
28/10/2022	Aboriginal Land Services	Preliminary draft developed and submitted to Water Corporation	Draft reviewed and sent back
22/11/2022	Aboriginal Land Services	Preliminary draft sent back for review	
09/12/2022	Aboriginal Land Services and Aboriginal Knowledge Holder: <ul style="list-style-type: none"> <li>• Glenn Colbung</li> </ul>	Follow up ethnographic consultation in Perth, Western Australia. This was due to lack of senior elders on the initial survey.	
12/12/2022	Aboriginal Land Services and Aboriginal Knowledge Holders: <ul style="list-style-type: none"> <li>• Eugene Eades</li> <li>• Shirley Williams</li> </ul>	Follow up ethnographic consultation in Walpole, Western Australia. This was due to the lack of senior elders on the initial survey.	Survey completed
19/01/2023	Aboriginal Land Services	Final survey report draft submitted to Water Corporation	Final draft reviewed
27/02/2023	Aboriginal Land Services	Final draft sent back for review	
09/03/2023	Aboriginal Land Services	Final complete survey report submitted with Water Corporation's feedback incorporated	

## 5 OBJECT AND PRINCIPLES OF THE EP ACT

Section 4A of the EP Act establishes that the objective of the Act is to protect Western Australia’s environment, having regard for the following principles:

1. The precautionary principle
2. The principle of intergenerational equity
3. Principles relating to improved valuation, pricing and incentive mechanisms
4. The principle of the conservation of biological diversity and ecological integrity
5. The principle of waste minimisation.

Table 13 identifies how these five EP Act principles have been considered for the proposal and provides a holistic description of how the objective of the EP Act has been met.

**Table 13: Object and principles of the EP Act**

Principle	Consideration
<p><b>The precautionary principle</b></p> <p>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</p> <p>In application of this precautionary principle, decisions should be guided by:</p> <ul style="list-style-type: none"> <li>• Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment</li> <li>• An assessment of the risk-weighted consequences of various options</li> </ul>	<ul style="list-style-type: none"> <li>• The Proposal will not cause threat of serious or irreversible damage and there is not a lack of scientific certainty through:                             <ul style="list-style-type: none"> <li>– Undertaking detailed site investigations to inform the impact assessment.</li> <li>– Avoidance of direct impacts to vegetation and fauna habitat and significant impacts to Groundwater Dependent Ecosystems from groundwater drawdown.</li> <li>– Identification of management measures to address residual impacts.</li> </ul> </li> </ul>
<p><b>The principle of intergenerational equity</b></p> <p>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for benefit of future generations.</p>	<p>This environmental impact assessment of the proposal demonstrates that potential impacts from the groundwater drawdown will be managed to ensure the following groundwater trigger levels will be achieved to ensure that the health, diversity and productivity of the environment is maintained and enhanced for benefit of future generations:</p> <ul style="list-style-type: none"> <li>• Early response trigger criterion – Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m.</li> <li>• Trigger criterion – Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m.</li> <li>• Threshold criterion – Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m.</li> </ul>
<p><b>Principles relating to improved valuation, pricing and incentive mechanisms</b></p>	
<ol style="list-style-type: none"> <li>1. Environmental factors should be included in the valuation of assets and services.</li> <li>2. The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</li> <li>3. The users of goods and services should pay prices based on the full lifecycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</li> </ol>	<p>The proponent accepts that any costs for environmental mitigation, management or offsets are part of the overall proposal costs. This includes residual impact management actions that will be addressed within corresponding management plans.</p>

**Principle**

**Consideration**

---

4. Environmental goals, have been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solution and response to environmental problems.

---

**The principle of the conservation of biological diversity and ecological integrity**

---

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Six key environmental factors (flora and vegetation, subterranean fauna, terrestrial environmental quality, terrestrial fauna, inland waters and social surroundings) relevant to the proposal have been identified in this report. Detailed investigations have been undertaken to identify potential impacts and mitigation options to minimise the impact of the proposal and align with the EPA's objective for each environmental factor.

---

**The principle of waste minimisation**

---

All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.

Waste will be minimised by adopting the hierarchy of waste controls; avoid, minimise, reuse, recycle and safe disposal.

## 6 ENVIRONMENTAL FACTORS AND OBJECTIVES

This supporting document has been prepared to address the EPA key environmental factors that are relevant to the proposed groundwater abstraction trial. Assessment of potential impacts to the environmental factors was undertaken based on the environmental investigations listed in Table 14.

Environmental factors that would potentially be impacted by the proposal are addressed in Sections 7 to 12, as outlined in Table 14.

**Table 14: EPA key environmental factors and their relevance to the proposed borefield expansion**

Theme	EPA factor	Relevance to proposal	Supporting technical investigation		
			Report	Survey timing	Appendix to this report
Sea	Benthic communities and habitats	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> No benthic communities or habitats are situated within, or within vicinity of the zone of influence (RPS, 2023). It is not anticipated that the proposal will result in impacts to the marine environment.	N/A	N/A	N/A
	Coastal processes	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> The proposal is situated over 6 km north of the Indian Ocean coast and is not likely to interact with the coastal processes.	N/A	N/A	N/A
	Marine environmental quality	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> The proposal is situated over 6 km north of the Indian Ocean coast and is not likely to interact with marine environmental quality.	N/A	N/A	N/A
	Marine fauna	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> The proposal is situated over 6 km north of the Indian Ocean coast and is not likely to interact with marine fauna.	N/A	N/A	N/A
Land	Flora and vegetation	<b>Section 7</b> No listed Threatened Ecological Communities (TECs), Priority Ecological Communities (PECs) or threatened flora species were identified within the zone of influence. The Kordabup vegetation complex is located within the zone of influence. Although this vegetation complex is not protected under the EPBC Act or BC Act, this vegetation is considered potentially significant as there is 2,972.23 ha known state-wide, 394.47 ha (13.27%) of which is mapped within the zone of influence (RPS, 2023). There is potential for groundwater dependent vegetation to be present within the modelled groundwater drawdown area. Potential impacts to groundwater dependent vegetation are discussed further in this report.	Swann Road Borefield; Flora and vegetation assessment (RPS, 2023)	Survey dates: <ul style="list-style-type: none"> <li>7–15 November 2022</li> <li>12–15 December 2022</li> <li>14–18 April 2023</li> <li>9–12 May 2023</li> </ul>	Appendix A
	Landforms	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> The desktop assessment undertaken as part of this report did not identify any significant landform features within the zone of influence. Furthermore, as no earthworks or ground disturbing activities are associated with this proposal, the proposed groundwater abstraction is unlikely to impact the integrity physical landforms within the area.	N/A	N/A	N/A
	Subterranean fauna	<b>Section 8</b> No Threatened or Priority stygofauna species were identified as present in the stygofauna study area. However, <i>Bathynellidae</i> sp. 'Walpole 1', <i>Bathynellidae</i> sp. 'Walpole 2' and <i>Fibulacamptus</i> 'BHA346' are considered to be potentially significant as they represent new taxa and have only been found within the stygofauna study area (Phoenix, 2023b). Of these species, only <i>Bathynellidae</i> sp. 'Walpole 1' was identified within the zone of influence, with <i>Bathynellidae</i> sp. 'Walpole 2' and <i>Fibulacamptus</i> 'BHA346' only recorded outside the zone of influence. There is potential for groundwater abstraction to impact subterranean fauna through changes in groundwater levels and quality. Potential impacts to subterranean fauna are discussed further in this report.	Detailed Stygofauna Survey for the Swann Road Walpole EIA Project (Phoenix, 2023b)	Survey timing: <ul style="list-style-type: none"> <li>Phase 1 (pilot study): 25 October to 1 November 2022</li> <li>Phase 2: 27 February to 3 March 2023.</li> </ul>	Appendix C
Terrestrial environmental quality	<b>Section 9</b> There is potential for potential acid sulfate soils to be exposed within the groundwater drawdown area (RPS, 2023c).	Acid sulfate soil detailed site assessment; Swann Road Borefield, Walpole (RPS, 2023c)	Ongoing	Appendix D	
Terrestrial fauna	<b>Section 10</b> Groundwater drawdown from the proposed trial may have indirect impacts on the following fauna habitat identified within the zone of influence: <ul style="list-style-type: none"> <li>Terrestrial fauna habitat which supports conservation significant fauna species, including the peregrine falcon, Baudin's cockatoo, Carnaby's cockatoo, wambenger brush-tailed phascogale, quokka, Nornalup frog, quenda, rakali and western false pipistrelle (Table 35) (Phoenix, 2023a).</li> <li>Aquatic fauna habitat within the Walpole River. Significant aquatic fauna identified within the upper Walpole River by Phoenix (2023) includes the Walpole burrowing crayfish, blackstriped dwarf galaxias, mud minnow, Balston's pygmy perch, little pygmy perch, salamander fish and Carter's freshwater mussel.</li> <li>Terrestrial fauna habitat for short range endemic species (SRE) (Phoenix Environmental, 2023d).</li> </ul>	<ul style="list-style-type: none"> <li>Terrestrial fauna assessment for the Swann Road borefield, Walpole EIA Project (Phoenix, 2023a).</li> <li>Stream fauna assessment for the Swann Road borefield project (Phoenix Environmental, 2023).</li> <li>Short-range endemic invertebrate survey for the Swann Road Walpole EIA Project (Phoenix Environmental, 2023d).</li> </ul>	Vertebrate fauna survey timing: <ul style="list-style-type: none"> <li>22 November to 2 December 2022.</li> </ul> Aquatic fauna survey timing: <ul style="list-style-type: none"> <li>29 October to 1 November 2022</li> </ul> SRE fauna survey timing: <ul style="list-style-type: none"> <li>Phase 1: 25 October to 1 November 2022.</li> <li>Phase 2: 22 November to 1 December 2022.</li> </ul>	<ul style="list-style-type: none"> <li>Terrestrial vertebrate fauna assessment Appendix H</li> <li>Aquatic fauna Appendix K.</li> <li>SRE Fauna Appendix L.</li> </ul>	
Water	Inland waters	<b>Section 11</b> The proposed groundwater abstraction has the potential to lower groundwater levels, result in changes in groundwater quality, lower surface water levels and stream flow and impact surface water quality in Groundwater Dependent Ecosystems (GDE). Indirect impacts to the following inland waters are discussed further in this report: <ul style="list-style-type: none"> <li>The upper Walpole River. The Walpole Weir is located outside (south-east of) the zone of influence. Due to the impounding impacts of the Walpole Weir, the water levels upstream and within the one of influence, are no longer representative of the original hydrology.</li> <li>Phreatophytic vegetation.</li> </ul>	Technical investigations used to inform the inland waters section includes: <ul style="list-style-type: none"> <li>Swann Road Borefield; Flora and vegetation assessment (RPS, 2023).</li> <li>Acid sulfate soil detailed site assessment; Swann Road Borefield, Walpole (RPS, 2023c).</li> </ul>	As discussed above.	As discussed above.

REPORT

Theme	EPA factor	Relevance to proposal	Supporting technical investigation		
			Report	Survey timing	Appendix to this report
Air	Air quality	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> There are unlikely to be significant impacts to air quality as a result of the proposal as the estimated carbon dioxide produced over the six-month trial is 24.5 tonnes.	N/A	N/A	N/A
	Greenhouse gas emissions	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> The proposal is unlikely to result in significant greenhouse gas emissions (i.e. <100,000 tonnes per annum of CO <sub>2-e</sub> ).	N/A	N/A	N/A
People	Social Surroundings	<b>Section 12</b> There is potential for groundwater drawdown to result in impacts to Aboriginal heritage and surrounding groundwater users. There is potential for bushfires to impact the proposal.	Walpole New Source Borefield; Aboriginal Heritage Study: An archaeological and ethnographic site identification survey with the Wagyl Kaip Southern Noongar representatives to inform CW01923 – Walpole New Source Borefield project. (Aboriginal Land Services, 2023)	<ul style="list-style-type: none"> <li>An Aboriginal Heritage Survey was undertaken over 28–29 September 2022.</li> <li>Further consultation was undertaken in December 2022.</li> </ul>	Appendix M
	Human health	<b>Not relevant – discussed in Section 13: Other environmental factors.</b> This factor primarily relates to project where radiation occurs within materials in a manner that could pose a risk to human health. The proposal is not expected to present any human health risk (Water Corporation, 2023a).	N/A	N/A	N/A

## 7 FLORA AND VEGETATION

### 7.1 EPA objective

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

### 7.2 Policy and guidance

- *Environmental Protection Act 1986*
- *Environment Protection and Biodiversity Conservation Act 1999*
- *Biosecurity and Agriculture Management (BAM) Act 2007*
- *Biodiversity Conservation Act 2016*
- Biodiversity Conservation Regulations 2018
- Statement of environmental principles, factors, objectives and aims of EIA (EPA, 2023)
- Environmental Factor Guideline: Flora and Vegetation (EPA, 2016a)
- Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA, 2016b).

### 7.3 Environmental investigations

RPS undertook a Detailed flora and vegetation investigation (RPS, 2023) of the zone of influence and site boundary, including an additional 120 m to 390 m buffer around the site boundary. The survey area encompassed approximately 500 ha (Figure 6). The survey was undertaken over the following dates:

- 7 to 15 November 2022 and 12 to 15 December 2022
- 14 to 18 April 2023 and 9 and 12 May 2023.

The detailed flora and vegetation survey was undertaken in accordance with *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016b). A targeted survey was also undertaken to search for conservation significant species known to occur or to potentially occur in the area.

Part of the primary survey was undertaken in December 2022, which is outside the recommended spring survey timing (September–November) for the South-West Botanical Province (EPA 2016b). However, as rainfall was higher than average before and during the first survey visit in November 2022, it is not expected that this compromised the quality of the survey undertaken in December 2022.

The supplementary survey was undertaken in May 2023 and will support any future environmental approvals should the groundwater abstraction trial be determined a success.

The Flora and vegetation assessment (RPS, 2023), which details survey methods, is provided in Appendix A.



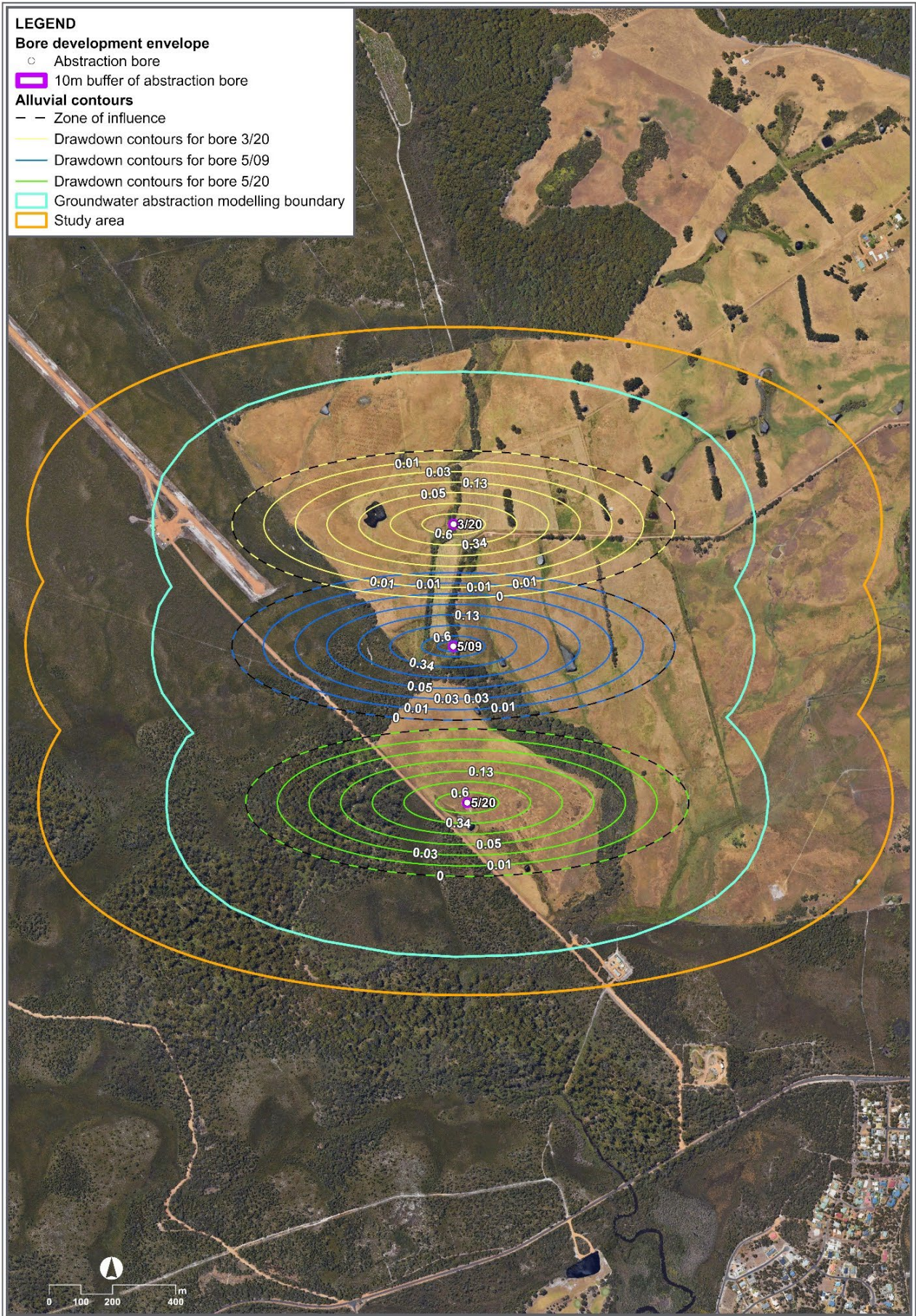


Figure 6: Ecological survey boundary (orange border)

## 7.4 Receiving environment

### 7.4.1 Interim Biogeographical Regionalisation of Australia

The zone of influence is situated within the Warren (WAR01) subregion of the Warren (WAR) bioregion (DCCEEW, 2021). The Warren subregion is composed of dissected undulating country, with loamy soils supporting Karri forest, laterites supporting Jarrah-Marri forest, leached sandy soils in plains and depressions supporting low Jarrah woodlands and paperbark / sedge swamps and marine dunes supporting *Agonis flexuosa* and *Banksia* woodlands and heaths (Hearn, 2002). The subregion covers 1,027,639 ha and its climate is considered unique due to its high rainfall and low evapotranspiration.

### 7.4.2 Regional vegetation mapping

#### 7.4.2.1 Beard vegetation associations

Regional scale pre-European vegetation mapping for Western Australia identified six mapped vegetation associations in the flora study area (Beard, 2013). Table 15 presents the remnant extent and reservation status of these vegetation associations within the Warren bioregion. The EPA's objective is to retain at least 30% of the pre-clearing extent of each ecological community in a bioregion (EPA, 2008). As shown in Table 15, none of the vegetation associations are below the 30% threshold level.

**Table 15: Pre-European vegetation associations, remnant extent and reservation status**

Vegetation association	Pre-European extent (ha)	2018 extent (ha)	% remaining	% of present extent in secure tenure
1 Tall forest; karri ( <i>Eucalyptus diversicolor</i> )	69,118.21	53,852.13	77.91	35.85
3 Medium forest; jarrah-marri	250,262.10	195,318.18	78.05	39.89
23 Low woodland; jarrah-banksia	37,736.16	27,083.22	71.77	48.74
51 Sedgeland; reed swamps, occasionally with heath	35,867.03	24,029.98	67.00	54.20
1139 Tall forest; karri and yellow tingle ( <i>Eucalyptus guilfoyleii</i> )	15,253.85	13,988.94	91.71	83.01
1144 Tall forest; karri & marri ( <i>Corymbia calophylla</i> )	159,668.36	127,836.26	80.06	34.17

(Source: Government of Western Australia 2019)

#### 7.4.2.2 Matiske and Havel vegetation complexes

The South West forest region of Western Australia was mapped for vegetation complexes by Matiske and Havel (1998) at a scale of 1:50,000. There are three vegetation complexes within the sit boundary. However only two of these are located within the predicted zone of influence.

- Collis: Tall open forest of *Eucalyptus diversicolor*-*Corymbia calophylla* on crests of hills arising above the southern coastal plain in the hyperhumid zone
- Hazelvale: Mosaic of a low woodland to woodland of *Eucalyptus marginata* subsp. *marginata*-*Eucalyptus patens*, low forest of *Agonis juniperina*-*Callistachys lanceolata* with closed heath of *Myrtaceae* spp. On sandy plains in the hyperhumid zone
- Kordabup: Mosaic of low forest of *Agonis juniperina*, closed heath of *Myrtaceae*-*Proteaceae*-*Papilionaceae* spp. With occasional emergent *Melaleuca preissiana* and *Banksia littoralis* on broad swampy plains in hyperhumid and perhumid zones.

The majority of the zone of influence is mapped as the Kordabup vegetation complex (137.69 ha), although much of this area comprises cleared agricultural land. There is only 2,972.23 ha of this vegetation complex within Western Australia, and the mapped extent of Kordabup complex within the zone of influence comprises 4.6% of this.

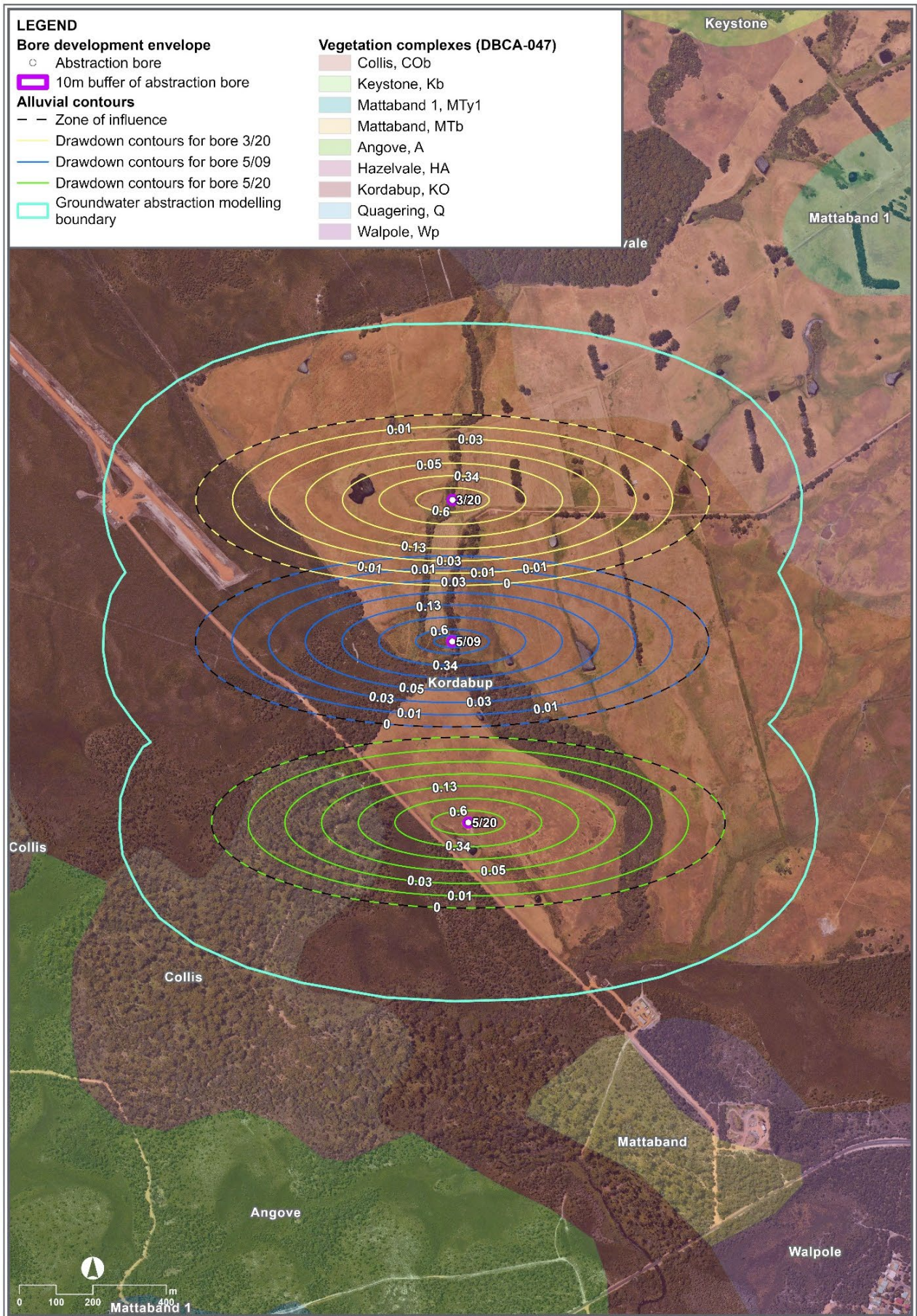


Figure 7: Vegetation complexes

### 7.4.3 Surveyed vegetation units

Nine vegetation units were identified within the zone of influence as shown (Figure 8 and Table 16). The remainder of the zone of influence (50.22% of the zone of influence) comprises areas mapped as cleared / infrastructure or paddock (RPS, 2023).

**Table 16: Vegetation units**

Vegetation unit	Vegetation unit code	Area within study area (ha) (Figure 6)	Total area within zone of influence (ha)		
			Modelled groundwater drawdown	Area (ha)	% within zone of influence
<i>Eucalyptus diversicolor</i> tall woodland/open forest over <i>Eucalyptus patens</i> , <i>Allocasaurina decussata</i> mid closed/open forest/woodland over <i>Acacia browniana</i> var. <i>browniana</i> sparse shrubland, <i>Pteridium esculentum</i> tall sparse forbland, <i>Lepidosperma gladiatum</i> sparse sedgeland	EdAbLg	36.8	0 m	2.24	1.50
			0.01 m	3.37	2.26
			0.03 m	2.83	1.89
			0.05 m	2.19	1.47
			0.13 m	1.31	0.88
			0.34 m	0.38	0.26
			0.6 m	0.17	0.11
<b>Total</b>			<b>12.49 ha</b>	<b>8.36%</b>	
<i>Eucalyptus guilfoylei</i> mid woodland over <i>Acacia browniana</i> var. <i>browniana</i> , <i>Trymalium odoratissimum</i> subsp. <i>Trifidum</i> , <i>Kunzea sulphurea</i> tall shrubland over <i>Gahnia trifida</i> , <i>Lepidosperma gladiatum</i> tall open sedgeland, <i>Anarthria scabra</i> low sparse sedgeland	EgAbToLg	4.7	0 m	0.45	0.30
			0.01 m	1.13	0.75
			0.03 m	0.57	0.38
			0.05 m	0.00	0.00
			0.13 m	0.00	0.00
			0.34 m	0.00	0.00
			0.6 m	0.00	0.00
<b>Total</b>			<b>2.15 ha</b>	<b>1.44</b>	
<i>Eucalyptus patens</i> , <i>E. megacarpa</i> , <i>Taxandria linearifolia</i> mid open woodland over * <i>Cenchrus clandestinus</i> closed grassland	EpmCec	2.3	0 m	0.13	0.09
			0.01 m	0.22	0.15
			0.03 m	0.23	0.16
			0.05 m	0.20	0.14
			0.13 m	0.17	0.11
			0.34 m	0.26	0.18
			0.6 m	0.16	0.10
<b>Total</b>			<b>1.37 ha</b>	<b>0.92%</b>	
<i>Corymbia calophylla</i> , <i>Eucalyptus patens</i> closed mid woodland over <i>Kingia australis</i> sparse tall shrubland, <i>Taxandria linearifolia</i> , <i>Xanthorrhoea preissii</i> sparse mid shrubland over <i>Cyathochaeta avenacea</i> open mid sedgeland over * <i>Cenchrus clandestinus</i> , * <i>Holcus lanatus</i> sparse grassland, <i>Opercularia hispidula</i> , * <i>Trifolium repens</i> var. <i>repens</i> sparse low forbland.	CcEpTICa	7.3	0 m	1.61	1.08
			0.01 m	1.93	1.29
			0.03 m	1.31	0.88
			0.05 m	0.46	0.30
			0.13 m	0.12	0.08
			0.34 m	0.00	0.00
			0.6 m	0.00	0.00
<b>Total</b>			<b>5.42 ha</b>	<b>3.63%</b>	
<i>Taxandria linearifolia</i> open tall shrubland over <i>Taraxis grossa</i> , <i>Cyathochaeta avenacea</i> closed sedgeland over * <i>Holcus lanatus</i> sparse grassland	TICa*HI	1.1	0 m	0.46	0.31
			0.01 m	0.34	0.23
			0.03 m	0.28	0.19
			0.05 m	0.00	0.00
			0.13 m	0.00	0.00
			0.34 m	0.00	0.00
			0.6 m	0.00	0.00
<b>Total</b>			<b>1.08 ha</b>	<b>0.72%</b>	

## REPORT

Vegetation unit	Vegetation unit code	Area within study area (ha) (Figure 6)	Total area within zone of influence (ha)		
			Modelled groundwater drawdown	Area (ha)	% within zone of influence
<i>Eucalyptus patens</i> open mid woodland over <i>Taxandria parviceps</i> , <i>Xanthorrhoea preissii</i> mid shrubland over <i>Dampiera hederacea</i> sparse low shrubland, <i>Anarthria prolifera</i> open low sedgeland	EpDpTh	51.0	0 m	4.75	3.18
			0.01 m	1.75	1.17
			0.03 m	1.63	1.09
			0.05 m	1.69	1.13
			0.13 m	0.72	0.48
			0.34 m	0.08	0.05
			0.6 m	0.00	0.00
<b>Total</b>				<b>10.62 ha</b>	<b>7.11%</b>
<i>Corymbia calophylla</i> , ( <i>Eucalyptus patens</i> ) sparse low trees over <i>Taxandria</i> spp. <i>Beaufortia sparsa</i> , <i>Homalospermum firmum</i> mid shrubland over <i>Leptocarpus thysananthus</i> , <i>Anarthria scabra</i> , <i>Lepidosperma gladiatum</i> sparse sedgeland	CcTBsLt	178.1	0 m	6.82	4.56
			0.01 m	5.50	3.68
			0.03 m	3.05	2.04
			0.05 m	1.93	1.29
			0.13 m	2.11	1.41
			0.34 m	0.79	0.53
			0.6 m	0.00	0.00
<b>Total</b>				<b>20.20 ha</b>	<b>13.52%</b>
<i>Eucalyptus globulus</i> shelter belt plantations	Eglo	5.6	0 m	0.18	0.12
			0.01 m	0.54	0.36
			0.03 m	0.30	0.20
			0.05 m	0.10	0.07
			0.13 m	0.18	0.12
			0.34 m	0.11	0.08
			0.6 m	0.00	0.00
<b>Total</b>				<b>1.42 ha</b>	<b>0.95%</b>
<i>Juncus holoschoenus</i> tall forbland over <i>Juncus pauciflorus</i> , <i>Hypochaeris glabra</i> low forbland, <i>Holcus lanatus</i> open low grassland	PJh	67.8	0 m	1.78	1.19
			0.01 m	1.51	1.01
			0.03 m	3.09	2.07
			0.05 m	4.34	2.91
			0.13 m	3.96	2.65
			0.34 m	3.16	2.12
			0.6 m	1.78	1.19
<b>Total</b>				<b>19.62 ha</b>	<b>13.13 %</b>
Paddock	Paddock	131.6	0 m	17.75	11.88
			0.01 m	17.42	11.66
			0.03 m	14.74	9.87
			0.05 m	10.63	7.11
			0.13 m	6.95	4.65
			0.34 m	4.12	2.76
			0.6 m	1.00	0.67
<b>Total</b>				<b>72.62 ha</b>	<b>48.60%</b>
Cleared for infrastructure	Cleared	12.7	0 m	0.48	0.32
			0.01 m	0.62	0.42
			0.03 m	0.29	0.19
			0.05 m	0.30	0.20
			0.13 m	0.31	0.21
			0.34 m	0.42	0.28
			0.6 m	0.01	0.01
<b>Total</b>				<b>2.43 ha</b>	<b>1.63%</b>

### 7.4.4 Vegetation condition

As shown in Table 17 and Figure 9, vegetation condition within the zone of influence ranges from Excellent to Completely Degraded.

**Table 17: Vegetation condition**

Condition	Area within zone of influence	% of zone of influence
Excellent	40.46 ha	27.08%
Very Good – Good	11.50 ha	7.70%
Completely Degraded	95.02 ha	63.59%
Cleared / infrastructure	2.43 ha	1.63%

### 7.4.5 Ecological communities

A search of Department of Biodiversity, Conservation and Attractions (DBCAs) Threatened Ecological Community (TEC) / Priority Ecological Community (PEC) database for known TEC and PEC records was undertaken within a 10 km radius of a central point. The results of the database search are provided in Table 18.

No conservation significant vegetation comprising TEC or PECs was recorded during the flora and vegetation survey. Although elements of the Priority 1 ecological community '*Reedia spathacea – Empodisma gracillimum – Schoenus multiglumis* dominated peat paluslopes and sandy mud floodplains of the Warren Biogeographical Region' were recorded, a key indicator species (*Reedia spathacea*) was absent and therefore this PEC is not present within the zone of influence.

Parts of the study area had been burnt two years prior to the survey being undertaken, including areas where elements of the Priority 1 ecological community were observed. *Reedia spathacea* is highly impacted by even low temperature fires, which can kill a large proportion of adult and juvenile plants and interrupt flowering cycles, with frequent fires diminishing the soil seedbank as seeds for this species have a low viability of 5% (DEWHA, 2008). Therefore, there is potential that *Reedia spathacea* was present prior to fire impacts.

**Table 18: Ecological communities**

Ecological community	Conservation status		Presence within survey area
	EPBC Act	BC Act	
<i>Reedia spathacea – Empodisma gracillimum – Schoenus multiglumis</i> dominated peat paluslopes and sandy mud floodplains of the Warren Biogeographical Region		Priority 1	<b>Not recorded during flora and vegetation surveys.</b> This ecological community is characterised by sedges / rushes of <i>Reedia spathacea</i> / <i>Empodisma gracillimum</i> / <i>Schoenus multiglumis</i> , approximately 1.5 m high, with <i>Homalospermum firmum</i> low open shrubs to scrub (DBCA 2022). Eight records of the PEC buffer zones were shown to intersect with the study area. The zone of influence comprises floristic elements of this PEC, however as a key diagnostic factor ( <i>Reedia spathacea</i> ) is not present, this PEC was not mapped within the zone of influence.
<i>Empodisma gracillimum</i> peatlands of south-west Western Australia.	N/A	N/A	A review of the EPBC Act finalised priority assessment list indicates that the ecological community; <i>Empodisma gracillimum</i> peatlands of south-west Western Australia may be listed under the EPBC Act at a future date (awaiting decision by the Minister). Based on flora and vegetation surveys undertaken to support the proposal, there is 0.79 ha of this potential TEC located within the zone of influence (Figure 10). Of the 0.79 ha of potential (not yet listed) TEC <i>Empodisma gracillimum</i> peatlands of south-west Western Australia, only is 0.000165 ha is located within the 0.5 m groundwater drawdown contour (groundwater level threshold criterion of 0.5 m).

REPORT

Ecological community	Conservation status		Presence within survey area
	EPBC Act	BC Act	
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Priority 3	<p><b>Not recorded during flora and vegetation surveys.</b></p> <p>This ecological community consists of mainly salt-tolerant vegetation including grasses, herbs, sedges, rushes and shrubs. Major vegetation units that generally correspond with the Subtropical and Temperate Coastal Saltmarsh PEC and TEC in Western Australia include:</p> <ul style="list-style-type: none"> <li>• Samphire shrublands dominated by <i>Tecticornia</i> species or <i>Sarcocornia</i> saltmarsh complex</li> <li>• Grasslands dominated by <i>Sporobolus virginicus</i></li> <li>• Sedgelands dominated by <i>Bolboschoenus caldwellii</i> or <i>Gahnia trifida</i></li> <li>• Rushlands dominated by <i>Juncus kraussii</i></li> <li>• Herblands dominated by <i>Wilsonia humilis/W. backhousei</i> with <i>Frankenia</i> spp. And <i>Triglochin striata</i> or <i>Samolus repens</i>.</li> </ul> <p>No records of the PEC and TEC were shown to intersect with the study area.</p>
Sphagnum Communities of the Tingle		Priority 2	<p><b>Not recorded during flora and vegetation surveys.</b></p> <p>This PEC has previously been recorded from three locations in the Walpole area. No records of the PEC were shown to intersect with the study area.</p>

No listed TECs or PECs were identified within the zone of influence.

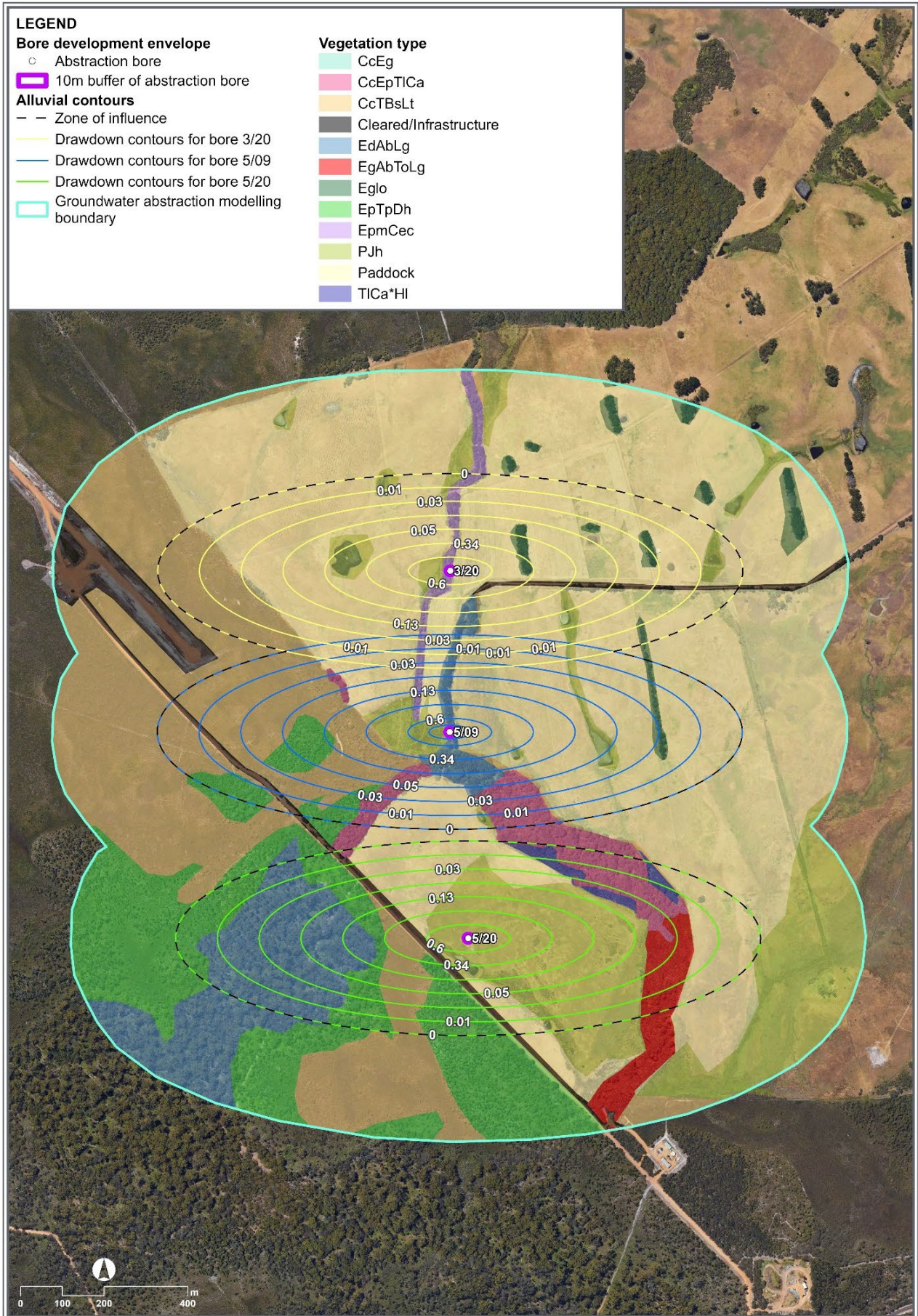


Figure 8: Vegetation units



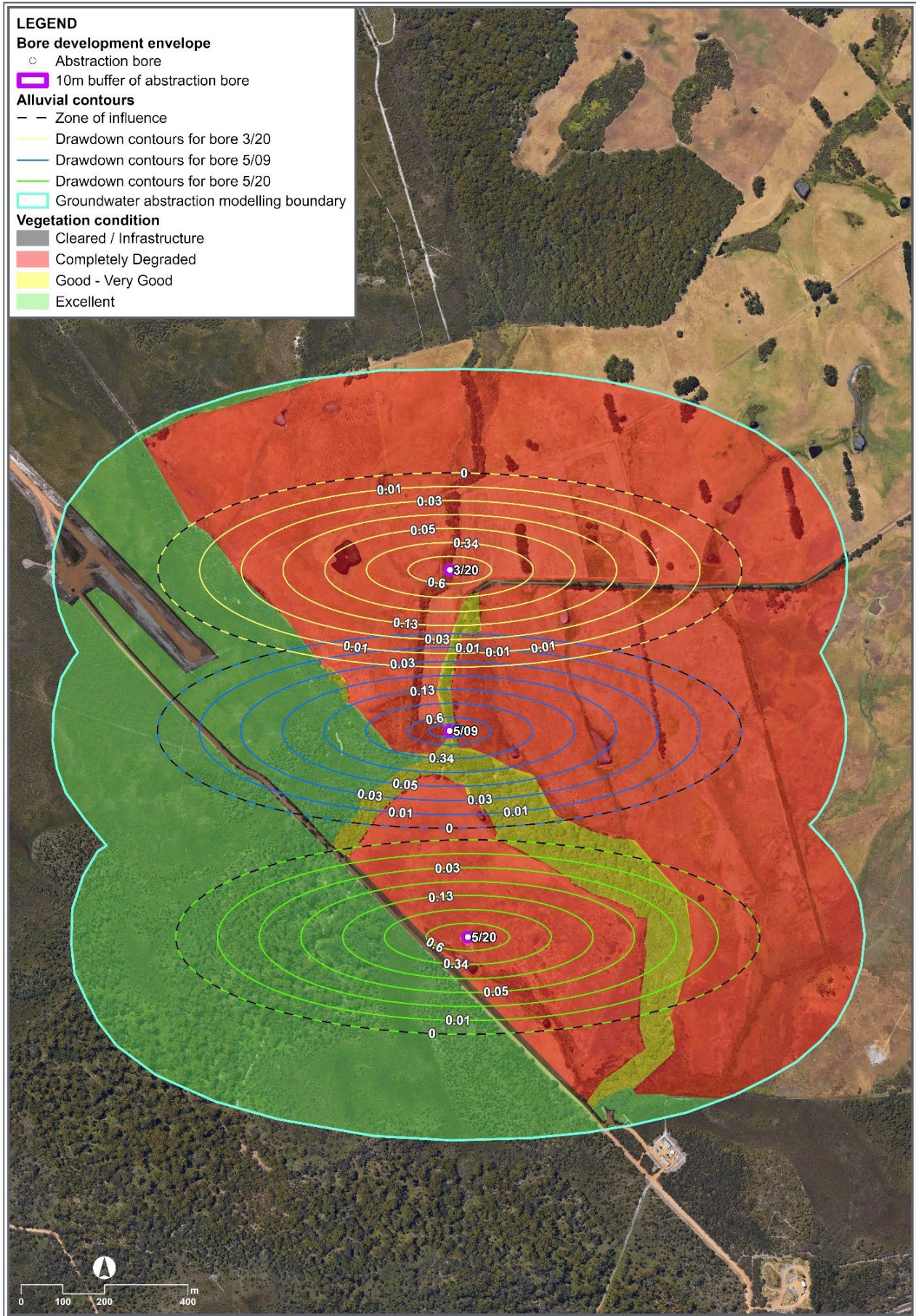


Figure 9: Vegetation condition

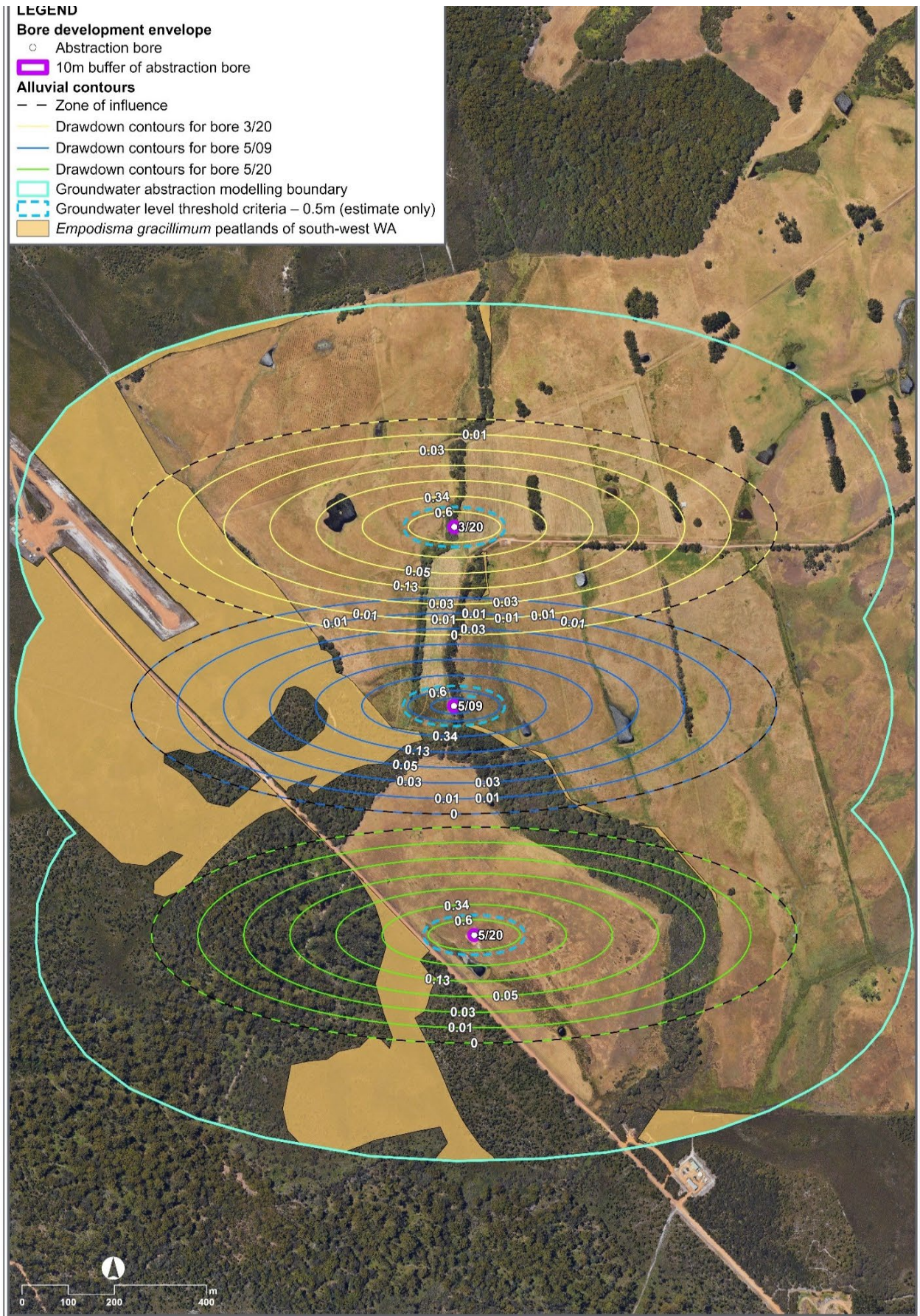


Figure 10: Potential (future and currently unlisted) TEC – *Empodisma gracillimum* peatlands of south-west Western Australia

### 7.4.6 Conservation significant flora

Conservation significant flora species with potential to occur within vicinity of the zone of influence are listed in Table 19.

No conservation significant flora species protected under the BC Act or EPBC Act were recorded during the survey (RPS, 2023)

One Priority species; *Aotus carinata* (P4) was recorded during the flora and vegetation survey (RPS, 2023) (Figure 11). Thirty-two individuals were recorded during the survey in low-lying dense scrub, of these ten individuals (31% of the overall individuals surveyed) from four locations were recorded within the zone of influence.

REPORT

Table 19: Database search results

Species	Status		Habitat	Likelihood of occurrence
	BC Act	EPBC Act		
<i>Acacia euthyphylla</i>	Priority 3		Margins of salt lakes and marshes, seasonal swamps.	Unlikely. out of usual range and record does not appear on FloraBase.
<i>Acacia semitrullata</i>	Priority 4		Sometimes over laterite, clay. Sandplains, swampy areas.	Possible. Suitable habitat occurs.
<i>Actinotus repens</i>	Priority 3		Slopes, creek banks, brown sandy loam, forest or shrubland	Possible. Suitable habitat occurs.
<i>Adelphacme minima</i>	Priority 3		Ridges, swamps, lower slopes, flats	Possible. Suitable habitat occurs.
<i>Andersonia auriculata</i>	Priority 3		Grey or peaty sand, often over laterite. Swampy areas, granite outcrops.	Possible. Suitable habitat occurs.
<i>Anthocercis sylvicola</i>	Priority 3		Sand.	Unlikely. No suitable substrate.
<i>Anzybas abditus</i> (previously known as <i>Corybas abditus</i> )(small helmet orchid)	Priority 3		No data available	Possible due to close record.
<i>Aotus carinata</i>	Priority 4		Sandy soils. Seasonally wet flats.	Recorded. Suitable habitat occurs.
<i>Banksia serra</i> (serrate-leaved dryandra)	Priority 4		Gravel, sand or clay loam over laterite. Hillslopes.	Unlikely. Suitable habitat may not occur. See Footnote <sup>1</sup>
<i>Banksia sessilis</i> var. <i>cordata</i>	Priority 4		Coastal limestone.	Unlikely. Suitable habitat may not occur.
<i>Banksia verticillate</i> (Albany banksia)	Threatened (Critically Endangered)	Vulnerable	Sandy loam. On or beside granite outcrops.	Unlikely. Suitable habitat may not occur.
<i>Boronia anceps</i>	Priority 3		White sand, gravelly laterite. Seasonally swampy heaths.	Unlikely. Suitable substrate may not occur.
<i>Boronia virgata</i>	Priority 4		Peaty sand or clay. Swampy or waterlogged places.	Possible. Suitable habitat occurs.
<i>Caladenia 44bbreviate</i> (coastal spider orchid)	Priority 3		Sand. Sand dunes.	Unlikely. Suitable habitat may not occur.
<i>Caladenia harringtoniae</i>	Threatened (Vulnerable)	Vulnerable	Sandy loam. Winter-wet flats, margins of lakes, creeklines, granite outcrops.	Possible. Suitable habitat may occur
<i>Caladenia interjacens</i> (Walpole spider orchid)	Priority 4		Sand. Consolidated coastal dunes.	Unlikely. Suitable habitat may not occur.
<i>Calectasia cyanea</i>	Threatened (Critically Endangered)	Critically Endangered	White, grey or yellow sand, gravel.	Unlikely. Suitable habitat may not occur
<i>Carpobrotus</i> sp. Lateral Flowers (N. Gibson & M. Lyons 973) PN	Priority 2		No data available	Unlikely. Suitable habitat may not occur
<i>Caustis</i> sp. Boyanup (G.S. McCutcheon 1706)	Priority 3		White or grey sand, yellow sand, clay. Low plain, gentle slopes	Unlikely. Suitable habitat may not occur.
<i>Chamaexeros longicaulis</i>	Priority 2		Grey or white sand, sandy clay with lateritic gravel.	Unlikely. Suitable habitat may not occur.
<i>Chamelaucium floriferum</i> subsp. <i>Diffusum</i>	Priority 2		Grey sandy loam, base of granite outcrops, duplex sands	Unlikely. Suitable habitat may not occur.
<i>Chamelaucium floriferum</i> subsp. <i>Floriferum</i>	Priority 2		Coastal heath, laterite, granite outcrop	Unlikely. Suitable habitat may not occur.
<i>Diuris drummondii</i> (tall donkey orchid)	Threatened (Vulnerable)	Vulnerable	Low-lying depressions, swamps.	Possible. Suitable habitat may occur.
<i>Drakaea micrantha</i> (dwarf hammer orchid)	Threatened (Endangered)	Vulnerable	White-grey sand.	Unlikely. Suitable habitat may not occur.
<i>Drosera binata</i>	Priority 2		Black peat. Winter-wet swamps.	Possible. Suitable habitat may occur.
<i>Drosera huegellii</i> var. <i>phillmanniana</i>	Priority 2		Sandy clay, steep slopes, hillsides, granite outcrops	Unlikely. Suitable habitat may not occur.
<i>Eriochilus scaber</i> subsp. <i>Orbifolius</i>	Priority 2		Interdunal flats and swales, often over granite.	Unlikely. Suitable habitat may not occur.
<i>Eucalyptus brevistylis</i> (Rate's tingle)	Priority 4		Sandy loam, sand.	Unlikely. Suitable habitat may not occur.
<i>Gahnia sclerioides</i>	Priority 4		Loam, sandy soils. Moist shaded situations.	Possible. Suitable habitat may occur.
<i>Gastrolobium formosum</i>	Priority 3		Clay loam. Along river banks or in swamps.	Possible. Suitable habitat may occur.
<i>Gonocarpus pusillus</i>	Priority 4		Grey sandy clay. Winter-wet swamps.	Possible. Suitable habitat may occur.
<i>Gonocarpus simplex</i>	Priority 4		Peaty sand. Swamps, seasonally inundated areas.	Possible. Suitable habitat may occur.
<i>Hemigenia microphylla</i>	Priority 3		Sandy sand, peaty clay, granite. Winter-wet depressions.	Unlikely. Suitable habitat may not occur.
<i>Juncus meianthus</i>	Priority 3		Black sand, sandy clay. Creeks, seepage areas.	Possible. Suitable habitat may occur.
<i>Kennedia glabrata</i>	Threatened (Vulnerable)	Vulnerable	Soil pockets, sandy soils. Granite outcrops.	Unlikely. Suitable habitat may not occur.
<i>Leptinella drummondii</i>	Priority 3		Clay loam, mud. Along rivers.	Unlikely. Suitable habitat may not occur.
<i>Leucopogon alternifolius</i>	Priority 3		Grey/white sand. Swampy areas, seasonally wet areas.	Possible. Suitable habitat may occur.
<i>Microtis globula</i> (south-coast mignonette orchid)	Threatened (Vulnerable)	Vulnerable	Peaty soils. Winter-wet swamps.	Possible. Suitable habitat may occur.
<i>Microtis pulchella</i> (beautiful mignonette orchid)	Priority 4		Peaty sand. Winter-wet swamps.	Possible. Suitable habitat may occur.
<i>Microtis quadrata</i> (south coast onion orchid)	Priority 4		Swamps, drainage, winter wet flats.	Possible. Suitable habitat may occur.
<i>Myriophyllum trifidum</i> (three-lobed meziella)	Priority 4		Flood plain, wetland, drainages, black peaty loam/sand.	Possible. Suitable habitat may occur.
<i>Reedia spathacea</i> (Reedia)	Threatened (Endangered)	Critically Endangered	Peaty sand. Swamps, river edges.	Recorded. See footnote <sup>2</sup> . Possible. Suitable habitat may occur.
<i>Rorippa cygnorum</i>	Priority 2		Damp depressions, drainages, granite. Brown loam	Unlikely. Suitable habitat may not occur.
<i>Schizaea rupestris</i> (grass fern)	Priority 2		Sand. Gullies, creek banks, shaded moist rock faces.	Unlikely. Suitable habitat may not occur.
<i>Sphenotoma drummondii</i>	DBC Threatened (Endangered)	Endangered	Stony or shallow soils over granite or quartzite. Steep rocky slopes, crevices of rocks.	Unlikely. Suitable habitat may not occur.
<i>Stylidium leeuwinense</i>	Priority 4		Winter-wet habitats and depressions. Shrubland, heath, sedgeland or low woodland.	Possible. Suitable habitat may occur.
<i>Styphelia granitica</i>	Priority 2		Loam, loam over granite. On hills, slopes.	Unlikely. Suitable habitat may not occur.
<i>Synaphea intricata</i>	Priority 3		Sand, peaty sand. Flats, swampy areas.	Possible. Suitable habitat may occur.
<i>Thomasia quercifolia</i> (oak leaved thomasia)	Priority 4		Limestone heath, coastal. Karri forest on loam	Possible. Suitable habitat may occur.
<i>Tripterococcus</i> sp. <i>Brachylobus</i> (A.S. George 14234)	Priority 4		Grey sand loam, Eucalypt woodland	Possible. Suitable habitat may occur.
<i>Verticordia lehmannii</i>	Priority 4		Sandy clay. Winter-wet flats.	Possible. Suitable habitat may occur.

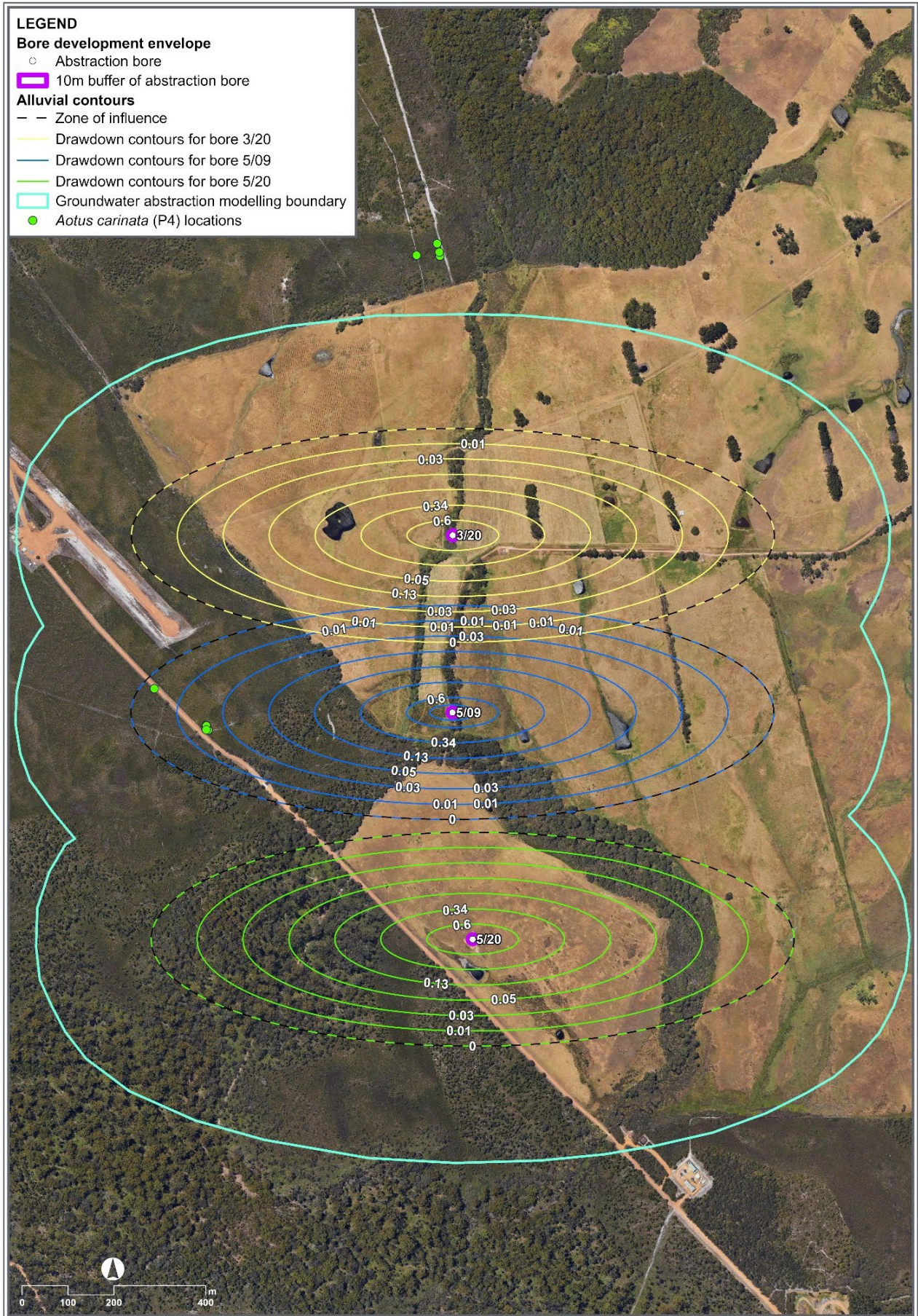


Figure 11: *Aotus carinata* (P4) locations

## 7.4.7 Introduced species

Twelve introduced flora species were recorded during the flora and vegetation survey (Table 20), none of which were listed as weeds of national significance (WoNS) or Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act).

**Table 20: Introduced taxa in the study area**

Family	Scientific name	Common name
Asteraceae	<i>Hypochaeris glabra</i>	Smooth cat's-ear
Fabaceae	<i>Lotus subbiflorus</i>	Hairy bird's-foot trefoil
	<i>Melilotus albus</i>	White melilot
	<i>Ornithopus pinnatus</i>	Orange birdsfoot
	<i>Trifolium repens</i> var. <i>repens</i>	White clover
Myrtaceae	<i>Eucalyptus globulus</i>	Tasmanian bluegum
Poaceae	<i>Bromus diandrus</i>	Great brome
	<i>Cenchrus clandestinus</i>	Kikuyu
	<i>Holcus lanatus</i>	Yorkshire fog
	<i>Lolium perenne</i>	Perennial ryegrass
Polygonaceae	<i>Rumex acetosella</i>	Sheep sorrel
Rosaceae	<i>Rosa canina</i>	Dog rose

## 7.5 Potential environmental impacts

Table 21 provides the potential key impacts to flora and vegetation from the proposal.

**Table 21: Potential impacts on flora and vegetation**

Phase	Impact class	Works / operations	Potential impacts
Establishment	<ul style="list-style-type: none"> <li>The abstraction bores have already been installed and no vegetation clearing is proposed.</li> </ul>		
Operation	Indirect	<ul style="list-style-type: none"> <li>Groundwater abstraction</li> </ul>	<ul style="list-style-type: none"> <li>Introduction and / or distribution of weeds, pests and diseases.</li> <li>Disturbance to surrounding native vegetation through personnel accessing the bores for maintenance or monitoring activities.</li> <li>Alteration of groundwater levels (drawdown) may reduce ground water availability for groundwater dependent vegetation and flora.</li> <li>Alteration of groundwater levels may result in the exposure of acid sulfate soils, resulting in groundwater quality impacts to groundwater dependent vegetation.</li> </ul>

### 7.5.1 Assessment of impacts

#### 7.5.1.1 Introduction and / or distribution of weeds, pests and diseases

There is the potential for Declared Pests, other weed species and disease to be introduced and / or spread during any monitoring or maintenance activities scheduled during the six-month trial period.

The bores and associated infrastructure are all located within existing cleared areas and access to these areas will be via existing roads and tracks. Therefore, as no soil or vegetation will be moved and vehicles and personnel will not traverse native vegetation to access the bores, the risk of impacts from weed or disease spread, and introduction is low.

As areas of native vegetation will not be accessed during the six-month trial, mitigation and management measures are not considered necessary.

### 7.5.1.2 Disturbance to surrounding native vegetation

The three bores are located within cleared areas and therefore, any maintenance or monitoring activities required during the trial period will not result in the disturbance of surrounding native vegetation. Access to the three bores will be via existing roads and tracks and therefore any damage to vegetation during monitoring or maintenance works is unlikely. No further management or mitigation measures are considered necessary.

### 7.5.1.3 Alteration of groundwater levels

An assessment of the potential groundwater dependence of vegetation within the zone of influence is provided in Section 11.4.3.

As outlined in Section 11.4.3, the greater the depth to groundwater, the lower the dependence on groundwater and the more tolerant vegetation is to water table drawdown. At groundwater depths of 10 m or greater, the importance of groundwater to terrestrial vegetation is reduced. As the depth to groundwater across the zone of influence is less than 1.5 MBGL (Figure 12), native vegetation within the zone of influence is likely to be groundwater dependent. Therefore, based on modelling predictions, there is potential for a temporary, indirect groundwater drawdown impact to native vegetation within the zone of influence as summarised in Table 22.

**Table 22: Groundwater dependent native vegetation within the zone of influence**

Phreatophytic vegetation classification	Vegetation unit code	Vegetation unit	Area within zone of influence
0–3 m (depth to groundwater) phreatophyte category vegetation (terrestrial)	EdAbLg	<i>Eucalyptus diversicolor</i> tall woodland/open forest over <i>Eucalyptus patens</i> , <i>Allocasaurina decussata</i> mid closed/open forest/woodland over <i>Acacia browniana</i> var. <i>browniana</i> sparse shrubland, <i>Pteridium esculentum</i> tall sparse forbland, <i>Lepidosperma gladiatum</i> sparse sedgeland	12.49 ha (8.36% of the zone of influence)
	EpThDp	<i>Eucalyptus patens</i> open mid woodland over <i>Taxandria parviceps</i> , <i>Xanthorrhoea preissii</i> mid shrubland over <i>Dampiera hederacea</i> sparse low shrubland, <i>Anarthria prolifera</i> open low sedgeland	10.62 ha (7.11% of the zone of influence)
0–3 m (depth to groundwater) phreatophyte category vegetation (wetland)	EgAbToLg	<i>Eucalyptus guilfoylei</i> mid woodland over <i>Acacia browniana</i> var. <i>browniana</i> , <i>Trymalium odoratissimum</i> subsp. <i>Trifidum</i> , <i>Kunzea sulphurea</i> tall shrubland over <i>Gahnia trifida</i> , <i>Lepidosperma gladiatum</i> tall open sedgeland, <i>Anarthria scabra</i> low sparse sedgeland	2.15 ha (1.44% of the zone of influence)
	EpmCec	<i>Eucalyptus patens</i> , <i>E. megacarpa</i> , <i>Taxandria linearifolia</i> mid open woodland over <i>Cenchrus clandestinus</i> closed grassland	1.37 ha (0.92% of the zone of influence)
	CcEpTICa	<i>Corymbia calophylla</i> , <i>Eucalyptus patens</i> closed mid woodland over <i>Kingia australis</i> sparse tall shrubland, <i>Taxandria linearifolia</i> , <i>Xanthorrhoea preissii</i> sparse mid shrubland over <i>Cyathochaeta avenacea</i> open mid sedgeland over <i>Cenchrus clandestinus</i> , <i>Holcus lanatus</i> sparse grassland, <i>Opercularia hispidula</i> , <i>Trifolium repens</i> var. <i>repens</i> sparse low forbland	5.42 ha (3.63% of the zone of influence)
	TICa*HI	<i>Taxandria linearifolia</i> open tall shrubland over <i>Taraxis grossa</i> , <i>Cyathochaeta avenacea</i> closed sedgeland over <i>Holcus lanatus</i> sparse grassland	1.08 ha (0.72% of the zone of influence)
	CcTBsLt	<i>Corymbia calophylla</i> , ( <i>Eucalyptus patens</i> ) sparse low trees over <i>Taxandria</i> spp. <i>Beaufortia sparsa</i> , <i>Homalospermum firmum</i> mid shrubland over <i>Leptocarpus thysananthus</i> , <i>Anarthria scabra</i> , <i>Lepidosperma gladiatum</i> sparse sedgeland	20.20 ha (13.52% of the zone of influence)
	PJh	<i>Juncus holoschoenus</i> tall forbland over <i>Juncus pauciflorus</i> , <i>Hypochaeris glabra</i> low forbland, <i>Holcus lanatus</i> open low grassland	19.62 ha (13.13% of the zone of influence)
	<b>Total</b>		

A risk assessment and discussion of potential impacts to groundwater dependent vegetation from the predicted groundwater drawdown is provided in Section 11.5.1.3.

### **7.5.1.3.1 Groundwater drawdown impacts to the potential (future) TEC – *Empodisma gracillimum* peatlands of south-west Western Australia**

Using the risk assessment methodology outlined in Section 11.5 to assess the impacts to groundwater dependent vegetation, the following impacts to the potential TEC *Empodisma gracillimum* peatlands of south-west Western Australia have been identified:

- 19.41 ha of the potential TEC within the zone of influence (96.1% of the TEC located within the zone of influence) is at a low risk of being impacted by the proposed groundwater abstraction.
- 0.79 ha of the potential TEC within the zone of influence (3.9% of the TEC located within the zone of influence) is at a moderate risk of being impacted by the proposed groundwater abstraction. Of this, only 0.000165 ha is located within the 0.5m groundwater drawdown contour (groundwater level threshold criterion of 0.5 m).
- No areas of the potential TEC are considered to be at a high risk of greater from the modelled groundwater drawdown.

As the predicted groundwater drawdown is temporary, significant or long-term impacts to the TEC are considered unlikely. Potential impacts to the 0.79 ha of the TEC from predicted groundwater drawdown includes:

- Temporary reduction of flowering and seed production
- Some mortality of individuals within the TEC may occur. However, considering the temporary nature of the groundwater drawdown, this is considered unlikely
- Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).

Potential responses of groundwater dependent vegetation within the moderate risk category to groundwater drawdown are discussed in greater detail in Section 11.5.1.

### **7.5.1.3.2 *Aotus carinata* (Priority 4)**

Ten individuals of the Priority species; *Aotus carinata* (P4) were recorded within the zone of influence. Based on the groundwater drawdown modelling, potential groundwater drawdown at the recorded locations of this species will range from 0.02 m and less than 0.01 m (Figure 11). This modelled drawdown is within the natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021). Therefore, potential impacts to this species as a result of indirect impacts from the modelled groundwater drawdown are unlikely.

### **7.5.1.4 Alteration of groundwater quality**

The modelled groundwater drawdown may result in the exposure of potential acid sulfate soils (ASS). Oxidation of ASS through exposure of the soils to air may release acid, which may subsequently reduce pH levels, increase acidity and release naturally occurring heavy metals and nutrients. There is a risk that deterioration of groundwater quality resulting from exposure of ASS may impact groundwater dependent vegetation.

The risk of exposure of ASS is discussed in Section 9.5.1.1 and impacts to groundwater and surface water quality and Groundwater Dependent Ecosystems are discussed further in Section 11.5.1.



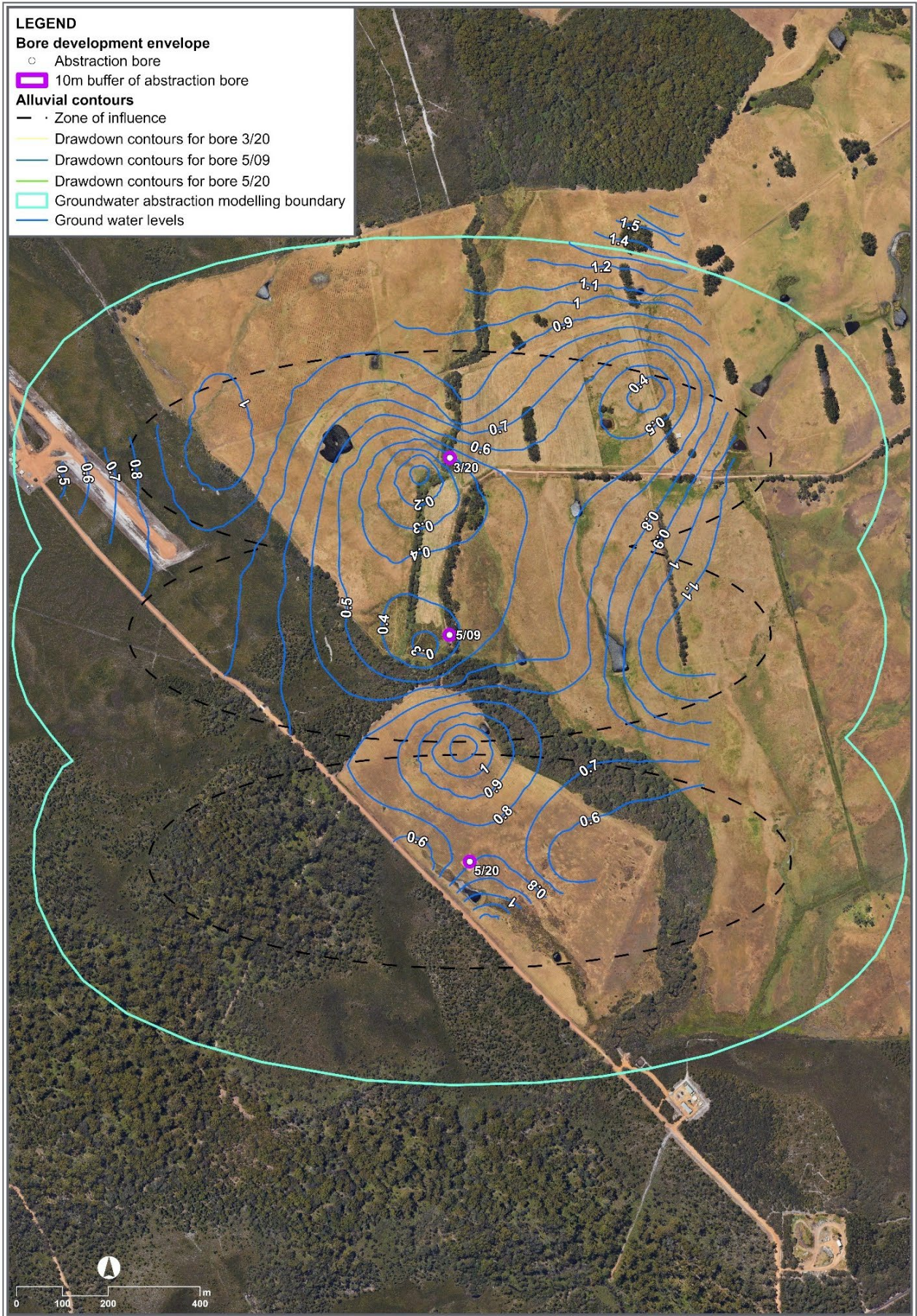


Figure 12: Depth to groundwater (MBGL)

## 7.6 Mitigation

Table 23 demonstrates how the EPA’s mitigation hierarchy (avoid, minimise and rehabilitate) has been applied to the environmental factor of flora and vegetation to address the key potential impacts.

**Table 23: Application of mitigation hierarchy to flora and vegetation**

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
Introduction and/or distribution of weeds, pests and diseases	Indirect	Avoid	<ul style="list-style-type: none"> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with operation of the bores will not be undertaken in or adjacent to native vegetation and the proposal will not result in the introduction of weeds or disease to areas of native vegetation. No further management is considered necessary.</li> </ul>	No residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>Mitigation measures are not considered necessary as the bores are located in already cleared and disturbed agricultural areas. As personnel and vehicle movement through vegetated areas is not required, impacts to native vegetation will be avoided.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N/A</li> </ul>	
Disturbance to surrounding native vegetation	Indirect	Avoid	<ul style="list-style-type: none"> <li>No native vegetation is proposed to be cleared. The bores have been installed within cleared areas and infrastructure associated with the bores will be installed in cleared areas only.</li> </ul>	No residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>The bores are located within cleared areas, therefore accidental disturbance of native vegetation is unlikely.</li> <li>During monitoring or maintenance activities at the bores, traffic management rules (e.g. keeping to designated tracks) will be implemented to avoid accidental disturbance of flora and vegetation.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N/A</li> </ul>	
Alteration of groundwater levels (drawdown) may reduce groundwater availability for groundwater dependent vegetation.	Indirect	Impacts to groundwater dependent vegetation is discussed in Section 11.		
Alteration of groundwater quality from drawdown may reduce groundwater quality for groundwater dependent vegetation.	Indirect	Impacts to groundwater dependent vegetation is discussed in Section 11.		
Groundwater drawdown impacts to the potential / future TEC	Indirect	Avoid	<ul style="list-style-type: none"> <li>The complete avoidance of potential impacts to the potential TEC is not considered an achievable outcome due to the nature of the proposal. However, avoidance of groundwater drawdown impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the Groundwater Dependent Ecosystem Management Plan (GDEMP) (RPS, 2023b) and the Walpole Groundwater Investigation Monitoring and Implementation Plan (WIMP) (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	0.79 ha of the potential/ future TEC has a risk of being temporarily impacted by the modelled groundwater drawdown.
		Minimise	<ul style="list-style-type: none"> <li>RPS has undertaken a risk assessment of the potential impacts of the proposed groundwater abstraction on phreatophytic vegetation within the zone of influence based on the framework developed by Froend &amp; Loomes (2004). This risk assessment is discussed in further detail in Sections 7.5.1.3 and 11.4.3 of this report. The risk assessment identified that impacts to the 0.79 ha of potential TEC are likely to be moderate.</li> <li>Based on assessments undertaken by Froend, the possible response of phreatophytic vegetation within the moderate risk category are summarised below:                             <ul style="list-style-type: none"> <li>Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying</li> <li>Some mortality of individuals may occur. However, the temporary and short term (six months) nature of the groundwater drawdown means this is unlikely</li> <li>Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).</li> </ul> </li> <li>Assessments of vegetation susceptibility and possible responses to groundwater drawdown undertaken by Froend (2005) indicate that it is unlikely that vegetation response to groundwater drawdown within the six-month trial period will be identifiable or measurable. However, the above responses may be observed after completion of the trial.</li> <li>A GDEMP (RPS, 2023b) has been prepared to minimise impacts to groundwater dependent vegetation (including the potential TEC) from indirect impacts associated with groundwater drawdown. The GDEMP (RPS, 2023b) is provided in Appendix B of this report and includes the following measures to ensure impacts to vegetation are consistent with the EPA objective for flora and vegetation (EPA 2016):                             <ul style="list-style-type: none"> <li>Groundwater monitoring will be undertaken at the baseline bore (19/22) and the monitoring bores (1/22, 4/22, 8/22 and 14/22) to manage and monitor groundwater drawdown and ensure the following triggers established in consultation with the Department of Water and Environmental Regulation (DWER) are not exceeded:                                     <ol style="list-style-type: none"> <li>Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m.</li> <li>Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m.</li> <li>Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m.</li> </ol> </li> <li>If these trigger levels are exceeded, then the management actions and corrective measures outlined in the GDE MP (RPS, 2023b) will be implemented as summarised below:                                     <ol style="list-style-type: none"> <li>If the early response trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> </ol> </li> </ul> </li> </ul>	

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
			<ul style="list-style-type: none"> <li>c. If the threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>d. If the threshold criterion (of 0.5 m) is exceeded, contingency vegetation monitoring in accordance with the Groundwater Dependent Vegetation Monitoring Plan (provided in Appendix A of the GDE MP) will be undertaken.</li> </ul> <ul style="list-style-type: none"> <li>• Of the 0.79 ha of potential (not yet listed) TEC <i>Empodisma gracillimum</i> peatlands of south-west Western Australia, only is 0.000165 ha is located within the 0.5 m groundwater drawdown contour (groundwater level threshold criterion of 0.5 m).</li> <li>• Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year from completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	N/A	
Groundwater drawdown impacts to <i>Aotus carinata</i> (P4)	Indirect	Avoid	<ul style="list-style-type: none"> <li>• The complete avoidance of potential impacts to the ten individuals of <i>Aotus carinata</i> (P4) is not considered an achievable outcome due to the nature of the proposal. However, avoidance of groundwater drawdown impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b) and the WIMP (Water Corporation, 2023a): <ul style="list-style-type: none"> <li>– Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m)</li> <li>– Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m)</li> <li>– Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>• The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	Implementation of the GDEMP (RPS, 2023b) will ensure there are no residual impacts to this species.
		Minimise	<ul style="list-style-type: none"> <li>• Ten individuals of the Priority species; <i>Aotus carinata</i> (P4) were recorded within the zone of influence. Based on the groundwater drawdown modelling, potential groundwater drawdown at the recorded locations of this species will range from 0.02 m and less than 0.01 m (Figure 11). This modelled drawdown is within the natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021). Therefore, potential impacts to this species as a result of indirect impacts from the modelled groundwater drawdown are unlikely.</li> <li>• A GDEMP (RPS, 2023b) has been prepared to minimise impacts to groundwater dependent flora and vegetation (including <i>Aotus carinata</i>) from indirect impacts associated with groundwater drawdown. The GDEMP (RPS, 2023b) is provided in Appendix B of this report and includes the following measures to ensure impacts to vegetation are consistent with the EPA objective for flora and vegetation (EPA 2016): <ul style="list-style-type: none"> <li>– Groundwater monitoring will be undertaken at the baseline bore (19/22) and the monitoring bores (1/22, 4/22, 8/22 and 14/22) to manage and monitor groundwater drawdown and ensure the following triggers established in consultation with the Department of Water and Environmental Regulation (DWER) are not exceeded: <ul style="list-style-type: none"> <li>a. Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m.</li> <li>b. Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m.</li> <li>c. Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m.</li> </ul> </li> <li>– If these trigger levels are exceeded, then the management actions and corrective measures outlined in the GDE MP (RPS, 2023b) will be implemented as summarised below: <ul style="list-style-type: none"> <li>a. If the early response trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>b. If the trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>c. If the threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>d. If the threshold criterion (of 0.5 m) is exceeded, contingency vegetation monitoring in accordance with the Groundwater Dependent Vegetation Monitoring Plan (provided in Appendix A of the GDE MP) will be undertaken.</li> </ul> </li> </ul> </li> <li>• Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year from completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	N/A	

## 7.7 Assessment and significance of residual impact

A total of 0.79 ha of the potential (currently under assessment by the Minister and not yet listed under the EPBC Act) TEC within the zone of influence (3.9% of the TEC located within the zone of influence) has a medium risk of being temporarily impacted by the modelled groundwater drawdown. Of this, only is 0.000165 ha is located within the 0.5 m groundwater drawdown contour (groundwater level threshold criterion of 0.5 m).

Research undertaken by Froend (2005) indicates that changes in vegetation composition due to groundwater drawdown are unlikely to occur over the short period of time the trial is proposed and that any changes in composition can be reversed after a short period of time (less than three years). Therefore, no significant changes to the TEC are anticipated as a result of the modelled drawdown over the six-month period. If vegetation responses do occur as a result of the trial, they may be observed after completion of the trial due to a lag in the vegetation response and may include a temporary reduction in flowering or seed production, some evidence of reduced growth and vigour and some mortality of individual plants, although mortalities are considered unlikely.

Residual impacts to other groundwater dependent vegetation are discussed in Section 11.7.

## 7.8 Environmental outcomes

The following key environmental outcomes are proposed to ensure that the EPA's flora and vegetation objective (EPA, 2016a) will be achieved:

- No vegetation will be cleared or directly impacted by the proposal.
- The GDEMP (RPS, 2023b) will be implemented to minimise indirect impacts to groundwater dependent flora and vegetation from groundwater abstraction and outlines trigger and threshold criteria that provides an early warning to ensure impacts to vegetation are consistent with the EPA objective for flora and vegetation (EPA 2016).
- Groundwater and surface water monitoring will be undertaken in accordance with the following documents to determine whether trigger and threshold criteria have been exceeded:
  - GDEMP (RPS, 2023b) provided in Appendix B
  - ASS detailed site assessment (RPS, 2023c) provided in Appendix D
  - WIMP (Water Corporation, 2023a) provided in Appendix E.
- In the event that monitoring undertaken in accordance with the above documents indicates an exceedance of the trigger or threshold criteria, Water Corporation will:
  - Report the exceedance to DWER.
  - implement the appropriate response actions outlined in the GDEMP (RPS, 2023b).
  - Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.

The environmental outcomes above are consistent with the EPA objective for flora and vegetation (EPA 2016), and thereby not significant, as they to protect flora and vegetation so that biological diversity and ecological integrity are maintained. Environmental outcomes applicable to other groundwater dependent vegetation are outlined in 'Inland waters' in Section 11.8.

## 8 SUBTERRANEAN FAUNA

### 8.1 EPA objective

To protect subterranean fauna so that biological diversity and ecological integrity are maintained (EPA, 2016d).

### 8.2 Policy and guidance

- Environmental Factor Guideline: Subterranean Fauna (EPA, 2016c)
- Technical Guidance: Subterranean Fauna Survey (EPA, 2016d)
- Technical Guidance – Subterranean fauna surveys for environmental impact assessment (EPA, 2021b).

Impacts to subterranean fauna are defined in the EPA's *Environmental Factor Guideline: Subterranean Fauna* (EPA, 2016c). These impacts may be direct or indirect, as summarised below:

- Direct impacts include the removal or destruction of habitat by drawdown of water levels, inundation, or water quality changes. The main threats include:
  - Excavation of rock types/habitat known to support subterranean fauna
  - Groundwater extraction for process or domestic purposes
  - Dewatering to facilitate mining below the water table, and groundwater reinjection of waste or excess water.
- Indirect impacts include changes to hydrology, siltation, void collapse, alteration to nutrient balance and contamination. The main threats include:
  - Changed surface topography due to compaction or creation of hard surfaces resulting in altered groundwater flow paths, increased runoff, and reduced infiltration and aquifer recharge
  - Clearing of surface vegetation leading to sedimentation and changed nutrient inputs
  - Potential leaks or leaching including tailings and waste water resulting in alterations to ground water chemistry and quality, and introduction of toxins or radiation; and salinisation due to intrusion of saline water into freshwater aquifers and leaching from pit voids.

The proposal has been assessed against the relevant potential impacts outlined in the EPA's guidelines, impacts relevant to the proposal are discussed in Section 8.5.

### 8.3 Environmental investigation

Phoenix Environmental Sciences Services undertook a detailed stygofauna survey to support the proposed trial (Phoenix, 2023b). As part of the survey, Phoenix (2023b) undertook a desktop review of habitat and relevant biological records, and a field survey to appraise the potential values of the site and surrounds in the context of subterranean fauna as summarised below.

#### 8.3.1 Desktop assessment

A desktop assessment and literature review was undertaken by Phoenix (2023) to identify and prepare lists of significant stygofauna that may occur within the groundwater drawdown footprint, including a search of the following sources:

- WA Museum Arachnid and Myriapod Database, Mollusca Database, Crustacea Database, and Insect Database
- Phoenix' internal database for stygofauna potentially occurring within 100 km of the drawdown area.

### 8.3.2 Stygofauna survey

The Detailed stygofauna survey was undertaken in accordance with relevant survey guidelines and guidance, including those listed in Section 8.2. Bores were sampled within a variety of habitat types and from bores screened within both the shallow and Superficial aquifer as summarised in Table 24. Bores sampled are shown in Figure 13. The stygofauna survey was undertaken over the following two phases:

- Phase 1: 25 October–1 November 2022
- Phase 2: 27 February–3 March 2023.

The stygofauna survey report is provided as Appendix C.

**Table 24: Stygofauna sample locations**

Bore	WC bore	Screened depth (aquifer)	Bore depth description	Habitat type
<b>Outside zone of influence</b>				
STY-01	1/07	15.25	Shallow	Qrc
STY-06	4/15	8.5	Shallow	Qrc
STY-07	3/15	8.5	Shallow	Qrc
STY-08	2/15	9	Shallow	Qrc
STY-10	8/08	23.6	Saprolite	Qrc
STY-15	13/08	30	Shallow	Qrc
STY-16	15/08	36.9	Deep	Qrc
STY-17	14/08	29.9	Deep	Qrc
STY-18	10/08	58.4	Saprolite	Qrc
STY-19	1/09	100	deep	Qrc
STY-20	13/22	-	Shallow	Qrc
STY-21	17/08	31.9	Deep	Qrc
STY-22	3l	-	Shallow	Qrc
STY-23	16/08	33.4	Deep	Qrc
STY-25	19/22	-	Shallow	Mn
STY-31	5/15	8.5	Shallow	Mn
STY-32	27/08	28.5	Deep	Mn
<b>Inside zone of influence</b>				
STY-02	7/09	5.75	Shallow	Qrc
STY-03	3/20	151.07	Deep	Mn/ Qrc
STY-04	6/09	4.2	-	Qrc
STY-05	5/09	88.4	Deep	Mn
STY-09	8/09	4.75	Shallow	Qrc
STY-11	2/20	131.39	deep	Mn
STY-12	18/22	-	Shallow	Qrc
STY-13	17/22	-	Shallow	Qrc
STY-14	2/22	-	Shallow	Mn
STY-24	1/20	158.42	deep	Mn
STY-26	5/22	-	Shallow	Qrc
STY-27	11/22	-	Shallow	Qrc
STY-28	10/22	-	Shallow	Qrc
STY-29	14/22	-	Shallow	Mn
STY-30	8/22	-	Shallow	Mn

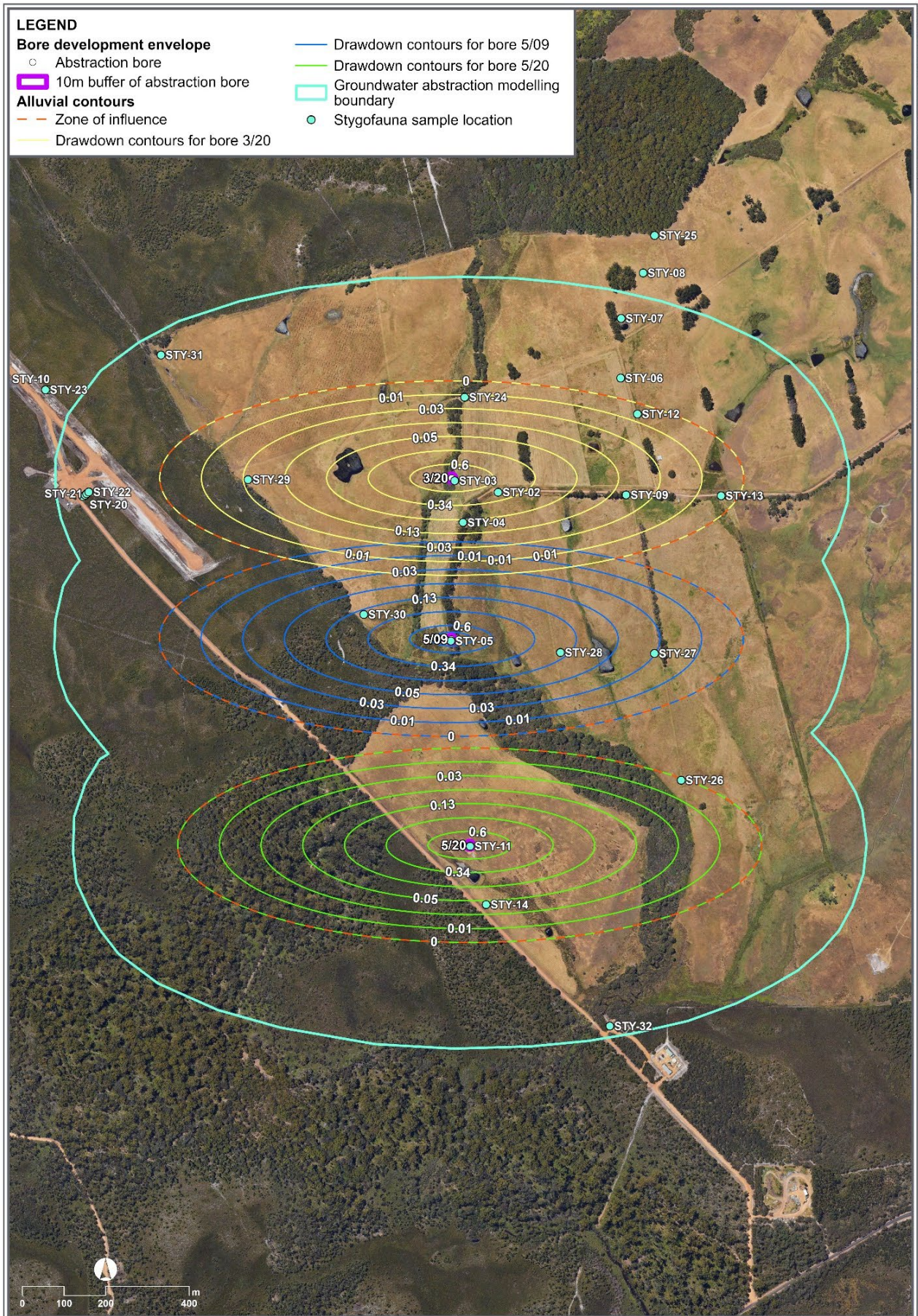


Figure 13: Stygofauna sampling locations

### 8.3.3 Groundwater quality sampling

At each bore sampled for stygofauna, bore depth, depth to groundwater and water quality parameters were recorded. Water quality parameters were measured in-situ with a YSP multiprobe and included temperature (°C), dissolved oxygen (%), dissolved oxygen (mg/L), conductivity (µs/cm), pH, total dissolved solids (TDS) (mg/L), salinity (ppt).

## 8.4 Receiving environment

### 8.4.1 Potential habitat

Subterranean fauna can exist within a variety of void networks, including solution cavities within calcrete and karst; fractured rock and coarse sediments such as cobble or gravel strata (Phoenix 2023). The zone of influence intersects the following geological formations (Phoenix, 2023b):

- Colluvial, sheetwash with local calcrete (Qrc), which comprises the majority of the site, within two isolated pockets in the east and west
- Gneiss, migmatite, dolerite, augen gneiss, felsic gneiss (Mn) occurs between the pockets of colluvial sediment.

Geological formations within the study area known to provide stygofauna habitat include Qrc, fractured rock aquifers, and hyporheic zones adjacent to streams and stream beds (Global Groundwater, 2021). The geological formation Mn is of low to medium suitability for subterranean fauna, depending on the level of fractures and degree of porosity (Phoenix, 2023b).

Two aquifers are present within the zone of influence; a deep aquifer and a shallow aquifer (Table 25). The shallow aquifer is formed by superficial strata and its thickness is determined by topography. The deep aquifer occurs due to folds and faults of basement rock, which have caused fractures and shear zones of up to 150 m in granitic gneiss (Phoenix, 2023b).

**Table 25: Aquifers within the zone of influence**

Aquifer number	Aquifer type	Lithology	Suitability for stygofauna
1	Fractured and weathered rocks – local aquifer, very minor or no groundwater resources	Granitoid gneiss, migmatite, quartzo-feldspathic gneisses; subsurface weathered to clay.	Medium
2	Sedimentary aquitards and local aquifer – minor to no groundwater resources	PALLINUP SILTSTONE – grey, brown siltstone, overlies the WERRILUP FORMATION (consisting of lignite and overlying sandstone, sand and clay or weathered basement.	Aquitards – Low Local aquifers – High

(Phoenix, 2023b)



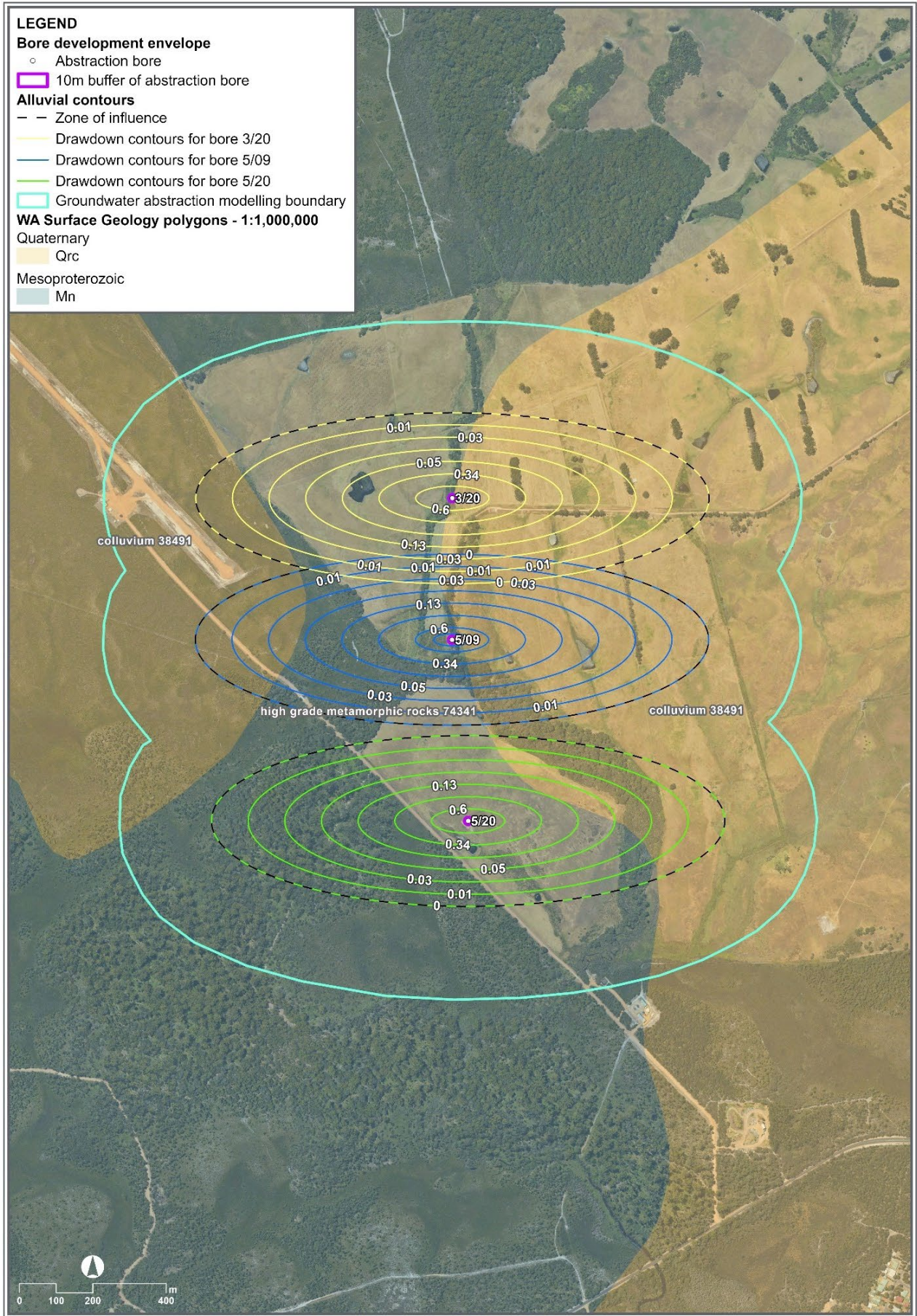


Figure 14: Geology

## 8.4.2 Stygofauna species

A total 41 specimens from five taxa and five families were recorded during the stygofauna survey as detailed in Table 26. The following three taxa are only known from the stygofauna survey; however this could be due to the limited sampling previously undertaken in the area (Phoenix, 2023b):

- Bathynellidae sp. 'Walpole 1'; nine specimens collected during the survey. This species was collected from both inside the zone of influence (STY08) and outside the zone of influence (STY04) and is therefore considered unlikely to be restricted as discussed below
- Bathynellidae sp. 'Walpole 2'; two specimens collected during the survey, from one bore outside the zone of influence (STY08)
- Fibulacamptus 'BHA346'; 26 specimens collected during the survey, from one bore outside the zone of influence (STY10).

The overlap of stygofauna species at STY 4 (in the study area and impact area) with STY08 and STY10 (in study area but outside the impact area), suggests physical and biological connectivity. Therefore, the stygofauna communities present are unlikely to be restricted to or impacted by the drawdown effect predicted for the six-month trial (Phoenix, 2023b).

**Table 26: Stygofauna species identified during surveys**

Species	Number of specimens collected	Details of sampling location				Comments
		Bore	Geology	Bore depth / aquifer	Within zone of influence	
<i>Fibulacamptus</i> 'BHA346'	26	Sty-10	Qrc	Screened depth: 23.6 m (saprolite)	Outside zone of influence	Morphological analysis revealed taxon not conspecific to any of the described species of <i>Fibulacamptus</i> recorded in Australia. Only recorded at Sty-10 by Phoenix and not within the zone of influence.
<i>Bathynellidae</i> sp. 'Walpole 1'	2	Sty-04	Qrc	Screened depth: 4.2 m (shallow)	Inside zone of influence	This specimen is 17.7–19% divergent from MT902722 ( <i>Bathynellidae</i> sp <i>Biologic-BATH003</i> ) and is therefore considered a new species. This species was recorded within (STY-04) and outside (STY-08) the zone of influence.
	7	Sty-08	Qrc	Screened depth: 9 m (shallow)	Outside zone of influence	
<i>Aeolosoma</i> sp. Indet.	6	Sty-10	Qrc	Screened depth: 23.6 m (saprolite)	Outside zone of influence	Little taxonomic framework for this group. Only recorded at Sty-10 by Phoenix and not within the zone of influence.
Enchytraeidae '2 bundle' s.l. (long thin 2 per seg)	1	Sty-10	Qrc	Screened depth: 23.6 m (saprolite)	Outside zone of influence	Likely not restricted. These broad morphotypes occur elsewhere in WA but little taxonomic work has been done on the enchytraeids. Only recorded at Sty-10 by Phoenix and not within the zone of influence.
Phreodrilidae sp. AP DVC s.l.	8	Sty-02	Qrc	Screened depth: 5.75 m (shallow)	Inside zone of influence	Widespread morphospecies. Occurs elsewhere in WA. This species was recorded within (STY-08) and outside (STY-02) the zone of influence.
	8	Sty-08	Qrc	Screened depth: 9 m (shallow)	Outside zone of influence	
<i>Bathynellidae</i> sp. 'Walpole 2'	2	Sty-08	Qrc	Screened depth: 9 m (shallow)	Outside zone of influence	This specimen is 17.3% divergent from <i>Pilbaranella ethelenis</i> and is therefore considered a new species. Only recorded at Sty-08 by Phoenix and not within the zone of influence.

(Phoenix, 2023b)

### 8.4.2.1 Conservation significance

No Threatened or Priority stygofauna were identified as present in the stygofauna study area (Phoenix, 2023b). However, some species were recorded which have been previously unidentified.

*Bathynellidae* sp. ‘Walpole 1’, *Bathynellidae* sp. ‘Walpole 2’ and *Fibulacamptus* ‘BHA346’ are considered to be potentially significant as they represent new taxa and have only been found within the stygofauna study area (Phoenix, 2023b). The sampling bores within which these species were located are provided below (Figure 13):

- *Bathynellidae* sp. ‘Walpole 1’ within sampling bores STY-04 (within the zone of influence) and STY-08 (outside the zone of influence)
- *Bathynellidae* sp. ‘Walpole 2’ within sampling bore STY-08 (outside the zone of influence)
- *Fibulacamptus* ‘BHA346’ within sampling bore STY-10 (outside the zone of influence).

Only *Bathynellidae* sp. ‘Walpole 1’ was recorded within the zone of influence during the surveys, the other species were recorded outside the zone of influence (Phoenix, 2023b).

## 8.5 Potential environmental impacts

Table 21 provides the potential key impacts to subterranean fauna from the proposal.

**Table 27: Potential impacts on subterranean fauna**

Phase	Impact class	Works/operations	Potential impacts
Establishment			<ul style="list-style-type: none"> <li>• The bores have already been installed, as such there is no establishment or construction phase associated with the proposal.</li> </ul>
Operation	Indirect	<ul style="list-style-type: none"> <li>• Groundwater abstraction.</li> </ul>	<ul style="list-style-type: none"> <li>• Alteration of groundwater levels (drawdown) may reduce ground water and habitat availability for subterranean fauna.</li> <li>• Alteration of groundwater levels may result in the exposure of acid sulfate soils, resulting in water quality impacts to stygofauna habitat.</li> </ul>

### 8.5.1 Assessment of impacts

#### 8.5.1.1 Groundwater drawdown

The proposed groundwater abstraction has the potential to remove stygofauna habitat by lowering the water table. Groundwater drawdown can also result in stygofauna being stranded in unsaturated areas. Stygofauna have limited ability to survive in unsaturated conditions for more than 48 hours (Hose GC, J Sreekanth, Barron O, Pollino C, 2015).

The impact of drawdown may be different for various species. The response of copepods to water drawdown was tested, with downward movement of the animals with the water table, and some stranding observed. While little downward movement of other species such as amphipods was observed, with the majority of these species being stranded (Hose GC, J Sreekanth, Barron O, Pollino C, 2015).

The overlap of stygofauna species at STY 4 (in the study area and impact area) with STY08 and STY10 (in study area but outside the zone of influence), suggests physical and biological connectivity (Phoenix, 2023b). Therefore, the stygofauna communities present are unlikely to be restricted to the zone of influence or impacted by the predicted groundwater drawdown.

Groundwater abstraction also has potential to remove stygofauna with the groundwater, in the same way that stygofauna are sampled through groundwater pumping (Hose GC, J Sreekanth, Barron O, Pollino C, 2015).. However, as the specimens which are considered new species were observed outside the zone of influence, impacts to these species as a result of the proposal are unlikely.

No Threatened or Priority stygofauna were identified as present in the stygofauna study area (Phoenix, 2023b) and of the new species recorded, only *Bathynellidae* sp. ‘Walpole 1’ was recorded within the zone of influence (Phoenix, 2023b).

### 8.5.1.2 Changes to groundwater quality

Acid sulfate soil investigations undertaken to support the proposed groundwater abstraction trial identified potential acid sulfate soils within the zone of influence. Groundwater drawdown resulting from the proposed abstraction may result in these potential ASS being exposed, potentially resulting in reduced pH levels, increased acidity and release naturally occurring heavy metals and nutrients to the groundwater.

Stygofauna can be sensitive to changes in water quality that deviate from the natural background conditions. Stygofauna also have limited capacity to recover from such impacts as they have low mobility and low reproductive rates, meaning recolonisation will be slow (Hose GC, J Sreekanth, Barron O, Pollino C, 2015).

## 8.6 Mitigation

Table 28 identifies additional information / technical investigations required to determine the likelihood of any residual impacts to subterranean fauna.

Table 28: Application of mitigation hierarchy to subterranean fauna

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
Alteration of groundwater levels may negatively affect stygofauna communities and/or reduce the extent of potential habitat available to stygofauna.	Indirect	Avoid	<ul style="list-style-type: none"> <li>No Threatened or Priority stygofauna were identified as present in the stygofauna study area (Phoenix, 2023b) and of the new species recorded, only <i>Bathynellidae</i> sp. 'Walpole 1' was recorded within the zone of influence (Phoenix, 2023b).</li> <li>The complete avoidance of potential impacts to stygofauna species present within the zone of influence from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b), Acid sulfate soil (ASS) report (RPS, 2023c) and the WIMP (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Interim groundwater level trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Groundwater trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Groundwater level threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	<ul style="list-style-type: none"> <li>There are no direct, residual impacts to stygofauna resulting from the proposal.</li> <li>Residual indirect impacts are limited to the modelled groundwater drawdown of 0.05 m at bore STY-04 (Figure 13), where the previously undescribed stygofauna species (<i>Bathynellidae</i> sp. 'Walpole 1') was identified.</li> </ul>
		Minimise	<ul style="list-style-type: none"> <li><i>Bathynellidae</i> sp. 'Walpole 1' was recorded within and outside the zone of influence (sampling bores STY-04 and STY-08). The fact that this species was sampled from both within and outside the zone of influence indicates physical and biological connectivity. Therefore, as the stygofauna community is not restricted to the zone of influence and is therefore unlikely to be significantly impacted by the predicted groundwater drawdown. Furthermore, sampling bore STY-04 is located within the modelled 0.05 m drawdown contour of the zone of influence. This modelled drawdown is within the natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020) (Global Groundwater, 2021).</li> <li>The GDEMP (RPS, 2023b) (Appendix B) outlines the trigger and threshold criteria listed above to minimise adverse impacts to potentially new stygofauna species identified during the stygofauna survey. If these trigger criteria are exceeded, Water Corporation will implement the following response actions in accordance with the GDEMP (RPS, 2023b) and ASS detailed site assessment (RPS, 2023c) to ensure impacts to stygofauna are consistent with the EPA objective for stygofauna (EPA, 2016c):                             <ul style="list-style-type: none"> <li>If the early response groundwater level trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed and any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the groundwater level trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring.</li> <li>If the groundwater level threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> </ul> </li> <li>Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N/A</li> </ul>	
Alteration of groundwater quality may negatively affect stygofauna.	Indirect	Avoid	<ul style="list-style-type: none"> <li>No Threatened or Priority stygofauna were identified as present in the stygofauna study area (Phoenix, 2023b) and of the new species recorded, only <i>Bathynellidae</i> sp. 'Walpole 1' was recorded within the zone of influence (Phoenix, 2023b).</li> <li>The complete avoidance of potential impacts to stygofauna species present within the zone of influence from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b), Acid sulfate soil (ASS) detailed site assessment (RPS, 2023c) and the WIMP (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Interim groundwater level trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Groundwater trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Groundwater level threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> <li>Trigger criterion of an exceedance of field groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) over two consecutive weekly monitoring events.</li> <li>Threshold criterion of an exceedance of laboratory groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) after one monitoring event.</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	<ul style="list-style-type: none"> <li>There are no direct, residual impacts to stygofauna resulting from the proposal.</li> <li>Residual indirect impacts are limited to the modelled groundwater drawdown of 0.05 m at bore STY-04 (Figure 13), where the previously undescribed stygofauna species (<i>Bathynellidae</i> sp. 'Walpole 1') was identified.</li> </ul>
		Minimise	<ul style="list-style-type: none"> <li><i>Bathynellidae</i> sp. 'Walpole 1' was recorded within and outside the zone of influence (sampling bores STY-04 and STY-08). The fact that this species was sampled from both within and outside the zone of influence indicates physical and biological connectivity. Therefore, as the stygofauna community is not restricted to the zone of influence and is therefore unlikely to be significantly impacted by the predicted groundwater drawdown. Furthermore, sampling bore STY-04 is located within the modelled 0.05 m drawdown contour of the zone of influence. This modelled drawdown is within the natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July 2020) (Global Groundwater, 2021). Impacts to stygofauna at the other sampling bores is unlikely.</li> <li>The GDEMP (RPS, 2023b) (Appendix B) outlines the trigger and threshold criteria listed above to minimise adverse impacts to potentially new stygofauna species identified during the stygofauna survey. If these trigger criteria are exceeded, Water Corporation will implement the following response actions in accordance with the GDEMP (RPS, 2023b) and ASS detailed site assessment (RPS, 2023c) to ensure impacts to stygofauna are consistent with the EPA objective for stygofauna (EPA, 2016c):                             <ul style="list-style-type: none"> <li>If the early response groundwater level trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed and any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> </ul> </li> </ul>	

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
			<ul style="list-style-type: none"> <li>- If the groundwater level trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring.</li> <li>- If the groundwater level threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>- If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>- If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>• Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	N/A	

## 8.7 Assessment and significance of residual impact

Based on the assessment outlined in Table 28, the residual impacts from implementation of the proposed trial are:

- There are no direct, residual impacts to stygofauna resulting from the proposal.
- Residual indirect impacts are limited to the modelled groundwater drawdown of 0.05 m at bore STY-04 (Figure 13), where the previously undescribed stygofauna species (*Bathynellidae* sp. 'Walpole 1') was identified. This species was also identified outside the modelled zone of influence and is therefore not restricted to the modelled groundwater drawdown area.

## 8.8 Environmental outcomes

Key environmental outcomes have been proposed to ensure that the EPA's subterranean fauna objective (EPA, 2016c) will be achieved:

- Potential impacts to water quality through the exposure of potential acid sulfate soils and water levels will be managed in accordance with the following documents:
  - GDEMP (RPS, 2023b) provided in Appendix B
  - ASS detailed site assessment; Swann Road borefield, Walpole (RPS, 2023c) provided in Appendix D
  - WIMP (Water Corporation, 2023a) provided in Appendix E.
- In the event that monitoring undertaken in accordance with these management plans indicates an exceedance of threshold criteria specified in the plans, the Water Corporation shall implement the appropriate response actions outlined in the management plans, including:
  - Report the exceedance to DWER.
  - Implement the appropriate response actions outlined in the management plans.
  - Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.

The environmental outcomes above are consistent with the EPA objective for Subterranean Fauna (EPA, 2016c) as they protect subterranean fauna so that biological diversity and ecological integrity are maintained.

## 9 TERRESTRIAL ENVIRONMENTAL QUALITY

### 9.1 EPA objective

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

### 9.2 Policy and guidance

- *Contaminated Sites Act 2003*
- Potentially Contaminating Activities, Industries and Landuses (DoE, 2004)
- Water quality protection note 65 – Toxic and hazardous substances (Department of Water, 2015)
- Water quality protection note 10 – Contaminant spills – emergency response plan (DWER, 2020)
- Water quality protection note 25 – Land use compatibility tables for public drinking water source areas (DWER, 2021)
- Water quality protection note 56 – Tanks for fuel and chemical storage near sensitive water resources (DWER, 2018)
- Environmental Factor Guideline: Terrestrial Environmental Quality (EPA, 2016e)
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (Department of Environment Regulation, 2015a)
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (Department of Environment Regulation, 2015b)
- Assessment and Management of Contaminated Sites (Department of Environment Regulation, 2014).

### 9.3 Environmental investigation

#### 9.3.1 Acid sulfate soil investigations

RPS completed an investigation to determine the nature of acid sulfate soils (ASS) within the zone of influence, in addition to determining the existing groundwater and surface water quality. The following scope of work has been completed to date (RPS, 2023c):

- Installation of 19 shallow monitoring wells to complement the existing network to a depth that typically extended to a minimum of 1 m below the modelled drawdown extent provided by WC
- The groundwater bores were surveyed for location and elevation data to enable accurate drawdown monitoring during any abstraction trials, and groundwater elevation loggers were installed
- Soil samples were collected during the groundwater bore installation. In addition, soils were sampled using manual techniques from five locations where access with a drill rig was not possible to ensure adequate characterisation of the soil types
- All soil samples (390 excluding quality control) collected were initially screening for ASS field parameters; pH field ( $pH_F$ ) and pH field oxidised ( $pH_{FOX}$ )
- Following review of the screening data, select soil samples (63 excluding quality control) were submitted for ASS confirmatory analysis; chromium reducible sulfur (CRS) long suite, titratable peroxide acidity (TPA) and  $pH_{ox}$
- Completion of a single round of groundwater monitoring at 22 locations (three existing, 19 installed) to assess groundwater quality across a range of seasonal conditions
- Completion of a single round of surface water monitoring, across eight sampling locations to assess surface water quality across a range of seasonal conditions.

Groundwater, surface water and soil monitoring locations are shown in Figure 15.



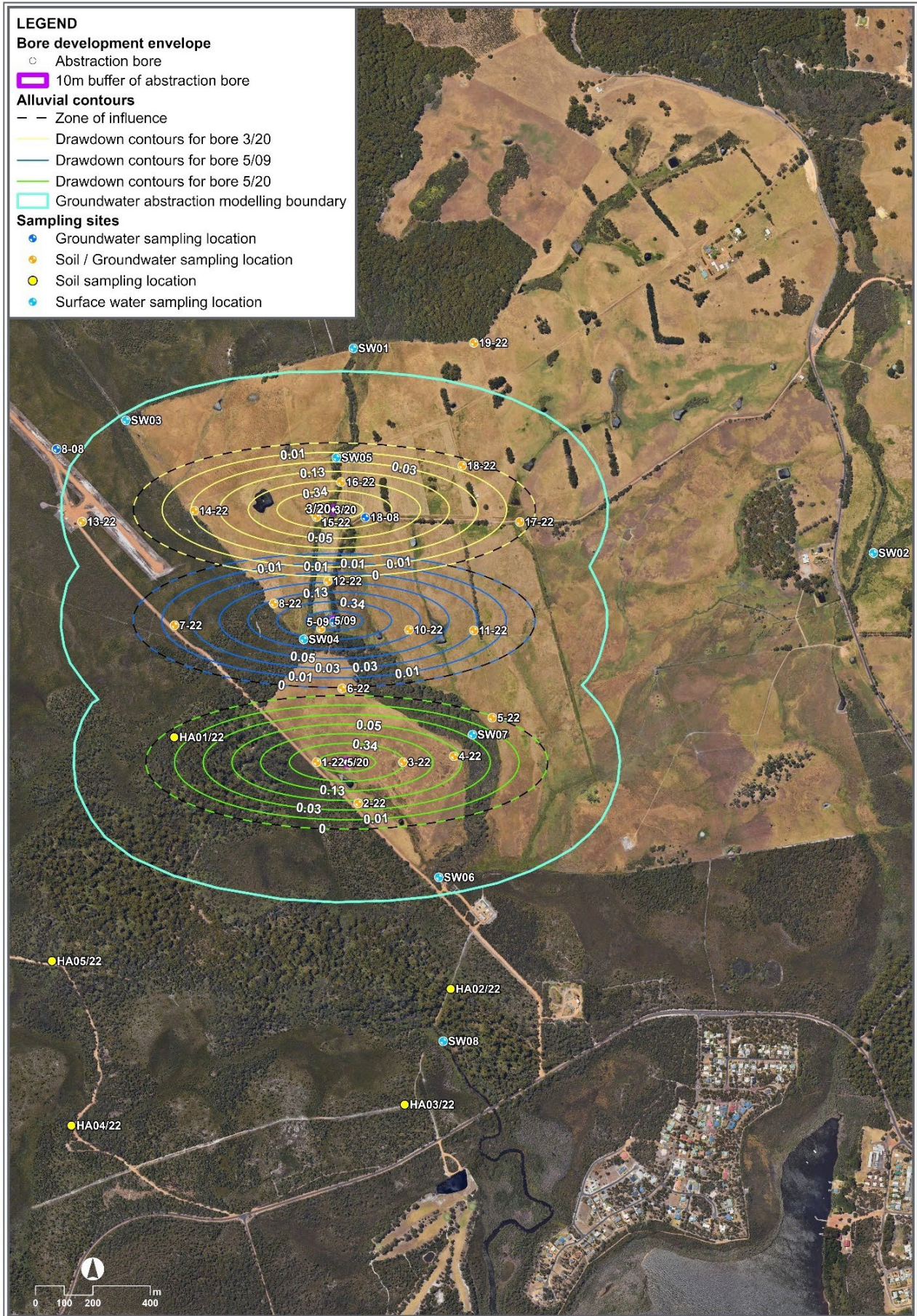


Figure 15: Groundwater, surface water and soil monitoring locations

## REPORT

To support the GDEMP (RPS, 2023b) and to establish a robust baseline dataset and to monitor groundwater and surface water quality during the trial from an ASS perspective, additional monitoring will be undertaken prior to, during or after the trial as detailed in the monitoring schedule provided in Table 29.

**Table 29: Additional monitoring proposed**

Monitoring activity	Parameters	Frequency	Responsibility
Prior to trial	<ul style="list-style-type: none"> <li>Field analysis: groundwater elevation, pH, EC, TTA, total alkalinity, dissolved oxygen.</li> <li>Laboratory: DWER Full Analytical Suite*</li> </ul>	<ul style="list-style-type: none"> <li>Three events<sup>†</sup></li> </ul>	RPS
Baseline	<ul style="list-style-type: none"> <li>Field analysis: groundwater elevation, pH, EC, TTA, total alkalinity, dissolved oxygen.</li> <li>Laboratory: DWER Full Analytical Suite*</li> </ul>	<ul style="list-style-type: none"> <li>Two weeks prior to trial<sup>†</sup></li> <li>Three events</li> </ul>	RPS
During trial	<ul style="list-style-type: none"> <li>Field analysis: groundwater elevation, pH, EC, TTA, total alkalinity</li> <li>Laboratory: DWER Full Analytical Suite*</li> </ul>	<ul style="list-style-type: none"> <li>Bimonthly during trial<sup>†</sup></li> <li>Two events</li> </ul>	RPS
	<ul style="list-style-type: none"> <li>Field analysis: groundwater elevation, pH, EC, TTA, total alkalinity, dissolved oxygen.</li> </ul>	<ul style="list-style-type: none"> <li>Weekly during trial<sup>‡</sup></li> <li>Twelve events</li> </ul>	WC
After trial	<ul style="list-style-type: none"> <li>Field analysis: groundwater elevation, pH, EC, TTA, total alkalinity, dissolved oxygen.</li> <li>Laboratory: DWER Full Analytical Suite*</li> </ul>	<ul style="list-style-type: none"> <li>Two weeks after trial</li> <li>Single event</li> </ul>	RPS
Post trial	<ul style="list-style-type: none"> <li>Field analysis: groundwater elevation, pH, EC, TTA, total alkalinity, dissolved oxygen.</li> <li>Laboratory: DWER Full Analytical Suite*</li> </ul>	<ul style="list-style-type: none"> <li>Bimonthly following trial<sup>†</sup></li> <li>Three events</li> </ul>	RPS

\* Total and dissolved metals, total acidity, total alkalinity, sulfate, chloride, cations, total suspended solids (TSS), total dissolved solids (TDS), and nutrients. Field parameters including pH, EC, TTA, dissolved oxygen and redox are recorded during sampling.

<sup>†</sup> Monitoring to include all 22 groundwater bores and eight surface water locations.

<sup>‡</sup> Monitoring to include a select 12 groundwater bores and five select surface water locations, locations to be advised following the additional sampling.

## 9.4 Receiving environment

### 9.4.1 Acid sulfate soils

#### 9.4.1.1 Regional acid sulfate soil mapping

Based on the DWER regional ASS risk mapping (Figure 16), the site is not mapped as having an ASS risk. Soils or sediment further downstream of the Walpole River and the Walpole Inlet are identified as having “high to moderate risk of ASS occurring within 3 m of the natural soil surface” (DWER, 2023a).

Regional ASS risk mapping is limited in regional areas and as such may not accurately represent the potential present of ASS. Given the local geology and presence of wetlands it is likely that the study area does contain ASS, with ASS typically present in areas low-lying riverine and wetland areas, and seasonally inundated plains.

#### 9.4.1.2 Acid sulfate soil investigations

Results from the ASS investigations undertaken by RPS are summarised below. Further results are detailed in the Acid sulfate soil detailed site assessment; Swann Road borefield, Walpole (Appendix D).

##### 9.4.1.2.1 Acid sulfate soil parameters

A summary of the data collected to date which indicates the potential impact to groundwater through the oxidation of sulfides is provided below (RPS, 2023c):

- Acidity concentrations are typically elevated from the shallow monitoring bores installed for the ASS investigation, all exceeding the DWER ASS criteria (40 mg/L) ranging between 63 to 150 mg/L (CaCO<sub>3</sub> equivalents). Results from the existing bores are lower and below the ASS criteria. The variance is potentially a reflection of localised oxidation of soils following installation.
- Total alkalinity concentrations ranged from <5 mg/L to 98 with a mean of 38 mg/L (all in CaCO<sub>3</sub> equivalents) across the site. Total acidity exceeded acidity at all locations, and the acidity:alkalinity generally exceeded the DWER ASS criteria of 1, indicative of existing acidity with groundwater having a low natural buffering potential.
- The ratio of sulfate:chloride was typically below the DWER ASS criteria (0.5) across the site, indicative that the existing acidity present is not a consequence of oxidation of sulfidic material (i.e. ASS).
- The TDS ranged between 80 mg/L and 2,100 mg/L.

The data supports a conclusion that PASS is present within the zone of influence and surrounding area in the majority of soils tested. Soils that are within the proposed drawdown typically comprise dark brown / grey clays and clayey sands. Soils that are within the predicted drawdown (extended by 1 m to consider periods when groundwater levels are lower based on November 2023 groundwater levels) typically comprise the similar clays and clayey sands detailed above, in addition to coffee rock that was isolated to one locations (RPS, 2023c).

Given the significantly elevated net acidities, these soils will potentially oxidise when exposed to air following drawdown. However, the net acidities within the drawdown area are generally low when compared to soils across the site. In addition, soils above the existing groundwater level are also characterised as ASS, generally having higher net acidities compared to those just below the groundwater interface and will be naturally oxidising during seasonal groundwater fluctuations (RPS, 2023c).

#### 9.4.1.2.2 Groundwater quality

Groundwater quality is typically acidic and contains elevated acidity and minimal alkalinity, and as such would be prone to further acidification with limited natural buffering capacity. Areas of highest existing acidity and lowest pH are typically in areas where the modelled drawdown is the lowest. Dissolved metal and nutrient concentrations are generally low with isolated exceptions likely due to variations in natural geology and in the vicinity of Walpole Airport. Further acidification may result in a release of metals and nutrients that are naturally present in the soils (RPS, 2023c).

#### 9.4.1.2.3 Surface water quality

A summary of field observations from surface water is provided in Table 30.

**Table 30: Summary of surface water physical parameters (RPS, 2023c)**

Parameter	Unit	Mean	Minimum (location)	Maximum (location)
pH	pH units	6.5	5.0 (SW03)	7.8 (SW07)
Electrical conductivity	µS/cm	6,111*	203 (SW01)	45,600 (SW08)
Redox	mV	87	-31 (SW07)	224 (SW03)
Dissolved oxygen <sup>^</sup>	mg/L	12	26 (SW02)	5.3 (SW05)

\* Excluding the elevated result at SW08, the mean is reduced to 470 µS/cm. ^ DO results appear erroneous.

A summary of the data collected from the various physical parameters assessed is provided below (RPS, 2023c):

- Surface water varies from slightly acidic to neutral, ranging from pH 5.0 (SW03) to 7.8 (SW07) and an average pH of 6.5 across the monitoring network.
- Excluding SW08, the mean surface water EC was 470 µS/cm and is relatively consistent across the site, with the salinity corresponding to ‘fresh’ as per *Stream salinity status and trends in south-west Western Australia* (DoE, 2005). The EC was significantly elevated at SW08 collected south of the site (45,605 µS/cm), potentially associated with evapoconcentration and influence from the inlet.

Surface water within Walpole River and Walpole River East has pH levels typically within the freshwater guidelines and classified as 'fresh' in accordance with *Stream salinity status and trends in south-west Western Australia* (DWER, 2005). The water has low acidity with higher alkalinity concentrations, and concentrations of heavy metals and nutrients are generally low.

### 9.4.2 Contaminated sites

The DWER online Contaminated Sites Database shows that there are no registered contaminated sites within, or adjacent to, the zone of influence by pumping (Figure 17).

Although not registered on the Contaminated Sites Database, the Walpole airstrip is located approximately 15 m west and outside of the zone of pumping influence. Fuel is stored at the Walpole airstrip in a covered bunded area (Department of Water, 2007). There are currently no fire retardants Walpole airstrip (Department of Water, 2007).

The Walpole airstrip is used for fire control by DBCA and other emergency purposes, including the Royal Flying Doctor Service, Silver Chain and Police (Department of Water, 2016).

As the airstrip is outside of the zone of influence, the risk of mobilisation of any potential contaminants due to the pumping from the confined abstraction bores during the trial will be low (no changes to existing groundwater movement would take place in areas outside of the zone of influence). Pressure monitoring of the production and monitoring bores will also be used during the trial to confirm groundwater movement.

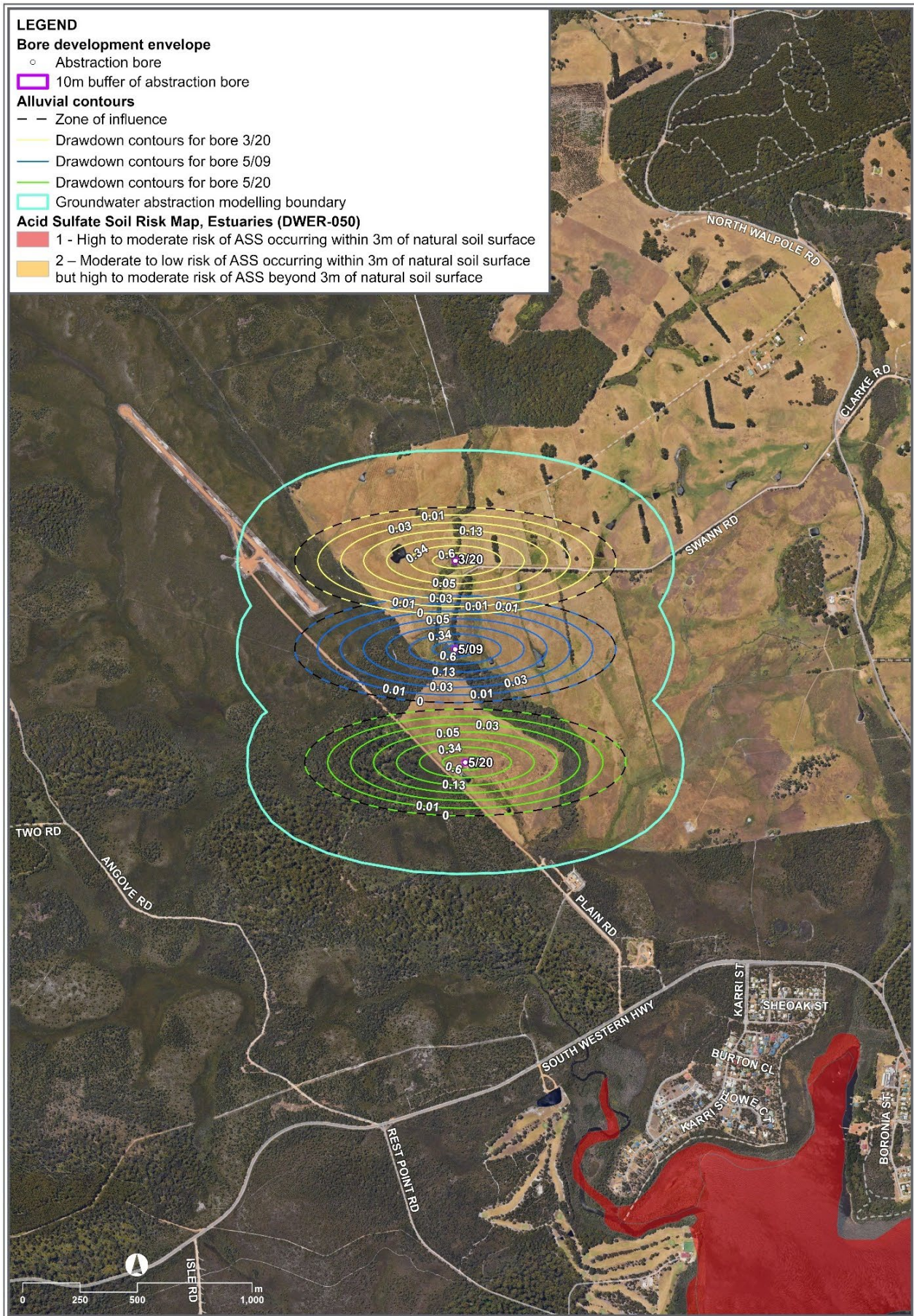


Figure 16: Acid sulfate soils

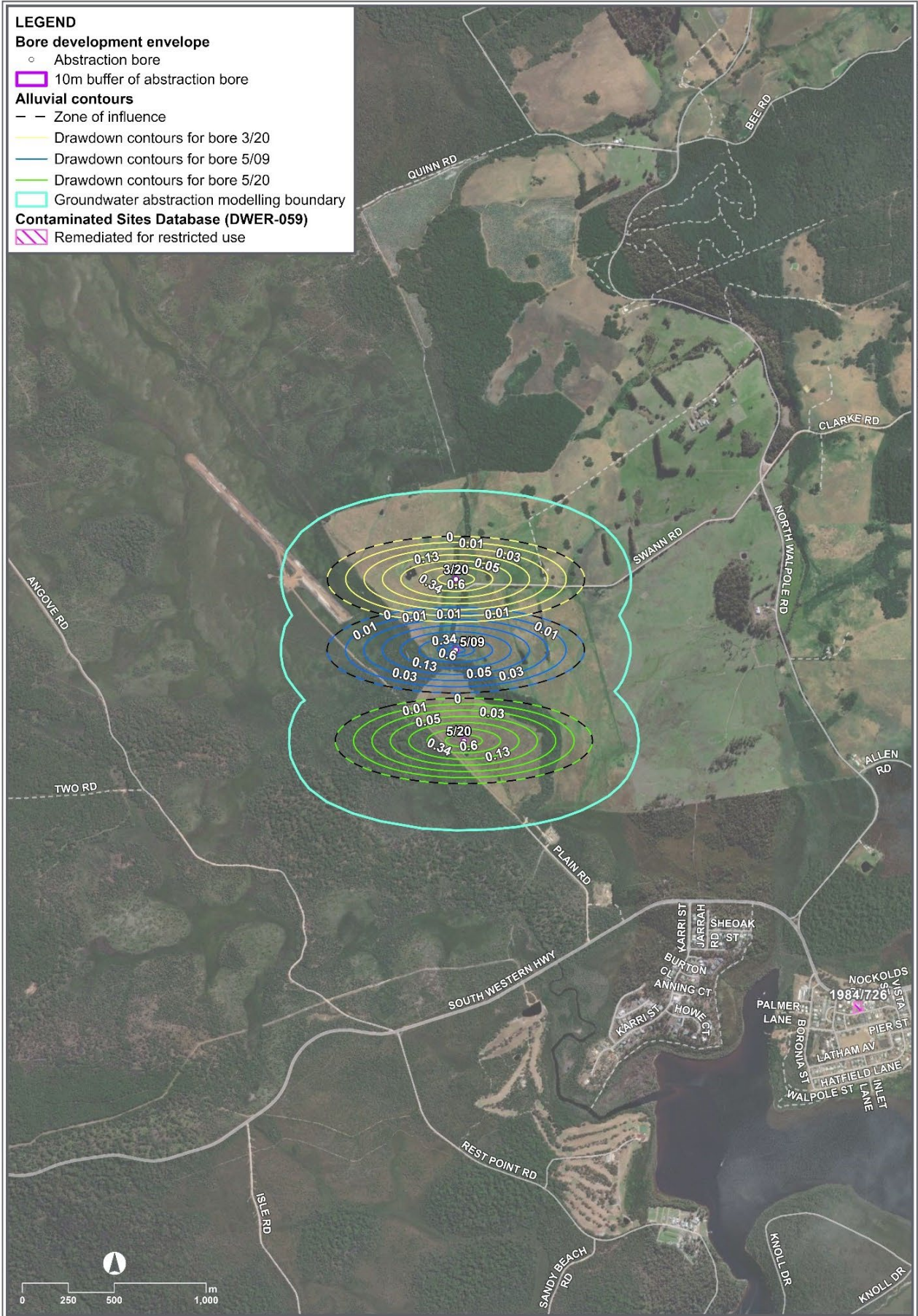


Figure 17: Contaminated sites

## 9.5 Potential environmental impacts

Table 31 provides the potential key impacts to terrestrial environmental quality from the proposal.

**Table 31: Potential impacts on terrestrial environmental quality**

Phase	Impact class	Works / operations	Potential impacts
Establishment	<ul style="list-style-type: none"> <li>The bores have already been installed, as such there is no establishment or construction phase associated with the proposal.</li> </ul>		
Operation	Indirect	<ul style="list-style-type: none"> <li>Groundwater abstraction.</li> </ul>	<ul style="list-style-type: none"> <li>Exposure of potential acid sulfate soils resulting from groundwater drawdown</li> <li>Potential hydrocarbon spills or leaks from generators and fuel tanks</li> <li>Mobilisation of potentially contaminated groundwater from the nearby Walpole airstrip.</li> </ul>

### 9.5.1 Assessment of impacts

#### 9.5.1.1 Exposure of acid sulfate soils

Acid sulfate soil investigations undertaken to support the proposed groundwater abstraction trial identified PASS within the zone of influence. Groundwater drawdown resulting from the proposed abstraction may result in these potential ASS being exposed. ASS oxidation effects caused through exposure of the soils to air may release acid, which may subsequently reduce pH levels, increase acidity and release naturally occurring heavy metals and nutrients.

Soils containing the highest net acidities are typically isolated in nature (i.e. coffee rock), external to the modelled drawdown area, or where drawdown is anticipated to be very limited (Figure 18). Furthermore, soils above the existing groundwater level were characterised as ASS and generally exhibit higher net acidities compared to those just below the groundwater interface. Indicating that soils are naturally oxidising during seasonal groundwater fluctuations. However, demand will be greatest during the summer months when groundwater levels are typically lowest, which has the potential to result in soils not normally exposed to oxygen to be dewatered.

There is a risk that deterioration in groundwater quality resulting from exposure of ASS can affect down-hydraulic gradient groundwater users, surface water quality and Groundwater Dependent Ecosystems. Impacts to groundwater and surface water quality and Groundwater Dependent Ecosystems are discussed further in Section 11.

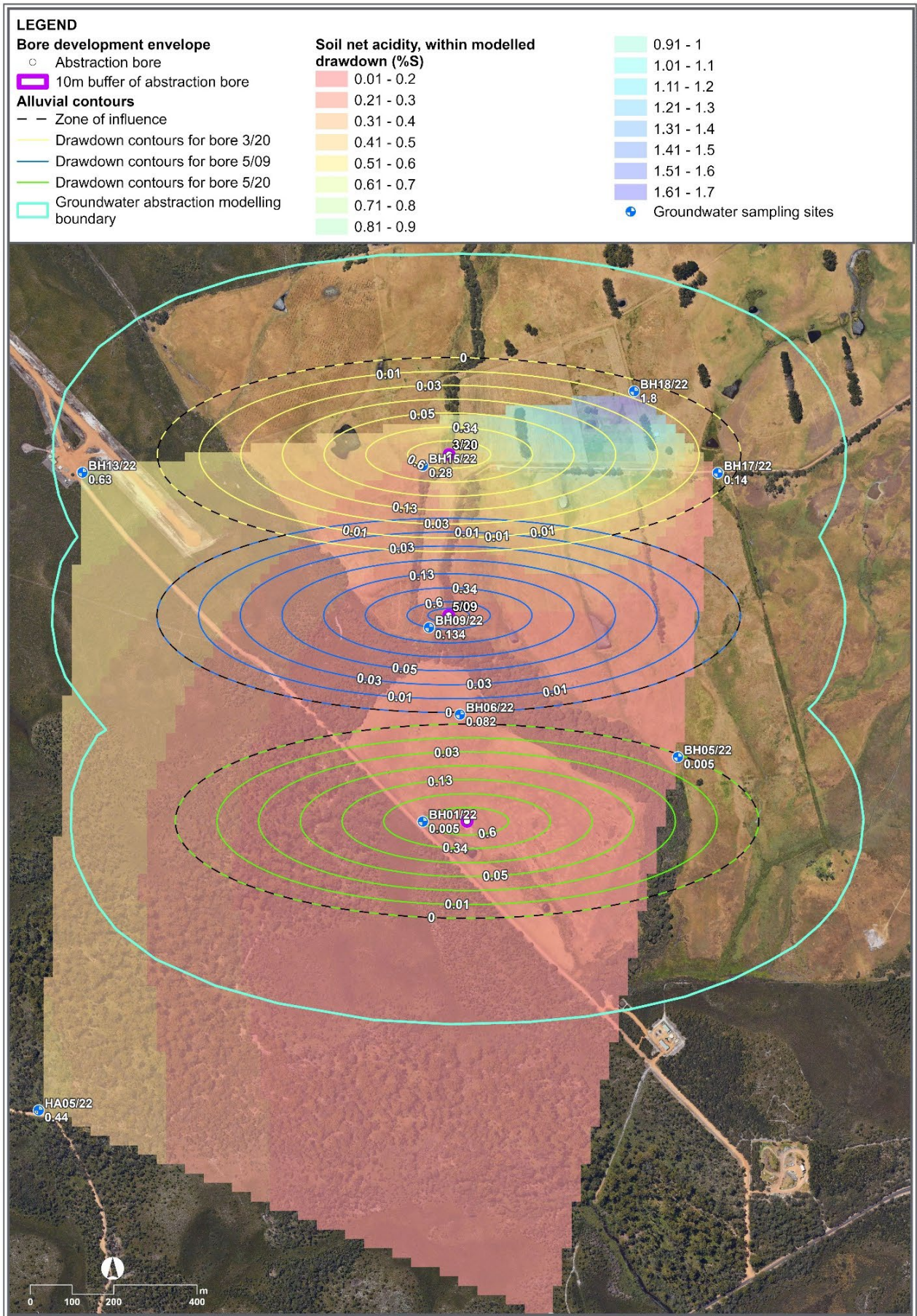


Figure 18 Soil net acidity within the zone of influence (RPS, 2023c)



### 9.5.1.2 Potential spills or leaks from infrastructure and equipment

Infrastructure related to the three abstraction bores includes generators and fuel tanks. The generator compounds will house the generators, fuel tanks, distribution board and control cubicle. There is potential for spills or leaks from this infrastructure during the trial, resulting in contamination of soils, groundwater or surface water. The following additional protections will be implemented to minimise the risk of spills and leaks:

- The generator compounds housing the generators and fuel tanks are remote from the bore compounds and have pads raised 300 mm above the natural ground level to guard against flood levels. As the trial will be undertaken over the summer and autumn period, flooding is considered a low risk.
- The diesel fuel tanks supplying the generators will comply as best as practicable with the Water Corporation document; *Fuel Storage in Drinking Water Catchments* (Appendix F), which summarises DWER guidance on best management practices for fuel stored near sensitive water resources. This has been communicated and accepted by DWER, relevant correspondence is provided in Appendix O.
- Relevant DWER guidance includes:
  - Water quality protection note 65 – Toxic and hazardous substances (Department of Water, 2015)
  - Water quality protection note 10 – Contaminant spills – emergency response plan (DWER, 2020)
  - Water quality protection note 25 – Land use compatibility tables for public drinking water source areas (DWER, 2021)
  - Water quality protection note 56 – Tanks for fuel and chemical storage near sensitive water resources (DWER, 2018).
- Double skinned self-bunded fuel storage tanks will be used.
- A temporary bund will be used for the generator, fuel tank and fuel lines, details are provided in the engineering summary report (Appendix G). Operators will check the bunds after rain.
- A fuel tank level alarm will identify if levels in the tank become too low, notifying occurrence of any major spill (Water Corporation, 2023c).

Consequently, the risk for a spill or leak to occur as a result of the proposal is low. However, as diesel refuelling will be undertaken outside of the generator compounds, there is a risk of fuel leaks from hoses during this time. A spill response procedure will be developed for the proposal.

### 9.5.1.3 Potential contamination

The DWER online Contaminated Sites Database shows that there are no registered contaminated sites within, or adjacent to, the zone of influence by pumping (Figure 17).

Although not registered on the Contaminated Sites Database, the Walpole airstrip is located approximately 15 m west and outside of the zone of pumping influence. Fuel is stored at the Walpole airstrip in a covered bunded area (Department of Water, 2007). There are currently no fire retardants Walpole airstrip (Department of Water, 2007).

The Walpole airstrip is used for fire control by DBCA and other emergency purposes, including the Royal Flying Doctor Service, Silver Chain and Police (Department of Water, 2016).

As the airstrip is outside of the zone of influence, the risk of mobilisation of any potential contaminants due to the pumping from the confined abstraction bores during the trial will be low (no changes to existing groundwater movement would take place in areas outside of the zone of influence). Pressure monitoring of the production and monitoring bores will also be used during the trial to confirm groundwater movement.

## 9.6 Mitigation

Table 32 demonstrates how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied to the environmental factor of Terrestrial Environmental Quality to address the key potential impacts.

**Table 32: Application of mitigation hierarchy to Terrestrial Environmental Quality**

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
<b>Acid sulfate soils</b>				
Acidification and release of heavy metals from ASS into the terrestrial environment and underlying groundwater	Indirect	Avoid	<ul style="list-style-type: none"> <li>The modelled drawdown of up to 0.6 m will typically be within natural seasonal groundwater fluctuations in the Superficial aquifer of greater than 2.5 m (with fluctuation ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July 2020) (Global Groundwater, 2021). Soils above the existing groundwater level (November 2022) are characterised as potential acid sulfate soils (PASS) and will be naturally oxidising during seasonal groundwater fluctuations. However, as water demand will be greatest during the summer months when groundwater levels are typically lowest, there is the potential for soils not normally exposed to oxygen to be dewatered. The potential effects of ASS oxidation will be monitored through groundwater and surface water monitoring as discussed below.</li> </ul>	Due to the natural, seasonal fluctuations of groundwater levels and groundwater quality, quantifying the potential residual impacts to terrestrial environmental quality resulting from oxidisation of acid sulfate soils is not possible. However, implementation of the monitoring and contingency actions outlined in the ASS detailed site assessment (RPS, 2023c), GDEMP (RPS, 2023b) and WIMP (Water Corporation, 2023a) will that residual impacts to groundwater or surface water quality resulting from oxidisation of PASS are minimised and consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e).
		Minimise	<ul style="list-style-type: none"> <li>Monitoring of surface water, groundwater and soils will be undertaken for assessment against relevant triggers. Should monitoring results exceed the triggers, appropriate contingency actions will be implemented to ensure that impacts resulting from exposure of ASS are not significant. The proposed monitoring, trigger criteria and threshold criteria and contingency measures are outlined in the following documents which will be implemented during the proposed trial:                             <ul style="list-style-type: none"> <li>An ASS detailed site assessment (RPS, 2023c) (Appendix D) to minimise impacts to flora, fauna and inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>A GDEMP (RPS, 2023b) (Appendix B) to minimise and monitor for impacts to GDEs from potential changes to groundwater and surface water quality resulting from exposure of ASS. Relevant threshold levels and contingency actions are summarised below:                                     <ol style="list-style-type: none"> <li>Early response trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.2 m. If the early response groundwater level trigger criterion is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>Trigger criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.25 m. If the groundwater level trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>Threshold criterion: Groundwater levels measured at monitoring bores (1/22, 4/22, 8/22 and 14/22) drop by 0.5 m. If the groundwater level threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>Trigger criterion of an exceedance of field groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) over two consecutive weekly monitoring events. If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>Threshold criterion of an exceedance of laboratory groundwater quality guideline values at bores closest to identified stygofauna populations (14/22 or 19/22) after one monitoring event. If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>The surface water quality trigger criterion states; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events. If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>The surface water quality threshold criterion states; no exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event. If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ol> </li> <li>The WIMP (Water Corporation, 2023a) (Appendix E) to minimise and monitor for impacts to GDEs, and the environment generally, from potential changes to groundwater and surface water quality resulting from exposure of ASS. Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> </ul>	
		Rehabilitate	N/A	
<b>Potential contamination</b>				
Mobilisation of potentially contaminated groundwater	Indirect	Avoid	<ul style="list-style-type: none"> <li>RPS undertook a contaminated sites desktop assessment as part of this impact assessment to assess the risk for contamination to be present within or adjacent to the zone of influence. Based on the desktop assessment, RPS determined the risk of contamination within and adjacent to the zone of influence to be low.</li> </ul>	There are no residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>As the airstrip is outside of the zone of influence, the risk of mobilisation of any potential contaminants due to the pumping from the confined abstraction bores during the trial is low. Pressure monitoring of the production and monitoring bores will also be used during the trial to confirm groundwater movement.</li> </ul>	
		Rehabilitate	N/A	
Potential spills or leaks from infrastructure and equipment	Indirect	Avoid	<ul style="list-style-type: none"> <li>The power source for the abstraction bores proposed will be diesel generators due to the temporary nature of the groundwater abstraction trial. Therefore, due to the nature of the proposal, it is not possible to completely avoid the risk for hydrocarbon spills.</li> </ul>	There are no residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>The following measures will be implemented to minimise the risk of spills and leaks, ensuring that the risk of a spill or leak impacting the surrounding environment is low:                             <ul style="list-style-type: none"> <li>The generator compounds, housing the generators and fuel tanks, are remote from the bore compounds and have pads raised 300 mm above the natural ground level to guard against flood levels. As the trial will be undertaken over the summer and autumn period, flooding is considered a low risk.</li> <li>The diesel fuel tanks supplying the generators will comply with the Water Corporation document; Fuel Storage in Drinking Water Catchments (Appendix F), which summarises DWER guidance on best management practices for fuel stored near sensitive water resources.</li> <li>Double skinned self-bunded fuel storage tanks will be used.</li> <li>A temporary bund will be used for the generator, fuel tank and fuel lines, details are provided in the Engineering summary report (Appendix G). Operators will check the bunds after rain.</li> <li>A fuel tank level alarm will identify if levels in the tank become too low, notifying occurrence of any major spill.</li> </ul> </li> </ul>	
		Rehabilitate	If a spill occurs, it will be appropriately contained and remediated through removal of any contaminated materials and off-site disposal in accordance with the <i>Contaminated Sites Act 2003, Landfill Waste Classification and Waste Definitions 1996 (amended 2019)</i> (DWER 2019) and Water Corporation's Emergency preparedness and response procedure provided in Appendix N.	

## 9.7 Assessment and significance of residual impact

Due to the natural, seasonal fluctuations of groundwater levels and groundwater quality, quantifying the potential residual impacts to terrestrial environmental quality resulting from oxidisation of acid sulfate soils is not possible. However, implementation of the monitoring and contingency actions outlined in the ASS detailed site assessment (RPS, 2023c), GDEMP (RPS, 2023b) and WIMP (Water Corporation, 2023a) will ensure that residual impacts to groundwater or surface water quality resulting from oxidisation of PASS are minimised and consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e).

## 9.8 Environmental outcomes

Key environmental outcomes have been proposed to ensure that the EPA's Terrestrial Environmental Quality objective (EPA, 2016e) will be achieved:

- ASS to be managed in accordance with the following management plans:
  - GDEMP (RPS, 2023b) provided in Appendix B
  - ASS detailed site assessment; Swann Road borefield, Walpole (RPS, 2023c) provided in Appendix D
  - WIMP (Water Corporation, 2023a) provided in Appendix E
- In the event that monitoring undertaken in accordance with these management plans indicates an exceedance of threshold criteria for groundwater and surface water quality and groundwater levels (as specified in these plans and summarised in above), the Water Corporation shall implement the appropriate response actions outlined in the management plans, including:
  - Report the exceedance to DWER.
  - Implement the appropriate response actions outlined in the GDEMP (RPS, 2023b), ASS detailed site assessment (RPS, 2023c) and WIMP (Water Corporation, 2023a).
  - Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.

The environmental outcomes above are consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e) and thereby not significant, as they protect Terrestrial Environmental Quality to maintain the quality of land and soils so that environmental values.

## 10 TERRESTRIAL FAUNA

### 10.1 EPA objective

To protect terrestrial fauna so that biological diversity and ecological integrity are protected (EPA, 2016f).

### 10.2 Policy and guidance

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Biodiversity Conservation Act 2016*
- Environmental Factor Guideline: Terrestrial Fauna (EPA, 2016f)
- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA, 2020)
- Technical Guidance: Sampling of shortrange endemic invertebrate fauna (EPA, 2016g)
- Environmental Protection (Noise) Regulations 1997.

### 10.3 Environmental investigation

#### 10.3.1 Terrestrial vertebrate fauna surveys

A detailed terrestrial vertebrate fauna survey was undertaken by Phoenix in late spring and early summer from 22 November to 2 December 2022. A total of 58 survey sites were sampled, comprising three systematic sites, two supplementary targeted aluminium box trap sites, 15 camera trapping sites and 37 opportunistic sites. An additional 63 sites were visited to identify and map the broad fauna habitats within the fauna study area.

Survey methods are summarised below:

- Initial habitat characterisation was undertaken using various desktop assessments. Habitats with the potential to support significant terrestrial fauna species were identified based on known habitats of such species
- Systematic trapping to capture terrestrial mammals, reptiles and amphibians
- Active diurnal and nocturnal searches were undertaken at each systematic site and one additional site to target diurnal and nocturnal herpetofauna and mammals from direct sightings and secondary evidence
- Avifauna surveys were undertaken at each systematic site and one additional site
- Song Meter SM4 recording devices were used to record bat echolocation calls at each systematic site. Recording devices were deployed for four consecutive nights, recording for between eight and 12 continuous hours per night
- Fifteen camera traps were deployed across the fauna survey area to target significant fauna identified in the desktop review as potentially occurring in the study area, including *Dasyurus geoffroii*, *Phascogale tapoatafa wambenger*, *Hydromys chrysogaster*, *Notamacropus irma*, *Notamacropus eugenii derbianus*, *Setonix brachyurus* and *Pseudocheirus occidentalis* (Phoenix, 2023a).

#### 10.3.2 Aquatic fauna surveys

An aquatic fauna survey was undertaken by Phoenix in spring, from 29 October to 1 November 2022, and included:

- Aquatic habitat assessments
- Collection of fish and crayfish species through deployment of dual wing fyke nets and box traps

## REPORT

- Targeted surveys for the Carter's freshwater mussel (*Westralunio carteri*) and Walpole burrowing crayfish (*Engaewa walpolea*)
- Water quality sampling for the following parameters; pH, dissolved oxygen (DO; % and mg/L), specific conductivity (EC; mS/cm) and water temperature (°C). Flow rates were also recorded during the survey
- Macroinvertebrate sampling was conducted using a D-frame, 250-micron mesh net, covering the stream width.

Aquatic fauna sampling sites and the Healthy Rivers Program Walpole River Sampling Sites (DWER 2020) are shown in Figure 19 and Figure 20, as summarised below:

- Walpole River – Plain Road Downstream (Site code: DR15WALP1, AWRC Reference:6064006) corresponds to Phoenix sampling site AQU02
- Walpole River – Plain Road Upstream (Site code: DR17WALP1, AWRC Reference: 6064005) corresponds to Phoenix sampling site AQU01.

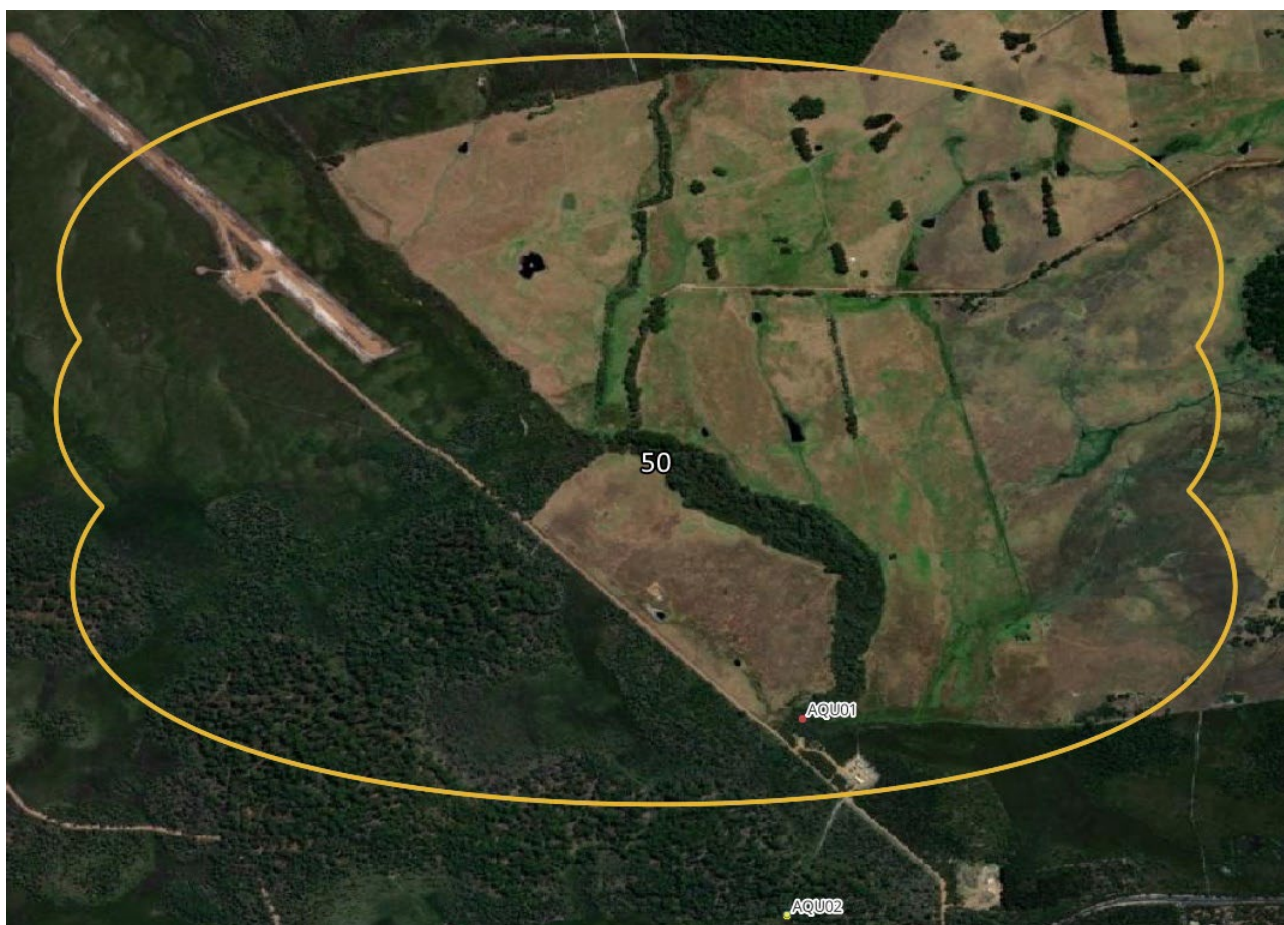
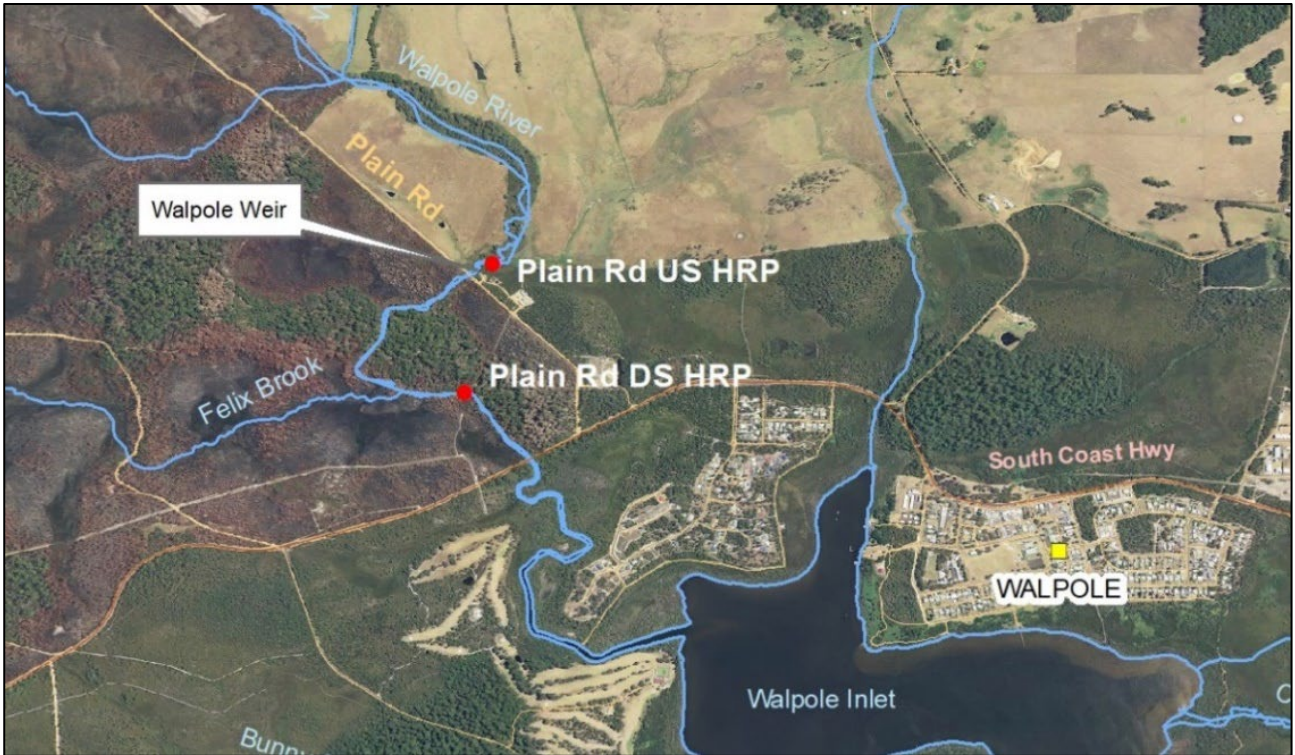


Figure 19: Stream fauna survey sites within and outside fauna study area (yellow boundary)



**Figure 20: Walpole Rivers Healthy Rivers program monitoring sites (DWER 2020)**

Photographs of the sampling sites are provided in Plates 1 to 2.

The aquatic fauna survey report is provided in Appendix K.

The Walpole Weir is located outside (south-east of) the zone of influence. Due to the impounding impacts of the Walpole Weir the water levels upstream are no longer representative of the original hydrology.



**Plate 1: Aquatic habitat at the Plain Road upstream site (AQU01), March 2020. Left – woody debris visible in water column and along surface of water. Right – submerged macrophyte at the upstream end of the site (DWER 2020)**



**Plate 2:** Aquatic habitat at the Plain Road downstream site (AQU02), March 2020. Left – woody debris visible in water column. Right – stream shading along river width, looking upstream (DWER, 2020)

### 10.3.3 Short range endemic surveys

Phoenix Environmental Sciences undertook a short-range endemic (SRE) fauna survey between 25 October 2022 to 1 November 2022 in accordance with *EPA Technical Guidance: Sampling of short-range endemic invertebrate fauna*. Sampling for SRE invertebrates was conducted in areas identified as suitable habitat for SREs (Figure 21). Sampling comprised wet pit trapping, dry pit trapping, active foraging and litter/soil sieving.

The short-range endemic fauna survey report is provided in Appendix L.

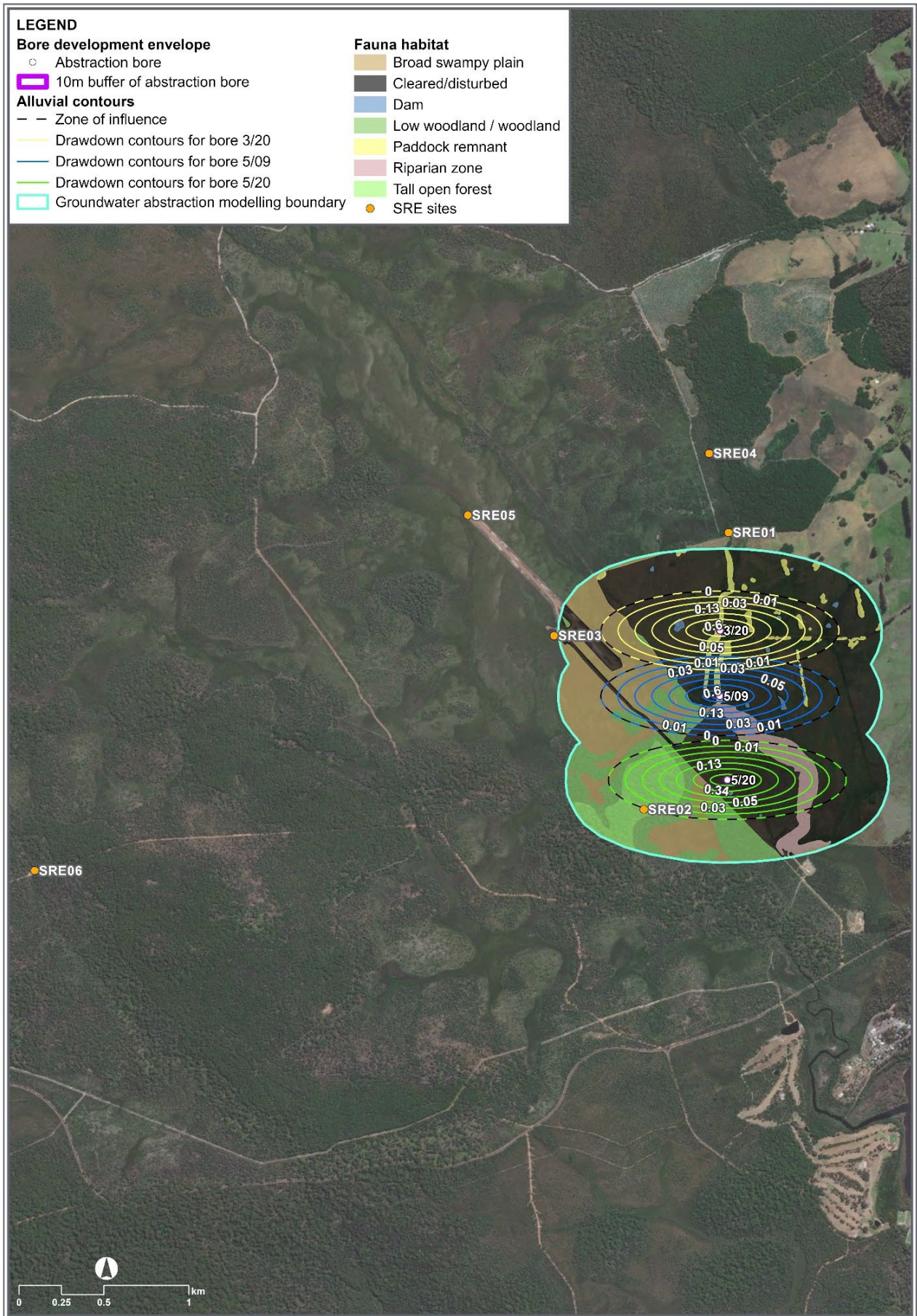


Figure 21: SRE survey sites



## 10.4 Receiving environment

### 10.4.1 Fauna habitats

#### 10.4.1.1 Terrestrial and riparian fauna habitat

Fauna habitat types identified by Phoenix Environmental Sciences (2023a) are detailed in Table 33 and shown in Figure 22. Phoenix identified that only 49.8 ha of the zone of influence comprised fauna habitat, with the remaining 99.62 ha (66.67% of the overall zone of influence) comprising areas that are not considered significant fauna habitat, including cleared or disturbed areas, isolated paddock remnant vegetation and farm dam habitat types. These disturbed habitat types do not comprise significant fauna habitat, however they do have potential to attract fauna from elsewhere in the zone of influence.

**Table 33: Fauna habitat present within the fauna survey area and modelled zone of influence**

Habitat type	Description	Extent within fauna survey area		Extent within zone of influence		
		Area (ha)	% within study area	Modelled groundwater drawdown	Area (ha)	% within zone of influence
Broad swampy plains and Broad swampy plains (SF)	Seasonally inundated peat swamp comprising a mosaic of low forest of <i>Taxandria juniperina</i> , closed heath of <i>Myrtaceae-Proteaceae-Papilionaceae</i> spp. with occasional emergent <i>Melaleuca preissiana</i> and <i>Banksia littoralis</i> <i>Reedia spathacea</i> - <i>Empodisma gracillimum</i> - <i>Schoenus multiglumis</i> and sandy mud flood plains.	130	23.9%	0 m	6.84	4.58
				0.01 m	4.95	3.31
				0.03 m	2.54	1.70
				0.05 m	1.57	1.05
				0.13 m	0.87	0.58
				0.34 m	0.46	0.31
				0.6 m	0	0.00
<b>Total</b>				<b>17.22 ha</b>	<b>11.52%</b>	
Low woodlands/ woodlands	Situated on fringes of, and islands in broad swampy plains including the transition zone between tall open forests and broad swampy plains. Comprises of <i>Eucalyptus</i> -low to mid trees, predominantly black-butt with isolated jarrah. Mid to low shrubs and ground cover varies from open to moderately dense to dense.	63.7	11.7%	0 m	4.43	2.97
				0.01 m	2.16	1.45
				0.03 m	2.42	1.62
				0.05 m	2.15	1.44
				0.13 m	2.16	1.44
				0.34 m	0.20	0.13
				0.6 m	0.00	0.00
<b>Total</b>				<b>13.51 ha</b>	<b>9.04%</b>	
Tall open forest	Characterised by tall, mature karri and marri suitable for foraging, roosting and nesting by black cockatoo species and the brush-tailed phascogale. Abundance of large hollow logs suitable for western quoll denning. Dense low ground cover of <i>Garnia</i> and ferns, and kangaroo paw. Deep continuous leaf litter throughout. Some seasonally inundated seepages suitable for the Nornalup frog.	45.4	8.3%	0 m	2.50	1.67
				0.01 m	3.46	2.32
				0.03 m	2.56	1.71
				0.05 m	1.59	1.06
				0.13 m	0.33	0.22
				0.34 m	0.00	0.00
				0.6 m	0.00	0.00
<b>Total</b>				<b>10.44 ha</b>	<b>6.98%</b>	

Habitat type	Description	Extent within fauna survey area		Extent within zone of influence		
		Area (ha)	% within study area	Modelled groundwater drawdown	Area (ha)	% within zone of influence
Riparian zone	Characterised by the main channel of the Walpole River winding through a mosaic of low forest to tall woodland of <i>Eucalyptus diversicolor</i> – <i>Corymbia calophylla</i> . The southern portion of the Riparian zone habitat within the study area comprises low forest of <i>Taxandria juniperina</i> and occasional emergent <i>Melaleuca preissiana</i> with isolated to scattered <i>Eucalyptus</i> / <i>Corymbia</i> trees.	13.2	2.4%	0 m	2.29	1.53
				0.01 m	3.17	2.12
				0.03 m	1.94	1.30
				0.05 m	0.53	0.35
				0.13 m	0.50	0.33
				0.34 m	0.21	0.14
				0.6 m	0.00	0.00
<b>Total</b>				<b>8.63 ha</b>	<b>5.78%</b>	
Cleared / disturbed	Predominantly farm paddocks cleared for livestock grazing and the Walpole airstrip in the north-west of the study area. Farm paddock supports common native species such as the western grey kangaroo, emu and straw-necked ibis.	281.1	51.6%	0 m	20.22	13.53
				0.01 m	19.77	13.23
				0.03 m	17.95	12.02
				0.05 m	15.15	10.14
				0.13 m	10.92	7.31
				0.34 m	7.88	5.28
				0.6 m	2.69	1.80
<b>Total</b>				<b>94.59 ha</b>	<b>63.3%</b>	
Isolated paddock remnant	Vegetation in paddocks and along Swann Road. Ranging from an isolated tree (predominantly karri and marri) to small (<1 ha) patches comprising 20–30 tall mature karri trees. Ground cover is dominated by introduced grasses for livestock grazing. Suitable for foraging and roosting (possible breeding depending on the presence of hollows) by black cockatoo species.	9.8	1.8%	0 m	0.26	0.17
				0.01 m	0.81	0.54
				0.03 m	0.70	0.47
				0.05 m	0.73	0.49
				0.13 m	0.66	0.44
				0.34 m	0.57	0.38
				0.6 m	0.41	0.27
<b>Total</b>				<b>4.13 ha</b>	<b>2.77%</b>	
Dam	Permanent water source mostly situated in open paddocks (two adjacent to riparian habitat along Walpole River). Supports rakali foraging, predominantly crayfish species. Attracts common waterbird species (Pacific black, wood and mallard ducks).	1.5	0.3%	0 m	0.12	0.08
				0.01 m	0.01	0.01
				0.03 m	0.21	0.14
				0.05 m	0.14	0.09
				0.13 m	0.40	0.27
				0.34 m	0.01	0.01
				0.6 m	0.00	0.00
<b>Total</b>				<b>0.89 ha</b>	<b>0.6%</b>	

### 10.4.1.2 Stream habitat

Stream habitat at the aquatic fauna sampling sites has been assessed by Phoenix Environmental Sciences (2023c) and as part of the Healthy Rivers Program (DWER, 2020) and is summarised in Table 34.

Table 34: Walpole River habitat assessment

Sampling site	Survey habitat description	Healthy Rivers assessment summary (DWER, 2020) (Phoenix, 2023)
AQU01 / Plain Road upstream (Plate 1)	Comprised of a meandering channel of up to 4.2 m wide with dense overhanging riparian zone vegetation. It was dominated by tea tree low forest to moderately dense mid shrubs. Dense, native grasses cover riverbanks with isolated patches of Eucalyptus trees. The riverbank canopy partially or totally overhangs the stream in places. Abundant woody debris, including large, submerged logs as well as medium and smaller branches are present. Isolated macrophytes are variably present.	<p><b>Channel morphology</b></p> <p>Comprised a meandering plane-bed channel. The bank full width measured between 10 to 15 m and the current water width measured between 4 to 10 m at the time of sampling (March 2020).</p> <p>The mean water depth throughout the site was about 0.6 m, with some deeper areas observed (maximum depth of 1.5 m). Minor sand deposition was also present throughout the site.</p> <p>Channel shape was a U-shaped channel, with concave banks and slight undercutting in some sections. The slope of the banks was steep (60–80% gradient) and had a fairly uniform channel depth of about 2 to 3 m.</p> <p>Approximately 20–49% of both banks had some undercutting present. However, the severity of the erosion was low to moderate with both banks having good structural integrity.</p> <p><b>Aquatic habitat and connectivity</b></p> <p>In-stream habitat was characterised by a moderate abundance of woody debris in a variety of sizes (&lt;5–49 cm). There was approximately 60–100% of biological substrate cover including epiphytes, algae, detritus and leaves throughout the assessment site. Additional habitat was provided by riparian vegetation draped into the water along almost the entire bank length (50–100%), as well as overhanging banks (50–100%).</p> <p>Canopy cover provided shade across much of the aquatic habitat, with shrubs and ground cover providing the majority of the shade across the width of the river, along the lengths of the bank. Macrophytes were present in small areas (about 2% of the site), including a submerged ribbon weed at the upstream end of site and a small area of ribbon weed (most likely <i>Triglochin</i> spp.) located towards the downstream end of site.</p> <p>In March 2020, flow velocities were non-detectable (&lt;0.1 m/s) throughout the assessment site and there was no flow over the Walpole Weir.</p> <p>Fish passage was possible throughout the assessment site; however, the Walpole Weir downstream of the assessment site presents a barrier to the movement of aquatic biota (despite the presence of a fishway) during times of low to no flow.</p>
AQU02 / Plain Road downstream (Plate 2)	Comprised a gently curved channel of up to 6 m wide with dense overhanging riparian zone vegetation. Mid to tall tea tree shrubs over dense low native grasses are present, with open tall forest adjacent to the riparian zone vegetation. Numerous large, submerged logs crossing the width of the channel are present, as well as medium and smaller branches.	<p><b>Channel morphology</b></p> <p>Comprised a straight to slight meandering channel. The bank full width measured between 12 to 15 m and the water width at the time of sampling measured between 5.5 to 8.5 m. The mean water depth throughout the site was about 1 m, with some deeper areas observed (maximum depth of 2 m). Minor sand deposition was also present.</p> <p>The channel was U-shaped, with low slope concave banks (10–30% gradient) and channel depth of about 1.5 to 2.0 m.</p> <p>The banks were assessed as having excellent structural integrity with only 0–4% of both the left and right banks showing signs of minor erosion.</p> <p><b>Aquatic habitat and connectivity</b></p> <p>In-stream habitat was characterised by dense abundance of woody debris in a variety of sizes (less than 5 cm to greater than 50 cm). There was approximately 60–100% of biological substrate cover including epiphytes, detritus and leaves throughout the assessment site. Additional habitat was provided by riparian vegetation draped into the water along almost the entire bank length (50–100%), as well as some overhanging roots (1–9%) and overhanging banks (50–100%).</p> <p>Canopy cover provided shade across much of the aquatic habitat, with shrubs and ground cover plants providing the majority of the shade along the lengths of the bank. There were no in-stream macrophytes; however, there was a proportion of emergent and inundated rushes and sedges that covered approximately 30 per cent of the assessment site.</p> <p>Fish passage was possible throughout the assessment site; however, movement of fish upstream from the site was prevented by a series of disconnected pools on either side of Plain Road bridge, as well as the Walpole Weir.</p>

### 10.4.2 Significant fauna

A desktop assessment undertaken by Phoenix (2023a and 2023c) identified 89 conservation significant species potentially occurring within 40 km of the proposal (Phoenix, 2023a). The species recorded, previously recorded in other surveys or considered likely or possible to occur within the zone of influence are discussed in Table 35. Further assessment of the likelihood of occurrence, including those species considered unlikely to occur is provided in the terrestrial fauna assessment report (Phoenix 2023a) provided in Appendix H.

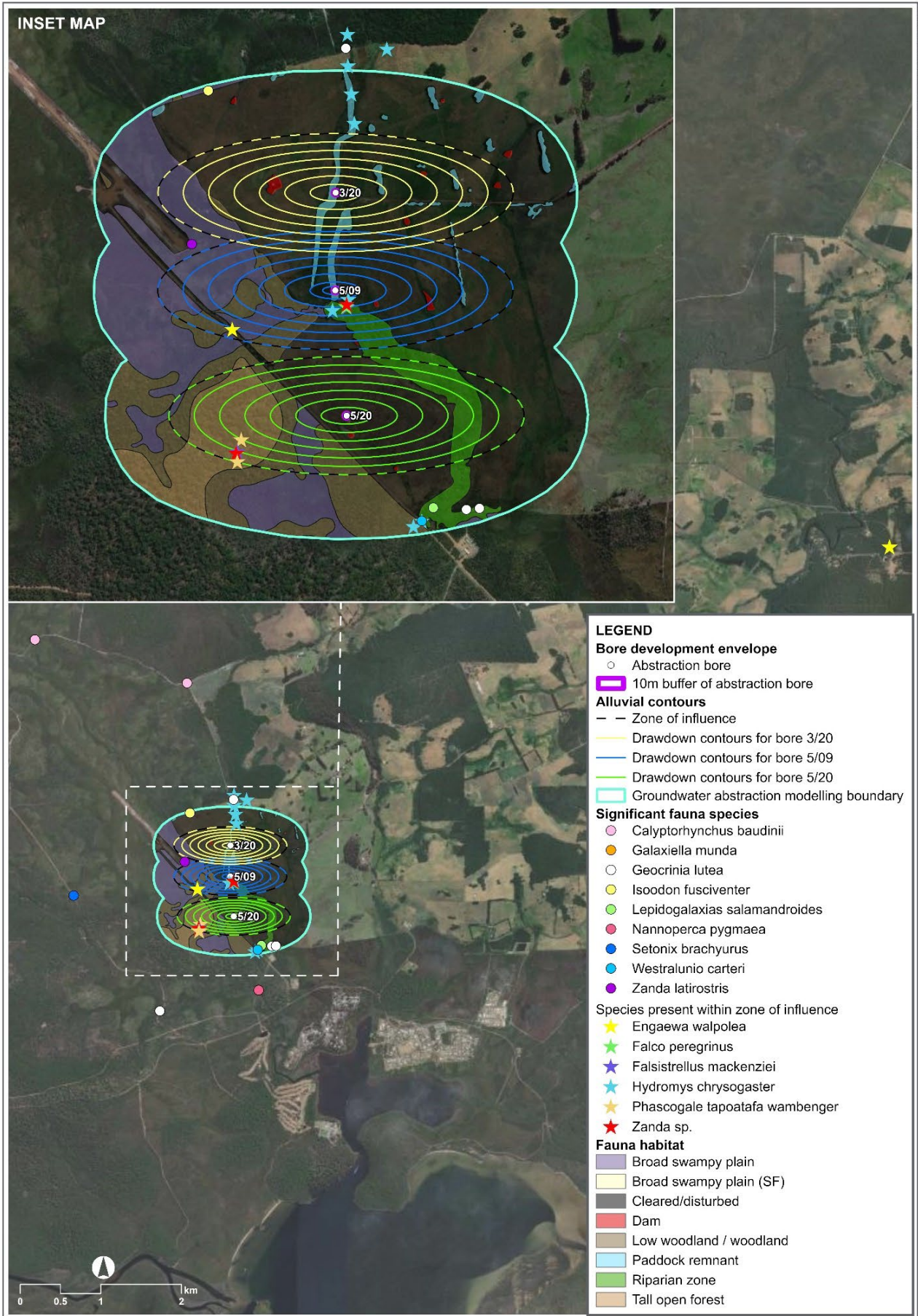


Figure 22: Fauna habitat mapping and location of conservation significant fauna species recorded

Table 35: Significant fauna species potentially occurring within vicinity of the proposal

Species	Threatened category		Likelihood assessment and observations	Suitable habitat				
	EPBC Act	BC Act		Broad swampy plains	Low woodlands and woodlands	Tall open forest	Riparian zone	
<b>Birds</b>								
<i>Zanda baudinii</i> (Baudin's cockatoo)	Endangered	Endangered	<p><b>Recorded (Figure 22)</b></p> <p>This species breeds in woodlands forests and occasionally isolated trees. They nest in hollows in live or dead trees, particularly karri, marri, jarrah, wandoo, bullich and tuart. They primarily feed on the seeds of marri, rarely jarrah, in woodlands and forest, and seeds of native proteaceous plant species (DCEEW, 2022).</p> <p>Suitable breeding habitat for black cockatoos within the study area includes tall open forest, riparian zone and mature <i>Eucalyptus</i> and <i>Corymbia</i> trees among remnant vegetation patches along Swann Road and in farm paddocks.</p> <p>This species was identified within the zone of influence by Phoenix.</p>					
<i>Zanda latirostris</i> (Carnaby's black cockatoo)	Endangered	Endangered	<p><b>Recorded (Figure 22)</b></p> <p>This species breeds in woodlands, forests and occasionally partially cleared areas including isolated trees. They nest in hollows in live or dead trees, particularly salmon gum, wandoo, tuart, jarrah, flooded gum, York gum, powderbark, karri and marri.</p> <p>They forage on shrubland, kwongan heathland and woodland, including seeds, flowers and nectar of native proteaceous plant species, <i>Callistemon</i> spp. and marri (DCEEW, 2022).</p> <p>Suitable breeding habitat for black cockatoos within the study area includes tall open forest, riparian zone and mature <i>Eucalyptus</i> and <i>Corymbia</i> trees among remnant vegetation patches along Swann Road and in farm paddocks.</p> <p>This species was identified within the zone of influence by Phoenix.</p>					
<i>Calyptorhynchus banksii naso</i> (forest red-tailed black-cockatoo)	Vulnerable	Vulnerable	<p><b>Likely</b></p> <p>This species breeds in woodlands, forests and occasionally partially cleared areas including isolated trees. They nest in hollows in live or dead trees, particularly marri, karri, wandoo, bullich, blackbutt, tuart and jarrah.</p> <p>They forage on seeds of jarrah and marri, wandoo, blackbutt, <i>Allocasuarina</i> cones and the fruits of snottygobble and mountain marri (DCEEW, 2022). Suitable foraging and nesting habitat is available within the zone of influence.</p>					
<i>Falco peregrinus</i> (peregrine falcon)		OS <sup>1</sup>	<p><b>Recorded (Figure 22)</b></p> <p>The peregrine falcon was recorded within the riparian zone habitat type. This is likely to represent a visitor to the fauna survey area, as part of the species wide foraging home-range.</p> <p>Foraging habitat is present within the zone of influence. However, although possible within the tall open forest woodland habitat type, it is considered unlikely (Phoenix 2023).</p> <p>As there is no critical habitat for this species present within the zone of influence, significant impacts to this species as a result of the proposal are unlikely.</p>					
<i>Oxyura australis</i> (blue-billed duck)		P4	<p><b>Possible</b></p> <p>Suitable habitat is present within the riparian and dam habitat types within the zone of influence. The most recent record from the vicinity is from 2005 from the town of Walpole (Phoenix 2023a).</p>					
<i>Actitis hypoleucos</i> (common sandpiper)	Migratory	Migratory	<p><b>Unlikely (Recorded previously)</b></p> <p>This species was previously recorded within the fauna survey area in 1998 and was likely a flyover. There is no suitable habitat within the survey area.</p>					
<i>Apus pacificus</i> (fork-tailed swift)	Migratory	Migratory	<p><b>Possible</b></p> <p>This species occurs in a wide range of dry or open habitats, including riparian woodlands, tea-tree swamps, low scrub, heathland, saltmarsh, grassland and spinifex sandplains, open farmland, and inland and coastal sand dunes (Phoenix 2023a). It is an aerial species and although it may forage over the site, there is no critical habitat present for this species.</p>					
<i>Hydroprogne caspia</i> (Caspian tern)	Migratory	Migratory	<p><b>Unlikely (Recorded previously)</b></p> <p>This species is coastal / pelagic and there is no suitable habitat within the fauna survey area. The previous record is from 1998 from cleared/disturbed areas and was likely a flyover.</p>					
<i>Thalasseus bergii</i> (crested tern)	Migratory	Migratory	<p><b>Unlikely (Recorded previously)</b></p> <p>No suitable habitat is present. There is one record within the study area from cleared / disturbed areas, likely a flyover.</p>					
<i>Motacilla cinerea</i> (grey wagtail)	Migratory	Migratory	<p><b>Possible</b></p> <p>May occasionally occur with the riparian areas of the zone of influence, however no critical habitat for this species is present.</p>					
<i>Pandion cristatus</i> (osprey)	Migratory	Migratory	<p><b>Possible</b></p> <p>This species mostly occurs in littoral and coastal habitats. There are numerous records located nearby, two of which are from cleared/disturbed areas in the fauna survey area (most recently from 1998), these are likely to be flyovers. No ospreys or osprey nests were identified within the zone of influence during the fauna surveys and the site does not comprise critical habitat for this species.</p>					
<b>Crustacean</b>								
<i>Engaewa walpolea</i> (Walpole burrowing crayfish)	Endangered	Endangered	<p><b>Recorded (Figure 22)</b></p> <p>The Walpole burrowing crayfish inhabits areas of very moist soils with a shallow, very accessible water table. These habitats include headwater seepages and broad drainage depressions. This species constructs burrows that extend down to the water table.</p> <p>This species was identified within the zone of influence by Phoenix (2022). There is suitable habitat for this species present and it has previously been recorded within the fauna survey area.</p> <p>A key threat to this species is reduced rainfall, which may result in the drying out and loss of swamp and drainage system habitats.</p>					

<sup>1</sup> Species otherwise in need of special protection (other specially protected).

Species	Threatened category		Likelihood assessment and observations	Suitable habitat				
	EPBC Act	BC Act		Broad swampy plains	Low woodlands and woodlands	Tall open forest	Riparian zone	
<b>Fish</b>								
<i>Galaxiella nigrostriata</i> (blackstriped dwarf galaxias)	Endangered	Endangered	<b>Recorded (in previous surveys)</b> This species is generally found in ephemeral, tannin-stained wetland habitats (DWER, 2023). Suitable habitat is present within the zone of influence and this species was recorded within the AQU02 sampling location within the Walpole River (Figure 19) by Phoenix.					
<i>Galaxiella munda</i> (mud minnow, western dwarf galaxias)		Vulnerable	<b>Recorded (Figure 22)</b> This species prefers relatively undisturbed, permanent stream habitats in small, gently flowing creeks and streams. It is found in low pH environments (as low as pH 3) and has a low salt tolerance. Fresh groundwater expression in streams appears to be a key factor in maintaining remnant populations (Phoenix 2023c).					
<i>Nannatherina balstoni</i> (Balston's pygmy perch)	Vulnerable	Vulnerable	<b>Recorded (in previous surveys)</b> This species is restricted to near-coastal streams, lakes and wetlands between upper Margaret River and the Goodga River. It is associated with slow-flowing, low salinity, acidic and tannin-stained waters, and complex instream habitat (DWER, 2023b). This species was not recorded by Phoenix (2023) during site surveys. However, it was identified directly below and approximately 200 m downstream of sampling point AQU02 (Figure 19) in 2020 as part of the Healthy Rivers Program.					
<i>Nannoperca pygmaea</i> (little pygmy perch)	Endangered	Endangered	<b>Recorded (Figure 22)</b> This species occupies a wide range of habitats within its restricted distribution, including flowing and static water, clear or tannin-stained water. It is tolerant of salinities up to slightly brackish and of mild acidity (associated with many tannin-rich environments). They prefer areas with good detritus and woody debris. This species was recorded within both sampling locations within the Walpole River (Figure 19) by Phoenix (2023c). These sampling locations have also historically been sampled as part of the Healthy Rivers Program, with the little pygmy perch identified at the sampling locations in 2020.					
<i>Lepidogalaxias salamandroides</i> (salamander fish)		Endangered	<b>Recorded (Figure 22)</b> This species is common within its restricted range in near-coastal wetlands between Augusta and Albany, although the species has undergone a severe reduction in the extent of occurrence and area of occupancy in the last two decades, which has coincided with an extensive period of severe drying of the region. It is primarily found in highly acidic, shallow, temporary (dry out in summer) pools and swamps in coastal heathland. Fish survive drying through summer months by burrowing into the substrate where they aestivate (a state of dormancy similar to hibernation, characterised by inactivity and a lowered metabolic rate). They will remain in the damp sandy soils until rains re-submerge the habitat the following year. Suitable habitat is present within the zone of influence and this species was recorded within the AQU01 sampling location within the Walpole River (Figure 19) by Phoenix.					
<i>Geotria australis</i> (pouched lamprey)		P3	<b>Likely</b> Although not recorded by Phoenix, this species has been previously recorded within the survey area. The species is anadromous (enters rivers from the ocean to spawn) and has a marine parasitic pre-adult stage. Sub-adults then enter freshwater rivers during winter and spring, moving upstream prior to spawning in the following year (Phoenix 2023c).					
<b>Mammal</b>								
<i>Pseudocheirus occidentalis</i> (western ringtail possum)	Critically Endangered	Critically Endangered	<b>Possible</b> The zone of influence is located within the south coast zone of distribution for this species. Within this zone, the western ringtail possum inhabits near-coastal limestone heath, jarrah marri thicket woodland and forest, riparian, peppermint woodland and karri forest vegetation. This species was not identified within the zone of influence by Phoenix (2023a), however there is potential habitat for this species present.					
<i>Falsistrellus mackenziei</i> (western false pipistrelle)		P4	<b>Recorded (Figure 22)</b> This species inhabits wet sclerophyll forests of karri, jarrah and tuart eucalypts, roosting in hollows of old trees, branches and stumps, in colonies of bats. It is vulnerable to the loss of roost sites in tree hollows through habitat removal and competition for hollows from the introduced European bee and rainbow lorikeet, the loss of feeding grounds is also a significant threat (Phoenix 2023a).					
<i>Hydromys chrysogaster</i> (rakali, water-rat)		P4	<b>Recorded (Figure 22)</b> This species occurs in a wide variety of freshwater habitats, from inland waterways to lakes, swamps and farm dams throughout WA. Populations associated with temporary water can be highly unstable because they are sensitive to heat stress and are unable to survive high temperatures without large amounts of water (Phoenix 2023a).					
<i>Isoodon fusciventer</i> (quenda)		P4	<b>Recorded (Figure 22)</b> This species occurs in dense shrublands and forests, often associated with wetlands, along the Swan Coastal Plain, specifically jarrah and karri forests north of Perth to the east of Esperance (Phoenix 2023a).					
<i>Notamacropus eugenii derbianus</i> (tammar wallaby)		P4	<b>Possible</b> This species feeds in open grassy habitats at night and shelter under shrubs during the day (Phoenix 2023a).					
<i>Notamacropus irma</i> (western brush wallaby)		P4	<b>Possible</b> This species feeds mostly in dense bushlands, tending to avoid more open habitats (Phoenix 2023a).					
<i>Phascogale tapoatafa wambenger</i> (wambenger brush-tailed phascogale)		Conservation dependent <sup>2</sup>	<b>Recorded (Figure 22)</b> This species has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees. It prefers large trees, particularly jarrah and marri (Phoenix 2023a).					
<i>Bettongia penicillata ogilbyi</i> (woylie)	Endangered	Critically Endangered	<b>Unlikely</b> Woylies are known to inhabit tall eucalypt forest and woodland, dense myrtaceous shrubland, kwongan proteaceous) or mallee heath. This species was not identified within the zone of influence by Phoenix (2023a).					

<sup>2</sup> Taxa whose survival depends upon ongoing conservation measures; without these measures, a conservation-dependent taxon would be classified as Vulnerable, Endangered or Critically Endangered.

REPORT

Species	Threatened category		Likelihood assessment and observations	Suitable habitat			
	EPBC Act	BC Act		Broad swampy plains	Low woodlands and woodlands	Tall open forest	Riparian zone
<i>Setonix brachyurus</i> (quokka)	Vulnerable	Vulnerable	<p><b>Possible</b></p> <p>In the southern forest, quokkas occupy a range of forest, woodland and wetland ecotypes. The most commonly occupied habitats comprise jarrah (<i>Eucalyptus marginata</i>), marri (<i>Corymbia calophylla</i>), karri (<i>E. diversicolor</i>) or tingle (<i>E. jacksonii</i> or <i>E. guilfoylei</i>) forest and riparian habitats with a sedge dominated understorey.</p> <p>This species was not identified within the zone of influence by Phoenix (2022); however tracks were identified outside the survey area by Phoenix. Therefore, this species may use the site.</p>				
<i>Dasyurus geoffroii</i> (chuditch)	Vulnerable	Vulnerable	<p><b>Possible</b></p> <p>The chuditch inhabits a variety of habitats, including woodlands, dry sclerophyll forests and riparian vegetation. This species was not identified within the zone of influence by Phoenix, however there is suitable foraging habitat and denning habitat present (Phoenix 2023a).</p>				
<b>Bivalves</b>							
<i>Westralunio carteri</i> (Carter's freshwater mussel)	Vulnerable	Vulnerable	<p><b>Recorded (Figure 22)</b></p> <p>This species inhabits slower flowing waters where sediments are stable and soft enough to allow the species to burrow between Moore River in the north and the Waychinicup River.</p> <p>This species was identified during surveys undertaken by Phoenix (2023); however it was recorded outside the zone of influence.</p>				
<b>Reptiles</b>							
<i>Elapognathus minor</i> (short-nosed snake)		P2	<p><b>Possible</b></p> <p>This species mostly inhabits heathland bordering swamps, also wet sclerophyll forest.</p>				
<b>Amphibians</b>							
<i>Anstisia lutea</i> (Nornalup frog)		P4	<p><b>Recorded (Figure 22)</b></p> <p>This species is restricted to the Walpole and Nornalup region and north to Mount Franklin. It inhabits dense swampy vegetation with wet leaf litter on peaty sand, typically bordering streams and steeps and often on the edge of forests (Phoenix 2023a).</p> <p>This species has been recorded outside the zone of influence.</p>				
<i>Spicospina flammocaerulea</i> (sunset frog)	Vulnerable	Vulnerable	<p><b>Possible</b></p> <p>The nearest record is over 12.3 km east of the proposal. However, as critical habitat for this species comprises peat swamps, which may be present in the broad swampy plains habitat type, there is potential for this species to occur.</p>				



#### 10.4.2.1 *Falsistrellus mackenziei* (western false pipistrelle)

Western false pipistrelle predominantly occurs in wet sclerophyll forests of karri, jarrah and tuart or high-rainfall zones of jarrah dry sclerophyll forests. It generally roosts in tree hollows, branches and stumps. This species was recorded from two locations, within tall open forest and riparian zone habitat types (Phoenix, 2023a). There is approximately 32.58 ha of suitable habitat for this species within the zone of influence, within the tall open forest, riparian zone and low woodlands / woodlands habitat types.

#### 10.4.2.2 *Hydromys chrysogaster* (rakali)

The rakali occurs in a wide variety of freshwater habitats including inland waterways, lakes, swamps and farm dams. This species was recorded within broad swampy plains and the riparian zone habitat types within the zone of influence, with all records within 1 m of water (Phoenix, 2023a).

Given the numerous desktop records of rakali nearby, with 21 of the 30 desktop records occurring at Nornalup inlet (less than 1 km south of the study area), the species is clearly locally abundant with suitable habitat including numerous rivers, streams, wetlands and farm dams outside the study area.

#### 10.4.2.3 *Isoodon fusciventer* (quenda)

Approximately 49.8 ha of suitable habitat is present within the zone of influence for this species, including the broad swampy plains, low woodlands/woodlands, tall open forest and riparian zone habitat types. This species was only recorded once within the broad swampy plains habitat at the northern extent of the fauna study area. With 39 previous records of quenda within 40 km of the study area, the nearest of which is less than 2 km south-south-west, the species is locally widespread (Phoenix, 2023a).

#### 10.4.2.4 *Phascogale tapoatafa wambenger* (wambenger brush-tailed phascogale)

The brush-tailed phascogale was recorded from tall open forest and low woodland/woodland habitats. These habitats contain mature hollow forming *Eucalyptus* (and *Corymbia*) trees and hollows in old fallen logs, which are critical to support the species. It is therefore reasonable to assume that the species also occurs within the riparian zone, given its similar woodland/forest structure and complex (Phoenix, 2023a). 32.58 ha of potential habitat is present within the zone of influence for this species.

#### 10.4.2.5 *Setonix brachyurus* (quokka)

Quokka was recorded from tracks over 600 m to the west of the fauna survey area. Although the quokka was located outside the survey area, there is potential for it to occur in the broad swampy plains, low woodlands / woodlands, tall open forest and riparian zone habitat types within the zone of influence (Phoenix, 2023a). These habitat types comprise 49.8 ha of the zone of influence.

#### 10.4.2.6 Black cockatoo species

Phoenix identified the following habitat types as comprising suitable habitat for the three species of black cockatoos (Figure 23):

- 'Tall open forest' covers 10.44 ha (6.98%) of the zone of influence and comprises potential breeding, roosting and foraging habitat.
- 'Riparian zone' covers 8.63 ha (5.78%) of the zone of influence and comprises potential breeding, roosting and foraging habitat.
- 'Low woodlands / woodlands' covers 13.51 ha (9.04%) of the zone of influence and comprises potential breeding, roosting and foraging habitat.
- 'Broad swampy plains' covers 17.22 ha (11.52%) of the zone of influence and comprises potential breeding, roosting and foraging habitat.
- 'Isolated paddock remnants' comprises 4.13 ha (2.77%) of the zone of influence and comprises potential breeding, roosting and foraging habitat.

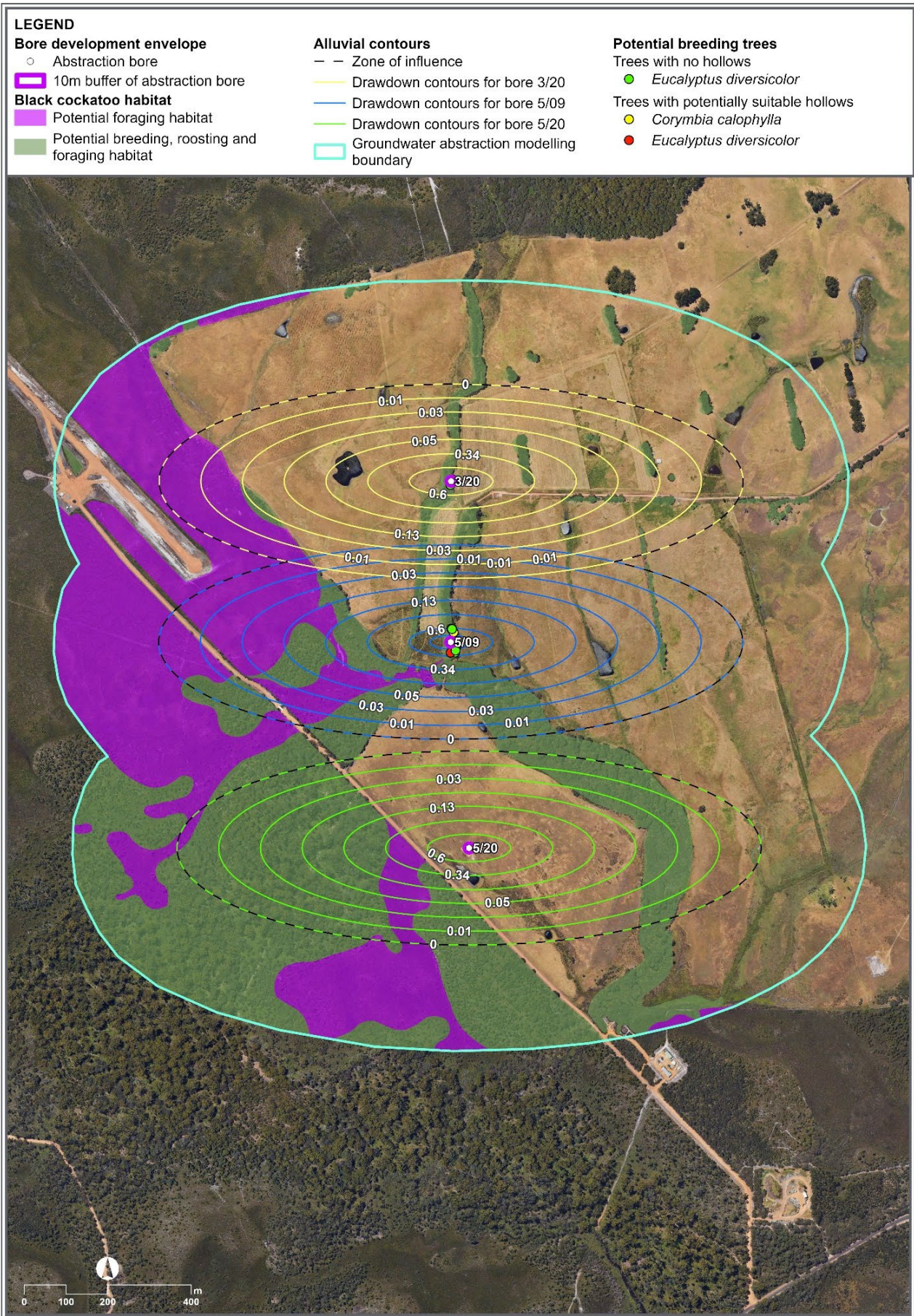


Figure 23: Potential black cockatoo habitat within the zone of influence

#### 10.4.2.7 *Anstisia lutea* (Nornalup frog)

The Nornalup frog (P4) is restricted to the Walpole and Nornalup region and occurs in dense swampy vegetation with wet leaf litter on peaty sand, typically bordering streams and steeps, and often on the edge of forests (Phoenix, 2023a). It was recorded from call recognition to the south of the zone of influence (Figure 22) and may occur within the following habitat types within the zone of influence:

- Broad swampy plains
- On the border of low woodland/woodland
- Riparian zone.

Approximately 39.37 ha of suitable habitat for this species is located within the zone of influence.

#### 10.4.2.8 *Spicospina flammocaerulea* (sunset frog)

The sunset frog is only found in the relictual peat swamps on the Frankland, Bow and Kent river catchments (Phoenix, 2023a). The zone of influence is located to the west and outside of the known distribution of this species. Phoenix (2023a) did not identify this species during site surveys, however, did identify 3.36 ha of potential habitat within the zone of influence. This habitat is shown in Figure 22 as 'Broad swampy plain (SF)'.

#### 10.4.2.9 Aquatic fauna

##### 10.4.2.9.1 *Galaxiella munda* (western mud minnow)

This species was recorded at site AQU02 by Phoenix (2023c) and as part of the Healthy Rivers monitoring program. Its known distribution occurs over the zone of influence as shown in Figure 24. This species prefers relatively undisturbed, permanent, gently flowing creeks and streams. It occurs in low pH environments and has low salt tolerance.

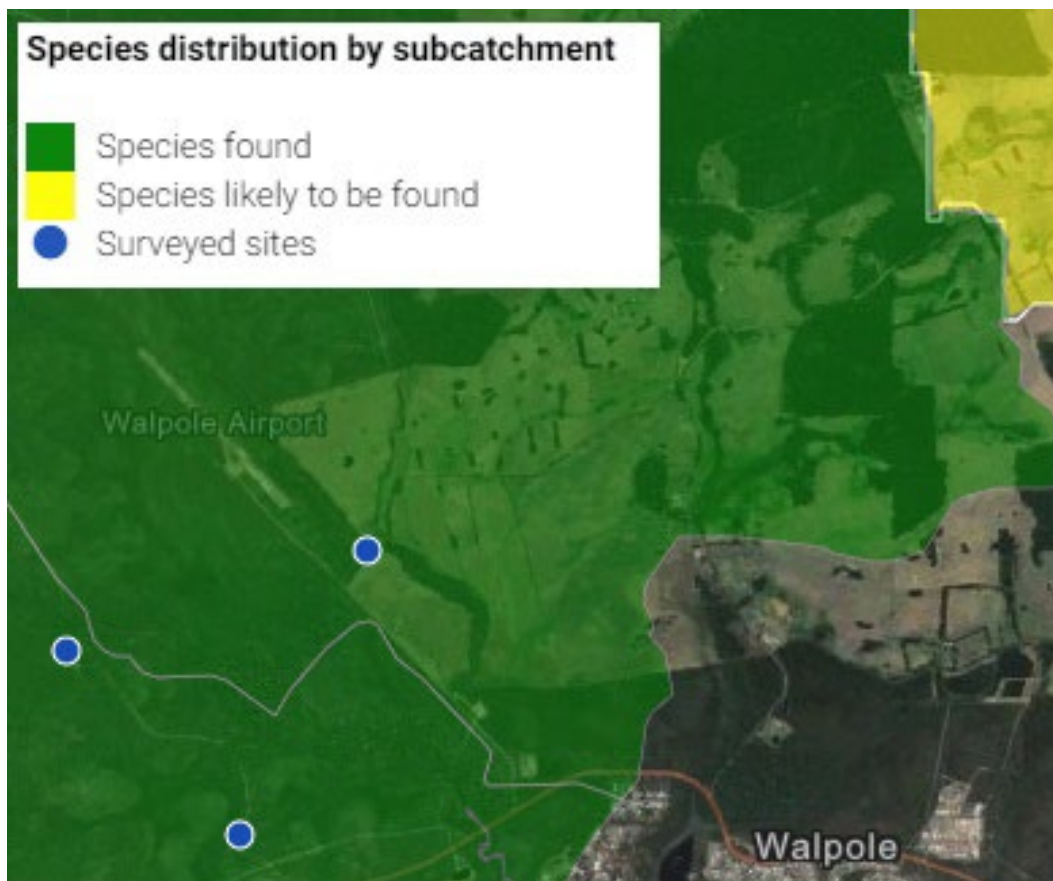


Figure 24: Known distribution of the western mud minnow

#### 10.4.2.9.2 *Galaxiella nigrostriata* (blackstriped dwarf galaxias)

The blackstriped dwarf galaxias was not recorded by Phoenix (2023c) or DWER as part of the Healthy River program. However, there is potential that this species occurs in the Walpole River. A threat to this species includes habitat modification through excessive anthropogenic groundwater extraction (Threatened Species Scientific Committee, 2018).

#### 10.4.2.9.3 *Nannatherina balstoni* (Balston's pygmy perch)

Balston's pygmy perch was previously recorded about 200 m downstream of the Walpole Weir in March 2020 as part of the Healthy River program (Department of Water and Environmental Regulation, 2020), although this is the first record of this species in the area. It was not recorded during the survey by Phoenix, although it may have gone undetected due to the disturbance caused by the high flow rates within the river (Phoenix, 2023c). The section of Walpole River within vicinity of the proposal is considered likely to provide suitable habitat for this species.

Conservation advice for the species indicates that one of the threats includes habitat alteration through any alterations to inflow and increased salinisation, siltation and eutrophication that occur through changes to flow regimes (regulation and abstraction), road maintenance, mineral sand exploration and mining, ground water extraction and agricultural and forestry practices in the uppermost catchment (Department of the Environment, Water, Heritage and the Arts, 2008).

#### 10.4.2.9.4 *Nannoperca pygmaea* (little pygmy perch)

The little pygmy perch was found in high abundance, particularly at site AQU01, where 228 out of the 233 individuals recorded across both sites were found (Phoenix, 2023c). This is a strong indication that the section of Walpole River within vicinity of the proposal provides important habitat for this species.

Conservation advice for the species indicates that groundwater extraction from aquifers, should they connect with refuge habitat of the species, could result in loss of key habitats (Threatened Species Scientific Committee, 2019).

#### 10.4.2.9.5 *Lepidogalaxias salamandroides* (salamander fish)

The aquatic fauna survey was conducted during a period of above average rainfall, which resulted in higher water levels and higher flow rates than expected. These conditions may have affected the survey results, as evidenced by the unexpected capture of four salamander fish at site AQU01. Salamander fish are rarely found in flowing streams and are typically found in highly acidic, shallow, temporary pools and swamps in coastal heathland. Consequently, it is possible that this species was displaced from adjacent shallow, slow flowing or still pools that intersect the main channel (Phoenix, 2023c).

#### 10.4.2.9.6 *Westralunio carteri* (Carter's freshwater mussel)

This species has been recorded to the south of the zone of influence (Figure 22) by Phoenix (2023c) and there is potential that this species also occurs within the portion of the upper Walpole River within the zone of influence.

Threats to this species includes water extraction, dehydration and heat stress (Threatened Species Scientific Committee, 2018b). This species prefers slower flowing waters where sediments are stable and soft enough to allow the species to burrow (DWER, 2023), therefore, any reductions in surface water flows within the river due to the proposal are unlikely to impact this species. However, there is potential for the proposed groundwater abstraction to impact this species, through potential impacts to surface water levels within the Walpole River.

#### 10.4.2.9.7 *Geotria australis* (pouched lamprey)

The pouched lamprey has been previously recorded in the sub-catchment and downstream of the study area, within the Nornalup Inlet (Phoenix 2023c) (Figure 25). In the early stage of their life cycle, lamprey burrow in sand in upper reaches of river systems and then migrate to the ocean where they may remain and feed for several years.

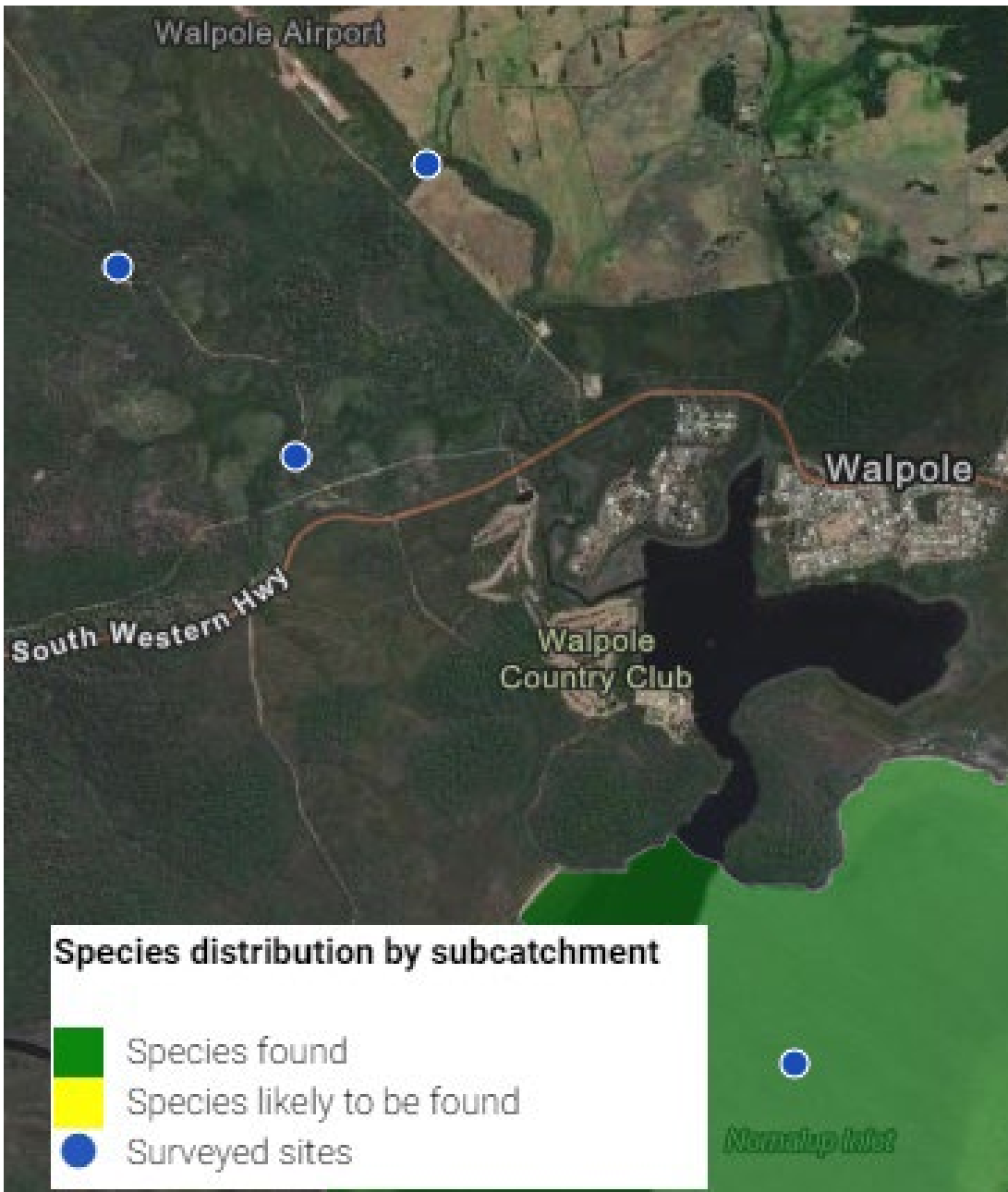


Figure 25: Known distribution of the pouched lamprey

#### 10.4.2.9.8 *Engaewa walpolea* (Walpole burrowing crayfish)

The Walpole burrowing crayfish is endemic to the area immediately surrounding the Walpole townsite and was recorded within the zone of influence by Phoenix (2023c) (Figure 22).

The Walpole burrowing crayfish uses a variety of habitats that provide very moist soils and a shallow, very accessible water table. These habitats include headwater seepages and broad drainage depressions. There is potential that this species would be impacted by the drying out and loss of swamp and drainage system habitats (DCCEEW, 2009).

### 10.4.3 Short range endemic species

Short range endemic (SRE) species are terrestrial and freshwater invertebrates that have naturally small distributions of less than 10,000 km<sup>2</sup>. Within this distribution, the actual areas occupied may be small, discontinuous or fragmented. Fauna with narrow distributions may be at greater risk of changes in conservation status as a result of habitat loss or other threatening processes (EPA, 2016g).

### 10.4.3.1 Short range endemic habitat

Phoenix Environmental Sciences (2023c) undertook a habitat assessment to determine its potential to support endemic SRE species and communities. Potential SRE habitat was rated as follows (Phoenix Environmental, 2023d):

- High – defined/known areas of habitat that contain elements that often give rise to specialisation or dependency in invertebrate fauna, such as aspect (e.g. south-facing slopes), geological features (e.g. granite), soil types that retain water (e.g. clay, loam). These habitats may also include habitat isolates, which have the capacity to restrict dispersal.
- Low – areas of largely intact native vegetation that occur broadly across the landscape, are less incised and typically link more restricted habitats. This may include land that was cleared but has since been rehabilitated or is in the process of being rehabilitated.
- None – land that has been previously cleared for other uses that no longer contains native vegetation.

Of the broad habitat types identified within the zone of influence by Phoenix, the following were determined to comprise potentially suitable habitat for SRE invertebrates (Phoenix Environmental, 2023d):

- Low. The broad swampy plains habitat type was deemed to have low suitability for SRE species due to being seasonally inundated with water
- High. Potential for SRE habitat includes the following habitat types. These habitat types have potential to support SRE taxa due to their relative isolation in the landscape and high moisture levels:
  - Open forests
  - Low woodlands / woodlands
  - Riparian zone.

Fauna habitat types are described in Table 33 and shown in Figure 22.

### 10.4.3.2 Short range endemic species

Phoenix Environmental Sciences (2023d) recorded 37 taxa from seven SRE groups during the SRE survey, of which four are likely to be SRE species (two millipedes and two isopods) and 28 are considered potential SRE species. The results of the first phase of sampling indicates that SRE species are likely to be present in suitable habitats throughout the zone of influence. However, these habitat types exist in the wider region and the zone of influence is not likely to represent restricted populations (Phoenix Environmental, 2023d).

**Table 36: Potential SRE species identified within the zone of influence**

Species	Location		SRE status
	Sample site	Habitat	
<i>Anamidae</i> `sp. indet.`	SRE03	Broad swampy plains	Potential
<i>Chenistonia</i> `MYG357`	SRE06	Tall open forest	Potential
<i>Merredinia</i> `MYG356`	SRE03, SRE05	Broad swampy plains, tall open forest	Potential
<i>Proshermacha</i> `MYG788`	SRE01, SRW-01	Tall open forest	Potential
<i>Megalopsalis minima</i>	SRE01, SRE03, SRE06	Broad swampy plains, tall open forest	Potential
<i>Nunciella</i> `Phoenix0120`	SRE01, SRE02, SRE06	Tall open forest	Potential
<i>Nunciella</i> `sp. indet.`	SRE01	Tall open forest	Potential
<i>Trienonychidae</i> `genus 008` `Phoenix0121`	SRE01	Tall open forest	Potential
<i>Trienonychidae</i> `genus indet.` `Phoenix0123`	SRE06	Tall open forest	Potential
<i>Trienonychidae</i> `genus indet.` `Phoenix0124`	SRE06	Tall open forest	Potential
<i>Trienonychidae</i> `sp. indet.`	SRE06	Tall open forest	Potential

## REPORT

Species	Location		SRE status
	Sample site	Habitat	
<i>Yatala</i> `sp. indet.`	SRE01	Tall open forest	Potential
<i>Lagynochthonius australicus</i>	SRE01, SRE02, SRE04, SRE06	Tall open forest	Widespread
<i>Nesidiochernes</i> `sp. indet.`	SRE03, SRE04	Broad swampy plains, tall open forest	Potential
<i>Protochelifer</i> `sp. indet.`	SRE04	Tall open forest	Potential
<i>Pseudotyranochthonius giganteus</i>	SRE06	Tall open forest	Potential
<i>Cercophonius sulcatus</i>	SRE06	Tall open forest	Widespread
? <i>Samichus decoratus</i>	SRE06	Tall open forest	Potential
<i>Iulomorphidae</i> `Phoenix0115`	SRE02, SRE04, SRE06	Tall open forest	Likely
<i>Iulomorphidae</i> `sp. indet.`	SRE06	Tall open forest	Potential
<i>Akamptogonus novarae</i>	SRE01, SRE02	Tall open forest	Widespread
<i>Antichiropus</i> `Phoenix0113`	SRE04	Tall open forest	Potential
<i>Antichiropus</i> `Phoenix0114`	SRE01	Tall open forest	Potential
<i>Siphonotidae</i> `Phoenix0116`	SRE02, SRE06	Tall open forest	Potential
<i>Siphonotidae</i> `Phoenix0117`	SRE01	Tall open forest	Potential
<i>Siphonotidae</i> `Phoenix0118`	SRE02, SRE04, SRE06	Tall open forest	Potential
<i>Calliuncus</i> `Phoenix0122`	SRE06	Tall open forest	Likely
<i>Bothriembryon cf. bradshawi</i>	SRE06	Tall open forest	Potential
<i>Buddelundia</i> `sp. 5`	SRE06	Tall open forest	Potential
<i>Pseudodiploexochus</i> `1`	SRE01, SRE06	Tall open forest	Likely
<i>Pseudolaureola wilsmorei</i>	SRE02, SRE06	Tall open forest	Widespread
<i>Spherillo</i> `3`	SRE06	Tall open forest	Potential
<i>Hanoniscus nichollsi</i>	SRE01	Tall open forest	Widespread
<i>Laevophiloscia</i> `1`	SRE01, SRE02, SRE04, SRE05, SRE06	Broad swampy plains, tall open forest	Potential
<i>Laevophiloscia</i> `2`	SRE01, SRE06	Tall open forest	Potential
<i>Platyarthridae</i> `1`	SRE02, SRE06	Tall open forest	Likely
<i>Styloniscus</i> `7`	SRE03, SRE06	Broad swampy plains, tall open forest	Potential

## 10.5 Potential impacts

Table 37 provides the potential key impacts to Terrestrial Fauna from the establishment and operation of the proposal.

**Table 37: Potential impacts on Terrestrial Fauna**

Phase	Impact class	Works / operations	Potential impacts
Establishment		<ul style="list-style-type: none"> <li>The bores have already been installed, as such there is no establishment or construction phase associated with the proposal. No vegetation or associated fauna habitat is proposed to be cleared to construct or implement the proposal.</li> </ul>	
Operation	Indirect	<ul style="list-style-type: none"> <li>Groundwater abstraction</li> <li>Monitoring activities during the six-month trial period.</li> </ul>	<ul style="list-style-type: none"> <li>Introduction and / or distribution of weeds, pests and diseases.</li> <li>Disturbance to surrounding terrestrial fauna habitat.</li> <li>Alteration of groundwater levels (drawdown) may reduce ground water availability for terrestrial fauna habitat which supports significant fauna species.</li> <li>Alteration of groundwater levels (drawdown) may reduce ground water availability for terrestrial fauna habitat which supports SRE species.</li> <li>Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially impacting aquatic fauna habitat.</li> <li>Alteration of groundwater levels may result in the exposure of acid sulfate soils, resulting in water quality impacts to the Walpole River.</li> <li>Disturbance to fauna from generator noise emissions.</li> </ul>

## 10.5.1 Assessment of impacts

### 10.5.1.1 Introduction and / or distribution of weeds, pests and diseases

There is the potential for Declared Pests, other weed species and disease to be introduced and / or spread during monitoring or maintenance activities scheduled during the six-month trial period.

The bores and associated infrastructure are all located within existing cleared areas and access to these areas will be via existing roads and tracks. Therefore, as no soil or native vegetation will be disturbed and vehicles and personnel will not traverse areas comprising significant fauna habitat to access the bores, the risk of impacts from weed or disease spread, and introduction is low. As areas of significant fauna habitat will not be accessed during the six-month trial, mitigation and management measures are not considered necessary.

### 10.5.1.2 Disturbance to surrounding terrestrial fauna habitat

The three bores are located within cleared areas and therefore, any maintenance or monitoring activities required during the trial period will not result in the disturbance of surrounding significant fauna habitat. Access to the three bores will be via existing roads and tracks and therefore any damage to native vegetation during monitoring or maintenance works is unlikely to occur. No further management or mitigation measures are considered necessary.

### 10.5.1.3 Groundwater drawdown impacts to terrestrial fauna habitat which supports significant fauna species

Threatened and priority species that were recorded during the vertebrate fauna survey are described in Section 10.4.2 and include the peregrine falcon, Baudin’s cockatoo, Carnaby’s cockatoo, wambenger brush-tailed phascogale, quokka, Nornalup frog, quenda, rakali and western false pipistrelle (Table 35). Although not recorded during surveys, the forest red-tailed black cockatoo is considered likely to use habitat within the zone of influence (Phoenix, 2023a).

The recorded location of these species is provided in Figure 22.

Other species such as the sunset frog, short-nosed snake, chuditch, tammar wallaby, western brush wallaby, western ring-tailed possum, osprey, grey wagtail, fork-tailed swift and blue-billed duck may use the habitat within the zone of influence. However, these species were not recorded during surveys, and it is unlikely that the zone of influence comprises critical habitat for these species.



Significant habitat for fauna species identified as likely to occur within the zone of influence includes:

- ‘Tall open forest’ covers 10.44 ha (6.98%) of the zone of influence.
- ‘Riparian zone’ covers 8.63 ha (5.78%) of the zone of influence.
- ‘Low woodlands / woodlands’ covers 13.51 ha (9.04%) of the zone of influence.
- ‘Broad swampy plains’ covers 17.22 ha (11.52%) of the zone of influence.
- ‘Isolated paddock remnants’ comprises 4.13 ha (2.77%) of the zone of influence. For the purposes of the impact assessment, the paddock remnant habitat type has been separated into the following:
  - ‘Isolated paddock remnants – terrestrial’ comprising 2.76 ha (1.85% of the zone of influence)
  - ‘Isolated paddock remnants – wetland’ comprising 1.37 ha (0.92% of the zone of influence).

Although the ‘paddock dams’ and ‘cleared / disturbed’ habitat types may occasionally be used by some of the conservation significant fauna species, such as the rakali, they are not considered significant fauna habitat and have not been included in the impact assessment.

A preliminary risk assessment of proposed groundwater abstraction on groundwater dependent habitat types has been undertaken based on the framework developed by Froend & Loomes (2004). This framework is based on the assumption that the greater the depth to groundwater, the lower the requirement for groundwater and the more tolerant vegetation will be to a decline in the water table. Response of Groundwater Dependent Ecosystems (GDEs) is described in further detail in Section 11 and the risk categories are described in Table 38.

**Table 38: Risk of impact level and magnitude of permissible change for phreatophytic vegetation**

Phreatophytic category	Low	Moderate	High	Severe
0–3 m (wetland)	0 m–0.25 m	0.25 m–0.5 m	0.5 m–0.75 m	>0.75 m
0–3 m (terrestrial)	0 m–0.75 m	0.75 m–1.25 m	1.25 m–1.75 m	>1.75 m
3–6 m	0 m–1.0 m	1.0 m–1.5 m	1.5 m–2.25 m	>2.25 m
6–10 m	0 m–1.25 m	1.25 m–2.0 m	2.0 m–2.75 m	>2.75 m

From Froend & Loomes (2004).

Due to the shallow depth of groundwater within the zone of influence, fauna habitat comprises either the 0–3 m (wetland) or 0–3 m (terrestrial) phreatophytic vegetation category types (Table 39). The groundwater drawdown model provided by Water Corporation provides the magnitude of drawdown at the end of the six-month trial period, not the rate of drawdown. Therefore, the risk assessment was based on the magnitude of drawdown alone. The results of the risk assessment of the impact of groundwater drawdown on significant fauna habitat are shown in Table 39 and Figure 26.

**Table 39: Risk assessment of groundwater drawdown on significant fauna habitat**

Magnitude of drawdown (m)	Area of habitat within the 0–3 m (wetland) phreatophytic vegetation category (ha)				Area of habitat within the 0–3 m (terrestrial) phreatophytic vegetation category (ha)	
	Tall open forest	Riparian zone	Broad swampy plains	Isolated paddock remnant (riparian)	Low woodlands / woodlands	Isolated paddock remnant (terrestrial)
0	2.50	2.29	6.84	0.13	4.43	0.13
0.01	3.46	3.17	4.95	0.22	2.16	0.59
0.03	2.56	1.94	2.54	0.23	2.42	0.47
0.05	1.59	0.53	1.57	0.20	2.15	0.52
0.13	0.33	0.50	0.87	0.17	2.16	0.49
0.34	0.00	0.21	0.46	0.26	0.20	0.31
0.6	0.00	0.00	0.00	0.16	0.00	0.25
<b>Total area (ha)</b>	<b>10.44</b>	<b>8.63</b>	<b>17.22</b>	<b>1.37</b>	<b>13.51</b>	<b>2.76</b>
% of zone of influence	6.98%	5.78%	11.52%	0.92%	9.04%	1.85%

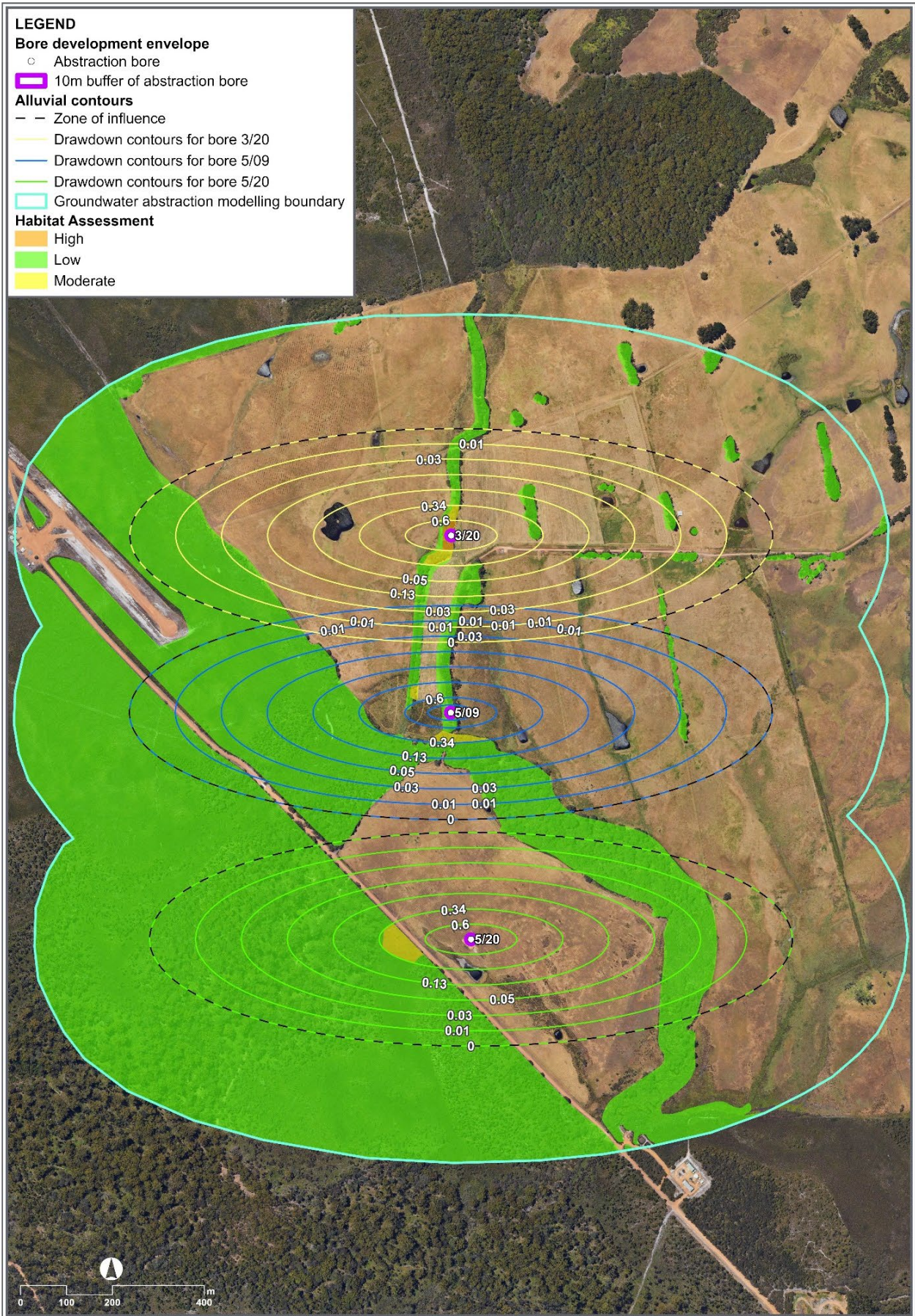


Figure 26: Risk impacts assessment of groundwater drawdown on significant fauna habitat

No severe risk of impacts to fauna habitat were identified. The potential for moderate or high risk of impacts to fauna habitat are summarised below:

- Moderate risk of groundwater drawdown impacts to 0.21 ha of riparian zone habitat
- Moderate risk of groundwater drawdown impacts to 0.46 ha of broad swampy plains habitat
- Moderate risk of groundwater drawdown impacts to 0.26 ha and high risk of impacts to 0.16 ha of isolated paddock remnant (riparian).

Froend (2005) details the possible response of phreatophytic vegetation within the risk categories outlined in Table 38. However, many of these changes would only be expected in association with long-term changes in water regimes and are not anticipated as a result of this proposal for a six-month trial. Froend (2005) states that changes in vegetation composition due to decreases in a water regime may be reversed after a short period of time (less than three years) through alleviating water stress on existing populations or allowing recolonisation of a species. Significant changes in species distribution or community structure that have occurred over several years can be reversed (although the character of the vegetation will not be identical) over an equivalent period of time. As such, only responses that may be expected from groundwater drawdown over a short time frame have been addressed in this report.

Assessments of vegetation susceptibility and possible responses to groundwater drawdown undertaken by Froend (2005) have been undertaken over several years and it is considered unlikely that vegetation response to groundwater drawdown within a six-month period will be identifiable or measurable. Based on assessments undertaken by Froend, the possible response of phreatophytic vegetation associated with the habitat types within the moderate or high-risk categories are summarised below:

- Moderate risk of groundwater drawdown impacts may result in the following possible responses:
  - Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying
  - Some mortality of individuals may occur. However, considering the temporary nature of the groundwater drawdown, this is considered unlikely
  - Some evidence of reduced growth, loss of height and loss of vigour
- High risk of groundwater drawdown impacts may result in the following possible responses:
  - Measurable reduction in rates of primary production in response to drying
  - Mortalities, potentially resulting in greater than 15% reduction in abundance of dominant species
  - Measurable crown dieback in overstorey species and/or reduction in cover of understorey
  - Measurable reductions in height due to loss of canopy and/or reduced diameter of adult stems.

As discussed previously, these impacts are unlikely to be observed over a six-month period. However, there may be a potential lag between the groundwater drawdown and vegetation response, resulting in impacts to vegetation after the trial. Groundwater monitoring during and after the trial will be undertaken and if threshold levels are exceeded, contingency vegetation monitoring will be undertaken.

An assessment of the moderate and high risk of impacts in regard to significant fauna recorded during the fauna surveys, or those that are considered likely to have critical or significant habitat present within the zone of influence are summarised in Table 40.

**Table 40: Summary of potential impacts to habitat suitable for significant terrestrial fauna species**

Species	Potentially suitable habitat	Summary of groundwater drawdown impacts on habitat
Black cockatoo species (Baudin's cockatoo, Carnaby's cockatoo and forest red-tail black-cockatoo)	<ul style="list-style-type: none"> <li>'Tall open forest'</li> <li>'Riparian zone'</li> <li>'Low woodlands / woodlands'</li> <li>'Broad swampy plains'</li> <li>'Isolated paddock remnant – riparian'</li> <li>'Isolated paddock remnant – terrestrial'</li> </ul>	<ul style="list-style-type: none"> <li>The majority of potential black cockatoo fauna habitat (53.28 ha; 98.78% of the overall area of black cockatoo habitat within the zone of influence) is within the low-risk category. <ul style="list-style-type: none"> <li>A targeted survey of this habitat area identified the following potential breeding trees. Research indicates that root systems of Eucalypt species may extend and extract water at depth varying between 5.6 m and 20 m (Knight, 1999), indicating that impacts to these trees as a result of the modelled groundwater drawdown are unlikely: <ol style="list-style-type: none"> <li>Three potential breeding trees (two <i>Eucalyptus diversicolor</i> and one <i>Corymbia calophylla</i>) with hollows.</li> <li>Three potential breeding trees (<i>Eucalyptus diversicolor</i>) without hollows</li> </ol> </li> </ul> </li> <li>Potential habitat with a moderate risk of impacts from the modelled groundwater drawdown is summarised below: <ul style="list-style-type: none"> <li>0.46 ha of potential foraging habitat (0.85% of the overall area of black cockatoo habitat within the zone of influence) associated with the broad swampy plains habitat type.</li> <li>0.47 ha of potential black cockatoo foraging habitat (0.87% of the overall area of black cockatoo habitat within the zone of influence) associated with the riparian zone habitat type.</li> <li>A targeted search of this area did not identify any potential breeding trees.</li> </ul> </li> <li>0.16 ha (0.29% of the overall area of black cockatoo habitat within the zone of influence) associated with the riparian paddock remnants has a high risk of impact from the groundwater drawdown. <ul style="list-style-type: none"> <li>A targeted survey of this habitat area identified three Potential breeding trees (<i>Eucalyptus diversicolor</i>) with hollows. Research indicates that root systems of Eucalypt species may extend and extract water at depth varying between 5.6 m and 20 m (Knight, 1999), indicating that, although within the area of high risk, impacts to these trees as a result of the modelled groundwater drawdown are unlikely.</li> </ul> </li> <li>There is no potential black cockatoo habitat with a severe risk of impact from the modelled groundwater drawdown.</li> </ul>
Wambenger brush-tailed phascogale	<ul style="list-style-type: none"> <li>'Tall open forest'</li> <li>'Low woodlands / woodlands'</li> </ul>	<ul style="list-style-type: none"> <li>All of the potential fauna habitat for the wambenger brush-tailed phascogale (23.95 ha; 100% of the overall area of potential habitat within the zone of influence) is within the low-risk category.</li> <li>There is no potential habitat with a moderate, high or severe risk of impact from the modelled groundwater drawdown.</li> </ul>
Peregrine falcon	Vegetation within the zone of influence is not considered significant habitat for this species, although they may occasionally forage in the area. Therefore, this species was not included in the risk impact assessment.	
Quokka Quenda	<ul style="list-style-type: none"> <li>'Tall open forest'</li> <li>'Riparian zone'</li> <li>'Low woodlands / woodlands'</li> <li>'Broad swampy plains'</li> </ul>	<ul style="list-style-type: none"> <li>The majority of potential habitat for the quokka and quenda (49.14 ha; 98.67% of the overall area of potential habitat within the zone of influence) is within the low-risk category.</li> <li>Potential habitat with a moderate risk of impacts from the modelled groundwater drawdown comprises 0.66 ha (1.33% of the overall area of potential habitat within the zone of influence).</li> <li>There is no potential habitat with a high or severe risk of impact from the modelled groundwater drawdown.</li> </ul>
Nornalup frog	<ul style="list-style-type: none"> <li>'Tall open forest'</li> <li>'Riparian zone'</li> <li>'Broad swampy plains'</li> </ul>	<ul style="list-style-type: none"> <li>The majority of potential habitat for the Nornalup frog (35.63 ha; 98.17% of the overall area of potential habitat within the zone of influence) is within the low-risk category.</li> <li>Potential habitat with a moderate risk of impacts from the modelled groundwater drawdown comprises 0.66 ha (1.83% of the overall area of potential habitat within the zone of influence).</li> <li>There is no potential habitat with a high or severe risk of impact from the modelled groundwater drawdown.</li> </ul>
Sunset frog	<ul style="list-style-type: none"> <li>Broad swampy plains (SF)</li> </ul>	<ul style="list-style-type: none"> <li>3.36 ha of potential habitat is located within the zone of influence. All of this habitat is located within the low-risk category.</li> </ul>
Rakali	<ul style="list-style-type: none"> <li>'Riparian zone'</li> <li>'Broad swampy plains'</li> <li>'Isolated paddock remnant - riparian'</li> </ul>	<ul style="list-style-type: none"> <li>The majority of potential rakali habitat (26.15 ha; 96.03% of the overall area of potential habitat within the zone of influence) is within the low-risk category.</li> <li>Potential habitat with a moderate risk of impacts comprises broad swampy plains, riparian zones and isolated paddock remnant – riparian and encompasses approximately 0.92 ha (3.4% of the overall area of potential habitat).</li> <li>0.16 ha (0.57% of the overall area of potential habitat within the zone of influence) associated with the riparian paddock remnants has a high risk of impact from the groundwater drawdown.</li> <li>There is no potential Rakali habitat with a severe risk of impact from the modelled groundwater drawdown.</li> </ul>
Western false pipistrelle	<ul style="list-style-type: none"> <li>'Tall open forest'</li> <li>'Riparian zone'</li> <li>'Low woodlands / woodlands'</li> </ul>	<ul style="list-style-type: none"> <li>The majority of potential western false pipistrelle habitat (32.38 ha; 99.37% of the overall area of potential habitat within the zone of influence) is within the low-risk category.</li> <li>Potential habitat with a moderate risk of impacts from the modelled groundwater drawdown comprises 0.21 ha (0.63% of the overall area of potential habitat within the zone of influence).</li> </ul>

The GDEMP for the proposal has been prepared to manage and minimise impacts to GDEs, flora and vegetation values and fauna habitat from indirect impacts associated with groundwater drawdown. The GDEMP is provided in Appendix B.

Water Corporation will prepare and submit a Groundwater Dependent Ecosystems Performance Report one year after completion of the trial which will include:

- An assessment of monitoring results against trigger criteria and threshold criteria
- Detail the results from any contingency vegetation monitoring, as outlined in the GDEMP (RPS, 2023b) (if required)
- Detail any impacts to known GDEs related to significant species habitat where trigger threshold criteria have been exceeded
- Provide an analysis of changes to vegetation health, particularly noting deleterious changes to health
- Detail any changes to groundwater pH in proximal locations to GDEs.

### 10.5.1.4 Groundwater drawdown impacts to SRE fauna habitat

Phoenix Environmental Sciences (2023d) identified that the following habitats have a high potential to support SRE taxa:

- ‘Tall open forest’, which comprises 10.44 ha (6.98%) of the zone of influence
- ‘Riparian zone’, which comprises 8.63 ha (5.78%) of the zone of influence
- ‘Low woodlands / woodlands’, which comprises 13.51 ha (9.04%) of the zone of influence.

The preliminary risk assessment outlined in Section 10.5.1.3 identified that the majority of suitable SRE habitat within the zone of influence has a low risk of being impacted by the predicted groundwater drawdown. With only 0.21 ha of riparian zone habitat identified as having a moderate impact of potentially being impacted by the modelled groundwater drawdown. Phoenix Environmental Sciences (2023d) concluded that impacts to 0.21 ha of SRE habitat from the proposal is considered unlikely to be significant because:

- Suitable SRE habitat types located within the zone of influence also exist in the wider region. Therefore, habitat within the zone of influence is not likely to represent restricted populations (Phoenix Environmental, 2023d).
- 0.21 ha of riparian zone habitat identified as having a moderate impact comprises 2.4% of the riparian zone habitat within the zone of influence. The remaining 8.42 ha is unlikely to be impacted by the proposal.

**Table 41: Risk assessment of groundwater drawdown on SRE habitat**

Magnitude of drawdown (m)	Area of habitat within the 0–3 m (wetland) phreatophytic vegetation category (ha)		Area of habitat within the 0–3 m (terrestrial) phreatophytic vegetation category (ha)
	Tall open forest	Riparian zone	Low woodlands / woodlands
0	2.50	2.29	4.43
0.01	3.46	3.17	2.16
0.03	2.56	1.94	2.42
0.05	1.59	0.53	2.15
0.13	0.33	0.50	2.16
0.34	0.00	0.21	0.20
0.6	0.00	0.00	0.00
<b>Total area (ha)</b>	<b>10.44</b>	<b>8.63</b>	<b>13.51</b>
% of zone of influence	6.98%	5.78%	9.04%

### 10.5.1.5 Alteration of groundwater levels potentially impacting aquatic fauna habitat

The ecological water requirements and groundwater-surface water interactions of the Walpole River are currently not well understood due to the lack of data. Monitoring data from the trial may provide the information required to further understand the baseflow of the Walpole River and associated groundwater-surface water interactions.

Due to the current lack of understanding regarding groundwater – surface water interactions, RPS has taken a conservative approach and have assumed that the Walpole River receives some groundwater baseflow. A discussion of potential impacts from reduction in baseflows is provided in the sections below.

#### 10.5.1.5.1 Changes to water quality

Studies on other rivers in the south-west of Western Australia identifies that groundwater discharge into the rivers supplies freshwater to the normally brackish riverine environment, allowing native freshwater fish species to use those parts of the river in summer (Department of Water, 2006). Therefore, if the Walpole River does receive groundwater baseflows, there is the potential for the reduction in these groundwater base flows to alter the water quality of the Walpole River and therefore potentially impacting aquatic habitat.

Changes to water quality may include potential increased electrical conductivity (salinity) from evapoconcentration in receding waters, and potential decreased dissolved oxygen levels with declines in surface water flow.

Changes to water quality resulting from the exposure of potential acid sulfate soils are discussed in Section 9.5.1.1.

#### 10.5.1.5.2 Changes in water levels and stream flow

The structure and function of riverine and wetland ecosystems are determined by patterns of temporal variation in water availability. Unseasonal drying, or reduced flows in rivers or creeks may impact species that are adapted to the current hydrological regime (Department of the Environment and Energy, 2016). Potential impacts to aquatic fauna habitats resulting from the proposed groundwater drawdown from the trial includes:

- Reduced water levels or desiccation of groundwater-dependent semi-permanent/permanent refugia pools within the Walpole River, particularly over the dry summer months
- A reduction or cessation of seasonal surface flows within the Walpole River. However, as surface water flows within the Walpole River cease during the summer months (DWER, 2020), implementation of the trial will not result in impacts to surface water flows during these periods of no flow.

Species of conservation significance that are known to occur within the aquatic habitats of the zone of influence that may be impacted by potential changes in water levels and streamflow include the western mud minnow, Balston's pygmy perch, blackstriped dwarf galaxias, little pygmy perch, salamander fish, Carter's freshwater mussel, pouched lamprey and the Walpole burrowing crayfish.

The Walpole Weir is located outside (south-east of) the zone of influence. Due to the impounding impacts of the Walpole Weir, the water levels upstream and within the zone of influence are no longer representative of the original hydrology.

#### 10.5.1.5.3 Exposure of acid sulfate soils

Impacts to soils, groundwater and surface water from exposure of potential acid sulfate soils is discussed in Section 9.5.

### 10.5.1.6 Disturbance to fauna from generator noise emissions

There is potential for noise emissions from operation of the generators result in disturbance responses in individual animals in adjacent areas. Species using audible cues for breeding activity may also experience disruption to breeding cycles or reduced breeding success. To reduce these impacts, Water Corporation is proposing to install a soundproof canopy enclosure around the generators. With the acoustic enclosure installed, noise emissions at 1m from the generators will be approximately 80 dB(A).

The generator supplying bores 3/20 and 5/09 is located within cleared pasture, adjacent to paddock remnant habitat and approximately 380 m from the broad swampy plain fauna habitat type. As the generator is located 380 m from significant fauna habitat, impacts to fauna from this generator are considered unlikely to be significant.

The generator that supplies bore 5/20 is located in cleared areas adjacent to Plain Road. Therefore, although some fauna within a small area of the broad swampy plain and low woodland / woodland habitat types may be impacted by noise emissions. These areas are may already be disturbed by minor road noise and therefore impacts to fauna from the additional noise from the generators are considered unlikely to be significant.

### 10.6 Mitigation

Table 42 demonstrates how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied to the environmental factor of Terrestrial Fauna to address the key potential impacts.

**Table 42: Application of mitigation hierarchy to Terrestrial Fauna**

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
Introduction and/or distribution of weeds, pests and diseases	Indirect	Avoid	<ul style="list-style-type: none"> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with the bores will not be undertaken in or adjacent to native vegetation comprising significant fauna habitat and the proposal will not result in the introduction of weeds or disease to areas of fauna habitat.</li> </ul>	No residual impacts
		Minimise	<ul style="list-style-type: none"> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with operation of the bores will not be undertaken in or adjacent to fauna habitat and the proposal will not result in the introduction of weeds or disease to areas of fauna habitat. No further management is considered necessary.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N/A</li> </ul>	
Disturbance to surrounding fauna habitat	Indirect	Avoid	<ul style="list-style-type: none"> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with the bores will not be undertaken in or adjacent to native vegetation comprising significant fauna habitat and the proposal will not result in indirect disturbance of fauna habitat.</li> </ul>	No residual impacts
		Minimise	<ul style="list-style-type: none"> <li>The bores are located within cleared agricultural areas. Therefore, any monitoring or maintenance work associated with operation of the bores will not be undertaken in or adjacent to fauna habitat and the proposal will not result in indirect disturbance to surrounding habitat. No further management is considered necessary.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N / A</li> </ul>	
Groundwater drawdown impacts to terrestrial fauna habitat which supports significant fauna species	Indirect	Avoid	<ul style="list-style-type: none"> <li>The complete avoidance of indirect impacts to terrestrial fauna habitat from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b) and the WIMP (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and trigger values and manage risk to the environment and ecosystems. The data obtained during the trial will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	1.08 ha (0.72% of the zone of influence) of potential fauna habitat has a medium or high risk of being temporarily impacted by the modelled groundwater drawdown.
		Minimise	<ul style="list-style-type: none"> <li>Groundwater drawdown impacts are minimised through strategic placement of the abstraction bores within cleared agricultural areas, resulting in 95.49 ha (63.9%) of the zone of influence comprising cleared areas with no value as fauna habitat.</li> <li>RPS undertook a risk assessment of proposed groundwater abstraction on the fauna habitat within the zone of influence based on the framework developed by Froend &amp; Loomes (2004) as described in Section 10.5.1.3 and shown in Figure 26. A summary of the risk assessment is provided below:                             <ul style="list-style-type: none"> <li>52.86 ha (35.37%) of fauna habitat has been assessed as having a low risk of being impacted by the predicted groundwater drawdown and impacts to this fauna habitat from groundwater drawdown are considered unlikely.</li> <li>0.92 ha (0.62% of the zone of influence) has a medium risk of being impacted by the modelled groundwater drawdown.</li> <li>0.16 ha (0.1% of the zone of influence has a high risk of being impacted).</li> </ul> </li> <li>Assessments of vegetation susceptibility and possible responses to groundwater drawdown undertaken by Froend (2005) indicate that it is unlikely that vegetation response to groundwater drawdown within a six-month period will be identifiable or measurable. Based on assessments undertaken by Froend, the possible response of phreatophytic vegetation associated with the habitat types within the moderate or high-risk categories are summarised below, however due to the lag in responses of vegetation to groundwater drawdown, these may occur after the trial is complete:                             <ul style="list-style-type: none"> <li>Moderate risk of groundwater drawdown impacts may result in the following possible responses:                                     <ol style="list-style-type: none"> <li>Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying</li> <li>Some mortality of individuals may occur. However, considering the temporary nature of the groundwater drawdown, this is considered unlikely</li> <li>Some evidence of reduced growth, loss of height and loss of vigour.</li> </ol> </li> <li>High risk of groundwater drawdown impacts may result in the following possible responses:                                     <ol style="list-style-type: none"> <li>Measurable reduction in rates of primary production in response to drying</li> <li>Mortalities, potentially resulting in greater than 15% reduction in abundance of dominant species</li> <li>Measurable crown dieback in overstorey species and/or reduction in cover of understorey</li> <li>Measurable reductions in height due to loss of canopy and/or reduced diameter of adult stems.</li> </ol> </li> </ul> </li> <li>A GDEMP (RPS, 2023b) has been prepared to minimise indirect impacts to groundwater dependent vegetation comprising fauna habitat from groundwater drawdown. The GDEMP (RPS, 2023b) is provided in Appendix B of this report and includes trigger values to ensure impacts to fauna habitat are consistent with the EPA objective for terrestrial fauna (EPA, 2016f). These trigger values are discussed in the avoidance section of this table. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:                             <ul style="list-style-type: none"> <li>If the early response groundwater level trigger criterion is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the groundwater level trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>If the groundwater level threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore. Contingency vegetation monitoring will also be undertaken in accordance with the GDEMP.</li> <li>If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> <li>Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year of the trial completion that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N / A</li> </ul>	



Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
Alteration of groundwater levels potentially impacting aquatic fauna habitat through impacts to water quality	Indirect	Avoid	<ul style="list-style-type: none"> <li>The complete avoidance of indirect impacts to water quality and aquatic fauna habitat from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b) and the WIMP (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Trigger criterion for water quality within the Walpole River; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events.</li> <li>Threshold criterion for water quality within the Walpole River; an exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event.</li> </ul> </li> </ul>	Implementation of the GDEMP (RPS, 2023b), ASS detailed site assessment (RPS, 2023c) and WIMP (Water Corporation, 2023a) will ensure there are no residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels, flow and quality. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to aquatic fauna habitat within the upper Walpole River are consistent with the EPA objective for terrestrial fauna (EPA, 2016f). These trigger values are discussed in the avoidance section of this table. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:                             <ul style="list-style-type: none"> <li>If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> </ul> </li> <li>Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year of the trial completion that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N / A</li> </ul>	
Alteration of groundwater levels potentially impacting aquatic fauna habitat through resulting in changes to water levels and stream flow	Indirect	Avoid	<ul style="list-style-type: none"> <li>The complete avoidance of indirect impacts to surface water levels and flows within the Walpole River from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria summarised below will be achieved through implementation of the GDEMP (RPS, 2023b) and the WIMP (Water Corporation, 2023a):                             <ul style="list-style-type: none"> <li>Trigger criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.30 m below the minimum baseline levels.</li> <li>Threshold criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.35 m below the minimum baseline levels.</li> <li>Trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir); Surface water flows exceed 63 consecutive days of no flow over the Walpole River Weir.</li> <li>Threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir); surface water flows exceed 85 consecutive days of no flow over Walpole River Weir.</li> </ul> </li> </ul>	Implementation of the GDEMP (RPS, 2023b), ASS detailed site assessment (RPS, 2023c) and WIMP (Water Corporation, 2023a) will ensure there are no residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels and flow. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to aquatic fauna habitat within the upper Walpole River are consistent with the EPA objective for terrestrial fauna (EPA, 2016f). These trigger values are discussed in the avoidance section of this table. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:                             <ul style="list-style-type: none"> <li>If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>If the threshold criterion for surface water levels is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. This data will be reviewed as well as an assessment of climatic data and surface water flows to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>If the trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. Water Corporation will also review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water flows declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>If the threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> </ul> </li> <li>Water Corporation will prepare and submit to DWER a Groundwater Dependent Ecosystems Performance Report within one year of the trial completion that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N / A</li> </ul>	
Disturbance to fauna from generator noise emissions	Indirect	Avoid	<ul style="list-style-type: none"> <li>The generator supplying bores 3/20 and 5/09 has been located in a cleared area approximately 380m, away from significant fauna habitat. As it has been located away from fauna habitat, noise impacts to fauna from this generator have been avoided.</li> </ul>	No residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>Water Corporation is proposing to install a soundproof canopy enclosure around both generators. With the acoustic enclosure installed, noise emissions at 1 m from the generators will be approximately 80dB(A).</li> <li>The generator that supplies bore 5/20 is located in a cleared area adjacent to Plain Road. There is potential for some fauna within the broad swampy plain and low woodland / woodland habitat types on the other side of Plain Road to be impacted by noise emissions. However, as these habitat areas are already disturbed by road noise, impacts to fauna are not considered likely to be significant.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N/A</li> </ul>	

## 10.7 Assessment and significance of residual impacts

Potential fauna habitat comprising 1.08 ha (0.72% of the zone of influence), has a medium or high risk of being temporarily impacted by the modelled groundwater drawdown, as summarised below:

- Moderate risk of groundwater drawdown impacts to 0.21 ha of riparian zone habitat
- Moderate risk of groundwater drawdown impacts to 0.46 ha of broad swampy plains habitat
- Moderate risk of groundwater drawdown impacts to 0.26 ha and high risk of impacts to 0.16 ha of isolated paddock remnant (riparian).

Research undertaken by Froend (2005) indicates that changes in vegetation composition due to groundwater drawdown are unlikely to occur over the short period of time the trial is proposed and that any changes in composition can be reversed after a short period of time (less than three years). Therefore, no significant changes to habitat types or reduction in habitat areas are anticipated as a result of the modelled drawdown over the six-month period.

Changes that may occur within the 1.08 ha area includes a temporary reduction in flowering or seed production, some evidence of reduced growth and vigour and some mortality of individual plants, although mortalities are considered unlikely as discussed in Section 10.5.1.3. Due to a potential lag in the responses of vegetation to groundwater drawdown, these impacts may not be apparent until after the trial is complete.

## 10.8 Environmental outcomes

The following key environmental outcomes are proposed to ensure that the EPA's terrestrial fauna objective (EPA, 2016f) will be achieved:

- No fauna habitat will be cleared or directly impacted by the proposal
- Potential fauna habitat at risk from groundwater drawdown comprises 1.08 ha (0.72% of the zone of influence). The remainder of the zone of influence has been assessed as having a low risk of being impacted by the predicted groundwater drawdown
- The GDEMP (RPS, 2023b) will be implemented to ensure that:
  - The risk of impacts to habitat outside the 1.08 ha of fauna habitat (comprising habitat suitable for SRE fauna and conservation significant terrestrial fauna, including Baudin's cockatoo, Carnaby's cockatoo and forest red-tail black-cockatoo, quokka, quenda, Nornalup frog, rakali, western false pipistrelle) with a medium or high risk of impacts from groundwater drawdown is minimised, as summarised below. The GDEMP will outline trigger and threshold criteria that will provide an early warning to ensure that impacts greater than this are avoided
  - Surface water levels, flows and quality within the Walpole River do not exceed the trigger thresholds outlined in the GDEMP and discussed in this table. The trigger and threshold criteria and response actions demonstrate that impacts to aquatic habitat within the upper Walpole River can be avoided or minimised
- Groundwater and surface water monitoring will be undertaken in accordance with the following documents to determine whether trigger and threshold criteria have been exceeded:
  - GDEMP (RPS, 2023b) provided in Appendix B
  - ASS detailed site assessment (RPS, 2023c) provided in Appendix D
  - Walpole Implementation and Monitoring Plan (WIMP) (Water Corporation, 2023a) provided in Appendix E
- In the event that groundwater and surface water monitoring undertaken in accordance with the above documents indicates an exceedance of the trigger or threshold criteria, Water Corporation will:
  - Report the exceedance to DWER
  - implement the appropriate response actions outlined in the GDEMP
  - Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.

The environmental outcomes above are consistent with the EPA objective for Terrestrial fauna (EPA, 2016f), and thereby not significant, as they protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

## 11 INLAND WATERS

### 11.1 EPA objective

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected (EPA, 2018a).

### 11.2 Policy and guidance

- Environmental Factor Guideline: Inland Waters (EPA 2018b)
- Water quality protection note 65 - Toxic and hazardous substances (Department of Water, 2015)
- Water quality protection note 10 - Contaminant spills - emergency response plan (DWER, 2020)
- Water quality protection note 25 - Land use compatibility tables for public drinking water source areas (DWER, 2021)
- Water quality protection note 56 - Tanks for fuel and chemical storage near sensitive water resources (DWER, 2018)
- Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (Department of Environment Regulation, 2015a)
- Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (Department of Environment Regulation, 2015b).

### 11.3 Environmental investigation

The fundamental consideration for this impact assessment is whether groundwater abstraction might impact groundwater, surface hydrology, Groundwater Dependent Ecosystems (GDEs) and other beneficial users of groundwater. The investigations outlined in Sections 11.3.1 to 11.3.3 have been undertaken to identify any potential impacts on inland waters.

#### 11.3.1 Surface water investigations

Surface water monitoring was undertaken by RPS at eight sampling locations (Figure 27) in February 2023. Further monitoring events will be completed at future dates to assess surface water quality across a range of seasonal conditions.

#### 11.3.2 Groundwater investigations

RPS completed an investigation to determine the nature and extent of ASS within the study area, in addition to determining the existing groundwater and surface water quality. The following scope of work has been completed to date:

- Installation of 19 shallow monitoring wells to complement the existing network to a depth that extended to a minimum of 1 m below the modelled drawdown extent provided by Water Corporation
- The groundwater bores were surveyed for location and elevation data to enable accurate drawdown monitoring during any abstraction trials, and groundwater loggers were installed
- Soil samples were collected during the groundwater bore installation. In addition, soils were sampled using manual techniques from five locations where access with a drill rig was not possible to ensure adequate characterisation of the soil types
- Complete three rounds of groundwater monitoring at 22 locations (three existing, 19 installed) to assess groundwater quality across a range of seasonal conditions. The first event has been completed, with further monitoring events scheduled in 2023 to obtain seasonal groundwater data prior to commencement of the trial.

As the groundwater monitoring program being undertaken by RPS to support this proposal (the trial) and any future, ongoing groundwater extraction (depending on the trial), results from previous investigations undertaken by Coffey Environments and Global Groundwater have been used to supplement the data and support this referral.

### 11.3.2.1 Coffey Environments

Coffey Environments Pty Ltd (now Tetra Tech Coffey) was commissioned by the Water Corporation in 2010 to undertake an investigation of the potential for acid sulfate soils to occur in shallow soil (between the surface and underlying granite bedrock) at Swann Road, Walpole, and to install shallow groundwater monitoring bores to establish baseline groundwater quality and levels.

The locations of the groundwater monitoring bores (1/08 ASS, 3/08 ASS, and 6/09 ASS) are shown on Figure 28. Bores were installed on 17 and 18 December 2009 (Coffey Environments, 2010). The Coffey Environments report is provided in Appendix I.

The investigations undertaken by Coffey Environments Pty Ltd (2010) were preliminary investigations and have been used to support the data obtained by RPS as part of the ASS investigations to support this referral (RPS, 2023c).

### 11.3.2.2 Global Groundwater

Global Groundwater undertook a review of previous groundwater monitoring undertaken and undertook a round of water level monitoring and associated bore data acquisition in December 2020 to assist in establishing groundwater flow. The investigations undertaken by Global Groundwater (2020) were preliminary investigations and have been used to support the data obtained by RPS as part of the ASS investigations to support this referral (RPS, 2023c). Data obtained by Global Groundwater is provided in Appendix J.

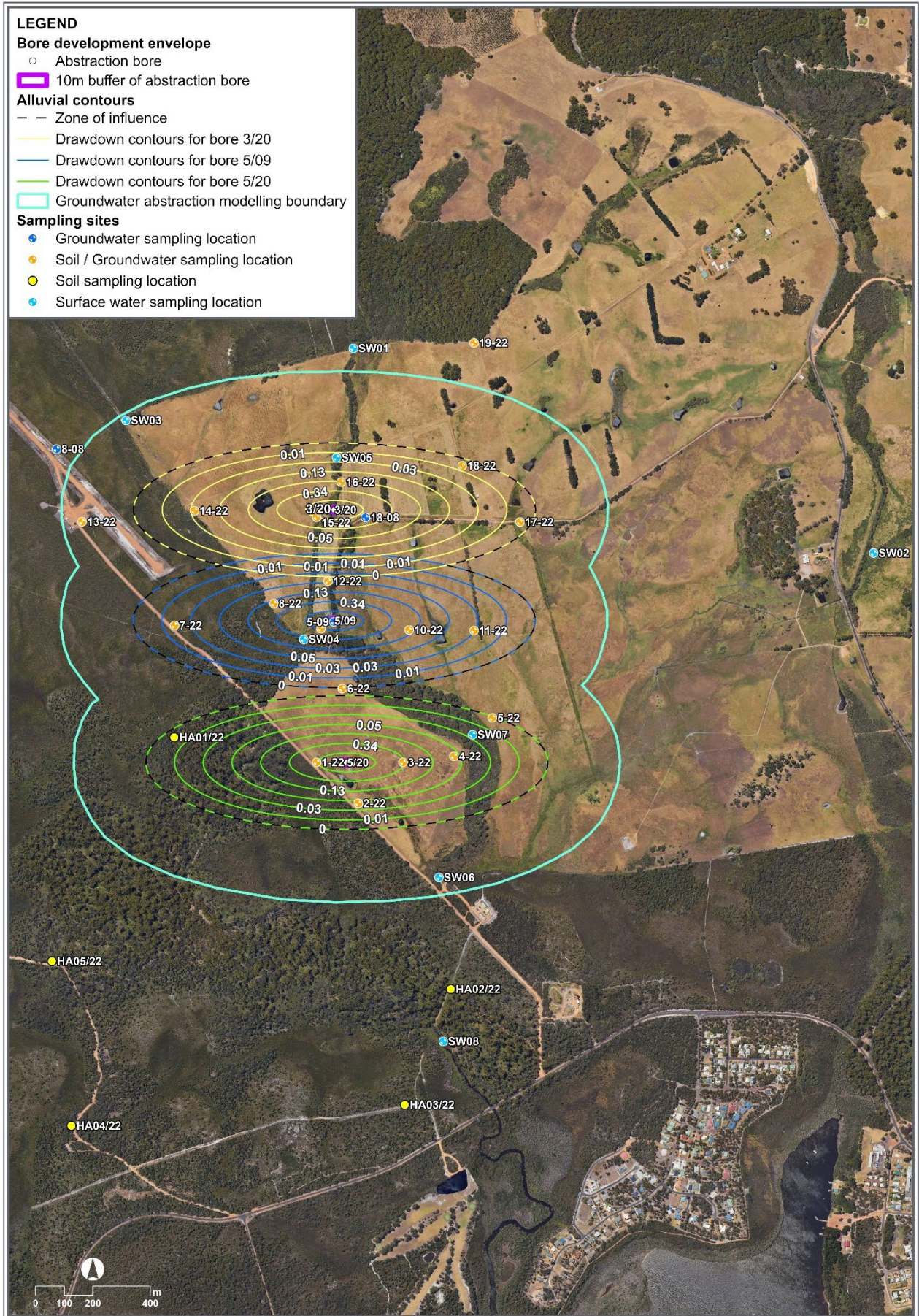


Figure 27: Surface water and groundwater monitoring locations

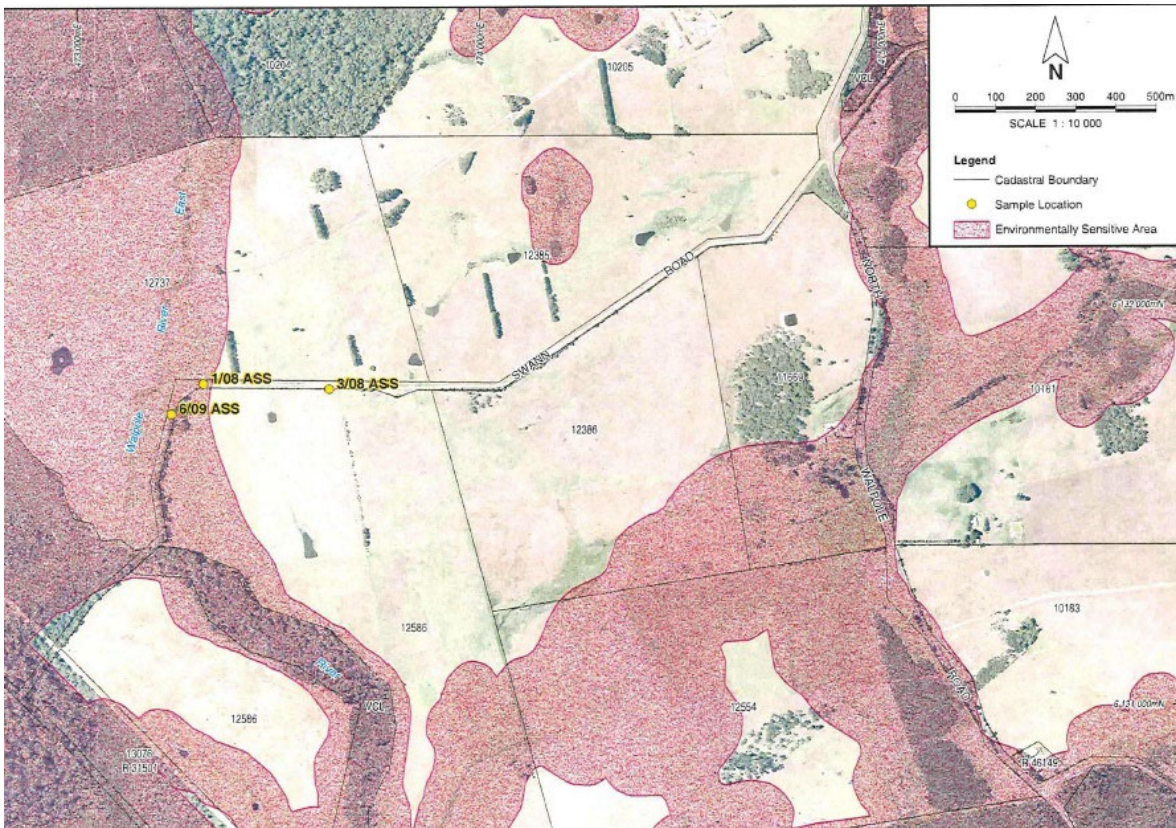


Figure 28: Coffey Environments' groundwater monitoring locations

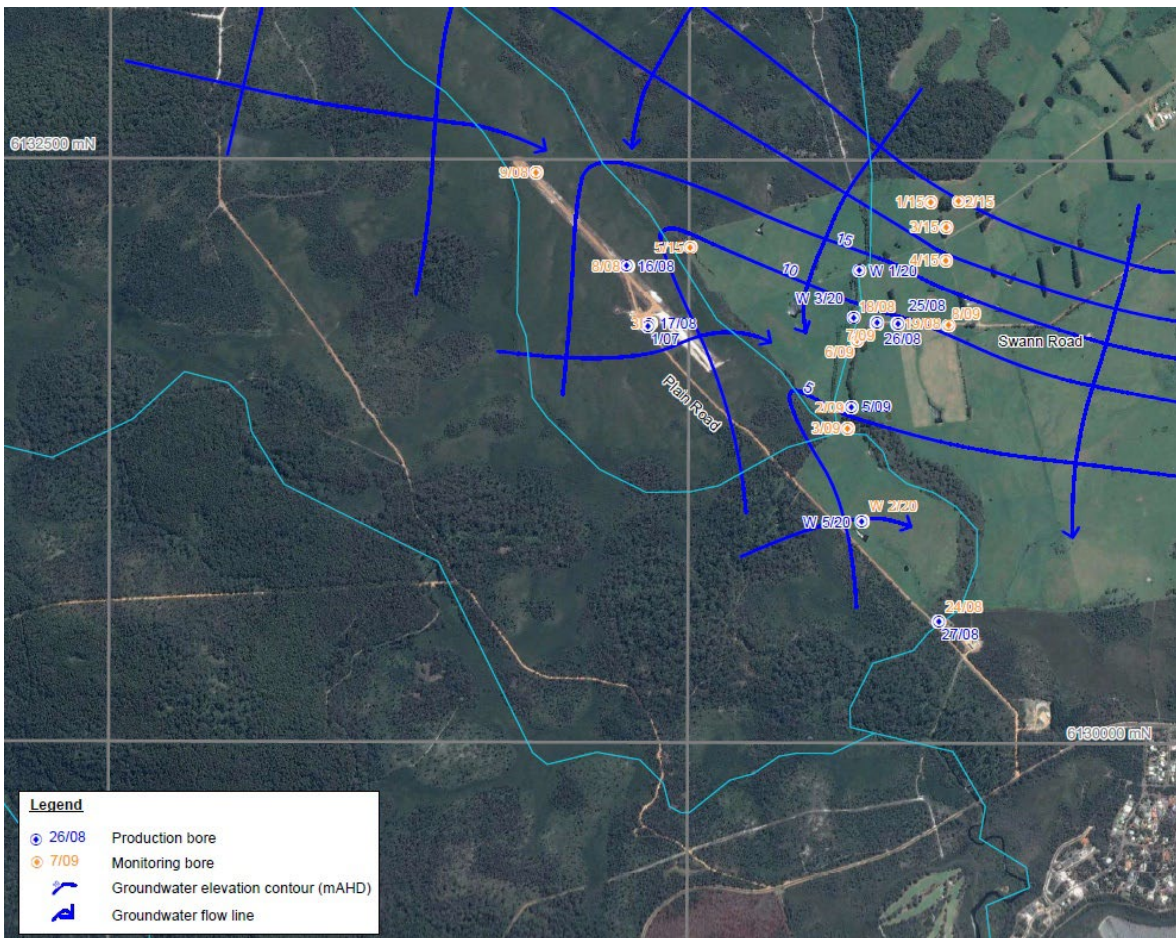


Figure 29: Global Groundwater's bore monitoring locations

### 11.3.3 Groundwater Dependent Ecosystems

A desktop study was undertaken to consider potential GDEs within the zone of influence. The desktop assessment included the following:

- A review of the results from the flora and vegetation survey to identify potential phreatophytic species and GDEs within the zone of influence
- A review of wetlands and other surface water features within the zone of influence
- Bureau of Meteorology's GDE Atlas
- An investigation into potential GDEs within the zone of influence through mapping the depth to groundwater.

## 11.4 Receiving environment

### 11.4.1 Groundwater

#### 11.4.1.1 Groundwater levels and flow

Two aquifers are present within the zone of influence; a deep aquifer and a shallow aquifer. Pump testing undertaken of bores in the area suggests that groundwater in the shallow, Superficial aquifer and groundwater in the underlying fractured granite aquifer are connected (Department of Water, 2016). However, the degree of connectivity is currently unknown, and the purpose of the proposed trial is to identify the degree of connectivity between the aquifers to then determine yield capacity as a future source.

As shown in Figure 29, groundwater in the Superficial aquifer follows topographical contours and flows towards the Walpole River, towards the south-east in the western portion of the zone of influence and towards the south-east in the eastern portion of the zone of influence.

Groundwater was identified at approximately 1.7 m below ground level (MBGL) during the groundwater sampling program undertaken by Coffey Environments on 19 January 2010.

Global Groundwater identified seasonal fluctuations in the Superficial aquifer of greater than 2.5 m, with levels in bore 8/09 (located within the northern area of the zone of influence (Figure 29)) ranging from 3.7 MBGL in May, 2020 to 1.15 MBGL in July, 2020. These seasonal fluctuations have been adopted to support this referral and will be reviewed as additional data becomes available from the groundwater monitoring program currently being undertaken by RPS. The modelled groundwater drawdown of up to 0.6 m is within this seasonal range.

Groundwater monitoring undertaken by RPS identified groundwater levels ranging from 5 m AHD and 17 m AHD as shown in Figure 30. Groundwater depths in MBGL are shown in Figure 12.

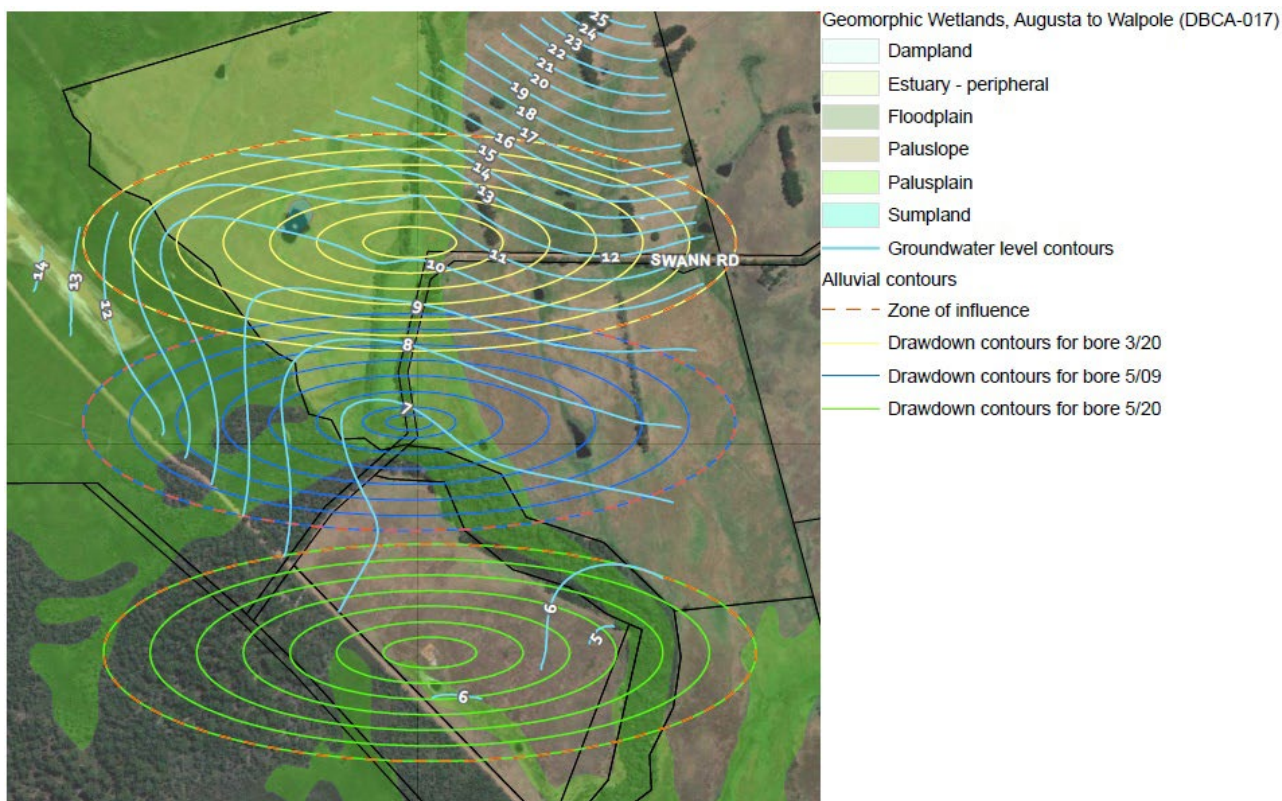


Figure 30: Groundwater contours

### 11.4.1.2 Groundwater quality

Results from groundwater sampling undertaken by RPS in November 2022 are summarised below:

- Groundwater varies from acidic to slightly acidic, ranging from pH 3.6 (bore 11/22) to 6.6 (bore 05/09), with an average pH of 5.3 across the monitoring network.
- Groundwater contains elevated levels of acidity above DWER guidance (40 mg/L CaCO<sub>3</sub> equivalents), with an average of 96 mg/L CaCO<sub>3</sub> equivalents.
- Groundwater contains low levels of alkalinity with an average of 38 mg/L CaCO<sub>3</sub> equivalents
- Sulfate:chloride ratios comply with the DWER guidance (>0.5); indicating that it is unlikely that the regional groundwater quality has been impacted from the oxidation of sulfides.
- Several bores exhibit some evidence of potential impacts from ASS, i.e. dissolved aluminium concentrations exceeding the DWER guidance (1 mg/L), and or low pH (<4), and or elevated acidity (>40 mg/L CaCO<sub>3</sub>).
- Whilst exceedances of the freshwater guidelines are observed for various parameters, concentrations of heavy metals and nutrients are generally low.

Further details on groundwater quality, including laboratory results are provided in the ASS detailed site assessment; Swann Road borefield, Walpole in Appendix D.

### 11.4.2 Surface water

#### 11.4.2.1 Wetlands

Geomorphic wetland mapping in Augusta to Walpole identified the following wetland classifications within the zone of influence (Figure 31):

- Palusplain (seasonally waterlogged flat)
- Sumpland (seasonally inundated basin).



### 11.4.2.2 Walpole River

The upper Walpole River runs through the zone of influence, eventually flowing into the Walpole Inlet and Nornalup Inlet.

The Walpole Weir (Plate 3) is located outside (south-east of) the zone of influence. Due to the impounding impacts of the Walpole Weir, the water levels upstream and within the one of influence, are no longer representative of the original hydrology.

The average annual stream flow of the Walpole River at the weir is estimated to be 19 100 ML. Supply to the weir is generated mostly from surface run-off, however groundwater seepage may influence flows during summer months.



**Plate 3: Walpole River Weir (downstream) (DWER 2020)**

#### 11.4.2.2.1 Surface water flows

Assessment of the gauged flow at the Walpole Wier collected by Water Corporation since 2012 indicates an indeterminate flow regime within the Walpole River, with surface water flows ceasing over the summer months. During the winter months (June–August), flow recorded at the Walpole Weir Gauging Station indicate that the Walpole River typically experiences its highest flow rates generally ranging from 1.019 m<sup>3</sup>/s to 2.809 m<sup>3</sup>/s as influenced by reasonably reliable rainfall and run-off from surrounding areas (Water Corporation, 2022).

Fish passage is possible throughout the assessment site. However, the Walpole Weir presents a barrier to the movement of aquatic biota (despite the presence of a fishway) during times of low to no flow (DWER 2020).

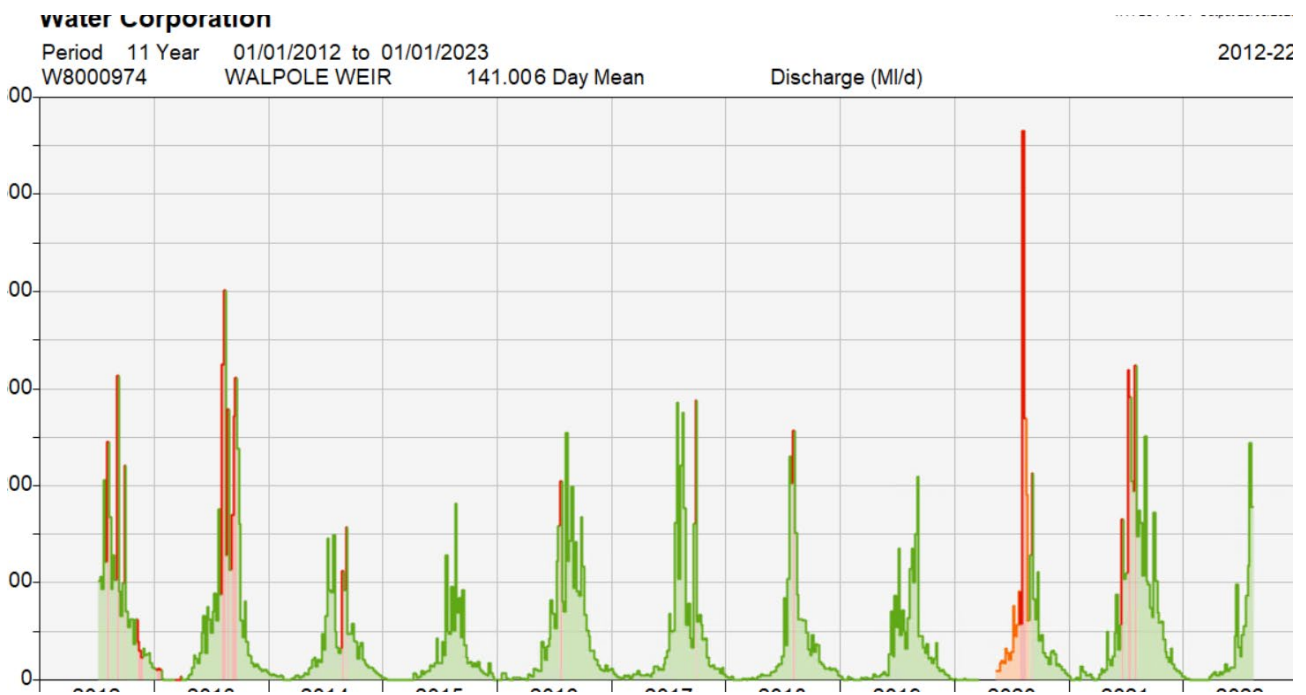
The minimum and maximum monthly flow rates, based on data obtained by Water Corporation, are shown in Table 43 and mean daily discharges are depicted in Graph 1.

**REPORT**

**Table 43: Monthly streamflow at the Walpole River Weir**

Month	Average daily stream flow (ML/D)		
	Minimum	Maximum	Mean
January	0	4.92	1.26
February	0	3.89	1.71
March	0	4.18	1.59
April	0.54	12.78	4.97
May	5.68	43.65	15.09
June	11.46	100.82	42.64
July	29.32	309.8	109.18
August	40.35	579	159.28
September	30.03	203.38	87.73
October	19.68	117.28	42.30
November	11.32	36.25	19.58
December	2.90	16.73	7.62

(Water Corporation, 2023f)



**Graph 1: Walpole River at Walpole Weir mean daily discharge (ML/D) 2012 to 2022 (red and orange indicate data of a lower quality) (Water Corporation 2023)**

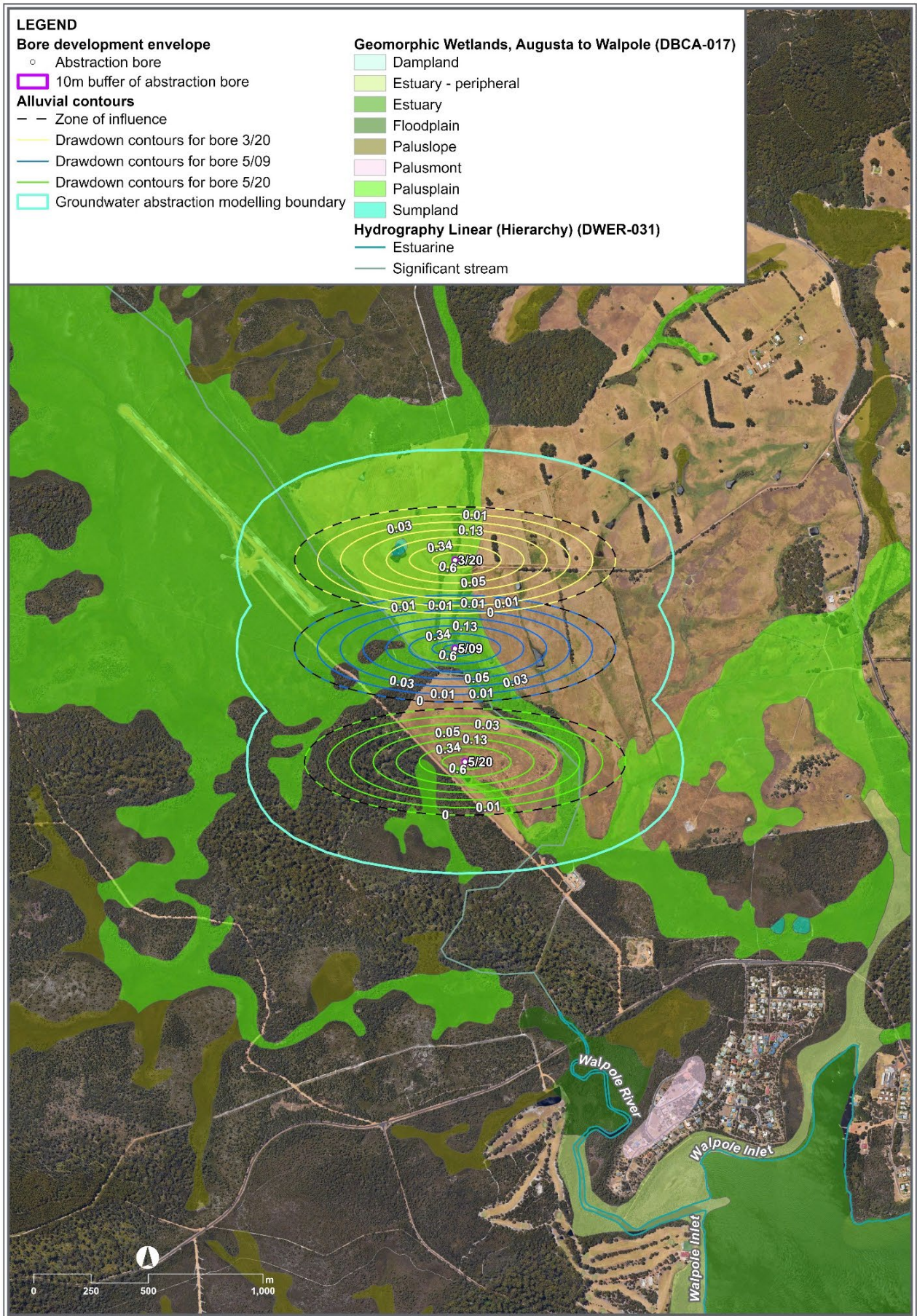


Figure 31: Surface water

### 11.4.2.2.2 Surface water quality

Results from surface water sampling undertaken by RPS in February 2023 are summarised below:

- Surface water varies from slightly acidic to neutral, ranging from pH 5.0 (SW03) to 7.8 (SW07) and an average pH of 6.5 across the monitoring network.
- Surface water contains low levels of acidity below the DWER guidance (40 mg/L CaCO<sub>3</sub> equivalents) with an average of 10 mg/L CaCO<sub>3</sub> equivalents.
- Whilst exceedances of the *Water Quality Australia, Australian and New Zealand Guidelines for Fresh and Marine Water Quality* are observed for various parameters, concentrations of heavy metals and nutrients are generally low.

Groundwater quality sampling undertaken as part of the Healthy Rivers program identified the following water quality at the surface water monitoring locations shown in Figure 32:

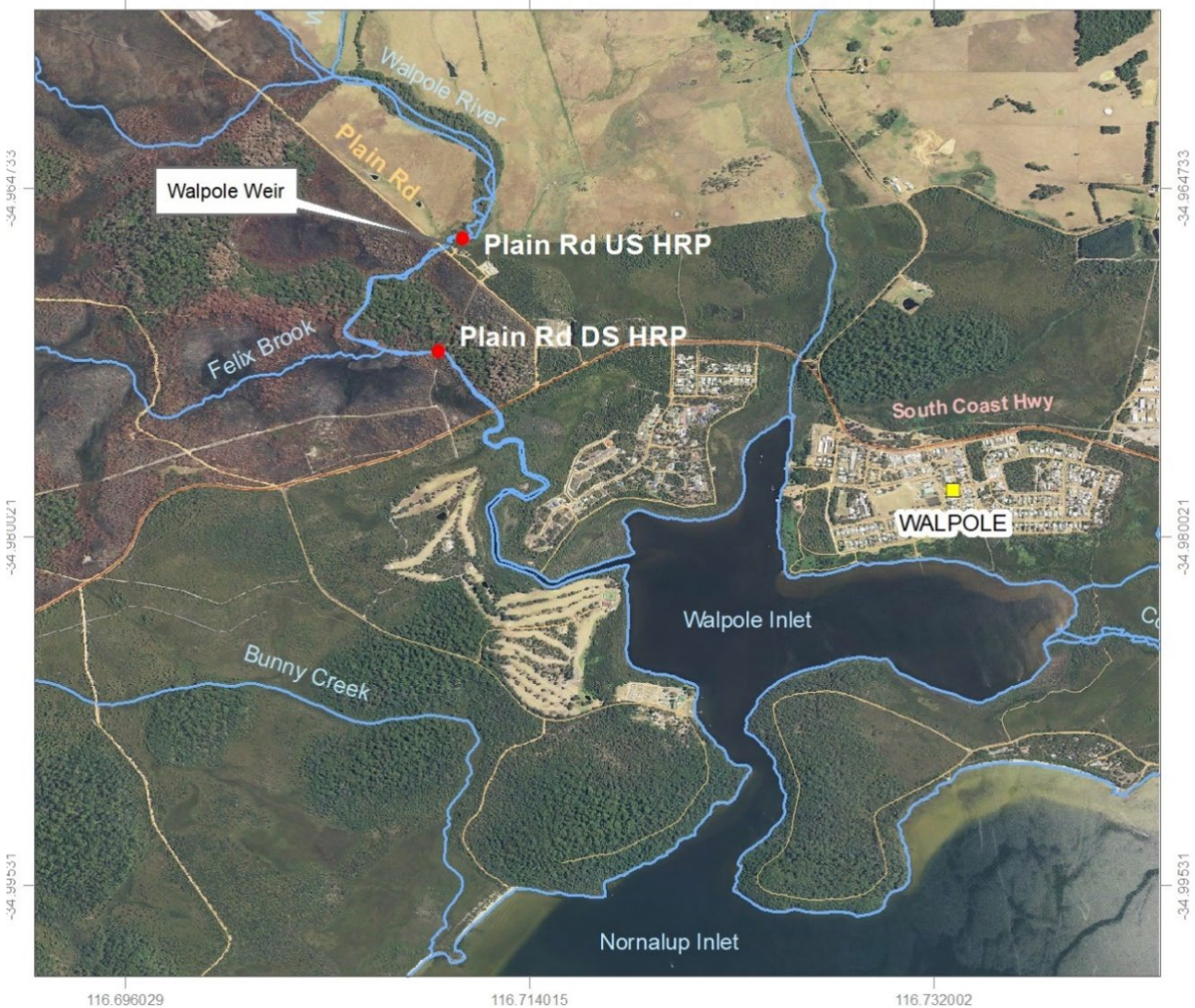
- Water quality at sampling site Plain Road US HRP:
  - The mean temperature was 18.56 (±1.11 °C SD) with a diel range of 3.18 °C
  - Salinity (TDS) was 433 (±8 mg/L SD)
  - From a single grab sample, colour (TCU) was 140 and turbidity was moderate at 9.1. Nutrients (total nitrogen and total phosphorus) exceeded the ANZECC/ARMCANZ 2000a guidelines with a high concentration of total nitrogen 1.5 mg/L and a moderate concentration of total phosphorus of 0.071 mg/L; indicative of eutrophication (DWER 2020).
- Water quality at sampling site Plain Road DS HRP:
  - The mean temperature was 20.61 (±0.86 °C SD) with a diel range of 2.32 °C.
  - pH was neutral with a mean of 6.91 (±0.01 SD)
  - Salinity (mg/L TDS) was 32610 TDS (±780 mg/L SD) due to tidal influence from the Walpole-Nornalup Inlet.
  - From the single grab sample, colour (TCU) was 36, turbidity was low at 0.7 (NTU), total nitrogen was low at 0.43 gm/L and total phosphorus was low at 0.013 mg/L (DWER 2020).

### 11.4.2.3 Surface water levels

Surface water levels for the monitoring sites shown in Figure 32 at the beginning and end of summer are summarised in Table 44.

**Table 44: Surface water levels at the Walpole River**

Date	Sampling location	Mean water level (m)
March 2020 (Department of Water and Environmental Regulation, 2020)	Plain Road US HRP	0.6 m
	Plain Road DS HRP	1.0 m
29 October to 1 November 2022 (Phoenix Environmental, 2023)	Plain Road US HRP (AQU01)	>2 m
	Plain Road DS HRP (AQU02)	1.8 to 2 m



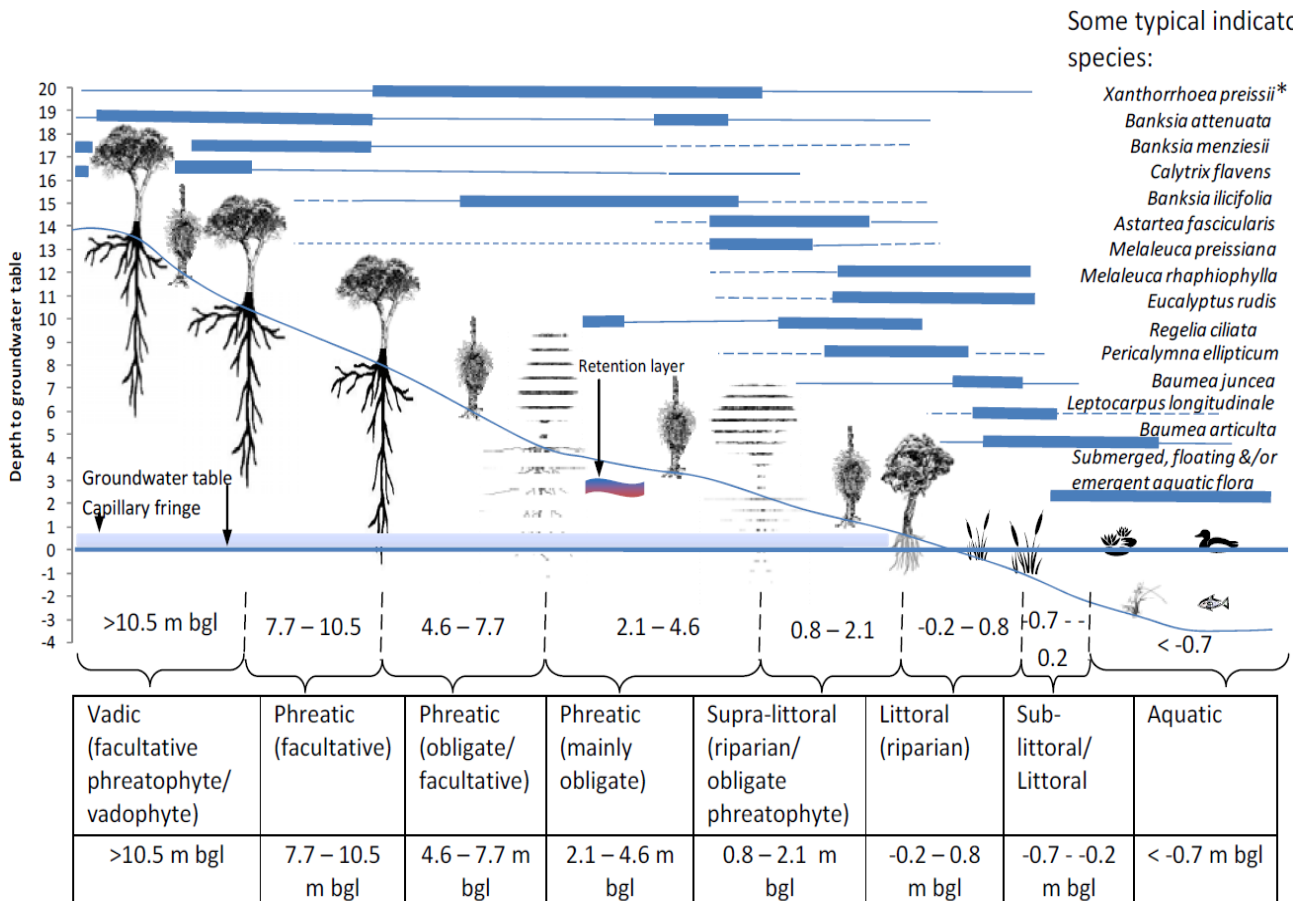
**Figure 32: Walpole River’s Healthy Rivers program monitoring sites (DWER 2020)**

### 11.4.3 Groundwater Dependent Ecosystems

GDEs are ecosystems that require access to groundwater to meet all or some of their water requirements to maintain the communities of plants, animals and the ecological processes they support (Richardson, 2011). Groundwater attributes on which the dependency of GDEs is based includes groundwater flow, depth, pressure (for confined aquifers) and quality. Depth to groundwater is generally the most important attribute for ecosystems that rely predominately on groundwater, while depth and frequency of inundation are most important to ecosystems that rely on both surface expressions of groundwater and overland flow of surface water (i.e. flood plains, wetlands and base-flow rivers) (R Froend & R Loomes, 2006).

Terrestrial vegetation that fully depends on groundwater or on a seasonal or episodic basis can exist wherever the water table is within the root zone of the plants, either permanently or episodically, as summarised below and shown in Figure 33 :

- Obligate groundwater use occurs when species presence is dependent upon continuous, seasonal or episodic access to groundwater. Even if groundwater is relied upon only infrequently or frequently but for short periods of time, groundwater dependency is still classified as obligate.
- Facultative dependency is when groundwater is used when available, although its absence does not necessarily result in adverse impacts to the vegetation. Facultative dependency may include species that access groundwater when at shallow depths and individuals that have not accessed groundwater throughout their lives (i.e. at higher positions in the landscape) (Sandra J. Zencich, 2002).



Extract from Bea Sommer & Ray Froend, 2010

**Figure 33: Vegetation ecohydrological states on the Gngangara mound**

The greater the depth to groundwater, the lower the dependence on groundwater and the more tolerant vegetation is to water table drawdown. At groundwater depths of 10 m or greater, the importance of groundwater to terrestrial vegetation reduced. As the depth to groundwater across the zone of influence is less than 1.1 MBGL (Figure 12), vegetation within the zone of influence is likely to be groundwater dependent and comprise riparian or obligate phreatophytes (Bea Sommer & Ray Froend, 2010).

The phreatophytic vegetation within the zone of influence has been separated into the following categories developed by Froend (2004) (Figure 34 and Table 45):

- Vegetation units within the 0–3 m phreatophyte category vegetation (wetland) includes:
  - **CcEpTICa**; *Corymbia calophylla*, *Eucalyptus patens* closed mid woodland over *Kingia australis* sparse tall shrubland, *Taxandria linearifolia*, *Xanthorrhoea preissii* sparse mid shrubland over *Cyathochaeta avenacea* open mid sedgeland over *\*Cenchrus clandestinus*, *\*Holcus lanatus* sparse grassland, *Opercularia hispidula*, *\*Trifolium repens* var. *repens* sparse low forbland
  - **CcTBsLt**; *Corymbia calophylla*, (*Eucalyptus patens*) sparse low trees over *Taxandria* spp. *Beaufortia sparsa*, *Homalospermum firmum* mid shrubland over *Leptocarpus thysananthus*, *Anarthria scabra*, *Lepidosperma gladiatum* sparse sedgeland
  - **EgAbToLg**; *Eucalyptus guilfoylei* mid woodland over *Acacia browniana* var. *browniana*, *Trymalium odoratissimum* subsp. *trifidum*, *Kunzea sulphurea* tall shrubland over *Gahnia trifida*, *Lepidosperma gladiatum* tall open sedgeland, *Anarthria scabra* low sparse sedgeland
  - **EpmCec**; *Eucalyptus patens*, *E. megacarpa*, *Taxandria linearifolia* mid open woodland over *\*Cenchrus clandestinus* closed grassland
  - **PJh**; *Juncus holoschoenus* tall forbland over *Juncus pauciflorus*, *\*Hypochaeris glabra* low forbland, *\*Holcus lanatus* open low grassland
  - **TICaHI**; *Taxandria linearifolia* open tall shrubland over *Taraxis grossa*, *Cyathochaeta avenacea* closed sedgeland over *\*Holcus lanatus* sparse grassland

- Vegetation units within the 0–3 m phreatophyte category vegetation (terrestrial) includes:
  - **EdAbLg**; *Eucalyptus diversicolor* tall woodland/open forest over *Eucalyptus patens*, *Allocasaurina decussata* mid closed/open forest/woodland over *Acacia browniana* var. *browniana* sparse shrubland, *Pteridium esculentum* tall sparse forbland, *Lepidosperma gladiatum* sparse sedgeland
  - **EpTpDh**; *Eucalyptus patens* open mid woodland over *Taxandria parviceps*, *Xanthorrhoea preissii* mid shrubland over *Dampiera hederacea* sparse low shrubland, *Anarthria prolifera* open low sedgeland.

**Table 45: Phreatophytic categories within the zone of influence**

Phreatophyte category	Area within zone of influence drawdown contours		
	Magnitude of drawdown	Area (ha)	% of zone of influence
0–3 m phreatophyte category vegetation (wetland)	0 m	11.25	7.53
	0.1 m	10.63	7.11
	0.03 m	8.53	5.71
	0.05 m	6.94	4.64
	0.13 m	6.36	4.26
	0.34 m	4.21	2.82
	0.6 m	1.93	1.29
	<b>Total</b>		<b>49.85 ha</b>
0–3 m phreatophyte category vegetation (terrestrial)	0 m	6.99	4.68
	0.1 m	5.12	3.43
	0.03 m	4.46	2.98
	0.05 m	3.88	2.60
	0.13 m	2.03	1.36
	0.34 m	0.46	0.31
	0.6 m	0.17	0.11
	<b>Total</b>		<b>23.11 ha</b>

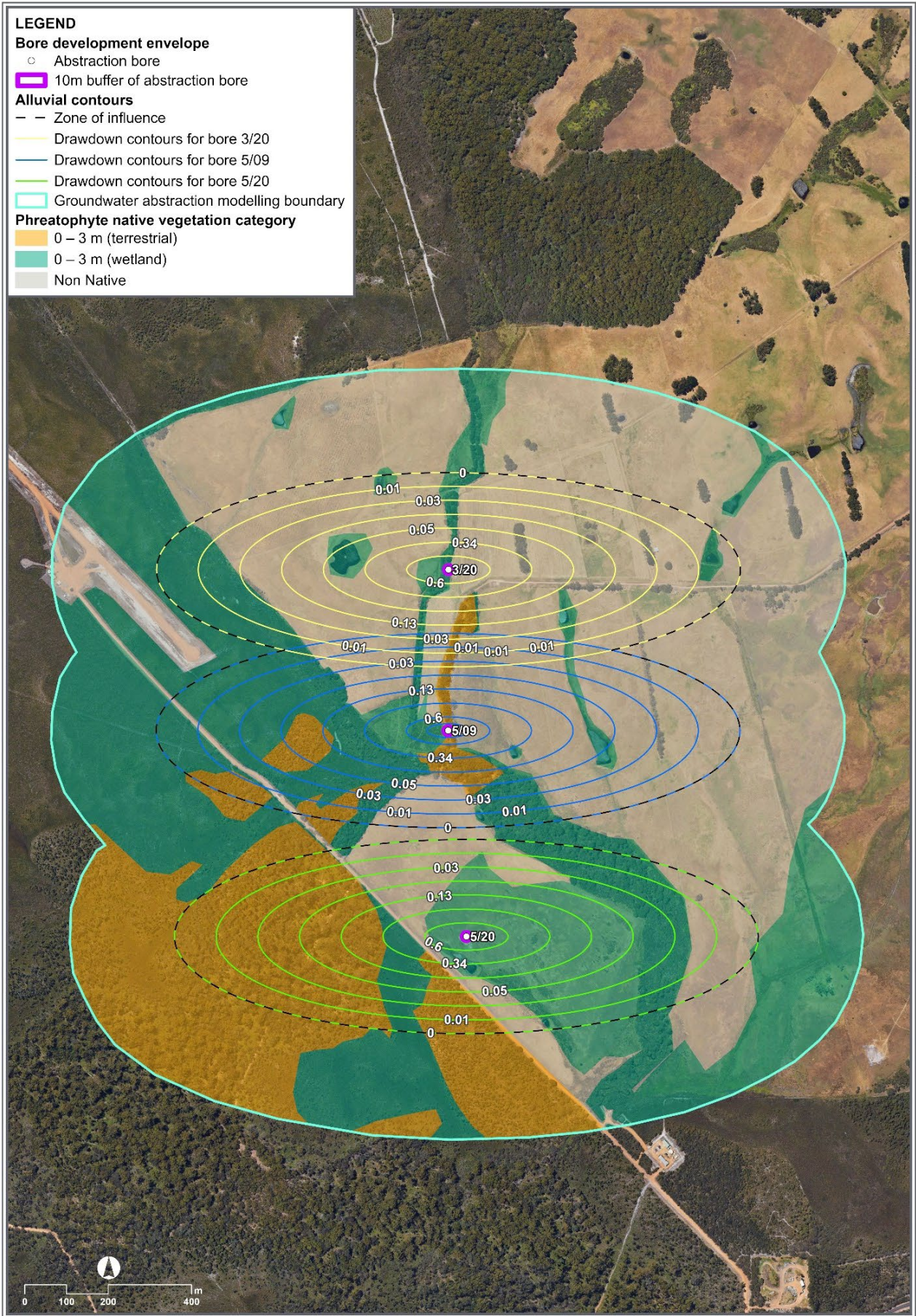


Figure 34: Potential Groundwater Dependent Ecosystems within the zone of influence



## 11.5 Potential impacts

Table 46 provides the potential key impacts to Inland Waters from the operation of the proposal.

**Table 46: Potential impacts to Inland Waters**

Phase	Impact class	Works/ operations	Potential impacts
Establishment	<ul style="list-style-type: none"> <li>The bores have already been installed and there is no establishment phase associated with this proposal.</li> </ul>		
Operation	Indirect	<ul style="list-style-type: none"> <li>Groundwater abstraction</li> </ul>	<ul style="list-style-type: none"> <li>There are no Ramsar or Wetlands of National Significance within the zone of influence.</li> <li>The upper Walpole River is located within the zone of influence. Groundwater drawdown may result in oxidisation of PASS, which may indirectly impact water quality within the river. These impacts are discussed in the Terrestrial Environmental quality section of this report.</li> <li>Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially resulting in reduced water levels and stream flow. However, as discussed previously, due to the natural seasonal cessation of flows within the river during summer, impacts to flows from the proposal are unlikely to be significant.</li> <li>An assessment of groundwater depths and vegetation types within the zone of influence was undertaken by RPS, in accordance with categories developed by Froend (2004) to identify potential terrestrial GDEs within the zone of influence. 72.96 ha (50.54% of the zone of influence) was mapped as a terrestrial GDE. Alteration of groundwater levels (drawdown) may reduce ground water availability for these GDEs.</li> <li>Alteration of groundwater levels (drawdown) may reduce ground water quality, potentially impacting terrestrial GDEs. These impacts are discussed in the Terrestrial Environmental quality section of this report.</li> </ul>

### 11.5.1 Assessment of impacts

Groundwater abstraction from the deep underlying fractured rock aquifer may result in localised drawdown in the overlying Superficial aquifer, which can affect the availability of groundwater to inland waters and GDEs. These impacts are discussed in the sections below.

#### 11.5.1.1 Changes in water quality within the Walpole River

Studies on other rivers in the south-west of Western Australia shows that groundwater discharge into the rivers supplies freshwater to the normally brackish riverine environment, allowing native freshwater fish species to use those parts of the river in summer (Department of Water, 2006). Therefore, if the Walpole River does receive groundwater baseflows, there is potential for a reduction in these flows to alter the water quality of the Walpole River, impacting the habitat available to aquatic species.

Changes to water quality may include potential increased salinity from evapoconcentration in receding waters, and potential decreased dissolved oxygen levels with declines in flow.

Acid sulfate soil investigations undertaken identified potential acid sulfate soils within the zone of influence. Groundwater drawdown resulting from the proposed abstraction may result in these potential ASS being exposed, potentially resulting in reduced pH levels, increased acidity and release naturally occurring heavy metals and nutrients to surface water and groundwater (RPS, 2023c). Changes to water quality resulting from the exposure of potential acid sulfate soils are discussed in Section 9.5.1.1.

### 11.5.1.2 Reduced water levels and stream flow within the Walpole River

The interaction between the Walpole River and groundwater is unknown, however it is possible groundwater supports the maintenance of flows in the Walpole River given the shallow depth to groundwater in the area. There is potential for groundwater drawdown to result in reduced baseflow within the Walpole River, leading to reduced surface water flows and levels. Potential impacts to surface water flows from the proposal are likely to be minimal however, as the flows naturally cease over the summer months.

The Walpole Weir is located outside (south-east of) the zone of influence. Due to the impounding impacts of the Walpole Weir, the water levels upstream and within the one of influence, are no longer representative of the original hydrology.

### 11.5.1.3 Reduced groundwater quality impacts to terrestrial Groundwater Dependent Ecosystems

Acid sulfate soil investigations undertaken identified PASS within the zone of influence (RPS, 2023c). Groundwater drawdown resulting from the proposed abstraction may result in these PASS being exposed, potentially resulting in reduced pH levels, increased acidity and release naturally occurring heavy metals and nutrients to surface water and groundwater (Shand, 2018). Changes to water quality resulting from the exposure of potential acid sulfate soils are discussed in Section 9.5.1.1.

### 11.5.1.4 Groundwater drawdown impacts to terrestrial Groundwater Dependent Ecosystems

A risk assessment of proposed groundwater abstraction on GDEs has been undertaken for the proposed six-month trial. The groundwater drawdown model provided by Water Corporation provides the magnitude of drawdown at the end of the six-month trial period, not the rate of drawdown. Therefore, risk assessments undertaken to support this referral are based on the magnitude of drawdown alone. Implementation of the proposed trial will provide the data required to understand the rate of drawdown from the aquifer to determine suitability has a long-term water source. The trial will also identify if there is a connection between aquifers and the degree of connectivity.

As the rate of drawdown was not available to support the risk assessment, it has been based on the framework developed by Froend & Loomes (2004), rather than the risk assessment detailed by Sommer and Froend (2010) which requires a rate of drawdown.

The adopted risk assessment framework is based on the assumption that the greater the depth to groundwater, the lower the requirement for groundwater and the more tolerant vegetation will be to a decline in the water table. The risk of impact to GDEs from groundwater drawdown is described in Table 47.

**Table 47: Risk of impact level and magnitude of permissible change for phreatophytic vegetation**

Phreatophytic category	Low	Moderate	High	Severe
0–3 m (wetland)	0 m–0.25 m	0.25 m–0.5 m	0.5 m–0.75 m	>0.75 m
0–3 m (terrestrial)	0 m–0.75 m	0.75 m–1.25 m	1.25 m–1.75 m	>1.75 m
3–6 m	0 m–1.0 m	1.0 m–1.5 m	1.5 m–2.25 m	>2.25 m
6–10 m	0 m–1.25 m	1.25 m–2.0 m	2.0 m–2.75 m	>2.75 m

From Froend & Loomes (2004).

The results of the risk assessment of the impact of groundwater drawdown on GDEs are summarised below and shown in Table 48 and Figure 35:

- No GDEs have a severe risk of being impacted from the six-month abstraction trial
- All terrestrial GDEs have a low risk of being impacted from the six-month trial (23.1 ha, 15.5% of the zone of influence)
- 43.7 ha of wetland GDEs have a low risk of being impacted from the six-month trial (29.25% of the zone of influence)

- 1.93 ha (1.29% of the overall zone of influence) of wetland GDEs comprising the EpmCec (0.16 ha) and PJh (1.78 ha) vegetation types have a high risk of being impacted from the six-month trial. However, as both of these vegetation types have been assessed as Completely Degraded, any potential impacts from groundwater drawdown are unlikely to be significant. Potential responses of GDEs to groundwater drawdown within this risk category includes:
  - Measurable reduction in rates of primary production in response to drying
  - Mortalities, potentially resulting in greater than 15% reduction in abundance of dominant species
  - Measurable crown dieback in overstorey species and/or reduction in cover of understorey
  - Measurable reductions in height due to loss of canopy and/or reduced diameter of adult stems (Froend 2005)
- 4.21 ha (2.82% of the overall zone of influence) of wetland GDEs comprising the following vegetation types have a moderate risk of being impacted from the six-month trial. As the majority of the vegetation identified as being at a moderate risk of being impacted is already Completely Degraded, only the 0.79 ha in Excellent condition is considered to be at risk from the proposal:
  - CcTBsLt (0.79 ha, 18.76% of the 4.21 ha at a moderate risk of impacts) in Good to Excellent condition
  - EpmCec (0.26 ha, 6.18% of the 4.21 ha at a moderate risk of impacts) in Completely Degraded condition
  - PJh (3.16 ha, 75.06% of the 4.21 ha at a moderate risk of impacts) in Completely Degraded condition
- Potential responses of GDEs to groundwater drawdown within the moderate risk category includes:
  - Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying
  - Some mortality of individuals may occur. However, considering the temporary nature of the groundwater drawdown, this is considered unlikely
  - Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).

Other GDE responses or changes resulting from groundwater drawdown detailed by Froend (2005) would only be expected in association with long-term changes in water regimes and are not anticipated as a result of the proposal. For example, Froend (2005) states that changes in vegetation composition due to decreases in a water regime may be reversed after a short period of time (less than three years) through alleviating water stress on existing populations or allowing recolonisation of a species. Significant changes in species distribution or community structure that have occurred over several years can be reversed (although the character of the vegetation will not be identical) over an equivalent period of time. As such, only responses that may be expected from groundwater drawdown over a short time frame have been included in the summary above.

**Table 48: Risk assessment of groundwater drawdown on GDEs**

Magnitude of drawdown (m)	GDE within the 0–3 m (wetland) phreatophytic vegetation category		GDE within the 0–3 m (terrestrial) phreatophytic vegetation category	
	Area (ha)	% of the zone of influence	Area (ha)	% within the zone of influence
0	11.25	7.53%	6.99	4.68%
0.01	10.63	7.11%	5.12	3.43%
0.03	8.53	5.71%	4.46	2.98%
0.05	6.94	4.64%	3.88	2.60%
0.13	6.36	4.26%	2.03	1.36%
0.34	4.21	2.82%	0.46	0.31%
0.6	1.93	1.29%	0.17	0.11%
<b>Total</b>	<b>49.85 ha</b>	<b>33.36%</b>	<b>23.11 ha</b>	<b>15.47%</b>

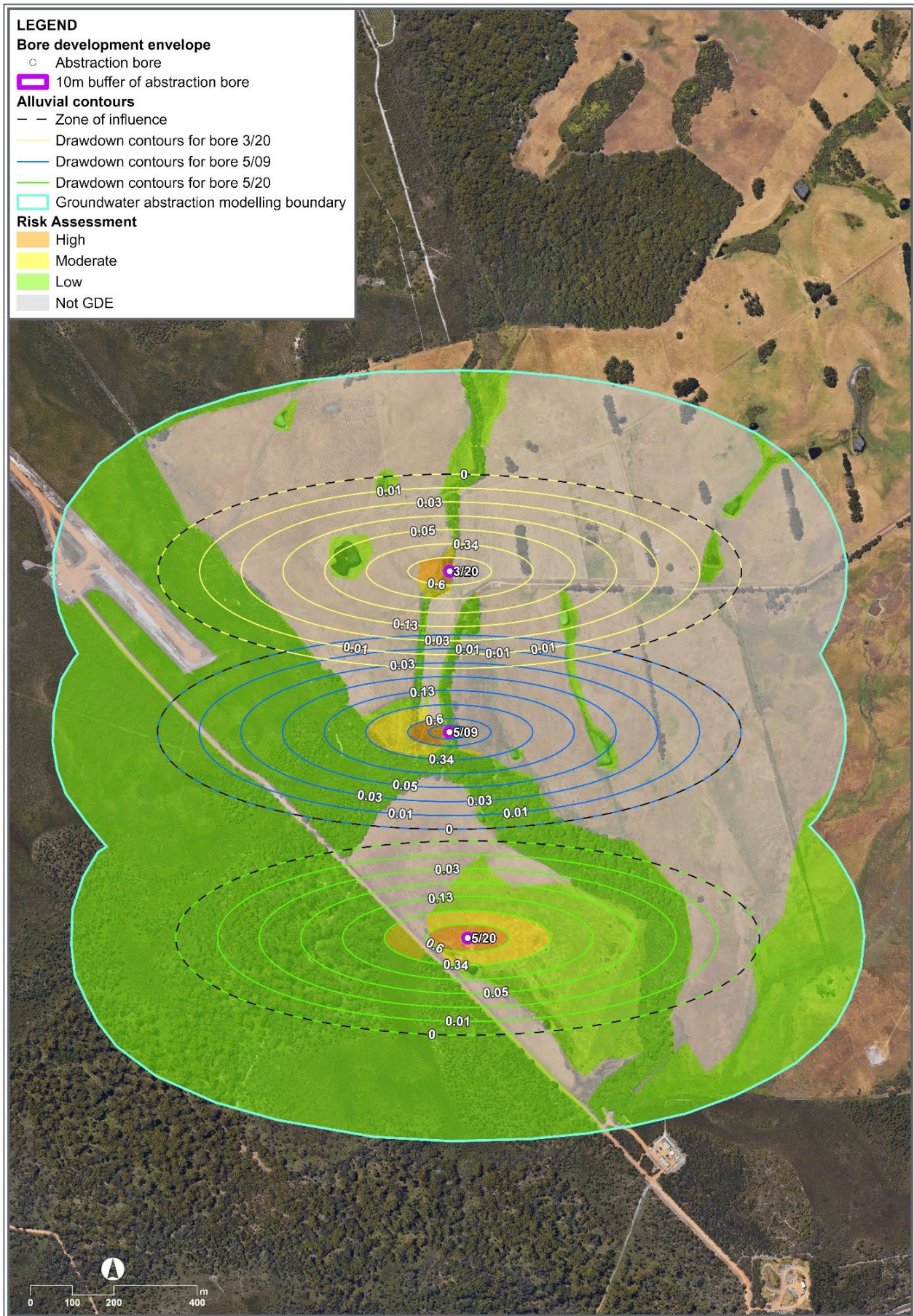


Figure 35: Risk impacts assessment of groundwater drawdown on GDEs

## 11.6 Mitigation

Table 49 identifies additional information / technical investigations required to determine the likelihood of any residual impacts to inland waters.

**Table 49: Application of mitigation hierarchy to Inland Waters**

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
Groundwater drawdown may result in water quality impacts to the Walpole River.	Indirect	Avoid	<ul style="list-style-type: none"> <li>The complete avoidance of potential impacts to inland waters from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded:                             <ul style="list-style-type: none"> <li>Trigger criterion for water quality within the Walpole River; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events</li> <li>Threshold criterion for water quality within the Walpole River; an exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event.</li> </ul> </li> <li>An ASS detailed site assessment (RPS, 2023c) (Appendix D) has been prepared to minimise impacts to inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and manage risk to the environment and ecosystems. The resultant data will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	Due to the natural, seasonal fluctuations of groundwater levels and groundwater quality, quantifying the potential residual impacts to terrestrial environmental quality resulting from oxidation of ASS is not possible. However, implementation of the monitoring and contingency actions outlined in the ASS Detailed Site Assessment (RPS, 2023c), GDEMP (RPS, 2023b) and WIMP (Water Corporation, 2023a) will that residual impacts to groundwater or surface water quality resulting from oxidation of PASS are minimised and consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e).
		Minimise	<ul style="list-style-type: none"> <li>The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River from indirect impacts associated with groundwater drawdown, including potential changes to surface water quality. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to the Walpole River are consistent with the EPA objective for inland waters. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:                             <ul style="list-style-type: none"> <li>If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> </ul> </li> <li>The Water Corporation will prepare and submit a Groundwater Dependent Ecosystems Performance Report within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown, any actions undertaken and contingencies.</li> <li>Impacts to soils, groundwater and surface water from exposure of potential acid sulfate soils, and associated mitigation measures, are discussed 'Terrestrial environmental quality' in Section 9.5.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N / A</li> </ul>	
Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially resulting in reduced water levels and stream flow.	Indirect	Avoid	<ul style="list-style-type: none"> <li>The complete avoidance of potential impacts to inland waters from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded:                             <ul style="list-style-type: none"> <li>Trigger criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.30 m below the minimum baseline levels.</li> <li>Threshold criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.35 m below the minimum baseline levels.</li> <li>Trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir); Surface water flows exceed 63 consecutive days of no flow over the Walpole River Weir.</li> <li>Threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir); surface water flows exceed 85 consecutive days of no flow over Walpole River Weir.</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and manage risk to the environment and ecosystems. The resultant data will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially resulting in reduced water levels and stream flow. However, due to the natural seasonal cessation of flows within the river during summer, residual impacts to surface water flows are considered unlikely.
		Minimise	<ul style="list-style-type: none"> <li>As surface water flows within the Walpole River naturally cease over the summer months (Water Corporation, 2023f), groundwater drawdown from the proposal will not impacts flows (or result in a reduction in flows) over this period.</li> <li>The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels and flows. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to the Walpole River are consistent with the EPA objective for inland waters. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:                             <ul style="list-style-type: none"> <li>If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>If the threshold criterion for surface water levels is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. This data will be reviewed as well as an assessment of climatic data and surface water flows to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>If the trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. Water Corporation will also review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water flows declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>If the threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> </ul> </li> <li>The Water Corporation will prepare and submit a Groundwater Dependent Ecosystems Performance Report within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown, any actions undertaken and contingencies.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N / A</li> </ul>	

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
Alteration of groundwater levels (drawdown) may reduce ground water availability for terrestrial GDEs.	Indirect	Avoid	<ul style="list-style-type: none"> <li>No phreatophytic vegetation associated with the GDEs within the zone of influence is protected under the EPBC Act or BC Act.</li> <li>The complete avoidance of potential impacts to terrestrial GDEs from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded:                             <ul style="list-style-type: none"> <li>Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m).</li> <li>Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m).</li> <li>Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and manage risk to the environment and ecosystems. The resultant data will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	Residual impacts are limited to the potential indirect groundwater drawdown impact to 0.79 ha (0.5% of the zone of influence) of terrestrial GDEs in Excellent condition has a medium risk of being impacted by the modelled groundwater drawdown. Vegetation associated with the terrestrial GDEs within the zone of influence are not protected under the EPBC Act or BC Act.
		Minimise	<ul style="list-style-type: none"> <li>Impacts to terrestrial GDEs have been minimised through strategic placement of the abstraction bores within cleared agricultural areas, resulting in 75.05 ha (50.22%) of the zone of influence comprising cleared areas.</li> <li>Of the 72.96 ha (50.54% of the zone of influence) of terrestrial GDE within the zone of influence, only 0.79 ha will potentially be impacted by the modelled groundwater drawdown. Based on assessments undertaken by Froend (2005), the possible response of phreatophytic vegetation within the moderate or high-risk categories are summarised below:                             <ul style="list-style-type: none"> <li>Some evidence of reduction in rates of primary production (e.g. flowering or seed production) in response to drying</li> <li>Some mortality of individuals may occur. However, the temporary and short-term (six month) nature of the groundwater drawdown means this is unlikely</li> <li>Some evidence of reduced growth, loss of height and loss of vigour (Froend 2005).</li> </ul> </li> <li>A GDEMP (RPS, 2023b) has been prepared to minimise and manage indirect impacts to the 0.79 ha of terrestrial GDEs in Excellent condition is at risk of being impacted by the groundwater drawdown. Groundwater monitoring will be undertaken at the baseline bore (19/22) and the monitoring bores (1/22, 4/22, 8/22 and 14/22) to manage and monitor groundwater drawdown and ensure the triggers discussed in the section above are not exceeded. If these trigger levels are exceeded, then the management actions and corrective measures outlined in the GDE MP (RPS, 2023b) will be implemented to ensure impacts to inland waters are consistent with the EPA objective (EPA, 2018a):                             <ul style="list-style-type: none"> <li>If the early response groundwater level trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the groundwater level trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>If the groundwater level threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>If the threshold criterion (of 0.5 m) is exceeded, contingency vegetation monitoring in accordance with the Groundwater Dependent Vegetation Monitoring Plan (provided in Appendix A of the GDE MP) will be undertaken.</li> </ul> </li> <li>The Water Corporation will prepare and submit a Groundwater Dependent Ecosystems Performance Report within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown, any actions undertaken and contingencies.</li> </ul>	
		Rehabilitate	<ul style="list-style-type: none"> <li>N/A</li> </ul>	
Alteration of groundwater levels (drawdown) may reduce ground water quality, potentially impacting terrestrial GDEs.	Indirect	Avoid	<ul style="list-style-type: none"> <li>No phreatophytic vegetation associated with the GDEs within the zone of influence is protected under the EPBC Act or BC Act.</li> <li>The complete avoidance of potential impacts to terrestrial GDEs from groundwater drawdown is not considered an achievable outcome due to the nature of the proposal. However, avoidance of impacts greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded:                             <ul style="list-style-type: none"> <li>Interim trigger level of 0.20 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.2 m)</li> <li>Trigger level of 0.25 m (the difference in water levels between the baseline bore (19/22) and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.25 m)</li> <li>Threshold criteria of 0.50 m (the difference in water levels between the baseline (19/22) bore and the monitoring bore (1/22, 4/22, 8/22 and 14/22) exceeds 0.5 m).</li> </ul> </li> <li>An ASS detailed site assessment (RPS, 2023c) (Appendix D) has been prepared to minimise impacts to inland waters. Monitoring specific water quality trigger levels for management and contingency actions will be developed prior to the trial commencing, following review of all pre-trial and baseline groundwater and surface water data.</li> <li>The proposed groundwater abstraction trial will manage and assess the groundwater drawdown against predictions and manage risk to the environment and ecosystems. The resultant data will determine the long-term viability of the source with regard to the avoidance of impacts to the environment and surrounding values.</li> </ul>	Due to the natural, seasonal fluctuations of groundwater levels and groundwater quality, quantifying the potential residual impacts to terrestrial environmental quality resulting from oxidisation of ASS is not possible. However, implementation of the monitoring and contingency actions outlined in the ASS Detailed Site Assessment (RPS, 2023c), GDEMP (RPS, 2023b) and WIMP (Water Corporation, 2023a) will that residual impacts to groundwater or surface water quality resulting from oxidisation of PASS are minimised and consistent with the EPA objective for Terrestrial Environmental Quality (EPA, 2016e).
		Minimise	<ul style="list-style-type: none"> <li>A GDEMP (RPS, 2023b) has been prepared to minimise and manage indirect impacts to the 0.79 ha of terrestrial GDEs in Excellent condition is at risk of being impacted by the groundwater drawdown. Groundwater monitoring will be undertaken at the baseline bore (19/22) and the monitoring bores (1/22, 4/22, 8/22 and 14/22) to manage and monitor groundwater drawdown and ensure the triggers discussed in the section above are not exceeded. If these trigger levels are exceeded, then the management actions and corrective measures outlined in the GDE MP (RPS, 2023b) will be implemented to ensure impacts to inland waters are consistent with the EPA objective (EPA, 2018a):                             <ul style="list-style-type: none"> <li>If the early response groundwater level trigger criterion (of 0.2 m) is exceeded, the production plan will be reviewed any necessary adjustments to abstraction will be undertaken to prevent groundwater water levels declining any further.</li> <li>If the groundwater level trigger criterion (of 0.25 m) is exceeded, Water Corporation will notify DWER and review the production plan, making necessary adjustments to groundwater abstraction to prevent the water levels declining any further. Water Corporation will also review groundwater levels within the baseline and monitoring bores against baseline data and climatic events to determine whether they are comparable to baseline monitoring. If baseline and monitoring bore levels have declined 0.25 m below the average low annual measured water level at respective bores, further adjustments to groundwater abstraction will be undertaken.</li> <li>If the groundwater level threshold criterion (of 0.5 m) is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and not used until water levels have returned to those consistent with the baseline bore.</li> <li>If the threshold criterion (of 0.5 m) is exceeded, contingency vegetation monitoring in accordance with the Groundwater Dependent Vegetation Monitoring Plan (provided in Appendix A of the GDE MP) will be undertaken.</li> </ul> </li> </ul>	

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
			<ul style="list-style-type: none"> <li>- If the groundwater quality trigger is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis will also be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>- If the groundwater quality threshold is exceeded, Water Corporation will notify DWER, and the production bore associated with the breached monitoring bore will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>• The Water Corporation will prepare and submit a Groundwater Dependent Ecosystems Performance Report within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown, any actions undertaken and contingencies.</li> <li>• Impacts to soils, groundwater and surface water from exposure of potential acid sulfate soils, and associated mitigation measures, are discussed 'Terrestrial environmental quality' in Section 9.5.</li> </ul>	
	Rehabilitate		<ul style="list-style-type: none"> <li>• N/A</li> </ul>	

## 11.7 Assessment and significance of residual impact

Residual impacts are limited to the potential indirect groundwater drawdown impact to 0.79 ha (0.5% of the zone of influence) of terrestrial GDEs in Excellent condition has a medium risk of being impacted by the modelled groundwater drawdown. Vegetation associated with the terrestrial GDEs within the zone of influence are not protected under the EPBC Act or BC Act.

Research undertaken by Froend (2005) indicates that changes in vegetation composition due to groundwater drawdown are unlikely to occur over the short period of time the trial is proposed and that any changes in composition can be reversed if the drawdown impacts are less than approximately three years. Therefore, no significant changes to the composition of terrestrial GDEs are anticipated as a result of the modelled drawdown over the six-month period.

Changes that may occur within the 0.79 ha area of terrestrial GDEs includes a temporary reduction in flowering or seed production, some evidence of reduced growth and vigour and some mortality of individual plants, although mortalities are considered unlikely.

Alteration of groundwater levels (drawdown) may result in reduced baseflow within the Walpole River, potentially resulting in reduced water levels and stream flow. However, as discussed previously, due to the natural seasonal cessation of flows within the river during summer, impacts to flows from the proposal are unlikely to be significant.

## 11.8 Environmental outcomes

The following key environmental outcomes are proposed to ensure that the EPA's inland waters objective (EPA, 2018a) will be achieved:

- No terrestrial GDEs will be cleared or directly impacted by the proposal
- No rivers or wetlands will be directly disturbed by the proposal
- The GDEMP (RPS, 2023b) will be implemented to ensure that:
  - No more than 0.79 ha of terrestrial GDEs will have at a medium of impacts from groundwater drawdown as summarised below. The GDEs that will be potentially impacted by groundwater drawdown do not comprise flora or vegetation protected under the EPBC Act or BC Act. The GDEMP will outline trigger and threshold criteria that will provide an early warning to ensure these areas and impacts are not exceed
  - Surface water quality, levels and surface water flows within the upper Walpole River do not exceed trigger levels outlined in the GDEMP (RPS, 2023b) and ASS detailed site assessment (RPS, 2023c)
- Groundwater and surface water monitoring will be undertaken in accordance with the following documents to determine whether trigger and threshold criteria have been exceeded:
  - GDEMP (RPS, 2023b) provided in Appendix B
  - ASS detailed site assessment (RPS, 2023c) provided in Appendix D
  - WIMP (Water Corporation, 2023a) provided in Appendix E
- In the event that monitoring undertaken in accordance with the above documents indicates an exceedance of the trigger or threshold criteria, Water Corporation will:
  - Report the exceedance to DWER
  - implement the appropriate response actions outlined in the GDEMP (RPS, 2023b)
  - Continue to implement these actions until it can be demonstrated that the threshold criteria are being met and implementation of threshold contingency actions are no longer required.

The environmental outcomes above are consistent with the EPA objective for inland waters (EPA, 2018a) and thereby not significant, as they maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.



## 12 SOCIAL SURROUNDINGS

### 12.1 EPA objective

To protect social surroundings from significant harm (EPA, 2023).

### 12.2 Policy and guidance

#### 12.2.1 Aboriginal heritage and culture

- *Aboriginal Cultural Heritage Act 2021*
- Environmental Factor Guideline: Social Surroundings (EPA, 2023).

#### 12.2.2 Natural and historic heritage

- *Heritage of Western Australia Act 1990*
- Environmental Factor Guideline: Social Surroundings (EPA, 2023).

#### 12.2.3 Bushfire

- *Fire and Emergency Services Act 1998*
- Environmental Factor Guideline: Social Surroundings (EPA, 2023)
- State Planning Policy (SPP) 3.7: Planning in Bushfire Prone Areas (Department of Planning and WAPC, 2015).

### 12.3 Environmental investigations

#### 12.3.1 Aboriginal heritage

An archaeological and ethnographic site identification survey was undertaken by Aboriginal Land Services Pty Ltd (ALS) for the proposal (Appendix M). The Aboriginal Heritage Study included:

- A site survey was undertaken between 28 and 29 September 2022 with Wagyl Kaip Southern Noongar representatives, Water Corporation representatives, and ALS.
- A second site visit and consultation were undertaken in December 2022 with senior elders who were unable to attend the first site visit.

### 12.4 Receiving environment

#### 12.4.1 Aboriginal heritage

The DPLH's Aboriginal Heritage Inquiry System identified that no 'Registered Heritage Sites' or 'Other' Heritage Places are located within the zone of influence (Figure 36). However, the Aboriginal Heritage Survey identified the Walpole River as a potentially ethnographic sensitive area within the zone of influence.

The Aboriginal Heritage Survey also identified the potential for the proposal to impact cultural values of the following heritage sites outside of the zone of influence:

- Site DPLH OHP ID 29672: Deep River. This site is located within 8 km of the zone of influence
- Site DPLH OHP ID 21906: Frankland River. This site is located within 7 km of the zone of influence.

### 12.4.1.1 Walpole River

The Aboriginal Heritage survey identified the Walpole River as a potential cultural landscape feature and a potentially newly identified ethnographic site (Aboriginal Land Services, 2023). The representatives requested that the Walpole River be registered with DPLH as a site and relevant information has been provided to DPLH for assessment and lodgement.

### 12.4.2 Natural heritage

The State Heritage Office's inHerit database identified that no heritage places listed on the State Register of Heritage Places are located within the zone of influence (Government of Western Australia, 2021).

### 12.4.3 Bushfire

SPP 3.7 defines a bushfire-prone area as an area that has been designated by the Fire and Emergency Services Commissioner under Section 18 of the *Fire and Emergency Services Act 1998* (as amended) as an area that is subject, or likely to be subject, to bushfires. A search of the Department of Fire and Emergency Service's (DFES) Map of Bushfire Prone Areas identified that abstraction bores 5/09 and 5/20 are either located within or adjacent to an area mapped as a Bushfire Prone Area (Figure 37).

### 12.4.4 Surrounding groundwater users

The majority of the zone of influence comprises reserves and national parks and Water Corporation managed land. However, approximately 0.5 ha of the predicted zone of influence comprises private landholdings that may be current users of groundwater (Figure 5). As the zone of influence not proclaimed under the RIWI Act, the status of groundwater use by surrounding properties is not available. However, stakeholder consultation as part of the proposal has not identified any potential surrounding groundwater users (Section 4).

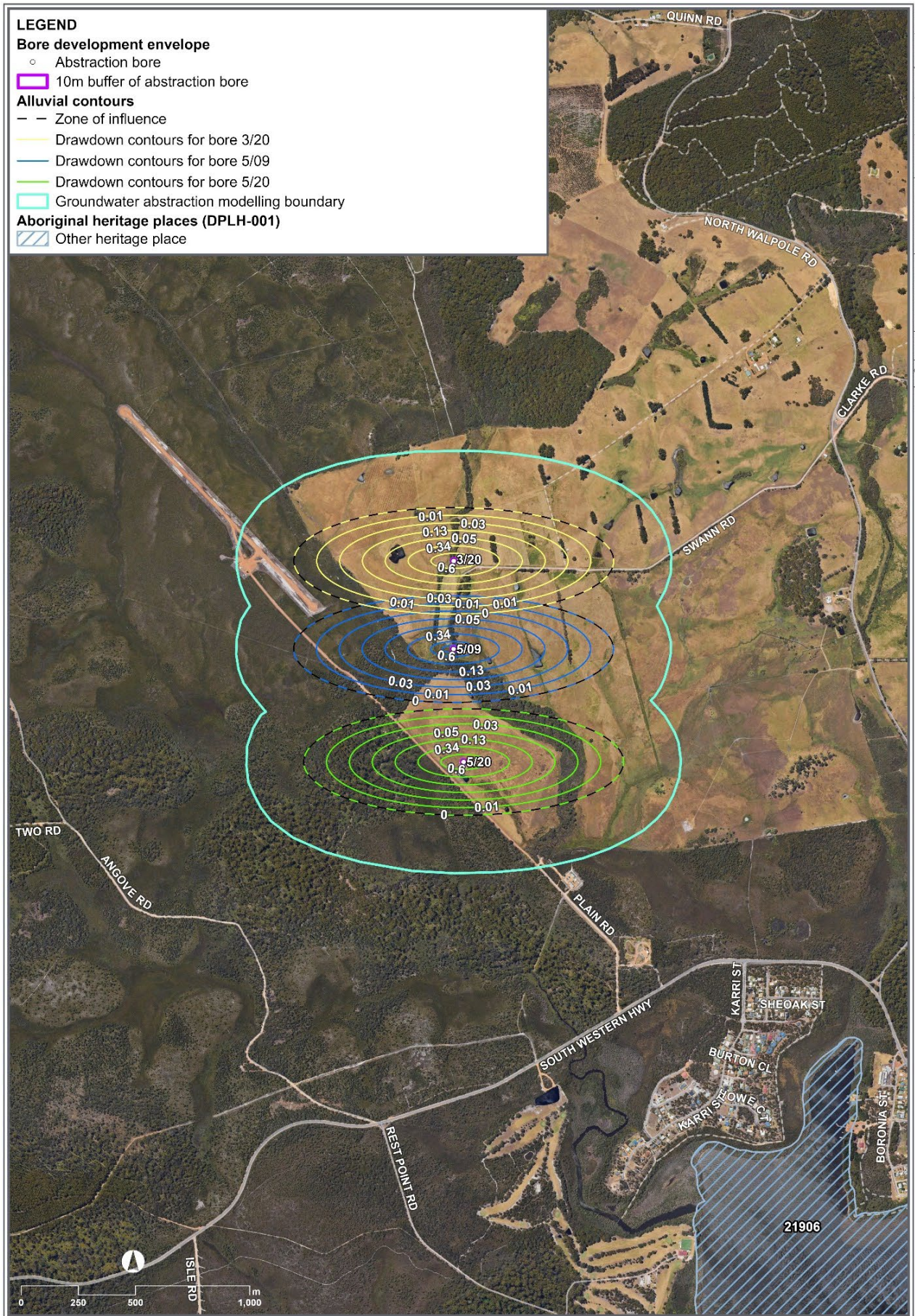


Figure 36: Mapped Aboriginal heritage sites (DPLH, 2023)

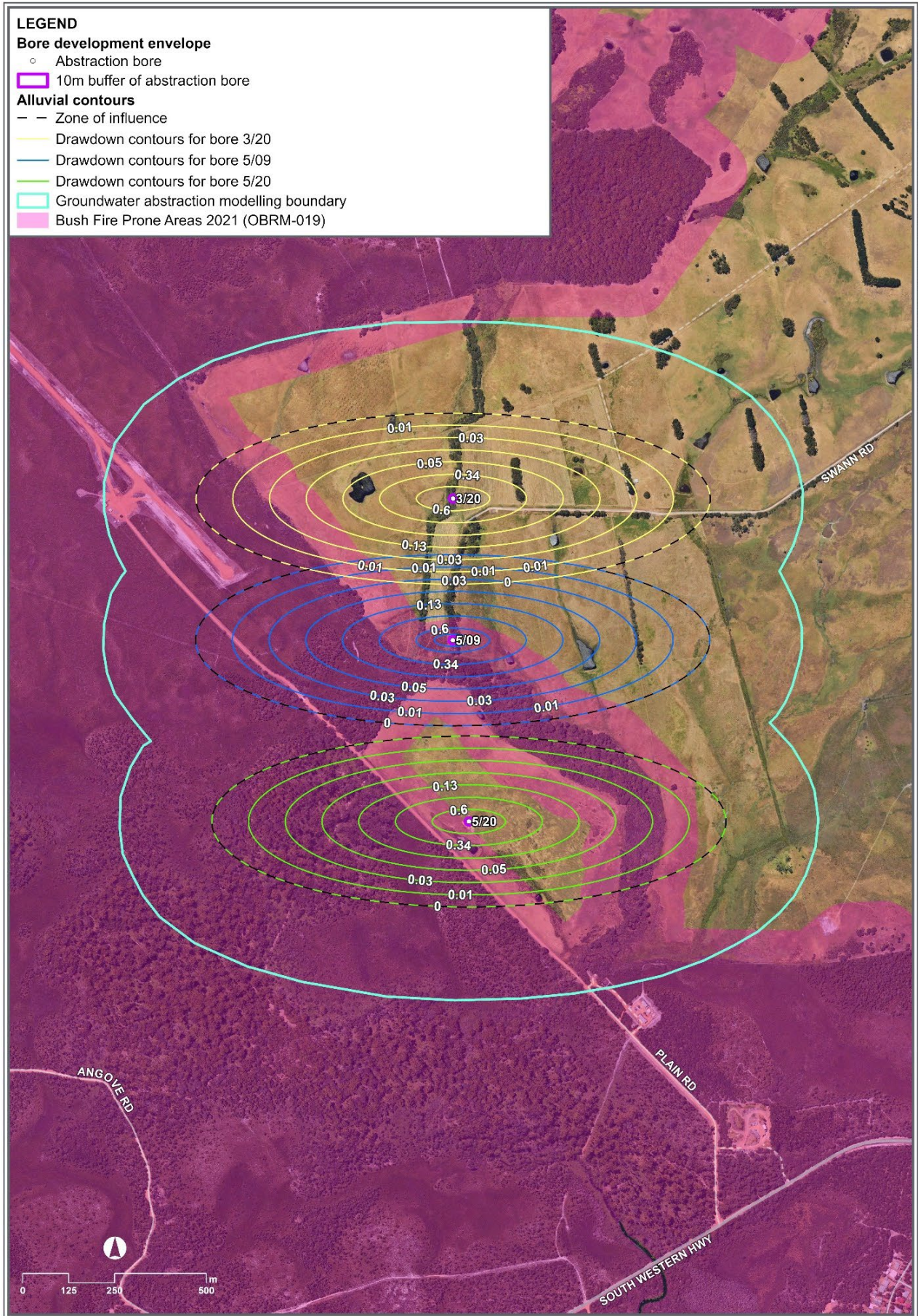


Figure 37: Bushfire prone areas

## 12.5 Potential impacts

Table 50 provides the potential key impacts relevant to the Social Surroundings from the proposal.

**Table 50: Potential impacts to Social Surroundings**

Phase	Impact class	Works / operations	Potential impacts
<b>Aboriginal heritage and culture</b>			
Operation	Indirect	Groundwater abstraction	<ul style="list-style-type: none"> <li>Groundwater drawdown impacts to the Walpole River, which although not a Registered or Other heritage site has been identified as being of potential ethnographic significance, may result in changes to surface water levels and flow. However, as flows naturally cease during the summer months, the trial is unlikely to significantly impact the riverine function and associated heritage values.</li> </ul>
<b>Bushfire</b>			
Operation	Indirect	Groundwater abstraction and operation of generators	<ul style="list-style-type: none"> <li>Damage to property and/or infrastructure from fire.</li> </ul>
<b>Surrounding land users</b>			
Operation	Indirect	Groundwater abstraction	<ul style="list-style-type: none"> <li>Impacts to domestic and agricultural users that may be reliant on groundwater, such as landowners with private bores.</li> </ul>

## 12.6 Assessment of impacts

### 12.6.1 Impacts to Aboriginal heritage

No areas of Aboriginal heritage or cultural significance were identified within the zone of influence from the desktop assessment of the DPLH Aboriginal Cultural Heritage Inquiry System (DPLH, 2023). However, the Walpole River was identified as having ethnographic significance during the Aboriginal Heritage Survey (Aboriginal Land Services, 2023). There is potential for the Walpole River to be impacted by the modelled groundwater drawdown, as outlined in Section 11.5.

### 12.6.2 Bushfire impacts

Abstraction bores and associated infrastructure are either located within or adjacent to an area mapped as a Bushfire Prone Area (Figure 37). The current bore and generator layouts have the following clearance from existing vegetation (Water Corporation, 2023c) and potential risks are considered minimal:

- From fence lines (including batter) – 1 m
- Cleared from electrical equipment / gensets – 1.5 m to 2 m.

### 12.6.3 Groundwater drawdown impacts to other land users

There is potential for Impacts to domestic and agricultural users that may be reliant on groundwater. However, as stakeholder consultation as part of the proposal has not identified any potential surrounding groundwater users (Section 4), impacts to surrounding groundwater users is considered unlikely.

## 12.7 Mitigation

Table 51 demonstrates how the EPA’s mitigation hierarchy (avoid, minimise and rehabilitate) has been applied to the environmental factor of Social Surroundings to address the key potential impacts.

**Table 51: Application of mitigation hierarchy to Social Surroundings**

Potential impacts	Impact class	Mitigation hierarchy	Proposed mitigation measures	Residual impacts
<b>Aboriginal heritage and culture</b>				
Groundwater drawdown impacts to the Walpole River, which has been identified as being of ethnographic significance.	Indirect	Avoid	<ul style="list-style-type: none"> <li>No Registered or Other areas of Aboriginal heritage or cultural significance were identified within the zone of influence. Although the Walpole River, which has been identified as being of potential ethnographic significance (Aboriginal Land Services, 2023), is located within the zone of influence.</li> <li>The complete avoidance of potential impacts from groundwater drawdown to the Walpole River is not considered an achievable outcome due to the nature of the proposal. However, as flows naturally cease during the summer months, the trial is unlikely to significantly impact the riverine function and associated heritage values.</li> <li>Avoidance of impacts to the Walpole River greater than the trigger and threshold criteria outlined in the GDEMP (RPS, 2023b) and summarised below will ensure impacts are minimised. Response actions outlined in the GDEMP will ensure these trigger levels are not exceeded:                             <ul style="list-style-type: none"> <li>Trigger criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.30 m below the minimum baseline levels</li> <li>Threshold criterion for surface water levels within the Walpole River (measured at the Walpole Weir); water levels drop by 0.35 m below the minimum baseline levels</li> <li>Trigger criterion for water quality within the Walpole River; an exceedance of field surface quality guideline values within the Walpole River (sites SW06 and SW08) over two consecutive weekly monitoring events</li> <li>Threshold criterion for water quality within the Walpole River; an exceedance of laboratory surface water quality guideline values within the Walpole River (sites SW06 and SW08) after one monitoring event</li> <li>Trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir); Surface water flows exceed 63 consecutive days of no flow over the Walpole River Weir</li> <li>Threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir); surface water flows exceed 85 consecutive days of no flow over Walpole River Weir.</li> </ul> </li> </ul>	As there are no Registered or Other Aboriginal heritage sites within the zone of influence and values within the Walpole River will be protected through implementation of the following plans, there are no residual impacts to Aboriginal heritage: <ul style="list-style-type: none"> <li>GDEMP (RPS, 2023b) (Appendix B)</li> <li>ASS detailed site investigation (RPS, 2023c) (Appendix D).</li> <li>WIMP (Water Corporation, 2023a) (Appendix E).</li> </ul>
		Minimise	<ul style="list-style-type: none"> <li>The GDEMP (RPS, 2023b) has been prepared to minimise impacts to the upper Walpole River, and any associated Aboriginal heritage values, from indirect impacts associated with groundwater drawdown, including potential changes to surface water levels, flow and quality. The GDEMP (RPS, 2023b) includes trigger values to ensure impacts to the Walpole River are consistent with the EPA objective for social surroundings. If these triggers are exceeded, the following actions will be implemented to minimise and manage impacts:                             <ul style="list-style-type: none"> <li>If the surface water quality trigger criterion is exceeded, Water Corporation will notify DWER and review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water levels declining any further. Additional field and laboratory analysis, including assessment of groundwater levels, will be undertaken to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results.</li> <li>If the surface water quality threshold criterion is exceeded, Water Corporation will notify DWER, and the production bore associated with the identified breach will be turned off and additional groundwater and surface water quality monitoring undertaken.</li> <li>If the trigger criterion for surface water levels is exceeded, Water Corporation will review the production plan and make preliminary adjustments to groundwater abstraction to prevent the surface water levels declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>If the threshold criterion for surface water levels is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. This data will be reviewed as well as an assessment of climatic data and surface water flows to confirm field results. The preliminary adjustments to groundwater abstraction will be finalised based on these results. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> <li>If the trigger criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. Water Corporation will also review the production plan and make preliminary adjustments to groundwater abstraction to prevent the water flows declining any further. Additional field and laboratory analysis will also be undertaken.</li> <li>If the threshold criterion for surface water flows within the Walpole River (measured at the Walpole Weir) is exceeded, Water Corporation will notify DWER. The production bore associated with the breach will be turned off and additional groundwater and surface water quality monitoring undertaken. If data reviews determine that flow declines are due to the proposal, then bores will not be turned back on until baseline levels return.</li> </ul> </li> <li>Water Corporation shall prepare and submit a Groundwater Dependent Ecosystems Performance Report to DWER within one year of completion of the trial that shall include a summary of monitoring results, any exceedance of triggers and analysis of potential responses to groundwater drawdown.</li> </ul>	
		Rehabilitate	N/A	
<b>Surrounding land users</b>				
Impacts to domestic and agricultural users that may be reliant on groundwater.	Indirect	Avoid	<ul style="list-style-type: none"> <li>Approximately 0.5 ha of the predicted zone of influence comprises private landholdings and therefore, impacts to surrounding groundwater users have been avoided as far as practicable. No further management or mitigation is considered necessary.</li> </ul>	No residual impacts.
		Minimise Rehabilitate	The majority of the predicted zone of influence does not comprise private landholdings and no minimisation or rehabilitation is anticipated to be required.	
<b>Bushfire</b>				
Damage to property and/or infrastructure from fire	Direct	Avoid	<ul style="list-style-type: none"> <li>Although the bores are within a mapped bushfire prone area, they are located within existing agricultural land, approximately 200 m from the native vegetation located in the west of the zone of influence.</li> </ul>	No residual impacts.
		Minimise	<ul style="list-style-type: none"> <li>Abstraction bores and associated infrastructure are either located within or adjacent to an area mapped as a Bushfire Prone Area (Figure 37). The current bore and generator layouts have the following clearance from existing vegetation (Water Corporation, 2023c) and potential risks are considered minimal.</li> </ul>	
		Rehabilitate	N/A	

## 12.8 Assessment and significance of residual impacts

As there are no Registered or Other Aboriginal heritage sites within the zone of influence and values within the Walpole River will be protected through implementation of the following plans, there are no residual impacts to Aboriginal heritage:

- GDEMP (RPS, 2023b) (Appendix B)
- ASS detailed site investigation (RPS, 2023c) (Appendix D)
- WIMP (Water Corporation, 2023a) (Appendix E).

## 12.9 Proposed environmental outcomes

Key environmental outcomes have been proposed to ensure that the EPA's Social Surroundings objective (EPA, 2023) will be achieved:

- There will be no direct impacts to Aboriginal heritage values.
- There will be no impacts to surrounding groundwater users from the proposed trial.
- Implementation of the below plans will ensure there are no residual, indirect impacts to Aboriginal heritage values within the zone of influence and therefore, the environmental outcomes are consistent with the EPA objective for Social Surroundings (EPA, 2023), and thereby not significant, as they protect social surroundings from significant harm:
  - GDEMP (RPS, 2023b) provided in Appendix B
  - ASS detailed site assessment (RPS, 2023c) provided in Appendix D
  - WIMP (Water Corporation, 2023a) provided in Appendix E.

## 13 OTHER ENVIRONMENTAL FACTORS OR MATTERS

The proposed six-month groundwater abstraction trial is predicted to have a temporary zone of influence of approximately 149.43 ha. Table 52 provides an overview of how the other environmental factors relate to the proposal.

**Table 52: Overview of other environmental factors**

Environmental factor	Objective	Relevance to the proposal
<b>Sea</b>		
Benthic communities and habitat	To protect benthic communities and habitats so that biological diversity and ecological integrity are maintained	The proposal is situated over 6 km north of the Indian Ocean coast. It is not anticipated that the proposal will result in impacts to the marine environment.
Coastal process	To maintain the geophysical processes that shape coastal morphology so that the environmental values of the coast are protected	
Marine environmental quality	To maintain the quality of water, sediment and biota so that environmental values are protected	
Marine fauna	To protect marine fauna so that biological	
<b>Land</b>		
Landforms	To maintain the variety and integrity of significant physical landforms so that environmental values are protected.	No significant landforms are present within the zone of influence that would be impacted by the proposed groundwater abstraction trial.
<b>Air</b>		
Air quality	To maintain air quality and minimise emissions so that environmental values are protected	<p>It is anticipated that a minor increase in local vehicle movements will occur to undertake monitoring and maintenance activities during the trial.</p> <p>It is considered that a minor increase in local vehicle movements required to support the proposal will not result in a significant effect in local air quality parameters.</p> <p>Two generators are proposed to support the groundwater abstraction. An estimate of the carbon dioxide emissions from operation of the generators for 24 hours a day, seven days a week has been undertaken and is summarised below:</p> <ul style="list-style-type: none"> <li>• Average daily carbon dioxide produced – 135 kg/day</li> <li>• Overall carbon dioxide produced – 24.5 tonnes.</li> </ul>
Greenhouse gas emissions	To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change	As discussed above, the estimated carbon dioxide emission from the proposal is 24.5 tonnes. Therefore, it is not anticipated that the six-month groundwater trial will result in the release of significant greenhouse gas emissions (i.e. <100,000 tonnes per annum of CO <sub>2-e</sub> ).
<b>People</b>		
Human health	To protect human health from significant harm	This factor primarily relates to project where radiation occurs within materials in a manner that could pose a risk to human health. The proposal is not expected to present any human health risk (Water Corporation, 2023a).



## 14 OFFSETS

The following policy and guidance are relevant to the assessment of offsets for the proposal:

- WA Environmental Offsets Policy (Government of Western Australia, 2011)
- WA Environmental Offsets Guidelines (Government of Western Australia, 2014)
- Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA, 2020b).

Consistent with Principle 1 of the WA Environmental Offsets Policy (Government of Western Australia 2011) Water Corporation has applied the mitigation hierarchy by identifying measures to avoid and minimise environmental impacts, as outlined in Sections 7 to 12 of this report. An assessment of the residual impacts indicates that the proposal may result in the following residual impacts:

- There will be no direct impacts from the proposal as no vegetation clearing is proposed
- Indirect, temporary groundwater drawdown impacts to 1.08 ha (0.72% of the zone of influence) of fauna habitat that may provide habitat for Baudin's cockatoo, Carnaby's cockatoo, forest red-tail black-cockatoo, quokka, quenda, Nornalup frog, sunset frog, rakali, western false pipistrelle and wambenger brush-tailed phascogale. This habitat is summarised below:
  - Moderate risk of groundwater drawdown impacts to 0.21 ha of riparian zone habitat
  - Moderate risk of groundwater drawdown impacts to 0.46 ha of broad swampy plains habitat
  - Moderate risk of groundwater drawdown impacts to 0.26 ha and high risk of impacts to 0.16 ha of isolated paddock remnant (riparian)
- Indirect, temporary groundwater drawdown impacts to 0.79 ha (0.5% of the zone of influence) of terrestrial GDEs in Excellent condition. This vegetation comprises the CcTBsLt vegetation type and is associated with the:
  - Potential (not yet listed and currently under assessment by the Minister) TEC *Empodisma gracillimum* peatlands of south-west Western Australia
  - Kordabup vegetation complex
- Residual indirect impacts are limited to the modelled groundwater drawdown of 0.05 m at bore STY-04 (Figure 13), where the previously undescribed stygofauna species (*Bathynellidae* sp. 'Walpole 1') was identified. This species was also identified outside the modelled zone of influence and is therefore not restricted to the modelled groundwater drawdown area.

There will be no direct impacts from the proposal as no vegetation clearing is proposed. The potential indirect impacts listed above will be managed through implementation of the below plans and an offset is not considered necessary to counterbalance the impact:

- GDEMP (RPS, 2023b) provided in Appendix B
- ASS detailed site assessment (RPS, 2023c) provided in Appendix D
- WIMP (Water Corporation, 2023a) provided in Appendix E.

The aim of the trial is to verify the accuracy and reliability of the groundwater model and its predictions to determine the suitability as a long-term source.

These management plans outline provisions to address potential impacts associated with the abstraction of groundwater for the six-month trial. However, some uncertainty remains as the assessment has been based on a groundwater drawdown model, and it is possible that there may be significant residual impact on terrestrial or aquatic GDEs. The aim of the trial is to verify the accuracy and reliability of the groundwater model and its predictions to determine the suitability as a long-term source. Monitoring undertaken during the trial will provide the data required to assess and quantify any residual impacts from groundwater drawdown.

## 15 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

Matters of National Environmental Significance that relate to the proposal includes threatened species as discussed in Table 53.

**Table 53: Matters of national environmental significance summary**

MNES	Distance from the proposal	Description
World heritage properties	There are no world heritage properties within 20 km of the proposal.	N/A
National heritage places	There are no national heritage places within 20 km of the proposal.	N/A
Wetlands of international significance	There are no nat. wetlands of international significance within 20 km of the proposal.	N/A
Great Barrier Reef Marine Park (GBRMP)	The GBRMP is not located within 20 km of the proposal.	N/A
Commonwealth marine areas	The EEZ and territorial sea is located over 15 km south of the proposal. This MNES is not relevant to the proposed action as it is not located in and does not interact with a marine environment.	N/A
Listed threatened ecological communities	The TEC subtropical and temperate coastal salt marsh is potentially located within 20 km of the proposal.	No vegetation representative of this TEC was identified within the zone of influence by RPS and RPS is confident this TEC does not occur in the zone of influence (RPS, 2023).
Listed threatened species	Within the zone of influence.	Listed threatened species recorded, or likely to occur within the zone of influence includes (Phoenix, 2023a): <ul style="list-style-type: none"> <li>• <i>Zanda baudinii</i> (Baudin's cockatoo) (Endangered)</li> <li>• <i>Zanda latirostris</i> (Carnaby's cockatoo) (Endangered)</li> <li>• <i>Calyptorhynchus banksii naso</i> (forest red-tailed black-cockatoo) (Vulnerable)</li> <li>• <i>Engaewa walpolea</i> (Walpole burrowing crayfish) (Endangered)</li> <li>• <i>Galaxiella nigrostriata</i> (blackstriped dwarf galaxias) (Endangered)</li> <li>• <i>Nannatherina balstoni</i> (Balston's pygmy perch) (Vulnerable)</li> <li>• <i>Nannoperca pygmaea</i> (little pygmy perch) (Endangered)</li> <li>• <i>Westralunio carteri</i> (Carter's freshwater mussel) (Vulnerable).</li> </ul> As discussed in Section 10, there is potential for groundwater drawdown from the proposal to indirectly impact suitable habitat for these species within the zone of influence.
Listed migratory species	Recorded within 20 km of the site.	Phoenix (2023a) did not record and listed migratory species within the zone of influence and did not consider it likely that any migratory species use the habitat within the zone of influence. Species that may possibly occur within the zone of influence are discussed in Table 35 and significant impacts to these species is considered unlikely.
Nuclear actions	None are located within 20 km of the proposal.	The proposal does not relate to this MNES.
Water resources in relation to coal seam gas and large coal mining development	None are located within 20 km of the proposal.	The proposal does not relate to this MNES.

## 16 HOLISTIC IMPACT ASSESSMENT

While the impacts of the proposal against the key environmental factors have been assessed individually, given the link between flora and vegetation, terrestrial fauna, inland waters and the potential impacts from groundwater drawdown, the connections and interactions between parts of the environment to inform a holistic view of impacts to the whole environment have also been considered.

The proposal has been designed to avoid all direct impacts to native vegetation. Of the modelled 149.43 ha zone of influence, only 72.96 ha (48.83%) comprises native vegetation. However, of this only 0.79 ha (0.5% of the zone of influence) is considered likely to be temporarily impacted by the predicted groundwater drawdown.

There is also a potential connection between the Social Surroundings and Inland Waters environmental factors. The Walpole River was identified to be a potential site of cultural significance during the Aboriginal Heritage Survey (Aboriginal Land Services, 2023). The proposed groundwater drawdown could potentially impact the Walpole River. The Walpole Weir is located outside (south-east of) the zone of influence. Due to the impounding impacts of the Walpole Weir, the water levels upstream and within the zone of influence, are no longer representative of the original hydrology.

Through the implementation of the proposed monitoring, triggers and contingency criteria outlined in the GDEMP, the potential impacts from groundwater drawdown on the environmental factors of flora and vegetation, terrestrial fauna, inland waters and social surroundings would be minimised. When the separate environmental factors of the proposal are considered together, and application of the mitigation hierarchy, the impacts from the proposal on environmental values are considered to be manageable during the six-month trial period.

## 17 CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

In accordance with EPA's instructions for a referral of a proposal under Section 38 of the EP Act (EPA, 2021), Water Corporation has assessed the cumulative environmental impacts through consideration of the significance of the impacts of the proposal, both in isolation (this proposal referral) and cumulatively (the proposal, together with other projects in the region). Only the environmental factors with a residual impact have been assessed, other factors are not considered given they are deemed a low risk to the environment and can be managed with routine management procedures and the GDEMP (RPS, 2023b), ASS detailed site assessment (RPS, 2023c) and WIMP (Water Corporation, 2023a).

Environmental factors included in this cumulative impact assessment include:

- Land factors
  - Flora and vegetation
  - Subterranean fauna
  - Terrestrial fauna
- Water factors
  - Inland waters.

On the basis of the below assessment, it is not considered that the proposal presents a significant risk relative to current, proposed or cumulative impacts for each key environmental factor.

### 17.1 Flora and vegetation

Indirect, temporary groundwater drawdown impacts to 0.79 ha (0.5% of the zone of influence) of terrestrial GDEs in Excellent condition. This vegetation comprises the CcTBsLt vegetation type and is associated with the:

- Potential (not yet listed and currently under assessment by the Minister) TEC *Empodisma gracillimum* peatlands of south-west Western Australia. As the potential TEC is not yet listed, or protected under the EPBC Act, potential impacts from surrounding projects cannot be assessed
- Kordabup vegetation complex.

A search of EPA referrals within the Walpole area and EPBC referrals and clearing permits (areas approved to clear and areas applied to clear) within 5 km of the proposal has been undertaken to assess the potential cumulative impacts to flora and vegetation. Vegetation clearing that has been approved within the search area included:

- Clearing no more than 1 ha of vegetation within the North Walpole Road reserve. This vegetation was mapped as Mattiske vegetation complexes Hazelvale, Keystone, Mattaband and Keystone (DWER, 2019)
- Clearing no more than 1.92 ha of vegetation located in north Walpole. This vegetation was mapped as the Keystone vegetation complex (DWER, 2021).

As the approved clearing of up to 2.92 ha does not comprise the Kordabup vegetation complex, it is not considered that the proposal presents a significant cumulative impact to this vegetation complex. Furthermore, as the proposal does not involve direct impacts to this environmental factor, the risk relative to current, proposed or cumulative impacts are not considered significant.

### 17.2 Subterranean fauna

As the area is not proclaimed, the status of any other groundwater users in the area is unknown. However, as stakeholder consultation undertaken as part of the proposal did not identify any potential surrounding groundwater users, cumulative impacts from groundwater abstraction to subterranean fauna is not considered likely to be significant.

## 17.3 Terrestrial fauna

The approvals to clear vegetation within 5 km of the proposal, includes impacts to up to 1.92 ha of potential black cockatoo habitat.

Potential indirect impacts to black cockatoo habitat from this proposal are summarised below:

- Potential habitat with a moderate risk of impacts from the modelled groundwater drawdown is summarised below:
  - 0.46 ha of potential foraging habitat (0.85% of the overall area of black cockatoo habitat within the zone of influence) associated with the broad swampy plains habitat type.
  - 0.47 ha of potential black cockatoo foraging habitat (0.87% of the overall area of black cockatoo habitat within the zone of influence) associated with the riparian zone habitat type.
  - A targeted search of this area did not identify any potential breeding trees.
- 0.16 ha (0.29% of the overall area of black cockatoo habitat within the zone of influence) associated with the riparian paddock remnants has a high risk of impact from the groundwater drawdown.
  - A targeted survey of this habitat area identified three Potential breeding trees (*Eucalyptus diversicolor*) with hollows. Research indicates that root systems of Eucalypt species may extend and extract water at depth varying between 5.6 m and 20 m (Knight, 1999), indicating that, although within the area of high risk, impacts to these trees as a result of the modelled groundwater drawdown are unlikely.
- There is no potential black cockatoo habitat with a severe risk of impact from the modelled groundwater drawdown.

The proposals contribution to cumulative impacts from indirect impacts to 1.09 ha of potential black cockatoo habitat is not considered significant.

## 17.4 Inland waters

There are no direct impacts to inland waters. Indirect impacts from the proposal that have been included in this cumulative impact assessment includes Indirect, temporary groundwater drawdown impacts to 0.79 ha (0.5% of the zone of influence) of terrestrial GDEs in Excellent condition. The potential for cumulative impacts associated with this vegetation is addressed in Section 17.1.

The proposals contribution to cumulative impacts from indirect impacts to inland waters is not considered significant.

## 18 REFERENCES

- Aboriginal Land Services Aboriginal Heritage Study: An archaeological and ethnographic site identification survey with the Wagyl Kaip Southern Noongar representatives to inform CW01923 – Walpole New Source Borefield project. [Report]. 2023.
- Bea Sommer & Ray Freund Gngangara Mound Ecohydrological Study [Report]. 2010.
- Beard J.S., Beeston, G.R., Harvey, J.M., Hopkins, A.J.M. and D.P. Shepherd, D The vegetation of Western Australia at the 1:3,000,000 scale. Explanatory memoir. Second edition. Conservation Science W. Aust. 9 (1): 1–152. [Report]. 2013.
- Coffey Environments. Acid sulfate soils investigation, Walpole groundwater source, Swann Road, Walpole [Report]. 2010.
- DBCA Guniyan Binba Conservation Park Joint Management Plan [Report]. 2020.
- DBCA Threatened Ecological Community Fact Sheet; Monsoon (vine) thickets on coastal sand dunes of Dampier Peninsula [Report]. 2020.
- DCCEEW *Engaewa walpolea* (Walpole Burrowing Crayfish) Conservation Advice [Report]. 2009.
- DCCEEW Interim Biogeographic Regionalisation for Australia, Version 7. [Online]. 2021. March 2023.. <https://www.dcceew.gov.au/sites/default/files/env/pages/5b3d2d31-2355-4b60-820c-e370572b2520/files/ibra-subregions.pdf>.
- DCEEW Referral guideline for 3 WA threatened black cockatoo species [Report]. 2022.
- Department of Environment and Energy Research to inform the assessment of ecohydrological responses to coal seam gas extraction and colat mining [Report]. 2016.
- Department of Environment Regulation Assessment and Management of Contaminated Sites [Report]. 2014.
- Department of Environment Regulation Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes [Report]. 2015a.
- Department of Environment Regulation Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes [Report]. 2015b.
- Department of Planning and WAPC State Planning Policy (SPP) 3.7: Planning in Bushfire Prone Areas [Report]. 2015.
- Department of Sustainability, Environment, Water, Population and Communities Conservation Advice for SUBTROPICAL AND TEMPERATE COASTAL SALTMARSH [Report]. 2013.
- Department of the Environment and Energy Wetlands and changes in water flows [Journal]. [s.l.] : Commonwealth of Australia, 2016.
- Department of the Environment, Water, Heritage and the Arts Approved Conservation Advice for *Nannatherina balstoni* (Balston's Pygmy Perch) [Report]. 2008.
- Department of Water A summary of investigations into ecological water requirements of groundwater-dependent ecosystems in the South West groundwater areas [Report]. 2006.
- Department of Water and Environmental Regulation Guideline; Assessment of environmental noise emissions [Report]. 2021.
- Department of Water and Environmental Regulation South West Index of River Condition data collected between 16-17 March, Healthy Rivers Program, Department of Water and Environmental Regulation, Perth Western Australia. [Report]. 2020.
- Department of Water Walpole drinking water source protection review; Walpole town water supply [Report]. 2016.
- Department of Water Walpole Weir and Butler's Creek Dam Catchment Areas Drinking Water Source Protection Plan [Report]. 2007.
- Department of Water Water quality protection note 65 - Toxic and hazardous substances [Report]. 2015.
- DEWHA Approved Conservation Advice for *Reedia spathacea* (Reedia). [Report]. 2008.
- DoE Potentially Contaminating Activities, Industries and Landuses [Report]. 2004.

## REPORT

---

- DPLH Aboriginal Cultural Heritage Enquiry System [Online]. 2023. 2023. <https://espatial.dplh.wa.gov.au/ACHIS/index.html?viewer=ACHIS>.
- DWER Balston's pygmy perch - *Nannatherina balstoni* [Online] // South west rivers. 2023b. 2023b. <https://rivers.dwer.wa.gov.au/species/nannatherina-balstoni/>.
- DWER Black-stripe minnow - *Galaxiella nigrostriata* [Online] // South West Rivers. 2023. March 2023. <https://rivers.dwer.wa.gov.au/species/galaxiella-nigrostriata/>.
- DWER Carter's freshwater mussel - *Westralunio carteri* [Online] // Healthy Rivers South West. 2023. <https://rivers.dwer.wa.gov.au/species/westralunio-carteri/>.
- DWER Clearing Permit Decision Report - 8448/2 [Report]. 2019.
- DWER Clearing Permit Decision Report - CPS 9082/1 [Report]. 2021.
- DWER South West Index of River Condition data collected between 16-17 March, Healthy Rivers Program, Department of Water and Environmental Regulation, Perth Western Australia [Report]. 2020.
- DWER Water quality protection note 10 - Contaminant spills - emergency response plan [Report]. 2020.
- DWER Water quality protection note 25 - Land use compatibility tables for public drinking water source areas [Report]. 2021.
- DWER Water quality protection note 56 - Tanks for fuel and chemical storage near sensitive water resources [Report]. 2018.
- EPA Environmental Factor Guideline: Flora and Vegetation [Report]. 2016a.
- EPA Environmental Factor Guideline: Inland Waters [Report]. 2018a.
- EPA Environmental Factor Guideline: Social Surroundings [Report]. 2023.
- EPA Environmental Factor Guideline: Subterranean Fauna [Report]. 2016c.
- EPA Environmental Factor Guideline: Terrestrial Environmental Quality [Report]. 2016e.
- EPA Environmental Factor Guideline: Terrestrial Fauna [Report]. 2016f.
- EPA Environmental Guidance for Planning and Development, Guidance Statement No. 33. [Report]. 2008.
- EPA Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual [Report]. 2020b.
- EPA Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual Requirements under the Environmental Protection Act 1986 [Report]. 2021c.
- EPA EPA Technical Guidance – Subterranean fauna surveys for environmental impact assessment [Report]. 2021b.
- EPA Instructions on how to prepare an Environmental Review Document [Report]. 2021.
- EPA Statement of environmental principles, factors, objectives and aims of EIA [Report]. 2023.
- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment [Report]. 2016b.
- EPA Technical Guidance: Sampling of short range endemic invertebrate fauna [Report]. 2016i.
- EPA Technical Guidance: Sampling of short range endemic invertebrate fauna [Report]. 2016g.
- EPA Technical Guidance: Subterranean Fauna Survey [Report]. 2016d.
- EPA Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment [Report]. 2020.
- Global Groundwater Walpole Test Pumping and Groundwater Investigation [Report]. 2021.
- Government of Western Australia WA Environmental Offsets Guidelines [Report]. 2014.
- Government of Western Australia inHerit database [Online]. 2021. 2023. <http://inherit.stateheritage.wa.gov.au/public>.
- Government of Western Australia WA Environmental Offsets Policy [Report]. 2011.
- Hearn R., Williams, K., and Comer, S. Warren (WAR – Warren) [Online]. 2002. March 2023. [https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/warren\\_p637-655.pdf](https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/warren_p637-655.pdf).

## REPORT

---

- Hose GC, J Sreekanth, Barron O, Pollino C Stygofauna in Australian Groundwater Systems: Extent of knowledge [Report]. Australia : CSIRO, 2015.
- Knight John. Root distributions and water uptake patterns in Eucalypts and other species [Journal]. [s.l.] : The ways trees use water. 66-93., 1999.
- Loomes R. Froend & R. South West Yarragadee; Assessment of vegetation susceptibility and possible response to drawdown [Report]. 2005.
- Phoenix Environmental Short-range endemic invertebrate survey for the Swann Road Walpole EIA Project [Report]. 2023d.
- Phoenix Environmental Stream fauna assessment for the Swann Road borefield assessment [Report]. 2023.
- Phoenix Stream fauna assessment for the Swann Road Borefield Project [Report]. 2023c.
- Phoenix Stygofauna survey for the Swann Road Walpole EIA Project [Report]. 2023b.
- Phoenix Terrestrial fauna assessment for the Swann Road Walpole EIA Project [Report]. 2023a.
- R Froend & R Loomes Determination of EWRs for Wetland and Terrestrial Vegetation – Southern Blackwood and Eastern Scott Coastal Plain [Report]. 2006.
- R. Froend R. Loomes, P. Horwitz, M. Bertuch, A. Storey and M. Bamford Study of Ecological Water Requirements on the Gngara and Jandakot Mounds under Section 46 of the Environmental Protection Act; Determination of Ecological Water Requirements [Report]. 2004.
- Richardson S., Irvine, E., Froend, R., P Boon, P., Barber, S., Bonneville, B. Australian groundwater-dependent ecosystem toolbox part 1: assessment framework, Waterlines report. [Report]. 2011.
- RPS. Acid sulfate soil detailed site assessment; Swann Road borefield, Walpole [Report]. 2023c.
- RPS. Acid sulfate soils report [Report]. 2023c.
- RPS. Flora and vegetation assessment, Swann Road borefield, [Report]. 2023.
- RPS. Groundwater Dependent Ecosystem management plan, Walpole [Report]. 2023b.
- Sandra J. Zencich Ray H. Froend, Jeffrey V. Turner & Vit Gailitis Influence of Groundwater Depth on the Seasonal Sources of Water Accessed by Banksia Tree Species on a Shallow, Sandy Coastal Aquifer [Report]. 2002.
- Shand P, Appleyard, S, Simpson, SL, Degens, B Mosley, LM National Acid Sulfate Soils Guidance: Guidance for the dewatering of acid sulfate soils in shallow groundwater environments. [s.l.] : Department of Agriculture and Water Resources, 2018.
- Threatened Species Scientific Committee Conservation Advice Galaxiella nigrostriata black-stripe minnow [Report]. 2018.
- Threatened Species Scientific Committee Conservation Advice Nannoperca pygmaea Little Pygmy Perch [Report]. 2019.
- Threatened Species Scientific Committee Conservation Advice Westralunio carteri Carter's freshwater mussel [Report]. 2018b.
- Water Corporation Data - Daily maximum and minimum water levels - Walpole Weir. 1998 to 2023. 2023f.
- Water Corporation Emergency preparedness and response procedure [Report]. 2023 g.
- Water Corporation Technical Advice; Walpole Conceptual Hydrogeology six month trial [Journal]. 2022b.
- Water Corporation Walpole Bores 6 Month Trial Engineering Design [Report]. 2023c.
- Water Corporation Walpole Groundwater Investigation (Six month abstraction trial); Implementation and monitoring plan [Report]. 2023a.
- Water Corporation Walpole New Source CW01923 Project Update [Journal]. 2023e.
- Water Corporation Walpole new source; Community engagement plan and contact register [Report]. 2023d.
- Water Corporation Walpole River at Walpole Weir, Analysis of observed flow regime [Report]. 2022.