



Mining Area C-South Flank Significant Amendment

**Central Pilbara Hub Surplus Water Proposal
Stage 1**

Referral supporting document

February 2025

Authorisation

Version	Description	Date
Draft	Draft for Traditional Owner review	4/10/2024
Version 1	Final version for referral to EPA	21/02/2025

Abbreviations

Term	Meaning
2D	Two dimensional
μS/cm	micro Siemens per centimeter
AARs	Annual Aquifer Reviews
ACCU	Australian Carbon Credit Units
AEP	Annual Exceedance Probability
AER	Annual Environmental Reports
AH Act	<i>Aboriginal Heritage Act 1972 (WA)</i>
ANZECC	Australian and New Zealand Environment and Conservation Council
ANZG	Australia and New Zealand guidelines
AMD	Acid mine drainage
AoC	Analytes of concern
AoPC	Areas of potential concern
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AUD	Australian Dollars
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BC Act	<i>Biodiversity Conservation Act 2016 (WA)</i>
BHP	BHP Iron Ore Pty Ltd
BIF	Banded Iron Formation
BNTAC	Banjima Native Title Aboriginal Corporation
BoM	Bureau of Meteorology
BWT	Below water table
CA	Calcium
CC Act	<i>Climate Change Act 2022</i>
CCS	Crown condition score
CS Act	<i>Contaminated Sites Act 2003</i>
CEO	Chief Executive Officer
CER	Clean Energy Regulator

Term	Meaning
CH ₄	Methane
CID	Channel Iron Deposit
CHMP	Cultural Heritage Management Plan
CH ₄	Methane
CPWRMP	Central Pilbara Water Resources Management Plan
CO ₂	Carbon dioxide
CPH	Central Pilbara Hub
CPWRMP	Central Pilbara Water Resource Management Plan
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DE	Development Envelope
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DGV	Design guideline value
DJTSI	Department of Jobs, Tourism, Science and Innovation
DO	Dissolved Oxygen
DoE	Department of the Environment
DPAW	Department of Parks and Wildlife
DWER	Department of Water and Environmental Regulation
EC	Electrical conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EP Act	<i>Environmental Protection Act 1986 (WA)</i>
EPA	Environmental Protection Authority (Western Australian)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)</i>
ERD	Environmental Review Document
EWR	Ecological Water Requirements
FMP	Fauna Management Plan
FullCAM	Full Carbon Accounting Model

Term	Meaning
FY	Financial Year
GCOSA	Grand Central Overburden Storage Area
GDE	Groundwater Dependent Ecosystem
GDV	Groundwater Dependant vegetation
GHG	Greenhouse Gas
GIS	Geographic Information System
GL	Gigalitre
GL/a	Gigalitres per annum
GST	Goods and Services Tax
GWL	Groundwater Licence
ha	hectare
HAC	Heritage Advisory Council
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessments
ICROA	International Carbon Reduction & Offset Alliance
IEA	International Energy Agency
ILUA	Indigenous Land Use Agreement
IRP	Impact Reconciliation Procedure
IRR	Impact Reconciliation Reporting
IUCN	International Union for Conservation of Nature
HCF	Hydrofluorocarbons
kL	kilolitre
km	kilometre
km ²	square kilometre
LSI	Langelier Saturation Index
LOR	Limit of reporting
LULUCF	Land clearing, land change and forestry
m	metre

Term	Meaning
m/s	metres per second
m ³ /s	cubic metres per second
MAC	Mining Area C
MAC-SF	Mining Area C-South Flank
MAR	Managed Aquifer Recharge
mAHD	metres Australian Height Datum
mbgl	metres below ground level
MC	Marillana Creek
MCP	Mine Closure Plan
mg/L	milligrams per litre
ML	Mining Lease
ML	Mega litres
ML/day	mega litres per day
mm	Millimetre
MNES	Matters of National Environmental Significance
MRL	Mineral Resources Limited
MS	Ministerial Statement
Mtpa	million tonnes per annum
MW	Mega watts
NAPP	Net acid producing potential
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
NVCP	Native Vegetation Clearing Permit
NTU	Nephelometric Turbidity Units
NUDLC	National Uniform Drilling Licensing Committee
NWQMS	National Water Quality Management Strategy
%	percent
OSA	Overburden storage area
PEC	Priority Ecological Community

Term	Meaning
PEAHR	Project Environmental and Aboriginal Heritage Review
PEOF	Pilbara Environmental Offsets Fund
PER	Public Environmental Review
PFAS	Per- and polyfluoroalkyl substances
PFCS	Perfluorocarbons
PFHxS	Perfluorohexanesulfonic acid
PFOS	Perfluorooctanoic Sulfonate
RAV	Runaway Valley
REC	Resource and Environmental Compliance
RiWI Act	<i>Rights in Water and Irrigation Act 1914</i> (WA)
REC	Renewable energy certificates
RTIO	Rio Tinto Iron Ore
SCHEMP	Social Cultural Heritage Environmental Management Plan
SF ₆	Sulphur hexafluoride
SMC	Safeguard Mechanism Credit
SME	Subject matter experts
SPR	Source-Pathway-Receptor
SRE	Short-range Endemic
TARs	Triennial Aquifer Reviews
tCO ₂ -e	Tonnes (t) of Carbon Dioxide (CO ₂) Equivalent (e)
TD	Tertiary Detrital
tpa	Tonnes per annum
TDS	Total dissolved solids
TEC	Threatened Ecological Community
WA	Western Australia
TN	Turkeys Nest
WAIO	Western Australia Iron Ore
WWTP	Wastewater treatment plant

Glossary

Term	Meaning
Approved Proposal	The works and activities for mining operations within Mining Area C and South Flank (the Central Pilbara Hub) comprising the Approved Proposal under the existing Ministerial Statement 1072.
BHP	BHP Iron Ore Pty Ltd, as manager and agent for and on behalf of BHP Billiton Minerals Pty Ltd, BHP Iron Ore (Jimblebar) Pty Ltd, United Iron Pty Ltd, the participants of the Mount Goldsworthy Joint Venture, Mount Newman Joint Venture and Yandi Joint Venture.
Cleared Area	The total area that has been cleared for the Approved Proposal ¹ .
Combined Proposal	The Significant Amendment together with the Approved Proposal.
Commonwealth Strategic Approval	The approval of the taking of an action or class of actions within the Strategic Assessment Area, granted by the (Federal) Minister for the Environment on 19 June 2017 in accordance with the Program given under section 146B of the EPBC Act.
Development Envelope	The maximum area within which the Combined Proposal footprint will be located.
Indicative Footprint	The location where the Proposal elements are planned to occur.
Previously Assessed Area	The total area of clearing assessed and approved for the Approved Proposal ¹ .
Proposal	The works and activities for which approval is sought (i.e. the Significant Amendment to the Approved Proposal).
Significant Amendment	An amendment to an Approved Proposal that is significant, according to the definition in the EP Act and requires referral under s38 (i.e. the Proposal).
Significant fauna	Fauna species listed as threatened under the EPBC Act or BC Act or as Priority fauna by the DBCA

¹ Area is indicative only and based on BHP GIS database.

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Executive summary

Table ES-1: General proposal content description

Proposal title	Mining Area C-South Flank Mining Operations
Proponent name	BHP Iron Ore Pty Ltd
Short description	The Combined Proposal is for mining operations at the Mining Area C Hub, located approximately 120 km north-west of the town of Newman. The proposal includes, but is not limited to the following activities and elements: • mine pit excavation above and below the water table • groundwater abstraction to dewater mine deposits and operational water supply • dewatering and surplus water infrastructure, including bores, infiltration ponds and pipelines • provision of environmental water requirements to Yandicoogina Gorge groundwater dependent ecosystem • surplus water management, including controlled discharge to creeks, infiltration ponds and injection to aquifers • surface water management infrastructure including culverts and creek diversions • installation of communication towers to support mine operation • ore stockpiles and topsoil stockpiles and associated stacking, reclaiming and loading activities • mineral waste management, including overburden storage areas • haul and access roads • borrow pits and laydown areas • ore processing and blending infrastructure, including crusher and beneficiation plant • ore transportation infrastructure, including overland conveyor and rail • ancillary infrastructure, including workshops, offices, hydrocarbon storage areas, accommodation villages, water treatment plant, wastewater treatment plant. The proposal is located within a 40,059 ha Development Envelope and will require the clearing of up to 22,900 ha of native vegetation.

Table ES-2: Proposal content elements

Element	Location / description	Existing proposal maximum extent, capacity or range (Approved Proposal)	Proposed amendment extent, capacity or range (Proposal – Significant Amendment)	Combined maximum extent, capacity or range (Combined Proposal)
Physical elements				
Mine and associated infrastructure • Open pits • Haul Roads • Overburden Storage Areas • Ore Processing and Blending	Figure 2-2	Part IV assessed and approved • Clearing of no more than 21,824 ha of native vegetation within the Development Envelope of 38,909 ha	Additional clearing of 1,076 ha of native vegetation Additional development envelope area of 1,150 ha	Clearing of no more than 22,900 ha of native vegetation, within the 40,059 ha Development Envelope
Operational elements				
Groundwater abstraction – mine pit dewatering and water supply		Part IV assessed and approved • Total abstraction up to 37.3 GL/for dewatering	Additional groundwater abstraction for mine pit dewatering of up to 28.4 GL/a	Groundwater abstraction of up to 65.7 GL/a

Element	Location / description	Existing proposal maximum extent, capacity or range (Approved Proposal)	Proposed amendment extent, capacity or range (Proposal – Significant Amendment)	Combined maximum extent, capacity or range (Combined Proposal)
Surplus water management		Part IV assessed and approved Up to 34.84 GL per annum via managed aquifer recharge, infiltration ponds, discharge from sedimentation basin and discharge to a drainage line that leads to Pebble Mouse Creek	Additional surplus water discharge volume of up to 21.37 GL/a	Surplus water management up to 56.21 GL/a
Surplus water management – surface water discharge to watercourses	Figure 2-2	Part IV assessed and approved Surface water discharge – Pebble Mouse Creek - Controlled discharge along drainage line and Pebble Mouse Creek to extend no further than 14 km from the discharge point or extend beyond the boundary of the Mining Area C development. - Shall be intermittent under natural no flow conditions for maximum of 120 days in any 12-month period. (up to 34.84 GL/a assessed under Part IV) Part V approved MAC Environmental License L7851/2002/6 12.76 tonnes per annum (tpa) surface water discharge to Pebble Mouse Creek	Additional surface discharge to watercourses	Upper Marillana Creek Controlled discharge of up to 30 ML/day of surplus water must not extend further than 27 km along Marillana Creek tributary from the discharge point. A dry period of 90-days proposed in any 12-month period. Maximum operational duration of 5 years from commissioning. Lower Marillana Creek Controlled discharge of up to 30 ML/day surplus water from existing licenced discharge point in BHP Yandi mine Site. A dry period of 90-days proposed in any 12-month period. Maximum operational duration of 5 years from commissioning.

Element	Location / description	Existing proposal maximum extent, capacity or range (Approved Proposal)	Proposed amendment extent, capacity or range (Proposal – Significant Amendment)	Combined maximum extent, capacity or range (Combined Proposal)
				Pebble Mouse Creek Controlled discharge along drainage line and Pebble Mouse Creek to extend no further than 14 km from the discharge point or extend beyond the boundary of the Mining Area C development. Shall be intermittent under natural no flow conditions for maximum of 120 days in any 12-month period.
Surplus water management – aquifer injection	Figure 2-2	Part IV assessed and approved Aquifer injection – South Flank MAR - Managed aquifer recharge in the South Flank area to limit groundwater level rise to 30 m from ground level within an area of 400 m around SF0095R bore. - up to 35 ML/d (12.78 GL/a) Infiltration – Runaway Valley - up to 30 ML/day (10.95 GL/a) Aquifer injection – Juna Downs MAR - up to 30 ML/day (10.95 GL/a) Central Sedimentation Basin - up to 23.5 ML/day (8.58 GL/a) Western Sedimentation Basin - up to 12 ML/day (4.38 GL/a) Part V approved MAC Environmental License L7851/2002/6 12,760,000 tpa (12.76 GL/a) South Flank MAR	Additional surplus discharge via managed aquifer recharge	Northern RAV MAR Groundwater injection and infiltration of up to 20 ML/day (7.3 GL/annum) via managed aquifer recharge. Yandicoogina Gorge Groundwater Supplementation Groundwater injection of up to 10 ML/day (3.65 GL/annum) via managed aquifer recharge as an environmental water requirement for the Yandicoogina Gorge GDE South Flank MAR Managed aquifer recharge in the South Flank area to limit groundwater level rise to 30 m from ground level within an area of 400 m around SF0095R bore. Groundwater injection of up to 35 ML/d (12.78 GL/a)

Element	Location / description	Existing proposal maximum extent, capacity or range (Approved Proposal)	Proposed amendment extent, capacity or range (Proposal – Significant Amendment)	Combined maximum extent, capacity or range (Combined Proposal)
		16,425,000 tpa (16.43 GL/a) Runaway Valley Infiltration Ponds (listed as Packsaddle Infiltration Ponds in the licence) 12,775,000 tpa (12.78 GL/a) Juna Downs MAR 8,760,000 tpa (8.76 GL/a) Central Sedimentation Basin 10,950,000 tpa (10.95 GL/a) Western Sediment Basin 12,760,000 tpa (12.76 GL/a) surface water discharge to Pebble Mouse Creek.		Runaway Valley Infiltration of up to 30 ML/day (10.95 GL/a) Juno Downs MAR Groundwater injection of up to 30 ML/day (10.95 GL/a) Central Sedimentation Basin Infiltration of up to 23.5 ML/day (8.58 GL/a) Western Sedimentation Basin Infiltration of up to 12 ML/day (4.38 GL/a)
Grand Central Overburden Storage Area Surface Water Diversion Structure	Figure 2-2	None	Inclusion of surface water diversion structures to mine infrastructure	Surface water diversion structure to protect flood inundation of the overburden storage area.
Tailings storage – in-pit tailings storage facilities		None	N/A	N/A
Ore processing		Part IV assessed 151,000,000 tonnes of ore per annual period Part V approved MAC Environmental Licence Part V L7851/2002/6: Production capacity of 151,000,000 tonnes per annum	No change	Processing of up to 151 Mtpa

Element	Location / description	Existing proposal maximum extent, capacity or range (Approved Proposal)	Proposed amendment extent, capacity or range (Proposal – Significant Amendment)	Combined maximum extent, capacity or range (Combined Proposal)
Mine pit voids and pit lakes		Part IV assessed In Mining Area C and Highway deposit (South Flank) all below water table pits to be backfilled to prevent the formation of pit lakes. Backfill in other deposits at South Flank to be assessed as part of the closure planning process.	No change	In Mining Area C and Highway deposit (South Flank) all below water table pits to be backfilled to prevent the formation of pit lakes. Backfill in other deposits at South Flank to be assessed as part of the closure planning process.
Greenhouse Gas Emissions				
Peak annual				
Scope 1	Mine Emissions covered by Safeguard Mechanism	Part IV assessed <i>Mining Area C MS1072:</i> Scope 1,2 and 3 emissions were not individually specified Maximum annual cumulative 1,975 kt tCO ₂ -e per annum	242,126 tCO ₂ -e per annum (2045)	Up to 1,032,246 tCO ₂ -e per annum (2035)
Scope 2	Electricity supply- (Grid-connected electricity demand)(	Part IV assessed <i>Mining Area C MS1072:</i> Scope 1,2 and 3 emissions were not individually specified Maximum annual cumulative 1,975 kt tCO ₂ -e per annum	62,137 tCO ₂ -e per annum (2041)	Up to 171,979 tCO ₂ -e per annum (2050)
Scope 3	Downstream emissions (including rail transport, port, iron ore shipping and steel making)	Part IV assessed <i>Mining Area C MS1072:</i> Scope 1,2 and 3 emissions were not individually specified Maximum annual cumulative 1,975 kt tCO ₂ -e per annum	59,782,907 tCO ₂ -e per annum (2041)	Up to 207,440,658 tCO ₂ -e per annum (2029)

Element	Location / description	Existing proposal maximum extent, capacity or range (Approved Proposal)	Proposed amendment extent, capacity or range (Proposal – Significant Amendment)	Combined maximum extent, capacity or range (Combined Proposal)
Annual average life of mine				
Scope 1	Mine Emissions covered by Safeguard Mechanism	Part IV assessed <i>Mining Area C MS1072:</i> Scope 1,2 and 3 emissions were not individually specified Average annual over mine life 1,200 kt tCO ₂ -e per annum	Up to 34,563 tCO ₂ -e per annum	Up to 431,311 tCO ₂ -e per annum.
Scope 2	Electricity supply-(Grid-connected electricity demand)	Part IV assessed <i>Mining Area C MS1072:</i> Scope 1,2 and 3 emissions were not individually specified Average annual over mine life 1,200 kt tCO ₂ -e per annum	Up to 10,317 tCO ₂ -e per annum	Up to 120,408 tCO ₂ -e per annum
Scope 3	Downstream emissions (including rail transport, port, iron ore shipping and steel making)	Part IV assessed <i>Mining Area C MS1072:</i> Scope 1,2 and 3 emissions were not individually specified Average annual over mine life 1,200 kt tCO ₂ -e per annum	Up to 5,888,132 tCO ₂ -e per annum	Up to 120,822,587 tCO ₂ -e per annum
Other elements which affect extent of effects on the environment				
Maximum project life:		Part IV assessed and approved Until 2073	No change	Expected life of asset :2073
Commissioning				
Commissioning of the additional dewatering infrastructure and tailings storage facilities will be undertaken subject to the operational elements above				
Rehabilitation and closure				
Progressive rehabilitation will be undertaken, where practicable, when disturbed areas are no longer required for operations.				

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

Inland Waters	
Potential impacts	• changes to groundwater regimes from groundwater abstraction for mine pit dewatering (direct) • changes to groundwater regimes from groundwater mounding due to surplus discharge (direct) • anthropologic connection of aquifers due to drilling (direct) • changes to groundwater quality due to surplus discharge (direct) • changes to surface water flow regimes and quantity of surface water due to surplus discharge (direct) • changes in flow regime and quantity of surface water due to catchment diversion (direct) • changes to surface water quality water due to surplus discharge (direct) • changes to surface water quality due to near managed aquifer recharge (MAR) schemes (indirect) • changes in surface water quality due to infrastructure (indirect) • changes in water quality due to mining operations (indirect)
Mitigation hierarchy	Avoid • continue to implement the avoidance measures for the Approved Proposal in the Central Pilbara Water Resource Management Plan (CPWRMP) Minimise • revise the CPWRMP to include further information on monitoring triggers and thresholds for management of environmental receptors including Marillana Creek and Yandicoogina Gorge • install groundwater bores consistent with guideline requirements and best practise • use of groundwater (dewatering) consistent with water use hierarchy in order of priority: environmental water requirements, operational use, MAR, and creek discharge • implement a 90-day drying period for the Upper Marillana Creek discharge and a wetting front limit reaching the confluence of the tributary with Marillana Creek to reduce mounding in the underlying aquifer and extent of wetting front • limit operational duration of creek discharge schemes to a 5-year period • implementation of calcium carbonate treatment system to prevent precipitate build-up in proposed creek discharge • construction of creek crossings consistent with best management practices for avoiding erosion and sedimentation • engineering design of Grand Central Overburden Storage Area (GCOSA) diversion structure to reduce flood inundation, erosion and sedimentation

	- implement and optimise MAR schemes to mitigate impacts to Weeli Wolli Springs from dewatering post-closure of Rio Tinto Iron Ore's (RTIO) Hope Downs Operations Rehabilitate - backfilling of mine voids at Northern Flank and Highway Deposit (at South Flank) to 5 m above pre-mining groundwater levels to prevent the formation of pit lakes to be undertaken at closure, further development of backfill of South Flank mine subject to future assessment - rehabilitation at closure consistent with the Mine Closure Plan
Residual impacts, including assessment of significance	Residual impacts on Inland Waters following application of the mitigation hierarchy: 1. decrease in groundwater levels (drawdown) from dewatering (not significant) 2. increase in groundwater levels to within 10 meters below ground level (mbgl) due to the use of MAR in the Northern RAV area (not significant) 3. creek discharge to Upper Marillana Creek and Lower Marillana Creek (not significant) 4. alteration of flow regime through the creation of a diversion structure (not significant) 5. changes to groundwater and surface water quality (not significant)
Proposed environmental outcomes	Environmental outcomes for the residual impacts on Inland Waters: 1. Maintenance of drawdown of groundwater levels consistent with Approved Proposal for Weeli Woolli Spring/PEC 2. No adverse impact on environmental values of Ben's Oasis as groundwater drawdown is unlikely 3. No adverse impact on environmental values of Coondewanna Flats as a direct result of the drawdown of groundwater 4. No adverse impacts on environmental values of Pools of Marillana Creek from baseline monitoring 5. Return of groundwater levels to 2018 levels Yandicoogina Gorge through groundwater supplementation after period of decline
Assessment of offsets (if relevant)	N/A: No significant residual impacts after mitigation
Flora and Vegetation	
Potential impacts	- loss of vegetation and flora from clearing (direct) - changes to vegetation from changes to groundwater regimes (indirect) - changes to vegetation from changes to surface water regimes (indirect) - changes to vegetation and flora from dust, fire and weeds (indirect)
Mitigation hierarchy	Avoid

	The Proposal has been designed to avoid impacts to significant flora and vegetation as far as practical. The Indicative Footprint location has been selected to prioritise the use of existing cleared land where possible, or to construct immediately adjacent to existing cleared land. Minimise • limit additional clearing for the Proposal to 1,076 ha of native vegetation • monitor vegetation health as per the CPWRMP • implement a 90-day drying period for the Upper and Lower Marillana Creek discharge (as a result of surplus water discharge from the Proposal) and a wetting front limit reaching the confluence of the tributary with Marillana Creek to reduce vegetation dependence on increased water availability • limit operational duration of creek discharge schemes to a 5-year period from commissioning. Rehabilitate • continue to manage rehabilitation and closure according to the measures in the Mine Closure Plan
Residual impacts, including assessment of significance	Residual impacts on Flora and Vegetation following application of the mitigation hierarchy: 1. Clearing of up to 1,043 ha of native vegetation in Good to Excellent condition (in the Pilbara IBRA region) (significant) 2. Clearing of up to 60 ha of riparian vegetation, (locally significant vegetation) (significant) 3. Potential degradation or loss of Eucalyptus trees within 162 ha of vegetation impacted by groundwater mounding for the Northern RAV MAR scheme (significant) 4. Clearing of less than 0.1% of each Beard vegetation association (not significant) 5. Clearing of no more than 13% of known populations and no more than 32% of records of Priority flora species in the Pilbara region
Proposed environmental outcomes	Environmental outcomes for the residual impacts on Flora and Vegetation: 1. Contributes to the cumulative clearing of Good to Excellent condition vegetation in the Pilbara bioregion 2. Potentially contributes to the clearing of vegetation associated with the Proposal if vegetation decline or death occurs of Eucalyptus trees within 162 ha of vegetation impacted by groundwater mounding for the Northern RAV MAR scheme 3. The representation of each Beard vegetation association in the Pilbara and Gascoyne bioregions will be maintained 4. No impacts to regionally significant vegetation (TECs and PECs); and locally significant vegetation will be maintained in the local area to an extent that ecological integrity is not threatened 5. No impacts to Threatened flora; and the viability of the Priority flora known from the Development Envelope will be maintained in the Pilbara and Gascoyne bioregions
Assessment of offsets (if relevant)	BHP proposes to offset the following significant residual impacts to counterbalance the impacts to ensure the EPA's objective for Flora and Vegetation can be met:

	- clearing of up to 1,043 ha of native vegetation in Good to Excellent condition (in the Pilbara IBRA region) (significant) - clearing of up to 60 ha of riparian vegetation (locally significant vegetation) (significant) - potential decline or death of approximately 155.7 ha of critical and/or supporting fauna habitat from groundwater mounding for the Northern RAV MAR scheme (significant)
Terrestrial Fauna	
Potential impacts	- loss of fauna habitat and/or fauna individuals/species records from clearing (direct) - fragmentation of fauna habitat (direct) - changes to fauna habitats from altered groundwater regimes (indirect) - changes to fauna habitats from altered surface water regimes (indirect) - increased risk of mortality or injury from vehicle strike/interactions with machinery (indirect) - habitat degradation or species disturbance due to increased dust, noise, vibration or light (indirect) - disturbances to fauna from invasive or introduced species (indirect)
Mitigation hierarchy	Avoid - the Proposal has been designed to avoid all Ghost Bat caves - the Proposal has been designed to avoid water pools as far as practical - the use of barbed wire fencing will be avoided (where practical) Minimise - limit additional clearing for the Proposal to 1,076 ha of fauna habitat - continue to implement the Mining Area C Fauna Management Plan - use suitably qualified fauna spotters for clearing in areas where Pilbara Olive Python and/or Northern Quoll records are known to occur - install fauna underpasses along the pipeline route - undertake construction during day-light hours - design and construct infrastructure using best management practices in order to minimise indirect impacts to terrestrial fauna habitats (i.e. sediment control, dust suppression measures, utilising existing cleared areas etc) - impose appropriate speed limits on access roads and construction areas - top edges of trenches and borrow pits will be sloped to enable fauna egress - if feral cats are observed on site, a feral cat management program will be implemented

	- if Cane Toads are observed on site, they will be reported to DBCA and humanely euthanised in accordance with DBCA guidelines - implement standard hygiene practices - continue monitoring vegetation (and fauna habitat) condition in accordance with the revised CPWRMP Rehabilitate - continue to manage rehabilitation and closure according to the measures in the Mine Closure Plan
Residual impacts, including assessment of significance	Residual impacts on Terrestrial Fauna following application of the mitigation hierarchy: - Clearing a total of 808 ha of critical foraging and dispersal habitat for significant fauna species including: Ghost Bat (808 ha), Northern Quoll (27.3 ha), Pilbara Olive Python (28.3 ha) and Grey Falcon (10.1 ha) (significant) - Clearing up to 1,045 ha of supporting habitat for Northern Quoll (40 ha), Pilbara Olive Python (39 ha), Pilbara Leaf-nosed Bat (1,044 ha) and Grey Falcon (395.4 ha) (significant) - Potential degradation or loss of up to 160.7 ha of critical and/or supporting habitat for the Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Northern Quoll and/or Grey Falcon, from impacts associated with groundwater mounding (potentially significant) - Potential indirect impacts to Ghost Bat caves located within 450 m of the Indicative Footprint as a result of increased dust, light, noise and vibration (not significant) - Clearing significant fauna records including four records of Northern Quoll, two records of Pilbara Olive Python and 17 records of Western Pebble-mound Mouse mounds (not significant) - Clearing known records of four Uncertain or Potential SRE species (not significant)
Proposed environmental outcomes	Environmental outcomes for the residual impacts on Terrestrial Fauna: - No disturbance to critical foraging and dispersal habitat for significant fauna outside the Development Envelope as a result of the Proposal - No disturbance to supporting habitat for significant fauna outside the Development Envelope as a result of the Proposal - No loss or degradation of critical and/or supporting habitat as a result of groundwater mounding outside the predicted mounding contours of the Proposal - The availability of Ghost Bat caves and connecting habitat will be maintained within the Development Envelope - The viability of significant fauna populations known from the Development Envelope will be maintained - The viability of the SRE fauna assemblage known from within the Development Envelope will be maintained
Assessment of offsets (if relevant)	BHP proposes to offset the following significant residual impacts to counterbalance the impacts to ensure the EPA's objective for Terrestrial Fauna can be met: clearing up to 808 ha of critical habitat and 1,045 ha of supporting habitat for Ghost Bat, Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat and Grey Falcon (significant)

	potential degradation or loss of up to 160.7 ha of critical and/or supporting habitat for the Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python and/or Grey Falcon from groundwater mounding for the Northern RAV MAR scheme (potentially significant)
Subterranean Fauna	
Potential impacts	- loss or modification of troglofauna habitat and species assemblages from groundwater mounding at the Northern RAV MAR scheme (direct) - loss of stygofauna habitat and species assemblages from groundwater drawdown (direct) - Modification of stygofauna habitat or assemblages from changes to groundwater quality (indirect)
Mitigation hierarchy	Avoid BHP shall not commence aquifer recharge at the Northern RAV MAR until potential impacts to troglofauna habitat and assemblages within the predicted areas of impact (i.e. groundwater mounding contours) can be verified through additional survey work (currently underway). BHP shall not exceed groundwater drawdown beyond the Approved Proposal limits at Coondewanna Flats until such a time that either the potentially restricted species at Coondewanna Flats are located outside the area of impact or habitat connectivity beyond the areas of impact can be confirmed. Minimise - groundwater abstraction will be minimised to that which is required for implementation of the Proposal and will be compliant with existing licence GWL89501 - once aquifer recharge at the Northern RAV MAR commences, mounding will be kept below 10 mbgl which will assist in retaining suitable above water table habitat for troglofauna - BHP will investigate a reduced dewatering duration for the hydraulically connected pits to Coondewanna Flats - towards the end of mine life, MAR will be optimised to increase water levels in the Weeli Wolli Springs catchment. Rehabilitate - continue to manage rehabilitation and closure according to the measures in the Mining Area C Mine Closure Plan - the Northern RAV scheme will be shut off when no longer required and mounding will cease, allowing troglofauna assemblages within the area to recover (if present)
Residual impacts, including assessment of significance	Residual impacts on Subterranean Fauna following application of the mitigation hierarchy: - loss or modification of stygofauna habitat in areas subject to additional groundwater drawdown (unlikely to be significant; pending outcomes of additional survey work) - loss or modification of individuals or species assemblages for three potentially restricted stygofauna species not known from outside the additional groundwater drawdown area: <i>Paramelitidae</i> sp. S04 (BR South), nr <i>Billibathynella</i> `sp. S1` and nr <i>Notobathynella</i> sp. S01 (unlikely to be significant; pending outcomes of additional survey work) - temporary loss of potentially suitable troglofauna habitat and/or species assemblages within the groundwater mounding contours at Northern RAV MAR (unlikely to be significant; pending outcomes of additional survey work)

Proposed environmental outcomes	Environmental outcomes for the residual impacts on Subterranean Fauna: 1. No adverse impact to stygofauna habitats and/or assemblages in areas outside the drawdown contours as a result of the Proposal 2. No adverse impact to stygofauna habitat and/or assemblages at Weeli Wolli Springs as a result of the Proposal 3. Maintenance of at least 96% of the stygofauna assemblage known from the local area 4. No adverse impact to troglofauna values within the mounding contours of the Northern RAV MAR as a result of the Proposal
Assessment of offsets (if relevant)	N/A: No significant residual impacts after mitigation (pending outcomes of additional survey work currently being implemented)
Social Surroundings	
Potential impacts	• disturbance of cultural heritage sites and values (direct) • impacts to access, landscape, and amenity (direct) • degradation of social, cultural and heritage values (indirect)
Mitigation hierarchy	Avoid BHP will avoid direct disturbance of known heritage sites Minimise • implement measures in the SCHEMP to manage access, involve Banjima representatives, through BNTAC and ensure ongoing consultation • implement the measures in the relevant environmental management plans to minimise impacts to cultural heritage values, including water values Rehabilitate • continue to manage rehabilitation and closure according to the measures in the Mining Area C Mine Closure Plan
Residual impacts, including assessment of significance	Residual impacts on Social Surroundings following application of the mitigation hierarchy: 1. Potential direct and indirect impact to Aboriginal social, cultural and heritage values
Proposed environmental outcomes	Environmental outcomes for the residual impacts on Social Surroundings: 1. No impacts to heritage sites and places of cultural significance 2. Identification of potential impacts on values in consultation with the Banjima Traditional Owners
Assessment of offsets (if relevant)	N/A: No significant residual impacts after mitigation

Greenhouse Gases	
Potential impacts	cumulative greenhouse gas emissions are a contributor to climate change. The cumulative emissions from the Combined Proposal will contribute to WA's greenhouse gas emissions
Mitigation hierarchy	Avoid BHP has avoided Scope 1 emissions where possible by minimising land clearing through the use of existing infrastructure where practicable to support the development and operation of the Proposal, including the use of existing cleared tracks and roads and mine processing infrastructure Minimise reduce GHG emissions in accordance with the NGER Act and Safeguard Mechanism including emission reduction
Residual impacts, including assessment of significance	Residual impacts on Greenhouse Gases following application of the mitigation hierarchy: Generation of GHG emissions (significant)
Proposed environmental outcomes	Environmental outcomes for the residual impacts on Greenhouse Gases: Contribution of Scope 1, Scope 2 and Scope 3 greenhouse gas emissions from the Combined Proposal
Assessment of offsets (if relevant)	Potential significant residual impacts for the contribution of Scope 1, Scope 2 and Scope 3 greenhouse gas emissions from the Combined Proposal. BHP proposes to implement offsets consistent with the Safeguard Mechanism

1 Introduction

1.1 Purpose and scope of this document

The purpose of this document is to present the environmental impact assessment undertaken by BHP Iron Ore Pty Ltd (BHP) for the Central Pilbara Hub Surplus Water Stage 1 Proposal (the Proposal; Figure 1-1). The Proposal is a Significant Amendment to the Approved Proposal Mining Area C-South Flank (MAC-SF) Ministerial Statement 1072 (MS1072).

This document is provided as a supplementary report to the referral of a Significant Amendment of the Approved Proposal (under MS1072) for the MAC-SF mine, known as the Central Pilbara Hub (CPH). As provided for in the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (EPA 2021a), where a proponent aims to provide sufficient information with the referral to enable the EPA to set 'Referral Information' as the level of assessment, the proponent may prepare a supplementary report/s for the referral, consistent with the requirements of an Environmental Review Document.

The scope of this document is an assessment of the potential significant environmental impacts from the Proposal in the context of the Approved Proposal (i.e. the Combined Proposal), which includes an increase in groundwater abstraction (dewatering), surplus water discharge, and additional surface water management infrastructure. This document and supporting information comprise the following:

- Referral Supporting Document for the Proposal
- Proposal Content Document (Appendix 1)
- Significant Amendment requirements:
 - analysis of Ministerial Statements for the Approved Proposal (Appendix 2)
 - compliance with Approved Proposal Ministerial Statements (Section 2.1.3 and Appendix 3)
 - Environmental Performance Report (Section 2.1.4 and Appendix 4)
- Proposed implementation conditions (Appendix 6)
- Supporting study and survey reports (Appendix 7, Appendix 10, Appendix 12, Appendix 18)
- Environmental Management Plans (Appendix 8, Appendix 16, Appendix 20)
- Index of Biodiversity Surveys for Assessments (IBSA) data package (Appendix 19)
- Offsets template and Impact Reconciliation Procedure (Section 14 and Appendix 21).

BHP has considered guidance in the Procedures Manual (EPA 2021a) and the following EPA Instructions, to prepare this document:

- *How to identify the content of a Proposal: Instructions and template* (EPA 2024a)
- *How to prepare an Environmental Review Document: Instructions* (ERD Instructions) (EPA 2024b)
- *Referral of a proposal under section 38 of the Environmental Protection Act 1986: Instructions* (Referral Instructions) (EPA 2024d)
- *How to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans: Instructions* (EPA 2024c)

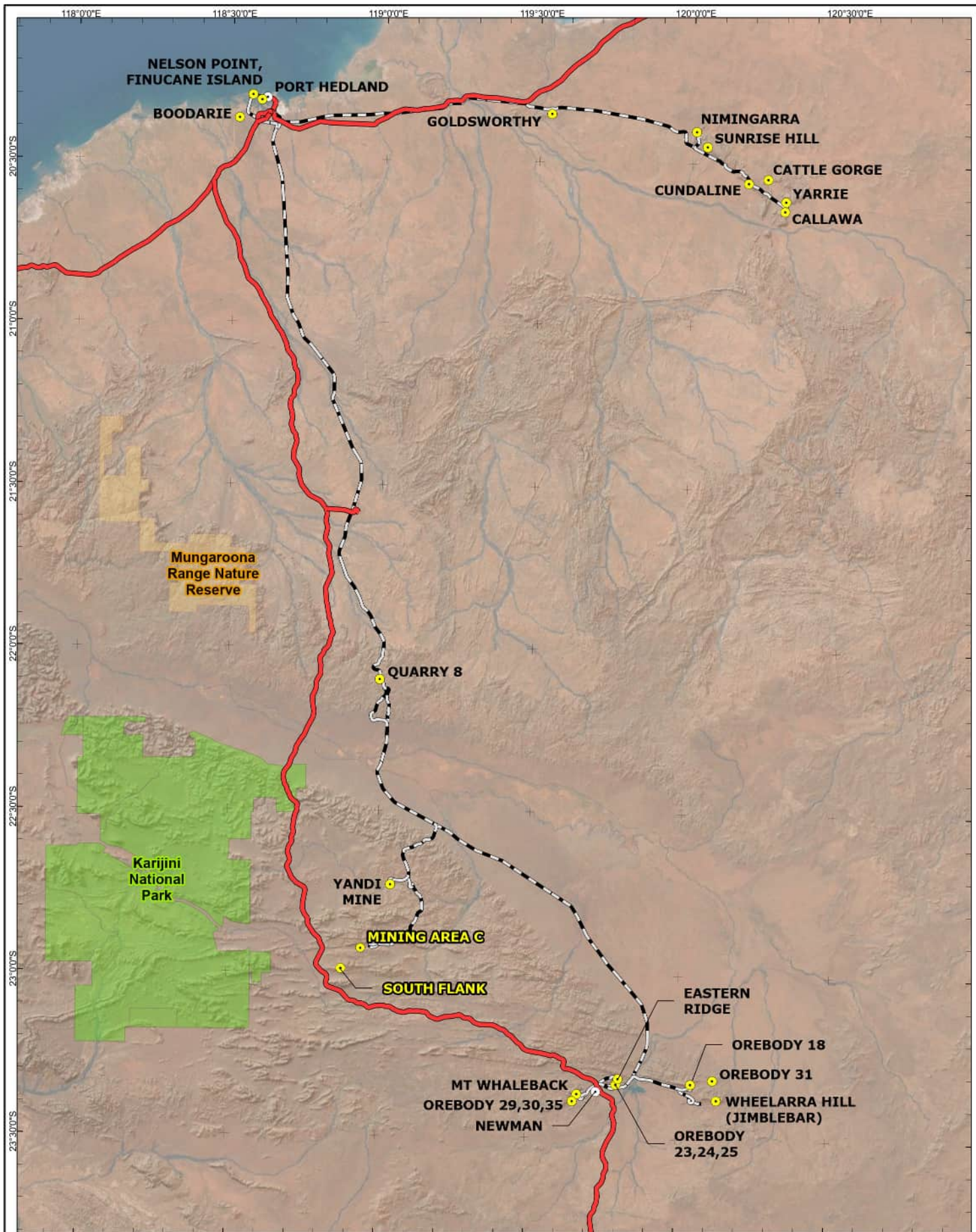
- EPA factor guidelines and technical guidance (see details under relevant factor).

1.2 Significant Amendment requirements

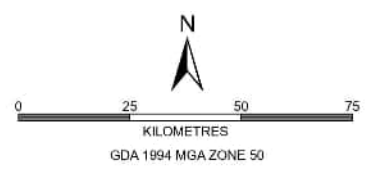
Table 1-1 outlines where in this document BHP has addressed the additional requirements for Significant Amendments, as required by the EPA's *Referral of a proposal under section 38 of the Environmental Protection Act 1986 Instructions* (EPA 2024d).

Table 1-1: Significant Amendment requirements

Significant Amendment requirement	Document location
1. Type of significant amendment	Section 3.1.1.1
2. Information of the approved proposal	Section 2.1.1
3. Combined effects	Sections 7.5, 8.4, 9.4, 10.4, 11.4 and 12.4
4. Existing implementation conditions	Section 3.1.1.2 and Appendix 2
5. Previous changes to the proposal and / or implementation conditions	Section 2.1.2
6. Compliance	Section 2.1.3
7. Environmental performance	Section 2.1.4
8. Control of implementation of significant amendment	Sections 7.8, 8.7, 9.7, 10.7, 11.7 and 12.7



- BHP WAIO operation
- Town
- National highway
- - - Rail
- National park
- Nature reserve



**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
REGIONAL LOCATION**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

PUBLIC

SCALE @ A4: 1:1,700,000 PREPARED: GEOMATICS FIGURE: **1-1**

DATE: 17/02/2025 REQUESTOR: ENV APPROVALS NO:

A1285-024-RevC

2 Proposal

2.1 Proposal content

2.1.1 Approved Proposal

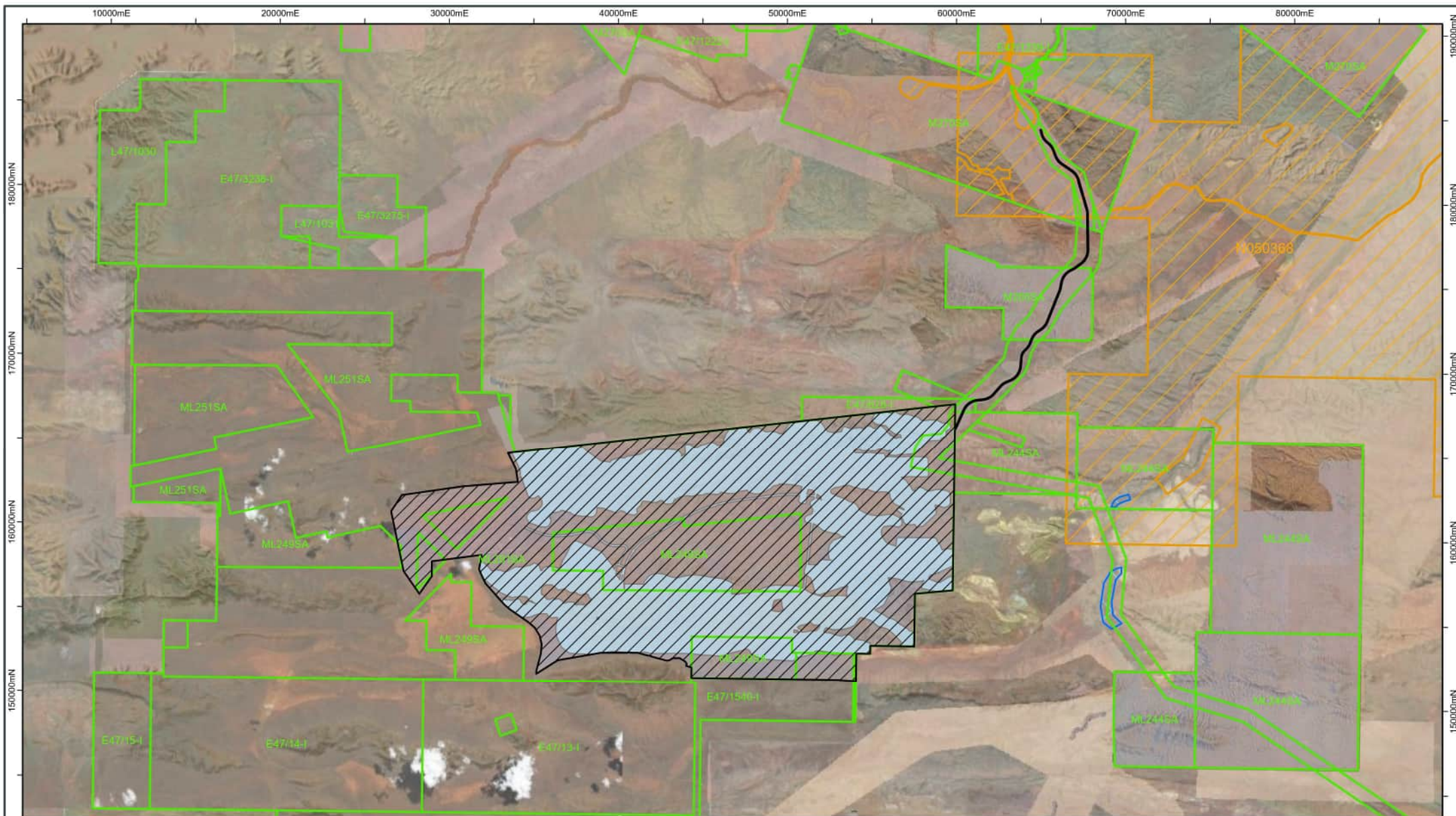
The Approved Proposal area is shown in Figure 2-1. The current surplus water management system associated with the Approved Proposal has been implemented over several phases to date, to manage surplus water from below water table mining activities. Additional surplus water management schemes are now required, including supporting infrastructure within South Flank, to manage surplus water and prevent recirculation of groundwater in mine pits. This Proposal is planned to address these requirements. Operations commenced in 2001 with the dewatering of the Northern Flank deposits at MAC, followed by the commencement of mining in 2003.

The implementation stage for the Approved Proposal is operations. The activities and elements of the Approved Proposal are summarised below:

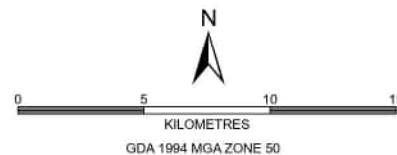
- mining above and below the water table
- open pits, overburden storage areas (OSAs) and the construction and operation of associated mine, processing and rail infrastructure (including offices, workshops, roads, dewatering infrastructure, ore and topsoil stockpiles)
- primary crushing of ore at the South Flank satellite orebody
- transportation of ore mined at South Flank via overland conveyor to stockpiles and ore handling facilities located at CPH
- dewatering of the satellite orebody aquifers and the preferential use of the water for operational purposes, with surplus water disposal options
- mobile equipment maintenance precinct. The maintenance precinct includes a warehouse delivery and laydown area, tyre storage and exchange facility, wastewater tanks, maintenance workshop, wash-down facility and parking
- South Flank ammonium nitrate products facility
- access, overland conveyors and haul roads
- mine closure (including potential formation of pit lakes in the South Flank pits)
- surplus water management comprising:
 - Managed Aquifer Recharge (MAR) at South Flank and Juna Downs
 - discharge to infiltration ponds and discharge from sedimentation basins
 - discharge along Pebble Mouse Creek.

BHP does not seek any changes to the following:

- mine pits and mining rates approved under MS1072
- current surplus water management schemes (Juna Downs MAR, South Flank MAR, Runaway Valley Infiltration Ponds, Central Sediment Basins, Western Sediment Basins and Pebble Mouse Creek Discharge).



-  Ministerial Statement 1072
-  BHP Tenements - Granted
-  BHP Freehold Leasehold Easements
-  BHP Special Agreement Areas
-  Approved Proposal Indicative Footprint




PUBLIC

MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

APPROVED PROPOSAL, MINISTERIAL

STATEMENT AND TENURE

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:300,000	REQUESTOR:	ENVIRONMENT	FIGURE:	2-1
DATE:	17/02/2025	PREPARED:	GEOMATICS	NO:	A1285-025 RevF
		REVIEWED:			

2.1.2 Previous changes to the Approved Proposal and implementation conditions

As required by the Referral Instructions (EPA 2024d) and ERD Instructions (EPA 2024b), Table 2-1 summarises the original Part IV approvals for the Approved Proposal and subsequent approved changes.

Table 2-1: Part IV Approved Proposals and summary of changes

Date	EP Act Section	Summary of Approved Proposal/amendment
15 January 2020	s. 45C	Attachment 1 to MS1072 New locating for managed aquifer recharge in South Flank Valley Discharge to drainage line that leads to Pebble Mouse Creek
20 February 2018	s. 38	Revised proposal (MS1072): The Revised Proposal to amend the Mining Area C operations subject of MS491, and superseded MS491 Proposal to include mining of the southern flank satellite orebody operations, and additional clearing at the northern flank operations of Mining Area C
22 June 2017	s. 45C	Attachment 7 to MS491: Amend the element 'Accommodation village' to 'Packsaddle Village', include a new element 'Mulla Mulla Village', increase total disturbance from 5,385 ha to 5,563.8 ha, and update Figures 1 and 2, and delineation coordinates
20 November 2014	s. 46C	Attachment 6 to MS491: Amendment to Condition 5, and Proponent Commitments 4 and 5 are deleted
24 March 2014	s. 45C	Attachment 5 to MS491: Removal of 'Water usage and dewatering requirements'
18 October 2013	s. 45C	Attachment 4 to MS491: Remove 'Ore reserves', 'Project components' and 'Ore Production', and revise 'Water usage and dewatering requirements' to 8,760 Megalitres per annum
24 April 2009	s. 45C	Attachment 3 to MS491: Installation of a diesel power generation facility and increase disturbance area for the extension of existing Packsaddle accommodation village and wastewater treatment facilities. Workforce numbers removed as no longer relevant to assessment criteria
8 May 2008	s. 45C	Attachment 2 to MS491: Increase in production to 55 million tonnes per annum, increase in permanent work force up to 950 personnel, and inclusion of minor modifications to existing ore handling plants
13 August 2007	s. 45C	Attachment 1 to MS491: Addition of E deposit to Mining Area C, to increase production to 42 million tonnes per annum, to increase water usage to up to 12 Megalitres per day, inclusion of project components for E deposit (expansion to stockpiles, workshops and maintenance facilities and village expansion) and to increase permanent workforce up to 770 personnel

Date	EP Act Section	Summary of Approved Proposal/amendment
24 December 1998	s. 38	Original proposal (MS491): Proposal to mine 14 deposits at Mining Area C, (A-F and R, P1-P6 and the Brockman Detrital Deposit) of iron ore in the Northern Flank area of Mining Area C, including on-site processing, the provision of services, infrastructure and a village and the construction and operation of a rail line. ,

2.1.3 Compliance

BHP reports annually on compliance in Annual Environmental Reports (AERs) submitted to Department of Water and Environment Regulation (DWER), with a separate chapter for each MS Compliance Assessment Report. As required by the Referral Instructions (EPA 2024d), BHP has provided the current status and history of compliance with the MS for the Approved Proposal (Table 2-2; Appendix 3).

Table 2-2: Current status and history of compliance

Year	AER	Summary of compliance
MS1072: Mining Area C		
Current 2023- 2024	AER 2023-2024 (BHP 2024a)	In the FY2024 reporting period, there were three potential non-compliances with the Approved Proposal. Condition 7-7 of the Approved Proposal states that <i>“In the event of exceedance of threshold criteria, the proponent shall meet the requirements in condition 3 (Compliance Reporting) and shall implement the measures outlined in the Plan, including, but not limited to, actions and investigations to be undertaken, and reporting to the CEO.”</i> A continuation of the non-compliance reported in January 2023 in relation to Ghost Bat monitoring. The monitoring program continued to not detect evidence of Ghost Bat presence at one or more High Value Ghost Bat Caves during FY2024. The cave relates to SF18 which has not detected presence since 2016. BHP reported to DWER verbally on 30 January 2023 and submitted letter to DWER on 10 February 2023. BHP has implemented the following actions: • Maintaining through FY2025 the increased monitoring to low value caves or alternative locations that the Ghost Bats may use • Comparing changes to results from the other BHP Ghost Bat Monitoring programs • Investigating the potential change in presence at the high value caves to be retained and determine if additional threshold actions are required. Monthly groundwater bore levels were not monitored as required under the Central Pilbara Water Resource Management Plan (CPWRMP) (Version 4.1) monitoring program. Condition 6-7 of the Approved Proposal states that <i>“The proponent shall implement the most recent version of the Plan approved by the CEO.”</i> The groundwater bore data was not collected for Weeli Wolli Spring at the following bore locations and times as required by the CPWRMP: • GWB0016DM- February 2024 • GWB0016SM- February 2024 • GWB0017DM- July and August 2023 • GWB0018DM- October 2023, April and May 2024 • GWB0032DM- February 2024

Year	AER	Summary of compliance
		The potential non-compliance was reported in writing by BHP to DWER on 16/7/2024 Although there are gaps in the monitoring requirements, BHP considers that operations have not affected the receptors as no dewatering activities have commenced in R Deposit. The cause of this non-compliance is administrative error. Condition 10-8 and 10-9 of the Approved Proposal states that <i>"The proponent shall submit an Impact Reconciliation Report in accordance with the Impact Reconciliation Procedure approved in condition 10-7"</i> and; <i>"The Impact Reconciliation Report required pursuant to condition 10-8 shall provide the location and spatial extent of the clearing undertaken with Areas A and B during each biennial reporting period"</i> The Impact Reconciliation Reporting (IRR) was not submitted on time (30 Sept 2023) BHP requested an extension for the IRR on 8 September 2023 which was subsequently not granted. Verbal reporting during a routine meeting with EPA Services was undertaken in September 2024. BHP attempted to combine State and Federal offset requirements into a single process several years ago. To this date an agreed Federal offset rate remains outstanding and there is no Regulator-endorsed Impact Reconciliation Procedure (IRP) of MS1072 that combines the offset requirements. This had delayed the ability to submit the IRR. Additionally, drafting of the IRR has been delayed due to an administrative error identified in MS1072 and the definition of 'Area A' habitat.
History		
Current 2022- 2023	AER 2022-2023 (BHP 2023a)	In the FY2023 reporting period, there were two potential non-compliances with the Approved Proposal. Condition 7-7 of the Approved Proposal states that <i>"In the event of exceedance of threshold criteria, the proponent shall meet the requirements in condition 3 (Compliance Reporting) and shall implement the measures outlined in the Plan, including, but not limited to, actions and investigations to be undertaken, and reporting to the CEO."</i> The BHP Ghost Bat monitoring in January 2023 did not detect evidence of bats at one or more High Value Ghost Bat Caves at Mining Area C. It is now 24 months since evidence of bats at one or more High Value Ghost Bat caves has been detected at Mining Area C, therefore meeting the threshold criteria of "Zero Ghost Bat records from scats at one or more High Value Ghost Bat Caves in a 24-month period." Zero Ghost Bat records from scats at one or more High Value Ghost Bat Caves in a 24-month

Year	AER	Summary of compliance
		period. Potentially attributed to increased mining activities, however, there has been no geographical correlation identified between the caves which reached the threshold. BHP reported to DWER verbally on 30 January 2023 and submitted letter to DWER on 10 February 2023. BHP implemented the following actions: - Increased the extent of the monitoring to low value caves or alternative locations that the Ghost Bats may use - Compared changes to results from other BHP Ghost Bat Monitoring programs - Investigated the potential change in presence at the high value caves to be retained and determine if additional threshold actions are required. After the Trigger was reached, the monitoring program was increased to include more Ghost Bat caves and population trends were investigated (e.g., ACW01, ACW06, ACW08, ACW10, ACW31, M1 and M2). Condition 6-7 of the Approved Proposal states that <i>"The proponent shall implement the most recent version of the Plan approved by the CEO."</i> Monthly groundwater bore levels were not monitored as required under the Central Pilbara Water Resource Management Plan (Version 4.1) monitoring program. The ground water bore levels were missed at the following locations: - Weeli Wolli Springs: Seven monthly level readings for Rio Tinto Iron Ore owned bores: GWB0017DM (March, April and June 2023), GWB0017SM (October 2022, December 2022 – February 2023), GWM0032SM (January – February 2023). - Ben's Oasis: Nine monthly level readings for BHP Western Australia Iron Ore (WAIO) owned bores: HD00004M (July – August 2022), HDD0003M (January 2023), HDD0001M (July – August 2022, October 2022 – January 2023). This potential non-compliance was identified during data QA/QC and reported to DWER associated with the preparation of 2023 AER. BHP considered that gap in the monitoring have not affected the water levels at these receptors, with consistent water level trends being visible in the available data and in adjacent bores with complete data sets, this was detailed in tables 3-59 and Table 3-60 of the AER.

Year	AER	Summary of compliance
		BHP commenced an investigation into the non-compliance and will provide an update in the FY2024 AER.
2021-2022	AER 2021-2022 BHP 2022a)	A potential non-compliance relating to monthly ground water data collection at monitoring location HCF0042M occurred in December 2021. This was identified during data QA/QC associated with the preparation of the 2021-2022 AER. The data recorded against this monitoring location was considered unreliable for the purposes of reporting and was excluded. Sampling recommenced correctly in January 2022 and every month thereafter. No environmental impact suspected or recorded as a result. The bore was tagged, a work order was put in place to ensure compliance to management plan.
2020-2021	AER 2020-2021 (BHP 2021a)	A non-compliance with condition 2-1 was identified during the FY2021 reporting period. Condition 2-1 of MS1072 states: <i>"The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State."</i> BHP Billiton Iron Ore Pty Ltd formally changed name to BHP Iron Ore Pty Ltd through the Australian Securities and Investments Commission on 19 February 2021. All other details including address and Australian Company Number remained the same. BHP submitted a PAF3 – <i>Notification of Change of Proponent Address and/or Company Name form</i>, for a list of relevant Ministerial Statements to DWER on 23 April 2021. This notification was not provided within the required timeframe.
2019-2020	AER 2019-2020 (BHP 2020)	In the FY2020 reporting period, there was one non-compliance reported against MS1072 regarding the Tree Health threshold criteria detailed in the Central Pilbara Water Resource Management Plan (CPWRMP). BHP reported an exceedance of the Threshold Criteria required by condition 6-2 regarding statistically significant canopy decline (defined as Crown Condition Score (CCS)), compared to baseline condition of reference trees over eight consecutive monitoring periods; or death of any tree (attributable to water stress caused by dewatering or reinjection), within monitoring sites 12, 15 or 20. Tree health decline was detected at the northern monitoring site (C15 at Coondewanna flats) and a small amount of suspected tree deaths (two to three young trees and multiple saplings/seedlings) adjacent to the C15 monitoring site. BHP determined that lower than average rainfall, lowering of the groundwater levels and changes in surface water flows may have contributed to the decline.

Year	AER	Summary of compliance
		In response BHP increased target monitoring at the C15 site (and adjacent area) in the following monitoring period and observed a recovery to within baseline data.
2018-2019	AER 2018-2019 (BHP 2019a)	There were no non-compliances or potential non-compliances with Ministerial Statement 1072 identified within the FY2019 reporting period.
2017-2018	AER 2017-2018 (BHP 2018a)	Following the approval of Ministerial Statement 1072 on 20 February 2018, which superseded Ministerial Statement 491, BHP identified on 21 February 2018, that approximately 13 hectares was cleared within 'Area A' prior to submission of an Impact Reconciliation Procedure to the DWER or agreement of the CEO in accordance with Condition 10-5 and approval of an Impact Reconciliation Procedure or agreement of the CEO in accordance with Condition 10-7. Internal communications to halt clearing activities was issued on 21 February 2018. The area had been previously assessed and approved to impact under Ministerial Statement 491, Environmental Management Plan Revision 6, and agreement of the CEO for impact in accordance with Condition 10-5 was given on 22 February 2018, therefore it is considered that there was no known actual or suspected environmental impact as a result of the non-compliance.

2.1.4 Environmental performance

BHP reports on environmental performance in AERs. As required by the Referral Instructions (EPA 2024d), BHP has provided a report on the current environmental performance of the Approved Proposal against the EPA's objectives for environmental factors relevant to the Proposal, and any Ministerial Statement implementation condition environmental outcomes and/or objectives (Appendix 4). As discussed in Table 2-3, BHP considers that the EPA's objectives for the environmental factors relevant to the Proposal have been met.

Table 2-3: Environmental performance report for the Approved Proposal

Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
Inland Waters: <i>To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected</i>	
MS1072 Condition 6: Water Management Environmental Management Plan Environmental Objectives 6-1: (1) no reduction in the extent of each of the following components of the Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats: (a) Coolibah woodlands over lignum over swamp wandiree, or (b) Coolibah and mulga woodland over lignum and tussock grasses on clay plains, attributable to the Revised Proposal. (2) no reduction in the extent of the Weeli Wolli Spring	Version 4.1 of the CPWRMP which was endorsed by DWER on 6 October 2021 was implemented for the entirety of FY2024. Reinjection at the Juna Downs MAR, located to the north of Coondewanna Flats was commissioned on 8 February 2019 and became operational on 30 May 2019. Monthly groundwater level monitoring occurred throughout the reporting year at sites GWB0039M, HCF0032M, HCF0023M, HCF0042M and HCF0045M. During the FY2024 reporting period, groundwater levels at prescribed bores did not exceed trigger or threshold criteria at GWB0039M, HCF0032M, HCF0023M, HCF0042M and HCF0045M as stipulated in the CPWRMP. FY2023 Coondewanna Flats bi-annual tree health monitoring (both on-ground and via remote sensing) was undertaken for the post-dry season in November 2023 and post-wet season in April 2024. All the four sites CF12, CF15, CF17 and CF20 were monitored in accordance with CPWRMP (Rev 4.1) between 1 July, 2023 and 30 June, 2024. For all four monitoring sites (CF12, CF15, CF17, and CF20), the mean Crown Condition Score (CCS) for <i>Eucalyptus victrix</i> trees indicated overall average tree health. CCS at site CF15 declined in December 2023 and April 2024, with both events found to be significantly different from baseline, meeting trigger level action criteria detailed in the CPWRMP. In response to meeting the trigger criteria in the CPWRMP, preliminary investigations have commenced into water level trends. For all four monitoring sites (CF12, CF15, CF17, and CF20), the mean CCS of <i>Acacia aptaneura</i> (mulga) trees ranged indicated average to below-average tree health. Mean CCS at was also lower at all sites in April 2024 but believed to be reflective of well-below average rainfall for the reporting period. CF17 declined in both wet and dry monitoring periods and sits at its lowest recorded value since baseline. Overall, in 2024, the mean change in CCS for <i>Eucalyptus victrix</i> and <i>Acacia aptaneura</i> has decreased since baseline year on year. Based on an analysis of monitoring results, BHP considers that the outcome: <i>'no reduction in the extent of each of the following components of the Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats:</i> <i>(a) Coolibah woodlands over lignum over swamp wandiree, or</i>

Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal (3) no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal.	<i>(b) Coolibah and mulga woodland over lignum and tussock grasses on clay plains, attributable to the Revised Proposal'</i> has been achieved for the FY2024 reporting period as the causation is likely due to rainfall rather than the Revised Proposal. R Deposit dewatering has been identified as a potential impact pathway to Weeli Wolli Spring. Nearby Hope Downs has commenced dewatering, lowering groundwater levels. As of the FY2024 reporting period, dewatering in R Deposit has not yet commenced, BHP considers that the outcome: <i>'no reduction in the extent of the Weeli Wolli Spring occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal'</i> has been achieved for the FY2023 reporting period. South Flank (Vista Oriental) dewatering has been identified as an impact pathway to Ben's Oasis via the Pebble Mouse Creek Valley. The dewatering of Vista Oriental commenced in November 2023, however, only in sub-deposit Vista A, which has been assessed as having no impact on Ben's Oasis water levels <i>'no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal'</i> has been achieved for the FY2024 reporting period.
Flora and Vegetation: <i>To protect flora and vegetation so that biological diversity and ecological integrity are maintained</i>	
MS 1072 Condition 9: Rehabilitation and Decommissioning Environmental Objectives Condition 9	Mining Area C Mine Closure Plan (version 4.0) was formally endorsed by DWER on 27 June 2022. The total area progressively rehabilitated in FY2024 was 622 ha. Based on an analysis of monitoring results, BHP consider that the outcome: <i>'ensure that the Proposal is rehabilitated and decommissioned in an ecologically sustainable manner'</i> has been achieved for the FY2024 reporting period.

Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
Ensure that the Proposal is rehabilitated and decommissioned in an ecologically sustainable manner.	
Terrestrial Fauna: <i>To protect terrestrial fauna so that biological diversity and ecological integrity are maintained</i>	
MS 1072 Condition 7: Ghost Bat Environmental Management Plan Environmental Objectives Condition 7 (1) maintain the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope as defined in Figure 1 of Schedule 1. (2) no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1.	Mining Area C Fauna Management Plan (FMP) was developed for Mining Area C and South Flank Operations. Mining Area C Fauna Management Plan revision 1.1 was endorsed by DWER on 28 January 2021. Revision 2.1 of the Mining Area C Fauna Management Plan was submitted to DWER in March 2023 and Revision 2.2 submitted in December 2024 (BHP 2024d). In FY2024, five field trips were undertaken as part of the bi-monthly scat collection monitoring program to determine presence/absence of Ghost Bats from scat deposits as outlined in the FMP. As outlined in Table 5 of the FMP, the targeted caves include: 18 high value caves retained for minimum 5 years caves (AC13, AC14, AC17, AC184, SF04, SF05, SF08, SF14, SF18, SF26, SF27, AC01, AC02, AC05, AC06, AC08, AC09, SF06) • The Mining Area C artificial roost (AGBC) • Reference sites at Tandanya and Mudlark Well, and • Four Early Response Indicator Caves (ERI)5 (SF03, SF09, SF28, SF30). Based on FY2024 analysis of monitoring results, there was a continuance of potential non-compliance with Ghost bat scat presence threshold criteria for the Population Outcome related only to SF18. The following response actions are proposed: • Maintain monitoring to low value caves or alternative location that the Ghost Bats may use; • Continue to compare changes to results from other BHP Ghost Bat Monitoring programs. In FY2024, no land disturbance occurred within the Early Response Indicator (ERI) zones at High Value retained AC17, SF14 and SF18. Project and Mining activities in these areas are ongoing. There were no exceedances of land disturbance trigger or threshold criteria as outlined in the endorsed FMP Table 5 – Outcome-Based Provisions.

Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
	Based on the outcomes of monitoring conducted during the FY2024 reporting period, and reported in the FY2024 AER, BHP considers that the outcomes: <i>'maintain the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope as defined in Figure 1 of Schedule 1' and</i> <i>'no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1.'</i> have been achieved for the FY2024 reporting period. Research into Ghost Bat ecology continued in FY2024. As required under Condition 7-9, the 'Ghost Bat Research Plan Year Five Results' report was submitted to the EPA on 20 February 2023 demonstrating how the outcomes in Condition 7-1 will be met, that is, provide key information on certain aspects of the Ghost Bat's ecology in the Pilbara that will inform on-ground management and thereby demonstrate that the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope will be maintained.
Social Surroundings: <i>To protect social surroundings from significant harm</i>	
MS 1072 Condition 5: Cultural Heritage Management Plan	The Cultural Heritage Management Plan continues to function as the primary mechanism for management of cultural heritage matters at Vista Oriental, Grand Central, Highway, Packsaddle 1-4 and North Flank A-F deposits at South Flank and Mining Area C. BHP and the representatives of the Banjima People participate in ongoing consultation through the Banjima Heritage Advisory Council, and the heritage sub-committee, in relation to BHPs mining operations at Mining Area C and South Flank. In FY2024, there have been no reportable incidents identified against the requirements of the Plan. The BHP Heritage Department reports the current status of heritage sites which BHP has legal consent to disturb. BHP considers the EPA's objective or Social Surroundings has been met
Greenhouse Gas Emissions: <i>To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change</i>	
MS1072	BHP reports greenhouse gas (GHG) emissions from Mining Area C annually in accordance with requirements of the <i>National Greenhouse and Energy Reporting Act 2007</i>, as agreed with DWER (Ref 2018-1527146782323).

Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
Condition 8: Greenhouse Gas Reporting	The Clean Energy Regulator requires energy and emissions data for Mining Area C, for the period 1 July 2023 to 30 June 2024 to be finalised by 31 October 2024. Therefore, the emissions data reported will reflect FY2023 as FY2024 energy and emissions for Mining Area C have not yet been finalised and submitted to the Clean Energy Regulator. The net emissions number and reported covered emissions is 470,614 t CO₂ equivalence.

2.2 Proposal content

As required by the *Instructions: How to identify the content of a Proposal* (EPA 2024a; the *Instructions*), the general proposal content description and proposal content elements are described in the separate *Mining Area C - Central Pilbara Hub Surplus Water Stage 1 Proposal Content Document* (Proposal Content Document; Appendix 1).

Figure 2-2 shows the location of the key elements of the Proposal in context with the Approved Proposal including the Indicative Footprint where the key physical elements of the Proposal will occur. The key physical elements within the Indicative Footprint can be summarised by location as follows:

- North-west scheme: includes the MAC to Upper Marillana Creek pipeline, Northern Runaway Valley (RAV) MAR, Upper Marillana Creek Discharge
- North-east scheme: includes the MAC to Yandi East pipeline, Yandicoogina Gorge Supplementation Scheme and Lower Marillana Creek Discharge
- Grand Central Overburden Storage Area (GCOSA) Diversion Structure: infrastructure to divert flows from Mount Robinson from inundating the OSA.

As the Proposal is a Significant Amendment, the Proposal Content Document describes and tabulates the existing proposal (Approved Proposal), the proposed amendment (the Proposal) and their combination (Combined Proposal).

2.2.1 Proposed Significant Amendment (the Proposal)

The Proposal includes the following key activities and elements:

- increase in dewatering from 100 ML/d (37.3 GL/a) to 180 ML/d (65.7 GL/a) to allow below water table (BWT) mining
- increase in surplus water management from 34.84 GL/a to 56.21 GL/a
- installation of dewatering and surplus water infrastructure; including but not limited to, bores, infiltration ponds and pipelines
- additional clearing of 1,076 ha of native vegetation for pipelines and associated infrastructure
- installation of communication towers to support mine operation
- installation of additional surface water management structures, including diversions (including Grand Central Overburden Storage Area (GCOSA) Diversion), bunds and floodways at South Flank to protect the OSA.

The Proposal includes the following water management strategy elements:

- supply of up to 10 ML/day to Yandicoogina Gorge to meet environmental water requirements
- provision of water for operational use including for the Approved Proposal and the proposed future Ministers North mine (15 ML/day)
- reinjection and infiltration back into aquifer including the Northern Runaway Valley (RAV) Infiltration Ponds and Managed Aquifer Recharge (MAR) of up to 20 ML/d
- creek discharge to Upper and Lower Marillana Creeks, as a contingency surplus water management method
 - Upper Marillana Creek Discharge (up to 30 ML/d, with 90-day no discharge in dry season with maximum 5-year operating life and maximum wetting front extent of 27 km)

- Lower Marillana Creek Discharge (up to 30 ML/d, with 90-day no discharge in dry season with maximum 5-year operating life).

2.2.2 Exclusions from the Proposal

BHP does not seek any changes to the following surplus water management and extents approved under Part IV of the EP Act for the Approved Proposal (see Appendix 1):

- existing surplus disposal schemes
- expansion in mine and associated infrastructure (pits, haul roads, overburden storage, processing, transport)
- increase in mine processing rates.

2.3 Assessment areas

The Proposal elements and activities occur within the Approved Proposal boundaries as well as in additional areas outside the authorised extent of the Approved Proposal (Table 2-4). The proposed Development Envelope (the maximum area within which the Combined Proposal will be located) and the Indicative Footprint (the location where the physical proposal elements of the Proposal are planned to occur) are shown in Figure 2-2. A breakdown of these areas is summarised in Table 2-4.

The Indicative Footprint includes some overlap of areas that have been assessed and approved for the Approved Proposal and have already been cleared. Table 2-5 shows the breakdown of these areas within the Indicative Footprint.

The remaining Previously Assessed Area outside the Indicative Footprint is still required for the Approved Proposal.

Table 2-4: Assessment areas

Proposal area	Development Envelope (ha)	Indicative Footprint (ha)	Proposed Clearing (ha)
Approved Proposal authorised extents • Mining Area C MS1072 Development Envelope (38,909 ha)	38,909	21,824	21,824
Proposal extents – additional areas	1,150	1,482	1,076 ²
Combined Proposal extents (Approved Proposal plus the Proposal)	40,059	23,306	22,900

² Note that the Indicative Footprint includes existing cleared areas, therefore the proposal additional clearing is less than the additional Indicative Footprint.

Table 2-5: Cleared Areas

Component	Area within Development Envelope (ha)
Cleared Area (as at FY2023) ¹	10,688
Approved Proposal Clearing Remaining	11,136
Proposed Clearing	1,076
Total	22,900

1. Includes cleared areas authorised under Part IV of the EP Act only at FY2023.

As required by the *Instructions* (EPA 2024a, d), to provide proposal flexibility, BHP has assessed potential impacts within all areas that may be subject to a final footprint (i.e. within the Indicative Footprint area and within the broader Development Envelope). This provides flexibility for the location of proposal elements, to allow for changes to the design and/or to avoid or minimise impacts.

2.4 Proposal alternatives

BHP has considered alternative Proposal options to sustain tonnes of ore from the Approved Proposal. These options are described below.

Infrastructure alternatives:

- maximise the reuse of dewatering surplus for fit for purpose water sources (such as supply to Ministers North, and potentially other mines)
- where possible, pipelines are aligned to existing tracks and linear infrastructure to reduce clearing
- use of MAR schemes in lieu of creek discharge.

Surface water diversion (GCOSA diversion structure):

- multiple alignments of the proposed diversion have been considered to reduce sediment transport, reduce peak flows and reduce risk at closure
- revised design includes a 100 m setback from Mount Robinson (a significant cultural heritage location)
- siting of the OSA for the least amount of impact.

Creek discharge and MAR:

- Upper Marillana Creek and Lower Marillana Creek discharge schemes were originally proposed as a 30 ML/day scheme. The scheme has been reviewed in consultation with stakeholders to have a 5-year operational limit and a 90-day drying out period
- increase network of MAR schemes
- Do not supplement Yandicoogina Gorge with groundwater

Do nothing approach:

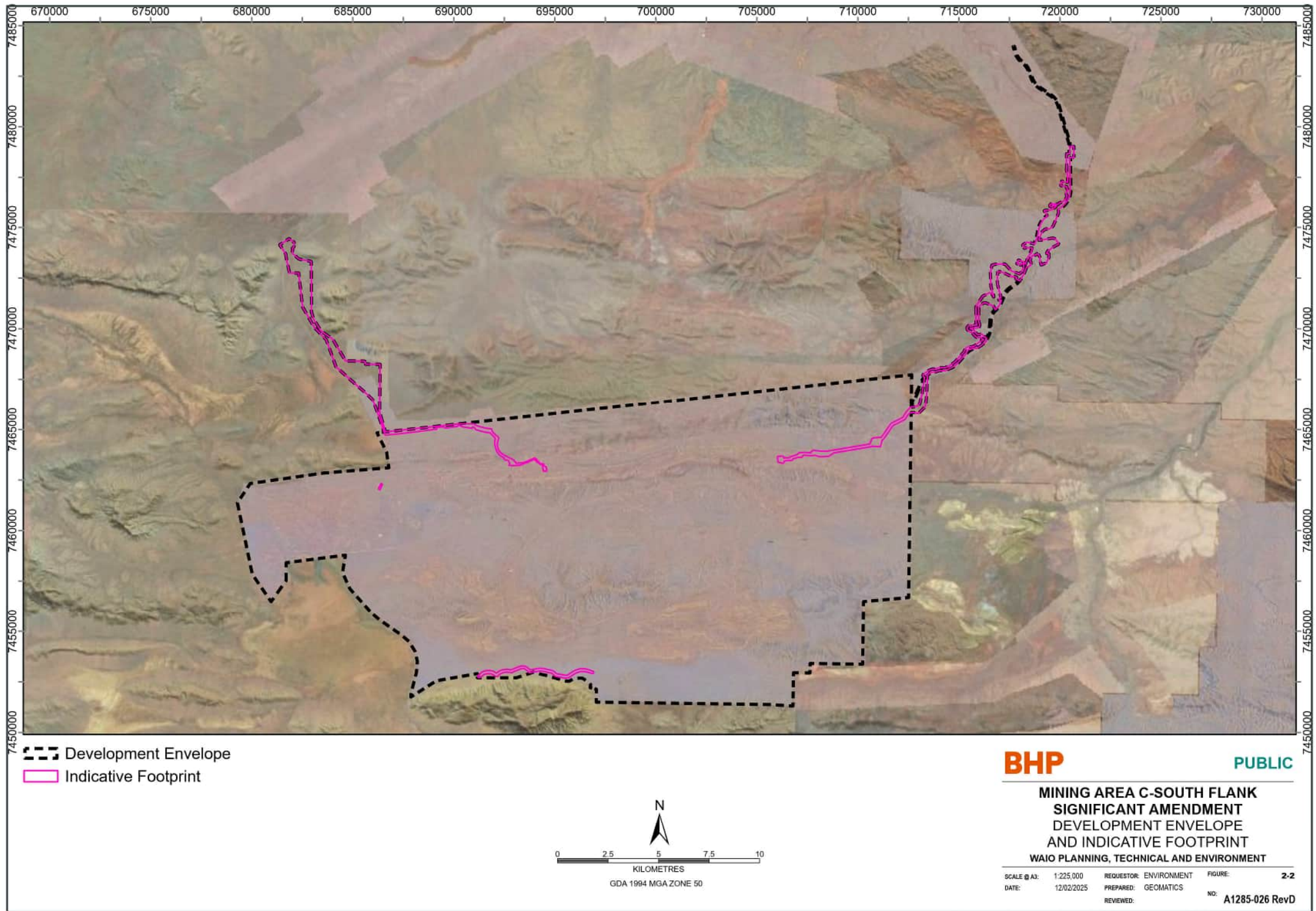
- limit operations to current authorised extents.

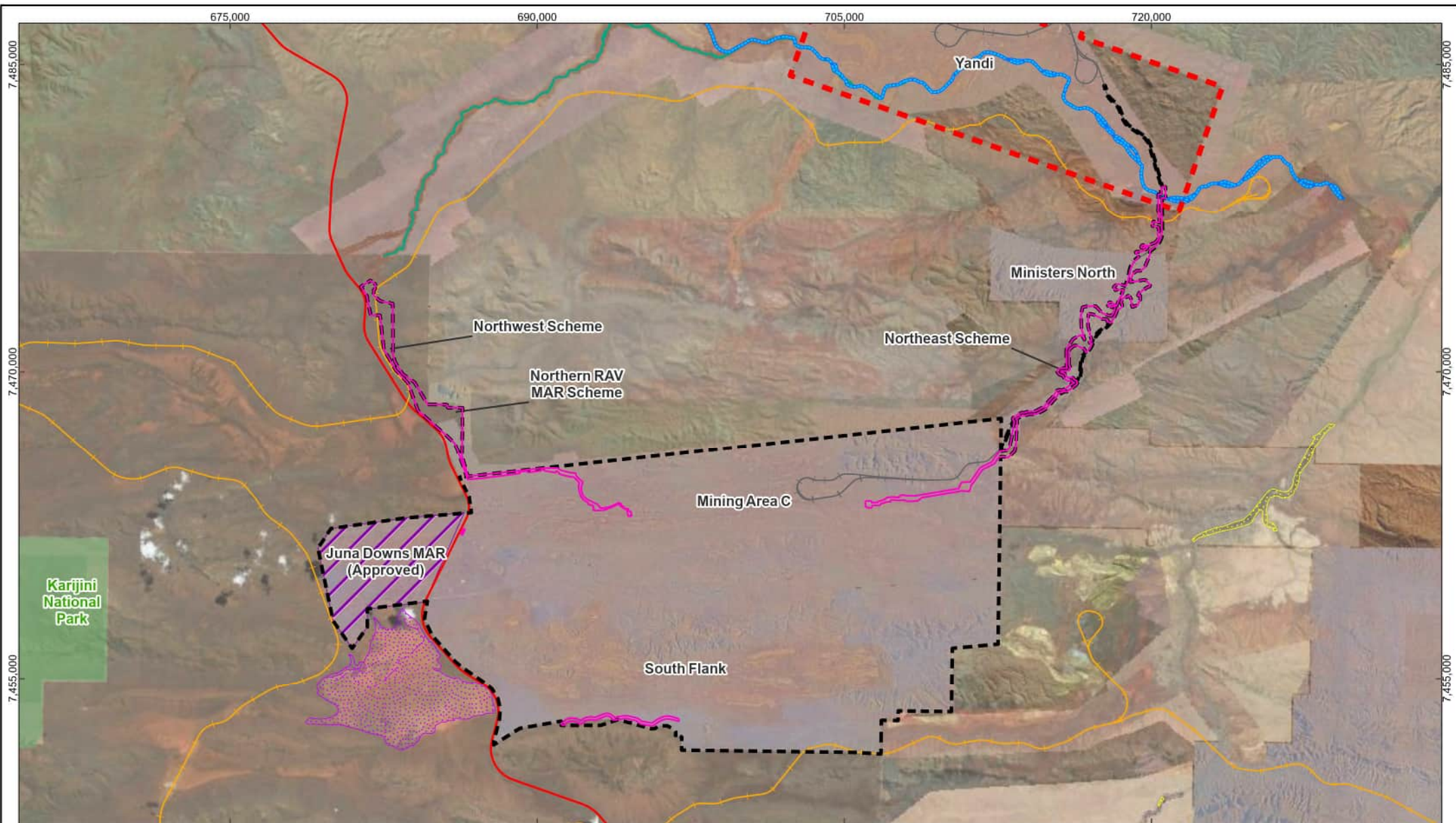
2.5 Local and regional context

The Proposal is located in the central Pilbara region of Western Australia and is located approximately 100 kilometres (km) north-west of the Newman Township (Figure 1-1). Operations at the CPH comprise of MAC deposits and the SF deposit, positioned approximately 8 km south of MAC (Figure 2-1). The dominant land use of the area is pastoral and iron ore mining operations, including BHP's existing operations at Yandi. The nearest third-party iron ore mining operations are Rio Tinto's Hope Downs 1 and Baby Hope operations, located approximately 3 km to the east of the Proposal at the closest point. The Proposal lies within the Banjima Native Title Determination Area (Figure 11-1).

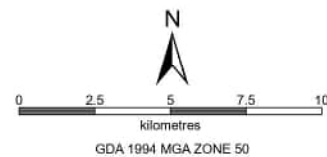
The Proposal is situated in the Hamersley subregion of the Pilbara bioregion. The area traverses a number of land systems, with the dominant land systems being the Newman and Boolgeeda land systems, comprising the plateaux, ridges, mountains and hills and their associated drainage zones of this section of the Hamersley Range. The nearest conservation estate to the Proposal is Karijini National Park, situated approximately 14 km west of the CPH (Figure 1-1). Approximately 47 km north of the CPH is the Fortescue Marsh, which is listed in the *Directory of Important Wetlands in Australia* (DCCEEW 2024c) and is a proposed Ramsar site (DoE 2013). It is also listed as a Priority Ecological Community (PEC) by DBCA.

The Proposal intersects several surface water catchments. To the west, the catchments are part of the internally draining Coondewanna Flats catchment which terminates at Lake Robinson, within Coondewanna Flats. The eastern sections of the Development Envelope drain into tributaries of Pebble Mouse Creek and Weeli Wolli Creek, both of which flow into the Fortescue Marsh sub-catchment area (also known as the Upper Weeli Wolli catchment and Upper Fortescue catchment).





- BHP Rail
- FMG Rail
- Rio Tinto Rail
- Great Northern Highway
- Marillana Creek
- Indicative Footprint
- - - Development Envelope
- - - Ministerial Statement 679
- - - MAR - Juna Downs
- Yandi Wetting Front
- Karijini National Park
- - - Weeli Wolli Spring
- - - Coondewanna Flats



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**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
LOCAL CONTEXT**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A4: 1:250,000 REQUESTOR: ENVIRONMENT FIGURE: 2-3
DATE: 17/02/2025 PREPARED: GEOMATICS

A1285_027_RevF

3 Legislative context

3.1 Environmental impact assessment process

3.1.1 Part IV of the Environmental Protection Act 1986

BHP has determined that the proposed amendment to the Approved Proposal is potentially significant and requires referral to the Environmental Protection Authority (EPA) under Part IV, s. 38 of the *Environmental Protection Act 1986* (EP Act). BHP considers that the significant amendment pathway (as provided for under s. 40AA) is appropriate, as the proposed amendments extend across the CPH and are within new and existing operational areas.

Should the EPA decide to assess the Proposal, BHP considers that a level of assessment of 'Assess on Referral Information' is appropriate. BHP has undertaken a comprehensive environmental impact assessment, documented in this report and supporting appendices.

3.1.1.1 Type of significant amendment

The type of significant amendment is an amendment to the Approved Proposal and an amendment to implementation conditions of the Approved Proposal.

3.1.1.2 Existing implementation conditions

As required by the Referral Instructions (EPA 2024d) and ERD Instructions (EPA 2024b), BHP has undertaken an analysis of the existing implementation conditions relating to the Approved Proposal (Appendix 2). As provided for under s. 40AA(3), BHP considers that the EPA should inquire into the implementation conditions as part of the assessment of the Proposal. As part of the analysis, BHP has also reviewed the extent of the proposal elements in the Ministerial Statement for the Approved Proposal in Appendix 2.

If the agreement or decision under s. 45 is that the Proposal may be implemented, BHP requests that the MS for the Approved Proposal (MS1072) is superseded and a new MS is issued for the Combined Proposal, as provided for under s. 40AA(6)(b).

3.1.2 Commonwealth EPBC Strategic Approval

BHP has a strategic approval (the Commonwealth Strategic Approval) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The *BHP Billiton Iron Ore Pilbara Strategic Assessment Program* (BHP Billiton Iron Ore 2017a) was endorsed by the Minister for the Environment and Energy on 11 May 2017 and an Approval Decision (with conditions) for taking actions in accordance with the Program was issued on 19 June 2017. The approval covers future activities (actions) within the Strategic Assessment Area, which is the same as the State Strategic Proposal boundary. The relevant Program Matters (Matters of National Environmental Significance (MNES)) are the following threatened fauna species: Pilbara Leaf-nosed Bat (*Rhynonictus auranus*), Northern Quoll (*Dasyurus hallucatus*), Greater Bilby (*Macrotis lagotis*), Ghost Bat (*Macroderma gigas*), Pilbara Olive Python (Pilbara subspecies) (*Liasis olivaceus barroni*), Grey Falcon (*Falco hypoleucos*) and Night Parrot (*Pezoporus occidentalis*).

All actions covered by the strategic approval must be taken in accordance with the endorsed Program. BHP administers a non-statutory validation decision process under Part C of the endorsed Program to decide whether an action will have an impact on Program Matters.

The Proposal is located within the Strategic Assessment Area and is therefore covered by the Commonwealth strategic approval. BHP has decided that the proposed action associated with the Proposal is notifiable and BHP will prepare a Validation Notice for the Proposal (BHP 2018b).

3.2 Other approvals and regulation

Tenure and State Agreements

BHP manages tenure holdings and legal structures on behalf of the Mount Goldsworthy Mining Associates Joint Venture, as the party to the *Iron Ore (Mount Goldsworthy) Agreement Act 1964* (Mount Goldsworthy State Agreement). The Mount Goldsworthy Mining Associates Joint Venture comprises of BHP Minerals Pty Ltd, Mitsui Iron Ore Corporation Pty Ltd, and Itochu Minerals and Energy of Australia Pty Ltd.

The Proposal interacts with various other tenements held by BHP which will co-exist with existing tenure being utilised for the Proposal and the new Miscellaneous Licences but are not required for execution of the Proposal.

BHP also manages tenure holdings and legal structures, as the party to the *Iron Ore (Marillana Creek) Agreement Act 1991* (Marillana Creek State Agreement). BHP currently has legal access to the land where there is existing tenure. The land the subject of the Proposal is Mining Lease 270SA (M270SA) which is granted pursuant to the Marillana Creek State Agreement.

The Proposal is located primarily on Mineral Lease ML281SA, Mineral Lease ML249SA, and proposed new tenure. Operations at the Central Pilbara Hub are situated on the tenure listed in Table 3-1 and shown on Figure 2-1.

Table 3-1: Central Pilbara Hub tenure

Lease	Description	Legislation
ML281SA	Mineral Lease 281SA	<i>Iron Ore (Mount Goldsworthy) Agreement Act 1964</i> (WA)
M270SA	Mining Lease - Activities and ancillary works connected with Mining and Exploration under the State Agreement. Incorporates the area of Mining Lease 47/292 which no longer exists.	<i>Iron Ore (Marillana Creek) Agreement Act 1991</i> (WA)
ML249SA	Mineral Lease 249SA	<i>Iron Ore (Mount Goldsworthy) Agreement Act 1964</i> (WA)
ML251SA	Mineral Lease 251SA	<i>Iron Ore (Goldsworthy-Nimigarra) Agreement Act 1972</i> (WA)

State Agreement approval is required prior to the commencement of activities, which includes grant of tenure, as outlined in Table 3-2, with other state approvals that are required for operations for the Combined Proposal.

Table 3-2: Other approvals

Decision-making authority	Legislation or Agreement regulating the activity	Approval required (and relevant proposal element)	Statutory decision-making process can mitigate impacts on the environment
Chief Executive Officer (CEO) DWER	EP Act- Part V	Works Approval and Licence (Processing, mining dewatering, surplus water management, waste management, bulk storage of chemicals etc.)	Yes Licence contains limits and conditions to mitigate impacts on the environment. Impacts related to discharges and emissions can be regulated through an amendment to existing MAC licence L7851/2002/6.
Minister for Water	<i>Rights in Water and Irrigation Act 1914</i> (WA) (RiWI Act)	26D & 5C Licence to construct bores and take water (Groundwater abstraction, including for dewatering) Permit to interfere with bed and banks (Creek diversions)	Yes Licenses contain limits and conditions (Groundwater operating strategy) to mitigate impacts on water resources and the environment. Impacts related to drawdown and abstraction will be regulated through an amendment to the MAC-SF groundwater licences.
Minister for Aboriginal Affairs	<i>Aboriginal Heritage Act 1972</i> (WA) (AH Act)	AH Act s. 18 consent to disturb, if previously unidentified sites are recorded and cannot be avoided	Yes s. 18 of the AH Act authorises impacts to Aboriginal sites. Impacts which are already approved under s. 18 will continue to apply.
Minister for Mines and Petroleum	<i>Mining Act 1978</i> (WA)	Mining lease (New tenure)	No New miscellaneous leases required for the proposed surplus water management strategies (pipelines routes)
Minister for State Development	<i>Iron Ore (Mount Goldsworthy) Agreement Act 1964</i> (WA) <i>Iron Ore (Marillana Creek) Agreement Act 1991</i> (WA) <i>Iron Ore (Goldsworthy-Nimingarra) Agreement Act 1972</i> (WA)	Additional State Agreement Proposal(s) <u>are</u> required under the relevant legislation (that being Mount Goldsworthy State Agreement and Marillana Creek State Agreement) prior to commencement of activities	Yes Approval under Part IV of the EP Act required.
Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)	<i>Mining Act 1978</i> (WA)	Mining Proposal	Yes An environmental risk assessment and management approach will be developed.

Decision-making authority	Legislation or Agreement regulating the activity	Approval required (and relevant proposal element)	Statutory decision-making process can mitigate impacts on the environment
Chief Dangerous Goods Officer DEMIRS	<i>Dangerous Goods Safety Act 2004 (WA)</i>	Dangerous goods licence	No
State Mining Engineer DEMIRS	<i>Mines Safety and Inspection Act 1994 (WA)</i>	Approval to commence mining operations	No

4 Stakeholder engagement

4.1 Key stakeholders

During the development of the Proposal, BHP undertook targeted stakeholder engagement based on interest and proximity to the Proposal location. The key stakeholders for the Proposal are summarised in Table 4-1.

Table 4-1: Key stakeholders

Stakeholder group	Stakeholder
State Government	Department of Water and Environmental Regulation (DWER) Department of Biodiversity, Conservation and Attractions (DBCA) Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) Department of Jobs, Tourism, Science and Innovation (DJTSI)
Traditional Owners, Native Title Claimants and Representative Bodies	Banjima Traditional Owners through Banjima Native Title Aboriginal Corporation (BNTAC)
Commonwealth Government	Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Local government	Shire of East Pilbara

4.2 Stakeholder engagement process

BHP meets regularly with the key stakeholders identified in Table 4-1 to facilitate regular, open and honest dialogue to understand expectations, concerns and interests of stakeholders and to incorporate them into business planning.

4.3 Stakeholder consultation outcomes

Table 4-2 summarises stakeholder consultation undertaken specifically for this Proposal. Section 11 provides a detailed description of social surroundings engagement with Traditional Owners and the outcomes of the engagements.

Table 4-2: Stakeholder engagement

Stakeholder	Date	Topics/issues raised	BHP response and outcome
Banjima representatives, BNTAC	1 November 2024	Endorsement of the Social, Cultural, Heritage and Environmental Management Plan (SCHEMP)	BHP to update SCHEMP with additional items. Response and outcomes provided in detail in Section 11.
Banjima representatives, BNTAC	May 2024	Social surroundings engagement including addressing updated scope of project, Yandicoogina Gorge, volumes of discharge, dewatering drawdown, locations of infiltration ponds and communication towers.	BHP to clarify scope of the project. Response and outcomes provided in detail in Section 11.
BNTAC	24 April 2024	Change of scope to CPHSW Project since 2022 social surroundings engagements and discussion on further consultation with Banjima representatives.	BHP and BNTAC agreed to further engagement on country regarding Yandicoogina Gorge, volumes of discharge, dewatering drawdown, and communication towers. Discussed in detail in Section 11 Social Surroundings.
DWER-Water Licensing	24 October 2023	Presentation of draft H3 assessment and modelling outcomes for Mining Area C Part IV referral.	Presented as a technical share.
Banjima representatives, BNTAC	18-22 July 2022	On-country social surroundings engagement including project overview, identification of existing values, potential impacts and proposed environmental management. On country discussion of	Discussed in detail in Section 11 Social Surroundings
Banjima representatives, BNTAC	13-17 June 2022	On country social surroundings engagement including project overview, identification of existing values, potential impacts and proposed environmental management.	Discussed in detail in Section 11 Social Surroundings

5 Object and principles of the EP Act

The Object of the EP Act (s4A) is to protect the environment of the State, having regard to the principles in s4A of the EP Act. Table 5-1 outlines BHP's consideration of the Object and principles of the EP Act in relation to the Proposal.

Table 5-1: Object and principles of the EP Act

Principle	Consideration
1. The precautionary principle <i>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.</i> <i>In application of this precautionary principle, decisions should be guided by:</i> <i>(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i> <i>an assessment of the risk-weighted consequences of various options.</i>	BHP has undertaken baseline biodiversity surveys and hydrological studies to provide scientific information for BHP to assess the risks and potential impacts on the environment from the Proposal. Where baseline surveys are still progressing management conditions have been proposed. The outcomes of these investigations have informed modifications to the Proposal Development Envelope and Indicative Footprint. In designing the Proposal, BHP has considered different options (Section 2.4) and has applied the mitigation hierarchy to avoid and minimise impacts on the environment. An options assessment for the surface water diversions was undertaken, the result has been the selection of an option which minimises potential impacts to downstream surface water receptors. BHP has also identified management measures to ensure ongoing monitoring and management of values to ensure that the EPA objective for each factor can be met.
2. The principle of intergenerational equity <i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i>	BHP has demonstrated how it has applied the mitigation hierarchy to avoid, minimise and rehabilitate environmental impacts, to maintain the health, diversity and productivity of the environment. BHP has undertaken social surroundings engagements with Banjima representatives (through BNTAC) to understand the aspects of the environment that are important to the Banjima Traditional Owners. BHP has also updated the MAC Mine Closure Plan (Appendix 5) which has an overarching closure objective to develop a safe, stable, non-polluting and sustainable landscape that is consistent with social and environmental values agreed by key stakeholders. This includes considering closure issues of interest to the Banjima Traditional Owners, and returning the site to a post-mining land use that is consistent with the pre-mining environment and is viable for future generations.
3. The principle of the conservation of biological diversity and ecological integrity <i>Conservation of biological diversity and ecological integrity should be a fundamental consideration</i>	BHP has considered biodiversity and hydrological information from recent surveys and studies completed for the Proposal and from extensive knowledge gained from numerous surveys and studies completed for the Development Envelope. This principle is a key consideration for the Proposal as it is also part of the EPA's objectives for the land biodiversity factors of Flora and Vegetation, Terrestrial Fauna and Subterranean Fauna. BHP has considered this principle through the assessment of these factors (Sections 8 to 10). Through the Proposal design and application of the mitigation hierarchy, BHP considers that biological diversity and ecological integrity will be conserved.
4. Principles relating to improved valuation, pricing and incentive mechanisms <i>(1) Environmental factors should be included in the valuation of assets and services.</i>	BHP accepts that it is responsible for the costs relating to the management of waste and pollution, including avoidance, containment, decommissioning, rehabilitation and closure. BHP recognises that cumulative GHG emissions are a contributor to climate change and that the cumulative emissions from the Proposal will contribute to WA's GHG emissions. BHP will bear the cost of emission

Principle	Consideration
(2) <i>The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i> (3) <i>The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</i> (4) <i>Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.</i>	reduction and offset strategies to minimise BHP's contribution to GHG emissions over the life of the Proposal.
5. The principle of waste minimisation <i>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.</i>	Standard waste management measures are a key element for the implementation of this Proposal. It is standard practice for BHP to apply the waste management hierarchy to all sites and this will be the case in relation to this Proposal (i.e. avoidance, reuse, recycling, recovery of energy, treatment, containment, and disposal). BHP has outlined the measures to minimise GHG emissions in Section 12. BHP's closure philosophy for the Proposal to minimise ex-pit waste through the backfill of mined out pit voids and deposition of tailings into pit voids, as outlined in the Mine Closure Plan. This will help to achieve backfill 5 m above water table and minimise additional disturbance.
Description of how the object of the EP Act has been considered: BHP has considered the object of this Act, which is to protect the environment of the State, by having regard to the principles of the EP Act above.	

6 Environmental factors

BHP considered the various matters that the EPA may have regard to in considering the significance of potential impacts, as outlined in the EPA's Procedures Manual (EPA 2021a) and *Statement of environmental principles, factors, objectives and aims of EIA* (EPA 2023c). Table 6-1 summarises whether BHP has identified that an environmental factor is a preliminary key environmental factor (i.e. those factors that may be significantly impacted by the Proposal) for the assessment.

Table 6-1: Identification of preliminary key environmental factors for the Proposal

Environmental factor	Potential environmental impacts	Preliminary key environmental factor for the Proposal
Land		
Flora and Vegetation	- loss of flora and vegetation - changes to vegetation from changes to groundwater and surface water regimes - changes to vegetation and flora from dust, fire and weeds	Yes (Section 8)
Terrestrial Fauna	- loss of fauna habitats and fauna - changes to fauna habitats from changes to water regimes - impacts to fauna from dust, introduced species and fire	Yes (Section 9)
Subterranean Fauna	changes to subterranean fauna habitat and species assemblage from changes to groundwater regimes and quality	Yes (Section 10)
Landforms	- modification of natural landforms - erosion of natural landforms	No (Section 13)
Terrestrial Environmental Quality	- increased erosion, including waste structures - contamination of land	No (Section 13)
Water		
Inland Waters	- changes to groundwater regimes - changes to surface water regimes - changes to water quality	Yes (Section 7)
Air		
Air Quality	particulate emissions (dust)	No (Section 13)

Environmental factor	Potential environmental impacts	Preliminary key environmental factor for the Proposal
Greenhouse Gas Emissions	contribution of GHG emissions to climate change	Yes (Section 12)
People		
Social Surroundings	- impacts to access, landscape and amenity - degradation of cultural heritage places and values (including water values)	Yes (Section 11)

BHP's assessment of the preliminary key environmental factors is detailed in Sections 7 to 12.

As discussed in Section 2.3, the proposed Development Envelope is an amendment to the Approved Proposal boundary (Development Envelope), where impacts have already been assessed and approved. BHP has provided information on the Approved Proposal so that the EPA can consider the environmental effects of the Proposal in context of the Approved Proposal. BHP has also outlined the combined effects which the implementation of the Approved Proposal and the Proposal (Combined Proposal) might have on the environment.

BHP's evaluation of 'other environmental factors' is summarised in Section 13. This includes justification as to why BHP considers that they are not preliminary key environmental factors.

7 Inland Waters

7.1 EPA environmental factor and objective

The EPA's environmental objective for the Inland Water factor is:

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

7.2 Relevant policy and guidance

BHP assessed this environmental factor considering the following relevant EPA policies and guidance, as outlined in Table 7-1.

Table 7-1 Inland Water Policy and Guidance

Policy and guidance	Consideration of policy and guidance
Environmental Protection Authority	
Environmental Factor Guideline - Inland Waters (EPA 2018a)	BHP completed the following items in relation to the Proposal: • Considered the links with other environmental factors • Applied the relevant considerations for environmental impact assessment • Considered the environmental values supported by or dependent on Inland Waters, and their significance • Undertook investigations and studies consistent with the information required for Environmental Impact Assessment (EIA)
Other State Departments/Authorities	
RiWi Act	The <i>Rights in Water and Irrigation Act 1914</i> (RiWi Act) provides for licences for the taking and use of water from certain sources (including underground water sources) and for the construction of bores. It applies to artesian wells throughout the state and non-artesian wells in proclaimed groundwater areas. Licences under the RiWi Act are required for mining and associated documentation is also required under the process including Groundwater Operating Strategies and Hydrogeological reporting.
<i>Western Australian Water in Mining Guideline</i> (DoW 2013)	BHP undertook the following steps consistent with the guideline: • consultation, proposal scoping, investigations, validation of impacts and post-closure management • considered options for surplus water from mine dewatering and potential impacts, including cumulative impacts
<i>Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence</i> (DoW 2009)	This policy provides guidance on when hydrogeological assessments and groundwater monitoring reports (collectively referred to as hydrogeological reports) will be required, and the information that they should contain. The policy facilitates the assessment of applications for a groundwater well licence, as well as the assessment of monitoring results.

Policy and guidance	Consideration of policy and guidance
<i>Use of operating strategies in the water licencing process</i> (DWER 2020b)	This policy identifies which water licence applicants may have to develop operating strategies. We describe how these strategies may form part of the conditions in a water licence, how licencees must abide by the commitments within them and how to amend, renew and transfer them.
<i>Policy: Use of mine dewatering surplus</i> (DWER 2020a)	BHP considered the following items in relation to the Proposal: • Determined the mine dewatering surplus • Considered regulatory requirements • Considered cumulative impacts, water quality and availability of water after mine closure, pipeline route
Pilbara Regional Water Plan 2010-2030 (DoW 2010)	Given the growing demand for a highly variable water resource, the purpose of this plan is to set the strategic directions for the management and development of the Pilbara region's water resources in a sustainable manner to maintain and enhance its natural environment, cultural and spiritual values, quality of life and economic development.
Approach to Risk-based Environmental Compliance for the Resource Industry (Department of Mines, Industry Regulation and Safety [DMIRS] 2023)	This policy demonstrates how the Department of Mines, Industry Regulation and Safety (DMIRS) Resource and Environmental Compliance (REC) Division delivers on its principal objective for environmental regulation using a risk-based compliance approach.
Commonwealth	
<i>National Water Quality Management Strategy</i> (NWQMS)	Australia's National Water Quality Management Strategy provides guidance on the management of water quality in Australia and New Zealand. This guidance has been used in consideration of surface water management and setting appropriate water quality targets
Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 (ANZECC & ARMCANZ 2000)	The Water Quality Guidelines provide authoritative guidance on the management of water quality for natural and semi-natural water resources in Australia and New Zealand.
Australian Guidelines for Water Quality Monitoring and Reporting (ANZG 2018)	The guidelines provided a comprehensive framework and guidance for the monitoring and reporting of freshwater, and marine water and groundwater. Described the design, application, analysis and reporting of monitoring programs. The document did not discuss drinking water, wastewater and effluents covered by separate NWQMS guidelines
Guidelines for Groundwater Quality Protection in Australia (DAWE 2013)	These guidelines are designed to support the overall objective of the NWQMS, focusing on protecting and enhancing groundwater quality to support the nominated environmental values and preventing groundwater contamination. The desired outcome of these guidelines is a consistent, high-level approach to groundwater quality protection across Australia, with the assignment of environmental values for all groundwater.
Assessing and managing water quality in temporary waters Technical Report (DAWE 2020)	This document provides guidance for the application of the ANZG (2018) Water Quality Management Framework for assessing water and/or sediment quality of temporary waters. It assumes that the normal WQMF process is applied but provides specific consideration for temporary waters.

BHP has specifically considered this guidance in the following ways:

- surveys (data collection and reporting) and analyses have been undertaken to describe the receiving environment and its significance

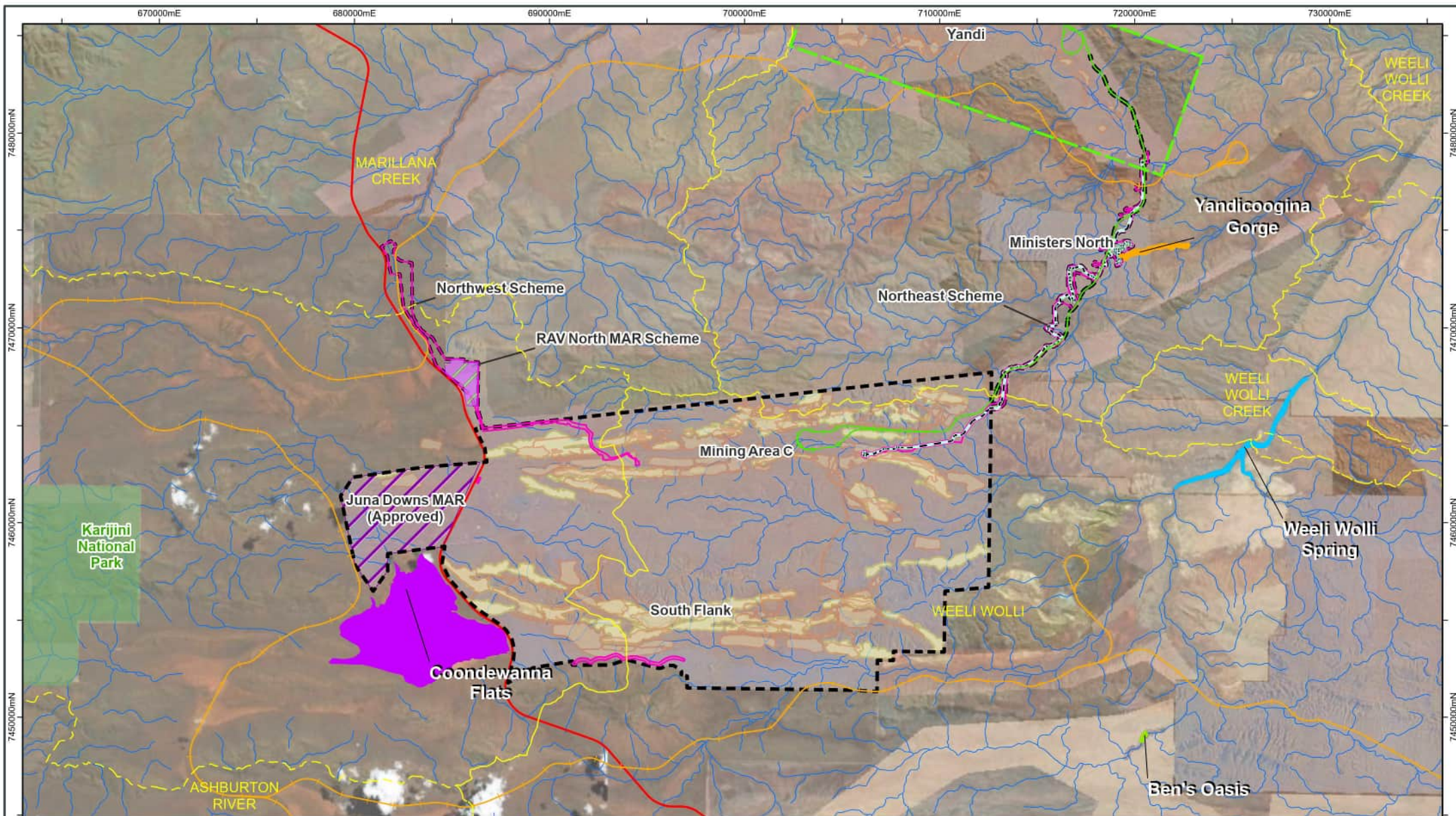
- identification of activities which may lead to impacts to Inland Waters
- application of the mitigation hierarchy in elements of Proposal design.

7.3 Receiving environment

7.3.1 Study Area

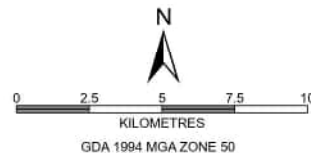
The Study Area, as relevant to Inland Waters, is larger than the Development Envelope to ensure it accounts for and includes potential impacts to sensitive receptors down gradient of the Development Envelope, as well as hydrological and hydrogeological catchment boundaries. Hydrological and hydrogeological catchments that have been included in the Study Area are those that will undergo change as a result of the increased groundwater abstraction and surplus water discharge.

Hydrological catchments and hydrogeological catchments are discussed further in Section 7.3.3.2 and Section 7.3.3.3, respectively. The Study Area, including sensitive receptors and catchments, is presented in Figure 7-1 below.



- Great Northern Highway
- BHP Rail
- Rio Tinto Rail
- Watercourse
- - - Northeast Pipeline
- Indicative Footprint
- - - Development Envelope
- Coondewanna Flats
- Weeli Wolli Spring

- Yandicoogina Gorge
- Ben's Oasis
- Karijini National Park
- MAR - Juna Downs
- Recommended Pit Design Outline
- Overburden Storage Area Outline
- Northern RAV MAR
- Hydrology Catchments
- Yandi



BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT REGIONAL OVERVIEW

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:260,000	REQUESTOR:	ENVIRONMENT	FIGURE:	7-1
DATE:	12/02/2025	PREPARED:	GEOMATICS		
		REVIEWED:		NO:	A1285-037 RevE

7.3.2 Studies and surveys

The studies undertaken by BHP to support the Inland Waters assessment for the Proposal are summarised in Table 7-2.

Table 7-2: Inland Waters – studies and surveys

Title	Date	Summary	Appendix
Surface water			
Marillana Creek Infiltration Proposal Geotechnical Mapping and Investigation Report (4DG 2019)	November 2019	A study of the geological conditions in the area of interest to support both the modelling of subsurface conditions and calculations of the wetting front movement along the alluvial channels through which the discharge water will flow.	Appendix 7
Marillana Creek Wetting Front Modelling (AQ2 2019)	December 2019	Assessment of the wetting front, taking account of constraints imposed by infiltration capacity and groundwater storage, to assess the timing associated with propagation of the wetting front and the likelihood of the wetting front reaching the Flat Rocks Area.	Appendix 7
Yandi E8 Creek Discharge Wetting Front (BHP 2021e)	October 2021	An anecdotal assessment of historical wetting front from existing discharge at proposed discharge point in Lower Marillana Creek.	Appendix 7
Update of South Flank Grand Central Overburden Storage Area Surface Water Management Plan and Surface Water Impact Assessment (WSP 2024)	July 2024	Hydrology and hydraulic analysis of catchments in their existing condition and with the implementation of the Proposal (diversion).	Appendix 7
Coondewanna Flats Natural History (Astron 2021)	December 2021	Remote sensing analysis of the flooding history and vegetation response at Coondewanna Flats.	Appendix 7
Groundwater			
Central Pilbara Hydrogeological Assessment (BHP 2025a)	January 2025	Hydrogeological analysis and modelling to predict potential impacts from dewatering at Mining Area C and South Flank.	Appendix 7
Runaway Valley North Updated Hydrogeological Assessment of MAR (Advisian 2024)	September 2024	Hydrogeological analysis to estimate Managed Aquifer Recharge (MAR) Scheme rates for Runaway Valley North	Appendix 7
Hydrogeological Investigation Drilling Program, Ministers North (RPS 2021)	April 2021	This report summarises the drilling and construction of two production bores and nine monitoring bores at the Ministers North proposal.	Appendix 7
FY23 Ministers North SUR Phase 1 Hydrogeological Drilling Completion Report (BHP 2023c)	March 2023	The purpose of this proposal is the implementation of a re-injection bore field to mitigate any further impact on the Yandicoogina Gorge groundwater dependant ecosystem (GDE). The Yandicoogina Gorge GDE has experienced consistent groundwater level declines since ongoing monitoring started in 2019. The mechanism of declining water	Appendix 7

Title	Date	Summary	Appendix
		levels is currently uncertain, whether it is due to natural climate cycles or due to mine dewatering, either localised mine dewatering (Yandi mine operations) or more widespread operations within the region.	
Technical Memorandum Ministers North Conceptual Hydrogeological Model (BHP 2019b)	October 2019	This memo includes the results of a 2019 field reconnaissance in an area of Yandicoogina Creek in the east of the tenement where groundwater is suspected to emerge in the streambed and sustain a groundwater dependent ecosystem. It also includes time series monitoring data from loggers installed in selected piezometers.	Appendix 7
FY22 Mick's Bore SUR Phase 2 Hydrogeological Drilling Completion Report (BHP 2023b)	May 2023	Completion report for the drilling of pilot and production bores to assess the viability for a MAR scheme at Mick's Bore (at Northern RAV).	Appendix 7
Yandicoogina Gorge Numerical groundwater modelling (BHP 2023i)	June 2023	A numerical model representative of the Ministers North / Yandicoogina Gorge groundwater system was constructed and calibrated to historical data from 2002 to 2022. The model was used to estimate the water requirements of two management strategies.	Appendix 7
Water quality			
Carbonate Precipitation from Groundwater – Source, Controls and Management (Earth Systems 2023)	February 2023	A study to understand the general quality of groundwater (e.g. dissolved metal concentrations) as well as potential risks posed by the discharge of the dewatering stream in terms of carbonate precipitation in the receiving environment.	Appendix 7
Preliminary PFAS Assessment Mining Area C (Cardno 2022)	January 2022	The overarching objective of the investigation is to identify potential source areas and provide a high-level understanding of potential per- and polyfluoroalkyl substances (PFAS) Source-Pathway-Receptor (SPR) linkages associated with MAC and assess the potential risks to human health and the environment.	Appendix 7
Acid and Metalliferous Drainage Risk Assessment – Mining Area C and South Flank (BHP 2021b)	July 2021	This acid and metalliferous drainage (AMD) risk assessment has been prepared for MAC and SF with consideration to BHP's internal preliminary AMD risk assessment procedure. The assessment has been restricted to potential AMD sources that may remain on site at closure, i.e. waste rock and low-grade ore.	Appendix 7
Yandicoogina Gorge Mitigation Water Quality Desktop Review (Biologic 2023f)	May 2023	Biologic Environmental Survey (Biologic) undertook a desktop assessment, to (1) provide a comparison of water quality between MAC and Yandicoogina Gorge. (ground and surface water), and (2) assess the risk of each mitigation strategy (MAR and surface	Appendix 7

Title	Date	Summary	Appendix
		discharge) to environmental receptors within the Yandicoogina Gorge.	
Ecohydrology			
Ministers North Ecohydrology (AQ2 2022)	March 2022	This report describes an initial review and preliminary ecohydrological conceptualisation. The study included a review of existing BHP reports and data (hydrological investigations, groundwater monitoring and vegetation mapping). The review was complemented by a site reconnaissance visit.	Appendix 7

7.3.3 Existing environment

Existing conditions on a regional and local scale have been reviewed in relation to the Proposal and hydrological and hydrogeological matters of interest. The review was based on the Study Area defined above in Section 7.3.1.

7.3.3.1 Climate

The Combined Proposal is located within the Pilbara region of the Northern Rangelands, in the hot desert of the inland areas (BoM 2019; WAAA 2016). The region is characterized by very hot summers, mild winters, and low, variable rainfall.

Rainfall is episodic and inconsistent, falling mostly in summer and autumn (influenced by tropical and monsoonal drivers) and lesser during winter and spring (BHP 2025a). Rainfall varies widely across catchments in the Pilbara and is mainly associated with thunderstorms and occasional tropical cyclones and tropical depressions (McFarlane 2015). The Hamersley Range is typified by orographic rainfall patterns, which results in higher precipitation forming over the ranges. As a result, the low-lying areas may receive almost half the annual rainfall that the ranges receive (McFarlane 2015). Local rainfall data has been collected by BHP since 2004 and is also available from the Bureau of Meteorology (BoM) station at Newman (Station No. 007176) located approximately 90 km southeast of the Proposal. Mean maximum temperature, mean minimum temperature, and mean rainfall from the Newman weather station (Station No. 007176) and mean rainfall from recorded by BHP is presented in Figure 7-2 below (BoM 2024; BHP 2025a). Mean annual rainfall recorded at the BoM station no. 007176 was 316 mm for the long-term record, and 420 mm from the BHP local record (BHP 2025a). There is marked seasonal variability with a mean monthly rainfall peak of 72 mm in February, and a low of 5 mm in September. Some lower-intensity rainfall can, however, occur in autumn and winter which can be more effective for plant growth and recharge given the lower temperatures (McFarlane 2015).

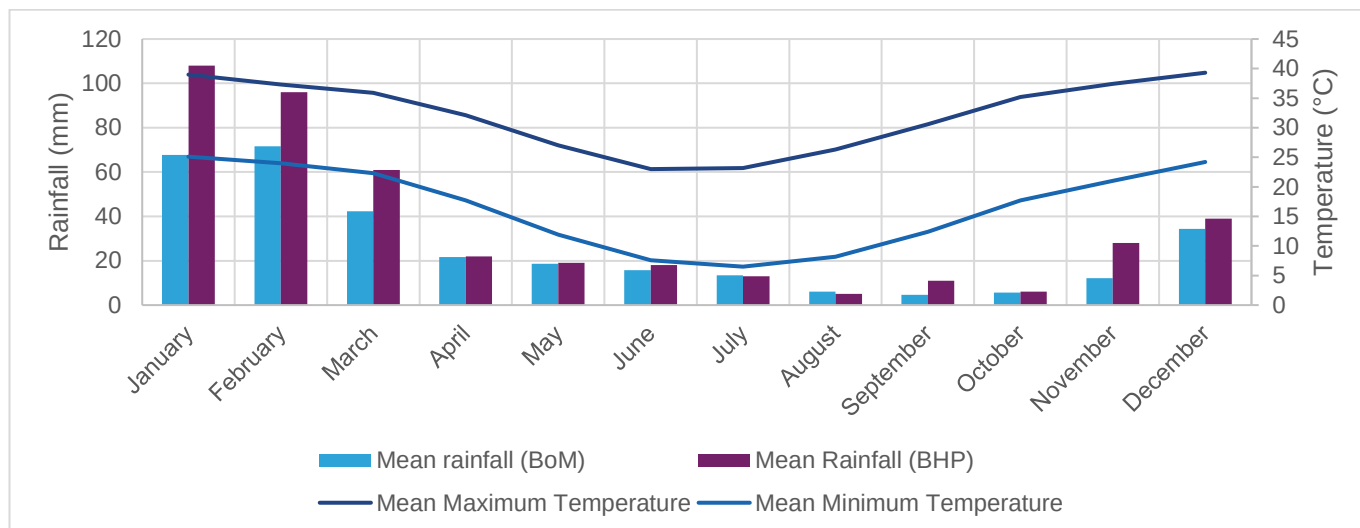


Figure 7-2: Climate data for Newman (Rainfall 1971 - 2023 and Temperature 1996 – 2023). Source (BoM Station No. 007176; BoM 2024) and Rainfall at MAC-SF (2004 – 2022) (BHP 2024a)

Average annual evaporation for the area was approximately 3,200 mm/yr (BoM station at Wittenoom (Station No. 005026) for the period 1951 to 2019. There is no evaporation data for the new/replacement station at Karijini North (Station No. 05098) which started operation in August 2018. This exceeds mean rainfall in every month of the year.

This demonstrates that there is typically a net deficit of rainfall to support runoff to surface water bodies and also highlights the importance of high rainfall events to recharge groundwater. The annual rainfall deficit (rainfall – Class A pan evaporation), ranges from about 2,400 mm in the Hamersley Range to more than 3,100 mm in low-lying areas, is illustrated in Figure 7-3 (McFarlane 2015). Potential evaporation exceeds rainfall by 7 to 13 times, depending largely on elevation.

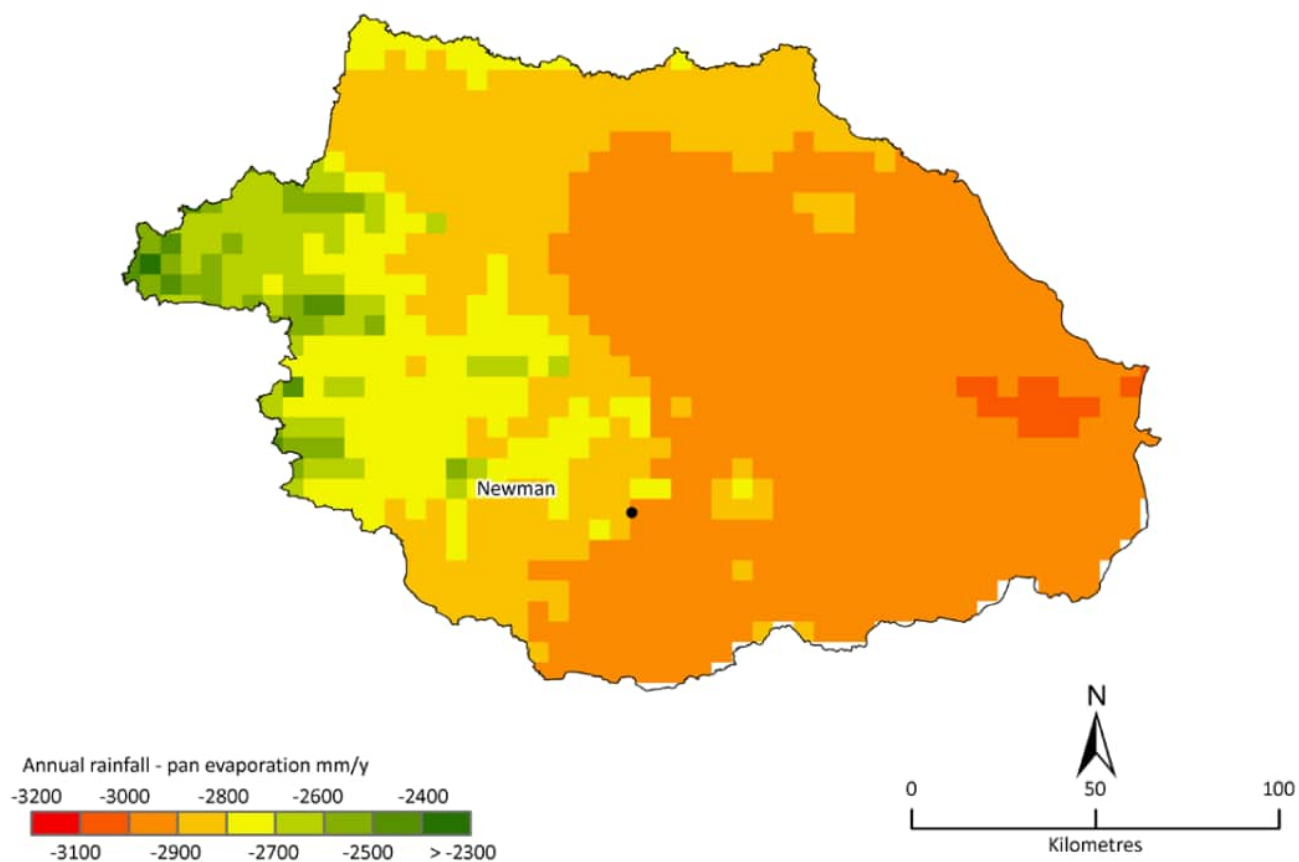


Figure 7-3: Rainfall deficits for the Upper Fortescue region (McFarlane 2015)

Future climate predictions

Australia's climate has warmed on average by 1.74 +/- 0.24°C since national records began in 1910, leading to an increase in the frequency of extreme heat events. For the Northern Rangelands, mean temperatures have increased by about 1.0 °C since 1910 (DWER 2021). Rainfall and streamflow have increased across parts of northern Australia since the 1970s. Year-to-year variability is strongly influenced by the El Niño Southern Oscillation (DWER 2021). There has been a decrease in the number of tropical cyclones observed in the Australian region since 1982. In the coming decades northern Western Australia can expect to experience:

- continued warming, with more extremely hot days and fewer extremely cool days
- more intense short-duration heavy rainfall events
- fewer tropical cyclones but a greater proportion to be of high intensity, with ongoing large variations from year to year; (BoM and CSIRO 2022).

By 2030, the mean annual warming across all emissions scenarios in the Northern Rangelands is proposed to be about 0.6 to 1.4 °C above the climate of 1986–2005 (DWER 2021).

In terms of mine dewatering, climate variability is unlikely to affect the predictions of either dewatering or drawdown during the operational phase of mining. Dewatering rates are expected to be many times more than the recharge from rainfall and runoff, and consequently, variation in rainfall is unlikely to affect drawdown rates. The results from a number of Global Climate Models (Charles et al 2015) show that the largest median predicted change in rainfall by 2050 is a 5% reduction in the wet season. Changes to rainfall in the Northern Rangelands are possible but confidence in the predictions are low given the spread of model results. As a consequence of this, median results are not shown because models do not always agree on the direction of change (DWER 2021). This is because rainfall in the Pilbara results from both tropical and more temperate meteorological processes, making predictions of future changes difficult because they vary in their response to raised GHG emissions (McFarlane 2015).

7.3.3.2 Surface water

The Combined Proposal is located in the Pilbara-Gascoyne Drainage Division within two regional River basins, the Fortescue River (River Region PG8) and the Ashburton River (River Region PG6). The drainage divide between the two river regions also marks the boundary between the Shire of East Pilbara and Shire of Ashburton Local Government Areas.

The Fortescue River flows west through the Fortescue Marsh, designated in the Directory of Important Wetlands in Australia under ecological and hydrological criteria and is also culturally significant to Traditional Owners. It discharges into the Indian Ocean at Mardie Station about 40 km southwest of Dampier. The headwaters area of Fortescue River is flat and marshy. It is a location where Western Creek, Warrawandu Creek and Fortescue River converge. The river then flows through a poorly defined channel as far as Gregory Gorge, when the river starts to form a well-defined channel. It then flows through a number of pools before reaching the estuarine area.

The Ashburton River flows as an intermittent stream west, north-west until discharging into the Indian Ocean 20 km to the south of Onslow. The river flows through regionally significant arid zone mangrove areas, and extensive floodplains. The river has a number of tributaries, including Beasley River, Henry River, Hardey River and Ethel River, which flow through prominent gorges. The Study Area includes a small portion of the Ashburton River catchment, located to the south of Coondewanna Flats, and the western portion of South Flank orebodies. This portion of River Region PG6 drainage is associated with Turee Creek East Branch, which is one of the upper tributaries of the Ashburton River, and accounts for approximately 2% of the drainage in the Study Area (BHP 2017a).

The Study Area is part of the Pilbara Surface Water Area Proclamation to protect, manage and regulate water under the RiWI Act (DWER 2022). This means it is illegal to take water from surface water without a licence or valid

exemption. During drought periods, restrictions make sure that available water is shared and that any potential damage to the environment, the resource and the user is minimised.

The Study Area intersects several surface water sub catchments including the following:

- Coondewanna Catchment (west)
- Weeli Wolli Catchment (east)
- Marillana Creek Catchment (north).

Coondewanna Catchment is an internally draining catchment, which forms part of the Ashburton River Basin. Pebble Mouse Creek, Yandicoogina Creek and Marillana Creek are sub-catchments of Weeli Wolli Creek which lies in the upper Fortescue River Basin. The drainage network map is presented in Figure 7-4 below.

The Coondewanna and Pebble Mouse Creek catchments have been disturbed by the Approved Proposal mining operations. These impacted areas have decreased the contributing catchment areas with corresponding decreases in peak discharge rates and volumes. Reduced peak flows and volumes, in turn, have the potential to reduce downstream floodplain connectivity and impact surface water dependent vegetation. Current operational disturbances of surface water catchments, based on the Approved Proposal (MWH 2016) are presented in Table 7-3 below.

Table 7-3 Current operational disturbance of surface water catchments

Catchment Name	Catchment Area (km ²)	Current BHP disturbance (%)
Coondewanna	860	6.9
Weeli Wolli	4,150	6.2
Marillana	2,228	0.6

Source: MWH 2016

Weeli Wolli Creek is affected by discharge from open cut iron ore mines which, conversely, extends the time that water flows in parts of the creek (McFarlane 2015). Further discussion on these individual surface water catchments is presented in the following sections.

Runoff Processes

In arid and semi-arid zones, such as the Pilbara, surface runoff is typically generated when the rate of rainfall exceeds the infiltration capacity of the ground causing overland flow. This is termed “infiltration excess” runoff. Surface runoff can also be generated from soils already saturated to the surface where additional rainfall becomes overland flow. This is termed “saturation excess” runoff and typically only occurs low in hillslopes, after prolonged events, or in riverbeds and riparian areas (McFarlane 2015). The Study Area is located within the Hamersley Plateau Zone, which is dominated by stony soils found around the hilly terrain and red shallow loams. Other soils include red/brown non-cracking clays and red loamy earths (Tille 2006). Fine grained soils such as clays and loams and which comprise a small portion of the surface materials, typically have a slower infiltration rate than coarser grained soils. As a result, only 2% to 13% (or 6 to 50 mm) of mean annual rainfall becomes runoff in the Pilbara (McFarlane 2015). Between 8 and 30 mm required per rainfall event to initiate runoff.

While the number of events that produce runoff may decrease under a dry future climate scenario, the rainfall threshold is not expected to substantially change. Soils dry rapidly between most rainfall events because potential evaporation greatly exceeds rainfall across the area (Section 7.3.3.1). Another mechanism for surface runoff

generation is by groundwater expression at surface (e.g. Weeli Wolli Spring). This is discussed further in Section 7.3.3.3. Similarly surface runoff could be lost from a catchment by infiltration and evaporation. Soil profiles in the region are weakly developed because of the hot, arid climate and sparse vegetative cover (McFarlane 2015). Upland soils in particular are skeletal, which enhances diffuse recharge during high-intensity rainfall events. More developed alkaline, clay-rich and saline soil profiles are associated with the Upper Fortescue Valley and Fortescue Marsh.

On a regional scale, only about 3.2% of annual rainfall was recorded as streamflow at the Pilbara streamflow stations, with a range of 2.0% to 5.5% (8 to 18 mm) (McFarlane 2015). This is partly because runoff often infiltrates downstream, so these values do not necessarily reflect total streamflows. Leakage from streambeds is considered to be the main source of recharge, and groundwater is the region's main water resource.

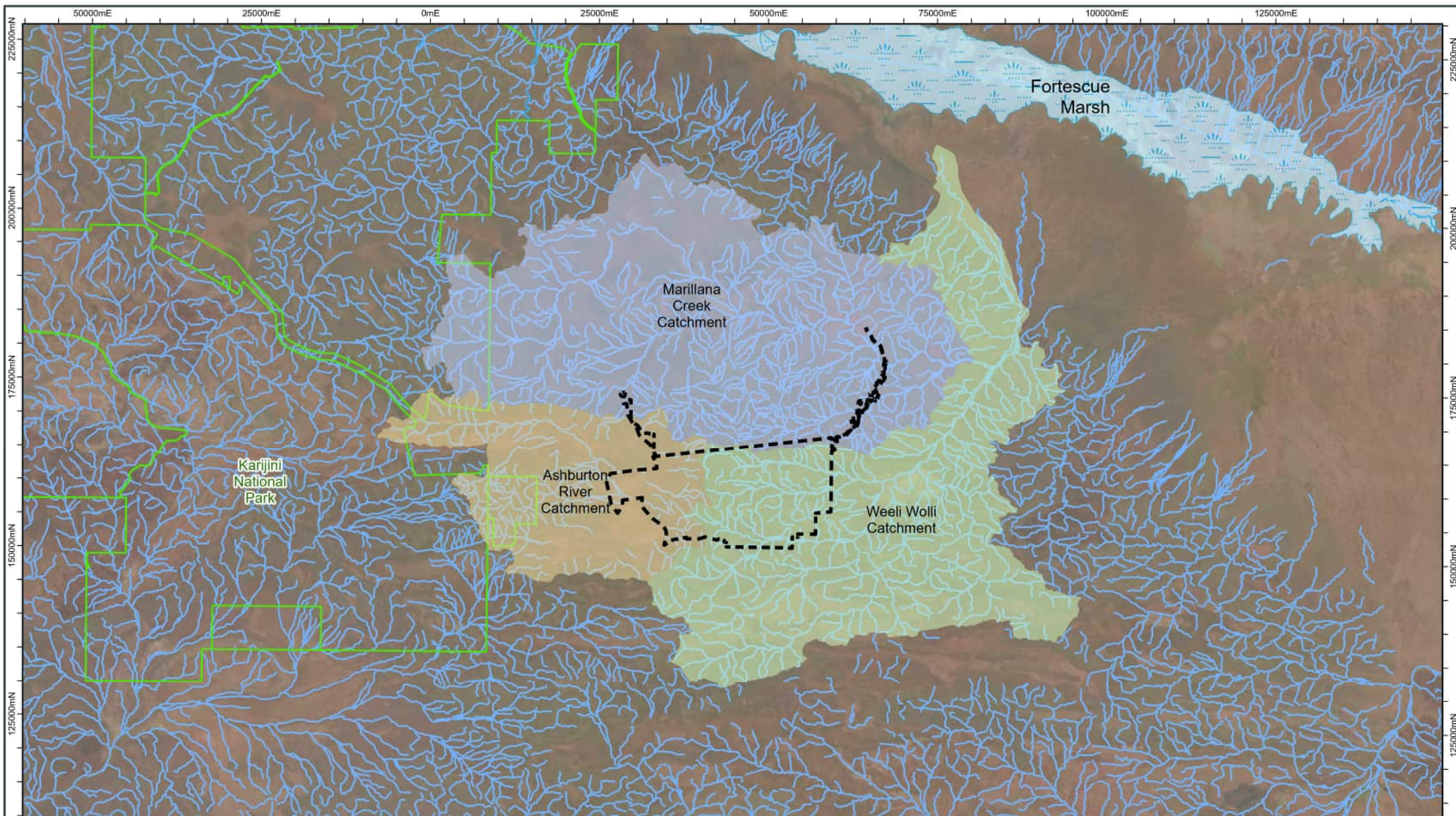
Streamflow exceeds recharge volumes by 5 to 6 times (McFarlane 2015). This difference is the result of very large flows during cyclonic events and tropical depressions exceeding the amount of water that can infiltrate during these events.

All of these runoff (generation and loss) processes may be active at the same time within the one catchment depending on rainfall intensity / duration / areal extent, as well as the variable catchment conditions including surface topography, soil types, soil depths, antecedent soil moisture status, vegetation conditions and hydrogeology.

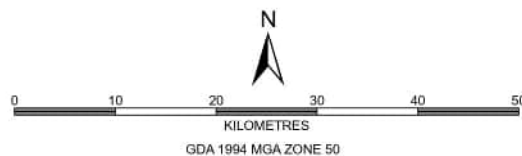
Catchment Water Quality

As most creeks in the Pilbara are ephemeral, the relationship between water quality and water quantity of creeks is important (Sinclair 2013). Water quality has a close but complex relationship with water quantity. The catchments are ephemeral and according to the "Characterising the relationship between water quality and water quantity" guidelines, can be considered as a dryland river ecosystem (Sinclair 2013).

Water quality naturally changes temporally and spatially in dryland rivers. Water quality during high rainfall flows is driven by the large volumes of catchment run-off. Flooding entrains organic carbon, sediment and nutrients from the floodplain areas into the river channels. Some systems also have high mineral turbidity, which is characteristic of the local geologies and land use. Ephemeral creek systems in the Pilbara are naturally exposed to high sediment loads during periods of rainfall stream flow and flood events.



-  Watercourses
-  Development Envelope
-  Karijini National Park
-  Fortescue Marsh
-  Marillana Creek Catchment
-  Weeli Wolli Catchment
-  Ashburton River Catchment



BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT REGIONAL HYDROLOGY

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:750,000	REQUESTOR:	ENVIRONMENT	FIGURE:	7-4
DATE:	18/02/2025	PREPARED:	GEOMATICS	NO:	A1285-038 RevE
		REVIEWED:			

Catchments

Coondewanna Catchment and Lake Robinson

Catchment and Flow Paths

In common with most natural drainage systems in the Pilbara region, the Coondewanna catchment contains ephemeral drainage systems flowing in direct response to rainfall. Streamflow mainly occurs during the summer months of December through to March and is associated with the seasonal large and more intense rainfall events. Streamflow in the smaller flow channels is typically short in duration and ceases soon after the rainfall passes. In the larger flow channels, which drain the larger sub-catchment areas, runoff can persist for several weeks following major rainfall events such as those resulting from tropical cyclones.

The Coondewanna catchment with an area of around 860 km² drains to an internal depression named Lake Robinson. Lake Robinson is located in the southeastern sector of the catchment and is the lowest lying area within the catchment with an elevation of approximately 687 metres above Australian Height Datum (mAHD). This lake bed elevation is approximately 130 m higher than Weeli Wolli Spring, which is located in the adjacent Weeli Wolli Creek catchment.

Large runoff events inundate the lake bed (Figure 7-5) and following runoff, surface water on the lake-bed slowly dissipates by seepage and evapotranspiration. Seepage infiltrates the lake bed area, replenishing soil water in the unsaturated zone contributing to groundwater recharge.

Sub-catchments and inferred main flowpaths are shown on Figure 7-8. Several east to west aligned ridgelines are located within the catchment, which dictate the drainage flow directions and include Mt Meharry, Mt Robinson and The Governor.

The main flowpath discharging to Lake Robinson is Homestead Creek, which drains the northern half of the catchment. Where Homestead Creek passes adjacent to Packsaddle Hill, approximately 8 km north from Lake Robinson, the creek has a well defined single alluvial channel. A BHP water level gauging site (SNPH0011) was installed in the creek in 2011. The gauging site registered three significant stream flow events, ranging from 1.20 m to 1.85 m in height in January 2014 which subsided within two weeks. The creek bed at this location is described as comprising coarse gravels and sands and is approximately 15 m wide with 1 to 2 m high banks (URS 2014). Scattered eucalypt trees are located along the creek bed. During 2012, additional BHP water level gauging sites were established within the Coondewanna catchment as part of the assessment conducted by URS, however they recorded no significant flow from April 2013 until April 2014 (<0.05 m height) (URS 2014).

Detailed topographical mapping shows that the catchment also contains numerous large relatively flat areas comprised of hardpan landscape unit which slow the down gradient water transfer, so that runoff tends to pool, flows slowly downstream and undergoes evaporation and infiltration. Overall, this reduces the volume of rainfall that enters creeklines and increases the proportion of evaporation / infiltration.

During a high rainfall event, runoff could potentially discharge to Lake Robinson from all sides, with proportionally higher runoff from ridgelines, which are in proximity (north-west, north-east, southeast and southwest of Coondewanna Flats). However, it is estimated that as runoff from over 50% of the catchment would need to pass through relatively flat and slowly draining areas prior to reaching Lake Robinson, relative runoff volumes to the lake would typically be low for small to medium rainfall events (AQ2 2016). Significant runoff to Lake Robinson would likely only occur after a large rainfall event (Figure 7-5).



Figure 7-5: Flooding at Coondewanna Flats (March 2012) after the 2011/2012 wet season – looking approximately north-west from southeast of Coondewanna Flats (AQ2 2016)

Flooding at Coondewanna Flats

The *Coondewanna Flats Natural History* study (Astron 2021; Appendix 7) was undertaken to understand the historical patterns of flooding and the response of vegetation to flood events at Coondewanna Flats. The flooding history was reconstructed using historical remote sensing imagery from 1986 to 2021 and captured 11 significant flood events during that period. The study aimed to understand the frequency, extent, and duration of flood events and their impact on the local ecosystem.

Flood events were identified using the Modified Normalise Difference Water Index (MNDWI) from Landsat imagery. The method allowed for the detection of significant inundation events (floods) and minor inundation (small or patchy wet areas). The extent of floods varied widely with the largest flood area being 2,290 ha in February 2012. The duration of flood events also varied ranging from 20 days (February 2011) to 112 days (April 1995).

Based on the study, Coondewanna Flats experiences flooding approximately once every three years. This is a higher frequency than previous estimate which suggested flooding occurred once every four years.

Interaction with Groundwater

Pre-development depth to groundwater within Coondewanna Flats was between 20 m below ground level (mbgl) and 30 mbgl (approximately 650 mAHD to 670 mAHD) (BHP 2025a). The Coondewanna Catchment largely interacts with groundwater through infiltration. Throughout the catchment, the ephemeral drainage systems are consistent with losing streams with surface flows lost to evaporation and infiltration to unconfined groundwater systems, including the calcretes and Tertiary Detritals.

Previous investigations by AQ2 (2016) completed to support the Approved Proposal indicated that surface water runoff to Coondewanna Flats and Lake Robinson pools over the lake area replenishing soil water in the unsaturated zone, potentially contributing to groundwater recharge. Recharge events occurred in 2006 and 2012. A recharge event was also inferred to have potentially occurred in 2003 (prior to investigations but based on analysis conducted).

Existing Alterations

Two Rio Tinto Iron Ore (RTIO) railway corridors and the main Great Northern Highway run through the Coondewanna catchment. Earthworks and infrastructure associated with these transport corridors interrupt the natural flowpaths. Culverts or bridges (and floodways on roads) are typically located at identified drainage flowpaths and sheetflow zones to allow runoff to pass downstream of the infrastructure. Similarly, access tracks may potentially interrupt the natural drainage flowpaths (AQ2 2016). The existing South Flank pits resulted in a decrease of 4.7% of catchment area for the Coondewanna Flats.

Upper Weeli Wolli Creek (Weeli Wolli Spring Sub-Catchment including Pebble Mouse Creek)

Catchment and Flow Paths

The surface water catchment upstream from Weeli Wolli Spring has an approximate area of 1,450 km². Catchment-wide, the creek and its tributaries drain in a north-easterly direction.

The catchment topography is defined by hills within the catchment rise to approximately 1000 mAHD (in the south-west) while the elevation at the spring outflow zone is 550 mAHD to 555 mAHD. The elevation near the confluence with Pebble Mouse Creek, about 5 km south of Weeli Wolli Spring, is 574 mAHD; hence Weeli Wolli Creek has an average gradient of about 0.4 to 0.5 across the catchment proximal to the spring. The elevation at the southern end of Weeli Wolli Spring is about 570 mAHD (RPS 2015).

The natural Weeli Wolli Creek channel and main tributaries are well defined, wide and deep. The bed slopes are moderately steep which, in conjunction with the flow regime, has resulted in the creek beds dominated by coarse gravels and pebbles. Large flood flows tend to overtop the banks, utilising the floodplains.

Weeli Wolli Spring occurs where Weeli Wolli Creek passes through a gorge eroded through the Wildflower Range. Immediately upstream of the spring is a dissected alluvial plain formed in calcrete. The creek channel is incised into the alluvial plain, with relatively steep banks (bank height approximately 2 m) and a narrow flanking floodplain (RPS 2015).

Based on historical streamflow data, Weeli Wolli Creek typically has up to two flow events a year (based on records from Tarina (DWER gauge 708014)). These events are generally short duration, with little post rainfall flow persistence (mean daily discharge of 0.72 m³/s, refer to Figure 7-6). However, following above average wet seasons, the creek can flow for a period of several months. Under natural conditions, Weeli Wolli Spring discharges (baseflow) are continuous and dissipate into the river gravels a few kilometres downstream of the Spring.

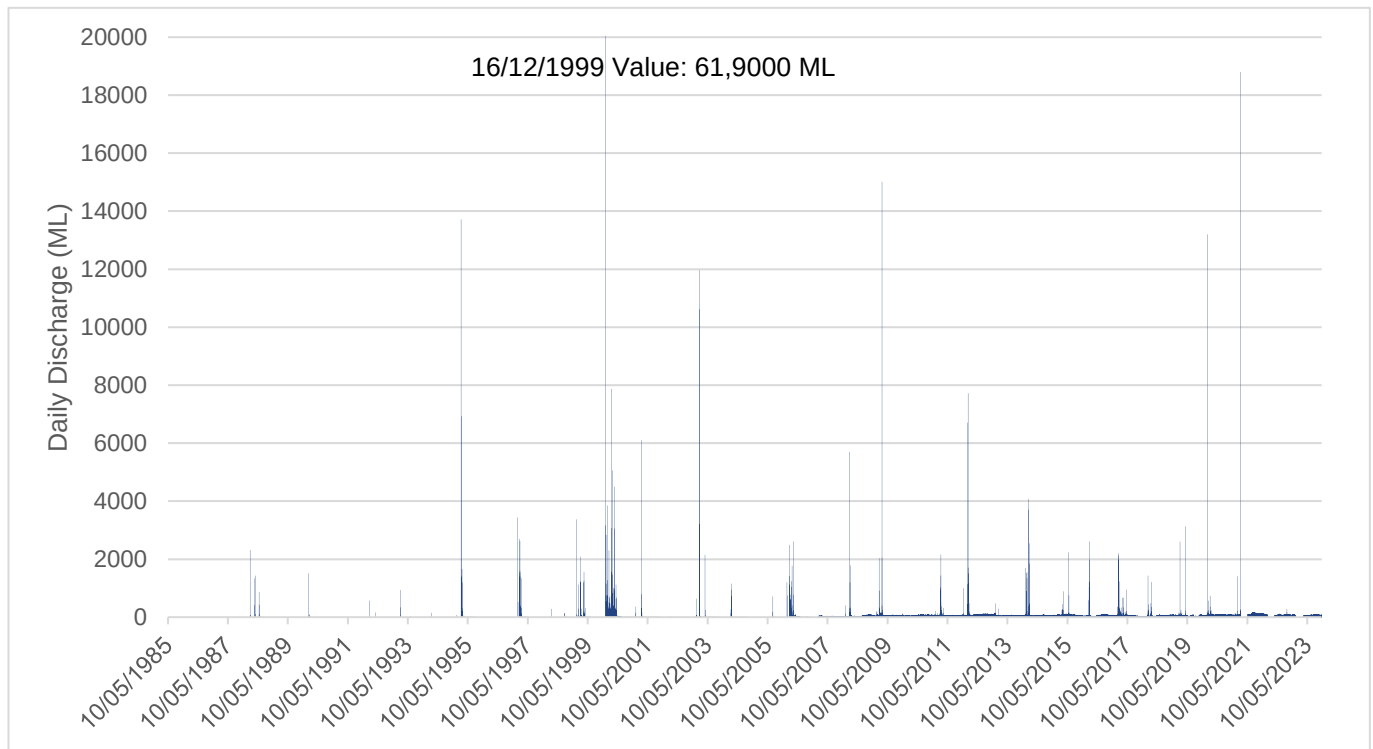


Figure 7-6: Historical streamflow data from Tarina (DWER gauge 708014) from 10/05/1985 until 31/10/2023

Interaction with Groundwater

Weeli Wolli Creek and its tributaries flow along valleys confined by outcrops of the Marra Mamba Iron and Brockman Iron formations. Preferential weathering of the Wittenoom Formation between these outcrops has resulted in a low-lying area that has since been filled with Tertiary Detrital deposits largely composed of alluvium sourced from the surrounding outcrops and chemically precipitated calcrete. Tertiary sediments are up to 75 m thick upstream of Weeli Wolli Spring and approximately 20 m thick at the spring. The Weeli Wolli Spring is located where the high permeability dolomite intersects low permeability shale and ironstone. This results in a natural damming effect, forcing groundwater to converge and to discharge to the surface, supporting a groundwater dependent ecosystem including the priority 1 Weeli Wolli Spring Priority Ecological Community (PEC).

Under natural conditions, spring discharge resulted in perennial flow in the creek. Permanent pools were also present in the creek bed in the vicinity of the spring. These pools are dynamic, subject to periodic changes in location, depth and dimensions. Perennial creek flow continues downstream of the spring for approximately 2 km before all water is removed by a combination of evapotranspiration and seepage into the underlying aquifer.

The Brockman Iron Formation and Mount McRae Shale are particularly resistant to erosion and form a prominent ridge (the Wildflower Range) along the northern extent of the Upper Weeli Wolli sub catchment. Weeli Wolli Creek flows through this ridge (across the regional geological strike) in a narrow fault-controlled valley. Under the creek,

the erosion-resistant Brockman Iron and Mount McRae formations rise to shallow subcrops (i.e. they form a rock bar).

The Tertiary sediments contain an extensive calcrete deposit that has a saturated thickness of around 5 m and is vuggy and permeable. Weeli Wolli Spring is likely to be an area of active calcrete formation because the base of the calcrete sits just below the water table. The calcrete is incised by the creek channel, which is in-filled with Quaternary alluvium. The calcrete is underlain by poorly sorted alluvium of clay, sands and gravels that overlies the bedrock.

Ben's Oasis is a perennial pool on Weeli Wolli Creek located approximately 20 km upstream from Weeli Wolli Spring with a catchment area of 418 km². The pool is a natural expression of the water table which has mounded upstream of a dolerite dyke (URS 2011). Ben's Oasis is also an occurrence of the Weeli Wolli Spring PEC. There is very little documented information regarding the geology, hydrology and ecology of Ben's Oasis.

Existing Alterations

The catchment has been altered by the other mines and proponents in the catchment. Mining operations include a diversion of Pebble Mouse Creek approximately 2 km eastwards from its natural course into the adjacent main Weeli Wolli Creek channel. This diversion is located approximately 3 to 4 km upstream from the natural confluence of the two creeks (RPS 2015).

Baseflow in Weeli Wolli Creek has increased significantly since 2007 and is now perennial due to excess dewatering water from Hope Downs 1 which is discharged into the main channel just downstream from Weeli Wolli Spring.

The majority of the Hope Downs 1 discharge is released from an outfall downstream of the Spring however there are additional smaller discharge spurs upstream of the Spring to provide environmental flows to the PEC. This is intended to mitigate impacts to the groundwater dependent ecosystem caused by lowering of the groundwater table (RPS 2015). The main dewatering discharges are believed to have created a surface expression of the water table in the creek bed downstream from Weeli Wolli Spring to around its junction with Marillana Creek approximately 15 km downstream. As shown in Figure 7-6 above, the Tarina Streamflow station recorded dry daily periods prior to 2008, consistent with general understanding of streamflow in the Pilbara being responsive to rainfall events. After 2008 daily flow is recorded at the station over a consistent period to present records.

The Approved Proposal is located partially within the Upper Weeli Wolli Creek catchment. The Approved Proposal included reduction in catchment of approximately 3.5% of catchment area (MWH 2015).

Marillana Creek

Catchment and Flow Paths

Marillana Creek flows from west to east through BHP Yandi Operations towards its confluence with Weeli Wolli Creek which then travels in a northern direction to ultimately discharge to Fortescue Marsh. The catchment can be divided into an upper and lower creek as there are distinct differences. The split in the catchment can be loosely defined as a north-south split along the line of Flat Rocks Gauging station (DWER gauge 708001). This gauging station experiences average discharge of 0.30 m³/s, refer to Figure 7-7 below.

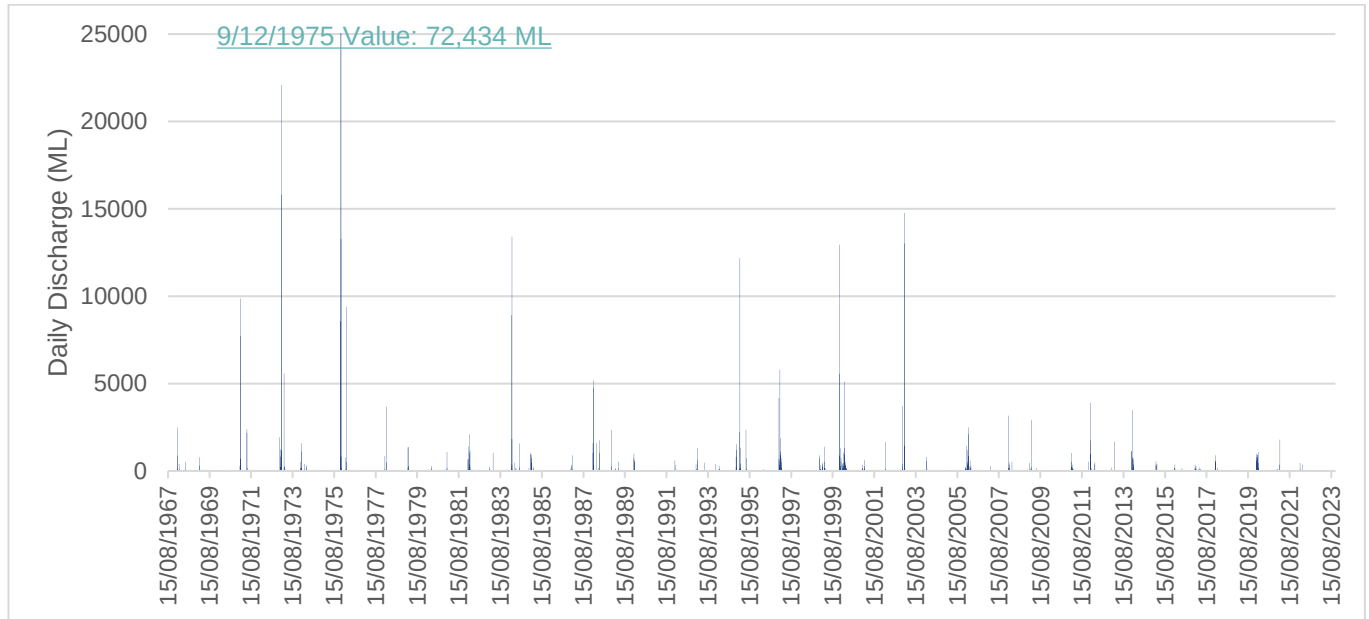


Figure 7-7: Historical streamflow data from Flat Rocks (DWER gauge 708001)

In the upper part of the catchment, the headwaters of Marillana Creek rise in high relief areas of the Hamersley Range in the west (at an elevation of around 1,200 mAHD). Several streams drain across broad areas of low relief in an easterly to north-easterly direction into and through the Munjina Claypan. The claypan marks the downstream boundary of the upper part of the catchment. Surface water flows in excess of the internal storage capacity of Munjina Claypan before moving south-east along Marillana Creek into the lower part of the catchment.

In the lower part of the catchment, major tributaries to Marillana Creek downstream of the Munjina Claypan include Iowa Creek, Lamb Creek, Phil's Creek and Yandicoogina Creek. Marillana Creek drains the catchment eastward into the lower reach of Weeli Wolli Creek before the latter discharges in a northerly direction into the Fortescue Valley.

Channel gradients along Marillana Creek are low at around 2 m/km. In the central and eastern sections of the catchment, the Marillana Creek alignment is topographically controlled with the river channel typically varying in width from 70 m to 150 m. The overall length of the main channel is around 104 km. The lower 80 km has an average gradient of around 2.5 m/km, increasing to around 9 m/km over the remaining 24 km. There is also a short steeper section immediately upstream of Flat Rocks gauging station.

Interaction with Groundwater

In the upper part of the catchment, upstream of the Flat Rocks gauging station, channel iron deposits (CID) are below the water table and often blanketed with sediments. They occur in a low relief area beneath and in the general vicinity of the Munjina Claypan. The CID are broadly coincident with Marillana Creek and several coalescing tributaries where broad, shallow flooding is expected during cyclonic rains.

In the lower part of the catchment, Marillana Creek is incised into higher relief bedrock terrain with narrow flanking floodplains. The creek follows the same valley in which the CID paleochannel developed and the creek bed has an increasing depth of alluvium moving from Flat Rocks (no alluvium) to BHP most easterly mines (some 20 m of alluvium) and probably greater thicknesses again through RTIO's Yandi mine to the confluence with Weeli Wolli Creek. Marillana Creek acts as a recharge mechanism for the CID and overlying alluvium in this region. Marillana Creek drains the catchment eastward into the lower reach of Weeli Wolli Creek before the latter discharges in a northerly direction into the Fortescue Valley.

In the lower part of the catchment, the creek flows alongside the CID, crosses it in some locations and in other sections it is remote from the CID and incised into bedrock. In BHP's Yandi mine tenement (M270SA), which starts at the upper boundary of the lower part of the Marillana Creek catchment, there are several areas where the creek

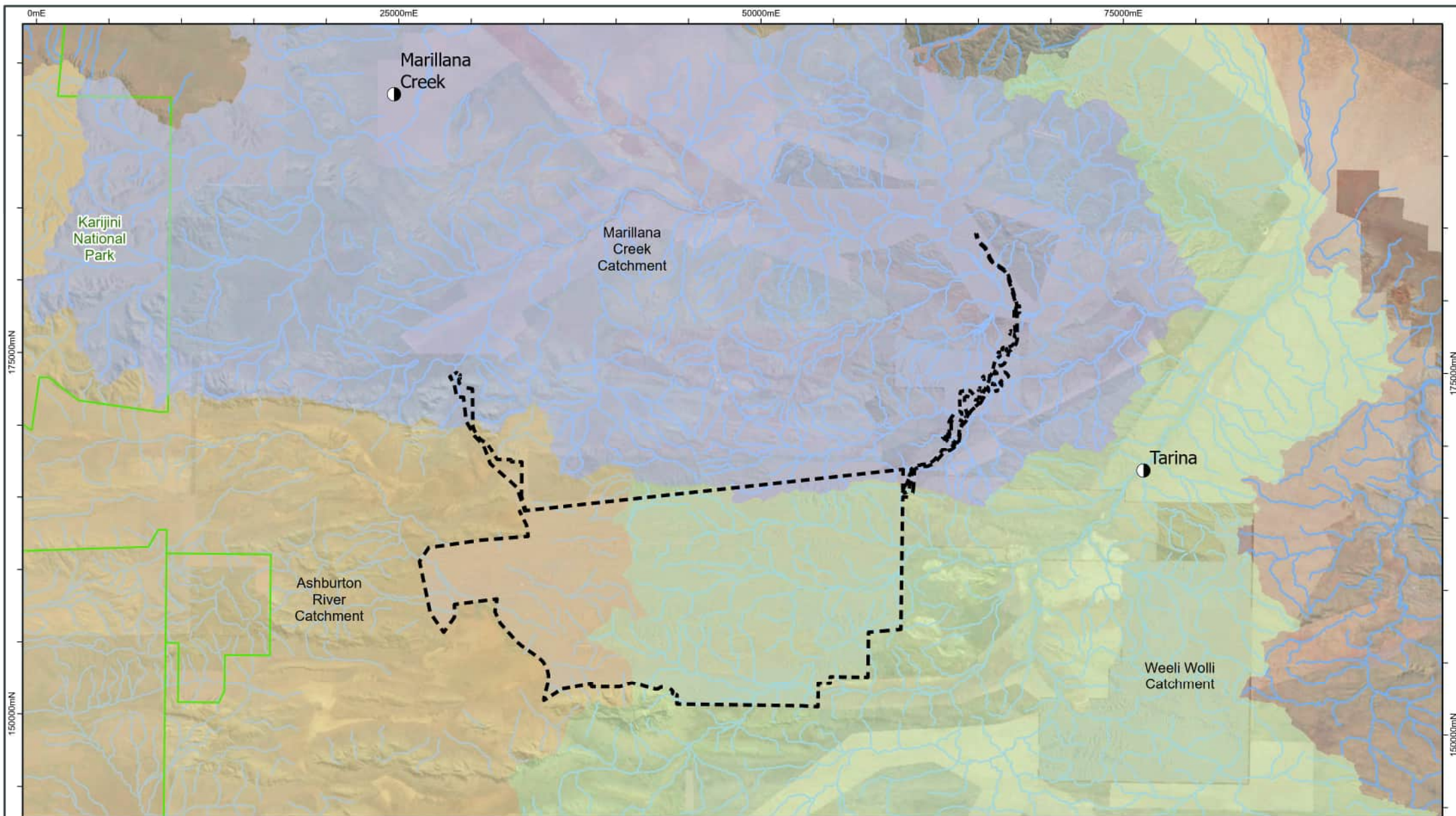
is remote from the CID. Further downstream, in RTIO's Yandicoogina mining area, Marillana Creek does not have broad floodplains but is commonly more or less coincident with potential mining areas. These existing mines and potential mines are subject to greater surface flows in Marillana and Weeli Wolli Creeks than the upper part of the catchment by virtue of the increased upstream area for runoff generation.

Existing Alterations

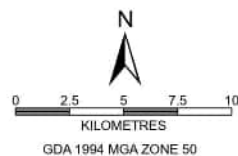
A number of operating mines are located within the Marillana Creek Catchment and generally found adjacent to the Marillana Creek or its tributaries. These include (Golder Associates 2015):

- Marillana Creek: BHP's Yandi Operations and RTIO's Yandicoogina Operation
- Phil's Creek: Phil's Creek Iron Ore Proposal – Mineral Resources Limited (MRL)
- Weeli Wolli Creek: Iron Valley Mine– (MRL).

The key alteration of Marillana Creek is its diversion in the BHP Yandi mine. The surplus water discharge point that exists on the lower side of the BHP site creates an artificial pool and wetting front.



-  Stream Gauging Stations
-  Watercourses
-  Development Envelope
-  Karijini National Park
-  Ashburton River Catchment
-  Marillana Creek Catchment
-  Weeli Wolli Catchment





**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
LOCAL CATCHMENTS AND WATERWAYS**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

PUBLIC

SCALE @ A3:	1:350,000	REQUESTOR:	ENVIRONMENT	FIGURE:	7-8
DATE:	12/02/2025	PREPARED:	GEOMATICS	NO:	A1285-039 RevC
		REVIEWED:			

7.3.3.3 Groundwater

The area is part of the Pilbara Groundwater Area Proclamation to protect, manage and regulate water under the RiWI Act (DWER 2022). This means it is illegal to take water from groundwater without a licence or valid exemption. During drought periods, restrictions make sure that available water is shared and that any potential damage to the environment, the resource and the user is minimised.

Conceptualisation

Substantial hydrogeological investigations have been undertaken in the Study Area since the mid 1990's. Thousands of boreholes have been completed, including exploration boreholes, monitoring bores and production bores. These bores were generally targeting the MAC and SF orebodies, with the region between containing more limited data. Data collection has led to the development of BHP's conceptual hydrogeological model, covering a very large domain, spanning approximately 80 km by 30 km (2,400 km²) and includes the entire Weeli Wolli Spring Catchment.

The Study Area comprises the Hamersley Group formations and overlying Tertiary Detritals. The Hamersley Group comprises a series of siliceous and carbonate-rich moderate to deep water sediments that have been chemically altered and iron enriched to form Banded Iron Formation (BIF) and dolomite. Subsequent additional iron enrichment of the BIF has formed orebodies. There is a marked increase in both porosity and permeability associated with the mineralisation process, as such the orebodies form important aquifers. The Hamersley Group makes up the following main aquifers in the Study Area:

- Orebody aquifers, which are made up of mineralised and sub mineralised material of the:
 - Marra Mamba Formation which hosts the North Flank Deposits (A, B, C, E, F, R and Dead End); the South Flank Deposits (Highway, Grand Central and Vista Oriental) and the RTIO Hope Downs 1 deposits
 - Brockman Iron Formation, which forms east/west striking aquifers in the north, hosted in the Packsaddle orebodies.
- Regional aquifers, which are located through the valley between North Flank and Packsaddle, the South Flank paleochannel, west near Coondewanna Flats and east near Weeli Wolli Spring, and are made up of:
 - Weathered Paraburdoo (and Bee Gorge) Members of the Wittenoom Formation. The Paraburdoo dolomite in particular, can be karstic and highly permeable
 - Sand, gravel and calcrete occurrences in the Tertiary Detritals. The Tertiary Detritals are very thick in places, reaching >100 m in some regional aquifers (e.g., South Flank Valley paleochannel).

The orebody and regional bedrock aquifers are separated by the various shale members of the Mt McRae / Mt Sylvia Formations and Wittenoom Formation. The Mt McRae and Mt Sylvia shales are present to the south of the Brockman orebodies and the West Angela Shale is found to the north of the Marra Mamba orebodies. In some areas, the regional aquifers are in direct contact with the orebody aquifers (e.g. A and C deposit) whereas in others they are hydraulically disconnected by the shale formations (e.g. most of the Packsaddle orebodies).

The hydrostratigraphy within the conceptual model boundaries also demonstrates the following properties:

- The Wittenoom Formation is less resistant to weathering than the surrounding geology and has been eroded to form the North Flank Valley flanked by ridges of Marra Mamba Formation to the south and Brockman Iron Formation to the north. Preferential erosion has resulted in karst development in the Wittenoom Formation, particularly in the dolomite of the Paraburdoo Member. The valley has been infilled with sediments that comprise erosional detritus from the surrounding outcrop (Tertiary Detritals).

- Some of the Packsaddle (Brockman Formation) orebodies to the north are above the water table and some extend below.
- The Marra Mamba Formation orebodies present significant saturated thicknesses and are in variable connection to the regional aquifers.
- At North Flank, the greatest connection, where orebody and dolomite aquifers are in direct contact, is believed to be at A Deposit. The least connection is believed to be at the eastern end of C Deposit, where the West Angela Shale forms an effective, if leaky, barrier between it and the regional aquifers.
- At South Flank the northern orebodies are separated from the southern orebodies in the west and east but come together in the central area (and in the far western margin). Generally, the northern orebodies are at a higher elevation and have a lower proportion of BWT ore. The southern orebodies are likely well connected to the regional aquifers at least along some of their strike length.
- Weeli Wolli Spring occurs where Weeli Wolli Creek passes through a gorge eroded through the Wildflower Range. Groundwater flows are concentrated into the spring by low permeability basement rocks. A shallow groundwater system occurs up-gradient from the spring and is associated with an extensive calcrete zone up to 40 m thick.
- Beneath Juna Downs and Coondewanna Flats the regional aquifer is extensive and comprised of karstic Paraburdoo dolomite overlain by a thick sequence of Tertiary Detritals. Depth to bedrock (dolomite) beneath the Juna Downs MAR borefield is generally greater than 50 m, while depth to bedrock beneath Coondewanna Flats varies from 30 – 50 m and is inferred to be more competent (i.e., less permeable).

Due to the scale and complexity of the aquifers found within the Development Envelope, a detailed hydrogeological conceptual model detailing the localised hydrostratigraphy of each orebody is presented in Appendix C of the Central Pilbara Hydrogeological assessment (BHP 2025a).

Regional and local structures play a significant role in the Central Pilbara groundwater system and generally behave as partial, if not almost complete, barriers to flow. The following features play a key role in controlling regional groundwater flow (Presented in Figure 7-9 below):

- Dolerite dykes – Generally north-east to southwest or north-west to southeast orientation. From west to east:
- Cross cut stratigraphy to the east of MAC E Deposit and South Flank Highway Deposit (Bruce Almighty Dyke)
- Cross cut stratigraphy in MAC E and C Deposits, cuts through the west of R Deposit, to the east of South Flank (and just south of Hope Downs South) and just to the north-east of Ben's Oasis.
- Rock mass flow barriers (or undefined dykes). From west to east:
 - A feature (likely low permeability rock mass and/or structure called Neale's Fault) separating West Packsaddle and Juna Downs
 - A feature cutting through the western end of E Deposit (between E West and E East Deposits)
 - A feature between the eastern end of A Deposit and the Hope Downs aquifer system
 - One, or a combination of features, at the eastern end of South Flank Vista Oriental Deposits
 - Several features in and around the Jinidi Deposits.

There may be other structures that are hydraulically significant through the South Flank area (and other Central Pilbara catchment areas). These are only likely to become apparent following monitoring of the response to significant dewatering of the South Flank orebodies or MAR injection in the South Flank Valley.

It is noted that a low permeability rock mass flow barrier is conceptualised to be found between A Deposit and Hope Downs (the “transition zone”). This barrier is formed by a combination of unmineralised Mt Newman Member, that splits A Deposit orebody into two at its southern end and an extensive unweathered dolomite adjacent to it. A limited thickness of Tertiary Detritals (maximum 20 to 30 m) overlies these lithologies and allows flow from west to east but pinches out to the north-east. In this way, as per the effect of the dykes to the west, the effective transmissivity of the regional aquifers is constrained significantly at this location.

Other Groundwater Users

The RTIO Hope Downs mine, is the only third-party groundwater user within the area. Hope Downs mine is located approximately 10 km downstream to the east of A deposit (BHP 2025a). Hope Downs mine consists of Hope Downs 1 (HD1) orebody, and Baby Hope orebody, located approximately 5 km to the southwest of HD1. The mine operates under the following groundwater licences (RTIO 2022):

- GWL161141 for up to 40.15 GL/annum (GL/a) from HD1 and Baby Hope, for mine dewatering and associated mining purposes
- GWL161143 for up to 0.5 GL/a for potable water supply at Hope Downs village.

It is assumed that dewatering at RTIO Hope Downs commenced in 2007 at a rate of approximately 70 ML/day (ML/d) with a maximum rate of approximately 100 ML/d reached a few years later. Dewatering at Hope Downs is currently expected to finish by the end of 2025, once mining and infilling is completed (RPS 2015).

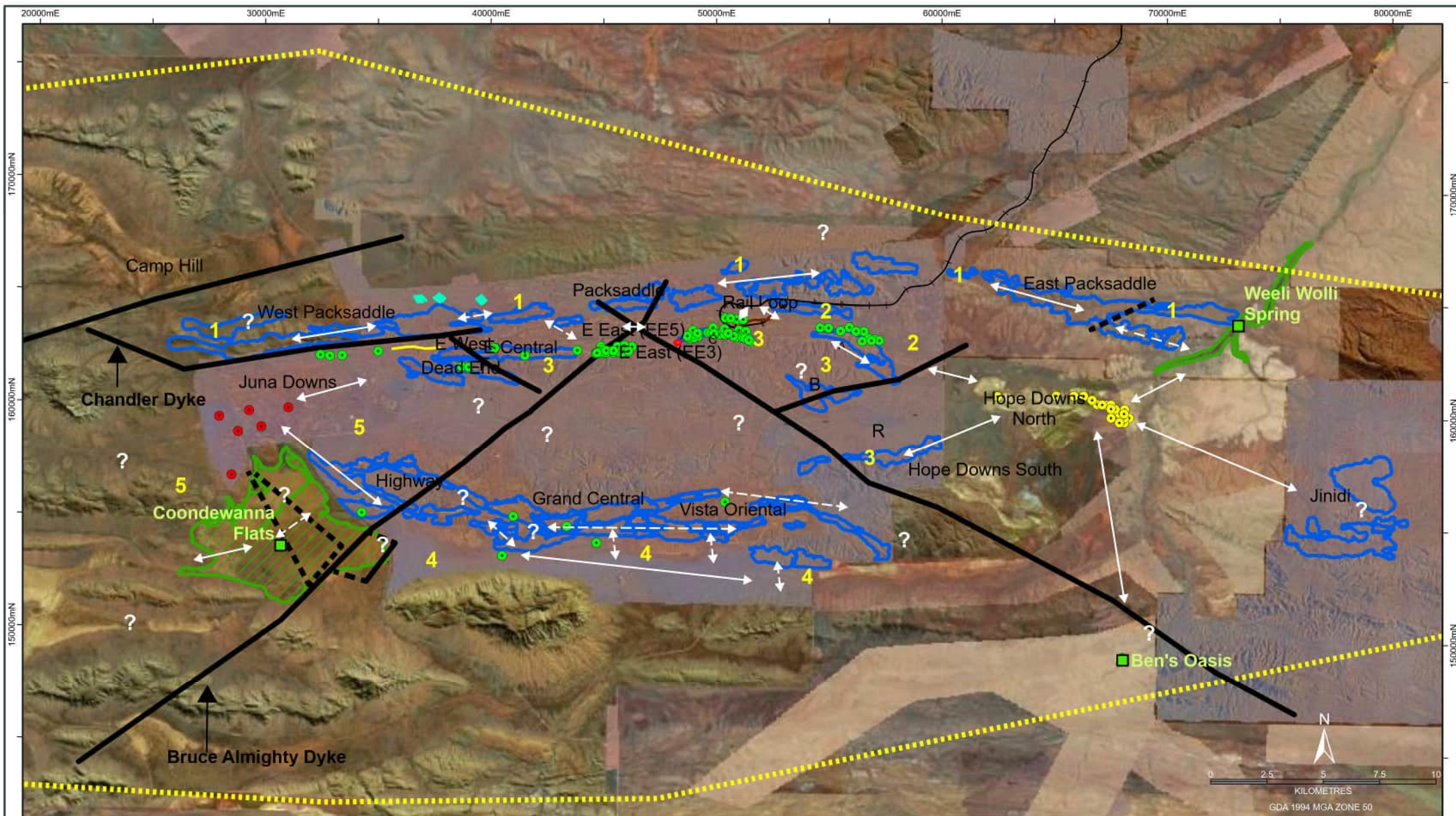
Groundwater Dependent Ecosystems

Ecosystems that rely on groundwater for some or all of their water requirements are classified as groundwater dependent ecosystems (GDEs).

GDEs are often typified by the presence of groundwater dependent vegetation (GDV) but can include aquatic ecosystems with a surface or groundwater component. These ecosystems can present in the form of creeks, rivers, pools, wetlands, springs (along with more hydrophytic or aquatic vegetation). GDEs that are found within the Study Area include:

- Weeli Wolli Spring, an aquatic GDE found to the east of the North Flank and Packsaddle orebodies
- Yandicoogina Gorge, an aquatic GDE found to the north of Packsaddle orebodies
- Ben’s Oasis is to the east of South Flank, Southeast of North Flank and Packsaddle
- Marillana Creek and associated pools.

Terrestrial GDEs are described in Section 7.3.4 and Section 8, Section 9, and stygofauna values are described in Section 9.1.



— Rail	— Central Sediment Basin
● BHP Abstraction	— Western Sediment Basin
● BHP Injection	— Conceptual Model boundary
● RTIO (Hope Downs)	— Priority Ecological Community
■ Environmental receptors	— Recommended Pit Design
— Runaway Valley Infiltration Ponds	— Flow Barrier
— C West Pit Lake	--- Partial or uncertain flow barrier
→ Groundwater flow	? Conceptualisation uncertain
→ Groundwater flow uncertain	

- #1. Brockman Orebodies (Packsaddle)
- #2. North Flank Valley Regional Aquifer
- #3. Marra Mamba Orebodies (North and South Flank)
- #4. South Flank Valley Regional Aquifer
- #5. Coondewanna Flats/Juna Downs Regional Aquifer

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MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

HYDROGEOLOGICAL CONCEPTUALISATION

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:225,000	REQUESTOR: ENVIRONMENT	FIGURE: 7-9
DATE: 12/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-050 RevC

Groundwater Recharge

Depth to groundwater across the catchment is generally greater than 20 m. The deepest groundwater is found at South Flank Deposits (170 m to 50 m) and Packsaddle Deposits (170 m to 80 m), whereas the shallowest groundwater is found at Weeli Wolli Spring (15 m to 0 m). The low rates of rainfall and high rates of evaporation within the Study Area, combined with the relatively deep groundwater levels indicate that rainfall recharge is likely generally small, in comparison with aquifer storage.

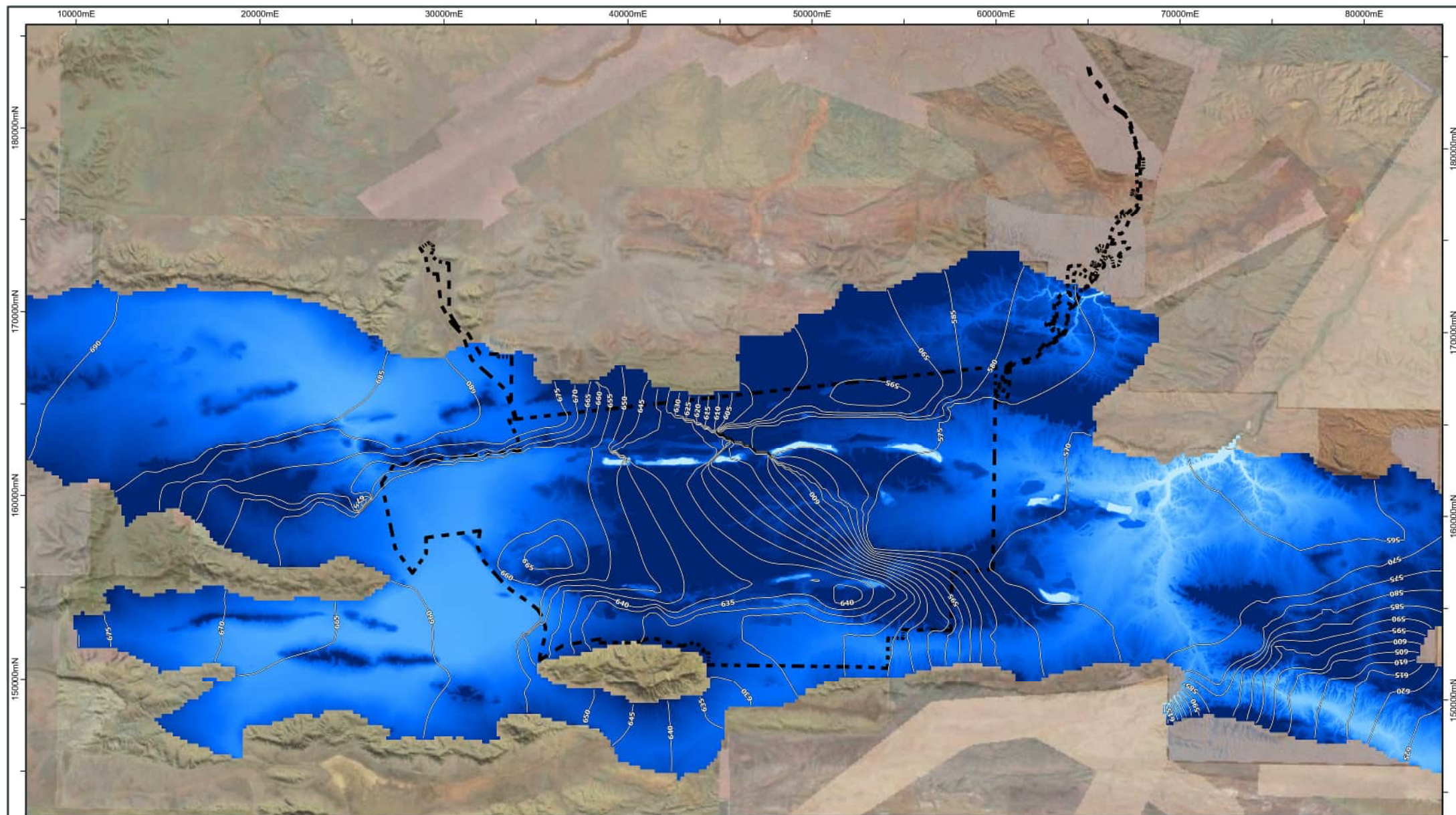
Rainfall recharge is evident, however, at Coondewanna Flats and Weeli Wolli Spring, as evidenced in the time variant groundwater levels presented in the Central Pilbara Hydrogeological Assessment (BHP 2025a). Groundwater levels within the two aquifer systems increase following major rainfall events, indicating that rainfall recharge is likely significant, albeit infrequent. Between 2005 and 2017 at Coondewanna Flats, groundwater level response to rainfall only occurred twice, in the 2005/2006 season (approximately 1.0 m) and the 2011/2012 season (approximately 4.0 m). Conversely, the Weeli Wolli Spring Aquifer shows a more frequent response to rainfall, with groundwater fluctuations occurring during most wet seasons.

Groundwater regime (level and flow)

The groundwater regime of the Study Area prior to anthropogenic influence can be understood using pre-development groundwater levels which were collected from exploration boreholes and supplemented with monitoring bore data. Pre-mining groundwater level and depth to groundwater are shown in Figure 7-10. Time-series groundwater bore data is provided in Appendix 7.

As outlined in the Central Pilbara Hydrogeological Assessment (BHP 2025a), the pre-development heads present excellent coverage, from a regional perspective, and exhibit the groundwater regime, and compartmentalisation of the aquifers, as a result of a number of rock mass flow barriers and dykes. The pre-development heads show that:

- water levels are the highest in Coondewanna Flats (approximately 660 mAHD) and lowest at Weeli Wolli Spring (approximately 562 mAHD)
- groundwater flows from the west through both the South and North Flank valleys towards Weeli Wolli Spring.
- Depth to pre-mining groundwater levels from surface vary across the Study Area from at surface in Weeli Wolli Spring and Ben's Oasis to depths of over 40m within the Development Envelope.

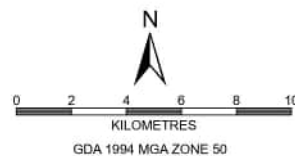


— 2017 Pre-development Groundwater Level (mAHd)

- - - Development Envelope

Pre-development Groundwater Depth (mbgl)

10
120



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MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT PRE-MINING GROUNDWATER LEVELS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:275,000	REQUESTOR:	ENVIRONMENT	FIGURE:	7-10
DATE:	12/02/2025	PREPARED:	GEOMATICS		
		REVIEWED:		NO:	A1285-083_RevC

The step-changes in heads found in the pre-development groundwater levels are a result of the dolerite dykes and rock mass flow barriers which have formed across the Development Envelope. These barriers form the compartmentalisation of the aquifer systems and are described below.

There is one step change between the Packsaddle West orebodies (approximately 650 mAHD) and the Packsaddle East orebodies (approximately 615 mAHD).

Groundwater levels in North Flank range from approximately 660 mAHD in the west, around E-West deposit to approximately 570 mAHD in the east, around the 'transition zone' east of A Deposit (described above). There are multiple steps found across North Flank, including:

- EW deposit to EC/EE5 deposit shows a change from approximately 660 mAHD to 645 mAHD, resulting from a potential dyke or transition zone
- EC/EE5 deposit to EE3 deposit show a change from approximately 645 mAHD to 628 mAHD, due to the southwest to north-east trending Bruce Almighty dyke
- EE3 deposit to C deposit show a change from approximately 628 mAHD to 585 mAHD, due to the north-west to southeast trending dyke.

Groundwater levels in the South Flank orebodies range from approximately 660 mAHD in the west, near the Highway deposits to approximately 620 mAHD in the east. The northern and southern orebodies are primarily located between two dolerite dykes, and within this area heads are approximately 640 mAHD in the northern orebodies, and approximately 628 mAHD in the southern orebodies. The aquifer compartments as a result of these step-changes in heads are presented in Figure 7-11.

Groundwater quality

As part of the groundwater operating strategy (BHP 2023d), monthly electrical conductivity (EC) and pH data is collected from a range of potable, dewatering, water supply and monitoring bores, and presented in the Annual Aquifer Review (AAR) and Triennial Aquifer Review (TAR). A summary of the results outlined in the latest TAR (Financial Year (FY)19 to FY22) (BHP 2022b), and FY24 AAR (BHP 2024a) are as follows.

- Juna Downs MAR recorded a near neutral to slightly alkaline pH range of 7.2 to 8.0, and EC ranged between 630 $\mu\text{S/cm}$ and 725 $\mu\text{S/cm}$, indicating freshwater conditions.
- Groundwater quality data was collected from the North Flank orebodies from the A, C and E Deposits. A Deposit recorded a pH range of 6.7 to 7.3 and an EC range of 696 $\mu\text{S/cm}$ to 766 $\mu\text{S/cm}$. C Deposit recorded a pH range of 6.5 to 7.8 and an EC range of 634 $\mu\text{S/cm}$ to 803 $\mu\text{S/cm}$. E Deposit recorded a pH range of 6.8 to 7.8 and an EC range of 618 $\mu\text{S/cm}$ to 803 $\mu\text{S/cm}$. The EC results at all three orebodies indicate freshwater conditions.
- South Flank orebodies reported a pH range of 7.0 to 7.8, and an EC of 579 $\mu\text{S/cm}$ to 1,100 $\mu\text{S/cm}$, indicating freshwater conditions. It is noted however that bore HSF5434P reported a higher EC of 1,100 $\mu\text{S/cm}$ to 1,400 $\mu\text{S/cm}$. The region of the South Flank MAR scheme, which began operation in FY23, reported a pH range of 7.0 to 9.3, and EC range of 360 $\mu\text{S/cm}$ to 650 $\mu\text{S/cm}$ indicating fresh, and slightly acidic to neutral conditions.
- Packsaddle orebodies reported a pH range of 5.7 to 6.9 and an EC range of 340 $\mu\text{S/cm}$ to 500 $\mu\text{S/cm}$ indicating circumneutral and fresh conditions.

Detailed groundwater conditions are reported in the FY23 AAR (Appendix 7) for the different formations at North Flank, South Flank, and Packsaddle.

An AMD risk assessment was prepared by BHP (2021b), with an earlier preliminary AMD risk assessment from 2017. BHP uses an internal system of classifying potential AMD, which is based on standard geochemical assays to form net acid producing potential (NAPP) values. This coding system has been applied to over 506,000 borehole samples, with results validated against specific acid base accounting data and other geochemical tests of representative drillhole samples, as outlined in BHP (2021b). The AMD classifications are as follows.:

- AMD Class 1 – All stratigraphies BWT, $\text{NAPP} \geq 3 \text{ kg.H}_2\text{SO}_4/\text{tonne}$
- AMD Class 2 – All stratigraphies above water table, $\text{NAPP} \geq 3 \text{ kg.H}_2\text{SO}_4/\text{tonne}$
- AMD Class 3 – All non-bedrock stratigraphies, $\text{NAPP} \geq 3 \text{ kg.H}_2\text{SO}_4/\text{tonne}$. Includes alluvial, scree and Tertiary Detritals
- AMD Class 0 – All other material.

The risk rating for each pit as a result of the assessment indicates that the majority has a risk rating of low, with the following exceptions:

Packsaddle

- Pit P1W waste and pit surface has a risk rating of low-moderate.

North Flank

- Pit B waste has a risk rating of low-moderate
- Pit E pit surface has a risk rating of low-moderate.

South Flank

- Highway deposits waste and pit surface have a risk rating of low-moderate
- Grand Central deposits waste has a risk rating of moderate-high and pit surface has a risk rating of low-moderate
- Visa Oriental deposits waste and pit surface have a rise of rating of low-moderate.

Per- and polyfluoroalkyl (PFAS) fire-fighting foams were phased out within the Development Envelope in 2021 as part of BHP's WAIO PFAS Phase Out Program.

A preliminary PFAS investigation was conducted by Cardno in 2022 in which 13 areas of potential concern (AoPC) were targeting for sampling (Appendix 7) Two of the 13 AoPCs could not be accessed, and therefore were not sampled. For the remainder of the AoPCs that were sampled, minor detection of PFAS were found at all locations sampled.

- Perfluorooctanoic acid (PFOA) was not identified above any regulatory guidelines with Perfluorooctanoic Sulfonate (PFOS) and Perfluorohexanesulfonic acid (PFHxS) representing the primary compounds of concern.

Results were compared against the NEMP 2020 (HEPA 2020) and toxicant default guideline values for aquatic ecosystem protection (DCCEEW 2023) and the following criteria exceedances were reported:

- No exceedances of the ecological 95% species protection limit (0.48 µg/L) were recorded in surface soil leachate analytical results from all AoPCs (DCCEEW 2023). One sample reported an exceedance above Health Drinking Water criteria at the MAC medical centre (emergency vehicle washdown area).
- No exceedances of the ecological 95% species protection limit (0.48 µg/L) were recorded, freshwater 99% exceedances were reported in sediment leachate analytical results at the following AoPCs:
 - Western, Central and Eastern Infiltration Ponds
 - Packsaddle wastewater treatment plant (WWTP)
 - Heavy vehicle workshop Evaporation Ponds
 - Bioremediation Farm.
- No exceedances of the ecological 99% species protection limit (0.0091 µg/L) were recorded in groundwater monitoring and groundwater production bores within the Development Envelope
- No exceedances of the ecological 95% species protection limit (0.48 µg/L) - the highest concentration of PFOS was reported in surface water analytical results, from the Bioremediation Farm.

An assessment by Earth Systems (2023) indicated that the majority of production bores at MAC host carbonate-saturated groundwater, suggesting widespread precipitation of carbonate minerals could be expected if discharged directly to the surface environment. Additionally, Earth Systems (2023) found groundwaters from certain deposits within the MAC (A and C deposits) are becoming increasingly carbonate saturated over time. The carbonate saturated groundwater reflects the dolomitic geologies in the area where the majority of groundwater is drawn from (Earth Systems 2023).

The potential of water to precipitate carbonate minerals (also known as 'scale' when affecting infrastructure such as pipes or pumps) can be indicated by either mineral saturation indices (SI; via equilibrium thermochemical calculations) or a less onerous (and less accurate) Langelier Saturation Index (LSI) calculation. Mineral SI's are used to indicate whether water of a given composition is in chemical equilibrium with a mineral. The LSI is a similar but independent measure of a solutions ability to dissolve or precipitate calcium carbonate and is commonly used in industry to assess scaling potential.

Few carbonate precipitation issues have been encountered in the Juna Downs MAR reinjection activities. This is likely because the increase in pressure associated with groundwater injection and storage at depth increases the solubility (e.g. dissolution) of carbonate in the injected water. Moreover, the water for reinjection has likely already precipitated some carbonate within the E Deposit Turkey's Nest Dam, lowering its capacity for further precipitation.

Existing groundwater use

Groundwater has been abstracted at MAC since 2001 for dewatering for BWT mining, construction and campsite purposes. The surplus water from abstraction is managed via MAR schemes, discharge via sedimentation basins and discharge to drainage lines. Under Schedule 1 of MS1072, BHP is authorised to:

- Dewater up to 37.3 GL/a
- Dispose of 34.48 GL/a of surplus water.

The Approved Proposal currently operates under four Section 5C licences to take groundwater, amounting to the 37.3 GL/a allocated under Schedule 1 of MS1072, including:

- GWL110044(12) for up to 36.5 GL/a for mine dewatering and associated mining purposes within ML70/281
- GWL166389(9) for up to 21.9 GL/a for mine dewatering and associated purposes within ML70/249, ML70/281, E47/13, E47/1540, and P47/1611. It is noted that this licence is used in conjunction with GWL110044(12) in that the total combined abstraction is 36.5GL/a
- GWL178477(4) for up to 0.75 GL/a from Juna Downs borefield for earthwork and campsite purposes within ML70/281
- GWL174613 for up to 0.05 GL/a from the Mulla Mulla camp borefield for campsite purposes. It is noted that the abstraction bore for this licence is not currently operational.

The annual water use for the MAC and South Flank Borefield by licence for the reporting period (as presented in the FY24 AAR) shows:

- GWL110044(13) – 14,425,795 kL approximately 40% of the allocation
- GWL166389(10) – 1404 kL approximately 0.01% of the allocation
- GWL178477(5) – 981,069 kL approximately, approximately 130% of the allocation. Abstraction exceeded yearly entitlement. An application to amend the licence was submitted in June 2024 to increase the yearly water entitlement from 750,000 kL to 1,250,000 kL. FY23 abstraction was managed under temporary licence 845,000 kL water entitlement.

Currently, the Approved Proposal has two operational MAR schemes that reinject surplus water back into the aquifer, located at Juna Downs and South Flank Valley. Supplementary to the MAR schemes, the Approved Proposal maintains three sedimentation basins, including, Central, Western and Runaway Valley/Packsaddle Ponds.

Historically, C West pit lake operated between 2011 and 2012, and A Deposit MAR scheme operated between 2012 and 2019. A Deposit MAR scheme was then decommissioned to allow for abstraction for BWT mining.

7.3.4 Environmental values

Environmental value is defined under the EP Act as a beneficial use or an ecosystem health condition. In relation to beneficial uses, water presents significant cultural and aesthetic values.

The ecosystem health values related to inland waters generally include ability to sustain vegetation, aquatic fauna and birdlife and the ecological processes that support them. Significant ecosystems that have the potential to be impacted by this Proposal include:

- springs and pools
- ecosystems which support significant flora, vegetation and fauna species or communities, including migratory waterbirds, bats, and subterranean fauna

- ecosystems which support significant amenity, recreation and cultural values.

In the Strategic Pilbara Proposal, BHP defines a series of ecological assets for the region. Significant ecological assets can be classified as Tier 1 (Protected by Federal or State legislation), Tier 2 (formal level of protection for conservation purposes or foreseeable level of future protection) and Tier 3 (no formal level of protection for conservation purposes or foreseeable level of future protection).

There are two Tier 2 and two Tier 3 ecological assets that were identified in the Ecohydrological Change Assessment from the Pilbara Strategic Proposal (BHP, n.d.) that may be affected by the Proposal. These include Tier 2 assets, Coondewanna Flats, and Weeli Wolli Spring /Ben's Oasis and Tier 3 assets Marillana Creek and Yandicoogina Gorge, which are discussed below.

7.3.4.1 Coondewanna Flats

Coondewanna Flats includes several vegetation communities with two being classified as PECs (Department of Parks and Wildlife (DPAW) 2014):

- Coolibah woodlands over lignum over swamp wandiree (Priority 1 Ecological Community). Lake Robinson has the only known occurrence of this community
- Coolibah and Mulga woodland over lignum and tussock grass on clay plains (Priority 3 Ecological Community). This community has only been identified at Coondewanna Flats and Wannamunna, which is about 40 km to the southeast. It is extensive on Coondewanna Flats to the south of Lake Robinson.

Waterbodies formed on the Coondewanna Flats from flood waters are ephemeral and may persist for several months following periods of heavy rainfall depending on the volume of surface water contribution. Little is known about the water quality or aquatic invertebrate assemblages of the flooded waterbody (Pinder et al. 2009).

An ecohydrological conceptualisation of Coondewanna Flats is provided in Figure 7-12 with the key aspects being:

- Surface water runoff from surrounding catchments is attenuated in the internally draining, low-relief landscape of the flats. It principally accumulates in Lake Robinson and other depressions to the south but extends more widely across the flats during large flood events.
- Surface water flow into Coondewanna Flats is likely to occur every three in four years and is an important process for replenishing soil moisture in the unsaturated profile.
- Beneath the flats, an unconfined calcrete aquifer is present at a depth of 20 to 30 m bgl. It is overlain by largely unsaturated Tertiary Detritals and underlain by low to high permeability dolomite of the Wittenoom Formation. This dolomite forms part of a regional groundwater flow system that ultimately reaches Weeli Wolli Spring.
- Groundwater recharge is associated with the infiltration of ponded surface water runoff. Recharge events are estimated to occur once in every four years. RPS (2014) estimated that annual average recharge rates are about 2.4 GL at Lake Robinson and 4 GL over the broader Coondewanna Flats area.
- The Coondewanna Flats is considered an important groundwater recharge area for Weeli Wolli Spring. An assessment of the origins of the water discharging at Weeli Wolli Springs is provided in the Central Pilbara Hydrogeological Assessment (BHP 2025a) (Appendix 7) which provides a more detailed approach than provided in the Approved Proposal.
- Groundwater discharge occurs as outflow to the South Flank and North Flank Valleys, which hydraulically connect the Coondewanna and Weeli Wolli Spring catchments from a groundwater perspective.
- A southwest-north-east trending dyke acts as a partial groundwater flow barrier to regional throughflow at the eastern end of Coondewanna Flats.

- *Eucalyptus. victrix* trees on Coondewanna Flats rely on stored soil moisture to meet their water requirements, which is replenished by surface water inflow. Studies completed by BHP indicate these trees are able to obtain soil moisture for prolonged periods from horizons within the unsaturated zone above the water table (Astron 2014). The *E. victrix* woodlands at Coondewanna Flats are considered unlikely to rely on groundwater.
- The surface water dynamics of Coondewanna Flats are likely to influence bud-set, flowering, seed production and seedling recruitment of the *E. victrix*. However, further investigations are necessary to understand the relationship between flooding regimes and the reproductive cycle of the woodland trees.
- Mulga is a shallow-rooted species with xerophytic adaptations to drought stress. Water use requirements of the Mulga communities on the flats are most likely met by soil water in surface layers (up to 5 mbgl), which is replenished by rainfall and runoff

Ongoing monitoring of groundwater, surface water and tree health has been undertaken for Coondewanna Flats consistent with the Approved Proposal through the implementation of the Central Pilbara Water Resource Management Strategy (CPWRMP) (BHP 2021c) and compliance with RiWI Act groundwater licence requirements.

Groundwater levels in Coondewanna Flats has been influenced by the operation of Juna Downs MAR and dewatering as part of the Approved Proposal. In the northern extent of Coondewanna Flats (near the MAR scheme) groundwater levels have increased by approximately 3-4 m which corresponds to 20 m below ground level (mbgl) with triggers and thresholds set at 15 mbgl and 7 mbgl respectively. In the remaining areas of Coondewanna Flats groundwater has shown a gradual decline of approximately 1 m between 2012 and 2024. Time series data for bores in the Coondewanna Flats is provided Figure 3.30 of the Central Pilbara Hydrogeological assessment (BHP 2025a) (Appendix 7). Discussion of tree health monitoring is provided in Section 8.

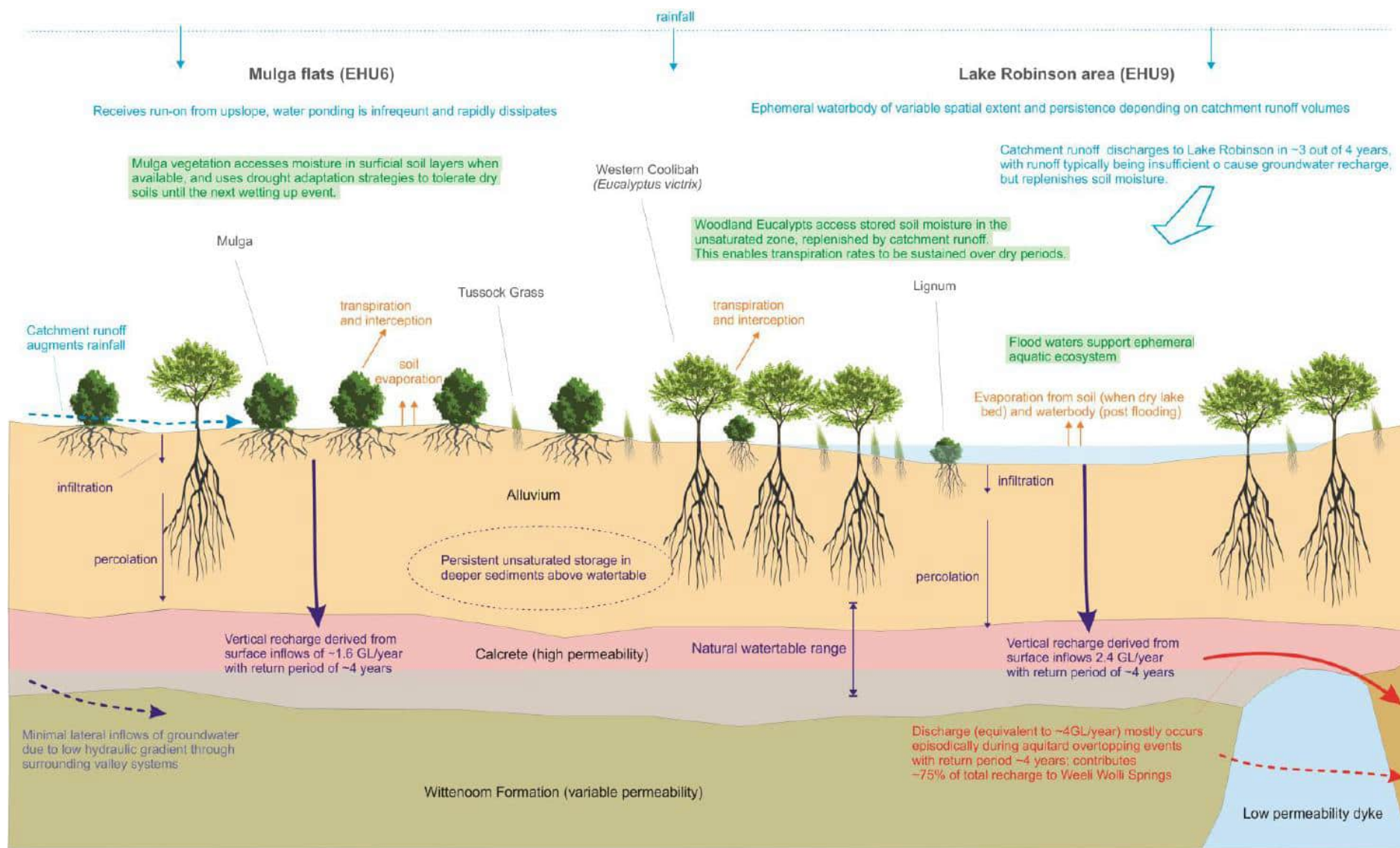


Figure 7-12: Coondewanna Flats ecohydrological conceptualisation

7.3.4.2 Weeli Wolli Spring and Ben's Oasis

Weeli Wolli Spring is a natural expression of groundwater discharge in Weeli Wolli Creek. The spring is located about 60 km upstream of the Fortescue Marsh and has a catchment area of about 1,450 km². It is perennial with shallow groundwater levels around the spring being maintained by a series of permanent pools (interconnected in places) within the creek. A shallow groundwater system with extensive areas of calcrete is present up-gradient of the spring. Downstream of the gorge, the creek flows via a narrow channel past the confluence with Marillana Creek and ultimately into the Fortescue River Valley.

The hydrological regime supports a unique riparian ecological community that is listed as a Priority 1 Ecological Community. In recent years, the hydrological regime at Weeli Wolli Spring has been influenced by dewatering and discharge activities at RTIO's Hope Downs operation.

The Weeli Wolli Spring area is recognised as having multiple ecological values that collectively contribute to its status as a Priority 1 Ecological Community (DBCA 2023). These include:

- Riparian woodland and forest associations are unusual as a consequence of understorey species composition including an assortment of wattles (*Acacia* spp.), sedges and herbs that fringe many of the pools and associated water bodies along the main channel. There are several species of conservation interest including one named after the spring (*Stylidium weeliwolli*). The woodland trees include the obligate phreatophyte *Melaleuca argentea*, and facultative phreatophytes *Eucalyptus camaldulensis* and *E. victrix*.

An ecohydrological conceptualisation of Weeli Wolli Spring is provided in Figure 7-13 with the key features being:

- Surface flow at Weeli Wolli Spring is a combination of groundwater discharge and seasonal surface water inflows.
- On average, the area experiences two surface water flow events each year. Local infiltration of the surface water results in recharge to the shallow groundwater system.
- The groundwater system comprises an unconfined aquifer sequence including calcrete and detritals. Groundwater is shallow being less than 10 mbgl and becoming shallower towards the spring. As the aquifer thins and narrows towards Weeli Wolli Spring, groundwater flow is concentrated and discharged over near-surface basement as baseflow.
- The water balance suggests that groundwater throughflow from the upstream catchment is about 11 ML/d. Discharge occurs as spring baseflow (7 ML/d), evapotranspiration (2.6 ML/d) and groundwater throughflow in the shallow aquifer (4 ML/d).
- There is no evidence for outflow associated with a fractured-rock aquifer through the gorge in Wildflower Range. There may be a zone of slightly enhanced permeability; otherwise, the basement at the spring is of low permeability.

Ongoing monitoring of groundwater levels and tree health has been undertaken for Weeli Wolli Springs and Ben's Oasis consistent with the Approved Proposal through the implementation of the Central Pilbara Water Resource Management Strategy v 4.1 (CPWRMP) (BHP 2021c)

Groundwater levels in Weeli Wolli Spring PEC have been influenced by RTIO Hope Downs dewatering operations and is maintained through artificial discharge through a series of spigots. In the southern extent of Weeli Wolli Spring (closest to Hope Downs Operations) groundwater levels were approximately 570 mAHD and either at or near ground surface prior to commencement of dewatering. From 2007 when Hope Downs dewatering commenced to 2024 groundwater levels have declined approximately 20 m. In the northern extent of Weeli Wolli Springs groundwater levels have decreased by approximately 2.5 to 3 m where groundwater was at or near natural surface. Time series data for bores in the Weeli Wolli Spring is provided Figure 3.31 of the Central Pilbara Hydrogeological assessment (BHP 2025a) (Appendix 7). Discussion of tree health monitoring is provided in Section 8.

Ben's Oasis is located 20 km upstream and south of Weeli Wolli Spring. In 2014, the Priority 1 Ecological Community-Weeli Wolli Spring Community was updated to also include Ben's Oasis. At this location the vegetation is concentrated along a relatively narrow creek channel adjacent to some surface water pools. Ben's Oasis also supports the phreatophyte *Melaleuca argentea*.

Groundwater levels at Ben's Oasis are assumed to be unaffected by the Approved Proposal and Hope Downs dewatering due to a regional dyke that behaves as a flow barrier between the Spring and the Hope Downs aquifer. Groundwater investigations in Ben's Oasis include the installation of four monitoring bores that were drilled in the area in 2017. When monitoring commenced in 2017, there was an approximate 30 m head difference between the water level in HDD0001M (south of the dyke) and the bores north of the dyke (HDD0002M-HD0004M). The groundwater level in HDD0001M is at the same elevation as the creek bed just to the north which suggests groundwater expresses at surface to form the spring. The groundwater water levels north of the dyke (within the Hope Downs aquifer compartment) are between 30 and 40 m below ground surface. Groundwater levels downstream (HDD0003M and HDD0004M) respond seasonally to rainfall patterns and have shown a decline of approximately 5 to 10 m since 2017. HDD0002M has become dry and is not at a depth able to determine seasonal responses.

Time series data for bores in the Ben's Oasis region is provided Figure 3.32 of the Central Pilbara Hydrogeological assessment (BHP 2025a) (Appendix 7). Discussion of tree health monitoring is provided in Section 8.

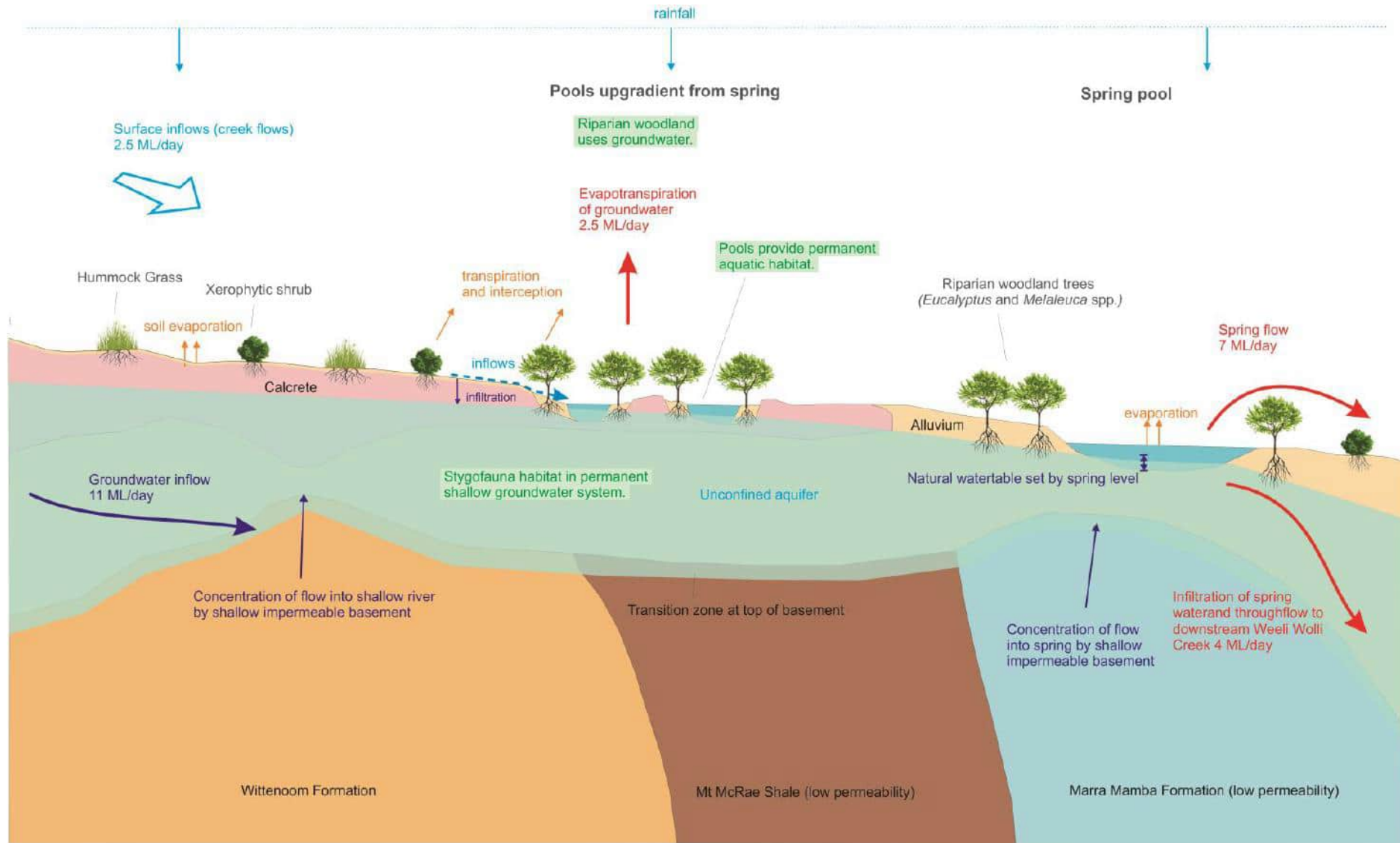


Figure 7-13: Weeli Wolli Spring ecohydrological conceptualisation

7.3.4.3 Pools in Marillana Creek

A series of semi-permanent to permanent pools occur along Marillana Creek, downstream of the proposed Upper Marillana discharge location and upstream of BHP's Yandi mine Development Envelope (Figure 7-14). A study conducted by Biologic (2024b, 2023b, 2022a) investigated the following pools:

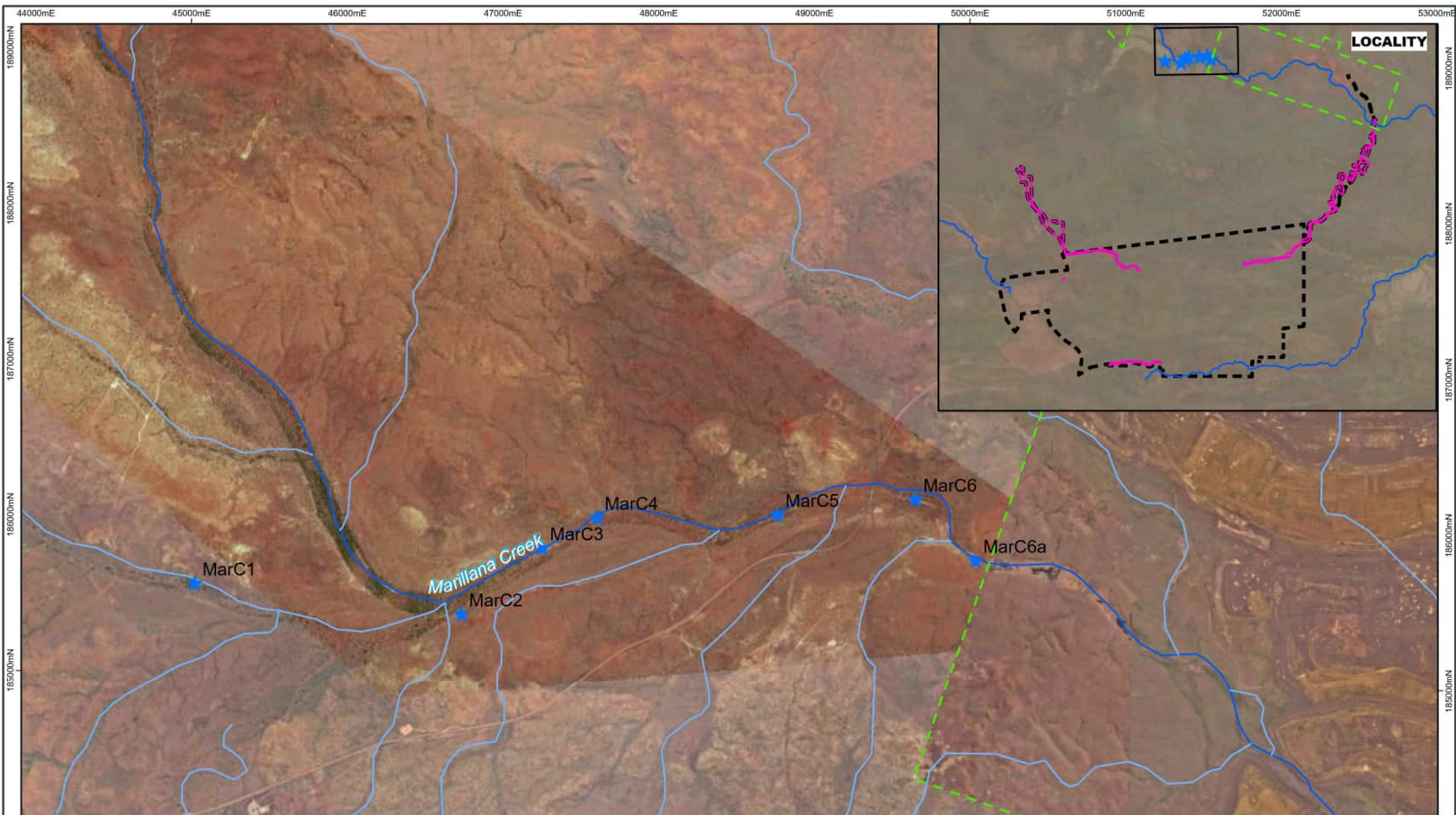
- Tributary of Marillana Creek (MarC1): One semi-permanent unnamed pool located on a tributary which flows into Marillana Creek, downstream of the potential discharge location.
- Marillana Creek: Three semi-permanent unnamed pools (MarC2, MarC4, MarC5) and one ephemeral pool (MarC3) located downstream of the confluence with the un-named tributary.
- Marillana Creek: One semi-permanent named pool (MarC6 (Flat Rocks), located downstream of the confluence with the un-named tributary.

A summary of the pools is provided in Table 7-4.

Table 7-4: Summary of Marillana Creek Pools

Site	Pool Type	Description
MarC1 (tributary)	Semi-permanent pools	Series of semi- permanent, shallow pools and riffles located on an un-named tributary of Marillana Creek. Mineral substrate dominated by pebbles and gravel, with small amounts of bedrock, cobbles, silt and clay. Maximum water depth of 0.2 m in both seasons.
MarC2	Semi-permanent pools	Series of semi-permanent, shallow pools located on the main channel of Marillana Creek, downstream of the confluence with the un-named tributary. Mineral substrate predominately comprised of pebbles and gravel, with some cobbles and silt also present. The maximum water depth was 0.3 m in the dry and 0.4 m in the wet.
MarC3	Ephemeral pool	Long open pool over bedrock. Substrate dominated by bedrock. Maximum water depth of 0.6 m in both seasons.
MarC4	Small semi- permanent pool	A small (15 m long, 11 m wide) semi-permanent pool. Mineral substrate was heterogenous, comprising bedrock, pebbles, gravel, sand and silt. Maximum water depth of 0.7 m recorded in the dry and 0.4 m in the wet.
MarC5	Semi-permanent pool	Series of permanent, shallow pools. Mineral substrate dominated by gravel and pebbles, with low amounts of bedrock, cobbles, sand and silt. The maximum water depth recorded was 0.3 m in the dry and 1.8 m in the wet.
MarC6 (Flat Rocks)	Semi-permanent pool	Semi-permanent pool colloquially referred to as Flat Rocks (Streamtec 2004). Likely was permanent historically. Most downstream site on Marillana Creek within the Study Area. Though located upstream of current mining operations, this site is thought to be impacted by drawdown from the nearby BHP Western Australia Iron Ore (WAIO) Yandi Operations (WRM 2018). Substrate comprising bedrock and clay, with small amounts of boulders, cobbles, pebbles, gravel and silt. Maximum water depth was 0.15 m in the dry and 1.5 m in the wet.

Source: Biologic 2024b, 2023b, 2022a



Development Envelope

Yandi

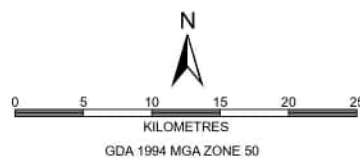
Indicative Footprint

Watercourse

Major

Minor

Marillana Creek Pool Locations (Biologic, 2023b)



BHP

PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
MARILLANA CREEK POOLS LOCATIONS
(BIOLOGIC 2023b)**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:32,500	REQUESTOR:	ENVIRONMENT	FIGURE:	7-14
DATE:	18/02/2025	PREPARED:	GEOMATICS	NO:	A1285-040 RevF
		REVIEWED:			

Marillana Creek comprises a major tributary of Weeli Wolli Creek (Figure 7-4). The Marillana Creek catchment covers an area of approximately 2,050 km². Its headwaters rise from the Hamersley Range, and flow in an east and north-easterly direction into the Munjina Claypan. When the internal water holding capacity of the claypan is exceeded, surface water flows south-east into the lower Marillana Creek catchment. The upper catchment is characterised by a broad alluvial plain with large areas of calcrete, while lower in the catchment, in the vicinity of the Study Area, the drainage is well defined (Johnson and Wright 2001). Marillana Creek is known to support several permanent and semi-permanent pools along its length naturally, including one named pool (Flat Rocks).

The following summarises the GDEs of varying levels of significance based on the types and extent of GDVs present (Appendix 10):

- Marillana Creek – High significance GDE from the confluence of the tributary and Marillana Creek (i.e., ~MarC2) extending 2.7 km downstream to MarC4.
 - Marillana Creek - Lower significance GDE from MarC4 downstream 1.45km to just below MarC5.
 - Tributary – A small, isolated lower significance GDE extending for approximately 250 m and encompassing sampling site MarC1.
- Of note, wetland flora richness within the Marillana Creek Pools was found to be high in comparison to nearby sites including, Weeli Wolli Spring Priority 1 PEC, as sampled prior to any impacts from mining or invasive species (i.e., when flora richness was likely at its highest) (Biologic 2023b).
 - Macroinvertebrate richness within the Study Area was high. In fact, macroinvertebrate richness was found to be statistically similar to sites known for their high diversity, including the Weeli Wolli Spring Priority 1 PEC (as sampled prior to any disturbance or mining impact) and the Davis River (Running Waters and Skull Springs) (Biologic 2023b).
 - Overall, three sites were found to hold considerable ecological value (Biologic 2024b, 2023b, 2022a):
 - MarC2 which recorded a high diversity of GDV species, a relatively high richness of groundwater dependent invertebrate taxa (stygobites and permanent hyporheos stygophiles), conservation significant stygobitic species, taxa restricted to springs and permanent pools of high ecological condition, and overall high macroinvertebrate taxa richness refer to Section 9.3.2.6).
 - MarC4 which recorded a high diversity of GDV species, high richness of wetland flora (submerged and emergent macrophytes) in comparison to other creeks in the region, a relatively high richness of groundwater dependent invertebrate taxa, restricted species and International Union for Conservation of Nature (IUCN) listed species (*Eurysticta coolawanyah*; refer to Section 9.3.2.6).
 - MarC5 which recorded high overall macroinvertebrate richness, high richness of odonate species, including IUCN listed species, and a high richness of Pilbara endemic taxa (refer to Section 9.3.2.6).

These pools are henceforth discussed as Marillana Creek Pools.

The ecohydrological conceptualisation of the Marillana Creek Pools is as follows:

- The part of Marillana Creek where the Pools are located is dominated by BIF, Shale BIF and hills of Dolerite. Locally, the old valley infill caps Shale BIF and forms low, standalone table hills. Here, Marillana Creek and its tributaries cross the dolerite units exposing rock along and within the channels, resulting in damming to form near permanent water pools. The river channel is dominated by high hydraulic conductivity cobbly gravels, shallow BIF and dolerite with patchy gravels and silty clay deposits, frequent to dense gum trees and paper barks (including *Eucalyptus victrix*, *Eucalyptus camaldulensis* and *Acacia citrinoviridis*).
- Several water quality characteristics indicated pools were maintained by both groundwater input and contribution by rainfall, with most sites being dominated by sodium (Na) cations and bicarbonate (HCO₃)

anions. The ionic composition is dominated by carbonate anions, similar to other spring systems of the Pilbara (Biologic 2023b)

- Surface waters within the pools were slightly basic to circum-neutral, with pH ranging from 7.37 (at MarC2 in the dry) to 9.24 (at MarC6 also in the dry). Despite this, no pH values were considered to be of ecological concern or out of the ordinary for Pilbara waters. Slightly basic pH is often recorded from Pilbara pools, especially those with some connection to groundwaters.
- MarC1, MarC2, MarC4 and MarC5 recorded marginally higher EC values in the wet season. This illustrates the permanence of the water in these areas, with limited evapoconcentration occurring during the dry season. MarC6 showed signs of evapoconcentration effects, with considerably higher EC recorded in the dry season.
- Only one site within the Study Area (MarC6 in the dry 2020) recorded total nitrogen notably in excess of the Default Guideline Value (DGV). At this site, total nitrogen was more than six times the DGV. Concentrations at MarC6 were notably high in the dry 2020, with total P being more than 16 times the DGV.

7.3.4.4 Yandicoogina Gorge

Yandicoogina Gorge is located approximately 83 km north-west of Newman and comprises of an area where surface water of Yandicoogina Creek and groundwater discharges. Yandicoogina Creek is approximately 42 km in length and flows north-east into Marillana Creek which drains eastward into Weeli Wolli Creek. Downstream of the gorge, the creek flows via a well defined channel into with Marillana Creek and ultimately into the Fortescue River Valley.

In the mid to lower reaches, the Yandicoogina Creek flows through a gorge system and becomes well defined. It is through this section that the groundwater appears to intercept the ground surface, forming a series of seeps and pools that extends for approximately 3.5 km (Yandicoogina Gorge). In 2019, numerous expressions of groundwater were seen throughout this section of the creek and GDV is present along its length. At least one permanent pool is present, which is likely maintained partially by aspect (against a cliff face), but is also likely groundwater fed. The vegetation and floristic assemblage present within Yandicoogina Gorge have affinities with the Priority 2 Ecological Community: Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara (Biologic 2020a)

The Ministers North aquifer has been investigated through hydrogeological drilling programs since 2017/2018 as part of future BHP mine planning with the installation and subsequent monitoring of up to 35 bores installed with continuous groundwater level loggers. Data prior to 2018 is limited with intermittent groundwater levels collected in two groundwater bores from 2002.

Groundwater monitoring in 2018 identified that groundwater levels across the Ministers North aquifer have a flat gradient and ranged from 563.3 mAHD to 564.0 mAHD. Since 2018, groundwater levels in the Ministers North aquifer have demonstrated a consistent decline in all but one bore. In the period from March 2018 to February 2023, groundwater levels demonstrated a decline of almost 3.5 m.

Water levels in the permanent pool of the Gorge have been recorded since 2020 and have declined approximately 1 m during that period. Periodic monitoring of tree health within the Gorge has also recorded tree deaths and decline of GDV health, which may be attributed to climate variability and/or dewatering of the channel iron deposit (CID) by BHP and third-party operators in the area. Dewatering as part of the Approved Proposal is not considered to impact water levels in Yandicoogina Gorge. Folds and thrusts in the subsurface profile create hydraulic barriers between the Approved Proposal and the Yandicoogina Gorge which has been confirmed with monitoring along the northern extent of the Development Envelope (Packsaddle).

The key features of the ecohydrological conceptualisation of Yandicoogina Gorge key features are presented below.

- Yandicoogina Creek is well defined as it flows through the gorge system, surface flow of Yandicoogina Creek is ephemeral
- There is a series of permanent, semi-permanent and persistent pools through the Gorge, some of which appear to have little seasonal variation and appear to intercept groundwater.
- Yandicoogina Gorge potentially hosts the Priority 2 PEC 'Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara' (Biologic 2020a)
- Riparian vegetation community, featuring *Melaleuca argentea*, *Eucalyptus victrix* and *Eucalyptus camaldulensis*. More information is provided in Section 8.
- The Pools also provide aquatic habitat, and a permanent water source for terrestrial fauna and avifauna of potentially significance (Golder Associates 2015; refer to Section 9).

Groundwater Supplementation Trial

BHP is currently working with the Banjima Traditional Owners through BNTAC, RTIO, EPA and DWER to mitigate further groundwater decline to the Gorge through a groundwater supplementation trial.

The supplementation is proposed to run as a short-term mitigation trial for 6 months with potential extension pending results and stakeholder feedback. The trial's objectives are to:

1. Stabilise groundwater levels within the Ministers North aquifer at the head of the Gorge, specifically to abate further groundwater decline. The infrastructure to support the trial has been designed to provide flexibility with supplementation rates, while maintaining practicability.
2. Improve understanding of the interactions between the Ministers North aquifer and Yandicoogina Gorge GDV, specifically how regional groundwater is supporting the GDV and to test hydraulic properties.

The scope of the trial has involved the following aspects:

1. Construction of 8 km of a 200-250 mm high-density polyethylene pipeline from BHP's Yandi mine.
2. Conveyance of up to 1.7 ML/day of surplus dewatered groundwater from existing approved surplus discharge point to a break tank within Ministers North Tenure.
3. Reinjection head works with a solar and/or diesel-powered pump to enable reinjection into one of four existing groundwater bores located near the head of the Gorge.
4. Installation of six additional groundwater monitoring bores at two locations within 200 m of the head of the Gorge to monitor reinjection levels and water quality.
5. Installation of three additional shallow groundwater monitoring bores in one location within Yandicoogina Creek, upstream from the Gorge and Ministers North to assess recharge of rainfall events.
6. Establishment of remote supervisory control and data acquisition systems to provide real time monitoring and control during the trial.
7. Development of a Trigger Action Response Plan, with trigger and threshold criteria values to support the trial.

Results of the trial are still pending as at time of publication reinjection of groundwater has not commenced. All results of the trial and associated hydrogeological field studies are proposed to be communicated regularly with all relevant stakeholders.

The supplementation of Yandicoogina Gorge with surplus water from the existing Yandi mine is considered a short-term option and cannot be used as a longer-term solution to provide environmental water requirements to the Gorge due to the nature of the pipework. The Proposal will provide a more sustainable and consistent water source to replace the current temporary trial to supplement the Gorge should supplementation be required long-term.

7.4 Proposed Water Management Strategy

To enable an assessment of environmental impacts in relation to the Inland Waters factor, a more detailed description and rationale for how water will be managed for the Proposal is provided. This section provides an overview of water management in relation to the Proposal to provide context for determining the environmental impacts.

The water management strategy and surplus use hierarchy is described in Section 7.6. Following environmental water requirements and operational water use, returning water to ground via injection and infiltration is the preferred surplus water management strategy as it will minimise discharge to the broader environment and minimise the overall loss of water from the Study Area.

Discharge of surplus water to the environment is subject to the DWER Water in Mining guidelines (DoW 2013), licence requirements, and ministerial conditions of approval. Discharge to the environment is not permitted where there is a likelihood that it will cause impacts on other land users (including inundation of land) or significant environmental damage (including water quality, acidification, erosion, damage to riverbed and/or banks and altered water levels at sites with ecological and cultural assets) (DoW 2013). The Proposal is consistent with these guidelines.

Surplus water discharge options of the Approved Proposal (South Flank MAR Scheme, Runaway Valley (RAV) Infiltration Scheme, Juna Downs MAR Scheme, Central and Western Sediment Basin) allow a total discharge of 136.5 ML/d to an annual maximum of 34.84 GL/annum. The (Draft) Central Pilbara Hydrogeological Assessment (BHP 2024a) supports a dewatering limit increase of up to 65.7 GL/annum and a capacity of 56.21 GL/annum is required in the surplus management scheme.

7.4.1 Proposed dewatering rates

A catchment wide numerical groundwater model was used to predict dewatering rates for the remaining life of the Combined Proposal. This is reported in the Central Pilbara Hydrogeological Assessment (BHP 2025a). The model was initially run with a number of scenarios with different hydraulic parameters to get a range in potential dewatering requirements and drawdown estimates. The best estimate model and the model that produced the greatest dewatering predictions were re-run with updated target dewatering levels at six of the pits. These were both deeper and required longer dewatering than the original runs. Based on the predictive modelling results the proposed peak dewatering rate is 180 ML/day. Water management infrastructure

A summary of all operational water use, environmental water requirements and surplus water management schemes is shown in Figure 7-15 and itemised in Table 7-5. To manage the increase of required dewatering, two additional surplus water discharge schemes are proposed for the Proposal. These are the North-West Surplus Scheme (50 ML/d), and the North-East Surplus Scheme (30 ML/d).

The North-West Surplus Scheme includes the Northern Runaway Valley MAR and discharge to Upper Marillana Creek. The North-East Surplus Scheme will include a discharge outlet to the Lower Marillana Creek discharge point. The North-East Surplus scheme will also provide a water supply to the future BHP Ministers North mine (for construction and mining operation, estimated 15 ML/day) and supplementation supply to Yandicoogina GDE (up to 10 ML/day). The North-East Scheme pipeline is built to a capacity to convey the entire 30 ML/day surplus discharge quantity to Lower Marillana Creek discharge in the event that either Ministers North mine does not proceed or Yandicoogina Gorge does not require groundwater supplementation.

The proposed components of surplus water management are discussed below, and a summary of use and volumes of currently operational and proposed schemes are presented in Table 7-5. The below schemes provides options and infrastructure to direct surplus water discharge, the sum of the volumes well exceeds proposed dewatering but the maximum surplus water discharge proposed is an increase of 21.37 GL/a to reach a proposed maximum of 56.21 GL/a for the Combined Proposal.

Dewatering will continue from Development Envelope with surplus water being discharged to either E Deposit Turkeys Nest (TN) or A Deposit TN. Surplus water from SF will be discharged to South Flank MAR and overflow will connect to the TNS.

7.4.1.1 Operational use at MAC-SF

The first preference for abstracted water is to be reused on site for mining operation the Approved Proposal currently utilise 26 ML/day for operational use including mine processing and dust suppression.

7.4.1.2 North-west scheme

Northern RAV MAR Scheme

A numerical model (Advisian 2024) was developed to assess impacts to the groundwater regime for a potential MAR scheme in Runaway Valley North, which is located to the north-west of the Development Envelope (Figure 7-15). The assessment is provided in Appendix 7.

The model configuration was based on single time water level observations from the extensive exploration drilling in the area, bolstered by observations at monitoring bores and the results of short-term test pumping at the three installed MAR bores. There is significant uncertainty remaining in terms of the receiving aquifers geometry and hydraulic parameters. The model was configured on the conservative side of the geometrical uncertainty (i.e. smaller aquifer compartment) and the parameter uncertainty was considered using a Monte Carlo analysis, based on what were considered reasonable distributions of hydraulic parameters.

The model was then used to simulate long-term injection into the three existing MAR bores and three additional bores (i.e. six in total) at rates of 20 and 30 ML/d, continuously for 20 years.

The results show that at a continuous injection rate of 20 ML/d, groundwater reached 10 mbgl in 50% of the modelled cases after 5 years and in 75% of the modelled cases by 16 years.

At the higher rate of 30 ML/d, groundwater reached 10 mbgl in 50% of the modelled cases after 2 years and in 75% of the modelled cases by 3 years.

Discharge to Upper Marillana Creek

The North-West surplus scheme includes a new 30 ML/d discharge outlet and flow monitoring station in the Upper Marillana Creek. This discharge location is to be utilised in the interim as an ephemeral system with the creek to undergo a drying period for 90 days in each calendar year during dry-season (April-November). The scheme will be operational for a 5 year period from commissioning.

7.4.1.3 North-east scheme

Discharge to Lower Marillana Creek

The North-East surplus scheme includes a 30 ML/d discharge outlet and flow monitoring station into the Lower Marillana Creek, at the location of an existing discharge point utilised by BHP Yandi Operations. The infrastructure is designed for a maximum volume of 30 ML/day to the Lower Marillana discharge point with two proposed junction points to supply water to Ministers North (15 ML/day) and Yandicoogina Gorge groundwater supplementation (10 ML/day).

Yandicoogina Gorge Groundwater Supplementation

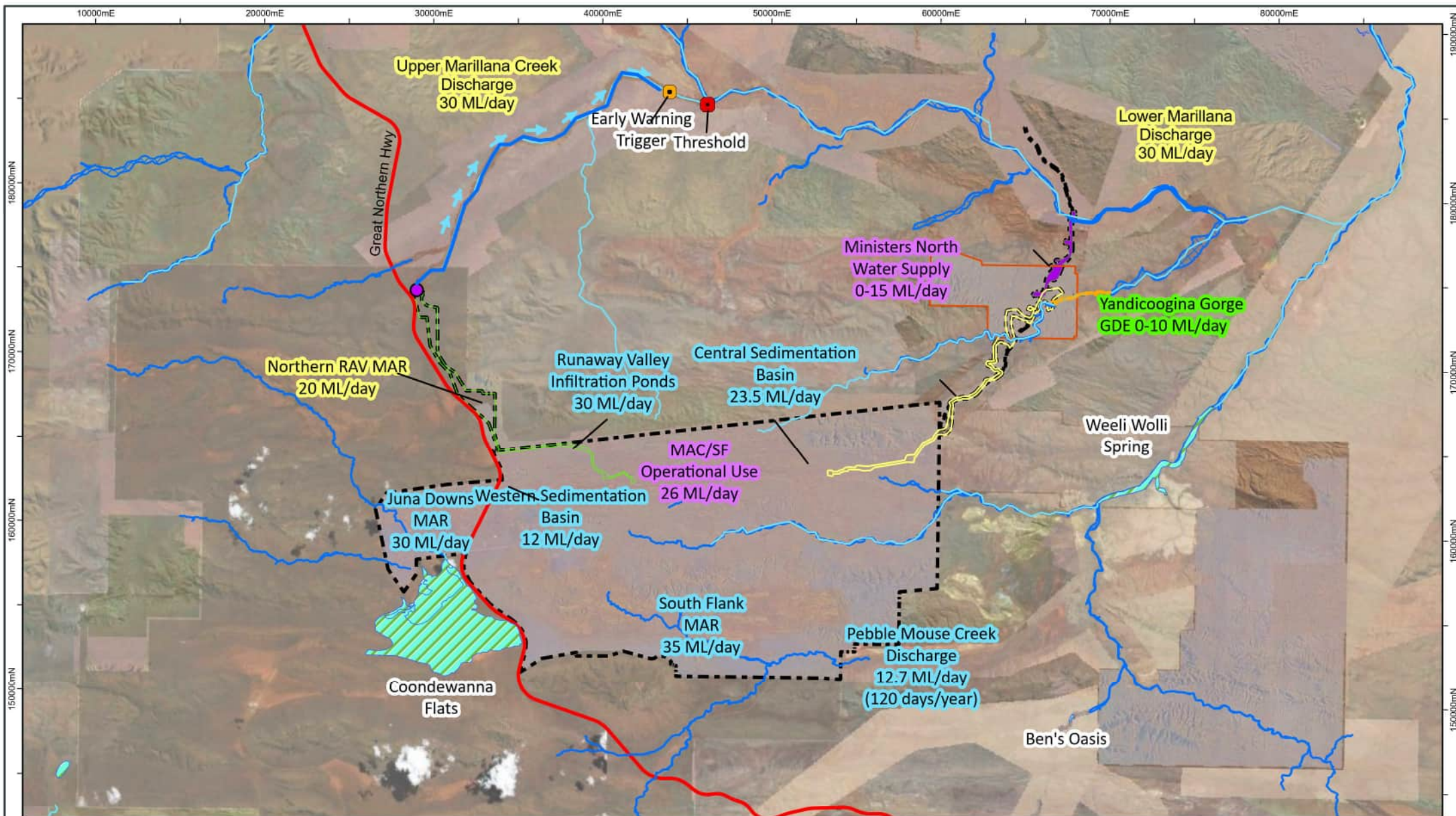
Analysis has been conducted to understand the water balance of the Ministers North aquifer system, specifically the amount of water being lost as the water level declines. Several approaches have been used and give a similar volume, at around 1 ML/d, as follows:

- Analytical calculation based on the observed water level decline indicates that 0.66 ML/d (or 960 ML over 1,445 days) were lost by the Ministers North aquifer system between March 2018 and March 2022 (BHP 2023).
- Numerical modelling predicts that ~0.6 ML/d is required to arrest the observed groundwater level decline (BHP 2023).

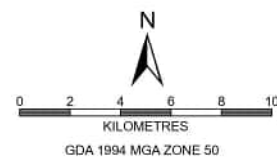
As detailed above a groundwater supplementation trial is proposed within the Yandicoogina Gorge area to assist in determining an appropriate volume of water to mitigate recently declining health of the GDE. The proposed maximum volume of 10 ML/day is subject to the implementation of trigger and action plan within the Gorge to support the GDE.

7.4.1.4 Operational use at Ministers North

Use in construction, mine processing and dust suppression is estimated to be 15 ML/day at the future Ministers North mine. Additional infrastructure to transfer water from the pipeline for use within the Ministers North mine will be provided as part of the referral of that project under the EP Act.



- ▨ Priority Ecological Community
- MAC discharge sites
- MAC to Yandicoogina Gorge Pipeline
- ▭ Ministers North
- ▨ Yandicoogina Gorge
- Text - Operational Use
- Text - Environmental Water Requirement
- ▨ Sensitive Pilbara Drainage
- Yandi East Pipeline (NE Scheme)
- MAC to Marillana Creek Pipeline (NW Scheme)
- - - Development Envelope
- Text - Existing Surplus Water Management
- Text - Proposed Surplus Water Management



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MINING AREA C-SOUTH FLANK CPWRMP COMBINED PROPOSAL SURPLUS WATER MANAGEMENT PLAN

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:300,000 REQUESTOR: ENVIRONMENT FIGURE: 7-15
DATE: 18/02/2025 PREPARED: GEOMATICS NO: A1285-044 RevG
REVIEWED:

Table 7-5 Summary of proposed operational, environmental and surplus water management strategy components

Mine Site Water Use	New/Existing	Use	Operational Start	Operational End	Volume (ML/d)
Mining Area C--Southern Flank	Existing	Priority	2003	2073	26
Ministers North (Future mine)	New	Priority	2026	2039	15
Infrastructure	New/Existing	Use	Operational Start	Operational End	Capacity/Volume (ML/d)
Juna Downs MAR Scheme	Existing	Priority	February 2019	Ongoing	30
South Flank MAR Scheme	Existing	Priority	2019	FY46	35
Northern RAV MAR Scheme	New	Priority	April 2027	FY38	20
Runaway Valley Infiltration Ponds	Existing	Interim Capacity	Existing	April 2027	30
Central Sediment Basins	Existing	Contingency / Peak	2021	Ongoing	23.5
Western Sediment Basins	Existing	Contingency / Peak	2018	FY24	12
Upper Marillana Creek Discharge	New	Interim Capacity /	October 2028	FY32	30
Lower Marilla Creek Discharge	New	Interim Capacity /	October 2028	FY32	30
Pebble Mouse Creek Discharge	Existing	Emergency	Existing	Ongoing	12.7 ¹
Yandicoogina GDE Supplementation Scheme	New	Environmental Water Requirement	October 2028	FY32	10 ²

Notes:

¹ Pebble Mouse Creek discharge has a limit of 12.68 GL/a, though this scheme can only be used in emergencies with a limit of no longer than 120 days per 12-month period.

² Yandicoogina GDE Supplementation Scheme has a limit of 10 ML/day, though this scheme will only be used as environmental supplementation for the GDE.

7.5 Potential environmental impacts

BHP has considered the potential impacts outlined in the *EPA's Environmental Factor Guideline - Inland Waters* (EPA 2018a), and considers that those relevant to the Proposal are:

- changes to groundwater regimes from groundwater abstraction for mine dewatering (direct)
- changes to groundwater regimes from MAR/supplementation schemes (mounding) (direct)
- connection of aquifers due to drilling (direct)
- changes in groundwater quality from MAR/supplementation schemes (direct)
- Changes to surface water regimes from the discharge of surplus water (direct)
- Change to surface water quality from surplus water discharge to creek (direct)
- Changes in surface water flow regime and quality due to catchment diversion (direct)
- Changes to surface water and groundwater quality from mining activities (indirect)
- Increased sediments in surface water from infrastructure and drainage (indirect)
- Mounding in aquifers associated with Marillana Creek discharge (Upper and Lower) (direct)
- Changes in surface water quality in Yandicoogina Gorge Pools due to the Yandicoogina GDE Supplementation Scheme (indirect).

The EIA for Inland Waters includes a discussion of impacts associated with the Proposal and includes consideration of impacts extending beyond the boundaries of the Development Envelope. BHP has provided information on the Approved Proposal so that the EPA can consider the environmental effects of the Proposal in the context of the Approved Proposal. BHP has also outlined the combined effects which the implementation of the Combined Proposal might have on the environment.

It is acknowledged that there are inherent links between Inland Waters and other environmental factors. For example, changes to the quality or quantity of inland waters can affect flora and vegetation, terrestrial fauna, subterranean fauna, landforms, social surroundings or human health. Where the impacts link it has been noted in this chapter and the details of these associated impacts and mitigation are described in the relevant chapter.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation measures are applied, if required).

7.5.1 Changes to groundwater regime from groundwater abstraction for mine dewatering

The Proposal includes an increase in dewatering to enable BWT mining to an extended groundwater depth. The groundwater modelling has been improved from the Approved Proposal through an updated conceptualisation of the hydrogeology of the Study Area, based on an additional five years of monitoring data. The 2025 model has been used to provide estimates of dewatering and groundwater drawdown for the Proposal (BHP 2025a). The 2025 model predicts the combined groundwater abstraction for the Approved Proposal, the increase in groundwater abstraction (for dewatering) for the Proposal and drawdown from RTIO Hope Downs Operation.

The 2025 model assessed the uncertainty around hydraulic parameters and target water levels (i.e. different mine plans). The uncertainty in hydraulic parameters produced variable dewatering rates and drawdown. The Proposal dewatering rate is based on the base case model (i.e. the best estimate and considered most likely). The drawdown predictions however are based on the range produced by all models, even those where the predicted dewatering rate exceeds the Proposal.

7.5.1.1 Dewatering rates

The Approved Proposal included an estimated dewatering rate of 60 to 102 ML/day stating a maximum groundwater abstraction of 37.3 GL/annum.

The base case 2025 model estimates that a dewatering rate of 180 ML/d (65.7 GL/a) will be required for the Combined Proposal. This represents an increase of 77.8 ML/d (28.4 GL/a) compared to the Approved Proposal (BHP 2025a).

The predicted groundwater abstraction for the Combined Proposal is therefore 65.7 GL/a comprising of 37.3 GL/a from Approved Proposal and an additional 28.4 GL/yr for the Proposal. Table 7-6 provides a comparison the Approved Proposal, the Combined Proposal and Cumulative Impacts.

7.5.1.2 Impacts to groundwater regime

Impacts to groundwater regimes has been estimated through analysis of the results of the base case and a worst-case scenario. The predicted drawdown in 2050 as a result of the Combined Proposal is shown in shown in Figure 7-16 and summarised below:

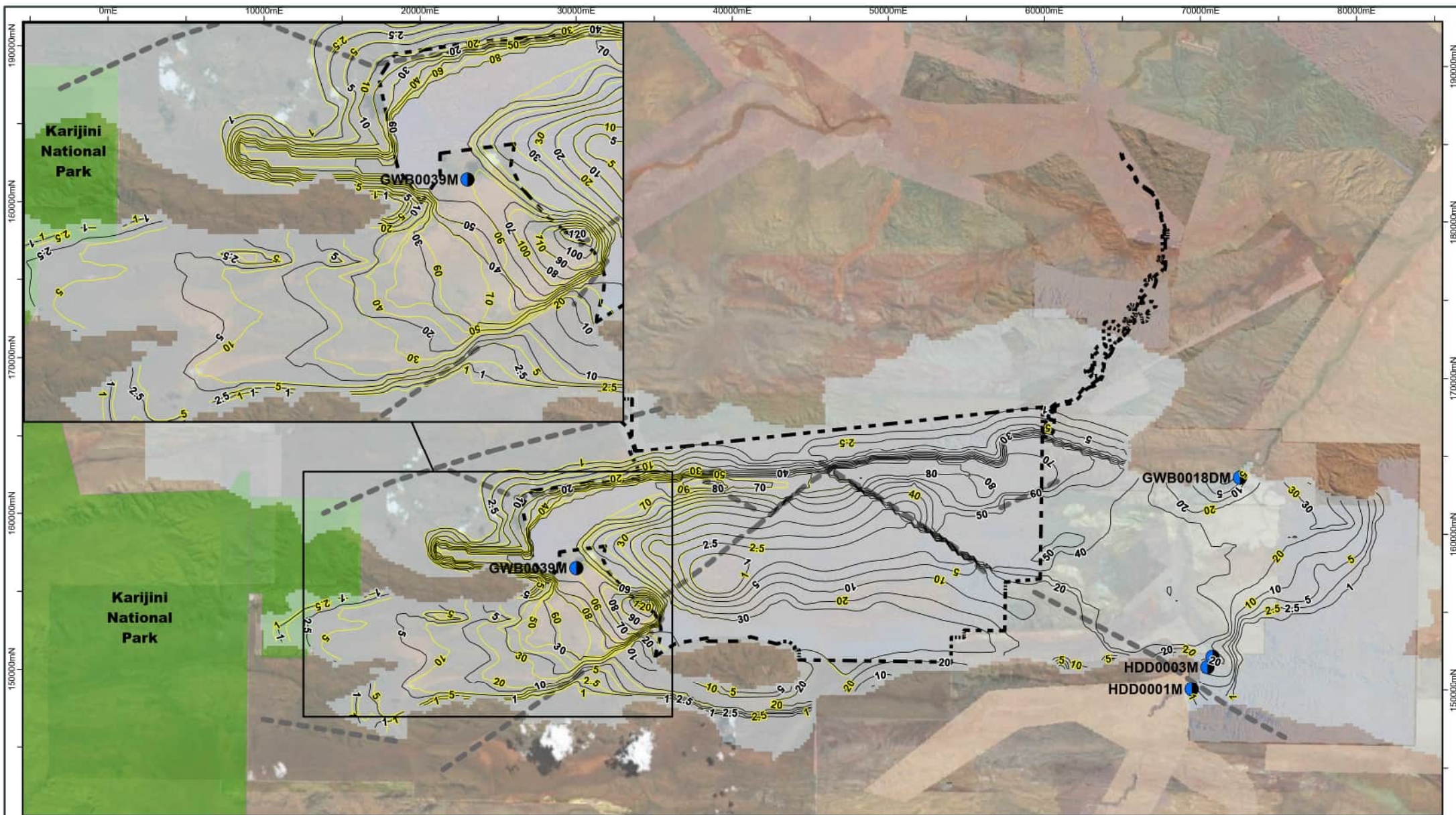
- Drawdown to 1 m extends approximately 21 km east, 5 km south and 22 km west of the Development Envelope. To the north, drawdown to 1 m is mostly within the Development Envelope but does extend approximately 1 km north of the Juna Downs MAR area.
- A drawdown of 120 m is associated with Highway deposit adjacent to Great Northern Hwy.
- Drawdown in the Grand Central and Vista Oriental orebodies is a maximum of 30 m.
- Drawdown in the Northern Flank orebodies is a maximum of 90 m.

The key difference between the base case and the worst-case scenarios are on the western boundary of Development Envelope where the drawdown in the Coondewanna Flats area is an additional 30 m and the western lateral extent to 1 m drawdown is approximately an additional 400 m.

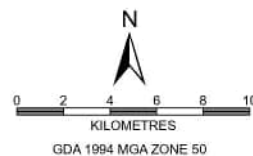
Overall, the predicted lateral drawdown extent (as defined by the 1 m drawdown contour) from the Combined Proposal is similar to the Approved Proposal (BHP 2016b). There are many local differences however, due to the deeper dewatering levels in the 2024 model and the uncertainty in hydraulic parameters. The key differences are summarised below, shown in Figure 7-17 and in Table 7-6.

- A combination of greater dewatering depth and changes in hydraulic parameters between the Approved Proposal and the Combined Proposal results in an increased drawdown in Coondewanna Flats by an additional 10 to 60 m.
- The southern extent of the 1 m drawdown of the Combined Proposal reduced by approximately 2.5 km (Combined Proposal within Approved Extent).
- A general reduction in drawdown (laterally and vertically) in the eastern extent beyond the Development Envelope towards Weeli Wolli Springs. (i.e. the Combined Proposal drawdown is within the Approved Extent).
- The drawdown extent to the north is within the Approved Extent. However, drawdown is expected to extend approximately 1.6 km in north-west corner beyond the Approved Extent.
- The drawdown extent to the southwest extends 1.6-4.2 km beyond the Approved Proposal towards Karijini National Park. Groundwater drawdown within Karijini National Park is predicted to be 1 m to 2.5 m in an area where depth to groundwater is between 60 to 80 mbgl (Figure 7-16). Given the depth to groundwater in this area, it is unlikely that any groundwater dependent vegetation would be impacted by the predicted drawdown. In addition, impacts to stygofauna values within the National Park boundary are also considered unlikely given that groundwater is too deep to be prospective for stygofauna (i.e. over 30 mbgl; Halse et al. 2014).

Given that there are no predicted impacts to ecological values from groundwater drawdown within the National Park boundary it is not discussed further. Locations where the Approved Proposal estimates drawdown in the National Park are shown in Figure 7-17.



- Monitoring Bores
- Dykes
- Worst Case Drawdown Scenario 2050
- Base Case Drawdown Scenario 2050
- Development Envelope
- Model Domain
- Karijini National Park



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MINING AREA C-SOUTH FLANK

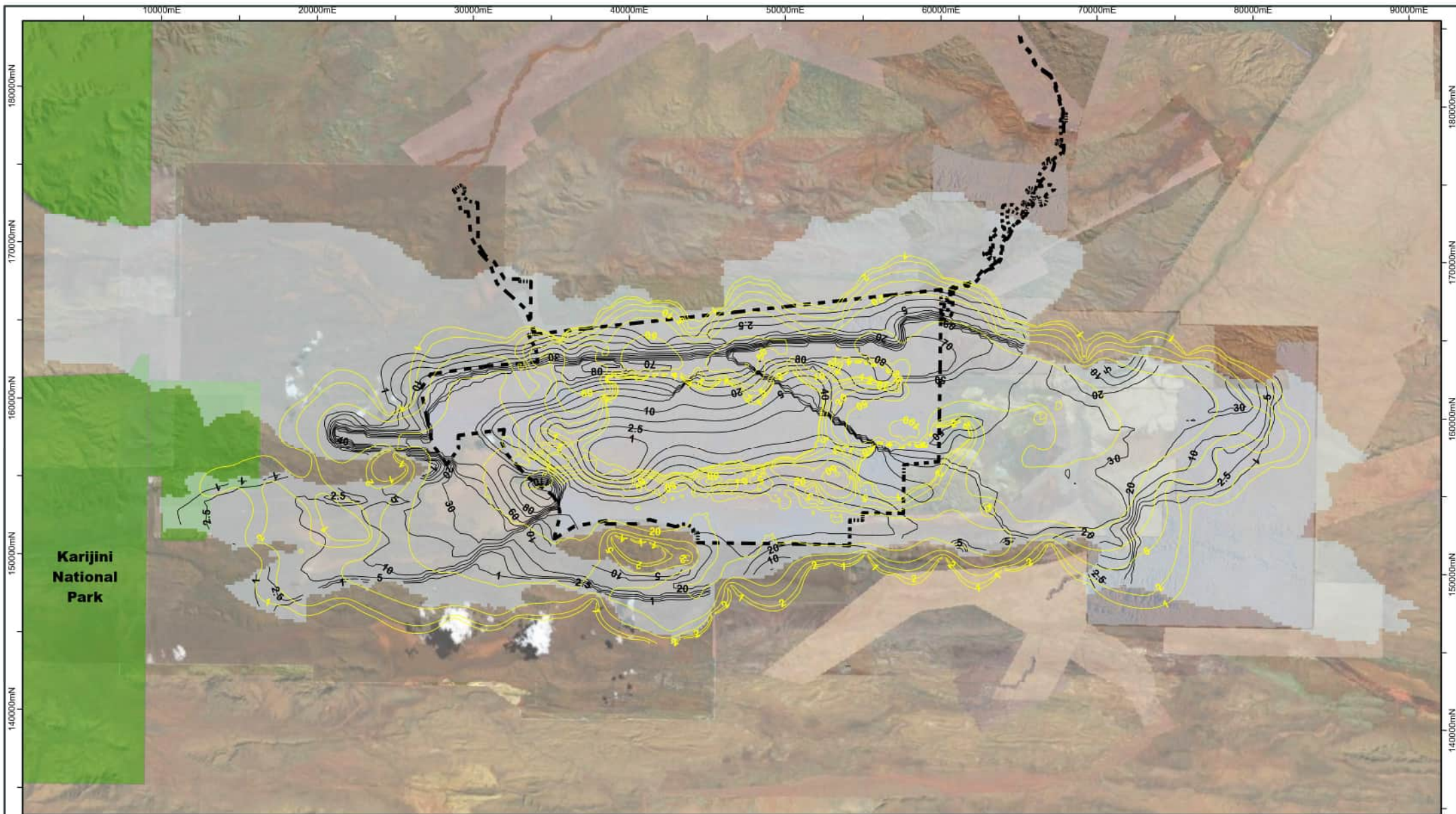
SIGNIFICANT AMENDMENT

PREDICTED GROUNDWATER LEVEL

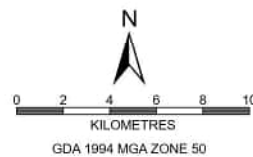
DRAWDOWN (2050)

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:325,000	REQUESTOR: ENVIRONMENT	FIGURE: 7-16
DATE: 18/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-045_RevF



- Development Envelope
- Combined Proposal
- Approved Proposal
- Model Domain
- Karijini National Park



MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

GROUNDWATER DRAWDOWN: APPROVED

PROPOSAL AND COMBINED PROPOSAL

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

PUBLIC

7-17

SCALE @ A3: 1:325,000

DATE: 18/02/2025

REQUESTOR: ENVIRONMENT

PREPARED: GEOMATICS

REVIEWED:

FIGURE:

NO: **A1285-053_RevE**

Table 7-6: Summary of Changes to Groundwater Regimes between the Approved Proposal and the Combined Proposal

Receptor	Approved Proposal	Combined Proposal	Cumulative impacts
Dewatering Volume	37.3 GL/yr (102 ML/d)	65.7 GL/yr (180 ML/d)	Allocation limits on Fractured Rock Aquifers of East Pilbara are set on case-by-case basis (DWER 2013)
Coondewanna Flats	Drawdown between 8 m-22 m by 2047 at GWB0039M	Drawdown up to 64 m (base case) and 98 m (worst case) by 2050 at GWB0039M	Drawdown up to 64 m (base case) and 98 m (worst case) by 2050 at GWB0039M
Weeli Wolli Spring	Up to 2045, the range of predicted cumulative drawdown is between 3 and 14 m at GWB0018DM The range in predicted maximum drawdown post 2045 is between 1 m and 2.5 m.	Combined Proposal proportion of cumulative impact in 2045 is 0.4 m (13%) Combined Proposal proportion of impact post 2045 is 3.5 m (28%)	Up to 2045, the range of drawdown is between 2.4 and 5.6 m at GWB0018DM The range in predicted maximum drawdown post 2045 is between 11.4 and 13.4 m (unmitigated).
Ben's Oasis	A predicted drawdown of less than 1 m	Drawdown unlikely	Drawdown unlikely

7.5.1.3 Groundwater drawdown impacts at Weeli Wolli Spring

Weeli Wolli Spring is cumulatively impacted by the surrounding mining operations (RTIO and BHP).

Drawdown at Weeli Wolli Spring (assessed at GWB00018M, just downstream from the Spring) due to the Approved Proposal was predicted to be between 3 and 14 m up to 2045 and between 1 and 2.5 m post 2045. The proportion of this drawdown that was associated with RTIO or BHP dewatering was not presented.

The predicted range of drawdown at the Spring up to 2045 due to the Combined Proposal (including cumulative drawdown from RTIO) is between 2.4 and 5.6 m. This includes active mitigation by RTIO Hope Downs (until 2045). The mitigation by RTIO Hope Downs has taken the form of discharging to Weeli Wolli Creek at a rate of approximately 20 ML/d and this is assumed to be combined with a further 20 ML/d of MAR at some of the RTIO Hope Downs dewatering bores once BWT mining ceases in 2025. The 2025 model suggests that dewatering at Combined Proposal contributes less than 13% (or 0.4 m) to the drawdown at the end of this period, based on the best estimate cumulative drawdown of 3.1 m. The expected drawdown up to 2045 is within the limits of the Approved Proposal (3 to 14 m).

From 2045, when RTIO Hope Downs mitigation is assumed to be completed, drawdown is predicted to increase at GWB0018M to between 11.4 and 13.4 m (with a best estimate of 12.7 m). The 2024 model has shown that this increase is a result of both RTIO and BHP dewatering, with the proportion associated with BHP estimated at 28% (or 3.5 m).

To summarise the above predicted impacts:

- drawdown at Weeli Wolli Spring is expected to be between 2.4 and 5.6 m prior to 2045 which is largely due to RTIO Hope Downs
- when RTIO mitigation ceases after 2045 the unmitigated impacts of the Combined Proposal (and residual impacts from RTIO dewatering) are expected to drawdown groundwater between 11.4 and 13.4 m.

Mitigation of dewatering impacts are provided in Section 7.6.4.1.

Consequently, there may be impacts to Flora, Vegetation, Terrestrial Fauna and Subterranean Fauna, discussed further in Section 8, 9 and 10.

7.5.1.4 Groundwater drawdown impacts at Ben's Oasis

Ben's Oasis is located outside the main Central Pilbara groundwater flow system where the Proposal is in operation. It lies on the upstream (southwestern) side of a regional dyke that behaves as a flow barrier. Ben's Oasis Spring is fed from an upstream groundwater compartment in which there is no active groundwater dewatering, as such there is no justification for including it in the numerical model domain (BHP 2025a).

In June 2023, a groundwater level difference of 37 m across the dyke was reported which indicates that the dyke acts as a flow barrier between MAC-SF/Hope Downs and Ben's Oasis (BHP 2023e). Drawdown is observed in the downstream bores (on the Hope Downs aquifer side of the dyke) but not in the bore on the upstream (Ben's Oasis side). These factors support the evidence of low hydraulic connection between Ben's Oasis and the Hope Downs aquifer compartment. However, this is based on relatively short-term monitoring and the situation may change as drawdown continues to increase on the Hope Downs side of the dyke and more data is collected.

The region between Ben's Oasis, South Flank and Hope Downs, as well as the dyke to the east of South Flank was included in the numerical model. The predicted range of drawdown at HDD0004M, located on the Hope Downs side of the dyke, peaks between 13 m and 21 m in the Combined Proposal. This drawdown is cumulative, and due to a combination of RTIO and BHP dewatering. The 2025 model indicates that the best estimate of drawdown at HDD0004M is 16.3 m. Of this, 3.1 m (or 19%) is associated with BHP dewatering (BHP 2025a).

Drawdown at HDD0004M was not presented in the Approved Proposal. A bore further north was used instead (GWB0020M). The Approved Proposal was expected to result in 20 to 40 m of drawdown at this bore. This was due to both RTIO and BHP dewatering, although the proportions were not indicated. Drawdown at GWB0020M in the Combined Proposal (2025 model) was between 41.9 and 46.5 m (BHP 2025a).

Dewatering from South Flank orebodies should have a negligible impact on Ben's Oasis due to the presence of another dyke along the main flow path between SF and the Hope Downs aquifer compartment. Dewatering from Mining Area C orebodies, other than R Deposit, is unlikely to impact Ben's Oasis.

As such, it is unlikely there will be impacts to Ben's Oasis and its associated ecosystems from the Combined Proposal.

7.5.1.5 Groundwater drawdown impacts at Coondewanna Flats

Drawdown due to abstraction within Coondewanna Flats is predicted to be primarily driven by dewatering from E West and Dead End deposits, and SF Highway 1 and 5 deposits. Drawdown from dewatering these orebodies is predicted to reach up to a maximum of 64 m in the Combined Proposal at groundwater monitoring bore GWB0039M. Drawdown is shown in Coondewanna Flats in Figure 7-16 which shows the maximum drawdown as occurring in the south east part of Coondewanna Flats extending up to 100 m for the base case and 110 m for the worst case scenarios.

The Approved Proposal predicted drawdown in Coondewanna Flats between 8 m and 22 m. Consequently, there may be impacts to Flora, Vegetation, Terrestrial Fauna and Subterranean Fauna, discussed further in Section 8, 9 and 10.

7.5.2 Changes to groundwater regimes from discharge of surplus water (mounding)

Managed aquifer recharge involves the infiltration or injection of water into an aquifer. Aquifer recharge of surplus water can occur for a range of purposes, including:

- as a disposal method for mine dewatering
- to recharge aquifers to increase the groundwater yield for drinking or other water supplies
- to recharge aquifers to increase groundwater levels to support the environment and maintain groundwater dependent ecosystems.

At MAR injection points mounding is caused by an increase in groundwater levels in the immediate discharge area. This has the potential to impact other factors including subterranean fauna, flora and vegetation. More specifically, mounding may flood habitats and/communities of troglofauna which reside above the current water tables and flood root systems of flora which may cause ecosystem health issues.

The Yandicoogina GDE Supplementation Scheme is intended to increase groundwater levels to support groundwater dependent ecosystems after an observed decline in tree health and is intended as satisfying an environmental water requirement and not a part of the surplus water management for the Combined Proposal. Groundwater mounding is the intention of the supplementation program to support existing ecosystems and return groundwater levels to long term levels. Groundwater bores used for the injection have been constructed as part of the Supplementation Trial and a temporary pipeline has been constructed from BHP's Yandi mine site to convey surplus discharge. Further discussion regarding the decline of GDV is discussed in Section 8.

The Northern RAV MAR Scheme is not located near any identified significant ecosystem as defined in Section 7.3.4, however there may be occurrences of flora and troglofauna which may be impacted. These impacts are further discussed further in Section 8 and Section 10, respectively.

Proposal

BHP operates a number of MAR schemes in the Approved Proposal, as presented in Table 7-5. The currently operating MAR schemes will not change in light of the Proposal, and as such, no additional impacts from these schemes are anticipated.

The two new schemes have been identified include the Northern RAV MAR scheme, and the Yandicoogina GDE Supplementation Scheme. The potential impacts of these schemes are discussed below.

Northern RAV MAR Scheme

The Northern RAV MAR scheme will be located within the Mick Bore deposit area, found to the north of Packsaddle 1 West deposit with groundwater expected to flow west (Figure 7-18). The geology of the area consists of surface scree, and three Tertiary Detrital (TD) units TD3, TD2 and TD1 above the basement rock. The aquifer potential of these units is predominately in the TD2 which consists of CID/Calcrete and Silcrete, with aquifer potential in TD1 and TD3 largely dependent on clast-size.

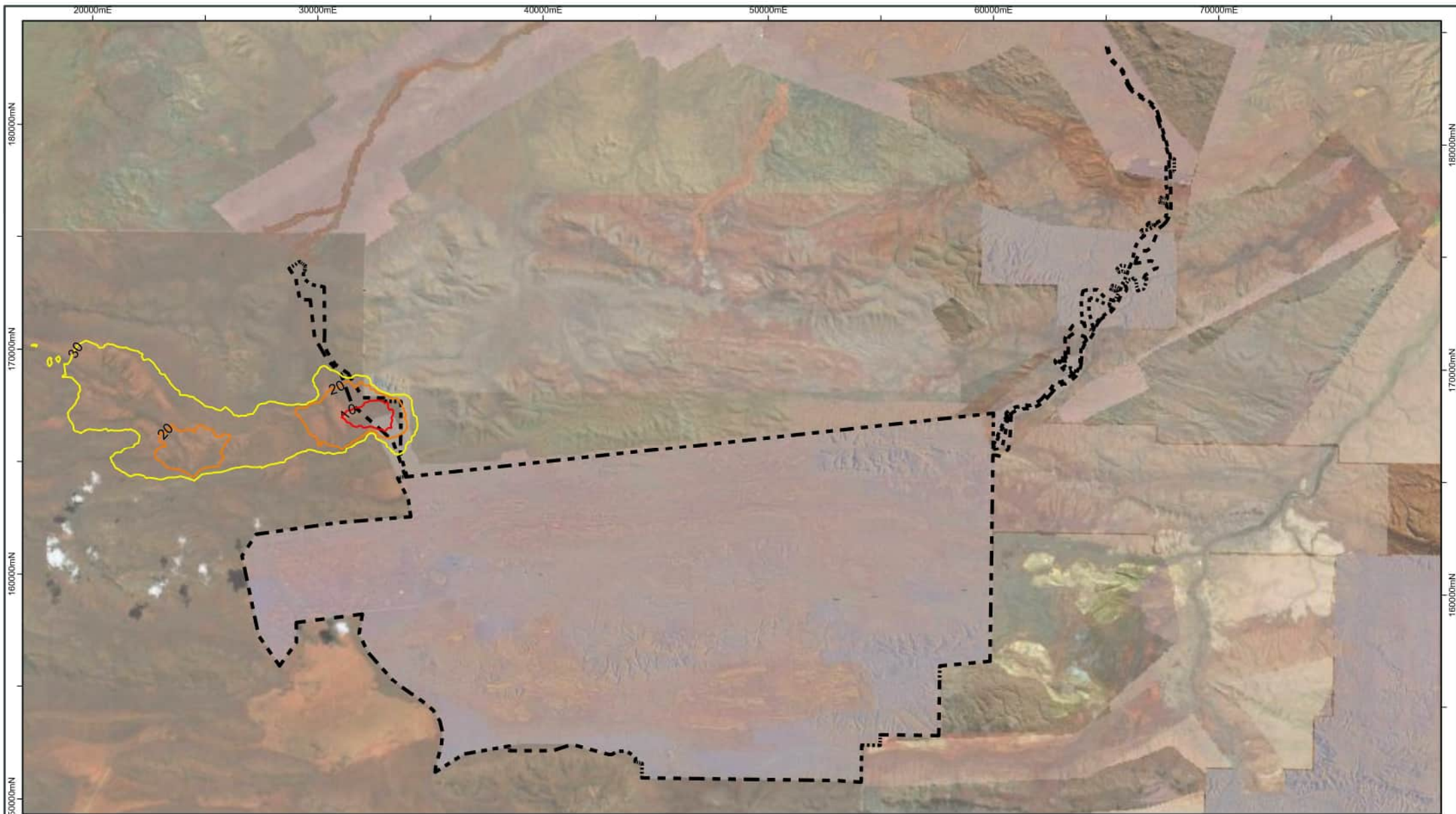
Modelling of the Northern RAV MAR is discussed in Section 0. The modelling showed that (Advisian 2024):

- There is significant uncertainty in the aquifer geometry and hydraulic parameters in that area
- The pre-MAR water levels in the Northern RAV MAR area are approximately 40 mbgl
- At continuous injection rates there is a high probability that the water level will increase (mound) to within 10 m of the ground surface. At 20 and 30 ML/d there is a 50% probability that this will happen after 5 years and 2 years respectively.

As shown in Figure 7-18 groundwater mounding at 20 years is predicted as follows:

- 10 m below ground surface over an area of approximately 205 ha
- 20 m below ground surface over an area of approximately 1,422 ha
- 30 m below ground surface over an area of 4,995 ha.

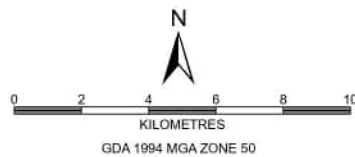
Modelling of pond infiltration at the same site was not simulated. However, in terms of mounding, the results from the MAR modelling should provide a reliable indication of what will happen with similar rates of pond infiltration.



Development Envelope

Predicted Groundwater Mounding

- 10mbgl
- 20mbgl
- 30mbgl



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**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
PREDICTED GROUNDWATER MOUNDING
AT NORTHERN RAV (20 YEARS AT 20 ML/DAY)
WAIO PLANNING, TECHNICAL AND ENVIRONMENT**

SCALE @ A3:	1:225,000	REQUESTOR:	ENVIRONMENT	FIGURE:	7-18
DATE:	18/02/2025	PREPARED:	GEOMATICS	NO:	A1285-046_RevF
		REVIEWED:			

Yandicoogina GDE Supplementation Scheme

The Yandicoogina GDE Supplementation Scheme is an environmental water requirement for an ecosystem of value, it represents the highest water use priority in the surplus water hierarchy as presented in Section 7.6.3.1, as such surplus water will be directed to Yandicoogina Gorge to satisfy the needs of the GDE prior to operational use or surplus disposal through other parts of the surplus management scheme. This scheme is being implemented to mitigate recent declines in local groundwater levels as discussed in Section 7.3.4.4. It is proposed to increase groundwater levels in the vicinity of the MAR to those observed in 2018.

As the scheme has been designed to increase and then maintain groundwater levels at previously observed values, mounding is not anticipated to negatively impact GDE at Yandicoogina Gorge. Instead, it is anticipated to have a positive impact associated with returning groundwater levels to 2018 levels.

Combined Proposal

There are two existing MAR schemes operating in the Approved Proposal, which are managed as part of Part V processes including the EP Act Licence L7851/2002/6. These are Juna Downs and South Flank MAR. The proposed locations for the new schemes compared to the existing schemes provide sufficient separation that there is limited combined effect of groundwater mounding as a result of the new and existing schemes, the schemes target areas of groundwater that have limited hydraulic connectivity. There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal.

The impact of groundwater mounding on Flora and Vegetation, Terrestrial Fauna and Subterranean Fauna is discussed in Section 8, 9 and 10.

7.5.3 Connection of aquifers from drilling

Incorrect installation of test, monitoring or production bores may lead to the establishment of preferential pathways between aquifers. Installation of a conduit for water to transfer between aquifers may lead to deleterious results, such as mixing of groundwater types, transfer of contamination or reduction of groundwater levels.

Proposal

Additional MAR schemes identified in Section 7.4 will need to have reinjection bores, monitoring bores and potentially additional test bores installed as part of their development. These bores may be installed across multiple aquifers which, if installed incorrectly, may lead to the development of preferential pathways between the Aquifers. Bores would be constructed in accordance with National Uniform Drilling Licensing Committee (NUDLC) (2020) to isolate intersected aquifers, preventing vertical connection and prevent any aquifer interference.

Combined Proposal

There are two existing MAR schemes operating as part of the Approved Proposal, which are managed as part of Part V processes including the EP Act Licence L7851/2002/6. These are Juna Downs and South Flank MAR. As these schemes are currently functional, and no plans to expand or increase production have been identified, no additional drilling is likely to occur, and no combined effects as a result of the Combined Proposal have been identified. Further, the proposed locations for the new schemes compared to the existing schemes provide sufficient separation that there is limited hydraulic connectivity between the new and existing schemes. There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal.

7.5.4 Changes in groundwater quality from MAR/Supplementation Schemes

There is potential to impact groundwater quality in proximity to the Yandicoogina GDE Supplementation Scheme and the Northern RAV MAR scheme due to differences in source and receiving environment water quality. This may be related to differences in geochemistry or a result of water quality issues affecting the source water, such as oxidation

as a result of extraction. Depending on the quality of the recharge water compared to the quality of receiving aquifer water, aquifer recharge has the potential to either improve or degrade water quality. In terms of MAR, it is a requirement to ensure that there is no significant deterioration of water quality and that there are no adverse impacts on associated environmental values.

Few carbonate precipitation issues have been encountered in the Juna Downs MAR reinjection activities. This is likely because the increase in pressure associated with groundwater injection and storage at depth increases the solubility (e.g. dissolution) of carbonate in the injected water. Moreover, the water for reinjection has likely already precipitated some carbonate within the E Deposit Turkey's Nest Dam, lowering its capacity for further precipitation.

Water quality impacts from mining activities

The source water may be impacted by contaminants from accidental spills or other mining activities, such as AMD, increased nitrates from blasting and PFAS.

Proposal

Change in groundwater quality due to Yandicoogina GDE Supplementation Scheme

Due to the sensitivity of Yandicoogina GDE Supplementation Scheme, based on the ecosystems present and that groundwater for supplementation will be sourced from a separate aquifer, an assessment of the water quality from the source aquifer, and comparison to ground and surface water quality within the Yandicoogina GDE, was required.

A desktop assessment of water quality data was conducted by Biologic (2023f), to provide a comparison of water quality between MAC and Yandicoogina Gorge (groundwater and surface water) and assess the risk of each mitigation strategy (surface discharge or MAR) to Yandicoogina Gorge (Appendix 7). The mitigation strategy for this water quality study included both injection of groundwater and surplus discharge, noting that surplus discharge at Yandicoogina Gorge is not part of this Proposal.

A water quality comparison and discussion of analytes of concern (AoC) was conducted as part of this desktop assessment. For groundwater (injection), AoC were pH, hardness as CaCO_3 (calcium carbonate which represents hardness), magnesium (Mg), sulfate (SO_4), nitrates (N-NO_3), boron (B) and electrical conductivity (EC).

Source groundwater quality from MAC C Deposit was broadly similar to that of Yandicoogina Gorge receiving environment groundwaters, on average pH being circum-neutral (albeit slightly higher at MAC), fresh and clear, with relatively low concentrations of dissolved metals (in comparison to ANZG DGVs). The most notable difference in groundwater quality was the markedly higher concentrations of nitrates (N-NO_3) in MAC groundwaters (Biologic 2023). However, the risk of eutrophication in groundwater is negligible due to the absence of light.

Among the ions, HCO_3 was the dominant cation, as was the case within Yandicoogina Gorge groundwaters. However, Na was the dominant anion, contrasting with Yandicoogina Gorge groundwaters, where Ca was predominant (although it was interchangeable with Na in some instances). Overall, hardness and concentrations of Mg and SO_4 were higher within MAC groundwaters. Relatively high CaCO_3 and Mg is likely due to production bores at MAC intercepting groundwater from dolomite-bearing carbonate lithologies, where groundwater is likely saturated with several carbonate minerals, such as calcite (CaCO_3), dolomite ($\text{CaMg}(\text{CO}_3)_2$) and/or magnesite (MgCO_3) (Earth Systems 2023). Elevated SO_4 is likely related to early-stage sulfide oxidation due to groundwater drawdown in the MAC area (Earth Systems 2023).

The risk of calcite precipitation was deemed to be negligible.

Based on the analysis of source water and existing water quality at Yandicoogina Gorge, there is unlikely to be any impacts to environmental receptors based on the above AoC.

Change in groundwater quality to Northern RAV MAR Scheme

There is no identified sensitive environmental receptor as per Section 7.3.3 that may be impacted by the MAR scheme at Northern RAV. Potential change in groundwater quality because of the MAR scheme has been assessed through analysis of groundwater quality results at the location in comparison with groundwater quality results from source water quality within the Development Envelope. Analysis of source water was undertaken by Biologic (2023f) and provided in Appendix 7.

Groundwater samples were collected from three bores proposed for the MAR scheme in Northern RAV and reported in the hydrogeological drilling report (BHP 2023b) (Appendix 7).

The below water quality can be summarised as follows:

- pH at Northern RAV is slightly basic between 8.3-8.4 and is comparable to the water quality in the Approved Proposal with mean pH of 7.6 and results ranging from 5.6-8.8. Water quality from the Approved Proposal is slightly fresher than Northern RAV.
- EC at Northern RAV is between 930-1200 $\mu\text{S}/\text{cm}$ whereas the Approved Proposal EC is between 70 - 1,100 $\mu\text{S}/\text{cm}$ with a mean of 610 $\mu\text{S}/\text{cm}$. Results indicate that all groundwater quality is fresh.
- Most ions within Northern RAV are comparable or slightly higher than those observed in the Approved Proposal, indicating there is unlikely to be any increase in hardness.
- Concentrations of metals are comparable between the Approved Proposal and Northern RAV with no values (where available) exceeding ANZG (2018).
- Nitrates (as N) are higher in the Northern RAV area in comparison to the Approved Proposal area with both exceeding the ANZG (2018).
- *Draft toxicant default guideline values for aquatic ecosystem protection: Nitrate in freshwater* (ANZG 2024) indicate that in areas with 'hard' water (greater than 150 mg/L CaCO_3), design guideline values for 99%, 95%, 90%, and 80% protection of species levels are 18 mg/L, 29 mg/L, 38 mg/L and 56 mg/L respectively. In consideration of these draft guidelines all concentrations of nitrate are within 99% protection of species.

Table 7-7: Water Quality Comparison between Northern RAV and the Approved Proposal

AoC	ANZG (2018)* 95%	Northern RAV Water Quality			Approved Proposal Mean Groundwater Quality [#]
		HMKB0015P	HMKB0016P	HMK0017P	
pH (pH units)	6-8		8.3	8.4	7.6
Electrical Conductivity (µS/cm)	250	1200	960	930	610
Turbidity (NTU)	15	0.9	<0.5	<0.5	15
Alkalinity (mg/L)		390	390	290	204
Hardness (mg/L)		440	460	330	247
Aluminium (mg/L)	0.055	<0.005	<0.005	<0.005	0.006
Arsenic (mg/L)	0.024	<0.001	<0.001	0.0020	0.001
Barium (mg/L)		0.0450	0.0610	0.0530	0.009
Boron (mg/L)	0.94	0.340	0.320	0.240	0.246
Cadmium (mg/L)	0.0002	<0.0001	<0.0001	<0.0001	0.00006
Calcium (mg/L)		78	83	61	43
Chromium (mg/L)	0.001	0.0020	0.0010	00.20	0.002
Copper (mg/L)		<0.001	<0.001	0.001	0.003
Lead (mg/L)	0.0034	<0.001	<0.001	<0.001	
Magnesium (mg/L)		60	62	43	30
Manganese (mg/L)	1.9	0.001	<0.001	<0.001	
Molybdenum (mg/L)		<0.001	<0.001	<0.001	
Nickel (mg/L)	0.011	<0.001	<0.001	<0.001	
Potassium (mg/L)		11	12	9.4	7.1
Selenium (mg/L)		0.002	<0.001	<0.001	0.001
Zinc		<0.005	<0.005	<0.005	
Nitrate as N (mg/L)	2.4*	6.099	5.648	5.873	1.47

*Guideline value for 95% protection of species from National Institute of Water & Atmospheric Research (NIWA) (2013) as recommended from ANZG (2018)

Biologic 2023f

Combined Proposal

There are two existing MAR schemes operating in the Approved Proposal, which are managed as part of Part V processes including the EP Act Licence L7851/2002/6. These are Juna Downs and South Flank MAR. The proposed locations for the new schemes compared to the existing schemes provide sufficient separation that there is limited combined effect of groundwater quality as a result of the new and existing schemes, the schemes target areas of groundwater that have limited hydraulic connectivity. There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal.

7.5.5 Changes to surface water regimes from the discharge of surplus water

Discharge of surplus water to creeks is expected to occur in the short term of the operation of this Proposal. This option is the lowest priority in the surplus water management hierarchy and will be utilised once environmental, operational and MAR schemes are at capacity. The following sections outline the potential direct impacts predicted to occur due to water discharge to creeks. To ensure adequate approved options for managing surplus water in the northern part of the Development Envelope, the Proposal includes provision for surplus water discharge to Marillana Creek at two locations (Upper and Lower).

Discharges to ephemeral creeks have the potential to change the flow regime of the creek (Smith *et al.* 2020). These changes could be:

- Increased frequency of flow or constant high flow events (compared to extended periods of dry channel conditions)
- Change to the flow volume at any one-time including periods of potential bank overtopping / floodplain inundation during high rainfall periods combined with a discharge event
- Changes in flow variability: natural variability of a stream's flow regime usually includes discrete low-frequency / high magnitude peak flow events linked to antecedent rainfall combined with extended periods of low flow – dry channel conditions.

Further discussion of the Upper and Lower Marillana Creek discharges are presented below. Potential indirect impacts resulting from changes to constant flow are:

- Mounding in associated alluvial aquifer and other connected aquifers, discussion in Section 0
- Impacts to riparian flora and vegetation within the wetting front, discussed further in Section 8.

Proposal

Upper Marillana Creek

Discharge to Upper Marillana Creek will be greatest in the early stages of the Proposal where the schemes for return to ground use do not have sufficient capacity. Periodic discharge to Upper Marillana Creek at a maximum of 30 ML/d with 90 days of no flow during the seasonal dry period for an operational period of 5 years. The discharge will have variable levels of utilisation and 30 ML/day is a conservative assumption.

A geotechnical and morphological assessment of the Marillana Creek downstream of the proposed discharge point to Flat Rocks was undertaken (4DG 2019). Creek flow throughout the area is sporadic and strongly influenced by seasonal rainfall. Rainfall amounts and intensities are highly variable and irregular due to periodic cyclonic events, thunderstorms and localised intense rainfall. Average annual rainfall varies from 300 to 400 mm. High rainfall events can occur in a short period of time, and over a relatively small geographic area, leading to localised flooding along affected watercourses. Such events can lead to high velocity flows concentrating in channels of Marillana Creek and its main tributaries (4DG 2019).

The size characteristics of the primary mapped channel (4DG 2019) does not follow what might be considered a typical river morphology. Surface flow capacity can be larger in various upstream tributaries, with lower flow capacity observed downstream from confluences, reflecting large initial inputs of rainfall-runoff which subsequently dissipates and is lost from the creek system due to evaporation and infiltration into the permeable channel bed. However, normal flow conditions for the wetting front are highly variable along the creek.

This observation may be attributed to typical Pilbara rainfall events, whereby precipitation events are isolated to sub-catchments of the drainage catchment such that high rainfall may fall on one tributary to the primary channel, but not the primary channel itself. It is frequently observed across the Study Area that one area will see significant rainfall and water flow where nearby areas receive no rainfall. These events would cause “flash flooding” of a tributary or tributaries causing the channel to be shaped disproportionately large for the catchment area with an initial unsustained surcharge of water flowing into the creek system which then dissipates into small flows in the low flow channels and/or subsurface flow through the river gravels (4DG 2019). The probability of a similar magnitude channel-shaping event falling on the main channel directly upstream from the tributary is then smaller. It is expected that the only time the entire creek system would likely see rainfall in the same period would be during cyclonic events where widespread rainfall is common and the full creek system would flow. During such events, surface water flow would likely cover the full primary channel as well as extending into secondary channels and floodplains during peak flow, before eventually reducing to flow through low flow channels and then to subsurface flow through gravels (4DG 2019).

A 2D hydraulic model of Marillana Creek was developed to estimate the extent of continuous flow for a range of surplus water discharge rates (AQ2 2019). This study was used in the planning and assessment of discharge options but does not consider the proposed 90 day drying period.

In the model, the discharge point was approximately 4 km from the intersection of the Upper Marillana Creek (Tributary of Marillana Creek) and the Yandi Access Rd. Since modelling was undertaken, the discharge point has been modified to be located near the intersection of the Yandi Access Rd and Upper Marillana Creek. As a result, modelled distances are more conservative an additional 2 km.

The model was created with the Flat Rocks at the downstream boundary of the model (27 km downstream from modelled discharge (29 km from actual discharge), so scenarios were run with Flat Rocks considered as the sensitive environmental receptor.

The modelling adopted a conservative approach and used a continuous discharge rate within the creek. The modelling considered the following discharge rates and periods of operation:

- 30 ML/day for duration of 5 and 10 years
- 50 ML/day for duration of 5 and 10 years
- 60 ML/day for duration of 5 and 10 years
- 80 ML/day for duration of 5 and 10 years.

A Base Case model was completed to assess the wetting front for these discharge scenarios. The Base Case identified two uncertainties within the model:

- The rate and volume of seepage water that can be drained by the underlying channel in deposit (CID) aquifer.
- The rate at which water can infiltrate from the creek into the underlying CID.

The above uncertainties were addressed through creating a constrained model where the transfer capacity of the wetting front to the CID was limited to 12 ML/day and an unconstrained model where the total capacity for the CID to receive/transfer infiltration was not limited.

The 30 ML/d scenario was the lowest surplus discharge volume scenario tested where the wetting front did not extend to Flat Rocks permanently during a 5-year period. For the extended 10-year 30 ML/d scenario, the wetting front seasonally oscillates between 23 km downstream of the discharge point during the wet season (when evaporation rates are high) and Flat Rocks (during the dry season, when evaporation rates are low). This indicates that the maximum capacity for this tributary of Marillana Creek to receive discharge water without reaching Flat Rocks (also referred to as MarC6 on Figure 7-14) is marginally less than 30 ML/d (AQ2 2019). At the nominated 30 ML/d, the predicted wetting front for Upper Marillana Creek is approximately 24 km. The wetting front for a 30 ML/d constant rate is estimated to be 24 km after 5 years and past Flat Rocks at 10 years of flow (AQ2 2019). The wetting front modelling is considered conservative as it does not allow for the proposed 90-day drying period coincident with the dry season.

Upper Marillana Creek is ephemeral, and at the time of the study conducted by AQ2 (2019), it was understood that only one pool of a persistent to permanent nature known as Flat Rocks, is located downstream of the proposed discharge point. As such, modelling was conducted to characterise potential impacts to the surface water regime of this pool, located downstream of the proposed discharge point. A more recent study (Biologic 2023b), however, identified at least five semi-permanent pools between the proposed discharge and Flat Rocks. The most upstream pool (MarC1) is located approximately 5 km upstream of Flat Rocks (shown on Figure 7-14). The potential impact is that the pools may become connected and / or create flow events with a lower proportion of runoff.

The management intention is that the wetting front in the creek resulting from the discharge never reaches Flat Rocks through nominating a trigger and threshold location to signal a reduction or to cease discharge of surplus water within the creek. Even when the wetting front from the proposed discharge waters has not reached Flat Rocks, the creek discharge is still likely to have some impact on the water available at Flat Rocks after rainfall events. The inundated low flow channel area is likely to reduce the recharge rates during creek flow events (AQ2 2019). As the nominated discharge rate is 30 ML/day and the wetting front is estimated to be 24 km based on 5 years of discharge and greater than 27 km based on 10 years of discharge, it is likely that the hydrological regime of these pools would be affected by surplus water discharge without mitigation. The model assumes that discharge would be at 100% utilisation year round. In reality, given the discharge will have moderate levels of utilisation and a 90-day drying period, this will be a conservative assumption.

Lower Marillana Creek

Marillana Creek is ephemeral upstream of the Lower Marillana Creek discharge point (Figure 7-15). Discharges from the existing Yandi Operation has created a short section of permanent flows.

The Lower Marillana Creek discharge point is an existing discharge point utilised by BHP Yandi Operations for up to 41.1 ML/d (daily average based on annual licence volumes from EP Act L6168/1991/11). This discharge is currently approved and managed under the Yandi Operations however, wetting front limits have not previously been set for this location. For this Proposal the discharge location is proposed to maintain its licensed discharge volume with a maximum of 30 ML/d as a result of this Proposal and up to 11 ML/day remaining for surplus discharge from Yandi Operations.

A technical memorandum (Water Engineering 2021) was prepared investigating historical wetting front from this discharge from Yandi mine focusing on two available datapoints, in 2008 and 2013. The wetting front recorded in April 2008 with a discharge of 29.3 ML/d was 9 km, with only minor streamflow recorded at the Flat Rocks stream gauging site located on Marillana Creek upstream of the BHP tenement. These small volumes recorded at Flat Rocks (DWER gauge 709001) are typical of seepage which occurs at the dolomite sill. They do not progress more than 1 km downstream and would not impact flows near the Yandi discharge point.

In 2013, the wetting front with a discharge of 22.5 ML/d was 6.5 km, with average streamflow of 3 ML/day for May at Flat Rocks (DWER gauge 708001). A more recent recording of a discharge of 10 ML/d in June 2023 returned a wetting front of 2.5 km.

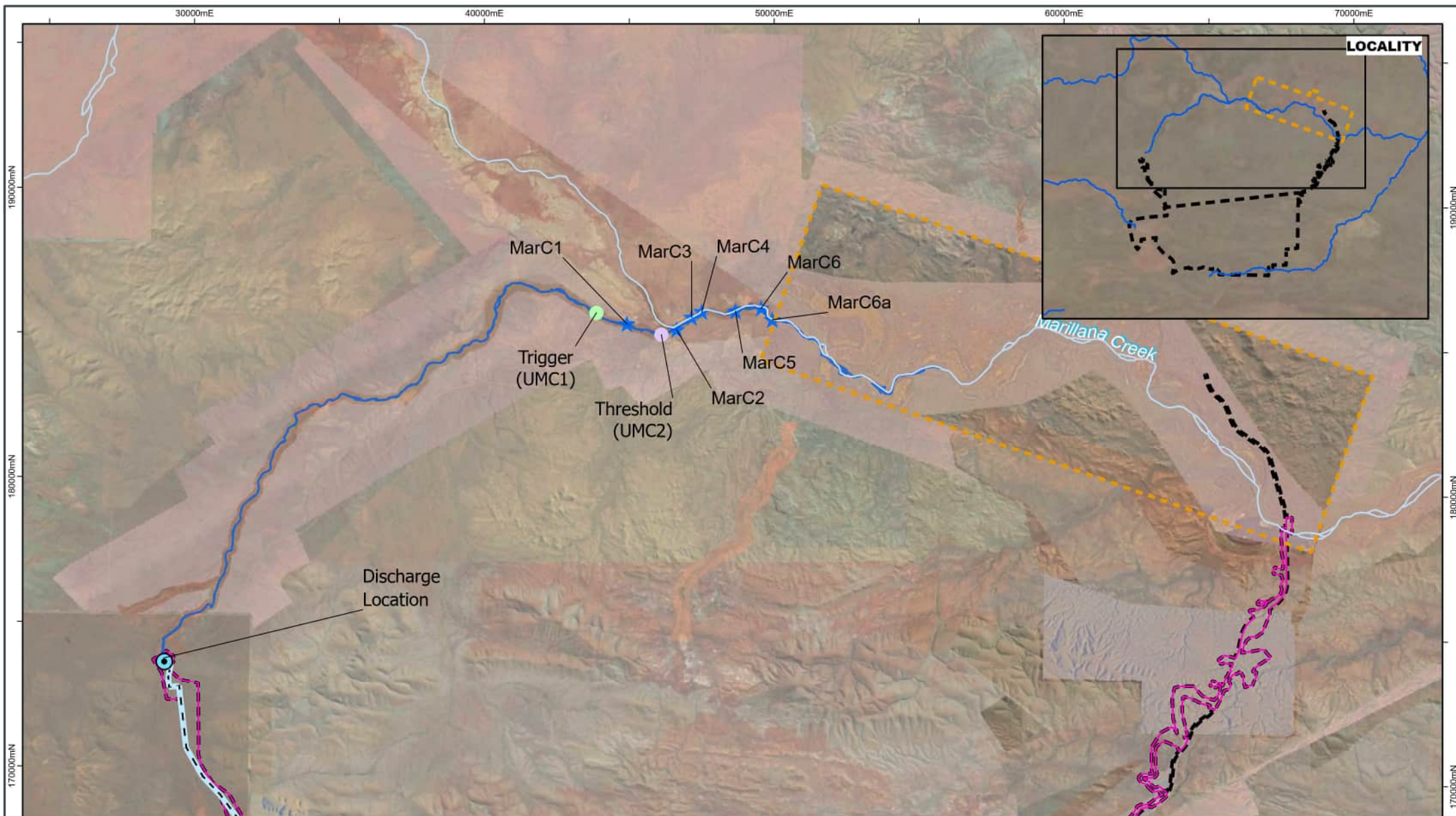
As a result of the Proposal, the surface discharge is expected to increase the flow of water along Marillana Creek but will remain within its current licensed discharge amount of 41.1 ML/day.

Combined Proposal

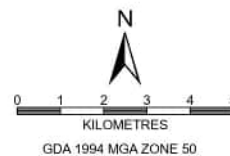
The Approved Proposal provides surplus water management limited to 34.84 GL/a via MAR, infiltration pond, discharge from sedimentation basin and discharge to a drainage line that leads to Pebble Mouse Creek. The Combined Proposal seeks an additional 21.37 GL/a to reach a total of 56.21 GL/a with additional MAR and creek discharge.

There is one existing approved creek discharge in Pebble Mouse Creek for the Approved Proposal, which is managed under Part V Licence L7851/2002/6. However, this is used for emergency releases only. The proposed locations for the proposed discharges including Upper and Lower Marillana Creek schemes to different sub-catchments to the existing approved discharge. There is no change to the approved Pebble Mouse Creek discharge.

The Yandi mine (licence L6168/1991/11) discharge will not change due to the Proposal. The existing maximum discharge will be balanced between the two operations and will not exceed the licensed amount of 41.1 ML/day. There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal. The 90-day drying period is proposed for the north-east scheme (surplus discharge from the Proposal) and not for Yandi mine.



- Trigger
- Threshold
- ⊙ Discharge Location
- ★ Marillana Creek Pool Locations (Biologic, 2023b)
- Watercourses
- Marillana Creek
- Indicative Footprint
- - - Development Envelope
- - - Yandi Tenement Boundary
- - - Northwest Scheme Pipeline



BHP **PUBLIC**

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
UPPER MARILLANA CREEK PROPOSED
WETTING FRONT**

WAO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:175,000 REQUESTOR: ENVIRONMENT FIGURE: 7-19
DATE: 17/02/2025 PREPARED: GEOMATICS
REVIEWED: NO: A1285-047 RevG

7.5.6 Change to surface water quality from surplus water discharge to creek

Proposal

There is a close and complex relationship between water quality and water quantity of creeks (Sinclair 2013). After a rainfall event, when the creek water levels recede and eventually dry up, the channel transitions to a series of connected or disconnected refuge pools. In the case of Marillana Creek, the Marillana Creek Pools is one of these features.

Water quality during high rainfall flows is driven by the large volumes of catchment run-off. Flooding entrains organic carbon and nutrients from the floodplain areas into the river channels. Some systems also have high mineral turbidity, which is characteristic of the local geologies and land use. Ephemeral creek systems in the Pilbara are naturally exposed to high sediment loads during periods of rainfall stream flow and flood events. A result of increased flow includes the increase of total suspended solids in the downstream environment for the duration of discharge, outside of the natural response to rainfall.

Marillana Creek is ephemeral and can be considered as a dryland river ecosystem, according to the “Characterising the relationship between water quality and water quantity” guidelines (Sinclair 2013). This is a generalisation based on the conceptual model of dryland rivers.

The Creek, at the location of the Upper Marillana Creek discharge and downstream to the confluence with Marillana Creek, is predominately dry all year round. As such proposed discharges will have different effects during the predominant no-flow conditions and the infrequent natural flow conditions and this requires consideration. During no-flow scenarios, water quality of the Upper Marillana Creek would predominately be composed of the abstracted water. During flowing scenarios, the water would undergo mixing with natural runoff.

A summary of the water quality sampling done in the Marillana Creek Pools is provided in 7.3.4.3.

Source water characterisation was conducted in the study conducted by Biologic (2023f) to conduct a risk assessment for receiving water at Yandicoogina Gorge. The characterisation of source water from the MAC C deposit is still relevant for this discharge, as follows:

- MAC C Deposit source groundwater was acidic (pH 5.6) to alkaline (pH 8.8), fresh (70 to 1,100 $\mu\text{S}/\text{cm}$ EC), warm (average temperature 29.0°C) and relatively clear (0.25 Nephelometric Turbidity Units (NTU) to 18 NTU turbidity; average 2.74 NTU). All EC values were above the ANZG (2018) DGV of 250 $\mu\text{S}/\text{cm}$. A small percentage (12%) of pH values were in exceedance of the upper ANZG (2018) guideline (pH 8.0), while a single pH value fell below the lower guideline (pH 6.0). No Dissolved Oxygen (DO) data were available. Ionic composition was dominated by HCO_3 anions, followed by SO_4 , with no Cl data available. Na was dominant amongst anions, followed by Ca, Mg and K (Biologic 2023f).
- Nitrate concentrations were relatively high in the MAC groundwater, with N_{NO_3} exceeding DGVs for eutrophication on 69% of sampling occasions. For total P, 31% of values exceeded the eutrophication guideline (0.01 mg/L), although the dataset was limited to 13 records. Only two records for N_{NO_x} and total N were provided, with all values being above DGVs (Biologic 2023f).
- Concentrations of most dissolved metals were below laboratory Limits of Reporting and/or ANZG (2018) DGV. Exceptions included Cd, Cu Ni and Zn, however, ANZG (2018) DGV exceedance frequency was 26% or lower for each of these analytes. The limit of reporting (LOR) for Cr (0.004 mg/L) was not sufficiently low to allow for comparison against the ANZG (2018) DGV (0.001 mg/L) (Biologic 2023f).
- Concentrations of hydrocarbons and other contaminants were mostly below analytical detection limits (Biologic 2023f).

Mineral precipitation (i.e. of carbonates) risk has been identified as potentially problematic within the surface water systems. A study by Earth Systems (2023) (Appendix 7) concluded, that based on changes in water chemistry within the Turkey's Nest, if production groundwater from the Development Envelope was discharged directly to the environment, it is possible that under optimum conditions close to 40 kg of calcium carbonate (CaCO_3) could be deposited for every 1 ML of water. At a discharge volume of 50 ML/day, this could result in the precipitation of approximately 2 tonnes of CaCO_3 per day downstream of the discharge point (Earth Systems 2023).

Combined Proposal

Discharge into Pebble Mouse Creek is included in the existing Approved Proposal, which is managed as part of Part V processes including the EP Act Licence L7851/2002/6. This is used for emergency releases. The proposed locations for the new discharges including Upper and Lower Marillana Creek schemes provide sufficient separation that there is limited combined effect on surface water as they will discharge to different catchments from the existing approved discharge catchment. There is no anticipated difference in surface water quality between the potential impact of the Approved Proposal to the Combined Proposal.

7.5.7 Changes in surface water flow regime and quality due to catchment diversion

The Approved Proposal includes the construction of typical mining infrastructure including mine pits and overburden storage areas (OSAs) that have the potential to modify the flow regime and surface water catchments. The refined design of the Grand Central Overburden Storage Area (GCOSA) has identified that runoff from natural watercourses and upstream catchments will be intercepted and can potentially inundate the GCOSA with flood waters.

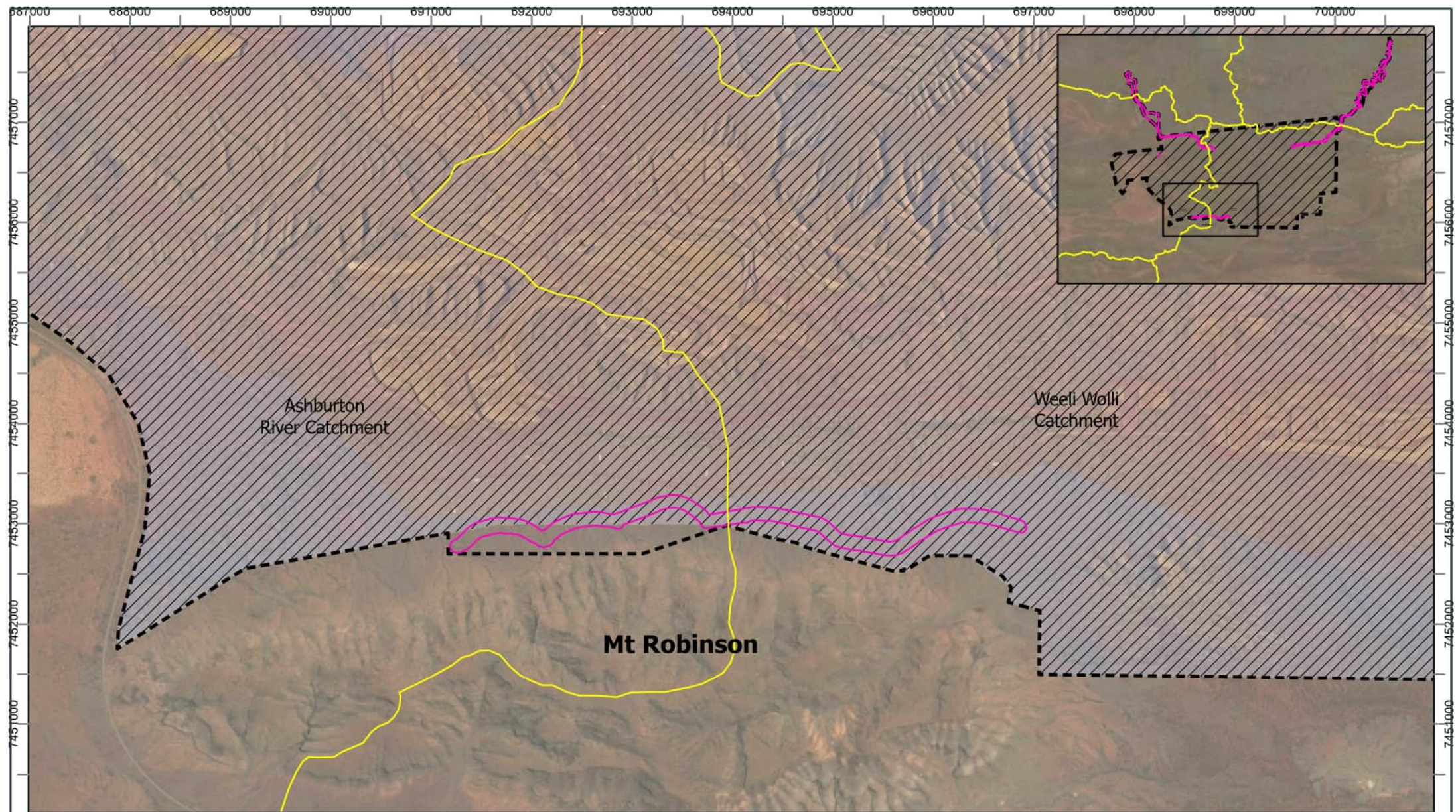
The GCOSA is located within the Mount Robinson Valley at the South Flank mine. As shown Figure 7-20, Mount Robinson is located south of the Development Envelope and is divided into two catchment areas. The west side contributes to the Coondewanna Catchment (and Coondewanna Flats) and the east part of Weeli Wooli Creek Catchment (via Pebble Mouse Creek). The GCOSA will intercept runoff conveyed in natural watercourses from the upstream catchments. Diversion channels upstream of the GCOSA are required to introduce a controlled interception of the runoff to prevent flood inundation of the downstream GCOSA.

The environmental impacts of the GCOSA itself were included in the Approved Proposal; this Proposal seeks approval for the inclusion of a diversion to ensure that flood inundation does not occur of the downstream OSA.

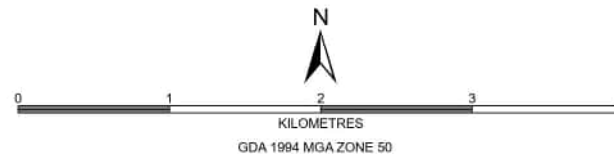
Design drawings for the diversion are included in Appendix 7. A summary of the civil design of the diversion channel includes the following:

- The total length of the east and west diversion channels are approximately 3.3 km and 2.7 km respectively.
- The east channel grades to the east and the west channel grades to the west consistent with existing catchments.
- The alignment of the diversion channels are defined such that the maximum longitudinal slope is achieved (meaning the alignments closely follow elevation contours of the existing topography).
- The base width of the channel varies from 15 m to 30 m with an average cut depth of 0.7 m to 1.5 m.
- The excavated material from the diversion channel will be used as fill for construction of a berm with an average height of 2.1 m to 2.6 m.

The diversion will intercept the parallel drainage lines which drain to the main creeks along the valley bottom from the Mount Robinson north slopes. These parallel drainage lines are well defined creek lines which generally concentrate into a single flow line before their confluence with the main creeks along the valley bottom.



- Indicative Footprint
- Development Envelope
- Ministerial Statement 1072
- Local Catchments



**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
PROPOSED GRAND CENTRAL
OVERBURDEN STORAGE DIVERSION
WAO PLANNING, TECHNICAL AND ENVIRONMENT**

PUBLIC

SCALE @ A3: 1:50,000

DATE: 18/02/2025

REQUESTOR: ENVIRONMENT

PREPARED: GEOMATICS

REVIEWED:

FIGURE: **7-20**

NO: **A1285-057_RevD**

Proposal

Hydrological and hydraulic modelling was prepared by WSP (2024) to inform the design of the diversion and determine the associated impacts to the surface water system, the report is included in Appendix 7. The construction of the diversion will impact the surface water catchments local to the GCOSA by reducing the area of the local catchment and the regional catchment. The impacts of the Proposal (diversion) on the overall catchment area are presented in Table 7-8 below. The Proposal will cause a 17% reduction in the West Catchment and 24% reduction for the East Catchment. The associated percentage reduction to regional catchments areas are 0.44% loss to the Coondewanna Catchment (west) and 0.05% to Weeli Wolli Catchment (east).

Table 7-8: Impact of the Proposal to local and regional catchments

Parameter	Local Catchments		Regional Catchments	
	West	East	Coondewanna Catchment	Weeli Wolli Catchment
Baseline Catchment Area (km ²)	16.38	8.97	860	4150
Loss to Catchment Area (km ²)	4.7	2.5	4.7	2.5
Percentage Reduction in Catchment Area (%)	29%	28%	0.55%	0.06%

Modelling of the existing conditions was undertaken to determine the peak flows and flow velocities in the 10%, 1% and 0.01% average exceedance probability (AEP) events. Table 7-9 below provides a comparison between the baseline peak flow rates and peak flow rates because of the Proposal. Overall, the reduction in peak flows can be seen across both catchments ranging from 15% to 37% in the West Catchment and 10% to 31% for the East Catchment.

Table 7-9: Impact of the Proposal to peak flow rates (East and West Catchments)

AEP	Baseline Peak Flow Rates m ³ /s		Proposal Peak Flow Rates (m ³ /s)	
	West	East	West	East
10%	55.01	35.84	46.75	32.26
1%	187.6	110.67	123.32	77.23
1 in 10,000	278.84	157.93	175.07	108.63

The impacts to velocities in the West and East catchment outlets are summarised in Table 7-10. The diversion has been designed with flat slopes to reduce the velocities within the diversion as much as practically possible, thereby reducing the risk of scour whilst maintaining high enough velocities to mimic the velocities of the parallel drainage lines. Overall, the predicted velocities with implementation of the diversion for the Proposal are comparable to existing velocities under the Approved Proposal, meaning that the sediment transport regime of both catchments will remain largely unchanged.

Table 7-10: Impact of the Proposal to velocities (East and West Catchments)

AEP	Baseline Velocity m/s		Proposal Velocity (m/s)	
	West	East	West	East
10%	1.05	1.19	1.05	1.16
1%	1.40	1.60	1.25	1.44
1 in 10,000 (0.01%)	1.54	1.74	1.36	1.56

Coondewanna Flats

Coondewanna Flats is the closest environmental receptor to the diversion with a change proposed to its upstream surface water catchment. The current flow path to Coondewanna Flats from the West Catchment is via existing culverts under the Great Northern Highway which act as a natural attenuator of larger events as such there is limited change to the peak flows reaching Coondewanna Flats from the existing condition.

The quantity of surface runoff reaching Coondewanna Flats will be marginally reduced by an associated catchment reduction of 0.55% (as shown in Table 7-8 above).

Combined Proposal

There are no additional impacts in assessment the Combined Proposal beyond the impacts stated for the Proposal.

7.5.8 Changes to surface water and groundwater quality from mining activities

The following section describes the potential impacts to water quality as a result of mining activities that are part of the Approved Proposal in consideration of the increased dewatering in the Proposal.

Acid Mine Drainage

As outlined in Section 7.3.3.3, BHP uses an internal system for classifying potential AMD, which is based on standard geochemical assays to form net acid producing potential values. AMD poses risks to groundwater when pit excavations expose acidic and/or metalliferous material. BWT mining at SF orebodies may pose AMD risks for the Proposal. Table 7-11 presents the results from the Acid and Metalliferous Drainage Risk Assessment for the Proposal (BH, 2021b). Further detail presented in BHP (2021b) indicates that a low risk rating applies to the following:

- Waste rock and low grade ore containing less than 0.5% AMD1 and less than 5% AMD2 and AMD3.
- Pit surface exposures containing less than 0.2% AMD1 and less than 2% AMD2 and AMD3.

The AMD risk from BWT mining at SF and the extended groundwater elevation at R deposit is considered to be low, with the exception of Grand Central deposit. A summary of the results for the risk rating is presented in Table 7-11 below.

Table 7-11: AMD results for SF and R deposit

Deposit	Source	AMD 1 (%)	AMD 2 and 3 (%)	Risk rating
Highway	Waste and low-grade ore	0	1.92%	Low
	Pit surfaces	0	0.8	Low
Grand Central	Waste and low-grade ore	0	6.63	Moderate
	Pit surfaces	0	1	Low
Vista Oriental	Waste and low-grade ore	0	2.31	Low
	Pit surfaces	0	0.7	Low
R	Waste and low-grade ore	0	0.05	Low
	Pit surfaces	0	0.1	Low

It is noted that the waste and low-grade ore risk rating for Grand Central deposit is considered to be conservative, as the volume of AMD2 and AMD3 material is overestimated by the model presented in BHP (2021b). This is due to all sulphur within the model being presented as pyrite, and the low-grade ore could be blended and shipped out of the Development Envelope.

Nitrates

Results from the FY22 TAR and FY24 AAR reported consistent exceedances of nitrates in groundwater samples above SSTVs outlined in the GWOS (BHP 2023d). Between July 2019 and May 2023, 116 nitrate samples were collected, of which, 62 exceeded the SSTVs. The largest exceedance was reported at the Packsaddle orebodies, in borehole HPSA1633M in March 2021, with a concentration of 52 mg/L. Nitrate detections in groundwater are likely derived from explosive use within the Approved Proposal.

Accidental spills of hazardous materials

During construction and operation, the Proposal has the potential to contaminate surface water due to spills of hazardous materials and waste. Site drainage will be designed to collect, minimise or eliminate surface runoff into areas where hydrocarbon contamination may occur. Hydrocarbon storage facilities will be appropriately constructed and bunded in accordance with Australian Standards. Regular facility inspection, maintenance, spill management procedures and staff training are expected to mitigate the risk of contamination effectively and this impact is not further discussed.

7.5.9 Increased sediments in surface water from infrastructure and drainage

Runoff in the region naturally has a high sediment load due to:

- Generation of overland runoff in the Pilbara is typically in response to intense storms or cyclonic activity, leading to large magnitude events over short periods of time
- There is availability of material deposited on the land surface which is not cohesive or has low particle size leading to elevated erosion risk

- Overland flow runoff has high transport competence due to flow velocities exceeding particle settling velocities.

While sediment transfer is a natural geomorphic process, disturbed material resulting from construction and/or mining activities and areas where vegetation cover has been removed may increase sediment supply and, hence, increase the sediment load in runoff.

Waterway crossings of roads and infrastructure increase this risk, due to the nature of earthworks leaving soil exposed in combination with the proximity of the disturbance to the waterway.

Erosion and sediment transport due to the Proposal is unlikely to present a significant environmental risk given the management measures to be implemented.

Proposal

The north-east pipeline will involve the clearing of native vegetation and construction works at creek crossings, of particular note the construction of the Yandicoogina GDE supplementation scheme pipeline is required to cross the Yandicoogina Creek waterway and infrastructure is required to be build adjacent to the Creek. This will lead to a temporary increase of construction traffic to this location for a short period of time, which has potential to cause erosion of the existing waterway crossing. Clearing will be required along the pipeline corridor, potentially increasing sediment load entering into the creek during intense storms. These sediments will be carried downstream to the Yandicoogina Gorge and Pilbara Pools PEC.

Combined Proposal

There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal for this potential impact due to no other works occurring in the vicinity of the pipeline alignment. Management of sedimentation across the Approved Proposal is undertaken through the use of best management practices and ongoing monitoring.

7.5.10 Mounding in aquifers associated with Marillana Creek (Upper and Lower)

Proposal

Investigations conducted for the Upper Marillana Creek Creek discharge, included a geotechnical study to distil mapping information collected in the field into a form that can be used as an input for infiltration and wetting front modelling. A Channel Domain Design Table has been created from the mapping data (AQ2 2019).

The model considers three main aquifers: the detrital aquifer, the surrounding detrital or basement aquifer and the CID aquifer, with the following mechanisms:

- The detrital aquifer was divided longitudinally into 28 x 1 km model cells, with infiltration to the model cells allowed across the low flow channel inundation area
- Losses from the system which were modelled including:
 - surface water evaporation
 - increased evapotranspiration
 - lateral seepage to the surrounding Tertiary Detrital or basement aquifer
 - seepage to the CID aquifer.

The proposed wetting front is likely to saturate the underlying creek bed so that even when the wetting front has not reached Flat Rocks, creek discharge in response to rainfall is likely to have less losses to the creekbed and produce

a higher flow which may have some impact on the water available at Flat Rocks after rainfall events. The inundated low flow channel area is likely to reduce the recharge rates during creek flow events and thereby increase the flow in Marillana Creek and at Flat Rocks (MarC6).

AQ2 modelling has assumed approximately 4 ML/day of recharge to the CID aquifer from the wetting front. The impacts from mounding could alter the ecology of Marillana Creek. The volume of Creek flow is impacted by rainfall, geomorphology, grade of the creek bed, and interactions with the underlying aquifer.

There are known locations where there is a natural relief point for the CID to release water into the creek, two are coincident with semi-permanent pools identified as MarC2 and MarC6 (Figure 7-15).

Groundwater mounding at MarC2 may result in an increase in the frequency and quantity of discharge from the CID into the pool. As part of the existing hydrology of Marillana Creek, the pool becomes inundated with seasonal creekflow. The ecosystem is adapted to ephemeral inundation and is therefore unlikely to be impacted. However, the contribution of discharge to creekbed may increase the extent of the wetting front distances and inundate a longer extent for an extended period.

Groundwater levels in the MarC6 area are measured regularly as part of the operation of the BHP Yandi mine Site and are currently impacted by dewatering operations with an estimated 12 m of drawdown. It is unlikely that mounding that is generated from the wetting front will make a substantial difference to the current lowered groundwater levels. However, BHP is currently investigating opportunities to mitigate drawdown in Flat Rocks (MarC6/MarC6a) as such, if groundwater levels were to rise it would be considered a positive impact.

Similar processes are likely to occur at the Lower Marillana Creek discharge due to the ongoing use of the licensed surplus water discharge point. A permanent artificial pool currently exists at the discharge point downstream beyond BHP tenure. The pool and associated wetting front have varied over time with the volume of discharge (BHP 2021e).

Combined Proposal

There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal for this potential impact due to no previous creek discharge being approved in the vicinity of the new surface water discharge of Upper Marillana Creek.

7.5.11 Changes in surface water quality in Yandicoogina Gorge Pools due to the Yandicoogina GDE Supplementation Scheme

Proposal

Surface water quality at the Yandicoogina Gorge Pools could potentially be impacted as a result of groundwater supplementation further upstream, assuming that injected water reaches the pools. An assessment of the water quality from the source aquifer, and comparison to groundwater and surface water quality within the Yandicoogina Gorge, was undertaken. This was undertaken due to the ecosystem sensitivity of Yandicoogina Gorge and that groundwater for supplementation will be sourced from a separate aquifer with potentially different characteristics.

A risk assessment was undertaken to determine any potential impacts to water quality as a result of the direct injection of groundwater into the receiving aquifer through existing groundwater bores.

Groundwater quality from MAC was generally comparable to Yandicoogina Gorge surface waters, which had predominantly neutral pH, warm water temperatures, and low salinity and turbidity. Composition of anions in MAC groundwater was slightly different to Yandicoogina Gorge surface waters, with Na being dominant over Ca, and Mg being notably higher in the MAC groundwaters (Biologic 2023f).

Concentrations of N-NO₃, N-NO_x and total N were also notably greater in MAC groundwaters, although the latter two analytes were limited to three and two records, respectively. Dissolved metals concentrations were generally low

in comparison to ANZG (2018) DGVs, analytical detection limits for most analytes were not sufficiently sensitive to enable comparison against Yandicoogina Gorge surface water 80 % percentile values (i.e., laboratory Limits of Reporting were higher than the 80 % percentile values in most cases). As such, ANZG (2018) DGVs were used to determine AoC for metals.

MAC groundwater AoC for Yandicoogina Gorge surface water (i.e., exceeding the Yandicoogina Gorge surface water 80 % percentile on over 25% of sampling occasions; 10 or more records) were (Biologic 2023f):

- B – exceeded the 80th percentile on 99% of sampling occasions
- HCO_3 - exceeded the 80th-percentile on 29% of sampling occasions
- Mg – exceeded the 80th percentile on 32% of sampling occasions
- N_NO_3 – exceeded the 80th percentile on 99% of sampling occasions
- pH – exceeded the 80th percentile on 66% of sampling occasions
- Zn – exceeded the ANZG (2018) DGV on 26% of sampling occasions.

Elevated nitrate is considered likely to occur in the receiving environment, as 99% of nitrate (N_NO_3) values exceeded the Yandicoogina Gorge groundwater 80 % percentile. Nitrate is both a stressor, leading the eutrophication at lower concentrations, and a toxicant, at higher concentrations leading to direct toxicity (ANZG 2018). Less than 1% of N_NO_3 values in MAC groundwater, however, exceeded the ANZG (2018) DGV for toxicity (2.1 mg/L). High water hardness also ameliorates nitrate toxicity in Pilbara waters (Van Dam *et al.* 2022).

As detailed in Section 7.3.3, for PFOS no exceedances of the ecological 99% species protection limit (0.0091 $\mu\text{g/L}$) were recorded in groundwater monitoring and groundwater production bores within the Development Envelope and most groundwater samples were recorded below the laboratory limit of detection.

Increased availability of nutrients from groundwater (compared to surface water) leading to an excess of algal and aquatic plant growth may indirectly trigger eutrophic conditions in pools. For supplementation, the risk assessment found that the AoPC of N_NO_3 , was deemed to pose a low eutrophication risk to Yandicoogina Gorge surface water pools (Biologic 2023f).

Combined Proposal

There are currently no discharges to Yandicoogina Gorge as part of the Approved Proposal.

There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal for this potential impact due to the isolated location of this scheme.

7.6 Mitigation

7.6.1 Mitigation hierarchy

The Proponent is committed to ensuring that the Combined Proposal avoids or minimises, where practicable, impacts on water-related environmental values known within the Development Envelope and downstream receiving environments.

The following section describes how the EPA mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during the Proposal design to develop appropriate mitigation and management strategies to address the key potential impacts on Inland Waters (as listed in Section 7.5). Mitigation is proposed to protect the key environmental values associated with inland waters, where mitigation is required to achieve the proposed environmental protection or outcome.

7.6.2 Avoid

To avoid PFAS contamination, the use of chemicals containing PFAS with the Approved Proposal operations has ceased (Old Firefighting Foam was phased out January 2021). No chemicals containing PFAS will be used for the Proposal. The Proposal will avoid the disturbance of any sites where PFAS has been detected.

The GCOSA diversion structure will provide a controlled interception of runoff to prevent flood inundation of the GCOSA. The diversion is intended as a means to avoid an increase in erosion and sedimentation of the OSA as a result of surface water flow from the Mount Robinson catchment.

7.6.3 Minimise

7.6.3.1 Surplus water management

Surplus water management for the Combined Proposal follows a system of preference, prioritising returning water to ground via injection and infiltration is the preferred surplus water management strategy as it will minimise discharge to the broader environment and minimise the overall loss of water from the Development Envelope. Environmental water requirements (Yandicoogina Gorge) and fit for purpose water use is prioritised with the surplus managed through the schemes (from the Proposal and Approved Proposal). BHP Water

The general proposed hierarchy of use for the Proposal is described as follows and locations of each scheme shown in Figure 7-15:

- Provide environmental water requirements to Yandicoogina Gorge via the Yandicoogina GDE Supplementation Scheme
- Fit-for-purpose consumptive uses within the mine site at MAC-SF and at Ministers North (future mine)
- Following this, the schemes are used in the following order of preference:
 - Juna Downs MAR
 - South Flank MAR
 - Northern RAV MAR
 - Runaway Valley Infiltration Ponds.
- Followed by the surface water discharges in Marillana Creek:
 - Lower Marillana Creek Discharge

- Upper Marillana Creek Discharge
- Lastly, the contingency and emergency uses:
 - Central Sediment Basin
 - Western Sediment Basin
 - Pebble Mouse Creek Discharge.

The intention of the surplus water hierarchy is to ultimately reduce the amount of surplus discharge via creek discharge and maximise the amount of water returned to ground.

7.6.3.2 Central Pilbara Water Resources Management Plan

BHP proposes to continue to manage surplus water discharge and dewatering impacts from the Proposal in accordance with the CPWRMP. The endorsed version of the CPWRMP for the Approved Proposal is Version 4.1 (BHP 2021c). BHP has prepared a revised version of the CPWRMP (Version 5.0) to include the Proposal (BHP 2025b; Appendix 8). The CPWRMP is both an outcomes-based and a management-based environmental management plan (EMP) specific to different environmental values and BHP has prepared the CPWRMP in accordance with the EPA's EMP Instructions (EPA 2024c).

BHP will manage the potential impacts to environmental receptors due to changes in the groundwater and surface water regimes from its operations. The management measures and controls are outlined in the CPWRMP (Appendix 8). Table 7-12 summarises the environmental receptor and the proposed approach of the CPWRMP

Table 7-12: Summary of CPWRMP Approach

Environmental Receptor	Approach
Coondewanna Flats	Outcome based approach • triggers and thresholds to associated with monitoring of tree health within the PEC • triggers and thresholds to control groundwater level rise from Juna Downs MAR • triggers and thresholds to limit the wetting front extent from Runaway Valley Ponds
Weeli Wolli Springs	Management approach • monitoring of tree health within the PEC • monitoring of water levels in conjunction with RTIO • ongoing collaboration with RTIO
Ben's Oasis	Management approach • monitoring of tree health within the PEC • monitoring of water levels in conjunction with RTIO
Yandicoogina Gorge	Outcome based approach

Environmental Receptor	Approach
	• monitoring of groundwater levels within the Gorge • monitoring of groundwater levels in the Ministers North aquifer • monitoring of surface water levels in permanent and semi-permanent pools
Upper Marillana Creek & Pools	Outcome based approach • implementation and monitoring of trigger and thresholds for wetting front extent • inspection for calcium precipitate scale • monitoring of riparian vegetation within Upper Marillana Creek • monitoring of Marillana Creek pools

The proposed CPWRMP aims to not overlap commitments from other legislative requirements including under Part V of the EP Act and RiWI Act. The current EP Act licence L7851/2002/6 for the Approved Proposal also contains requirements in relation to the discharge of surplus water (mine dewatering), including monitoring of discharge rates, monitoring of discharge water quality (salinity and other parameters) and annual reporting (of exceedances of trigger values and details of investigations conducted, including outcomes, environmental impacts and remedial actions). BHP is seeking changes to this licence in relation to surplus discharge for the addition of the two MAR schemes and two surface water discharges and amendment to existing discharge locations.

BHP will continue to implement the minimisation measures for surplus water at the hub scale (for the Approved Proposal as part of the Combined Proposal if approved).

7.6.3.3 Northern RAV

For MAR schemes, BHP implements a risk management process for the project development in an accordance with the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) Managed Aquifer Recharge (NRMCC-NHMRC 2009).

Initial Hydrogeological Assessment of MAR for Northern RAV has been conducted by Advisian (2024) to model the basic MAR scenarios to identify areas of mounding. Mounding will be kept below 10 mbgl and monitored to ensure that mounding does not rise above that level.

7.6.3.4 Connection of aquifers

All bores for MAR will be constructed in accordance with Minimum Construction Requirements for Water Bores in Australia (4th Edition, NUDLC 2020). Prior to bore construction a RiWI Act 26D licence to construct will be sought to confirm adherence to best practices.

7.6.3.5 Upper and Lower Marillana Creek Discharge

To limit the impacts to the existing surface water regime, the wetting front at Upper Marillana Creek Discharge will be managed using a trigger location at 24 km and a threshold of 27 km to limit any potential impacts to the Marillana Creek Pools. The proposed creek discharge will also cease discharge on an annual basis for a period of 90 days during the dry season from the Combined Proposal to prevent the creation of a permanently saturated creek bed.

The Lower Marillana Creek Discharge is currently being utilised by BHP Yandi minesite and the Proposal will operate within its licensed limit of 41.1 ML/day.

Both scheme's operational duration has also been limited to a 5-year period after commissioning to further prevent any long-term changes to the Marillana Creek environment.

7.6.3.6 Calcium Carbonate

To prevent the formation of precipitate and scale in creek discharges due to calcium carbonate, BHP proposes to treat dewatering discharge water within the Development Envelope prior to discharge to either the north-west or north-east scheme. The treatment method proposed is to promote carbon dioxide degassing of the water and drive out the calcium carbonate to precipitate.

For the north-east scheme the following is proposed:

- treat all water reporting to the A Deposit Turkey's Nest (starting point of the north-east scheme pipeline)
- the existing turkey's nest will be used to achieve the required detention time and capture the precipitate
- this central point of treatment will be easier to operate and maintain (rather than treating at each individual discharge point)

For the north-west scheme the following is proposed:

- treat all water reporting to E Deposit Turkey's Nest suitable for creek discharge
- existing turkey's nest used to achieve the detention time and capture the precipitate
- this central point of treatment within the mining operations will be easier to operate and maintain.

7.6.3.7 Changes to surface water quality from clearing and construction of the pipeline

The route for infrastructure crossing of Creek, upstream of the gorge has been chosen based on pre-disturbed area for a creek crossing track, to ensure limited further disturbances to the creek

Use best management practices, including construction outside of foreseen wet periods, physical barriers for sediment control during construction and ongoing management to prevent any increase in sediment within the creek.

7.6.4 Rehabilitation

7.6.4.1 Decrease in water table at Weeli Wolli Spring

The Central Pilbara Hydrogeological Assessment (BHP 2025a) included an assessment of the likely mitigation requirements at Weeli Wolli Spring. This was based on the assumption that successful long-term mitigation will result from returning groundwater levels within the Weeli Wolli Spring and Hope Downs aquifer compartments to pre-development conditions (no anthropogenic influence). The assessment showed that:

- The publicly available RTIO Hope Downs mitigation strategy is insufficient to account for the Hope Downs proportion of impacts at the spring.
- To fully account for Hope Downs impacts, the RTIO mitigation strategy was adjusted within the 20-year post closure timeframe (2025 to 2045). The creek discharge was increased from 20 ML/d to 28 ML/d and MAR was increased from 20 ML/d to 55 ML/d.

- Assuming BHP utilises existing production bores in the vicinity of B and R Deposits for MAR and that the RTIO mitigation is adjusted as described above, mitigation of BHP impacts was achieved with:
 - Injection of 40 ML/d into both B and R deposit (80 ML/d total) from 2041 (when dewatering ceases) to 2045. This equates to a total volume of 146 GL.
 - Then, injection of 12ML/d at both B and R deposits (24 ML/d) from 2046 to 2051. This equates to a further 53 GL.

This mitigation strategy results in an increase in the predicted dewatering rate at R and B Deposits.

7.6.4.2 Backfill options

All below water table pits at the North Flank and Highway Deposit at South Flank will be backfilled to at least 5 m above the pre-mining water level (D deposit and F deposit have already been backfilled to pit crest). Backfilling of pits at Highway deposit at South Flank is required as part of the Approved Proposal.

The closure strategy for South Flank is to be developed as part of mine closure planning with Traditional Owners and relevant stakeholders.

Recovery of groundwater levels following mine pit closure was modelled and presented in the Central Pilbara Hydrogeological Assessment (BHP 2024a). Two backfill scenarios were simulated, which aligned with the MCP which are:

- All pits backfilled above pre-development water table elevation
- All pits backfilled above pre-development water table elevation with the exception of South Flank pits Vista Oriental and Grand Central which received no backfill.

As the E East 3 / E Central dyke has been mined out, the models were run with this feature removed.

7.6.4.3 Rehabilitation of infrastructure

Decommissioning of pipelines and groundwater bore infrastructure and rehabilitation of ground disturbance footprint will be undertaken at closure.

7.6.5 Other statutory decision-making processes

Table 7-13 summarises whether another statutory decision-making process can mitigate the potential environmental impacts of the Proposal on Inland Waters, considering the EPA's guideline *Taking decision making processes into account in EIA: Interim Guidance* (EPA 2021b).

Table 7-13 also provides reasons, including how, in relation to the specific potential impacts of the Proposal, the decision-making process meets the EPA's objective for Inland Waters.

Table 7-13: Inland Waters - other statutory decision-making processes

Potential impact from the Proposal	Statutory decision-making process can mitigate impacts on the environment?	Reasons (if Yes)
Changes to groundwater regimes from groundwater abstraction (dewatering)	Yes	RIWi Act 5C licence to take water - Licence specifies location of groundwater abstraction, maximum abstraction rate and compliance requirements - Operating Strategy (licence condition) specifies abstraction, monitoring and reporting details - Licence contains outcome-based conditions (including operating strategy) that can maintain the hydrological regimes of surface water to protect environmental values, to meet the EPA's objective for Inland Waters
Connection of aquifers from drilling	Yes	RIWi Act 26D licence to construct a groundwater well - Licence specifies location and purpose of well - Confirms well construction - Requires confirmation of subsurface geology and depth of well
Changes to groundwater and surface water regimes from discharge of surplus water	Yes	EP Act Part V licence - Licence specifies location of surplus discharge, discharge rate limit, monitoring locations and parameters, triggers, reporting and compliance requirements - Licence contains outcomes-based conditions that can maintain the hydrological regimes of groundwater and surface water to protect environmental values to meet the EPA's objective for Inland Waters.
Changes to water quality from discharge of surplus water	Yes	EP Act Part V licence - Licence specifies location of surplus discharge, discharge rate limit, monitoring locations and parameters (rates and water quality), triggers, reporting and compliance requirements - Licence contains outcomes-based conditions that can maintain the groundwater quality to protect environmental values to meet the EPA's objective for Inland Waters Contaminated Sites Act (CS Act) The CS Act was developed to manage the legacy of contamination resulting from spills, leaks and past waste disposal practices. It complements (rather than duplicates) the measures in the EP Act aimed at preventing pollution and

Potential impact from the Proposal	Statutory decision-making process can mitigate impacts on the environment?	Reasons (if Yes)
		environmental harm. Contamination at mine sites should only be reported where: • There are grounds to suspect contamination • There is known contamination
Changes in surface water quality due to increased sediments	Yes	RiWi Act Bed and Banks Permit • Permit ensures health and wellbeing of a watercourses ecology Licence contains outcome-based conditions (including operating strategy) that can maintain the hydrological regimes of surface water to protect environmental values, to meet the EPA's objective for Inland Waters

7.7 Assessment and significance of residual impacts

7.7.1 Changes to groundwater regime from groundwater abstraction for mine dewatering

Groundwater drawdown

The drawdown from the Proposal will have a residual impact on the local groundwater regimes and shown in Figure 7-16.

Abstraction of groundwater from the local aquifers will be from existing and future production bores installed across the Development Envelope to service mine construction and operation phases. During the life of the mine the groundwater levels will be depressed within the extent of the groundwater catchment (as defined by the Central Pilbara Hydrogeological Assessment (BHP 2025a).

Groundwater abstraction will be undertaken in accordance with the RiWi Act and abstraction will be monitored in accordance with 5C licence(s) issued under the RiWi Act.

Drawdown of groundwater in areas of significant ecosystems is managed under outcome based and objective based plans in the CPWRMP. Further discussion on the significance of the residual impacts of environmental receptors is presented in the following sections.

Groundwater drawdown at closure

The residual impacts are presented below as two potential scenarios at closure: backfilling of all pit voids above the water table and backfilling all pit voids above the water table except Grand Central and Vista Oriental (in South Flank). Numerical modelling results in Appendix 7 (BHP 2025a).

Backfilling all pit voids (along with mitigation) should result in water levels returning to a pre-development state in the area of Weeli Wolli Spring. In the areas of North Flank, South Flank and Coondewanna Flats, the removal of the dyke (between E East 3/Central E) may have some impacts. In more detail:

- Increasing the heads by:
 - Approximately 4 m in the E East 3 compartment (Area 5 on Figure 7-11)
 - Between 1.0 m and 2.5 m in the C/A compartment (Area 6 on Figure 7-11)
 - Between 0.1 m and 0.0 m in the Weeli Wolli Spring area. However, this is likely beyond the level of accuracy the numerical model is capable of.
- Decreasing the heads by:
 - Between 5 m and 8 m in the Central E compartment (Area 4 on Figure 7-11)
 - Between 3 m and 4 m in the area of Coondewanna Flats
 - By approximately 4 m in the South Flank compartment.

No backfilling of pit voids at the Grand Central and Vista Oriental pits is predicted to cause a permanent reduction in heads throughout the catchment, driven in this scenario mostly by the depths of the GC2, VO1, VO4a and VO6 pits. In more detail, the modelling suggests that water levels are permanently drawn down (compared to pre-development observations):

- in the South Flank Valley aquifers by between 40 and 50 m
- in the Coondewanna Flats compartment by 5 and 10 m

- in the North Flank Valley aquifers:
 - between 5 and 10 m in E West and E Central
 - less than 1 m in C and A Deposits.
- in the Hope Downs aquifers between 1 and 2.5 m
- in the Weeli Wolli Spring area by less than 0.25 m.

Simulations with the backfilled pit scenario using the time variant model suggest that full recovery of the system (whatever the backfill scenario) will take several hundreds of years. Given the high uncertainty in many factors underpinning this prediction over this time scale (climate most importantly) any more detail in these predictions at this time would be misleading.

Time for full recovery will depend on which backfill strategy is used and on climatic conditions (rainfall and evaporation). With the BHP and RTIO MAR and creek discharge simulated with the mitigation model, recovery will be rapid in the area of Weeli Wolli Spring and the Hope Downs aquifer compartment (i.e. full recovery by 2060). In the other areas of the catchment however, with the assumption that no mitigation will occur in here, recovery will be much slower. The uncertainties are too great to define this to any degree of accuracy at this stage, but it is clear that the recovery in the Coondewanna Flats, North Flank and South Flank compartments will be measured in centuries.

Drawdown of groundwater in areas of significant ecosystems is managed under outcome based and objective based plans in the CPWRMP. Further discussion on the significance of the residual impacts of environmental receptors is presented in the following sections.

Coondewanna Flats

Modelling predicts that drawdown beneath below Coondewanna Flats will peak between 64 to 98 m At GWB0039M and up to 100 and 110 m in the southeast area in the worst case scenarios as a result of the Combined Proposal. The Coondewanna Flats ecosystem is understood to be a surface water system relying on rainfall and surface flows to maintain its health. Therefore, drawdown is not predicted to result in any impact to the availability of surface water.

Monitoring of groundwater levels and associated tree health will continue at Coondewanna Flats as part of the CPWRMP.

Groundwater abstraction will be undertaken in accordance with the RiWi Act and abstraction rates and groundwater elevation will be monitored in accordance with 5C licence(s) issued under the RiWi Act.

Weeli Wolli Spring

Up to 2045 the drawdown at Weeli Wolli Spring in the Combined Proposal is predicted to be between 2.4 to 5.6 m. This is within what was predicted in the Approved Proposal (3 to 14 m) and there are therefore no residual impacts predicted beyond what has been approved.

The significance of residual impacts within Weeli Wolli Spring are currently dependent on combined mitigation from both RTIO Hope Downs and MAC-SF as outlined in Section 7.6.4.1. Predictive modelling shows that BHP and RTIO MAR and creek discharge is an effective mitigation strategy, with recovery to pre-development conditions in the area of Weeli Wolli Spring and Hope Downs aquifer by 2060.

Groundwater abstraction will be undertaken in accordance with the RiWi Act and abstraction will be monitored in accordance with 5C licence(s) issued under the RiWi Act. The drawdown of groundwater within Weeli Wolli Spring will be managed under management-based outcomes in the CPWRMP. If mitigation strategies, including those outlined in Section 7.6.3 are implemented and which involve an increased discharge rate from RTIO Hope Downs, and MAR in B and R deposit at MAC-SF, then significant residual impacts are unlikely.

Through the management of water abstraction in accordance with the RiWi Act and the implementation of mitigation strategies at Weeli Wolli Spring, residual impacts to groundwater from the Proposal are not considered significant.

Ben's Oasis

Conceptual modelling of the hydrogeology around Ben's Oasis, as presented in the Central Pilbara Hydrogeological Assessment (BHP 2025a), indicated that drawdown is unlikely. However, groundwater modelling predicts that the maximum drawdown is approximately 21 m on the upstream side of the dyke. BHP will therefore continue monitoring Ben's Oasis consistent with the CPWRMP to confirm the conceptual hypothesis regarding the functioning of the dyke as a flow barrier.

7.7.2 Changes to groundwater regimes from discharge of surplus water (mounding)

The groundwater mounding from the proposal will result in the following residual impacts.

- Northern RAV MAR: localised mounding at the location of the MAR scheme. Groundwater levels to be maintained at 10 mbgl. No anticipated impact to environmental receptors.
- Groundwater mounding is the objective at the Yandicoogina GDE Supplementation Scheme to recover groundwater levels and support the GDE from a recent decline. Localised mounding is anticipated but unlikely to impact environmental receptors.

As a result of management of water discharge to meet the requirements of the Part V licence of the EP Act (item 6, Schedule 1 of EP Regs 1987), there is not considered to be any significant residual impacts.

7.7.3 Connection of aquifers from drilling

BHP propose to follow the best practice guideline in groundwater drilling, as such there is unlikely to be residual impact to the connection of aquifers from drilling.

7.7.4 Change in groundwater quality from MAR/Supplementation Schemes

Changes in groundwater quality may arise in the Development Envelope as a result of Northern RAV MAR Schemes and Yandicoogina Gorge that use infiltration or injection bores. There are no significant differences in physical and chemical properties between the source water and the receiving environment.

The Schemes will be managed through the Part V licence of the EP Act, and groundwater mounding in significant ecosystems are managed under outcome and objective based commitments in the CPWRMP. As such, there are not considered to be any significant residual impacts.

Change in groundwater quality: Yandicoogina GDE Supplementation Scheme

Changes in groundwater quality may arise within Yandicoogina Gorge due to the proposed Groundwater Supplementation Scheme that uses injection bores. Where there are significant differences in physical and chemical stressors between the source water and the receiving environment, deterioration of water quality may occur.

A water quality assessment (Biologic 2023f) was conducted on the source water (MAC) and receiving environment (Yandicoogina Gorge) which is discussed in Section 7.5.7. The assessment reported analytes within source water which recorded a high proportion of values outside of the 80th percentile and 20th percentile within the receiving environment, which are considered likely to present a risk of disturbance (ANZG 2018). The analytes exceeding the 80th percentile reported in the assessment, their risk, and mitigating factors are presented in Table 7-14.

Table 7-14: AoPC risks presented in the Water Quality Assessment

Analyte	Frequency above 80 %-ile	Risk	Mitigating Factors
pH	66	Negligible	- MAC median pH (7.7) only marginally above the Yandicoogina Gorge (YG) groundwater (GW) median (pH 7.3) - Median pH well below the YG GW maxima (pH 8.4) - pH does not appear to be increasing over time in MAC GW - Groundwater pH of the local area (Yandicoogina/Weeli Wolli Creek catchment areas) typically neutral to basic (>7.5) - Stygofauna unlikely to be affected by slight increase in pH
Ions (CaCO₃, Mg, SO₄)	CaCO ₃ : 75 Mg: 82 SO ₄ : 85	Negligible	- None of these analytes appear to be increasing significantly over time in MAC GW - Toxic effects of Mg likely to be ameliorated due to high water hardness and high Ca in MAC and YG GW - The above could be confirmed by ecotoxicity testing - Ongoing monitoring of ions and hardness should continue for early detection of changes in composition - Stygofauna community unlikely to be impacted by shifts in ionic composition; salinity a more important factor
N_NO₃	95	Negligible	- Eutrophication will not occur in GW; absence of light a limiting factor for eutrophication - Some nitrate may be taken up / assimilated in the GW environment before surface expression - Direct toxicity unlikely; less than 1% of N_NO₃ values exceed the ANZG toxicity DGV (2.4 mg/L) - N_NO₃ does not appear to be increasing over time in MAC GW - Ongoing monitoring of N_NO₃ should continue for early detection of increases above toxicity levels - Phosphorus more likely to be the limiting growth factor for algae, rather than N_NO₃
B	99	Negligible	- Toxicity unlikely as no dissolved boron values exceeded the 95% ANZG toxicity DGV (0.94 mg/L) - Boron does not appear to be increasing over time in MAC GW - Stygofauna typically less sensitive to metals toxicity due to slow metabolic rates

Analyte	Frequency above 80 %-ile	Risk	Mitigating Factors
EC	32	Negligible	- Relatively low exceedance percentage (32%); significant shifts in EC therefore unlikely - MAC median (612 $\mu\text{S/cm}$) and mean (611 $\mu\text{S/cm}$) below YG GW 80th percentile (650 $\mu\text{S/cm}$) - TDS (analogue for salinity) not flagged as an AoPC; all values well below 1,500 mg/L (concentration at which impacts to stygofauna are expected) - Ongoing monitoring of EC should continue for early detection of salinity increases

Source: Biologic 2023f

The MAR and Supplementation Scheme will be managed through the Part V licence of the EP Act, and as all analytes outside of the 80th percentil are considered negligible, there is not considered to be any significant residual impacts.

Change in surface water quality due to Yandicoogina GDE Supplementation Scheme

Indirect impacts to surface water quality may arise because of the Yandicoogina GDE Supplementation Scheme due to surplus water reaching the pools within the Gorge. The Water Quality Assessment (Biologic 2023) found that the majority of AoPCs pose a negligible risk to surface water environmental receptors, with the exception of N₂O. Increased concentrations of N₂O may lead to eutrophication characterised by an excess of algal and aquatic plant growth. The risk of eutrophication due to the Yandicoogina GDE Supplementation Scheme is considered to be low in surface water pools. As such, significant residual impacts are unlikely.

7.7.5 Change to surface water regime from surplus water discharge (creek discharge)

Upper Marillana Creek

The Proposal is anticipated to create a semi-permanent wetting front extending up to a maximum of 27 km during natural no flow events, downstream of the discharge point which will alter the existing surface water hydrology of the creek by establishing creek flow in the absence of rainfall. The anticipated maximum flow is 30 ML/day which will restrict flows to the existing creek bed. The wetting front will be monitored and managed to this distance to prevent any residual impacts from surface water flow to existing semi-permanent pools in Marillana Creek and Flat Rocks.

Both the trigger and threshold locations as shown in Figure 7-19 are located prior to the confluence of Upper Marillana Creek (Tributary of Marillana Creek) with Marillana Creek. Between the trigger and threshold points is Marillana Creek Pool MarC1 a semi-permanent pool within the Upper Marillana Creek.

The existing hydrology of the MarC1 pool would be characterised by seasonal inundation and connectivity to the creek bed during the wet season. There may be residual impact to this pool as it sits inside the proposed wetting front extent, and it is possible that it would be subject to inundation but would have a 90-day period during the dry season where it would not receive flows from creek discharge.

There will be no impacts to the remaining pools identified in Marillana Creek including Flat Rocks as the wetting front will not reach this extent through the application of monitoring and management measures.

After the 5-year operational period from commissioning, any surface water disturbances would be remediated.

In summary, there is residual impact anticipated to the surface water regime of the Upper Marillana tributary with an increase in flow within the main creek channel outside of rainfall events and natural creek flow events, and potential intersection of the wetting front with pool MARC1. There are no residual impacts anticipated to the remaining pools identified in Marillana Creek. BHP acknowledges that the use of creek discharge is considered significant to Banjima People and the implementation of mitigation measures will reduce any potential impacts to impacts to culturally significant areas (further discussed in Section 11).

Lower Marillana Creek

Discharge to Lower Marillana Creek is currently approved and operational consistent with L6168/1991/11 and has been operating for approximately 15 years for the existing BHP Yandi Operations. The Proposal is anticipated to have no changes to the approved discharge volume but to include surplus water from the Proposal at this location. Consequently, residual impacts as a result of the Proposal are minimal to Lower Marillana Creek.

BHP acknowledges that the use of creek discharge is considered significant to Banjima People, the implementation of mitigation measures will reduce potential impacts to culturally significant areas (discussed in Section 11).

Any surface water disturbances would be remediated on closure as part of the MCP, noting some changes may remain if considered appropriate for post mining land use.

7.7.6 Changes to surface water quality from surplus water discharge to creek

Implementation of trigger and threshold wetting front extents at Marillana Creek limit potential impacts to surface water quality pools in Upper Marillana Creek to MARC1 pool. Table 7-15 shows the mean water quality results collected at MARC1 biannually pool between dry season 2020 and wet season 2023 by Biologic in comparison to groundwater quality from the Approved Proposal (as summarised in Biologic 2023b).

The below water quality comparison can be summarised as follows:

- pH at MARC1 is neutral with a mean pH of 7.5 and is comparable to the water quality in the Approved Proposal with mean pH of 7.6 ranging from 5.6-8.8.
- EC at MARC1 is between 1,463-1,590 $\mu\text{S}/\text{cm}$ with a mean of 1,542 $\mu\text{S}/\text{cm}$ whereas the Approved Proposal EC is between 70 -110 $\mu\text{S}/\text{cm}$ with a mean of 610 $\mu\text{S}/\text{cm}$. EC in pools can vary widely based on seasonal rainfall patterns and evaporation. Results indicate that all groundwater quality is fresh.
- Hardness and alkalinity in MARC1 are comparable or slightly higher than those observed in the Approved Proposal, indicating there is unlikely to be any increase in hardness.
- Concentrations of metals are comparable between the Approved Proposal and MARC1 with no values exceeding ANZ DG 95% protection of species.
- Nutrients are generally higher in the mean groundwater quality from the Approved Proposal than those at MARC1. There is a low risk of eutrophication occurring within the pool MARC1 which will be managed through further monitoring as part of the CPWRMP (BHP 2025b).
- *Draft toxicant default guideline values for aquatic ecosystem protection: Nitrate in freshwater* (ANZG 2024) indicate that in areas with 'hard' water (greater than 150 mg/L CaCO_3), design guideline values for 99%, 95%, 90%, and 80% protection of species levels are 18 mg/L , 29 mg/L , 38 mg/L and 56 mg/L respectively. Nitrate values are well within the 95% protection of species for hard water environments.

Table 7-15: Comparison of Water Quality in MARC1 and the Approved Proposal

AoC	ANZ DGV Level of Protection 95%	MARC1	Mean Groundwater Quality#
pH (pH units)	6-8	7.5	7.6
Electrical Conductivity (µS/cm)	250	1542	610
Turbidity (NTU)	15	4.25	15
TSS		8.5	3.6
Alkalinity (mg/L)		308	204
Hardness (mg/L)		536	247
Sodium (mg/L)		81.95	30
Aluminium (mg/L)	0.055	0.005	0.006
Arsenic (mg/L)	0.024	0.001	0.001
Barium (mg/L)		0.124	0.009
Boron (mg/L)	0.94	0.223	0.246
Cadmium (mg/L)	0.0002	0.00005	0.00006
Calcium (mg/L)		90.7	43
Chromium (mg/L)	0.001	0.0002	0.002
Copper (mg/L)	0.0014	0.0002	0.003
Lead (mg/L)	0.0034	0.0001	0.001
Magnesium (mg/L)		75.2	30
Manganese (mg/L)	1.9	0.0954	0.004
Molybdenum (mg/L)		0.0002	0.001
Nickel (mg/L)	0.011	0.0005	0.008
Potassium (mg/L)		11.925	7.1

AoC	ANZ DGV Level of Protection 95%	MARC1	Mean Groundwater Quality#
Selenium (mg/L)		0.0002	0.001
Nitrate as N (mg/L)	2.4	0.01	1.47
Total Nitrogen (mg/L)	0.3	0.235	0.85
Total Phosphorus (mg/L)	0.01	0.027	0.03

Biologic 2023f

An analysis of surplus water quality within the Development Area indicates that there is unlikely to be impacts to surface water quality for the following analytes: pH, salinity, and dissolved metals. The risk of eutrophication because of elevated nutrients is considered low as some attenuation of nitrate in saturated sediments may occur in MARC1 pool. Ongoing monitoring of the pools of Marillana Creek will detect any evidence of eutrophication.

After the water treatment strategy proposed for calcium precipitate there are unlikely to be any residual impacts to surface water quality. Visual inspection for calcium precipitate scale has been included in the CPWRMP (Appendix 8).

7.7.7 Changes in surface water flow regime and quality due to catchment diversion

The implementation of the Proposal will result in the permanent alteration of existing watercourses to not intercept with the GCOSA to remove the risks associated with flood waters encroaching on the OSA. The engineering design of the diversion has maintained the overall hydrologic behaviour of the regional catchments.

As discussed in Section 7.5.7, there are unlikely to be direct or indirect impacts to surface water flows towards Coondewanna Flats or Pebble Mouse Creek. The potential reduction in surface water availability from loss of catchment due to the Proposal is predicted to be up to 0.55%, for the Coondewanna Catchment and 0.06% for Weeli Wolli Catchment. A reduction in catchment area of less than 5% is within the natural variation of seasonal rainfall runoff. This is not considered a significant reduction in catchment area on a local or regional scale, particularly given the highly seasonal nature of streamflow in the Pilbara, as well as the annual variability of rainfall. Therefore, there is unlikely to be any significant impacts on surface water catchments from the Proposal.

There is unlikely to be a significant residual impact on sediment load and transport as a result of the diversion as flow velocities have been maintained from the existing conditions and informed the design of the diversion.

7.7.8 Changes in surface water and groundwater quality due to mining activities

Indirect impacts to groundwater quality due to mining activities are outlined in Section 7.5.7, and include impacts due to AMD, PFAS and nitrate. The risks from AMD due to BWT mining is considered to be low, and as such, there is not likely to be any residual impacts.

As outlined in Section 7.5.7, there is likely PFAS impacted groundwater within the SF orebodies from washdown of emergency vehicles. Due to the distance of approximately 18 km to closest sources, the levels of impact are expected to be negligible. The presence of PFAS impacted groundwater will be managed in line with the PFAS NEMP 2020 guidelines (HEPA 2020), and as such, there is not likely to be any residual impacts.

7.7.9 Increased sediments in surface water from infrastructure and drainage

After the application of best management practices in construction and clearing near waterways, it is unlikely that there will be any residual impacts to water quality.

7.7.10 Mounding in aquifers associated with Marillana Creek (Upper and Lower)

Mounding in aquifers associated with surplus discharge is expected to occur in Lower Marillana Creek consistent with the existing Part V licence L6168/1991/11.

In Upper Marillana Creek, it is likely that surplus discharge will infiltrate into the underlying channel iron deposit aquifer and create temporary mounding. During rainfall events over the proposed 5-year operation of the scheme there may be increased water discharging downstream in the MarC2 pool and the Flat Rocks area (MarC6).

MarC2 may experience a greater water permanence as a result of the additional recharge but should water levels exceed the pools capacity, flow will be contributed to Marillana Creek.

Given the Flat Rocks (MarC6) is currently experiencing low water levels the additional recharge could potentially improve the ecosystem. The residual impact due to groundwater mounding could be result as a positive increase to depressed groundwater levels in the area.

7.7.11 Changes in surface water quality in Yandicoogina Gorge due to the Yandicoogina GDE Supplementation Scheme

It is unlikely that there will be residual impacts to surface water quality in Yandicoogina Gorge based on the analysis of source water from the Development Area and analysis of existing water levels in the Gorge. Water quality monitoring of the pools will be undertaken regularly to determine any potential changes through the implementation of the CPWRMP.

7.7.12 Significant residual impacts

Following the application of the mitigation hierarchy (Section 7.5) and applying the Residual Impact Significance Model in the WA Offsets Guidelines (Government of Western Australia 2014), BHP considers that there is no significant residual impact to Inland Waters from the Proposal. Whilst impacts are not considered significant to the Inland Water factor, they do have the potential to result in significant indirect impacts to other factors which are considered in Sections 8, 9, 10 and 11. See Section 7.7 for the discussion on the outcomes relating to the identified residual impacts of the Combined Proposal and BHP's proposed assurance (regulation) and monitoring, where required.

7.8 Environmental outcomes

An environmental outcome, in the context of the EIA, is the state of the environment at a point in time during implementation or after a Proposal has been implemented. Environmental outcomes:

- reflect specific and measurable environmental states
- define a clear boundary, size, extent, or limit
- are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes and objectives that apply to Inland Waters are set out below.

Table 7-16 summarises the environmental outcomes, proposed regulation, and proposed monitoring (if required) for each residual impact for Inland Waters. Detail of the proposed monitoring is set out in the CPWRMP and other relevant statutory decision-making documents discussed in Section 7.6. Table 7-16 demonstrates how the proposed environmental outcomes for the Proposal, together with the proposed regulation and monitoring, are consistent with the EPA's objective for Inland Waters.

As required by the EPA's ERD Instructions, for Significant Amendments, BHP has included information about the existing implementation conditions for the Approved Proposal (Appendix 6). BHP considers that the EPA should inquire into the Approved Proposal implementation conditions (relating to Inland Waters), as provided for under s40AA(3), as part of the assessment of the Proposal under s40 and in the EPA's assessment report required under s44, for the following reasons:

- there are multiple conditions relating to Inland Waters in the Ministerial Statement MS1072 for the Approved Proposal
- to contemporise the conditions to reflect the contemporary condition setting approach (in recommended conditions in EPA Reports and Ministerial Statement since early 2023).

Table 7-16: Inland Waters - Environmental outcomes, proposed regulation and monitoring

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed monitoring	Consistency with EPA objective
Increase in groundwater abstraction for dewatering. Decrease in groundwater levels (drawdown) from dewatering	Groundwater levels in the regional aquifer will be maintained outside the predicted drawdown extent.	Condition A1 Limitations and Extent of Proposal Limit on rate of annual groundwater abstraction for the Combined Proposal. Condition B1 Inland Waters (1) no reduction in the extent of each of the following components of the Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats: (a) Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats: (b) Coolibah and mulga woodland over lignum and tussock grasses on clay plains (2) no reduction in the extent of the Weeli Wolli Spring occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal (3) no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal RiWi Act 5C licence to take water Amendment to existing licence GWL110044(12) - limit on rate of annual groundwater abstraction - condition – GWOS	RiWi Act 5C licence to take water Groundwater Operating Strategy will set out monitoring requirements Condition B1 Inland Waters Groundwater level monitoring outlined in the CPWRMP Version 5 (BHP 2025)	Subject to regulation (EP Act Part IV Condition and RiWi Act Licence), the environmental outcome is likely to be consistent with the EPA's objective

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed monitoring	Consistency with EPA objective
		conditions – groundwater monitoring reviews		
If any pit voids are left open (Grand Central and Vista Oriental) post-mining pit lakes will form. Recovery of groundwater levels lower than pre-development.	Post mining reduction in groundwater levels in the orebody and regional aquifers.	Condition B6 Decommissioning and Rehabilitation Implementation of the MCP (BHP 2024)	Condition B6 Decommissioning and Rehabilitation Continue monitoring outlined in the MCP (BHP 2024)	Subject to regulation (EP Act IV Condition) the environmental outcome is likely to be consistent with the EPA's objective.
Increase in groundwater levels from discharge of surplus water (Northern RAV and Yandicoogina GDE Supplementation Scheme)	Increase in current groundwater levels in the vicinity of the MAR/Supplementation Scheme.	Condition B1 Inland Waters No increase in groundwater levels and pool water levels in Yandicoogina Gorge beyond historical recorded levels. EP Act Part V licence Amendment to existing licence (L7851/2022/6): - add Yandicoogina Gorge as a surplus discharge location - add Northern RAV as a surplus discharge location - amend conditions to include monitoring at this location - limit on surplus discharge from the Combined Proposal to 10 ML/day to Yandicoogina GDE Supplementation Scheme. - limit on surplus discharge from the Combined Proposal to 20 ML/day to Northern RAV MAR	Condition B1 Inland Waters Groundwater level monitoring outlined in the CPWRMP Version 5 (BHP 2025b) EP Act Part V licence Licence conditions will set out monitoring requirements	Subject to regulation (EP Act Part IV Condition and EP Act Part V) the environmental outcome is likely to be consistent with the EPA's objective.

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed monitoring	Consistency with EPA objective
Potential changes in groundwater quality	Groundwater quality is expected to will remain within existing groundwater quality range.	EP Act Part V licence Amendment to existing licence (L7851/2002/6): - add Yandicoogina GDE Supplementation Scheme as a surplus discharge location - add Northern RAV MAR as a surplus discharge - amend conditions to include monitoring at this location	EP Act Part V licence Licence conditions will set out monitoring requirements	Subject to regulation (EP Act Part V) the environmental outcome is likely to be consistent with the EPA's objective
Change in surface water flow regime	Temporary change to surface water regime as a result of creek discharge	Condition B1 Inland Waters Monitoring of the wetting front and pools at Upper Marillana considered in CPWRMP Version 5 (BHP 2025b) EP Act Part V licence Amendment to existing licence (L7851/2002/6): - add Upper Marillana Creek as a surplus discharge location - amend conditions to include monitoring at this location include wetting front extent	Condition B1 Inland Waters Monitoring of Marillana Creek Pools and wetting front outlined in the CPWRMP Version 5 (BHP 2025b) EP Act Part V licence Licence conditions will set out monitoring requirements	Subject to regulation (EP Act Part IV Condition and EP Act Part V) the environmental outcome is likely to be consistent with the EPA's objective.
Change in surface water quality due to creek discharge	Temporary change to surface water quality and MARC1 pool.	Condition B1 Inland Waters CPWRMP Version 5 (BHP 2025b) EP Act Part V licence - Amendment to existing licence (L7851/2002/6): - add Upper Marillana Creek discharge point	Condition B1 Inland Waters Surface water quality monitoring outlined in the CPWRMP Version 5 (BHP 2025b) EP Act Part V licence Licence conditions will set out monitoring requirements	Subject to regulation (EP Act Part IV Condition and EP Act Part V) the environmental outcome is likely to be consistent with the EPA's objective.

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed monitoring	Consistency with EPA objective
		amend conditions to include monitoring of Surface Water Pools		
Changes in surface water regime and surface water quality due to catchment diversion	Surface water availability and quality will remain within natural variation of seasonal runoff at the local and regional scale	RiWi Act: Bed and Banks Permit Permit ensures health and wellbeing of a watercourses ecology Standard management practices Design and construct infrastructure according to applicable Australian Standards.	RiWi Act Bed and Banks Permit Permit condition will set out management strategy.	Subject to standard management practices, the environmental outcome is likely to be consistent with the EPA's objective.
Changes to groundwater regimes as a result of surplus discharge.	Temporary change to groundwater regime as a result of creek discharge	Condition B1 Inland Waters Monitoring of the wetting front and pools at Upper Marillana considered in CPWRMP Version 5 (BHP, 2024b)		Subject to standard management practices, the environmental outcome is likely to be consistent with the EPA's objective.

See the Proposal Content Document (Appendix 1) and the proposed implementation conditions (Appendix 6) for the regulation for the Combined Proposal.

8 Flora and Vegetation

8.1 EPA environmental factor and objective

The EPA's objective for the Flora and Vegetation factor is:

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

8.2 Relevant policy and guidance

BHP assessed this environmental factor consistent with the following relevant EPA policies and guidance, as outlined in Table 8-1.

Table 8-1: Flora and Vegetation - policy and guidance

EPA policy and guidance	Consideration of EPA policy and guidance
<i>Environmental Factor Guideline: Flora and Vegetation</i> (EPA 2016a)	- Applied the relevant considerations for environmental impact assessment - Identified the values of flora and vegetation, and their significance - Identified activities that can impact on flora and vegetation - Considered the links with other environmental factors
<i>Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment</i> (EPA 2016g)	Surveys listed in Table 8-2 were undertaken in accordance with the guidance
<i>WA Environmental Offsets Policy</i> (Government of Western Australia 2011) <i>WA Environmental Offsets Guidelines</i> (Government of Western Australia 2014)	- Applied avoidance and mitigation measures to the Proposal - Considered cumulative impacts in the regional context in determining significant residual impact - Quantified the significant residual impact

8.3 Receiving environment

8.3.1 Studies and surveys

A total of 50 flora and vegetation surveys have been undertaken wholly or partially within the Development Envelope. These surveys comprise 31 detailed surveys, 12 targeted surveys, four reconnaissance and three desktop assessments. A complete list and summary of these surveys is provided in Appendix 9. All surveys were completed in accordance with the EPA guidance (relevant at the time of surveying). Surveys undertaken post-2009 have also been completed in accordance with BHP's Vegetation and Flora Survey Procedure (BHP 2018c) that was developed to ensure a consistent approach for all surveys undertaken for BHP.

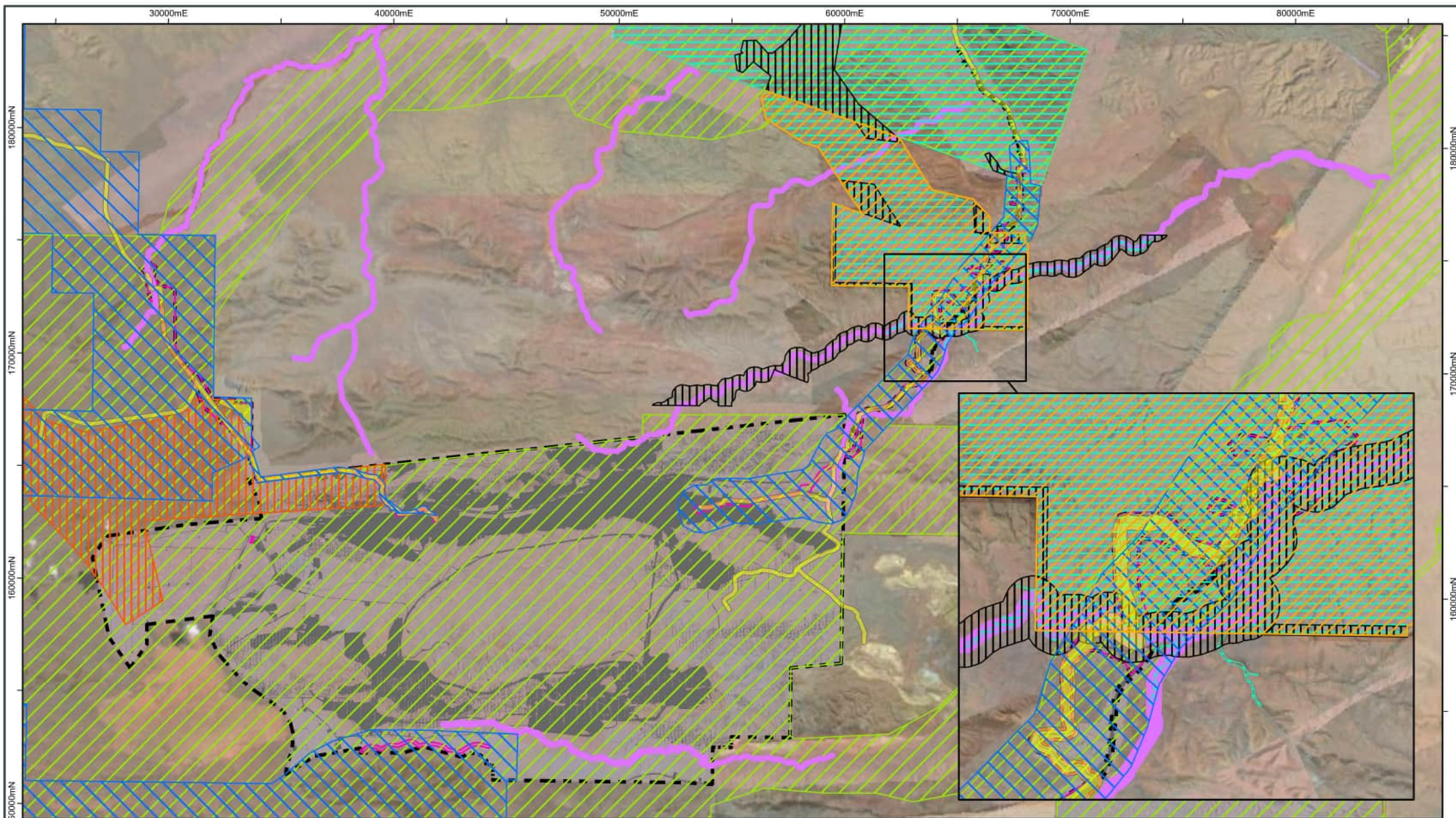
Table 8-2 summarises recent surveys undertaken across the Development Envelope to support the assessment of Flora and Vegetation for the Proposal, and Figure 8-1 shows the location of these surveys. The associated survey reports are provided in Appendix 10 and IBSA data package as Appendix 19.

Some periphery areas of the Development Envelope have minimal or no survey information available due to survey boundary misalignment and age of surveys, with mining commencing at the MAC-SF Operations mine in 2003. Collectively, these areas account for less than 0.1% of the Development Envelope.

Table 8-2: Flora and Vegetation - studies and surveys

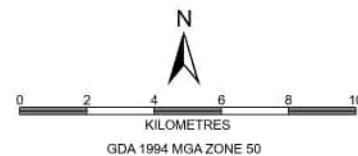
Title	Survey Dates	Summary	Appendix
Central Pilbara Hub Detailed and Targeted Flora Survey (Biologic 2024a)	Nov 2021 Mar 2022 Apr 2022 May 2022 June 2022	A multiple season detailed and targeted flora survey, including targeted GDV survey, to map the vegetation and assess the flora taxa present, or likely to be present, within parts of the Development Envelope (north-eastern, north-western and south-western areas) and covering the majority of the Indicative Footprint. The survey covered a total area of 60,000 ha.	Appendix 10
Ministers North Targeted Significant Flora and Vegetation Assessment (Spectrum 2023)	30 May – 7 June 2023	A single season targeted flora and vegetation assessment to identify any significant flora species or significant vegetation types occurring in the study area. This survey intersected the central portion of the north-east scheme part of the Development Envelope, covering a total of 405 km of targeted traverses.	Appendix 10
Targeted Flora Surveys of Pipeline Corridors (GHD 2022)	Apr - May 2021	Single season targeted flora survey of two pipeline corridors; the Yandi pipeline (north-eastern portion of Development Envelope) and the Pineapple Hill pipeline and, Packsaddle North Infiltration Pond area (north-western portion of Development Envelope). The survey covered a total area of 2,993 ha.	Appendix 10
Ministers North and Yandi Vegetation Association and Condition Mapping (Onshore 2020)	June 2020	Detailed desktop review to consolidate all existing vegetation association and condition mapping across BHP's Ministers North and Yandi tenements and associated infrastructure corridors. The far north-eastern corner of the Development Envelope overlaps this mapping area.	Appendix 10
Ministers North Miscellaneous Licence Area Amendment Surveys and Yandicoogina Creek Detailed Flora and Vegetation Assessment (Biologic 2020a)	Sept 2019 Apr 2020	Two season detailed flora and vegetation survey for Yandicoogina Creek, including the Yandicoogina Gorge area, and a single season detailed flora and vegetation survey and targeted flora survey of additional areas in the Ministers North miscellaneous licence area. Portions of the north-eastern corner of the Development Envelope were included in this study. The Yandicoogina Creek survey covered an area of 1,745 ha. The Ministers North survey covered an area of 2,011 ha.	Appendix 10
Runaway Valley Baseline Vegetation Monitoring Survey (Astron 2020)	Mar 2019 Oct 2019	Two-season baseline monitoring survey, comprising on-ground surveying and remote sensing, to assess the current health and condition of vegetation (specifically Mulga and riparian communities) within the Runaway Valley project area. A section of the north-western corner of the Development Envelope was included in this study.	Appendix 10
Area C West to Yandi Flora and Vegetation Assessment (Astron Environmental 2019)	Nov 2018	A literature and database review of flora and vegetation of five creeklines (Marillana Creek, Pebble Mouse Creek, Yandicoogina Creek, Lamb Creek and Area C North Creekline) within the vicinity of Mining Area C,	Appendix 10

Title	Survey Dates	Summary	Appendix
		South Flank and Yandi operations, to verify existing vegetation mapping, complete vegetation mapping for unmapped areas, and record the occurrence of significant flora species and GDV. Parts of the north-western and north-eastern, as well as southern areas of the Development Envelope were covered by this study. The survey covered a total area of 3,729 ha.	
Consolidation of Regional Vegetation Mapping, BHP Billiton Iron Ore Pilbara Tenure (Onshore 2014a)	2013-2014	Desktop study to consolidate previous vegetation mapping into one consolidated regional Geographic Information System (GIS) database that provides consistency in methods and nomenclature across BHP's Pilbara tenure.	Appendix 10



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Central Pilbara Hub Detailed and Targeted Flora Survey (Biologic, 2024)
- Ministers North Targeted Significant Flora and Vegetation Assessment (Spectrum, 2023)
- Targeted flora surveys of pipeline corridors (GHD 2022)

- Ministers North Miscellaneous Licence Area Amendment Surveys, Sanders Seep and Yandicoogina Creek Flora and Vegetation (Biologic, 2020)
- Runaway Valley Baseline Vegetation Monitoring Survey, March 2019 (Astron, 2020)
- Area C: West to Yandi Flora and Vegetation Assessment (Astron, 2019)
- Ministers North and Yandi Vegetation Association and Condition Mapping (Onshore, 2020)
- Consolidation of Regional Vegetation Mapping BHP Billiton Iron Ore Pilbara Tenure (Onshore, 2014)



BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT FLORA AND VEGETATION SURVEYS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A4: 1:225,000	REQUESTOR: ENVIRONMENT	FIGURE: 8-1
DATE: 17/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-007 RevE

8.3.2 Environmental values

8.3.2.1 Vegetation

Regional Vegetation

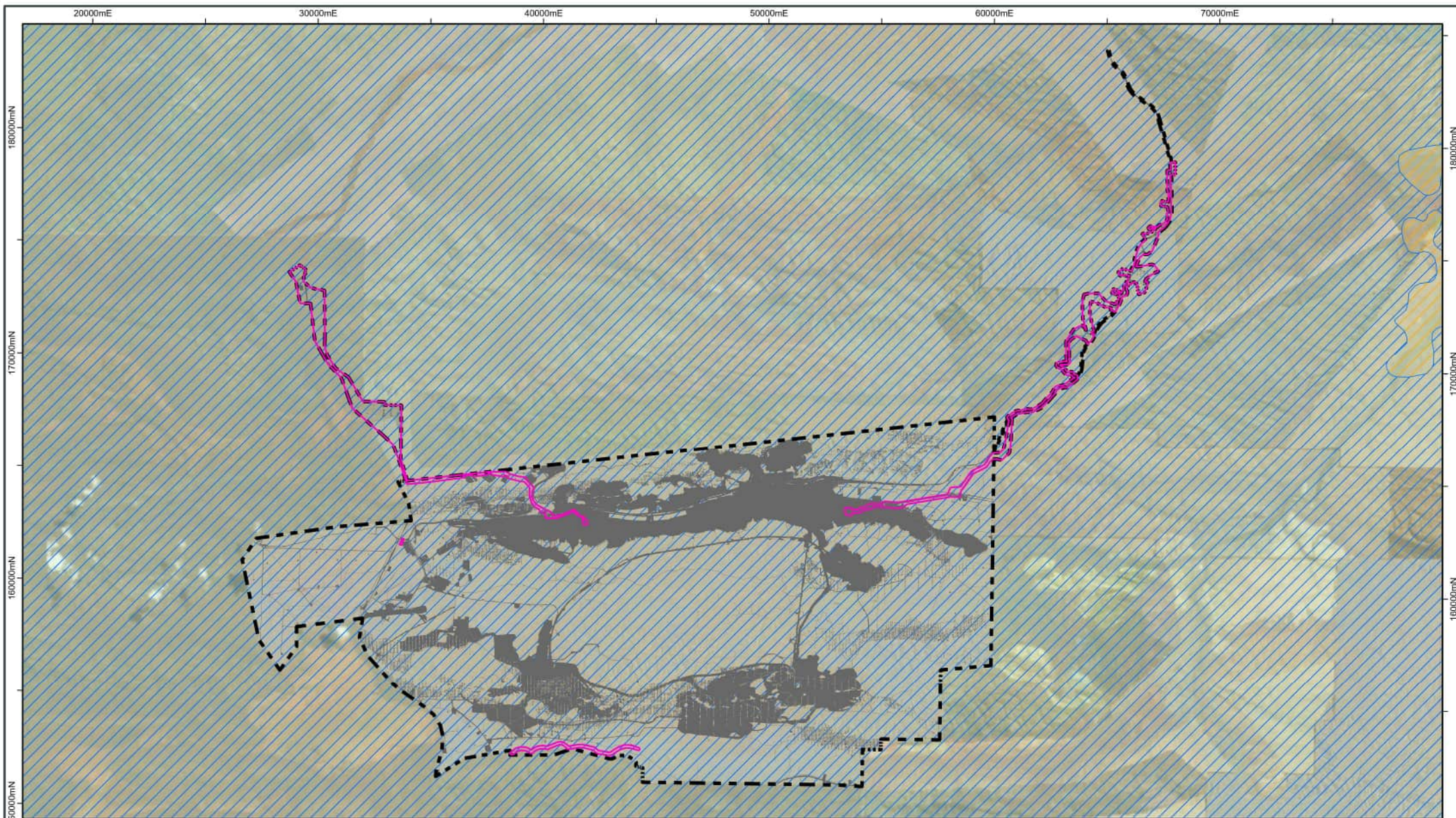
The Development Envelope is located within the Pilbara bioregion as defined by the Interim Biogeographic Regionalisation for Australia (IBRA), and wholly within the Hamersley subregion (PIL3) (DCCEEW 2020) (Figure 8-2). The Hamersley subregion is characterised by mountainous areas of Proterozoic sedimentary ranges (ironstone ranges) and plateaux dissected by gullies and gorges (Kendrick 2001). Mulga low woodland over bunch grasses on fine-textured soils dominates in valley floors, while skeletal soils of the ranges are dominated by snappy gum over *Triodia brizoides*. Drainage is typically into the Fortescue River to the north, the Ashburton River to the south, or the Robe River to the west (Kendrick 2001).

The vegetation of the Development Envelope, as mapped by Beard (1975) and refined by Shepherd et al. (2002), is classified as the following two associations (Figure 8-3):

- Association 18 – low mulga woodland dominated by *Acacia aneura*
- Association 82 – hummock grasslands, low tree steppe and snappy gums over *Triodia wiseana*.

The dominant association in the Development Envelope is association 82, representing approximately 60% of the remaining vegetation in the Development Envelope (Figure 8-3).

The regional vegetation associations that occur within the Development Envelope all have over 99% of their pre-European extent remaining and are not considered regionally significant. The associations are well represented within Western Australia occurring broadly within, or extending beyond, the Pilbara bioregion.



- Indicative Footprint
- Development Envelope
- Existing Disturbance

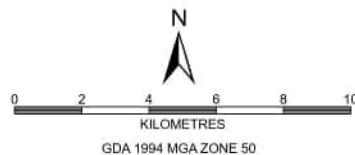
Interim Biogeographic Regionalisation For Australia (IBRA) V7 - Regions

Pilbara

Interim Biogeographic Regionalisation For Australia (IBRA) V7 - SubRegions

Fortescue

Hamersley



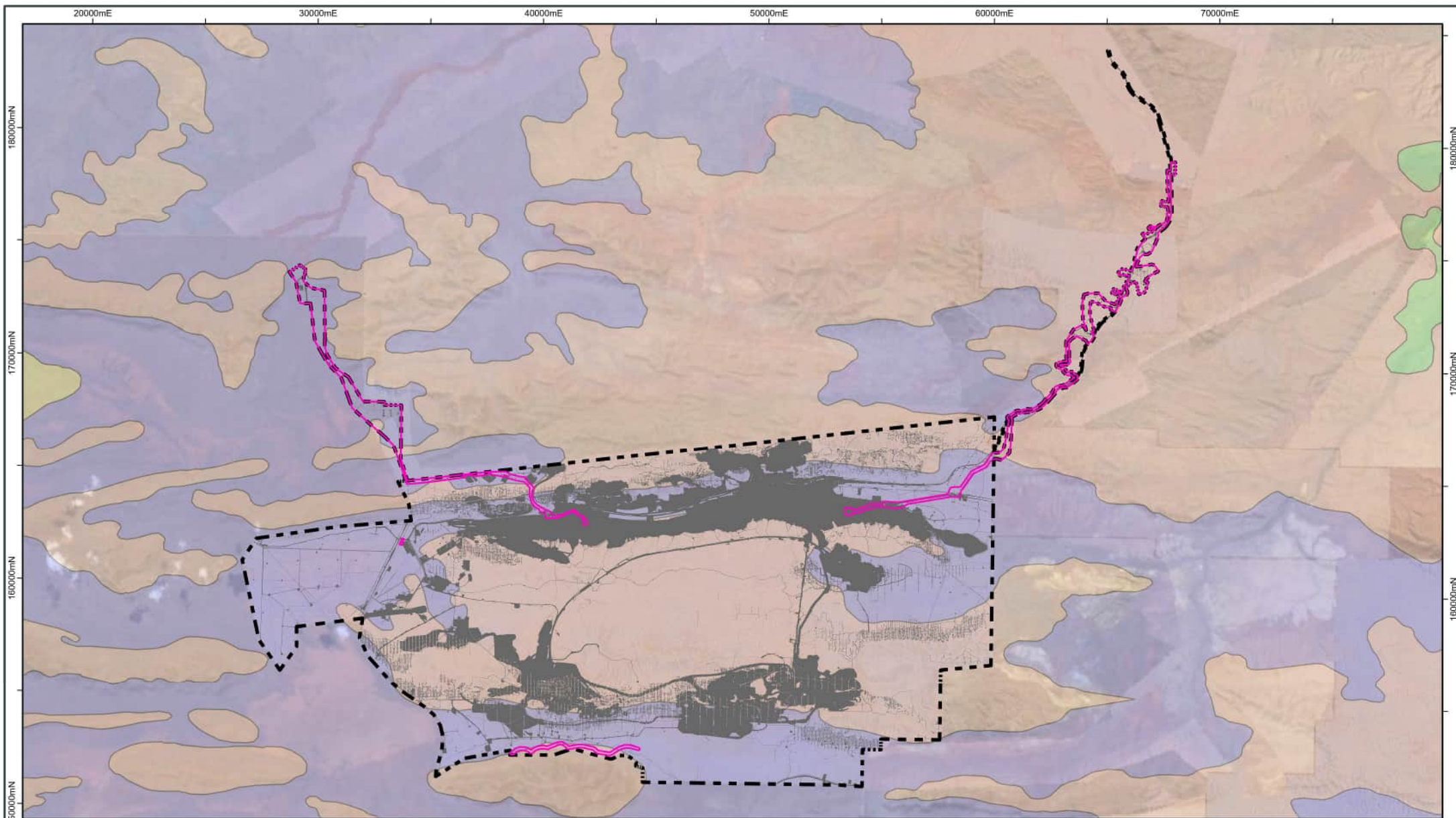
BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT IBRA BIOREGIONS AND SUBREGIONS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

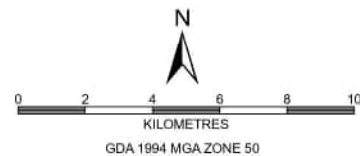
SCALE @ A3:	1:225,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-2
DATE:	17/02/2025	PREPARED:	GEOMATICS	NO:	A1285-008 RevD
		REVIEWED:			



- Indicative Footprint
- Development Envelope
- Existing Disturbance

Beard's Pre-European Vegetation Classification

- Hamersley Association 82 - Hummock grassland with scattered bloodwoods & snappy gum
- Hamersley Association 18 - Mulga *Acacia aneura* and associated species
- Fortescue Valley Association 29 - Mulga *Acacia aneura* and associated species
- Hamersley Association 567 - Hummock grassland with scattered shrubs or mallee



BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT BEARD VEGETATION ASSOCIATIONS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:225,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-3
DATE:	17/02/2025	PREPARED:	GEOMATICS	NO:	A1285-009 RevD
		REVIEWED:			

Local vegetation

A total of 77 vegetation associations, from 24 broad floristic formations have been described and mapped within the Development Envelope (Table 8-3; Figure 8-4).

The majority of these vegetation associations were mapped by BHP in 2014 as part of the consolidation of vegetation mapping which was undertaken across its Pilbara tenements (Onshore 2014a). Some other parts of the Development Envelope have been mapped more recently by nearby intersecting surveys (Astron 2019, Onshore 2020, Biologic 2019b), as well as (Biologic 2024a) which mapped the majority of the Indicative Footprint in 2021 to 2022. Recent mapping has been used in place of the consolidated mapping at these locations. Due to survey area misalignment with lease boundaries, some of the vegetation association mapping around the edges of the Development Envelope is unmapped or has been sourced from previous surveys (Astron 2010a, b; Onshore 2011b). Collectively, these areas account for less than 0.1% of the Development Envelope and are listed as vegetation codes 4a-11d in Table 8-3 (or as 'No survey data' in the impact assessment tables provided in Section 8.4).

The dominant vegetation association of the Development Envelope is *Triodia* Hummock Grassland (HS TsTwTp EllCh AhiAaa), which makes up approximately 27% of the vegetation in the Development Envelope.

A number of vegetation associations are considered locally significant, as identified in Table 8-3, and are discussed in more detail below.

Table 8-3: Vegetation associations within the Development Envelope

Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
10d	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> in red brown loam soils on plains, low rises, foot slopes and spur hill slopes.	None
10e	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia brizoides</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> in red brown clay loam on steep hill slopes and U-shaped gullies.	None
10g	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> and Open Mallee of <i>Eucalyptus kingsmillii</i> subsp. <i>kingsmillii</i> and <i>Eucalyptus gamophylla</i> in red brown loam soils on hill crests and hill slopes.	None
11b	Triodia Open Hummock Grassland	Open Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Open Shrubland of <i>Acacia hilliana</i> , <i>Acacia adoxa</i> var. <i>adoxo</i> and <i>Indigofera monophylla</i> in skeletal orange brown loam soils on hill crests and upper hill slopes.	None
11c	Triodia Open Hummock Grassland	Open Hummock Grassland of <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Open Shrubland of <i>Acacia maitlandii</i> , <i>Acacia adoxa</i> var. <i>adoxo</i> and <i>Corchorus lasiocarpus</i> in red brown loam soils on undulating low hills.	None
11d	Triodia Open Hummock Grassland	Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Very Open Mallee of <i>Eucalyptus gamophylla</i> in red brown loam soils on foot slopes.	None
4a	Eucalyptus/Corymbia Low Woodland	Low Woodland of <i>Corymbia ferritcola</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> and <i>Eriachne mucronata</i> and Open Hummock Grassland of <i>Triodia pungens</i> in red brown loam soils along gorges.	None
4b	Eucalyptus/Corymbia Low Woodland	Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Corymbia hamersleyana</i> over Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Petalostylis labicheoides</i> and <i>Gossypium robinsonii</i> over Open Hummock Grassland of <i>Triodia pungens</i> in red brown loam soils along medium drainage lines.	None
7a	Acacia Open Scrub	Open to Closed Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> and <i>Acacia monticola</i> over Hummock Grassland of <i>Triodia pungens</i> (or Tussock Grassland of <i>Themeda triandra</i>) with Low Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> in red brown loam soils along minor drainage lines.	None
9b	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Aristida lazaridis</i> with Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Acacia aneura</i> var. <i>tenuis</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Eremophila longifolia</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> in red brown clay loam soils on unincised drainage lines and drainage floodplains.	None
9c	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> and <i>Eriachne tenuiculmis</i> with Low Woodland of <i>Corymbia ferritcola</i> , <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over High Shrubland of <i>Petalostylis labicheoides</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia tumida</i> var. <i>pilbarensis</i> in red brown loam soils in dissected medium drainage lines with steep or vertical cliff faces.	None

Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
CP TwTrag Ese AbPIApyp	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia angusta</i> with Open Mallee of <i>Eucalyptus socialis</i> subsp. <i>eucentrica</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Petalostylis labicheoides</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on light brown clay loam on calcrete plains.	None
FP AaAcaoAp ErInSolPto ArcErdiArj	Acacia Low Open Woodland	Low Open Woodland of <i>Acacia aptaneura</i> , <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia paraneura</i> over Low Open Shrubland of <i>Eremophila lanceolata</i> , <i>Solanum lasiophyllum</i> and <i>Ptilotus obovatus</i> over Very Open Tussock Grassland of <i>Aristida contorta</i> , <i>Eragrostis dielsii</i> and <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> on red brown clay loam on hardpan intergrove plains.	Ecosystem at risk (Valley floor mulga, Grove/inter-grove mulga)
FP AaApApt TtChfErb	Acacia Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> , <i>Acacia paraneura</i> and <i>Acacia pteraneura</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eriachne benthamii</i> on red brown clay loam on floodplains.	Ecosystem at risk (Valley floor mulga, Grove/inter-grove mulga)
FP AcaoAaEx Erff Tp	Acacia Low Woodland	Low Woodland of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> , <i>Acacia aptaneura</i> and <i>Eucalyptus xerothermica</i> over Open Shrubland of <i>Eremophila forrestii</i> subsp. <i>forrestii</i> over Open Hummock Grassland of <i>Triodia pungens</i> on red sandy loam on floodplains.	None
FP ErbEuaTt Ev Duf	Eriachne Tussock Grassland	Tussock Grassland of <i>Eriachne benthamii</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> with Woodland of <i>Eucalyptus victrix</i> over Open Shrubland of <i>Duma florulenta</i> on orange brown loamy clay on alluvial plains.	None
FP Ev Aa EuaErbTt	Acacia Low Woodland	Woodland of <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia aptaneura</i> over Open Tussock Grassland of <i>Eulalia aurea</i> , <i>Eriachne benthamii</i> and <i>Themeda triandra</i> on orange clay loam on floodplains.	None
FP TtEua ExAa AprAtpErlo	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> with Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Acacia aptaneura</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Eremophila longifolia</i> on red brown clay loam on unincised drainage lines and floodplains.	Ecosystem at risk (Valley floor mulga)
FP TtEuaChf ErfoErloSal ExAa	Themeda Tussock Grassland	Tussock grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Chrysopogon fallax</i> with open shrubland of <i>Eremophila forrestii</i> , <i>Eremophila longifolia</i> and <i>Santalum lanceolatum</i> with low scattered trees of <i>Eucalyptus xerothermica</i> and <i>Acacia aptaneura</i> on red clay loam on floodplains and drainage areas.	None
FS Tp EgEl Aat	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> with scattered trees of <i>Eucalyptus gamophylla</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia atkinsiana</i> on brown silty loam on footslopes and hillslopes.	None
FS Tp(Tv) Eg AeAd	Triodia Hummock Grassland	Mid to Low Hummock Grassland of <i>Triodia pungens</i> (+/- <i>Triodia vanleeuwenii</i>) with low Mallee trees of <i>Eucalyptus gamophylla</i> over tall shrubs of <i>Acacia elachantha</i> and <i>Acacia dictyophleba</i> over low shrubs of <i>Seringia exastia</i> on footslopes and hill slopes	None
FS Ts CdHc AancAiGrwh	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> and <i>Hakea chordophylla</i> over Open Shrubland of <i>Acacia ancistrocarpa</i> , <i>Acacia inaequilatera</i> and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> on red brown sandy loam on footslopes and stony plains.	None
FS TsTpTw El AbApaAanc	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia pungens</i> and <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyachra</i> and <i>Acacia ancistrocarpa</i> on red brown loam on footslopes, low undulating hills and stony plains.	None

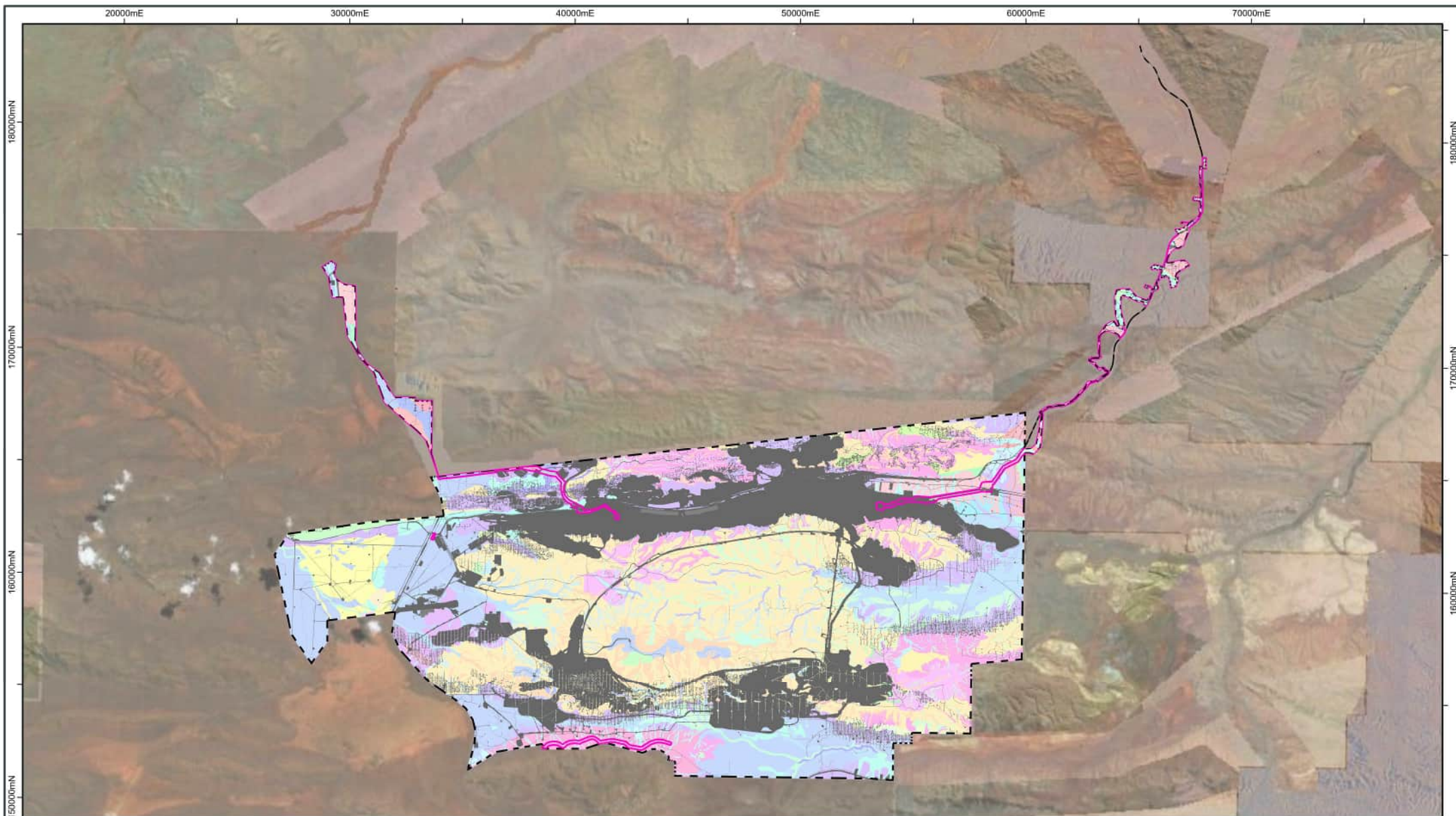
Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
FS Tv CddHc AancAiGrwh	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> with Low Open Woodland of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> and <i>Hakea chordophylla</i> over Open Shrubland of <i>Acacia ancistrocarpa</i> , <i>Acacia inaequilatera</i> and <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> on footslopes and hillslopes.	None
FS Tv Tp CdEll AatAtenAanc	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> and <i>Triodia pungens</i> with Low Open Woodland of <i>Corymbia deserticola</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over High Open Shrubland of <i>Acacia atkinsiana</i> , <i>Acacia tenuissima</i> and <i>Acacia ancistrocarpa</i> on footslopes and hillslopes.	None
FS Tv EllCdd AbSolAten	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> with scattered <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia deserticola</i> subsp. <i>deserticola</i> over Open Shrubland of <i>Acacia bivenosa</i> , <i>Solanum lasiophyllum</i> , <i>Acacia</i> spp. mid to tall shrubs on footslopes.	None
FS TvTp Eg Ell	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> and <i>Triodia pungens</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on footslopes.	None
FS TvTpTw Ell AbApaAanc	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> , <i>Triodia pungens</i> and <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyachra</i> and <i>Acacia ancistrocarpa</i> on footslopes.	None
FS Tw Ell	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> with Scattered Low Trees of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on red silty clay on hill slopes and footslopes.	None
GG CcolCfEll ErmuThmbCya	Callitris Low Open Forest	Low Open Forest of <i>Callitris columellaris</i> , <i>Corymbia ferritcola</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Tussock Grassland of <i>Eriachne mucronata</i> , <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471) and <i>Cymbopogon ambiguus</i> and Very Open Hummock Grassland of <i>Triodia pungens</i> on orange brown loam on upper gorges.	None
GG CfEllFib AhDovmAsha CyaErmuThmb	Corymbia Low Woodland	Low Woodland of <i>Corymbia ferritcola</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Ficus brachypoda</i> over Open Shrubland of <i>Acacia hamersleyensis</i> , <i>Dodonaea viscosa</i> subsp. <i>mucronata</i> and <i>Astrotricha hamptonii</i> over Open Tussock Grassland of <i>Cymbopogon ambiguus</i> , <i>Eriachne mucronata</i> and <i>Themeda</i> sp. Mt Barricade on red brown loam along cliffines and gorge walls.	None
GG TtErmuThmb EllChCf AtpGoroPI	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> and <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Corymbia hamersleyana</i> and <i>Corymbia ferritcola</i> over High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Gossypium robinsonii</i> and <i>Petalostylis labicheoides</i> on red brown sandy loam on narrowly incised rocky drainage lines.	None
HC TpTwTs EllCh AarGooKeve	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> , <i>Triodia wiseana</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Shrubland of <i>Acacia arida</i> , <i>Gompholobium oreophilum</i> and <i>Keraudrinia velutina</i> subsp. <i>elliptica</i> on red brown loam on hill crests and upper hill slopes.	None
HC Tw Ah EkkEgCh	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> with Shrubland of <i>Acacia hamersleyensis</i> and Open Mallee of <i>Eucalyptus kingsmillii</i> subsp. <i>kingsmillii</i> , <i>Eucalyptus gamophylla</i> and <i>Corymbia hamersleyana</i> (mallee form) on red brown loam and silty loam on hill crests.	None
HC Tw AiAb InrSeao	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> with High Open Shrubland of <i>Acacia inaequilatera</i> and <i>Acacia bivenosa</i> over Low Open Shrubland of <i>Indigofera rugosa</i> and <i>Senna artemisioides</i> subsp. <i>oligophylla</i> on red silty loam on dolerite hill crests.	None
HC TwTsTp EllCh Ah	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and	None

Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
		<i>Corymbia hamersleyana</i> over Open Shrubland of <i>Acacia hamersleyensis</i> on red brown clay loam on hill crests and upper hill slopes.	
HC TwTvTp EllCh Ah	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Shrubland of <i>Acacia hamersleyensis</i> on red brown clay loam on hill crests and upper hill slopes.	None
HS AaApr ErjpAmarCocf TwTp	Acacia Low Woodland	Low Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Shrubland of <i>Eremophila jucunda</i> subsp. <i>pulcherrima</i> , <i>Acacia marramamba</i> and <i>Codonocarpus cotinifolius</i> over Open Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia pungens</i> on red brown loam on steep hill slopes.	None
HS TbrTw Ell	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia brizoides</i> and/or <i>Triodia wiseana</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on brown sandy loam on steep hill slopes.	None
HS Tp AaApr ErfrAmarSegl	Triodia Open Hummock Grassland	Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Shrubland of <i>Eremophila fraseri</i> , <i>Acacia marramamba</i> and <i>Senna glutinosa</i> subsp. <i>x luerssenii</i> on red brown loam on undulating hills.	None
HS Tp Ell SeggGrwhErll	Triodia Open Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> with Scattered Low Trees of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and Scattered Shrubs of <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Eremophila latrobei</i> subsp. <i>latrobei</i> on skeletal orange brown loam on stony hill slopes.	None
HS TsTw Eg GrwhSeggAb	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) and <i>Triodia wiseana</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> over Open Shrubland of <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> and <i>Acacia bivenosa</i> on red brown sandy clay loam on hill slopes.	None
HS TsTwTp EllCh AhiAaa	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Open Shrubland of <i>Acacia hilliana</i> and <i>Acacia adoxa</i> var. <i>adoxa</i> on red brown sandy loam on hill slopes.	None
HS Tv(Tw) Ell AbAancSegg	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> (<i>Triodia wiseana</i>) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia ancistrocarpa</i> , <i>Senna glutinosa</i> subsp. <i>glutinosa</i> with <i>Hakea spp.</i> scattered low trees.	None
HS Tv(Tw) EllCdd AhiAaa	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> (+/- <i>Triodia wiseana</i>) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia deserticola</i> subsp. <i>deserticola</i> over Low Open Shrubland of <i>Acacia hilliana</i> and <i>Acacia adoxa</i> var. <i>adoxa</i> on hill slopes.	None
HS TvTwTp EllCh AhiAaa	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> , <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Low Open Shrubland of <i>Acacia hilliana</i> and <i>Acacia adoxa</i> var. <i>adoxa</i> on hill slopes.	None
HS TwTpTbr Ell Ep	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia brizoides</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Mallee of <i>Eucalyptus pilbarensis</i> on red brown loam on steep hill slopes.	None
HS TwTpTs Ell AprAaAanc	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> and <i>Acacia ancistrocarpa</i> on red brown loam on plains and low hills.	None

Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
HS TwTpTv Ell AprAaAanc	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia aptaneura</i> and <i>Acacia ancistrocarpa</i> on red brown loam on plains and low hills.	None
MA AtpAypAse Ecr ThmbTtCyp	Acacia High Shrubland	High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Acacia sericophylla</i> with Scattered Trees of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> over Open Tussock Grassland of <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471), <i>Themeda triandra</i> and <i>Cymbopogon procerus</i> on brown loam and gravels on major drainage channels.	Ecosystem at risk (Major ephemeral watercourse), Riparian
MA CcCs Aci EcrEv	Cenchrus Closed Tussock Grassland	Closed Tussock Grassland of <i>*Cenchrus ciliaris</i> and <i>*Cenchrus setiger</i> with Low Open Forest of <i>Acacia citrinoviridis</i> and Scattered Low Trees of <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> on banks and floodplains of major drainage line with brown sandy loam.	Ecosystem at risk (Major ephemeral watercourse), Riparian
MA EcrEv AciAypMg CcEuaTt	Eucalyptus Woodland	Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> and <i>Eucalyptus victrix</i> over High Open Shrubland of <i>Acacia citrinoviridis</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Melaleuca glomerata</i> over Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> on brown clay loam on banks of major drainage lines.	Ecosystem at risk (Major ephemeral watercourse), potential GDV, Riparian
MA EcrEv AcpAtheEv TpTlo	Eucalyptus Woodland	Woodland to Open Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> and <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Atalaya hemiglaucula</i> and <i>Eucalyptus victrix</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia longiceps</i> on brown sand along major drainage lines.	Ecosystem at risk (Major ephemeral watercourse), potential GDV, Riparian
MA EcrEvEx AypAtpGoro TtEuaCyp	Eucalyptus Low Open Forest	Low Open Forest of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Eucalyptus xerothermica</i> over High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Gossypium robinsonii</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cymbopogon procerus</i> on red brown clay loam on major drainage lines.	Ecosystem at risk (Major ephemeral watercourse), potential GDV, Riparian
MA EcrEvMa AcpAamAthe TydCyv	Eucalyptus Open Forest	Open Forest of <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Melaleuca argentea</i> over Low Open Forest of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Acacia amplexa</i> and <i>Atalaya hemiglaucula</i> over Open Sedges of <i>Typha domingensis</i> and <i>Cyperus vaginatus</i> on brown sandy clay loam along major rivers with permanent water.	Ecosystem at risk (Major ephemeral watercourse), GDV, Riparian
MA EvAciEcr TercCocrAyp CcEuaTt	Eucalyptus Woodland	Woodland of <i>Eucalyptus victrix</i> , <i>Acacia citrinoviridis</i> and <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> over Low Open Shrubland of <i>Tephrosia rosea</i> var. <i>clementii</i> , <i>Corchorus crozophorifolius</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> over Very Open Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> on brown loamy sand on channels of major drainage lines.	Ecosystem at risk (Major ephemeral watercourse), potential GDV, Riparian
ME ApyScspSal TtPamu ExCh	Acacia open shrubland	Open shrubland of <i>Acacia pyrifolia</i> , <i>Scaevola spinescens</i> and <i>Santalum lanceolatum</i> over scattered tussock grasses of <i>Themeda triandra</i> and <i>Paraneurachne muelleri</i> with low scattered trees of <i>Eucalyptus xerothermica</i> and <i>Corymbia hamersleyana</i> on red clay loam on medium drainage lines.	Riparian
ME AtpAmAma TtEuaTp ChEllEx	Acacia Mid Open Shrubland	Mid Open Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia monticola</i> , <i>Acacia maitlandii</i> over Open Tussock Grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> with <i>Triodia pungens</i> hummock grasses with Low <i>Corymbia hamersleyana</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus xerothermica</i> along medium drainage lines.	Riparian
ME Tp(Tv) AaAprEx Pl	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> (+/- <i>Triodia vanleeuwenii</i>) with Low Woodland of <i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> , <i>Eucalyptus xerothermica</i> over Tall Open Shrubland of <i>Petalostylis labicheoides</i> along medium drainage lines	Riparian

Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
ME TpTlo ExAciCh PIApyGoro	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia longiceps</i> with Low Woodland of <i>Eucalyptus xerothermica</i> , <i>Acacia citrinoviridis</i> and <i>Corymbia hamersleyana</i> over High Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Gossypium robinsonii</i> on red brown clay loam on medium drainage lines and surrounding floodplains.	Riparian
ME TtAriCya ChEll AmPIAnI	Themeda Open Tussock Grassland	Open Tussock Grassland of <i>Themeda triandra</i> , <i>Aristida inaequiglumis</i> and <i>Cymbopogon ambiguus</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia monticola</i> , <i>Petalostylis labicheoides</i> and <i>Androcalva luteiflora</i> on red brown alluvium on minor and medium drainage lines.	Riparian
ME TtChfEua ExEvCh PIApyApy	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eulalia aurea</i> with Low Open Woodland of <i>Eucalyptus xerothermica</i> , <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pachyacra</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on red sandy loam on medium drainage lines.	Riparian
ME TtEuaEte ApyAtpPI EvCh	Eucalyptus Low Woodland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Eriachne tenuiculmis</i> with High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Petalostylis labicheoides</i> and Open Woodland of <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> on red brown silty loam on medium drainage lines and flood plains.	Riparian
MI AtpPIAm TpTs ChEll	Acacia Open Scrub	Open Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> and <i>Acacia monticola</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on red brown sandy loam on minor drainage lines.	Riparian
MI AtpPIAm TpTv ChEll	Acacia Open Scrub	Open Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> and <i>Acacia monticola</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on red brown sandy loam on minor drainage lines.	Riparian
MI PIAtpAm ChEll TwTp	Petalostylis Shrubland	Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Acacia monticola</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia pungens</i> on red brown loam on minor drainage lines.	Riparian
MI Td Acow ExAapr	Typha Tall Thicket	Tall thicket of <i>Typha domingensis</i> with tall sparse shrubland of <i>Acacia cowleana</i> over low sparse shrubs of <i>Stemodia grossa</i> Low Scattered Trees of <i>Eucalyptus xerothermica</i> , <i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> on minor drainage lines.	Riparian
MI TtErmu ChEll AmaAmAnI	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Low Open Shrubland of <i>Acacia maitlandii</i> , <i>Acacia monticola</i> , <i>Androcalva luteiflora</i> on minor drainage lines.	Riparian
SP AaApr TmTwTp TtChfAri	Acacia Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Hummock Grassland of <i>Triodia melvillei</i> , <i>Triodia wiseana</i> and <i>Triodia pungens</i> over Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Aristida inaequiglumis</i> on red brown loam on stony plains.	Ecosystem at risk (Valley floor mulga)
SP AcaoAa ArobDiaChf	Acacia Low Open Forest	Low Open Forest of <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and <i>Acacia aptaneura</i> over Very Open Tussock Grassland of <i>Aristida obscura</i> , <i>Digitaria ammophila</i> and <i>Chrysopogon fallax</i> on red brown clay loam on lower stony plains.	Ecosystem at risk (Valley floor mulga)

Vegetation Code	Broad Floristic Formation	Vegetation Association Description	Local significance
SP TbTp HallAancAi Ch	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia basedowii</i> and <i>Triodia pungens</i> with High Open Shrubland of <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Acacia ancistrocarpa</i> and <i>Acacia inaequilatera</i> and Scattered Low Trees of <i>Corymbia hamersleyana</i> on red brown loamy sand on stony plains.	None
SP Tm(ArcTt) AaApr	Triodia Mid Open Hummock Grassland	Mid Open Hummock Grassland of <i>Triodia melvillei</i> (+/- Tussock Grasses of <i>Aristida contorta</i> and <i>Themeda triandra</i>) with Low Isolated clumps of Trees of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> on stony plains.	None
SP TpTb Eg PIAbAanc	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia bivenosa</i> and <i>Acacia ancistrocarpa</i> on red brown loamy sand on stony plains and footslopes.	None
SP TpTm AaExAcao ApaErffAads	Triodia Open Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia melvillei</i> with Low Open Woodland of <i>Acacia aptaneura</i> , <i>Eucalyptus xerothermica</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and Open Shrubland of <i>Acacia pachyacra</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Acacia adsurgens</i> on red brown clay loam or silty loam on stony plains and floodplains.	None
SP TsTwTp EgEt AbApaApr	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> and <i>Eucalyptus trivalva</i> over Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyacra</i> and <i>Acacia pruinocarpa</i> on red brown sandy loam and clay loam on stony plains.	None
SP Tt(ArcEua) Hall(Aan)	Themeda Mid Tussock Grassland	Mid Tussock Grassland of <i>Themeda Triandra</i> (+/- <i>Aristida contorta</i> , <i>Eulalia aurea</i>) with Low Isolated clumps of Trees of <i>Hakea loreus</i> subsp. <i>lorea</i> (+/- <i>Acacia aneura</i> group) on stony plains.	None
SP TvTwTp EgEt AbApaApr	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> , <i>Triodia wiseana</i> and <i>Triodia pungens</i> with Very Open Mallee of <i>Eucalyptus gamophylla</i> and <i>Eucalyptus trivalva</i> over Open Shrubland of <i>Acacia bivenosa</i> , <i>Acacia pachyacra</i> and <i>Acacia pruinocarpa</i> on stony plains.	None



Indicative Footprint	FS Tp EgEII Aat	GG CIEIFib AhDownAsha CyeEmuThmb	HS Tv EII AbAancSgg	MA EorEvMa AcApAmAthe TydCyy	MI TEEmu CHEI AmaAmAni
Development Envelope	FS Tp(Tv) Eg AaAd	GG TIErmuThmb EIIChOI AlpGoroPI	HS Tv EIIChOI AhaAa	MA EvAcEor TeroCocApyp CcEuaTI	SP AaApr TmTwTp TICHIAn
Existing Disturbance	FS Ts CdhC AancAIGwh	GG TpTwTs EIICh AarGooKeve	HS Tv(Tw) EII AbAancSegg	ME ApySspSai TIPanu ExCh	SP AcaoAa ArobdAaChf
Cleared	FS TsTpTw EII AbApaAanc	HC Tw Ah EkmEgCh	HS Tv(Tw) EIIChOI AhaAa	ME AlpAmAma TIEuaTp CHEIEx	SP TbTp HallAancAI Ch
CP TwTa Eso AbPIApy	FS Tv CdhC AancAIGwh	HC Tw AAb InrSoo	HS TvTwTp EIICh AhaAa	ME Tp(Tv) AaApeEx PI	SP TbTp HIAancAI Ch
CP TwTriag Eso AbPIApy	FS Tv CdhC AancAIGwh	HC TwTsTp EIICh Ah	HS TwTpTsr EII Ep	ME TpTlo ExAcCh PIAppGoro	SP Tm(ArcTI) AaApr
FP AaAcaoAp EriSulPto ArcErdAry	FS Tv EIIChOI AabAaAanc	HC TwTvTp EIICh Ah	HS TwTpTs EII AprAaAanc	ME TIAncCya CHEI AmPIAnI	SP TpTlo Eg PIAaAanc
FP AaApApt TICHErb	FS Tv EIIChOI Ac	HS AaApr EriPAmarCoc TwTp	HS TwTpTv EII AprAaAanc	ME TICHIUua ExEvCh PIApaApy	SP TpTm AaExAcao ApeErfAads
FP AcaoAaEx EriT Tp	FS TVTp CdhC AaAAtenAanc	HS TsrTw EII	MA AlpApyAse Eor ThmbTICyp	ME TIEuaEte ApyApPI EvCh	SP TsTwTp EgEII AbApaApr
FP EriEuaTI Ev Duf	FS TVTp Eg EII	HS Tp AaApr EriPAmarSegI	MA CcCs Aoi EorEv	MI AlpPIAm TpTs CHEI	SP TIArcEua Hall(Aan)
FP Ev Aa EuaEriTI	FS TVTpTw EII AbApaAanc	HS Tp EII SeggGwhEriI	MA EorEv AcApypMg CcEuaTI	MI AlpPIAm TpTv CHEI	SP TpTvTwTp EgEII AbApaApr
FP TIEua ExAa AprAlpEriI	FS Tw EII	HS TsTw Eg GwhSeggAb	MA EorEv AcApAtheEv TpTlo	MI PIApAm CHEI TwTp	
FP TIEuaCh EriEriSai ExAa	GG CcCIEII EriThmbCya	HS TsTwTp EIICh AhaAa	MA EorEvEx ApyApGoro TIEuaCyp	MI Td Aow ExAaApr	



PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT VEGETATION ASSOCIATION MAPPING

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:225,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-4
DATE:	12/02/2025	PREPARED:	GEOMATICS	NO:	A1285-010 RevE
		REVIEWED:			

Groundwater Dependent Vegetation

Drainage lines within and in the region surrounding the Development Envelope have the potential to support groundwater dependent vegetation (GDV) i.e. vegetation that may be reliant on groundwater for part or all water requirements.

GDV is typically characterised by the presence of flora species that rely on groundwater and are known as phreatophytes. Phreatophytes may be classified as either obligate or facultative phreatophytes depending on their reliance on groundwater (Eamus *et al.* 2016):

- Obligate phreatophytes are flora species confined to habitats with permanent access to groundwater.
- Facultative phreatophytes are flora species that can utilise groundwater to satisfy a proportion of their ecological water requirement (EWR) when it is available. However, some individuals may also satisfy their EWR by relying solely on uptake from upper unsaturated soils layers where groundwater is inaccessible.

Bureau of Meteorology National GDE Atlas

The Groundwater Dependent Ecosystems Atlas (GDE Atlas) is a national dataset of Australian GDEs to inform groundwater planning and management (BoM 2025). The GDE mapping in the GDE Atlas comes from two broad sources:

- National assessment: national-scale analysis based on a set of rules that describe potential for groundwater/ ecosystem interaction and available Geographic Information Systems (GIS) data
- Regional studies: more detailed analysis undertaken by various State and regional agencies using a range of different approaches including field work, analysis of satellite imagery and application of rules/conceptual models.

The BoM GDE Atlas indicates low to moderate potential to support both terrestrial and aquatic GDE within the Development Envelope and surrounds. Weeli Wolli Creek and Marillana Creek are mapped as a moderate potential aquatic GDE, while the potential for terrestrial GDE is mapped as low to moderate (Figure 8-5). However, Weeli Wolli Creek is a known significant terrestrial and aquatic GDE so it is evident that the mapping does not capture all known GDEs. This is a function of the national-scale analysis following a set of rules which utilised imagery at a 25 m resolution (Doody *et al.* 2017). The national scale is an initial remotely sensed task of the overall project with follow-up surveys and investigations required to determine the presence of GDEs

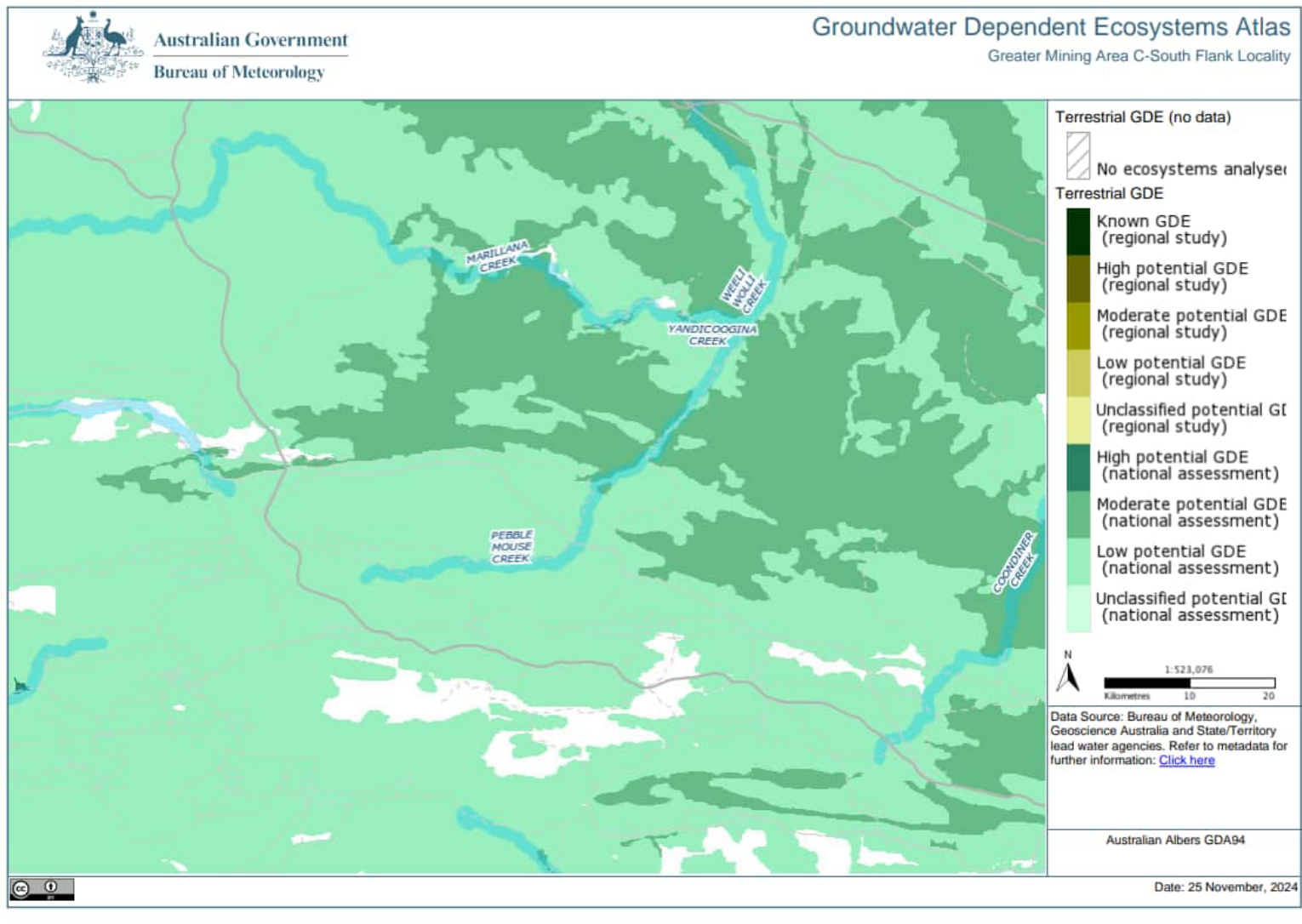


Figure 8-5: BoM GDE Atlas mapping for the Greater Mining Area C-South Flank locality (Terrestrial GDE mapping Layer) (BoM 2025)

GDV assessment within and outside of Development Envelope

Assessment of potential GDV within the Development Envelope and surrounding area was undertaken by review of baseline vegetation association mapping, baseline groundwater depth and targeted GDV survey.

Most of the vegetation associations mapped from numerous flora and vegetation surveys across the Development Envelope and surrounding area are known to have no potential to be GDV. However, a total of 19 riparian vegetation associations occur in the Development Envelope, and an additional 59 occur outside the Development Envelope within approximately 30 km, some of which have potential to be groundwater dependent. These were selected based on DWER's definition 'distinctive vegetation associated with a wetland or watercourse' and includes all vegetation association codes beginning with 'MI', 'ME' and 'MA' (Figure 8-6) (DWER 2019a). The groundwater dependency of these vegetation associations was assessed by reviewing the flora assemblage present using the framework presented in Table 8-4. This framework was developed from a combination of known and documented uses of hydrophytic/mesophytic/phreatophytic flora, including both field-observed expertise and utilising database sources (e.g. Florabase [WAH 2024], Graham et al. 2003 and Rio Tinto 2023, as cited in Biologic 2025 *in prep*).

Additional context taken into account for the assessment was the approximate pre-development groundwater levels (Figure 8-7). Where *Melaleuca argentea* was absent, potential GDV was assigned a rating based on the characteristics listed in Table 8-4 and its likelihood of reliance on groundwater was based on the pre-development groundwater level being either less than, or greater than, 20 mbgl.

A targeted GDV survey was undertaken in areas of relatively shallow groundwater to the east of the Development Envelope, including Weeli Wolli Creek and tributaries (Biologic 2025 *in prep*). This survey targeted areas of potential GDV determined from baseline vegetation association mapping, to provide a higher level of detail on the presence (or absence) of known hydrophytic/mesophytic/phreatophytic flora. This survey also included some areas not previously surveyed by BHP, targeting areas highlighted as potential GDV from analysis of satellite remote sensing data, using seasonally weighted vegetation and moisture indices derived from Landsat data.

In line with Biologic (2025 *in prep*), the dependence of each vegetation type on groundwater presence was assessed based on the Groundwater Dependence rating and associated reasoning in Table 8-4.

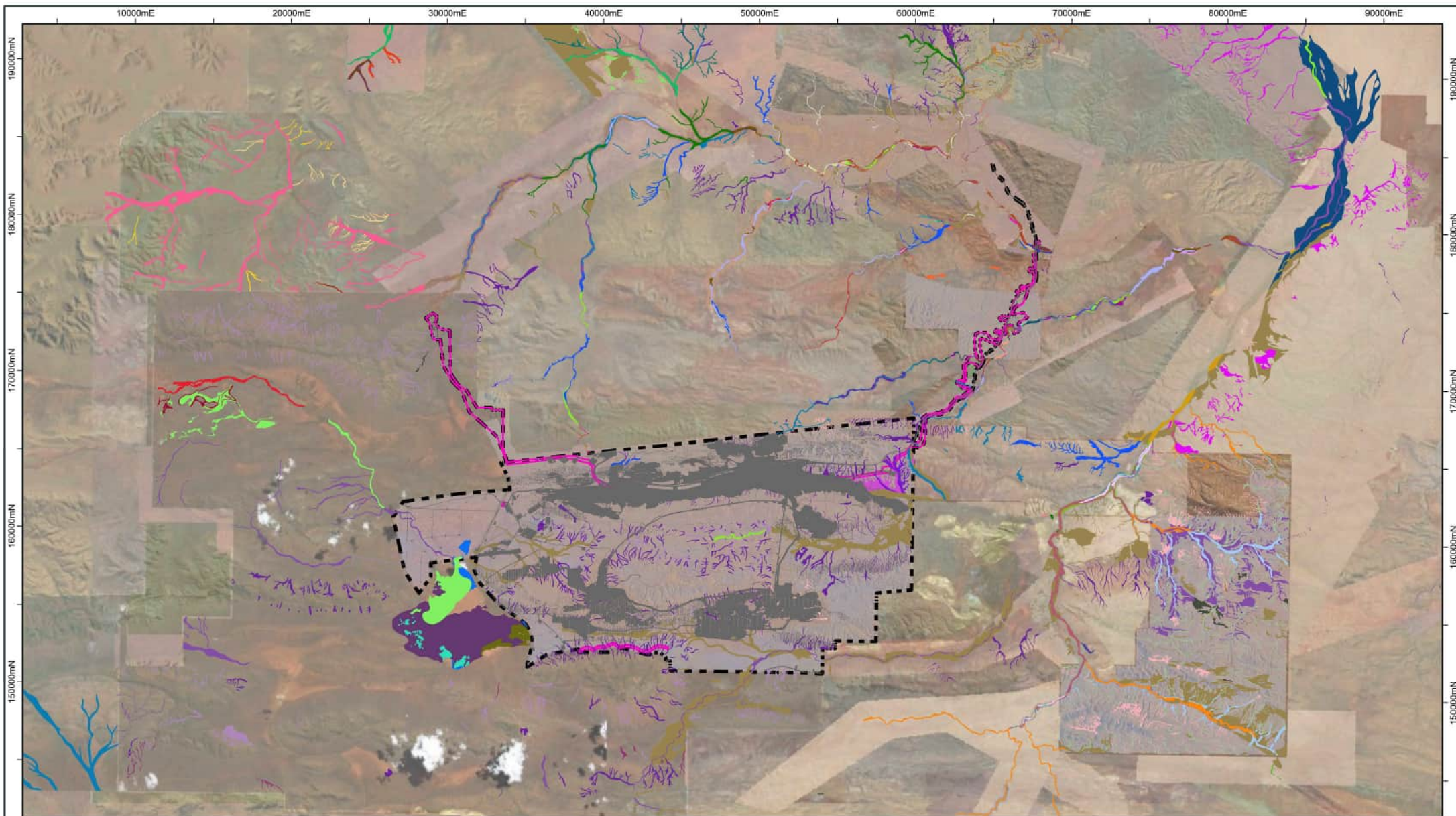
Table 8-4: Groundwater Dependence rating system

Groundwater Dependence	Reasoning	Key/most common indicator species and density		
		Phreatophytic/Riparian	Mesophytic	Hydrophytic
High (GDV)	- Presence of mature obligate phreatophytes (i.e., <i>Melaleuca argentea</i>) with permanent to semi-permanent water bodies present. - A high diversity and density of mesophytic and hydrophytic taxa.	Abundant: <i>Melaleuca argentea</i> Common: <i>Eucalyptus camaldulensis</i> Present: <i>Sesbania formosa</i> <i>Arecaceae spp.</i> (introduced and/or native)	Abundant to Common: <i>Acacia ampliceps</i> <i>Kirganelia baccata</i> <i>Melaleuca glomerata</i> <i>Melaleuca bracteata</i> Present: <i>Cullen leucanthum</i> <i>Gymnanthera cunninghamii</i> (P3) <i>Imperata cylindrica</i>	Abundant to Common: <i>Characeae spp.</i> <i>Potamogeton spp.</i> <i>Hydrocharitaceae spp.</i> <i>Ruppia spp.</i> Present: <i>Ammannia spp.</i> <i>Cladium procerum</i> <i>Eleocharis spp.</i> <i>Fimbristylis sieberiana</i> (P3) <i>Lobelia arnhemiaca</i> <i>Pteris vittata</i> <i>Samolus spp.</i> <i>Schoenoplectiella spp.</i> <i>Schoenoplectus subulatus</i> <i>Schoenus spp.</i> <i>Stylidium spp.</i>
Moderate (potential GDV)	- Presence of mature facultative phreatophytes (with potential for semi-mature to young obligate phreatophytes). - Semi-permanent water bodies may be present. A moderate	Abundant: <i>Eucalyptus camaldulensis</i> Common: <i>Eucalyptus victrix</i>	Abundant: <i>Atalaya hemiglauca</i> <i>Melaleuca glomerata</i> <i>Sesbania cannabina</i>	Abundant: <i>Ammannia spp.</i> <i>Cyperus spp.</i> <i>Goodenia lamprosperma</i>

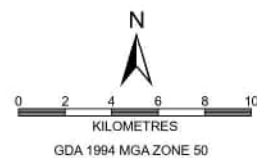
Groundwater Dependence	Reasoning	Key/most common indicator species and density		
		Phreatophytic/Riparian	Mesophytic	Hydrophytic
	diversity and density of mesophytic and hydrophytic taxa.	Present: <i>Melaleuca argentea</i> <i>Acacia citrinoviridis</i> <i>Acacia coriacea</i> subsp. <i>pendens</i> <i>Stylobasium spathulatum</i>	Common to Present: <i>Adriana tomentosa</i> <i>Dodonaea lanceolata</i> <i>Duma florulenta</i> <i>Gymnanthera cunninghamii</i> (P3) <i>Kirganelia baccata</i> <i>Melaleuca bracteata</i> <i>Myoporum montanum</i> <i>Plumbago zeylanica</i> <i>Tinospora smilacina</i>	<i>Fimbristylis microcarya</i> <i>Marsilea</i> spp. <i>Typha domingensis</i> <i>Vigna</i> spp. Present: <i>Characeae</i> spp. <i>Flueggea virosa</i> <i>Hydrocharitaceae</i> spp. <i>Ipomoea plebeia</i> <i>Ipomoea racemigera</i> (P3) <i>Muellerolimon salicorniaceum</i> <i>Potamogeton</i> spp. <i>Ruppia</i> spp. <i>Schenkia</i> spp. <i>Schoenoplectiella</i> spp. <i>Schoenoplectus subulatus</i> <i>Stemodia grossa</i>
Low	- Scattered presence of facultative phreatophyte (<i>Eucalyptus camaldulensis</i>) and/or abundance of mature vadophyte (i.e., <i>Eucalyptus victrix</i>). - Medium to minor flowlines. Ephemeral to semi-permanent	Abundant to Common: <i>Acacia citrinoviridis</i> <i>Acacia coriacea</i> subsp. <i>pendens</i> <i>Eucalyptus victrix</i> <i>Eucalyptus xerothermica</i>	Abundant to Common: <i>Cyperus</i> spp. <i>Eulalia aurea</i> <i>Eriachne benthamii</i> <i>Gossypium sturtianum</i>	Present: <i>Ammannia</i> spp. <i>Cathetus</i> spp. <i>Commicarpus australis</i> <i>Elytrophorus spicatus</i>

Groundwater Dependence	Reasoning	Key/most common indicator species and density		
		Phreatophytic/Riparian	Mesophytic	Hydrophytic
	water bodies may be present. Low diversity and density of mesophytic and hydrophytic taxa.	• <i>Stylobasium spathulatum</i> Present: • <i>Acacia sclerosperma</i> • <i>Corymbia candida</i> • <i>Eucalyptus camaldulensis</i> • <i>Sesbania cannabina</i> • <i>Ventilago viminalis</i>	• <i>Stemodia grossa</i> Present: • <i>Abutilon amplum</i> • <i>Atalaya hemiglauca</i> • <i>Dodonaea lanceolata</i> • <i>Ehretia saligna</i> • <i>Melaleuca glomerata</i> • <i>Plumbago zeylanica</i>	• <i>Eragrostis elongata</i> • <i>Fimbristylis microcarya</i> • <i>Flueggea virosa</i> • <i>Goodenia lamprosperma</i> • <i>Leptochloa digitata</i> • <i>Marsilea</i> spp. • <i>Myriophyllum</i> spp. • <i>Najas</i> spp. • <i>Pluchea dentex</i> • <i>Pluchea rubelliflora</i> • <i>Sorghum</i> spp. • <i>Striga curviflora</i> • <i>Urochloa</i> spp. • <i>Typha domingensis</i> • <i>Wahlenbergia</i> spp. • <i>Vigna</i> spp.
Negligible	• Minor to medium flowlines and drainage areas. Mostly inflow dependent riparian species (i.e., <i>Acacia tumida</i>) are prevalent and dominant.	No groundwater indicator species present or not present at the density that would indicate presence of soil moisture. Mostly mature vadophytic taxa, with riparian tree species (i.e., <i>Eucalyptus xerothermica</i> , <i>Corymbia hamersleyana</i>). High diversity of riparian species abundant and common.		

Source: Biologic 2025 *in prep*



- Indicative Footprint
- - - Development Envelope
- Existing Disturbance



BHP

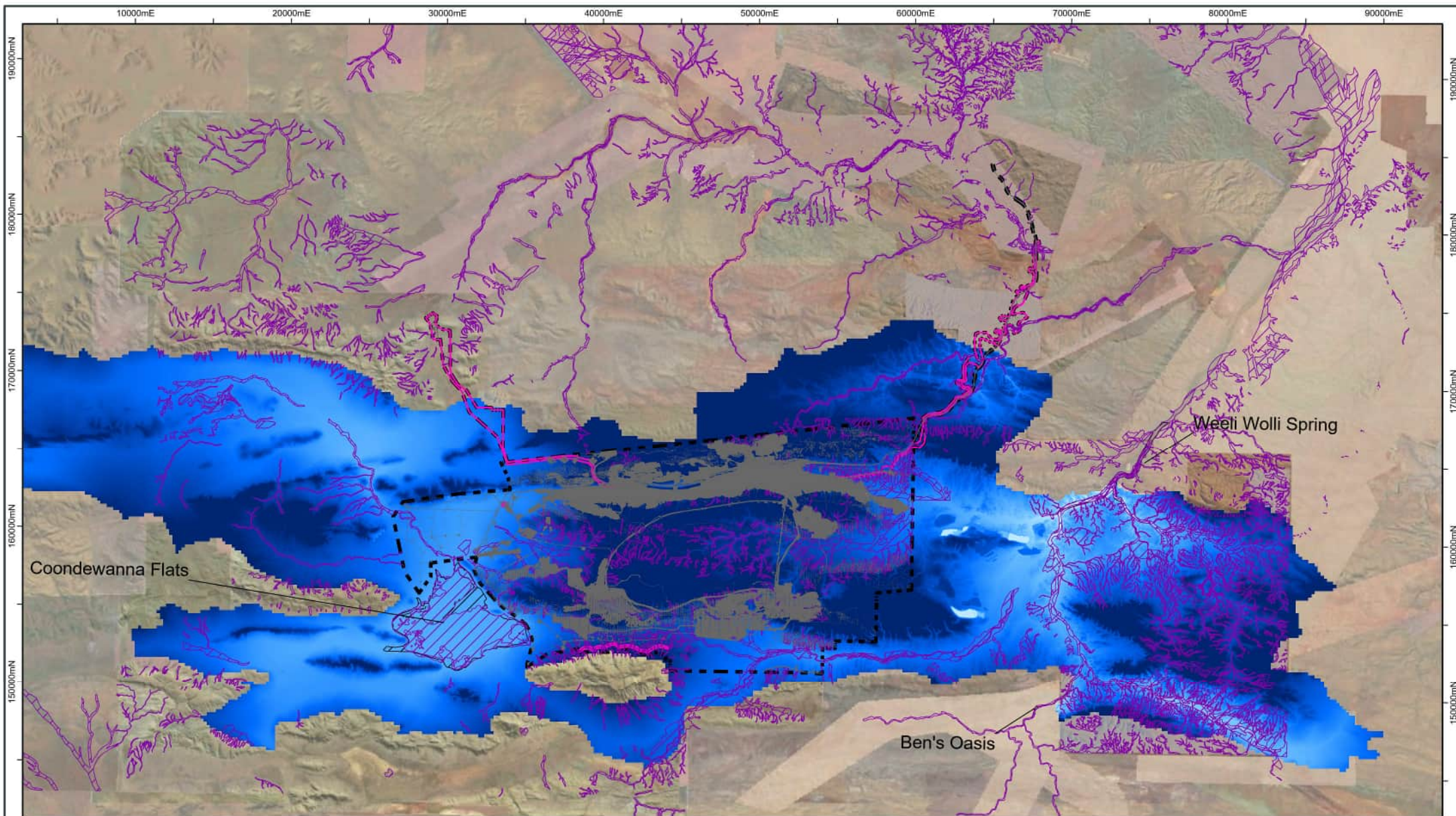
PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
RIPARIAN VEGETATION**

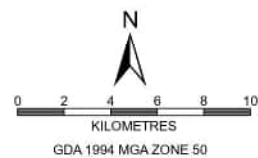
WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:325,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-6a
DATE:	12/02/2025	PREPARED:	GEOMATICS	NO:	A1285-078 RevC
		REVIEWED:			

FP AaEv Duf EuaErbArc	MA EcrEv AciApyMg CcEuaTt	ME EcEv AciAcor CcTtErb PIAPy Cocr	MI AmAnIAanc Tp EIICH
FP AaEv ErbEua Duf	MA EcrEv AcpAtheEv TpTI	ME EuaTtErt EvEx GoroAeAma	MI AtGrwAm Tp ErmuTt AnIDol Ch
FP AaEv EuaErb Duf	MA EcrEv SoplEuaTt ApyAtpPI	ME EvEc ExAci ErbTtEua ApyAnIGoro CocrTefc	MI AtPIAPy ExCh ErmuTtEua AnIIsi Tefclng
FP ErbEuaTt Ev Duf	MA EcrEvEx ApyAtpGoro TtEuaCyp	ME Mg Erb Ec	MI AtpGrwhApy TpTb CcCs
FP Ev Aa EuaErbTt	MA EcrEvMa AcpAamAh TydCyv	ME TP EIICH AtpAbGoro	MI AtpGwApy TpTb CcCs
FP Tp ChHallEv TefcApy	MA EcrEvMa AcpAamAthe TydCyv	ME Tp AaptAprEx PI	MI AtpPIAm TpTs Ch EI
FP TtEuaAri EvCa GoroErloAthe	MA EcrMaEv AciAcp AbGosnGoro	ME TpAmAnIApy ExCh	MI AtpPIAm TpTs ChEI
MA AaAciApr CcTtChf EvEcr	MA Ev TefcCocrApy TtSoplCya	ME TpTlo ExAciCh PIAPypGoro	MI ChExEv AtpAppPI AlTrfMa CcTtCam Tp
MA Aci CcTt PIAPy Cocr EvEc	MA EvAciEcr TercCocrApy CcEuaTt	ME Tt ExChAa ApaAaAci	MI CyncDishCynt NeggGlVsh
MA AciAcpAthe Tp EteEnl	MA EvEcoAcp Mg PldClvPhm	ME TtAriCya ChElI AmPIAnI	MI Erb VfAteAa PihCemPtgo
MA AtpApyAse Ecr ThmbTtCyp	MA Ma	ME TtChfEua ExEvCh PIAPaApy	MI PIATpAm ChElI TwTp
MA AtuGrwAl EcEv TtCyaCc	MA MaEc AamAtAl TtCyaCc	ME TtCyaCc EvExAci PIAnIGoro	MI Td Ac Sg ExAapt
MA CcCs Aci EcrEv	MA MaEc AtheAam CyvFisElg Tyd	ME TtCyaEnl Cyv AcpEvCh	MI Tp TtCya Ch
MA CcCs EvAciAthe	MA MaEco CyvTydFis TtEua	ME TtErteCya Ev AbAtVf	MI TpTw CddElIEg AmAbGrw
MA ClpTydCyg FisElg LoaStw Ma	MA MaEcr AciAcpAam TydCyv	ME TtEuaCya ExCh AnIApyErlo	MI Tt EIIEExHal ApySeggSeao
MA CocrTerfc EcrEv EteCcEpd	MA MaEcrEv MgAcpAtr Cyv	ME TtEuaEte ApyAtpPI EvCh	MI TtErmu ChElI AlPIGrw
MA Ec	MA MgAcpGoro EuaTtErmu EvEco	ME TtEuaEte ApyAtpPI EvCh	MI TtEuaAri ChEx AmAnIAma
MA Ec AtheAam GoroGosnStsp Cyv	MA Pt Ecr TdScsuCyv	ME TtThsErga ExAaCh GostAln	MI TtErmu ChElI AmAmoAnI
MA Eco EuaTtSogl AtpGoroCule	MA TtCc PIAbAnI EIICH	MI AadsAnIDop Tp EIICH	Ma EvEco AtpGoroAnI TtEuaCyo
MA EcoEv AciAcp TtEuaCc	MA TydCyv EcrEv AciAcp	MI AbAdAma Tp TtPamuEua	
MA EcoEv EuaTtCyo Mg	ME ApyScspSal TtPamu ExCh	MI AmAancAe TpTw TtPamuEua	
MA EcoMa AtpCuleGoro TtEuaSopl	ME AtGrwAl Ch TpErmuTtCya	MI AmAmaGoro TtCyaPamu ChElI	
MA EcrEv AciAcp Mg	ME AtpAcmAm TtEua Tp ChElIEx	MI AmAncPI TsTwTp TtErmuErt	



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Ecological Community
- Riparian Vegetation
- Pre-development Groundwater Depth (mbgl)**
- 10
- 120



BHP

PUBLIC

MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

ESTIMATED PRE-DEVELOPMENT

GROUNDWATER LEVELS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:325,000

DATE: 12/02/2025

REQUESTOR: ENVIRONMENT

PREPARED: GEOMATICS

REVIEWED:

FIGURE: **8-7**

NO: **A1285-079 RevD**

Inside the Development Envelope

Of the 19 riparian vegetation associations within the Development Envelope, eight were rated low-high likelihood for groundwater dependence and 11 were rated as negligible likelihood (Table 8-5). The five vegetation associations with a moderate or high likelihood of being groundwater dependent are considered to represent GDV/potential GDV and are shown on Figure 8-8.

One vegetation association was rated as highly likely to be GDV; MA EcrEvMa AcpAamAthe TydCyv (GDV) which occurs in the northern-most part of the north-east scheme of the Development Envelope, along Marillana Creek within the Yandi mining lease. This vegetation association is considered to be a confirmed GDV based on the presence of mature *Melaleuca argentea*. A total of four vegetation associations were rated as having moderate likelihood to be GDV (potential GDV) and occur within and adjacent to Marillana Creek within the Yandi mining lease portion of the Development Envelope and along other minor non-perennial watercourses throughout the north-eastern arm of the Indicative Footprint, and in the west and south of the Development Envelope (Figure 8-8).

Table 8-5: Groundwater dependent likelihood assessment of riparian vegetation inside and outside the Development Envelope

GDV likelihood	Vegetation association	Vegetation description	Occurs within Development Envelope
High	MA ClpTydCyg FisElg LoaStw Ma	<i>Cladium procerum</i> (P2), <i>Typha domingensis</i> , <i>Cyperus vaginatus</i> tall to mid open sedgeland over <i>Fimbristylis sieberiana</i> (P3), <i>Eleocharis geniculata</i> low sparse sedgeland over <i>Lobelia arnhemiaca</i> , <i>Stylidium weeliwolli</i> (P3) low sparse forbland with <i>Melaleuca argentea</i> low isolated trees, on often skeletal and submerged black soils in major drainage lines containing a series of open calcareous rocky areas supporting permanent surface water and connecting pools.	
High	MA Ec AtheAam GoroGosnStsp Cyv	<i>Eucalyptus camaldulensis</i> mid open forest over <i>Atalaya hemiglauc</i> , <i>Acacia ampliceps</i> low open woodland over <i>Gossypium robinsonii</i> , <i>G. sturtianum</i> , <i>Stylobasium spathulatum</i> tall open shrubland over <i>Cyperus vaginatus</i> low isolated clumps of sedges on brown sandy clay loam on major drainage lines (dense, wet wooded areas adjacent sections of Weeli Wolli Creek, occupying raised creek banks and islands out of main channel).	
High	MA Eco EuaTtSogl AtpGoroCule	Mid open woodland (to mid woodland) of <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> (with occasional <i>Melaleuca argentea</i>) over high to mid open tussock grassland of <i>Eulalia aurea</i> , <i>Themeda triandra</i> and <i>Sorghum plumosum</i> with high sparse shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Gossypium robinsonii</i> and <i>Cullen leucanthum</i> on red/ brown sandy clay loam on major drainage lines.	
High	MA EcoMa AtpCuleGoro TtEuaSopl	Mid open woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> and <i>Melaleuca argentea</i> over high open shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Cullen leucanthum</i> and <i>Gossypium robinsonii</i> over high to mid open tussock grassland <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Sorghum plumosum</i> on brown silty clay loam on major drainage lines.	
High	MA EcrEvMa AcpAamAh TydCyv	Open Forest of <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Melaleuca argentea</i> over Low Open Forest of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Acacia ampliceps</i> and <i>Atalaya hemiglauc</i> over Open Sedges of <i>Typha domingensis</i> and <i>Cyperus vaginatus</i>	
High	MA EcrEvMa AcpAamAthe TydCyv	Open Forest of <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Melaleuca argentea</i> over Low Open Forest of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Acacia ampliceps</i> and <i>Atalaya hemiglauc</i> over Open Sedges of <i>Typha domingensis</i> and <i>Cyperus vaginatus</i> on brown sandy clay loam along major rivers with permanent water	✓
High	MA EcrMaEv AciAcp AbGosnGoro	Open Forest of <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> , <i>Melaleuca argentea</i> and <i>Eucalyptus victrix</i> over Low Open Woodland of <i>Acacia citrinoviridis</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> over Shrubland of <i>Acacia bivenosa</i> , <i>Gossypium sturtianum</i> and <i>Gossypium robinsonii</i> on brown silty sand and clay along Weeli Wolli Creek	
High	MA Ma	<i>Melaleuca argentea</i> mid isolated trees on brown sandy clay loam on major drainage lines, occupying the bare stony portions of the channel.	
High	MA MaEc AamAtAl TtCyaCc	Low woodland to open woodland of <i>Melaleuca argentea</i> , <i>Eucalyptus camaldulensis</i> over high shrubland of <i>Acacia ampliceps</i> , <i>Acacia tumida</i> , <i>Androcalva luteiflora</i> over open tussock grassland of <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> , <i>*Cenchrus ciliaris</i> on brown sandy loam on major drainage lines	
High	MA MaEc AtheAam CyvFisElg Tyd	<i>Melaleuca argentea</i> , <i>Eucalyptus camaldulensis</i> mid woodland over <i>Atalaya hemiglauc</i> , <i>Acacia ampliceps</i> low open woodland over <i>Cyperus vaginatus</i> , <i>Fimbristylis sieberiana</i> (P3), <i>Eleocharis geniculata</i> mid to low open sedgeland with <i>Typha domingensis</i> tall isolated clumps of rushes over low isolated clumps of annual herbs. On brown sandy clay loam on major drainage lines. Drainage line contains series of open calcareous rocky areas supporting permanent surface water and connecting pools.	
High	MA MaEco CyvTydFis TtEua	Mid woodland of <i>Melaleuca argentea</i> and <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> over high to low open sedgeland of <i>Cyperus vaginatus</i> , <i>Typha domingensis</i> and <i>Fimbristylis sieberiana</i> over mid sparse tussock grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> on black clay loam on major drainage lines.	
High	MA MaEcr AciAcpAam TydCyv	Open Forest of <i>Melaleuca argentea</i> and <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> over Low Woodland of <i>Acacia citrinoviridis</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Acacia ampliceps</i> over Open Sedges of <i>Typha domingensis</i> , <i>Cyperus vaginatus</i> and <i>Fimbristylis sieberiana</i> on brown silty sand and clay on levee banks and within stream channels with permanent water at Weeli Wolli Spring	
High	MA MaEcrEv MgAcpAtr Cyv	High Open Forest of <i>Melaleuca argentea</i> , <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> and <i>Eucalyptus victrix</i> over High Open Shrubland of <i>Melaleuca glomerata</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Acacia trachycarpa</i> over Very Open Sedges of <i>Cyperus vaginatus</i> on alluvial gravelly soils on major drainage channels with seasonal pools	
High	MA Pt Ecr TdScsuCyv	Open Herbs of <i>Potamogeton tricarinatus</i> with Open Woodland of <i>Eucalyptus camaldulensis</i> and Very Open Sedges of <i>Typha domingensis</i> , <i>Schoenoplectus subulatus</i> and <i>Cyperus vaginatus</i> on brown light clay on dolerite platforms of major drainage lines	
High	MA TydCyv EcrEv AciAcp	Sedges of <i>Typha domingensis</i> and <i>Cyperus vaginatus</i> with Open Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> and <i>Eucalyptus victrix</i> over Low Open Woodland of <i>Acacia citrinoviridis</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> on brown clayey sand on permanent pools along major drainage lines	

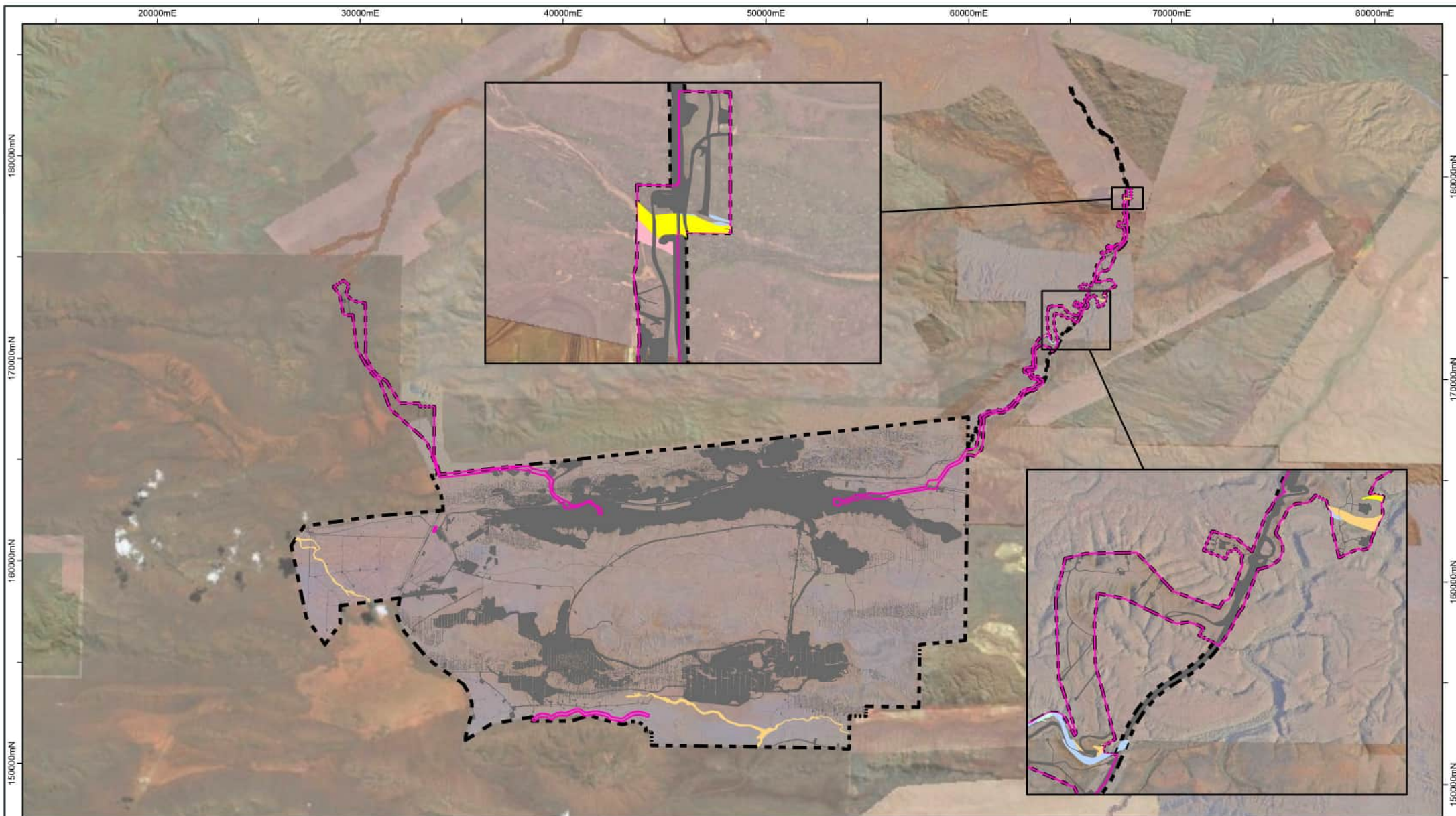
GDV likelihood	Vegetation association	Vegetation description	Occurs within Development Envelope
Moderate	MA AaAciApr CcTtChf EvEcr	Low Open Forest of <i>Acacia aptaneura</i> , <i>Acacia citrinoviridis</i> and <i>Acacia pruinocarpa</i> very Open Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Themeda triandra</i> and <i>Chrysopogon fallax</i> with Open Woodland of <i>Eucalyptus victrix</i> and <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> on brown loamy sand on major drainage lines with broad and deeply incised drainage channels	
Moderate	MA AtpAypAse Ecr ThmbTtCyp	High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Acacia sericophylla</i> with Scattered Trees of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> over Open Tussock Grassland of <i>Themeda</i> sp. Mt Barricade (M.E. Trudgen 2471), <i>Themeda triandra</i> and <i>Cymbopogon procerus</i> on brown loam and gravels on major drainage channels.	✓
Moderate	MA AtuGrwAl EcEv TtCyaCc	High shrubland of <i>Acacia tumida</i> , <i>Grevillea wickhamii</i> , <i>Androcalva luteiflora</i> with low open woodland of <i>Eucalyptus camaldulensis</i> , <i>Eucalyptus victrix</i> over open tussock grassland of <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> , <i>*Cenchrus ciliaris</i> on red-brown sandy loam on major creeklines	
Moderate	MA CocrTerfc EcrEv EteCcEpd	Low Open Heath of <i>Corchorus crozophorifolius</i> and <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186) with Scattered Trees of <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> and Scattered Tussock Grasses of <i>Eriachne tenuiculmis</i> , <i>*Cenchrus ciliaris</i> and <i>Eriachne pulchella</i> subsp. <i>dominii</i> on creekbed of major drainage line with brown clay loam	
Moderate	MA Ec	<i>Eucalyptus camaldulensis</i> mid isolated trees on brown sandy clay loam on major drainage lines, occupying the bare stony portions of the channel.	
Moderate	MA EcoEv AciAcp TtEuaCc	Woodland of <i>Eucalyptus camaldulensis</i> var. <i>obtusa</i> and <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia citrinoviridis</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> over Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cenchrus ciliaris</i> on major drainage lines with brown sand	
Moderate	MA EcoEv EuaTtCyo Mg	Mid to low open woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> and <i>Eucalyptus victrix</i> over mid open tussock grassland of <i>Eulalia aurea</i> , <i>Themeda triandra</i> and <i>Cymbopogon obtectus</i> over mid sparse shrubland of <i>Melaleuca glomerata</i> on brown loamy sand on major drainage lines.	
Moderate	MA EcrEv AciAcp Mg	Open Woodland of <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> over Low Open Woodland of <i>Acacia citrinoviridis</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> over High Open Shrubland of <i>Melaleuca glomerata</i> on river bed with brown sand	
Moderate	MA EcrEv AciAypMg CcEuaTt	Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> and <i>Eucalyptus victrix</i> over High Open Shrubland of <i>Acacia citrinoviridis</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Melaleuca glomerata</i> over Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> on brown clay loam on banks of major drainage lines	✓
Moderate	MA EcrEv AcpAtheEv TpTlo	Woodland to Open Woodland of <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Atalaya hemiglauca</i> and <i>Eucalyptus victrix</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia longiceps</i> on brown sand	✓
Moderate	MA EcrEv SoplEuaTt ApyAtpPI	Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> and <i>Eucalyptus victrix</i> over Open Tussock Grassland of <i>Sorghum plumosum</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> with High Open Shrubland of <i>Acacia pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Petalostylis labicheoides</i> on brown clayey sand on major drainage lines	
Moderate	MA EcrEvEx AypAtpGoro TtEuaCyp	Low Open Forest of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Eucalyptus xerothermica</i> over High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Gossypium robinsonii</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cymbopogon procerus</i> on red brown clay loam on major drainage lines	✓
Moderate	MA Ev TefcCocrApy TtSoplCya	Low Woodland of <i>Eucalyptus victrix</i> over Low Shrubland of <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186), <i>Corchorus crozophorifolius</i> and <i>Acacia pyrifolia</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Sorghum plumosum</i> and <i>Cymbopogon ambiguus</i> on brown sand on major drainage lines.	
Moderate	MA EvAciEcr TercCocrAyp CcEuaTt	Woodland of <i>Eucalyptus victrix</i> , <i>Acacia citrinoviridis</i> and <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> over Low Open Shrubland of <i>Tephrosia rosea</i> var. <i>clementii</i> , <i>Corchorus crozophorifolius</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> over Very Open Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> on brown loamy sand on channels of major drainage lines	✓
Moderate	Ma EvEco AtpGoroAnl TtEuaCyo	Mid to low open woodland of <i>Eucalyptus victrix</i> and <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> over high sparse shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Gossypium robinsonii</i> and <i>Androcalva luteiflora</i> over mid open tussock grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cymbopogon obtectus</i> on red sandy clay loam on major drainage lines.	
Moderate	MA EvEcoAcp Mg PldClvPhm	Mid to low open woodland of <i>Eucalyptus victrix</i> , <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> and <i>Acacia coriacea</i> subsp. <i>pendens</i> over high open shrubland of <i>Melaleuca glomerata</i> over low sparse herbland of <i>Pluchea dentex</i> , <i>Cleome viscosa</i> and <i>Phyllanthus maderaspatensis</i> on red/ brown clay loam on major drainage lines.	
Moderate	MA MgAcpGoro EuaTtErmu EvEco	High shrubland (to high open shrubland) of <i>Melaleuca glomerata</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Gossypium robinsonii</i> over mid open tussock grassland of <i>Eulalia aurea</i> , <i>Themeda triandra</i> and <i>Eriachne mucronata</i> with mid to low open woodland (to sparse woodland) of <i>Eucalyptus victrix</i> and <i>Eucalyptus camaldulensis</i> subsp. <i>obtusa</i> on brown clayey loam sand on major drainage lines.	

GDV likelihood	Vegetation association	Vegetation description	Occurs within Development Envelope
Moderate	ME EcEv AciAcor CcTtErb PIAPy Cocr	<i>Eucalyptus camaldulensis</i> , <i>E. victrix</i> mid woodland over <i>Acacia citrinoviridis</i> , <i>A. coriacea</i> low open woodland over * <i>Cenchrus ciliaris</i> , <i>Themeda triandra</i> , <i>Eriachne benthamii</i> low open tussock grassland with <i>Petalostylis labicheoides</i> , <i>A. pyrifolia</i> tall sparse shrubland over <i>Corchorus crozophorifolius</i> low sparse shrubland. On brown sandy clay loam on medium drainage lines (and adjacent major drainage lines, occupying dryer sections of creek bed, banks, islands and floodplains)	
Low	FP AaEv Duf EuaErbArc	Low Woodland of <i>Acacia aptaneura</i> and <i>Eucalyptus victrix</i> with Scattered Shrubs of <i>Duma florulenta</i> over Open Tussock Grassland of <i>Eulalia aurea</i> , <i>Eriachne benthamii</i> and <i>Aristida contorta</i> on orange brown clay loam on floodplains	
Low	FP AaEv ErbEua Duf	"Closed Forest of <i>Acacia aptaneura</i> and <i>Eucalyptus victrix</i> over Open Tussock Grassland of <i>Eriachne benthamii</i> and <i>Eulalia aurea</i> with Open Shrubland of <i>Duma florulenta</i> on red brown clay on floodplains	
Low	FP AaEv EuaErb Duf	Open Forest of <i>Acacia aptaneura</i> and <i>Eucalyptus victrix</i> over Open Tussock Grassland of <i>Eulalia aurea</i> and <i>Eriachne benthamii</i> with Open Shrubland of <i>Duma florulenta</i> on red brown clay loam on plains	
Low	FP ErbEuaTt Ev Duf	Tussock Grassland of <i>Eriachne benthamii</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> with Woodland of <i>Eucalyptus victrix</i> over Open Shrubland of <i>Duma florulenta</i> on orange brown loamy clay on alluvial plains	
Low	FP EuaErbTt EvAa Duf	Tussock Grassland of <i>Eulalia aurea</i> , <i>Eriachne benthamii</i> and <i>Themeda triandra</i> with Woodland of <i>Eucalyptus victrix</i> and <i>Acacia aptaneura</i> over Open Shrubland of <i>Duma florulenta</i> on red brown clay loam on alluvial plains	
Low	FP Ev Aa EuaErbTt	Woodland of <i>Eucalyptus victrix</i> over Low Woodland of <i>Acacia aptaneura</i> over Open Tussock Grassland of <i>Eulalia aurea</i> , <i>Eriachne benthamii</i> and <i>Themeda triandra</i> on orange clay loam on floodplains	
Low	FP Tp ChHallEv TefcApy	Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> and <i>Eucalyptus victrix</i> over Low Open Shrubland of <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186) and <i>Acacia pyrifolia</i> on brown sandy loam on floodplains and drainage lines	
Low	FP TtEuaAri EvCa GoroEroAthe	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Aristida inaequiglumis</i> with Open Woodland of <i>Eucalyptus victrix</i> and <i>Corymbia aspera</i> and High Open Shrubland of <i>Gossypium robinsonii</i> , <i>Eremophila longifolia</i> and <i>Atalaya hemiglauca</i> on brown sandy loam on plains	
Low	MA Aci CcTt PIAPy Cocr EvEc	<i>Acacia citrinoviridis</i> low open forest over * <i>Cenchrus ciliaris</i> , <i>Themeda triandra</i> low open tussock grassland with <i>Petalostylis labicheoides</i> , <i>A. pyrifolia</i> tall sparse shrubland over <i>Corchorus crozophorifolius</i> low sparse shrubland with <i>Eucalyptus victrix</i> , <i>E. camaldulensis</i> low isolated trees on brown sandy clay loam on major and medium drainage lines, occupying the rocky drier sections (islands, floodplains).	
Low	MA CcCs Aci EcrEv	Closed Tussock Grassland of * <i>Cenchrus ciliaris</i> and * <i>Cenchrus setiger</i> with Low Open Forest of <i>Acacia citrinoviridis</i> and Scattered Low Trees of <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> on banks and floodplains of major drainage line with brown sandy loam.	✓
Low	MA CcCs EvAciAthe	Tussock Grassland * <i>Cenchrus ciliaris</i> and * <i>Cenchrus setiger</i> with Low Woodland of <i>Eucalyptus victrix</i> , <i>Acacia citrinoviridis</i> and <i>Atalaya hemiglauca</i> on brown sandy loam on major drainage lines and adjacent flood plains	
Low	ME EuaTtErt EvEx GoroAeAma	Tussock Grassland of <i>Eulalia aurea</i> , <i>Themeda triandra</i> and <i>Eriachne tenuiculmis</i> with Low Open Woodland of <i>Eucalyptus victrix</i> and <i>Eucalyptus xerothermica</i> and High Open Shrubland of <i>Gossypium robinsonii</i> , <i>Acacia elachantha</i> and <i>Acacia maitlandii</i> in medium drainage lines.	
Low	ME EvEc ExAci ErbTtEua ApyAnlGoro CocrTefc	<i>Eucalyptus victrix</i> , <i>E. camaldulensis</i> mid open woodland over <i>E. xerothermica</i> , <i>Acacia citrinoviridis</i> low open woodland over <i>Eriachne benthamii</i> , <i>Themeda triandra</i> , <i>Eulalia aurea</i> low open tussock grassland with <i>A. pyrifolia</i> , <i>Androcalva luteiflora</i> , <i>Gossypium robinsonii</i> mid to tall sparse shrubland over <i>Corchorus crozophorifolius</i> , <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186) low sparse shrubland. On red sandy loam on medium drainage lines.	
Low	ME Mg Erb Ec	<i>Melaleuca glomerata</i> tall open shrubland over <i>Eriachne benthamii</i> low sparse tussock grassland with <i>Eucalyptus camaldulensis</i> mid isolated trees on brown sand amongst rocky outcropping (mixed geology) in medium drainage lines, occupying narrow areas of creekline with high flow and high erosive force.	
Low	ME TtChfEua ExEvCh PIAaApy	Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eulalia aurea</i> with Low Open Woodland of <i>Eucalyptus xerothermica</i> , <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pachyacra</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on red sandy loam on medium drainage lines	✓

GDV likelihood	Vegetation association	Vegetation description	Occurs within Development Envelope
Low	ME TtCyaEnI Cyv AcpEvCh	Open Tussock Grassland of <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> and <i>Enneapogon lindleyanus</i> with Open Sedges of <i>Cyperus vaginatus</i> with Low Open Woodland of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> on brown silty loam on medium drainage lines.	
Negligible	MA AciAcpAthe Tp EteEnI	Low Woodland of <i>Acacia citrinoviridis</i> , <i>Acacia coriacea</i> subsp. <i>pendens</i> and <i>Atalaya hemiglauca</i> with Open Hummock Grassland of <i>Triodia pungens</i> and Open Tussock Grassland of <i>Eriachne tenuiculmis</i> and <i>Enneapogon lindleyanus</i> on brown loam on raised levee banks of major drainage line	
Negligible	MA TtCc PIAbAnI EICh	Tussock Grassland of <i>Themeda triandra</i> and <i>*Cenchrus ciliaris</i> with Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia bivenosa</i> and <i>Androcalva luteiflora</i> and Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> on red brown loam on drainage levees	
Negligible	ME ApyScspSal TtPamu ExCh	"Open shrubland of <i>Acacia pyrifolia</i> , <i>Scaevola spinescens</i> and <i>Santalum lanceolatum</i> over scattered tussock grasses of <i>Themeda triandra</i> and <i>Paraneurachne muelleri</i> with low scattered trees of <i>Eucalyptus xerothermica</i> and <i>Corymbia hamersleyana</i> on red clay loam on medium drainage lines	✓
Negligible	ME AtGrwAl Ch TpErmuTtCya	High open shrubland to shrubland of <i>Acacia tumida</i> , <i>Grevillea wickhamii</i> , <i>Androcalva luteiflora</i> with low open woodland to low scattered trees of <i>Corymbia hamersleyana</i> over open to scattered hummock grassland of <i>Triodia pungens</i> and open to scattered tussock grassland of <i>Eriachne mucronata</i> , <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> on brown sandy loam on medium to minor drainage lines	
Negligible	ME AtpAmAma TtEua Tp ChElIEx	Mid Open Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia monticola</i> , <i>Acacia maitlandii</i> over Open Tussock Grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> with <i>Triodia pungens</i> hummock grasses with Low <i>Corymbia hamersleyana</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus xerothermica</i> along medium drainage lines	✓
Negligible	ME Tp(Tv) AaAprEx PI	Hummock Grassland of <i>Triodia pungens</i> (+/- <i>Triodia vanleeuwenii</i> , Tussock Grasses) with Low Woodland of <i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> , <i>Eucalyptus xerothermica</i> over Tall Open Shrubland of <i>Petalostylis labicheoides</i> along medium drainage lines.	✓
Negligible	ME TP EICh AtpAbGoro	"Open hummock grassland of <i>Triodia pungens</i> with low open woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over high open shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Acacia bivenosa</i> and <i>Gossypium robinsonii</i> on red silty loam on medium drainage lines	
Negligible	ME TpAmAnIApy ExCh	Open Hummock Grassland of <i>Triodia pungens</i> High Shrubland of <i>Acacia monticola</i> , <i>Androcalva luteiflora</i> and <i>Acacia pyrifolia</i> and Low Open Woodland of <i>Eucalyptus xerothermica</i> and <i>Corymbia hamersleyana</i> on medium drainage lines and floodplains with brown sandy loam	
Negligible	ME TpTlo ExAciCh PIAppyGoro	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia longiceps</i> with Low Woodland of <i>Eucalyptus xerothermica</i> , <i>Acacia citrinoviridis</i> and <i>Corymbia hamersleyana</i> over High Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Gossypium robinsonii</i> on red brown clay loam on medium drainage lines and surrounding floodplains	✓
Negligible	ME Tt ExChAa ApaAaAci	Closed Tussock Grassland of <i>Themeda triandra</i> with Low Woodland of <i>Eucalyptus xerothermica</i> , <i>Corymbia hamersleyana</i> and <i>Acacia aptaneura</i> over High Open Shrubland of <i>Acacia pachyacra</i> , <i>Acacia aptaneura</i> and <i>Acacia citrinoviridis</i> on red brown clay loam along unincised medium drainage lines	
Negligible	ME TtAriCya ChElI AmPIAnI	Open Tussock Grassland of <i>Themeda triandra</i> , <i>Aristida inaequiglumis</i> and <i>Cymbopogon ambiguus</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Shrubland of <i>Acacia monticola</i> , <i>Petalostylis labicheoides</i> and <i>Androcalva luteiflora</i> on red brown alluvium on minor and medium drainage lines	✓
Negligible	ME TtCyaCc EvExAci PIAnIGoro	Tussock Grassland of <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> and <i>Cenchrus ciliaris</i> with Low Woodland of <i>Eucalyptus victrix</i> , <i>Eucalyptus xerothermica</i> and <i>Acacia citrinoviridis</i> with High Open Shrubland of <i>Petalostylis labicheoides</i> , <i>Androcalva luteiflora</i> and <i>Gossypium robinsonii</i> on medium drainage lines with brown sand	
Negligible	ME TtErteCya Ev AbAtVf	Open tussock grassland of <i>Themeda triandra</i> , <i>Eragrostis tenellula</i> , <i>Cymbopogon ambiguus</i> with open woodland of <i>Eucalyptus victrix</i> over high open shrubland of <i>Acacia bivenosa</i> , <i>Acacia tumida</i> , <i>*Vachellia farnesiana</i> on red-brown sandy loam on medium drainage lines	
Negligible	ME TtEuaCya ExCh AnIApyErlo	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cymbopogon ambiguus</i> with Low Open Woodland of <i>Eucalyptus xerothermica</i> and <i>Corymbia hamersleyana</i> and High Open Shrubland of <i>Androcalva luteiflora</i> , <i>Acacia pyrifolia</i> and <i>Eremophila longifolia</i> in medium drainage lines	
Negligible	ME TtEuaEte ApyAtpPI EvCh	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne tenuiculmis</i> and <i>Cymbopogon ambiguus</i> with High Shrubland of <i>Acacia monticola</i> , <i>Androcalva luteiflora</i> and <i>Santalum lanceolatum</i> and Low Open Woodland of <i>Eucalyptus victrix</i> , <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> in minor drainage lines	

GDV likelihood	Vegetation association	Vegetation description	Occurs within Development Envelope
Negligible	ME TtEuaEte ApypAtpPI EvCh	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Eriachne tenuiculmis</i> with High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Petalostylis labicheoides</i> and Open Woodland of <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> on red brown silty loam on medium drainage lines and flood plains	✓
Negligible	ME TtThhsErga ExAaCh GostAln	Closed Tussock Grassland of <i>Themeda triandra</i> , <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) and <i>Eriachne aff. benthamii</i> with Low Open Woodland of <i>Eucalyptus xerothermica</i> , <i>Acacia aptaneura</i> and <i>Corymbia hamersleyana</i> and Very Open Herbs of <i>Goodenia stellata</i> and <i>Alternanathera nana</i> on brown light clay on medium drainage lines	
Negligible	MI AadsAnlDop Tp EllCh	Open Heath of <i>Acacia adsurgens</i> , <i>Androcalva luteiflora</i> and <i>Dodonaea pachyneura</i> over Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> on brown loamy sand on minor drainage lines	
Negligible	MI AbAdAma Tp TtPamuEua	Shrubland of <i>Acacia bivenosa</i> , <i>Acacia dictyophleba</i> and <i>Acacia maitlandii</i> over Open Hummock Grassland of <i>Triodia pungens</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Paraneurachne muelleri</i> and <i>Eulalia aurea</i> on brown sandy loam on minor drainage lines.	
Negligible	MI AmAancAe TpTw TtPamuEua	Open Scrub of <i>Acacia monticola</i> , <i>Acacia ancistrocarpa</i> and <i>Acacia elachantha</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia wiseana</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Paraneurachne muelleri</i> and <i>Eulalia aurea</i> in minor drainage lines	
Negligible	MI AmAmaGoro TtCyaPamu ChEll	Open Scrub of <i>Acacia monticola</i> , <i>Acacia maitlandii</i> and <i>Gossypium robinsonii</i> with Open Tussock Grassland of <i>Themeda triandra</i> , <i>Cymbopogon ambiguus</i> and <i>Paraneurachne muelleri</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on brown sandy loam on minor drainage lines	
Negligible	MI AmAncPI TsTwTp TtErmuErt	Open Scrub of <i>Acacia monticola</i> , <i>Acacia ancistrocarpa</i> and <i>Petalostylis labicheoides</i> over Open Hummock Grassland of <i>Triodia</i> sp. Shovelanna Hill (S. van Leeuwen 3835), <i>Triodia wiseana</i> and <i>Triodia pungens</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> and <i>Eriachne tenuiculmis</i> on brown sandy clay loam on minor drainage lines	
Negligible	MI AmAnlAanc Tp EllCh	Open Scrub of <i>Acacia monticola</i> , <i>Androcalva luteiflora</i> and <i>Acacia ancistrocarpa</i> with Open Hummock Grasland of <i>Triodia pungens</i> and Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> on minor drainage lines with brown sandy loam	
Negligible	MI AtGrwAm Tp ErmuTt AnlDol Ch	<i>Acacia tumida</i> , <i>Grevillea wickhamii</i> , <i>A. monticola</i> tall open shrubland over <i>Triodia pungens</i> low open hummock grassland with <i>Eriachne mucronata</i> , <i>Themeda triandra</i> low sparse tussock grassland with <i>Androcalva luteiflora</i> , <i>Dodonaea lanceolata</i> mid sparse shrubland with <i>Corymbia hamersleyana</i> low isolated trees. On red sandy clay loam on minor gullies and minor drainage lines high in the landscape.	
Negligible	MI AtpGrwhApyp TpTb CcCs	Open Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> over Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> over Open Tussock Grassland of <i>*Cenchrus ciliaris</i> and <i>*Cenchrus setiger</i> on brown sandy loam on minor drainage lines and floodplains	
Negligible	MI AtpGwApy TpTb CcCs	Open Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> over Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia basedowii</i> over Open Tussock Grassland of <i>*Cenchrus ciliaris</i> and <i>*Cenchrus setiger</i> on brown sandy loam on minor drainage lines and floodplains	
Negligible	MI AtPIApy ExCh ErmuTtEua AnlIsi TefcIng	<i>Acacia tumida</i> , <i>Petalostylis labicheoides</i> , <i>A. pyrifolia</i> tall open shrubland with <i>Eucalyptus xerothermica</i> , <i>Corymbia hamersleyana</i> low open woodland over <i>Eriachne mucronata</i> , <i>Themeda triandra</i> , <i>Eulalia aurea</i> low open tussock grassland with <i>Androcalva luteiflora</i> , <i>Isotropis iophyta</i> mid sparse shrubland over <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186), <i>Indigofera georgei</i> low sparse shrubland On red sandy clay loam on minor and medium drainage lines low in the landscape.	
Negligible	MI AtpPIAm TpTs Ch Ell	High Shrubland of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> and <i>Grevillea wickhamii</i> over Open Tussock Grassland of <i>Cymbopogon ambiguus</i> , <i>Eriachne tenuiculmis</i> and <i>Themeda triandra</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> in minor drainage lines and gorges	✓
Negligible	MI AtpPIAm TpTs ChEll	Open Scrub of <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>Petalostylis labicheoides</i> and <i>Acacia monticola</i> over Open Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia</i> sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of <i>Corymbia hamerselyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on red brown sandy loam on minor drainage lines	✓
Negligible	MI ChExEv AtpAppPI AITrfMa CcTtCam Tp	<i>Corymbia hamersleyana</i> and <i>Eucalyptus xerothermica</i> low scattered trees, with occasional <i>Eucalyptus victrix</i> mid scattered trees over <i>Acacia tumida</i> var. <i>pilbarensis</i> , <i>A. pyrifolia</i> var. <i>pyrifolia</i> and <i>Petalostylis labicheoides</i>	
Negligible	MI CyncDishCynt NeggGlfVsh	Tussock Grassland of <i>Cynodon convergens</i> , <i>Dichanthium sericeum</i> subsp. <i>humilius</i> and <i>Cynodon tenellus</i> with Herbs of <i>Neptunia gracilis</i> forma <i>gracilis</i> , <i>Glycine falcata</i> and <i>Vigna</i> sp. Hamersley Clay (A.A. Mitchell PRP 113) with Low Open Woodland of <i>Acacia aptaneura</i> and <i>Eucalyptus xerothermica</i> on brown light medium clay on minor gilgai drainage lines/zones	

GDV likelihood	Vegetation association	Vegetation description	Occurs within Development Envelope
Negligible	MI Erb VfAteAa PihCemPtgo	Tussock Grassland of <i>Eriachne benthamii</i> with Shrubland of * <i>Vachellia farnesiana</i> , <i>Acacia tetragonophylla</i> and <i>Acacia aptaneura</i> over Open Herbs of <i>Pimelea holroydii</i> , <i>Centipeda minima</i> and <i>Ptilotus gomphrenoides</i> on red silty loam on basalt parent rock on minor drainage lines	
Negligible	MI PIAtpAm ChElI TwTp	Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Acacia monticola</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Open Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia pungens</i> on red brown loam on minor drainage lines	✓
Negligible	MI Td Acow ExAaApt	<i>Typha domingensis</i> tall thicket with <i>Acacia cowleana</i> tall parse shrubland over <i>Stemodia grossa</i> low sparse shrubs with <i>Eucalyptus xerothermica</i> , <i>Acacia aptaneura</i> , <i>Acacia pruinocarpa</i> low scattered trees	✓
Negligible	MI Tp TtCya Ch	Open Hummock Grassland of <i>Triodia pungens</i> with Open Tussock Grassland of <i>Themeda triandra</i> and <i>Cymbopogon ambiguus</i> and Low Open Woodland of <i>Corymbia hamersleyana</i> in minor drainage lines	
Negligible	MI TpTw CddElIEg AmAbGrw	Open hummock grassland of <i>Triodia pungens</i> and <i>Triodia wiseana</i> with low scattered trees of <i>Corymbia deserticola</i> subsp. <i>deserticola</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus gamophylla</i> over scattered tall shrubs of <i>Acacia monticola</i> , <i>Acacia bivenosa</i> and <i>Grevillea wickhamii</i> on red silty loam on minor drainage lines	
Negligible	MI Tt ElIExHal ApySeggSeao	"Open tussock grassland of <i>Themeda triandra</i> with low open woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> with occasional <i>Eucalyptus xerothermica</i> and <i>Hakea lorea</i> over scattered shrubs of <i>Acacia pyrifolia</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> and <i>Senna glutinosa</i> subsp. <i>glutinosa</i> on red clay loam on minor drainage lines	
Negligible	MI TtErmu ChEl AIPIGrw	Tussock grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> with low to open woodland of <i>Corymbia hamersleyana</i> , <i>Eucalyptus leucophloia</i> over high shrubland to open shrubland of <i>Androcalva luteiflora</i> , <i>Petalostylis labicheoides</i> , <i>Grevillea wickhamii</i> on red-brown sandy clay loam on minor creeklines	
Negligible	MI TtEuaAri ChEx AmAnlAma	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Aristida inaequiglumis</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus xerothermica</i> and High Open Shrubland of <i>Acacia monticola</i> , <i>Androcalva luteiflora</i> and <i>Acacia maitlandii</i> on brown loamy sand on minor drainage lines	
Negligible	MI TtErmu ChElI AmaAmAnl	Tussock Grassland of <i>Themeda triandra</i> , <i>Eriachne mucronata</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> over Low Open Shrubland of <i>Acacia maitlandii</i> , <i>Acacia monticola</i> , <i>Androcalva luteiflora</i> on minor drainage lines.	✓



- Indicative Footprint
- Development Envelope
- Existing Disturbance

High Groundwater Dependence

--- MA EcrEvMa AcpAamAthe TydCyv

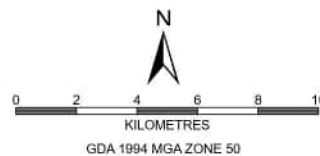
Moderate Groundwater Dependence

--- MA EcrEv AciApyyMg CcEuaTt

--- MA EcrEv AcpAtheEv TpTi

--- MA EcrEvEx ApyyAtpGoro TtEuaCyp

--- MA EvAciEcr TercCocrApyy CcEuaTt



**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
GROUNDWATER DEPENDENT VEGETATION
IN THE DEVELOPMENT ENVELOPE**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

PUBLIC

SCALE @ A3: 1:250,000

DATE: 17/02/2025

REQUESTOR: ENVIRONMENT

PREPARED: GEOMATICS

REVIEWED:

FIGURE: **8-8**

NO: **A1285-085 RevA**

Outside the Development Envelope

In addition to the 19 riparian vegetation types that occur within the Development Envelope, a further 70 occur in the local region surrounding the Development Envelope (Table 8-5). These vegetation associations are shown on Figure 8-6 and their GDV potential rating shown on Figure 8-8. A total of 33 of these are confirmed or have potential to be GDV (based on their High or Moderate likelihood of being groundwater dependent (Table 8-5; Figure 8-10). The GDV ratings were assigned to these vegetation associations by applying the same framework as Biologic (2025 *in prep*) as well as considering pre-development groundwater levels (Figure 8-10).

Areas of confirmed GDV based on vegetation association mapping and pre-development groundwater levels are shown on Figure 8-10 to Figure 8-12 and occur north and east of the Development Envelope. These are considered confirmed GDV based on them having a High likelihood of being groundwater dependent, presence of *Melaleuca argentea*, and these areas coincide with shallow groundwater levels as per Figure 8-10 to Figure 8-12. The key areas of High GDV likelihood (with regard to potential impacts from groundwater drawdown to be discussed in Sections 8.4.2 and 8.6.2) are Area D and Area F shown on Figure 8-11 and Figure 8-12 respectively. Area D contains confirmed GDV along Weeli Wolli Creek in the vicinity of Weeli Wolli spring which comprises the following vegetation associations:

- **MA EcrMaEv AciAcp AbGosnGoro:** open Forest of *Eucalyptus camaldulensis* var. *refulgens*, *Melaleuca argentea* and *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* over Shrubland of *Acacia bivenosa*, *Gossypium sturtianum* and *Gossypium robinsonii* on brown silty sand and clay along Weeli Wolli Creek.
- **MA MaEcr AciAcpAam TydCyv:** open Forest of *Melaleuca argentea* and *Eucalyptus camaldulensis* var. *refulgens* over Low Woodland of *Acacia citrinoviridis*, *Acacia coriacea* subsp. *pendens* and *Acacia ampliceps* over Open Sedges of *Typha domingensis*, *Cyperus vaginatus* and *Fimbristylis sieberiana* on brown silty sand and clay on levee banks and within stream channels with permanent water at Weeli Wolli Spring.
- **MA ClpTydCyg FisElg LoaStw Ma:** *Cladium procerum* (P2), *Typha domingensis*, *Cyperus vaginatus* tall to mid open sedgeland over *Fimbristylis sieberiana* (P3), *Eleocharis geniculata* low sparse sedgeland over *Lobelia arnhemiaca*, *Stylidium weeliwolli* (P3) low sparse forbland with *Melaleuca argentea* low isolated trees, on often skeletal and submerged black soils in major drainage lines containing a series of open calcareous rocky areas supporting permanent surface water and connecting pools.
- **MA Ec AtheAam GoroGosnStsp Cyv:** *Eucalyptus camaldulensis* mid open forest over *Atalaya hemiglaucula*, *Acacia ampliceps* low open woodland over *Gossypium robinsonii*, *G. sturtianum*, *Stylobasium spathulatum* tall open shrubland over *Cyperus vaginatus* low isolated clumps of sedges on brown sandy clay loam on major drainage lines (dense, wet wooded areas adjacent sections of Weeli Wolli Creek, occupying raised creek banks and islands out of main channel).
- **MA Ma:** *Melaleuca argentea* mid isolated trees on brown sandy clay loam on major drainage lines, occupying the bare stony portions of the channel.
- **MA MaEc AtheAam CyvFisElg Tyd:** *Melaleuca argentea*, *Eucalyptus camaldulensis* mid woodland over *Atalaya hemiglaucula*, *Acacia ampliceps* low open woodland over *Cyperus vaginatus*, *Fimbristylis sieberiana* (P3), *Eleocharis geniculata* mid to low open sedgeland with *Typha domingensis* tall isolated clumps of rushes over low isolated clumps of annual herbs. On brown sandy clay loam on major drainage lines. Drainage line contains series of open calcareous rocky areas supporting permanent surface water and connecting pools.

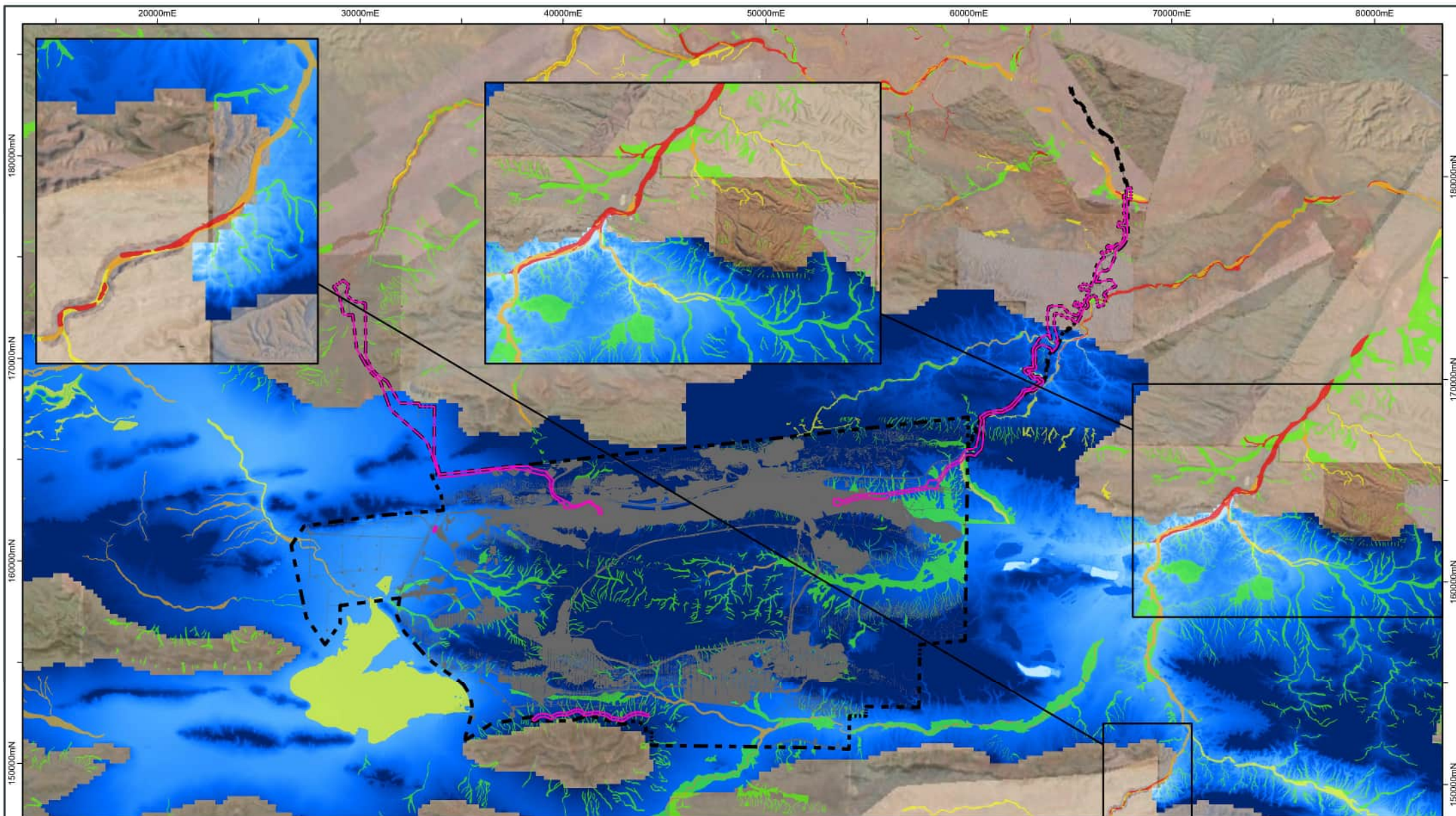
Area F contains confirmed GDV near Ben's Oasis:

- **MA MaEc AtheAam CyvFisElg Tyd:** *Melaleuca argentea*, *Eucalyptus camaldulensis* mid woodland over *Atalaya hemiglauc*, *Acacia ampliceps* low open woodland over *Cyperus vaginatus*, *Fimbristylis sieberiana* (P3), *Eleocharis geniculata* mid to low open sedgeland with *Typha domingensis* tall isolated clumps of rushes over low isolated clumps of annual herbs. On brown sandy clay loam on major drainage lines. Drainage line contains series of open calcareous rocky areas supporting permanent surface water and connecting pools.

The areas of Moderate potential GDV occur in various locations surrounding the Development Envelope as shown in Figure 8-10. These areas have been identified as potential GDV based on their Moderate likelihood of being groundwater dependent, absence of *Melaleuca argentea*, and presence of one or both of the facultative phreatophyte species *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix*. Further context with regard to estimated pre-development groundwater levels in the areas shown on Figure 8-10 is presented in Table 8-6.

Table 8-6: Moderate GDV and estimated pre-development groundwater levels

Area containing Moderate potential GDV	Description of approximate pre-development groundwater levels where Moderate GDV occurs, and conclusion on likelihood of vegetation being reliant on groundwater
A	Approximate range 25-114 mbgl. The potential Moderate GDV in this area is unlikely to be reliant on groundwater as the pre-development levels where the potential GDV occurs all exceed 20 mbgl.
B	Approximate range 7 mbgl -109 mbgl. Some areas where the pre-development groundwater levels range between 7-20 mbgl (these occur in the north-east of Area B) may indicate some reliance on groundwater where the potential Moderate GDV occurs. The occurrence of Moderate GDV in the south of Area B coincides with Pre-development groundwater levels well above 20 mbgl (in the order of 70-100 mbgl).
C	Approximate range 34-85 mbgl. Potential Moderate GDV unlikely to be reliant on groundwater.
D	Approximate range <1-26 mbgl. The shallower areas, i.e. <20mbgl may indicate some reliance on groundwater for the Moderate GDV. These areas have been subject to significant drawdown from the Hope Downs 1 operation, and monitoring has indicated minimal effects to date on riparian vegetation despite some areas having shallow groundwater levels pre-development (Rio Tinto 2024). This is discussed further in Sections 8.4.2 and 8.6.2, however provides useful context in confirming these areas are likely being supported by the mitigation currently being implemented by RTIO.
E	The Moderate GDV along this north-south stretch of Weeli Wolli Creek lacks <i>Melaleuca argentea</i> and the pre-development groundwater levels in these areas range from 7 mbgl in the north, to 46 mbgl in the south. This stretch of Weeli Wolli Creek has been subject to significant drawdown from the Hope Downs 1 operation, and monitoring has indicated minimal effects to date on riparian vegetation despite some areas having shallow groundwater levels pre-development. This is discussed further in Sections 8.4.2 and 8.6.2, however provides useful context in confirming these areas do not appear to be reliant on groundwater.
F	In this area surrounding Ben's Oasis, the pre-development groundwater levels where potential GDV occurs are the same elevation as the creek (as described previously with regard to bore HDD0001M), therefore the Moderate GDV in the Ben's Oasis area is likely to be reliant on groundwater for a portion of the key GDV species' water requirements.



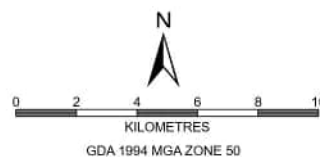
— Indicative Footprint
- - - Development Envelope
— Existing Disturbance

Pre-development Groundwater Depth (mbgl)

— 10
— 120

GDV Rating

— High
— Moderate
— Low
— Negligible



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MINING AREA C-SOUTH FLANK

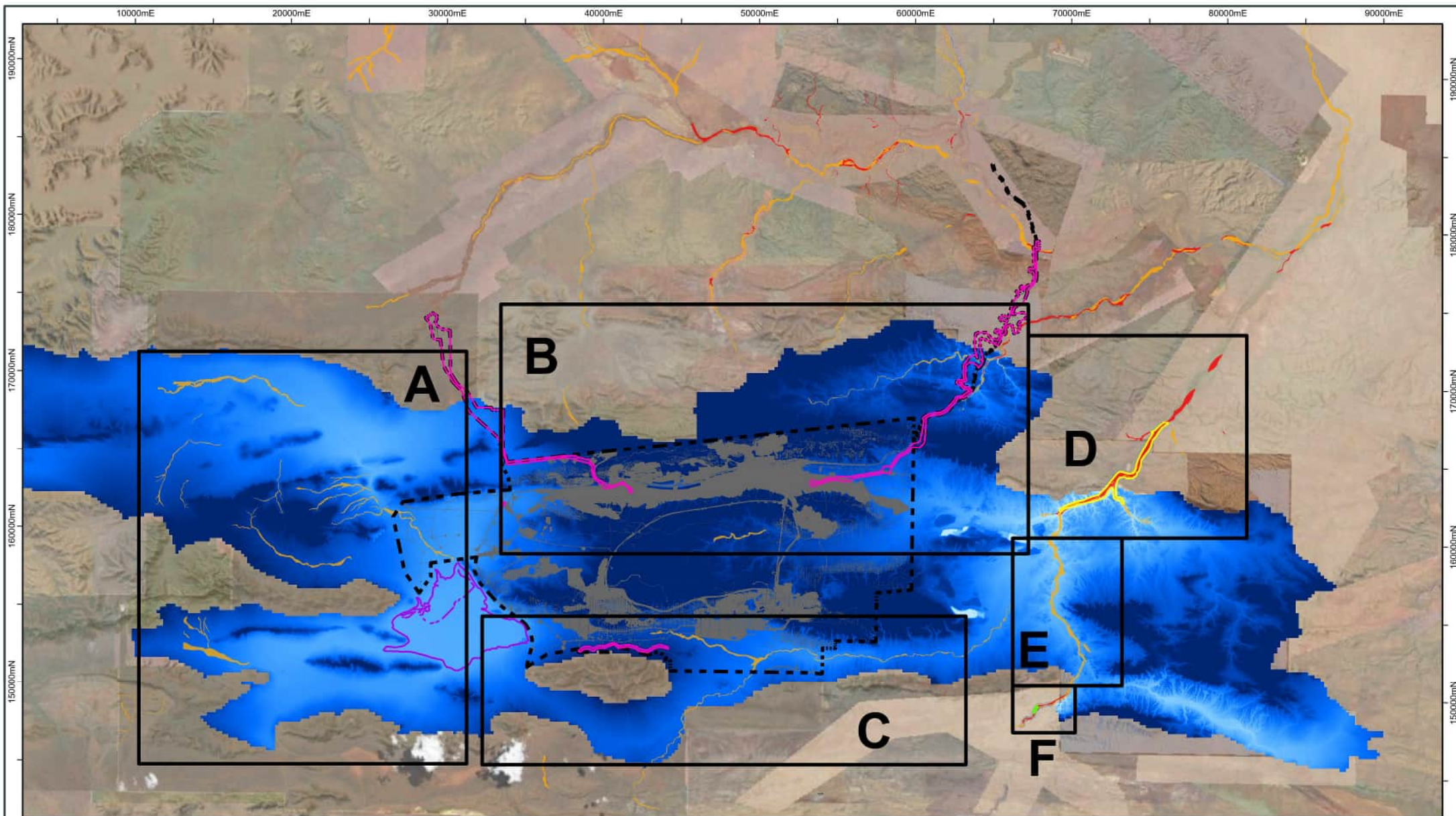
SIGNIFICANT AMENDMENT

POTENTIAL GROUNDWATER DEPENDENT

VEGETATION

WAO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:250,000	REQUESTOR: ENVIRONMENT	FIGURE: 8-9
DATE: 12/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-011 RevJ



Indicative Footprint

Development Envelope

Existing Disturbance

Pre-development Groundwater Depth (mbgl)



PECs

Ben's Oasis

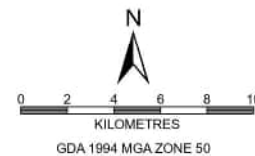
Coondewanna Flats

Weeli Wolli Spring

GDV Category

High

Moderate



BHP

PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
HIGH (CONFIRMED) AND MODERATE
POTENTIAL GDV**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:325,000
DATE: 12/02/2025

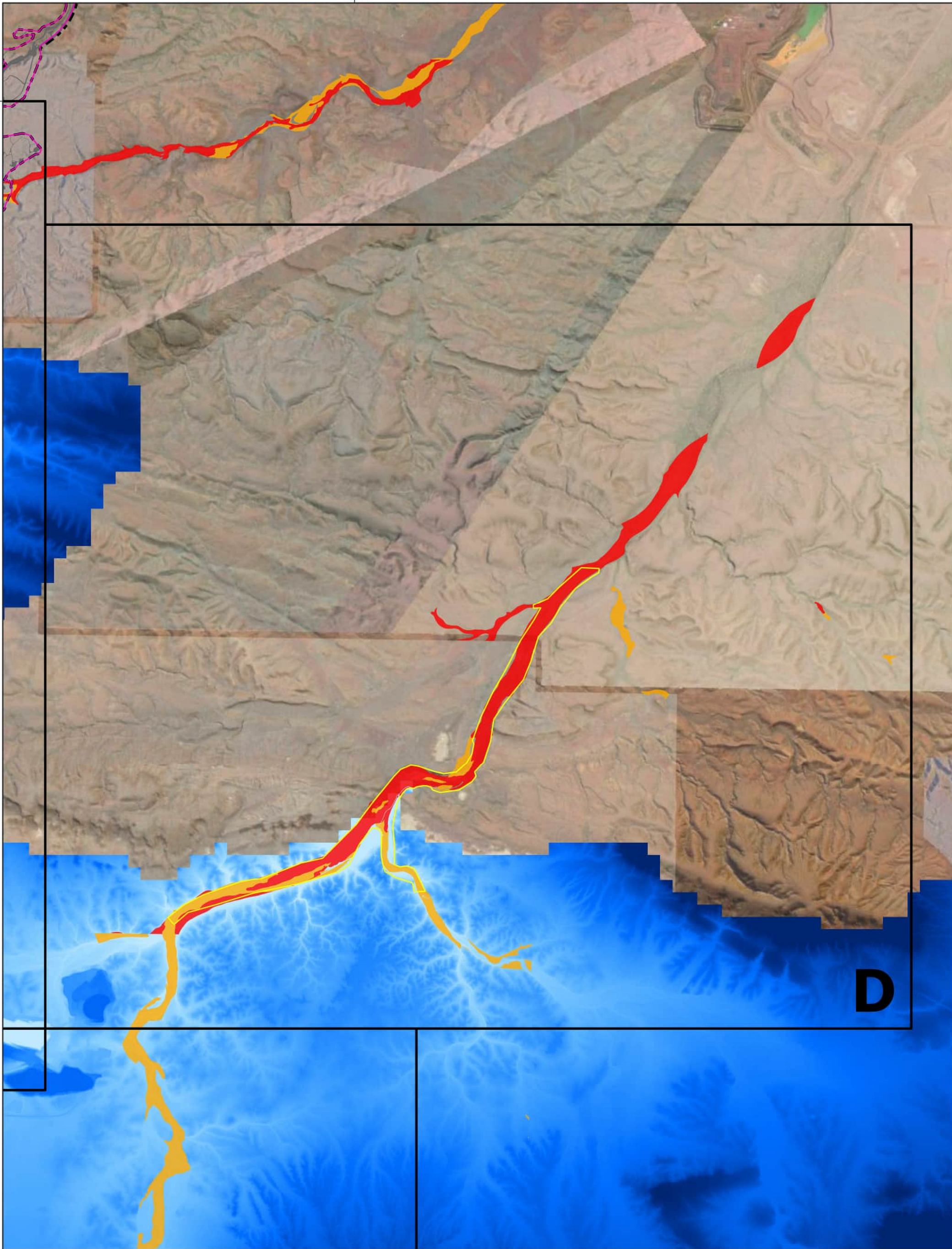
REQUESTOR: ENVIRONMENT
PREPARED: GEOMATICS
REVIEWED:

FIGURE: **8-10**
NO: **A1285-080_RevF**

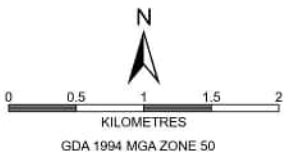
725000mE

7475000mN

7475000mN



- Weeli Wolli Spring
- Indicative Footprint
- Development Envelope
- Existing Disturbance
- GDV Category**
- High
- Moderate



BHP PUBLIC

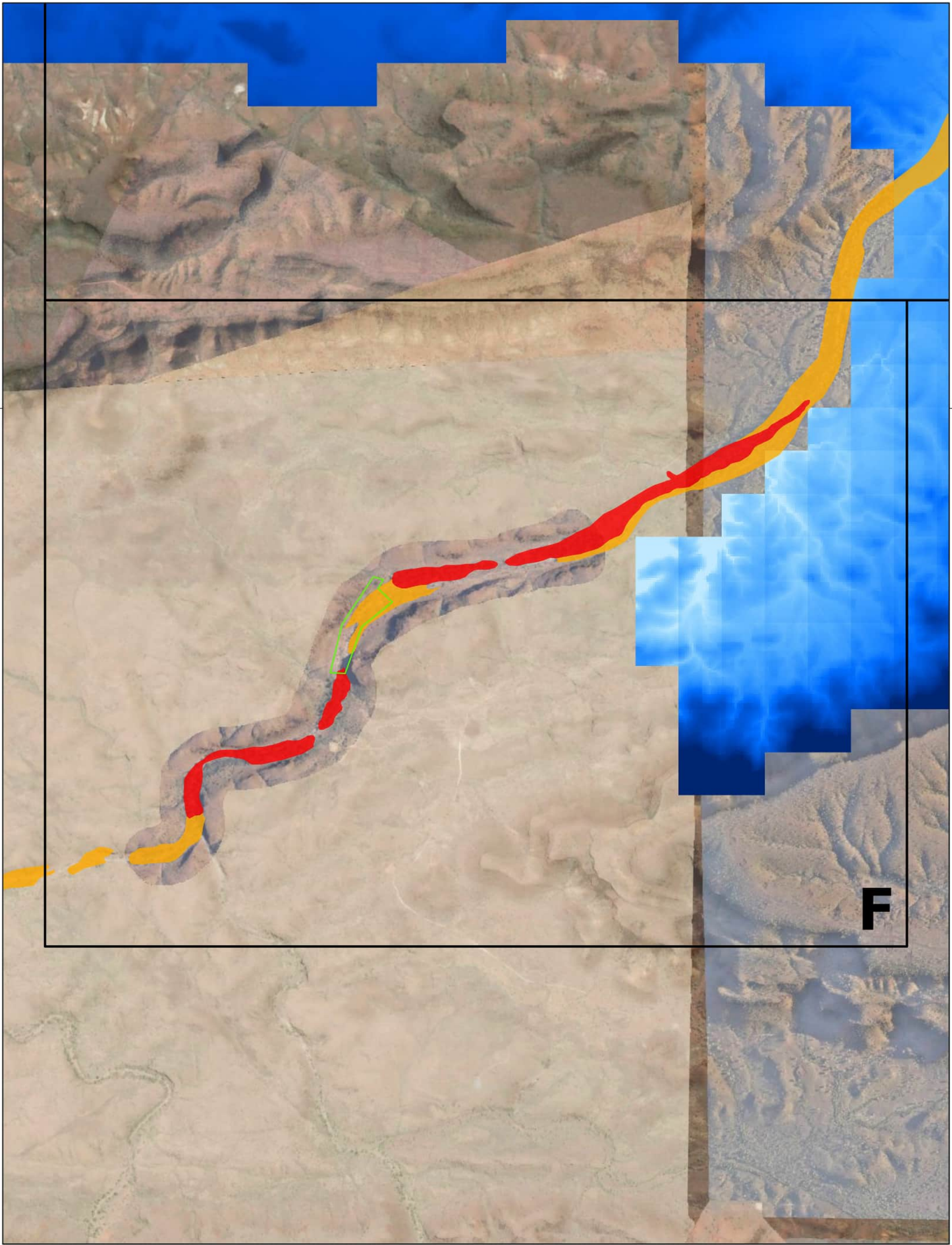
**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT**
HIGH (CONFIRMED) AND MODERATE
POTENTIAL GDV: Area D

WAIO- PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3:	1:56,000	REQUESTOR:	ENVIRONMENT	FIGURE:	B-11
DATE:	18/02/2025	PREPARED:	GEOMATICS		
		REVIEWED:		NO:	A1285-084 RevC

745000mN

745000mN



Ben's Oasis Pre-development Groundwater Depth (mbgl)

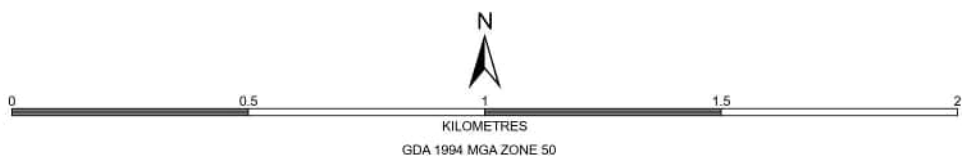
GDV Category

High

Moderate

10

120



BHP**PUBLIC**

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT**
HIGH (CONFIRMED) AND MODERATE
POTENTIAL GDV: Area F

WAIO- PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3: 1:16,000
DATE: 18/02/2025

REQUESTOR: ENVIRONMENT
PREPARED: GEOMATICS
REVIEWED:

FIGURE: 8-12
NO: **A1285-084 RevC**

Ecosystems at Risk

A total of 12 vegetation associations within the Development Envelope are analogous with ‘ecosystems at risk’ for the Hamersley subregion (Kendrick 2001) (Table 8-7; Figure 8-13).

Five of these vegetation associations are considered to be ‘valley floor mulga’ as they contain mulga species as the most dominant components (*Acacia aptaneura*, *Acacia paraneura* and/ or *Acacia pteraneura*) of either open forest, woodland, or open woodland occurring on lower valley floor landforms (i.e. floodplains and stony plains as outlined in Table 8-7). Two of these vegetation associations are considered in part to be ‘grove/ inter-grove mulga’ (Biologic 2024a). Mulga has an extensive shallow root system that efficiently utilises ephemeral surface water. Mulga communities that occur in a patterned sequence of alternating grove and inter-groves are considered likely to be dependent on sheetflow water for resource (nutrient and water) capture (Greene 1992). The ‘valley floor mulga’ vegetation types also contained tussock/ bunch grasses as the grassland layer³. These mulga over tussock grass ecosystems occur on loamy, friable soils susceptible to erosion, and are open to heavy grazing and fire, making them vulnerable to ecosystem degradation/ alteration (van Vreeswyk et al. 2004).

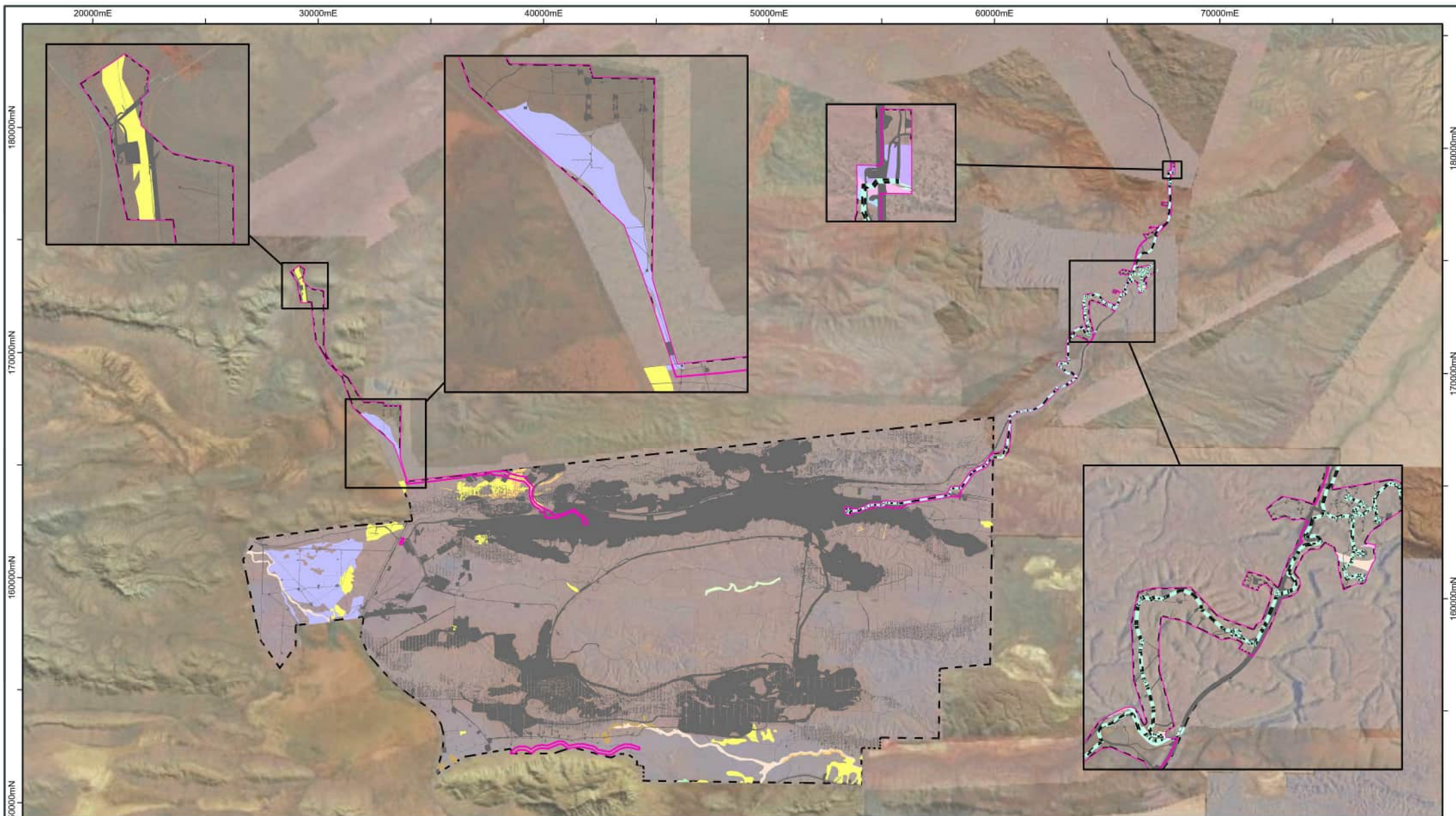
The remaining seven of the 12 vegetation associations analogous with ‘ecosystems at risk’ are major drainage line vegetation occurring in the Development Envelope and therefore represent ‘major ephemeral water courses’ and are described as being at risk by Kendrick (2001). Threatening processes for these ecosystems include stock, weeds, frequent fires, and mining (Kendrick 2001).

Table 8-7: Ecosystems at Risk within the Development Envelope

Ecosystem at Risk	Analogous Vegetation Types	Landform(s)	Key threatening processes
Valley floor mulga	- FP AaAcaoAp ErlnSolPto ArcErdiArj - FP AaApApt TtChfErb - FP TtEua ExAa AprAtpErlo - SP AaApr TmTwTp TtChfAri - SP AcaoAa ArobDiaChf	Floodplains, stony plains	Introduced fauna, weeds, changed fire regimes and water shadow from linear infrastructure ¹
Grove/inter-grove mulga	- FP AaApApt TtChfErb - FP AaAcaoAp ErlnSolPto ArcErdiArj	Floodplains	Introduced fauna, weeds, changed fire regimes and water shadow from linear infrastructure
Major ephemeral water courses	- MA AtpApypAse Ecr ThmbTtCyp - MA CcCs Aci EcrEv - MA EcrEv AciApypMg CcEuaTt - MA EcrEv AcpAtheEv TpTl - MA EcrEvEx ApypAtpGoro TtEuaCyp - MA EcrEvMa AcpAamAthe TydCyp - MA EvAciEcr TercCocrApyp CcEuaTt	Major drainage lines	Introduced fauna and weeds

¹ Generally unlikely compared to Grove/intergrove Mulga.

³ Mulga vegetation types with hummock grasses (*Triodia* spp.) present were excluded (SP AaApr TmTwTp TtChfAri).



Valley Floor Mulga

- FP AaAcaoAp ErlnSolPto ArcErdiArj
- FP AaApApt TtChfErb
- FP TtEua ExAa AprAtpErlo
- SP AaApr TmTwTp TtChfAri
- SP AcaoAa ArobDiaChf

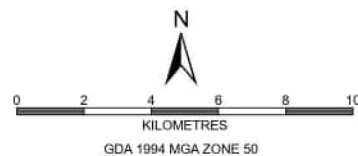
Grove / Inter-Grove Mulga

- FP AaAcaoAp ErlnSolPto ArcErdiArj
- FP AaApApt TtChfErb

Major Ephemeral Water Courses

- MA AtpAypAse Ecr ThmbTtCyp
- MA CcCs Aci EcrEv
- MA EcrEv AciAypMg CcEuaTt
- MA EcrEv AcpAtheEv TpTl
- MA EcrEvEx AypAtpGoro TtEuaCyp
- MA EcrEvMa AcpAamAthe TydCyy
- MA EvAciEcr TercCocrAyp CcEuaTt

- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Northeast Pipeline



BHP

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MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT DBCA ECOSYSTEMS AT RISK

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:225,000	REQUESTOR: ENVIRONMENT	FIGURE: 8-13
DATE: 12/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-012 RevD

Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) are known from within the Development Envelope. One PEC (known as Coondewanna Flats) has a buffer overlapping with the Development Envelope (Figure 8-14), but the location of the actual occurrence of this PEC is not directly within the Development Envelope. One additional PEC occurs within 10 km of the Development Envelope (Figure 8-14), Weeli Wolli Spring Community (P1).

Coondewanna Flats

Coondewanna Flats is located on the western side of the Development Envelope, south of Juna Downs MAR and west of Great Northern Highway. The PEC consists of woodland or forest of *Eucalyptus victrix* (coolibah) over thicket of *Duma florulenta* (lignum) on red clays in run-on zones. Associated species include *Eriachne benthamii*, *Themeda triandra*, *Aristida latifolia*, *Eulalia aurea* and *Acacia aneura* (DBCA 2023).

The two PEC sub-types that occur at Coondewanna Flats specifically comprise:

- **Priority 1:** Coolibah woodlands over lignum (*Duma florulenta*) over swamp wanderrie (*Eriachne benthamii*) (Lake Robinson is the only known occurrence of this community in the Pilbara region) (DBCA 2023)
- **Priority 3:** Coolibah and Mulga (*Acacia aptaneura*) woodland over lignum and tussock grass on clay plains (Coondawanna Flats and Wanna Munna Flats) (DBCA 2023).

Coondewanna Flats is known to be a surface water dependent (rather than a groundwater dependent) ecosystem (Section 7.3.4.1). Surface flow and flooding are likely to be important in sustaining the structure and composition of the PEC (Astron 2014; AQ2 2016 as cited in Astron 2021). Flooding and/or high soil moisture levels are also known to promote the regeneration of seedlings of riparian species in arid zone environments (Astron 2021). A recent study by Astron in 2021 (Astron 2021) also found the time series data for vegetation condition on the flats using the MSAVI index from Landsat data showed a strongly cyclical pattern where condition increases after heavy rainfall and flood events.

In general, no major changes in vegetation health within the Flats have been observed since 2015, despite changes to groundwater levels. This excludes damage to some areas of vegetation from two fire events in 2019, as well as significant decline and death of some *Eucalyptus victrix* trees at monitoring site CF15 during the period 2018-2019, which was considered most likely due to lower than average rainfall across an extended period that year (Astron 2020). The health of the trees recovered in subsequent monitoring years, however the results of the most recent monitoring indicated one site (CF15) has shown periodic declines in vegetation health that maybe associated with the extended periods of below average rainfall (2019-2023) (Astron 2024a).

Lake Robinson occurs within a topographic low at the north-eastern extent of the flats and is one of the terminus areas for catchment runoff. It supports distinct *Eucalyptus victrix* woodland vegetation communities. The *E. victrix* trees on the flats are likely to be mostly dependent on the soil stores of moisture at depth, replenished by periodic surface water inflows, rather than groundwater which occurs at approximately 20 mbgl (Astron 2014; 2021, AQ2 2016), which is reflected in the vegetation monitoring results to date, as described above. The surrounding flats are characterised by poorly defined drainages with Mulga woodland vegetation and occasional scattered Eucalypts.

Weeli Wolli Spring

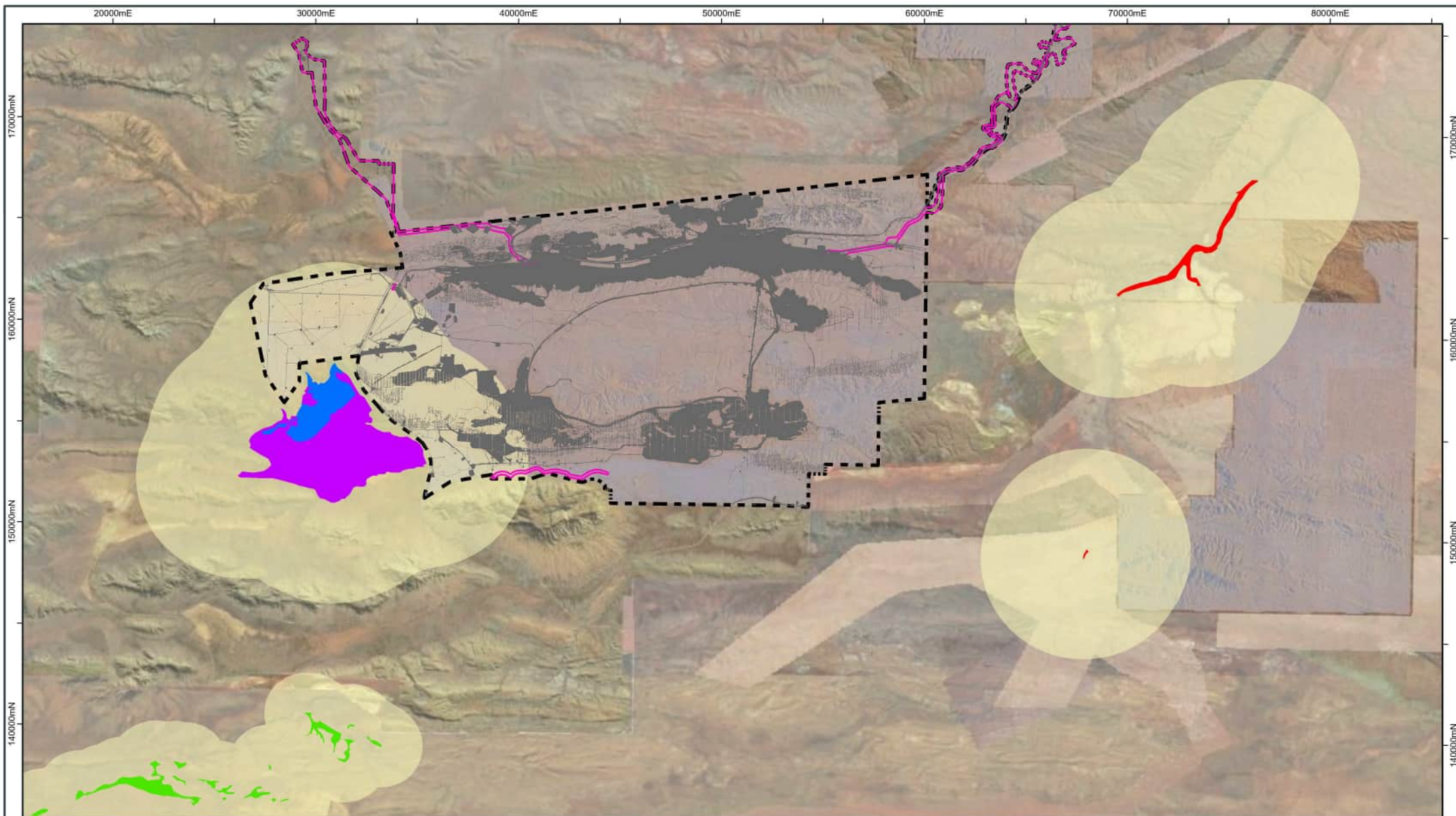
The Weeli Wolli Spring Community (and buffer) is located approximately 10 km west of the Development Envelope and is recognised as having multiple ecological values that collectively contribute to its DBCA listing as a Priority 1 ecological community. The community is described by DBCA (2023) as being:

“... riparian woodland and forest associations are unusual as a consequence of composition of the understorey. The sedge and herffield communities that fringe many of the pools and associated water bodies along the main channels of Weeli Wolli Creek have not been recorded from any other wetland site in the

Pilbara. The spring and creekline are also noted for their relatively high diversity of stygofauna and this is probably attributed to the large-scale calcrete and alluvial aquifer system associated with the creek. The valley of Weeli Wolli Spring also supports a very rich microbat assemblage including a threatened species".

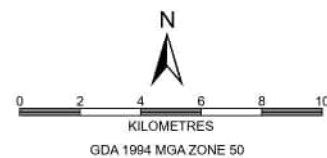
Weeli Wolli Spring supports the GDV/potential GDV species *Melaleuca argentea*, *Eucalyptus camaldulensis* and *Eucalyptus victrix*, and the presence of permanent water and very moist sediment also provides suitable habitat for many sedges and herbs. In 2014, the Weeli Wolli Spring PEC was considered by the DBCA (then DPaW) to also include Ben's Oasis (DPaW 2014), an area located approximately 20 km further upstream and south of Weeli Wolli Spring. At this location, the vegetation is concentrated along a relatively narrow creek channel adjacent to some surface water pools.

None of the vegetation associations described from the Development Envelope align with any of the PECs described above, or any other TECs or PECs known to occur in the Pilbara bioregion.



- Indicative Footprint
- Existing Disturbance
- Development Envelope
- Priority Ecological Communities Buffer

- Coolibah and mulga (*Acacia anuera*) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats) - Priority 3
- Coolibah woodlands over lignum (*Duma florulenta*) over swamp wanderrie (Lake Robinson is the only known occurrence) - Priority 1
- Weeli Wolli Spring Community - Priority 1
- West Angelas Cracking-Clays - Priority 1



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MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT TECS AND PECS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:250,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-14
DATE:	20/09/2024	PREPARED:	GEOMATICS	NO:	A1285-013 RevD
		REVIEWED:			

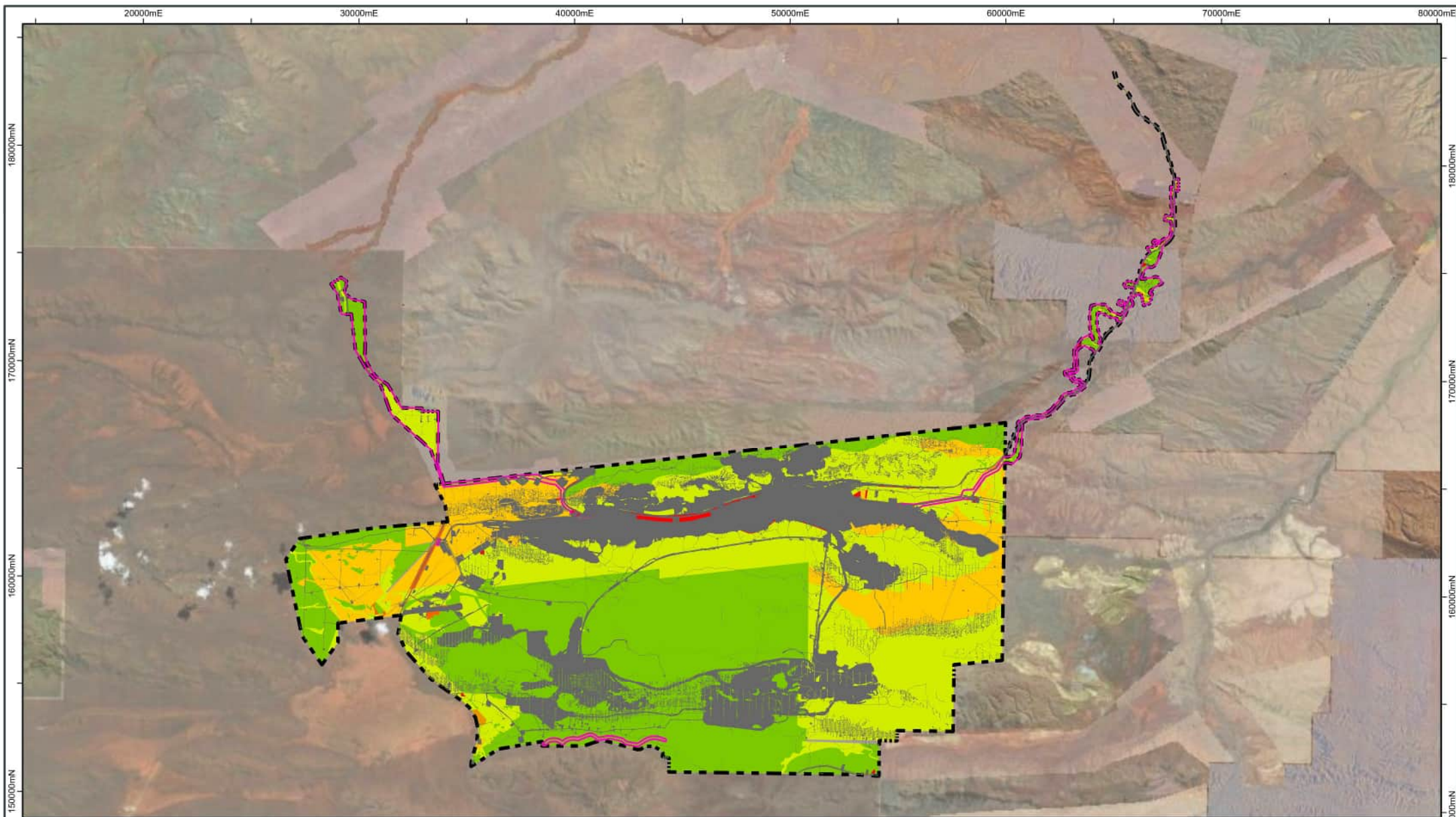
Vegetation condition

The majority of the remaining vegetation in the Development Envelope is rated as Good to Excellent condition, and only a small portion is rated as Poor to Completely Degraded (Table 8-8, Figure 8-15), based on the vegetation condition scales outlined in the EPA *Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016g).

Table 8-8: Vegetation condition in the Development Envelope

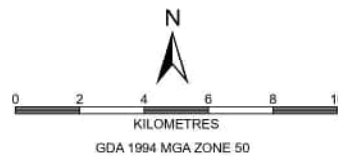
Vegetation condition	Current extent in the Development Envelope (ha)	% of total remaining vegetation in Development Envelope
Excellent	8,938.8	53%
Very Good	5,379.9	32%
Good	2,363.3	14%
Poor	20	<1%
Degraded	123.3	<1%
Completely Degraded	34.8	<1%
No survey data ¹	74.5	<1%
TOTAL	16,935	100.0%

1. These are periphery areas of the Development Envelope that have minimal or no survey information available due to survey boundary misalignment and age of surveys, with mining commencing at the Mining Area C mine in 2003. This area accounts for <1% of the Development Envelope.



- Indicative Footprint
- Development Envelope
- Existing Disturbance

- Vegetation Condition**
- Completely Degraded
 - Degraded
 - Poor
 - Good
 - Very Good
 - Excellent



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MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

VEGETATION CONDITION

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3:	1:235,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-15
DATE:	17/02/2025	PREPARED:	GEOMATICS	NO:	A1285-014 RevE
		REVIEWED:			

8.3.2.2 Significant flora

Threatened flora

No plant taxon gazetted as Threatened flora under the *Biodiversity Conservation Act 2016* (BC Act) or under the EPBC Act have been recorded from within the Development Envelope. Threatened flora will therefore not be discussed further.

Priority flora

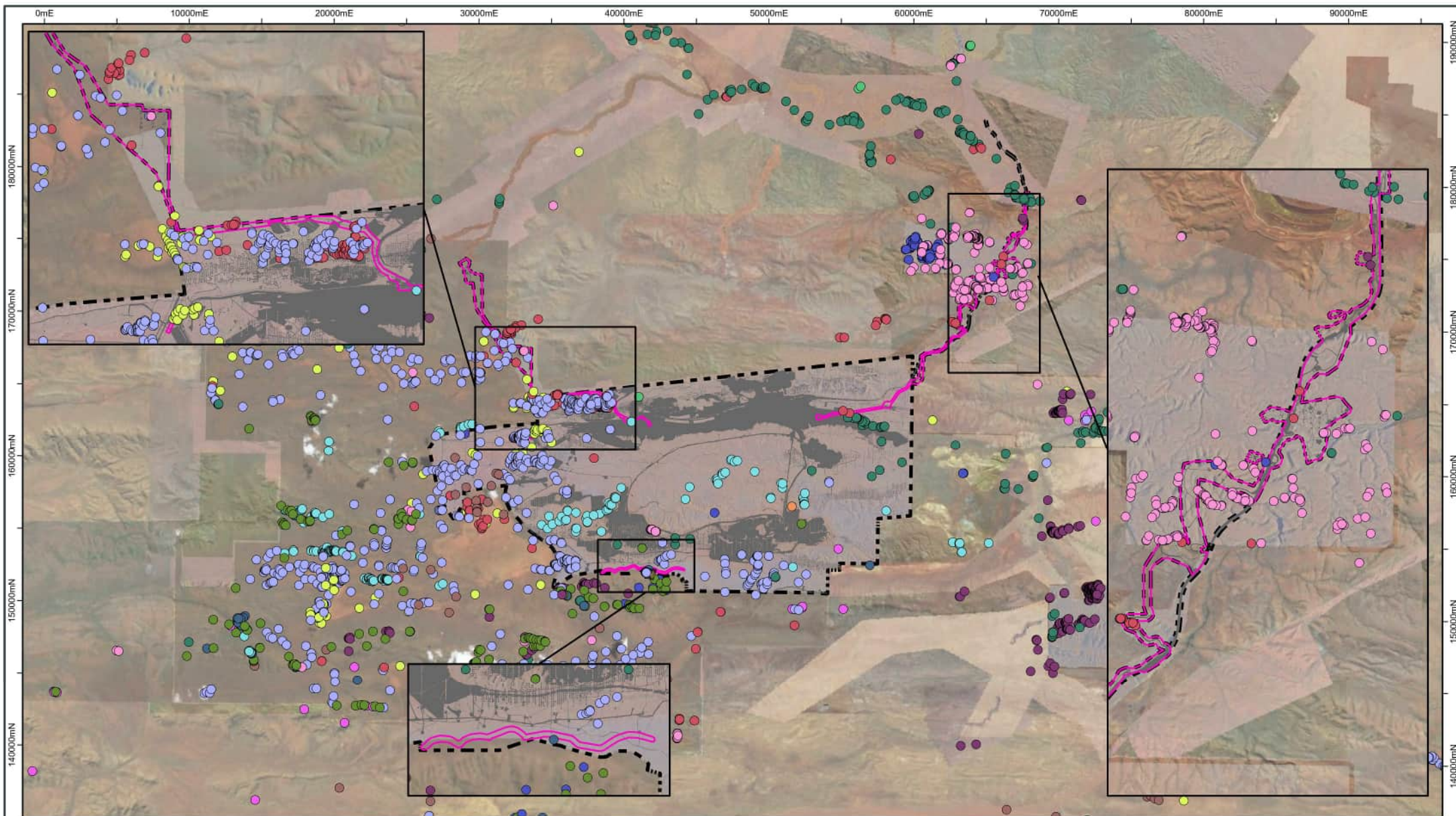
A total of 14 Priority (P) flora species, as listed by the DBCA, have been recorded within the Development Envelope (Figure 8-16):

- *Acacia bromilowiana* (P4)
- *Aristida jerichoensis* var. *subspinulifera* (P3)
- *Aristida lazaridis* (P3)
- *Eremophila magnifica* subsp. *magnifica* (P4)
- *Grevillea saxicola* (P3)
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2)
- *Isotropis parviflora* (P3)
- *Lepidium catapycnon* (P4)
- *Nicotiana umbratica* (P3)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
- *Rostellularia adscendens* var. *latifolia* (P3)
- *Sida* sp. Barlee Range (S. van Leeuwen 1642) (P4)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3).

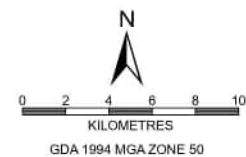
Introduced flora (weeds)

A total of 23 introduced flora (weed) species have been recorded within the Development Envelope (Figure 8-17). The most commonly recorded species are **Bidens bipinnata*, **Rumex vesicarius*, **Argemone ochroleuca* subsp. *ochroleuca* and **Melinis repens*. The introduced flora species largely occur along existing disturbance and infrastructure areas, or along drainage channels.

None of the introduced flora species are listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act).



Indicative Footprint	<i>Acacia bromilowiana</i>	<i>Lepidium catapycnon</i>
Development Envelope	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	<i>Nicotiana umbratica</i>
Existing Disturbance	<i>Aristida lazaridis</i>	<i>Rhagodia</i> sp. <i>Hammersley</i> (M. Trudgen 17794)
	<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	<i>Rostellularia adscendens</i> var. <i>latifolia</i>
	<i>Grevillea saxicola</i>	<i>Sida</i> sp. <i>Barlee Range</i> (S. van Leeuwen 1642)
	<i>Hibiscus</i> sp. <i>Gurinbiddy Range</i> (M.E. Trudgen MET 15708)	<i>Themeda</i> sp. <i>Hammersley Station</i> (M.E. Trudgen 11431)
	<i>Isotropis parviflora</i>	<i>Triodia</i> sp. <i>Mt Ella</i> (M.E. Trudgen 12739)

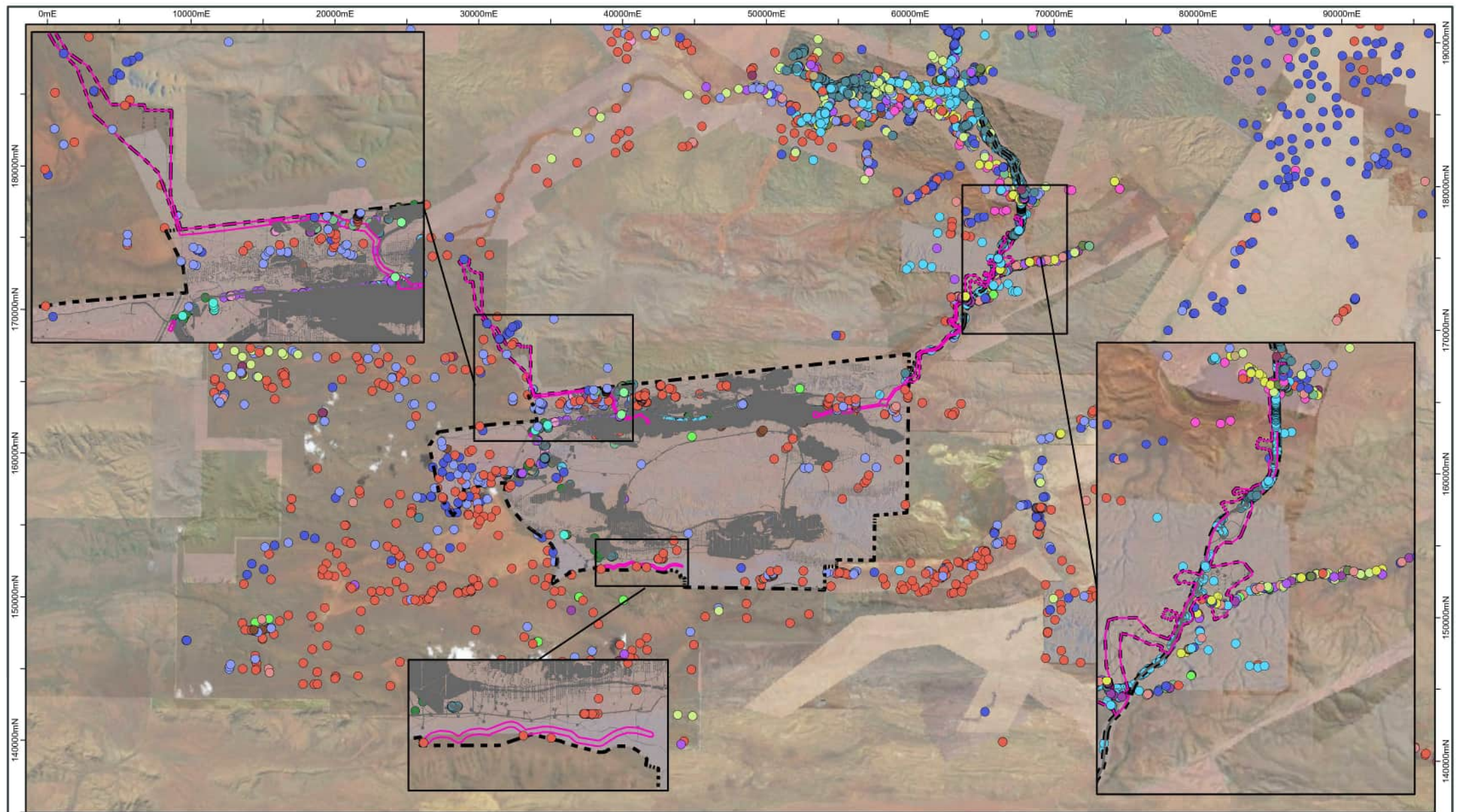


BHP **PUBLIC**

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT SIGNIFICANT FLORA SPECIES

WAO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:350,000	REQUESTOR: ENVIRONMENT	FIGURE: 8-16
DATE: 17/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-015 RevF

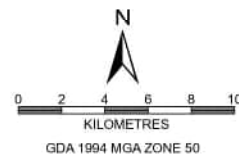


- Indicative Footprint
- Development Envelope
- Existing Disturbance

- *Aerva javanica*
- *Argemone ochroleuca*
- *Argemone ochroleuca* subsp. *ochroleuca*
- *Bidens bipinnata*
- *Cenchrus ciliaris*
- *Chloris barbata*

- *Chloris virgata*
- *Citrullus colocynthis*
- *Cynodon dactylon*
- *Datura leichhardtii*
- *Digitaria ciliaris*
- *Erigeron bonariensis*
- *Lactuca serriola*
- *Malvastrum americanum*
- *Melinis repens*

- *Rumex vesicarius*
- *Setaria verticillata*
- *Sigesbeckia orientalis*
- *Sisymbrium orientale*
- *Solanum nigrum*
- *Sonchus oleraceus*
- *Tridax procumbens*
- *Vachellia farnesiana*



BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT INTRODUCED FLORA SPECIES

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:350,000 REQUESTOR: ENVIRONMENT FIGURE: 8-17
DATE: 17/02/2025 PREPARED: GEOMATICS NO: A1285-016 RevD
REVIEWED:

8.3.2.3 Regional flora and vegetation values

The Coondewanna Flats and Weeli Wolli Spring PECs occur in proximity to the Development Envelope, as discussed in Section 8.3.2.1. In addition, downstream of the proposed Upper Marillana discharge location there is a series of semi-permanent to permanent pools (termed ‘the Marillana Creek Pools’) as well as some pools within the Flat Rocks area, both just upstream and to the north-west of the Yandi mine lease (Figure 7-14). These pools are not recognised as a TEC or PEC, but contain significant ecological values including a high diversity of GDV species, and in some cases high richness of wetland flora (submerged and emergent macrophytes) in comparison to other creeks in the region (described in Section 7.3.4.3).

Yandicoogina Gorge (approximately 10 km north-east of the Development Envelope) is an important feature of the Pilbara, located at the convergence of surface and groundwater flows from the upstream catchment. Vegetation in the gorge is typically characteristic of riparian and/or GDV as it supports mature stands of *Melaleuca argentea* and *Eucalyptus camaldulensis* subsp. *obtusata*. The presence of these phreatophytes, and more specifically, the obligate phreatophyte *Melaleuca argentea*, suggests groundwater is persistently at or just below the surface (Biologic 2020a). This is further supported with the presence of numerous water features, with some permanent and potentially representing aquatic groundwater dependent ecosystems (GDEs) (Biologic 2020a).

Some of the vegetation and floristic assemblage present within Yandicoogina Gorge has affinities with the Priority 2 Ecological Community: *Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara* (hereafter referred to as the Pilbara Pools PEC; DBCA 2023); however, are not recognised as a confirmed PEC. This PEC occurs sporadically throughout the Pilbara, with several occurrences in Karijini National Park. The presence of phreatophytic flora, permanent to semi-permanent pools as well as several of the key relictual/indicator understorey species suggests that portions of Yandicoogina Gorge represent the PEC (Biologic 2020a). The significant flora species recorded from Yandicoogina Gorge also include species that are consistent with the PEC, including *Imperata cylindrica* (more commonly occurs in the wetter Kimberley region and the records in the Pilbara are relictual occurrences from a wetter past) and *Fimbristylis sieberiana* (P3). These species are almost exclusively restricted to riparian zones of permanent wetlands with high soil moisture maintained by groundwater flows (Biologic 2020a).

As described in Section 7, regional groundwater level decline and impacts to vegetation health has been observed in Yandicoogina Gorge in recent years. The cause for groundwater decline is thought to be linked to climate variability and/or cumulative dewatering of the CID by BHP and third-party operators in the vicinity. Dewatering as part of the Approved Proposal is not considered to impact water levels or vegetation health in Yandicoogina Gorge as described in Section 7.

8.4 Potential environmental impacts

BHP has considered the potential impacts outlined in the EPA's *Flora and Vegetation Factor Guideline* (EPA 2016a) and considers that those relevant to the Proposal are:

- loss of flora and vegetation from clearing (direct)
- changes to vegetation from changes to groundwater regimes (indirect)
- changes to vegetation from changes to surface water regimes (indirect)
- changes to vegetation or impacts to flora species from dust, fire and weeds (indirect).

BHP has focused the discussion on potential direct and indirect impacts of the Proposal within the Indicative Footprint of the Development Envelope and has also outlined the combined effects which implementation of the Combined Proposal might have on the environment. Information about impacts associated with the Approved Proposal have been provided for context; however, it should be noted that impacts previously assessed for the Approved Proposal have not been reassessed here (unless relevant). Cumulative impacts to Flora and Vegetation are addressed in Section 16.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation measures are applied, if required).

8.4.1 Loss of flora and vegetation from clearing

The Proposal will result in the direct impact to flora and vegetation through the removal of up to 1,076 ha of vegetation within the Development Envelope (additional to clearing authorised for the Approval Proposal). An additional 132 ha in the Indicative Footprint is already approved to be cleared, as it falls within the Indicative Footprint of the Approved Proposal and is referred to as the 'Previously Assessed Area'.

8.4.1.1 Vegetation

Direct clearing of native vegetation for the Proposal has the potential to affect the ecological integrity of vegetation (at the regional and local scale) and reduce the condition of vegetation, particularly where the existing vegetation is in Good to Excellent condition.

Regional vegetation

Two vegetation associations (as mapped by Beard (1975) and refined by Shepherd et al. (2002) are located within the Development Envelope (Figure 8-3). Table 8-9 shows the area of each association within the Development Envelope and Indicative Footprint.

Proposal

Assuming disturbance occurs within the Indicative Footprint, the potential impact of the Proposal on any association (as a percentage of the current extent) is less than 0.1%.

Combined Proposal

When considering the Combined Proposal, assuming disturbance occurs within the Indicative Footprint, both associations will have 97.9% or more of their pre-European extent remaining with 1.4% of Association 18 impacted and 0.5% of Association 82 impacted.

Table 8-9: Flora and Vegetation - potential impacts to Beard vegetation units

Beard Vegetation Association	Pre-European Extent (ha) ¹	Current Extent (ha)	% of Association Remaining	Total mapped area in DE (ha)	Approved Proposal (ha)	Area remaining in DE (outside Approved Proposal area) (ha)	Area within Indicative Footprint (ha) ²	Combined Proposal Impact (ha)	% of Association Remaining (Proposed Clearing) ³	% of Association Remaining (Combined Proposal) ⁴
18	676,557	671,843	99.30	16,432	8,977.3	6,831.5	594.8	9,572.2	99.2	97.9
82	2,563,583	2,550,888	99.50	23,628	12,749.6	10,103.1	481.2	13,230.7	99.5	99.0
Total	-	-	-		21,727⁵		1,076	22,803⁶	-	-

1. Pre-European Extent and Current Extent based on current DBCA data for the Pilbara bioregion (DBCA 2019).
2. Excluding cleared areas and areas within the Approved Proposal (previously assessed area).
3. Current Extent minus area in the Indicative Footprint as a percentage of Pre-European Extent
4. Current Extent minus area in the Indicative Footprint for the Proposal and already assessed or cleared under the Approved Proposal, as a percentage of Pre-European Extent.
5. The Approved Proposal indicative footprint spatial file differs slightly from the amount of clearing approved under MS 1072 by 97 ha (<1% of the 21,824 ha approved to be cleared).
6. The Combined Proposal impact will be 22,900 ha when including the 97 ha not captured in the Approved Proposal spatial footprint.

Local vegetation

This section describes the predicted loss of vegetation within the Indicative Footprint, noting that flexibility has been allowed for the final location of Proposal elements.

The Proposal will clear up to 1,076 ha of native vegetation (Table 8-10). Of the 77 vegetation associations mapped within the Development Envelope, 39 occur within the Indicative Footprint and will be directly impacted by clearing. A total of 60 ha of riparian vegetation will require clearing for the Proposal. The proposed clearing of each vegetation association is shown in Table 8-10.

Broad scale mapping at the detailed vegetation association level occurs over a limited extent within the Pilbara, so inference of vegetation associations regionally at a fine scale is not possible. However, the consolidation of vegetation mapping within BHP's Pilbara tenure (Onshore 2014a) provides a unique database from which to undertake a preliminary assessment of representation at the vegetation association level. Using this consolidated vegetation mapping, and assuming disturbance occurs within the Indicative Footprint, the potential impact to the associations is shown in Table 8-10.

Proposal

The Proposal will result in clearing no more than 1,076 ha of vegetation within a 1,482 ha Indicative Footprint. Up to 60 ha of riparian vegetation is proposed to be cleared.

Of the 24 locally significant vegetation associations identified from the Development Envelope in Section 8.3.2.1, 15 occur in the Indicative Footprint and will be impacted from clearing (Table 8-10). Of these associations, 10 will be subject to less than 1% impact to their mapped extent in the BHP database, and four will be subject to less than 6% impact from the Proposal. Up to 17.3% of the remaining locally significant association; MA CcCs Aci EcrEv will be impacted from the Proposal, based on its mapped extent in the BHP database. MA CcCs Aci EcrEv represents a major ephemeral watercourse ecosystem at risk and is only mapped across a small, newly mapped area (4 ha) in the far north-eastern portion of the Development Envelope that falls within the Yandi mine lease boundary (Figure 8-13).

The potential impacts to two non-significant vegetation associations; FS Tp EgEl Aat and FS TvTpTw El AbApaAnc are 33% and 69%, of their mapped extents, respectively. However, these are newly mapped units which have not been aligned to BHP's consolidated database yet and are discussed further in Section 8.6.1.1.

Combined Proposal

The combined effect of the Proposal and Approved Proposal (i.e. Combined Proposal) on the vegetation associations identified of local significance is shown in Table 8-10 as a percentage of the consolidated vegetation mapping.

The Proposal will clear up to 60 ha of riparian vegetation across 14 riparian vegetation associations. An assessment of the combined effect for the Approved Proposal is not possible as the authorised extent of riparian vegetation clearing was not specified in the approval documentation for the Approved proposal, nor is it defined in MS 1072.

As described above, of the 24 locally significant vegetation associations identified in Section 8.3.2.1, 15 occur in the Indicative Footprint and will be impacted from clearing (Table 8-10). Of these associations, four will be subject to less than 1% impact of their mapped extent in the BHP database from the Combined Proposal, four will be subject to less than 5% impact and two will have 10% or less impact. The remaining five locally significant associations will be subject to between 17% and 80% impact from the Combined Proposal to their mapped extent in the BHP database. Most of these are newly mapped associations which have not been aligned to BHP's consolidated database yet and are discussed further in Section 8.6.1.1.

The potential impacts to the two substantially impacted non-significant vegetation associations; FS Tp EgEl Aat and FS TvTpTw El AbApaAnc will remain the same from the Combined Proposal as the Proposal for FS Tp EgEl Aat, where 33% of its mapped extent in the BHP database will be cleared from the Proposal. The Combined Proposal will

result in an impact of 75% of the mapped extent of FS TvTpTw Ell AbApaAanc in the BHP database. The status of these as newly mapped vegetation associations and how this contributes to the discussion of the unlikely significance of these impacts is discussed further in Section 8.6.1.1.

Table 8-10: Flora and Vegetation - potential impacts to vegetation associations

Vegetation Association	Significance			Total area mapped in DE (ha)	Approved Proposal (ha)	Area remaining within DE (outside Approved Proposal area) (ha)	Area within Indicative Footprint (ha) ²	Combined Proposal impact (ha)	Area within BHP Consolidated Mapping (ha) ³	Proposal Clearing as % of Consolidated Mapping	Combined Proposal Clearing as % of Consolidated Mapping
	Potential GDV	Ecosystem at risk ¹	Riparian vegetation								
FP AcaoAaEx Erff Tp				<0.1	0	<0.1	<0.1	0.0	4,480.8	0.0%	0.0%
FS Tp EgEl Aat				61.8	0	59.4	59.4	59.4	182.1	32.6%	32.6%
FS Tp(Tv) Eg AeAd				35.3	0	32.0	32.0	32.0	1,032.7	3.1%	3.1%
FS Tv CddHc AancAiGrwh				570.1	375.7	185.6	126.2	501.9	4,162.7	3.0%	12%
FS TvTp CdEl AatAtenAanc				6.3	0	6.3	6.2	6.2	1,781.1	0.3%	0.3%
FS Tv ElCdd AbSolAten				700.6	400	281.5	33.3	433.3	4,935.0	0.7%	8.8%
FS TvTp Eg El				4.7	0	4.1	4.1	4.1	540.9	0.8%	0.8%
FS TvTpTw El AbApaAanc				11.5	0.9	9.9	9.4	10.3	13.7	68.6%	75.2%
FS Tw El				5.8	0	5.8	5.7	5.7	44.6	12.8%	12.8%
GG CfElFib AhDovmAsh CyaErnuThmb				1,596.2	995.5	596.4	1.3	996.8	3,729.9	0.0%	26.7%

Vegetation Association	Significance			Total area mapped in DE (ha)	Approved Proposal (ha)	Area remaining within DE (outside Approved Proposal area) (ha)	Area within Indicative Footprint (ha) ²	Combined Proposal impact (ha)	Area within BHP Consolidated Mapping (ha) ³	Proposal Clearing as % of Consolidated Mapping	Combined Proposal Clearing as % of Consolidated Mapping
	Potential GDV	Ecosystem at risk ¹	Riparian vegetation								
GG TtErmuThmb ElIChCf AtpGoroPI				642.7	213.2	424.8	8.8	222.0	1,117.0	0.8%	19.9%
HC Tw AiAb InrSeao				29.6	2.6	26.4	22.2	24.8	11,041.2	0.2%	0.2%
HC TwTsTp ElICh Ah				295.6	88.3	197.3	24.9	113.3	7,149.7	0.3%	1.6%
HC TwTvTp ElICh Ah				113.2	0.4	110.37	108.7	109.1	2,906.6	3.7%	3.8%
HS TbrTw Ell				2,316.4	1,264.98	1,048	1.9	1,266.9	12,700.2	0.0%	10.0%
HS TsTwTp ElICh AhiAaa				10,863.7	5,714.3	4,993.7	0.8	5,715.1	38,970.8	0.0%	14.7%
HS Tv(Tw) Ell AbAancSegg				127.7	43.5	80.9	19.2	62.7	274.6	7.0%	22.8%
HS Tv(Tw) EllCdd AhiAaa				323.9	15	294.7	158.9	173.9	838.0	19.0%	20.8%
HS TvTwTp ElICh AhiAaa				65.7	22.9	40.2	24.8	47.7	957.9	2.6%	5.0%
MA CcCs Aci EcrEv		✓ c	✓	4.2	0	4.1	4.1	4.1	23.7	17.3%	17.3%

Vegetation Association	Significance			Total area mapped in DE (ha)	Approved Proposal (ha)	Area remaining within DE (outside Approved Proposal area) (ha)	Area within Indicative Footprint (ha) ²	Combined Proposal impact (ha)	Area within BHP Consolidated Mapping (ha) ³	Proposal Clearing as % of Consolidated Mapping	Combined Proposal Clearing as % of Consolidated Mapping
	Potential GDV	Ecosystem at risk ¹	Riparian vegetation								
MA EcrEv AciApypMg CcEuaTt	✓	✓ c	✓	0.5	0	0.5	0.5	0.5	689.3	0.1%	0.1%
MA EcrEv AcpAtheEv TpTlo	✓	✓ c	✓	0.6	0	0.6	0.6	0.6	61.5	1.0%	1.0%
MA EcrEvEx ApypAtpGoro TtEuaCyp	✓	✓ c	✓	198.6	56.6	141.0	3.7	60.3	3,732.6	0.1%	1.6%
MA EcrEvMa AcpAamAthe TydCyv	✓	✓ c	✓	2.3	0.1	2.2	2.2	2.3	118.2	1.9%	1.9%
MA EvAciEcr TercCocrApyp CcEuaTt	✓	✓ c	✓	5.1	0.3	4.8	4.3	4.6	462.1	0.9%	1.0%
ME AtpAmAma TtEuaTp ChElIEx			✓	145.5	20.3	123.2	8.5	28.8	153.6	5.5%	18.8%
ME TpTlo ExAciCh PIApypGoro			✓	1,557.8	782.93	746.0	3.7	786.63	8,129.3	0.0%	9.7%
ME TtAriCya ChElI AmPIAnI			✓	217.7	68.4	143.2	3.5	71.9	1,555.7	0.2%	4.6%

Vegetation Association	Significance			Total area mapped in DE (ha)	Approved Proposal (ha)	Area remaining within DE (outside Approved Proposal area) (ha)	Area within Indicative Footprint (ha) ²	Combined Proposal impact (ha)	Area within BHP Consolidated Mapping (ha) ³	Proposal Clearing as % of Consolidated Mapping	Combined Proposal Clearing as % of Consolidated Mapping
	Potential GDV	Ecosystem at risk ¹	Riparian vegetation								
ME TtChfEua ExEvCh PlApaApy			✓	33.5	0.6	32.8	9.3	9.9	1,729.4	0.6%	0.6%
MI AtpPIAm TpTs ChEll			✓	1,550.8	985.3	538.9	0.8	986.1	4,261.2	0.0%	23.1%
MI AtpPIAm TpTv ChEll			✓	257.7	186	68.0	18.3	204.3	668.8	2.7%	30.5%
MI Td Acow ExAaApr			✓	0.8	0.8	0.0	<0.1	0.8	1.0	0.3%	80%
MI TtErmu ChEll AmaAmAnl			✓	0.3	0	0.3	0.3	0.3	7.7	3.9%	3.9%
SP AaApr TmTwTp TtChfAri		✓ (a)		694.3	340.4	340.4	32.3	372.7	5,653.8	0.6%	6.6%
SP TbTp HallAancAi Ch				3.3	0.2	3.0	3.0	3.2	17,787.7	0.0%	0.0%
SP Tm(ArcTt) AaApr				151	34.6	111.1	111	145.6	750.1	14.8%	19.4%
SP TpTm AaExAcao ApaErffAads				4,638.6	1,356.3	3,152.2	116.7	1,473.0	32,549.2	0.4%	4.5%

Vegetation Association	Significance			Total area mapped in DE (ha)	Approved Proposal (ha)	Area remaining within DE (outside Approved Proposal area) (ha)	Area within Indicative Footprint (ha) ²	Combined Proposal impact (ha)	Area within BHP Consolidated Mapping (ha) ³	Proposal Clearing as % of Consolidated Mapping	Combined Proposal Clearing as % of Consolidated Mapping
	Potential GDV	Ecosystem at risk ¹	Riparian vegetation								
SP Tt(ArcEua) Hall(Aan)				91.2	0	87.8	87.8	87.8	357.3	24.6%	24.6%
SP TvTwTp EgEt AbApaApr				0.6	0.2	0.4	0.3	0.5	241.0	0.1%	0.2%

1. Letters in brackets correspond to the applicable ecosystem at risk: (a) Valley floor mulga, (b) Grove/inter-grove mulga and (c) Major ephemeral water courses

2. Excluding cleared areas and area within the Approved Proposal (previously assessed area).

3. Current extent in BHP's consolidated mapping (clearing removed)

NOTE: Total hectares for the Development Envelope have not been stated as this table focuses on only the vegetation associations that will be impacted by the Proposal.

Vegetation Condition

Over one quarter of the Development Envelope has already been cleared for the Approved Proposal. As described in Section 8.3.2.1, the majority of vegetation remaining in the Development Envelope is in Good to Excellent condition. Areas in Poor to Completely Degraded condition (<1% of native vegetation mapped in the Development Envelope) are generally adjacent to creek lines (due to impacts from cattle grazing) or adjacent to existing mining operations.

Proposal

The Indicative Footprint overlaps some areas that have previously been disturbed as part of the Approved Proposal (Figure 8-15), or that have been cleared under other mechanisms (NVCPS, non-BHP Clearing, historic BHP clearing, exploration etc.). Collectively, these areas represent approximately 275 ha or 19% of the Indicative Footprint (Table 8-11). A further 131 ha falls within the Indicative Footprint of the Approved Proposal and has been assessed previously. Of the remaining areas of vegetation within the Indicative Footprint, most is mapped as being in Excellent (577 ha) or Very Good (412 ha) condition, representing approximately 67% of the Indicative Footprint (Table 8-11).

A total of up to 1,043 ha of native vegetation in Good to Excellent condition will be impacted by the Proposal (Table 8-11).

Combined Proposal

The Combined Proposal will result in loss of up to 20,739.8 ha of native vegetation in Good to Excellent condition. This consists of 19,696 ha from the Approved Proposal and 1,043 ha for the Proposal.

Table 8-11: Flora and Vegetation - potential impacts to vegetation condition from the Combined Proposal

Vegetation condition	Total area mapped in Development Envelope (ha)	Approved Proposal (ha)	Area within Indicative Footprint (ha)	% of Indicative Footprint	Combined Proposal impact (ha)
Excellent	17,182.8	7,831.0	577.0	54%	8,408.0
Very Good	14,583.9	8,777.1	412.3	38%	9,189.4
Good	5,642.9	3,088.1	53.3	5%	3,141.4
Poor	23.7	0	12.4	1%	12.4
Degraded	234.0	19.2	0.0	0%	19.2
Completely Degraded	2,292.1	1,994.9	21.0	2%	2,015.9
No survey data ¹	100.5	16.6	0	0%	16.6
TOTAL	40,059	21,727²	1,076	100%	22,803³

1. These are periphery areas of the Development Envelope that have minimal or no survey information available due to survey boundary misalignment and age of surveys, with mining commencing at the Mining Area C mine in 2003. This area accounts for <1% of the Development Envelope.
2. The Approved Proposal spatial footprint differs slightly from the amount of clearing approved under MS 1072 by 97 ha (<1% of the 21,824 ha approved to be cleared).
3. The Combined Proposal impact will be 22,900 ha when including the 97 ha not captured in the Approved Proposal spatial footprint.

8.4.1.2 Significant flora

The Proposal has the potential to affect the representation and distribution of significant flora species as a result of direct clearing native vegetation.

Fourteen Priority flora species, as listed by the DBCA, are known to occur within the Development Envelope (Figure 8-16). The potential impacts to ten of these species within Mining Area C and South Flank have previously been assessed and approved as part of the Approved Proposal.

Proposal

Seven Priority flora species have been recorded from within the Indicative Footprint. Table 8-12 shows the potential impact on each species. Based on disturbance occurring within the Indicative Footprint, the potential impact to all of these species is less than 10% based on known populations in the Pilbara and 5% or less of known records of all but one species; 11.1% of known populations and 11.9% of known records of *Aristida Lazaridis* (P3) will be impacted by the Proposal (Table 8-12). There are no predicted impacts from the Proposal to the remaining Priority flora species that occur in the Development Envelope, assuming disturbance occurs within the Indicative Footprint.

Combined Proposal

When considering the combined effect of the Proposal and Approved Proposal, there are potential combined impacts to six of the seven Priority flora species that will be impacted by the Proposal (all except *Lepidium catapycnon* (P4) which has not been affected by the Approved Proposal). The combined effect on five of the six impacted species will be 10% or less based on known populations and records (Table 8-12). For one Priority flora species (*Aristida Lazaridis* (P3)), the predicted loss of known populations from the Combined Proposal is 14.3% and the predicted loss of records is 31.3% (Table 8-12). However the vast majority of this impact is from the Approved Proposal (Table 8-12).

When assuming disturbance may occur anywhere within the Development Envelope (i.e. worst-case potential impacts if clearing was to occur outside of the Indicative Footprint or previously assessed areas), the potential impacts to Priority flora are less than 10% (based on known populations) for three species (Table 8-12), however the potential impacts to the remaining four species is greater than 10% (*Acacia bromilowiana* (12.5%), *Aristida Lazaridis* (17.5%), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (13.2%) and *Rostellularia adscendens* var. *latifolia* (10.9%)). While it is considered unlikely, disturbance may potentially occur outside of the Indicative Footprint. However, it is highly unlikely that the proposed clearing would impact all known records or populations of the Priority flora within the Development Envelope.

Table 8-12: Flora and Vegetation - potential impacts to significant flora

Species	Known populations ¹ (and records ²) within Pilbara	Populations (and records) within Development Envelope	% of known populations (and records) within Development Envelope	Populations (and records) within Approved Proposal	Populations (and records) within Indicative Footprint	% of known populations (and records) within Indicative Footprint	Combined Proposal impact to populations and records ³	Combined Proposal impact as % of known populations (and records)
<i>Acacia bromilowiana</i> (P4)	24 (100)	3 (4)	12.5 (4)	1 (1)	1 (2)	4.2 (2)	2 (3)	8.3 (3)
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3)	89 (417)	7 (60)	7.9 (14.4)	3 (15)	2 (15)	2.2 (3.6)	5 (30)	5.6 (7.2)
<i>Aristida lazardis</i> (P3)	63 (553)	12 (161)	19 (29.1)	2 (107)	7 (66)	11.1 (11.9)	9 (173)	14.3 (31.3)
<i>Lepidium catapycnon</i> (P4)	82 (1069)	1 (1)	1.2 (0.1)	0	1 (1)	1.2 (0.1)	1 (2)	1.2 (0.1)
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3)	159 (1961)	21 (369)	13.2 (18.8)	12 (125)	4 (25)	2.5 (1.3)	16 (150)	10.1 (7.6)
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	92 (551)	10 (23)	10.9 (4.2)	6 (32)	2 (3)	2.2 (0.5)	8 (35)	8.7 (6.4)
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P4)	59 (369)	3 (34)	5.1 (9.2)	1 (10)	2 (20)	3.4 (5.4)	3 (30)	5.1 (8.1)

1. A population is defined as a spatially discrete individual or group of individuals of a taxon that is separated by more than 500 m from the nearest spatially discrete individual or group of individuals (as defined by DBCA).
2. Based on BHP database, comprising of BHP survey data, publicly available data and data sourced from DBCA.
3. Potential impact from the Proposal (based on the Indicative Footprint) and from the Approved Proposal (i.e. potential impacts from the Combined Proposal).

8.4.2 Changes to vegetation from changes to groundwater regimes

The Proposal involves additional mine dewatering and associated surface water discharge. The proposed water management strategy is provided in (Section 7.4). The following components have the potential to impact GDV:

- Changes to groundwater regimes from groundwater abstraction (drawdown) for mine dewatering
- Changes to groundwater regimes from groundwater mounding due to surplus discharge (MAR) and the Yandicoogina Gorge groundwater supplementation program
- Changes to groundwater quality due to surplus water discharge and/or the MAR scheme and/or the Yandicoogina Gorge groundwater supplementation program.

Groundwater abstraction has the potential to impact GDV by lowering the groundwater table beyond the rooting depth of vegetation, which may result in a decline in vegetation health. Surplus water discharge via MAR involves the disposal of surplus mine dewater via infiltration or injection into an aquifer. MAR has the potential to cause groundwater 'mounding' which can impact vegetation by flooding the root system of plants near the injection points. If the groundwater quality is also altered through these water management strategies, this could also affect the health of GDV. Vegetation within the Development Envelope, as well as nearby significant vegetation, including PECs, could potentially be impacted from these changes to groundwater regimes.

Potential changes to groundwater quality due to the north-west MAR scheme and the Yandicoogina Gorge groundwater supplementation program are not expected to impact riparian vegetation or GDV, based on the analysis of source water from the Development Envelope (Section 7.5.5). In addition, it is a requirement under the Part V licence of the EP Act for the schemes to ensure that there is no significant deterioration of water quality and that there are no adverse impacts on associated environmental values and monitoring will be conducted to ensure this requirement is fulfilled (Section 8.5.2). The Part V licence will therefore ensure regular monitoring and reporting of water quality in the Gorge and the north-west MAR scheme and results be provided to DWER as part of the AER process. Any changes to water quality as a result of surplus management will be detected. Therefore, potential changes to groundwater quality and potential impacts to vegetation are not considered significant and are not discussed further.

Proposal

The 2025 groundwater modelling predicts a peak dewatering rate of 180 ML/day (65.7 GL/a) for the Proposal, representing an increase of 78 ML/day (28.4 GL/annum) for the Proposal, compared to the Approved Proposal. The increase in dewatering and surplus water management is required for implementation of the Combined Proposal rather than the Proposal alone. As such, impacts to flora and vegetation resulting from changes to groundwater regimes are assessed as part of the Combined Proposal below.

Northern RAV MAR

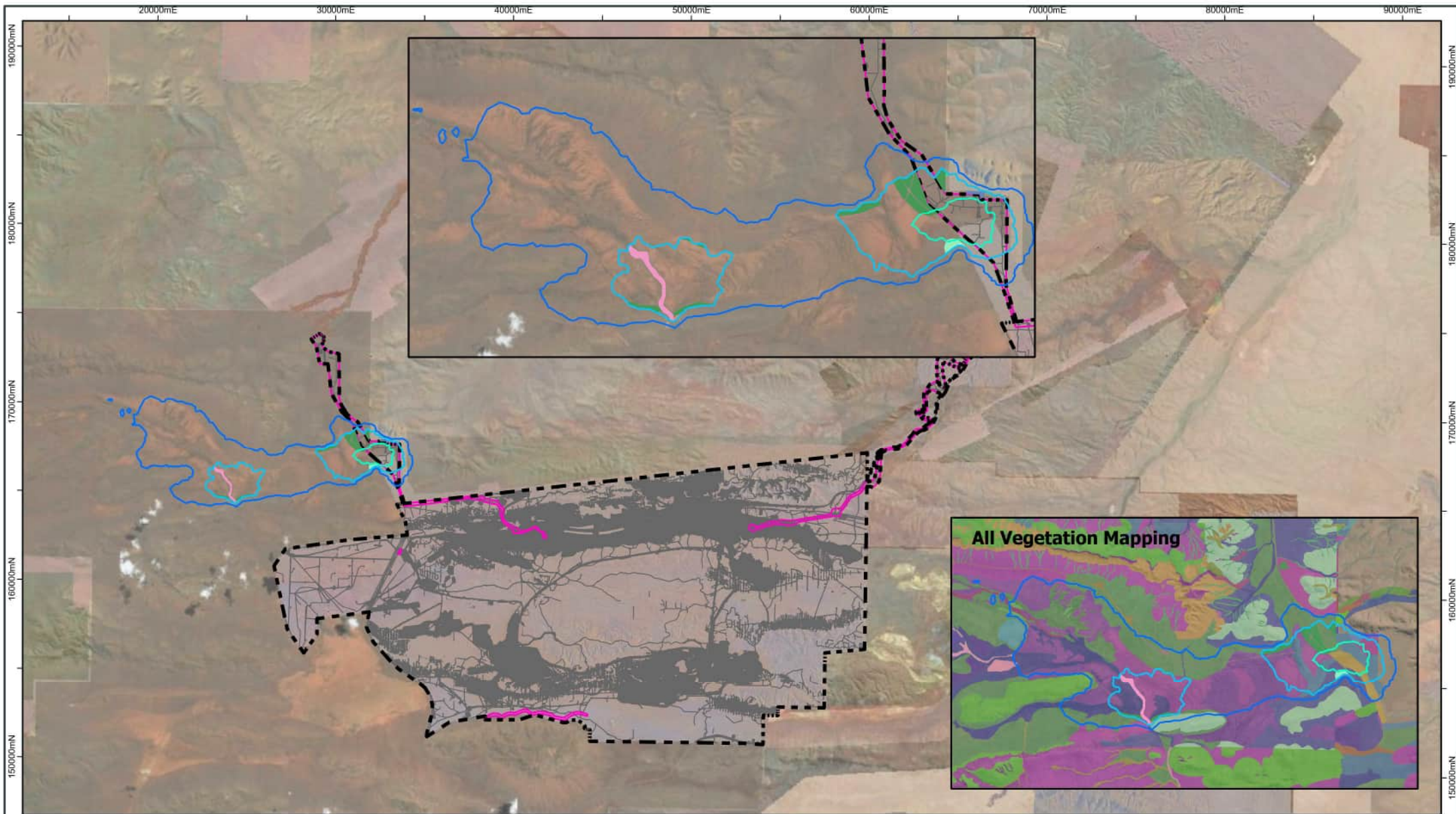
BHP currently operates MAR schemes in the Central Pilbara (Section 7.5.2.2) which will not change as part of the Proposal. One new MAR scheme is proposed as part of the Proposal, the Northern RAV MAR scheme. The Northern RAV MAR scheme is proposed to dispose of surplus mine dewater, and is located within the Development Envelope, along the north-west scheme that extends from the Approved Proposal (Figure 7-15). Groundwater mounding from the Northern RAV MAR scheme is predicted to occur in and around the north-west pipeline scheme location up to a maximum of 10 mbgl. The vegetation at this location comprises mostly low shrubs and mixed grasses with no local significance.

Five of the vegetation associations occurring within the 0-20 mbgl mounding contour bands may be impacted by the rise in groundwater levels, covering a total area of approximately 162 ha (Table 8-13 and Figure 8-18). These associations contain potentially deep-rooted species (*Eucalyptus xerothermica*, *Eucalyptus leucophloia* subsp.

leucophloia or *Eucalyptus victrix*) that may be impacted both while mounding is occurring and after it has receded. If groundwater rises to be persistently above the baseline rooting depth of these tree species, deep roots may be waterlogged and die or may benefit from the increased water supply for the duration of the mounding. When mounding recedes, and access to water reduces, tree health decline or mortality may occur. The potential impacts to these vegetation associations depend in part on whether the baseline root depth is within the level of predicted mounding; this is uncertain, due to limited knowledge of the localised geology and potential restrictions to root growth. The potential significance of these impacts is discussed in Section 8.6.2.

Table 8-13: Vegetation associations occurring within the 0-20 mbgl mounding contours which contain *Eucalyptus* trees

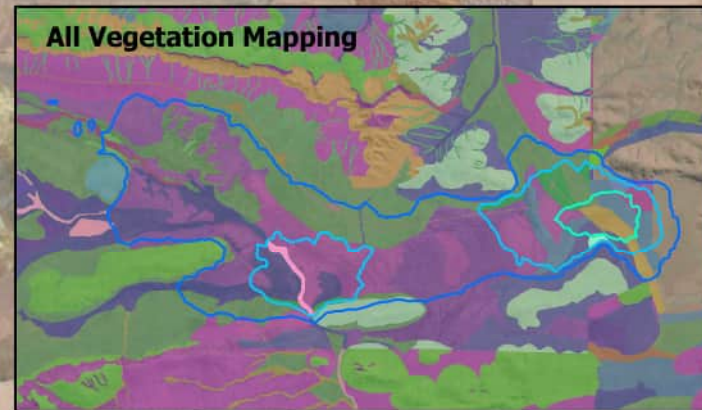
Vegetation Association	Broad Floristic Formation	Description	Area within 0-20 mbgl contours
ME BoeTtChf AaEv Sal	Bothriochloa mid tussock grassland	Mid Tussock Grassland of <i>Bothriochloa ewartiana</i> , <i>Themeda triandra</i> and <i>Chrysopogon fallax</i> with Low Woodland of <i>Acacia aptaneura</i> and <i>Eucalyptus victrix</i> over Scattered Tall Shrubs of <i>Santalum lanceolatum</i> on brown clayey sand on medium drainage lines.	37.1
FS TvTp Eg EII	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia vanleeuwenii</i> and <i>Triodia pungens</i> with Open Mallee of <i>Eucalyptus gamophylla</i> and Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> on footslopes.	10.1
HC TwTvTp EIICh Ah	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> , <i>Triodia vanleeuwenii</i> and <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> over Open Shrubland of <i>Acacia hamersleyensis</i> on red brown clay loam on hill crests and upper hill slopes.	1.5
HS Tw(Tv) EIICh AaaAhiAm	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> (<i>Triodia vanleeuwenii</i>) with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> and Low Open Shrubland of <i>Acacia adoxa</i> var. <i>adoxo</i> , <i>Acacia hilliana</i> , <i>Acacia</i> spp. on ironstone hills.	9.75
SP TpTm AaExAcao ApaErffAads	Triodia Open Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia melvillei</i> with Low Open Woodland of <i>Acacia aptaneura</i> , <i>Eucalyptus xerothermica</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and Open Shrubland of <i>Acacia pachyacra</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Acacia adsurgens</i> on red brown clay loam or silty loam on stony plains and floodplains.	103.3
Total			162



- Indicative Footprint
 Development Envelope
 Existing Disturbance
Groundwater Mounding Contours
— 10 mbgl
— 20 mbgl
— 30 mbgl

Vegetation Containing Potentially Deep Rooted Species

- FP ErbEuaTt Ev Duf
— FP TtCsCc AaAprEx ErloSeaoSeah
— FS TvTp Eg Ell
— HC TwTvTp EllCh Ah
— HS Tw EllCh AaaAhi
— SP TpTm AaExAcao ApaErffAads



BHP **PUBLIC**

MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
PREDICTED GROUNDWATER
MOUNDING AND VEGETATION
WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3: 1:285,000 REQUESTOR: ENVIRONMENT FIGURE: **8-18**
 DATE: 13/02/2025 PREPARED: GEOMATICS NO: **A1285-029 RevD**
 REVIEWED:



Yandicoogina GDE Supplementation Scheme

The Yandicoogina GDE Supplementation Scheme also forms part of the Proposal. The groundwater supplementation program is located directly adjacent to the north-east scheme of the Indicative Footprint (Figure 7-17) and is being implemented to mitigate recent declines in local groundwater levels (discussed in Section 7.3.4.4). Reinjection bores are already constructed and will be operational for the trial of the program in late 2024. The Pipeline proposed will provide a water supply to the existing infrastructure to support the program, in particular to enable larger quantities of water to be supplemented as part of the longer-term program (subject of this Proposal).

As the supplementation scheme has been designed to increase and then maintain groundwater levels at previously observed values, mounding is not anticipated to negatively impact GDV at Yandicoogina Gorge. Rather, it is intended to improve vegetation health by increasing the groundwater levels to allow GDV to access groundwater where it has previously declined, and is discussed further in Section 8.6.2.

Combined Proposal

Groundwater modelling predicted the drawdown effects of the Combined Proposal up to 20 years of post-dewatering to assess mitigation and recovery of Weeli Wolli Spring. This modelling includes influences from nearby Hope Downs operations which may be more representative of cumulative drawdown; however, this has been included for the Combined Proposal.

A summary of groundwater level change as a result of the Approved Proposal compared to the Combined Proposal is provided in Section 7.5.1.

Overall, the predicted lateral drawdown extent (as defined by the 1 m drawdown contour) from the Combined Proposal is similar to the Approved Proposal (BHP 2016b). There are many local differences however, due to the deeper dewatering levels in the 2024 model and the uncertainty in hydraulic parameters. The key differences are summarised below, shown in Figure 7-16 and in Table 7-6.

- The combination of greater dewatering depth and changes in hydraulic parameters result in an increased drawdown in Coondewanna Flats by an additional 10 to 60 m.
- Southern extent of drawdown to 1 m of the Combined Proposal reduced by approximately 2.5 km (Combined Proposal within Approved Extent).
- General reduction in drawdown (laterally and vertically) in the eastern extent beyond the Development Envelope towards Weeli Wolli Springs. (Combined Proposal within Approved Extent)
- Lateral extent to the north is within the approved extent. Drawdown is expected to extend approximately 1.6 km in north-west corner beyond the approved extent

The groundwater drawdown contours do not extend into Yandicoogina Gorge so potential impacts to this feature from groundwater drawdown is not discussed further. As described in Section 8.3.2, the *Eucalyptus victrix* (Coolibah) trees on the Coondewanna Flats are unlikely to be accessing groundwater and are instead utilising unsaturated soil-stored moisture (Astron 2014; 2021; AQ2 2016). Therefore, these trees are unlikely to be impacted by groundwater drawdown and are also not discussed further.

Confirmed GDV

The areas of confirmed High likelihood GDV (containing *Melaleuca argentea*) which intersect the groundwater drawdown contours for the Combined Proposal occur at two locations along Weeli Wolli Creek; Weeli Wolli Spring and vegetation in the vicinity of Ben's Oasis (Figure 8-19). This GDV could potentially be impacted by groundwater drawdown.

Weeli Wolli Spring and the area of Weeli Wolli Creek in the vicinity of the spring, are cumulatively impacted by the surrounding mining operations, including the Combined Proposal and RTIO Hope Downs. The Hope Downs operation has dewatered a significant volume of water from the surrounding aquifer such that groundwater heights are no longer high enough for groundwater discharge to occur into and through the Weeli Wolli Spring area (Rio Tinto 2024). This impact to the groundwater system is mitigated in the vicinity of the springs by discharge and groundwater mounding at the gabion as well as from a series of irrigation spurs within the initial parts of the springs (prior to the gabion) (Rio Tinto 2024). Up to 2045, a decline in groundwater levels of approximately 2.4-5.6 m is predicted to occur at Weeli Wolli Spring as a result of cumulative impacts associated with the Combined Proposal and RTIO Hope Downs. This is within the approved limit of 3-14 m and is not expected to be greater than previously assessed (see Section 7.5.1). Therefore, additional impacts from the Combined Proposal to vegetation at Weeli Wolli Spring and the surrounding area of Weeli Wolli Creek are not expected to occur. However, in 2045 when the RTIO Hope Downs mine closes and their mitigation measures cease, drawdown at Weeli Wolli Spring is predicted to increase to between 11-14 m (without mitigation). The potential impacts to flora and vegetation at the spring are discussed in the cumulative impacts chapter (Section 16).

Ben's Oasis Spring is fed from an upstream groundwater compartment in which there is no active groundwater dewatering, as such there is no justification for including it in the numerical model domain (Section 7.5.1.4). As described in Section 7.3.4.2, the groundwater monitoring bore HDD0001M falls within the High likelihood GDV area north of Ben's Oasis and has been monitored since 2017. The groundwater level in this bore is the same elevation as the creek bed just to the north which suggests groundwater expresses at surface to form the spring. The groundwater levels in the two bores further downstream (HDD0003M and HDD0004M) are much deeper, between 30-40 mbgl and have shown a decline of approximately 5 to 10 m since 2017. There is a regional dyke located between the two areas as shown on Figure 8-19 which BHP's hydrogeological modelling indicates could potentially be acting as a flow barrier between Ben's Oasis (including the surrounding High likelihood GDV) and the Hope Downs Aquifer. As described above, drawdown is observed in the downstream bores (on the Hope Downs aquifer side of the dyke) but not in the bore upstream on the Ben's Oasis side. These factors support the evidence of low hydraulic connection between Ben's Oasis and the Hope Downs aquifer compartment. However, this is based on relatively short-term monitoring and the situation may change as drawdown continues to increase on the Hope Downs side of the dyke and more data is collected. RTIO have also conducted hydrogeological modelling which suggests Ben's Oasis is disconnected from the hydrological influence of the Hope Downs project and is currently undertaking detailed work to better understand the hydrogeological conceptualisation of the Ben's Oasis site and the characteristics of the groundwater system and associated discharge (Rio Tinto 2024).

Based on the above discussion, potential impacts to the spring and associated riparian vegetation from groundwater drawdown are considered unlikely, however given this is not yet conclusive, BHP are taking a conservative approach and assuming potential impacts may occur to the GDV south of the dyke (Figure 8-19).

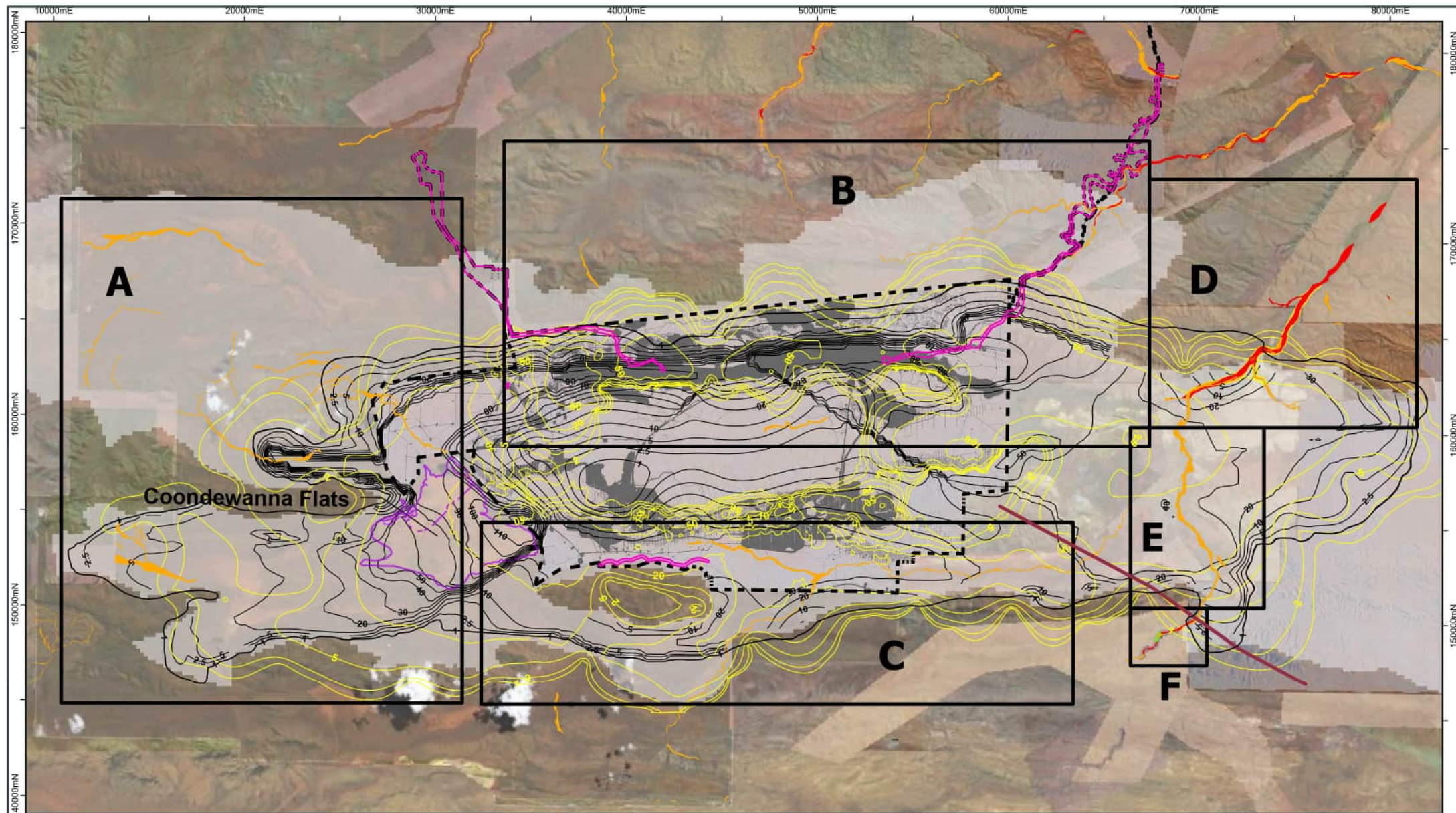
Moderate Potential GDV

For the areas of GDV rated as having a Moderate likelihood of being groundwater dependent identified within and outside of the Development Envelope (Section 8.3.2.1), there is uncertainty as to whether the vegetation is reliant on groundwater given the absence of *Melaleuca argentea* and presence of one or both of the facultative phreatophyte species *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix*. These two species may occasionally utilise groundwater when it is at a depth accessible by the root systems (Section 8.3.2.1). Facultative phreatophytes are susceptible to extended periods of water stress and have good physiological and/or morphological adaptations to reduce their water demands during drought-like conditions. Tree roots of *Eucalyptus camaldulensis* and *Eucalyptus victrix* can have been confirmed to reach a maximum depth of 21 m (Muir 1995). Therefore, it is difficult to predict whether a significant impact to these areas of vegetation (where they intersect groundwater contours for the Combined Proposal) is likely. In order to further refine the likelihood of these areas of potential GDV being reliant/partially reliant on groundwater, the pre-development groundwater levels at those locations were reviewed. Table 8-14 outlines the potential impacts to Moderate likelihood GDV in the six key mapped areas.

Table 8-14: Potential impacts to Moderate likelihood GDV from groundwater drawdown

Area containing Moderate likelihood GDV	Description	Potential impacts
A	The pre-development groundwater levels exceed 20 mbgl in this area (approximate range 25-114 mbgl). Based on this, the potential GDV species <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> are unlikely to be accessing groundwater here and therefore lowering the groundwater table in this area is unlikely to impact these species.	Unlikely to be impacted by groundwater drawdown
B	The north-eastern corner of Area B where Moderate likelihood GDV occurs has pre-development groundwater levels as shallow as 7 mbgl. However, the groundwater drawdown contours do not extend to those locations. The only location where the groundwater drawdown contours intersect with Moderate likelihood GDV in Area B, is within the Development Envelope along the Area B southern boundary. The pre-development groundwater levels in that area are deep, and range between approximately 70-109 mbgl. <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> are unlikely to be accessing groundwater and therefore lowering the groundwater table in this area is unlikely to impact these species.	Unlikely to be impacted by groundwater drawdown
C	The pre-development groundwater levels where Moderate likelihood GDV occurs in Area C are approximately 34-85 mbgl. This is considered too deep for <i>Eucalyptus camaldulensis</i> and <i>Eucalyptus victrix</i> to access. Based on this, the Moderate likelihood GDV in this area is unlikely to be impacted. Potential impacts to MA EcrEvEx ApypAtpGoro TtEuaCyp (Moderate likelihood GDV) in this area from groundwater drawdown were also assessed for the Approved Proposal, in the vicinity of Pebble Mouse Creek. The assessment also concluded that based on the pre-mining groundwater levels in that area being too deep for the potential GDV to access, impacts to this vegetation association from groundwater drawdown were unlikely. It is notable that Rio Tinto rated the potential GDV along Pebble Mouse Creek in this area as having a Low likelihood of being dependent on groundwater. RTIO have also observed that where the Hope Downs 1 operation has led to drawdown of the underlying aquifers, Pebble Mouse Creek remains relatively unchanged (Rio Tinto 2024). This is predominantly because of the fact that groundwater heights within the regional aquifer in the Pebble Mouse Creek area are generally beyond 30 mbgl (Rio Tinto 2024).	Unlikely to be impacted by groundwater drawdown
D	As described in Table 8-6 in Section 8.3.2.1, pre-development groundwater levels in Area D where potential GDV occurs range between approximately <1-26 mbgl. The shallower areas, i.e. <20mbgl may indicate some reliance on groundwater for the Moderate GDV. This area has also been subject to significant drawdown from the Hope Downs 1 operation. Monitoring by Rio Tinto has indicated however	Unlikely to be impacted by groundwater drawdown

Area containing Moderate likelihood GDV	Description	Potential impacts
	that there have been minimal effects to date on riparian vegetation in this area (Rio Tinto 2024). BHP has also recently commenced monitoring of GDV in this area, specifically <i>Melaleuca argentea</i> trees within the mapped High likelihood GDV in Weeli Wolli Spring, and although it is early in the program, the general results have been positive for vegetation condition and tree health (Biologic 2025 <i>in prep</i>). These areas of GDV are likely being supported by the mitigation currently being implemented by RTIO. As per the discussion of potential impacts to confirmed High likelihood GDV at Weeli Wolli Spring and surrounds, up to 2045, a decline in groundwater levels of approximately 2.4-5.6 m is predicted to occur at Weeli Wolli Spring as a result of cumulative impacts associated with the Combined Proposal and RTIO Hope Downs. This is within the approved limit of 3-14 m and is not expected to be greater than previously assessed (see Section 7.5.1). Therefore, additional impacts from the Combined Proposal to vegetation at Weeli Wolli Spring and the surrounding area of Weeli Wolli Creek (High and Moderate likelihood GDV) are not expected to occur. However, in 2045 when the RTIO Hope Downs mine closes and their mitigation measures cease, drawdown at Weeli Wolli Spring is predicted to increase to between 11-14m (without mitigation). The potential impacts to flora and vegetation at the spring are discussed in the cumulative impacts chapter (Section 16).	
E	As described in Table 8-5 in Section 8.3.2.1, the Moderate likelihood GDV along the north-south stretch of Weeli Wolli Creek has been minimally impacted by dewatering of Hope Downs 1 despite significant groundwater drawdown (Rio Tinto 2024). Pre-development groundwater levels along this stretch of the creek range from 7 mbgl in the north, to between 46 mbgl in the south. Potential impacts to this stretch of Weeli Wolli Creek are considered unlikely based on minimal impacts to GDV to date and that a large portion of this stretch of creek lies in areas of deep pre-development groundwater levels, which is discussed further in Section 8.6.2.	Unlikely to be impacted by groundwater drawdown
F	The Moderate likelihood GDV closer to Ben's Oasis (which occurs in conjunction with the mapped High likelihood GDV in that area) is likely to be reliant on groundwater for a portion of the key GDV species' water requirements. Based on the shallow groundwater levels in this area this GDV could potentially be impacted by drawdown. However, the regional dyke could potentially be acting as a flow barrier between Ben's Oasis and the Hope Downs Aquifer (based on RTIO and BHP hydrogeological modelling), which may minimise the risk of impact. As described previously, further studies are required to confirm this. Given this is not yet conclusive, BHP are taking a conservative approach and assuming potential impacts may occur to the GDV south of the dyke.	Potentially impacted by groundwater drawdown



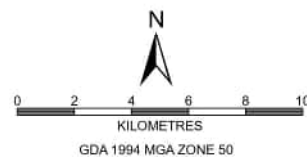
- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Domain
- Combined Proposal
- Approved Proposal
- Indicative Location of Regional Dykes

Ecological Communities

- Weeli Wolli Spring
- Ben's Oasis
- Coondewanna Flats

GDV Category

- High
- Moderate



**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
PREDICTED GROUNDWATER DRAWDOWN
AND POTENTIAL GDV
WAO PLANNING, TECHNICAL AND ENVIRONMENT**

PUBLIC

SCALE @ A3:	1:265,000	REQUESTOR:	ENVIRONMENT	FIGURE:	8-19
DATE:	17/02/2025	PREPARED:	GEOMATICS		
		REVIEWED:		NO:	A1285-017 RevL

8.4.3 Changes to vegetation from changes to surface water regimes

The Proposal involves surplus water discharge along creeklines as part of the water management strategy. This has the potential to alter surface water regimes via changes to water quality, quantity, flow rates, and/or physical or biological attributes. The construction of pipelines and diversion infrastructure for the Proposal also have the potential to interfere with the natural sheetflow of water and increase erosion and sedimentation.

Proposed surplus water discharge along ephemeral creeklines may result in impacts to riparian vegetation (vegetation health) due to increased inundation. Discharge of surplus water may also impact on riparian vegetation by creating a dependency on permanent surface water flow, which has the potential to alter the composition of the ecological community and vegetation health.

Changes to surface water quality due to the discharge of surplus water along Marillana Creek are not expected to occur. As described in Section 7.6.3, to prevent the formation of a calcium precipitate and scale forming in creeks, BHP will treat water quality going to both the Upper Marillana and Lower Marillana Creek discharge points. The use of chemicals containing PFAS at the MAC-SF Operations has also ceased and therefore no chemicals containing PFAS will be used for the Proposal, minimising the risk of surface water contamination. Management of PFAS is discussed in Section 7. Potential impacts to riparian vegetation and GDV in relation to surface water quality are considered unlikely, and therefore are not discussed further.

Proposal

Upper Marillana Creek Discharge

Dewatering for the Proposal will result in an increase in surplus water disposal from 95.3 mL/day to 154 mL/day per day. The discharge of surplus water via creeklines for the Proposal will occur at two discharge points: one in Upper Marillana Creek and one in Lower Marillana Creek (see Section 7.5.5).

Altered water regimes resulting from surplus water discharge into Marillana Creek may cause impacts to the riparian vegetation of Marillana Creek from potential waterlogging. The action of discharging surplus water will also artificially increase water availability to vegetation downstream of the discharge location. The change in hydrological regime is likely to result in temporary changes to riparian tree species (*Eucalyptus victrix* and *Eucalyptus camaldulensis*) and *Acacia citrinoviridis* and potentially change the vegetation composition by increasing or decreasing the abundance of riparian shrub, sedge, grass and weed species and mulga vegetation along the discharge pathway. The surplus water discharge may also attract livestock and feral herbivores, resulting in trampling and/or overgrazing. *Acacia citrinoviridis* has an extensive shallow root system that utilises ephemeral flow of surface water, and are susceptible to waterlogging, while riparian Eucalyptus trees have the potential to decline in health when they are permanently inundated. It is anticipated that vegetation adaptation to the altered hydrological regime will be species specific and could include decline in health and/or new growth as well as changes to the composition and/or density of vegetation within the wetting front. The Upper Marilana Creek discharge also has the potential to impact GDV and riparian vegetation present at the Marillana Creek Pools and Flat Rocks, through changes to surface water volumes.

As described in Section 7.5.5, a water balance model along the tributary of Marillana Creek between the proposed surplus water discharge point extending 29 km to BHP Yandi Operations was prepared to simulate various surplus water discharge rates and periods to approximate the wetting front generated from surplus water from the Proposal (AQ2 2019). The Upper Marillana Creek discharge point is proposed to have a maximum rate of 30 ML/day which is predicted to have a wetting front of up to 27 km occupying the low flow channel of Marillana Creek tributary. The extent of the wetting front will remain within the low flow channel of the creek and is estimated to be 15 m to 22 m in width (compared to the main channel width of 100 to 200 m) (AQ2 2019). BHP mapped the centreline of the inundation predicted by AQ2 in 2019, and buffered it by 15 m either side to conservatively estimate the vegetation present along the 15 to 22 m wide predicted wetting front (30 m total), up to the second monitoring trigger point shown on Figure 8-20. A total of 75 ha of vegetation occurs along this extent (Table 8-15), comprised of 71 ha of

riparian vegetation, 0.5 ha of SP AaApr TmTwTp TtChfAri which represents Valley Floor Mulga (ecosystem at risk) and 3.5 ha of other non-significant grasses and shrublands (Figure 8-20, Table 8-15).

A total of six riparian vegetation associations (highlighted grey in Table 8-15 below), totalling 70.5 ha within the wetting front extent contain one or more of the species *Eucalyptus victrix*, *Eucalyptus camaldulensis* or *Acacia citrinoviridis* which are susceptible to impacts from continuous discharge of water for long periods.

Table 8-15: Vegetation associations occurring within Upper Marillana Creek discharge wetting front

Vegetation Association	Broad Floristic Formation	Description	Local significance	Area within 30 m wide wetting front (ha)
CP TwTrag Ese AbPIApyp	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> and <i>Triodia angusta</i> with Open Mallee of <i>Eucalyptus socialis</i> subsp. <i>eucentrica</i> and Open Shrubland of <i>Acacia bivenosa</i> , <i>Petalostylis labicheoides</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on light brown clay loam on calcrete plains	None	0.4
FP TtEua ExAa AprAtpErlo	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> and <i>Eulalia aurea</i> with Low Woodland of <i>Eucalyptus xerothermica</i> and <i>Acacia aptaneura</i> over Open Shrubland of <i>Acacia pruinocarpa</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Eremophila longifolia</i> on red brown clay loam on unincised drainage lines and floodplains	None	<0.1
FP TtEuaCc ChEx AdAacAmc	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>*Cenchrus ciliaris</i> with Low Open Woodland of <i>Corymbia hamersleyana</i> and <i>Eucalyptus xerothermica</i> over High Open Shrubland of <i>Acacia dictyophleba</i> , <i>Acacia ancistrocarpa</i> and <i>Acacia macraneura</i> on brown silty clay loam on floodplains	None	2.7
HC Tw AiAb InrSeao	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia wiseana</i> with High Open Shrubland of <i>Acacia inaequilatera</i> and <i>Acacia bivenosa</i> over Low Open Shrubland of <i>Indigofera rugosa</i> and <i>Senna artemisioides</i> subsp. <i>oligophylla</i> on red silty loam on dolerite hill crests	None	<0.01
MA EcrEv AciApypMg CcEuaTt	Eucalyptus Woodland	Woodland of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> and <i>Eucalyptus victrix</i> over High Open Shrubland of <i>Acacia citrinoviridis</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Melaleuca glomerata</i> over Tussock Grassland of <i>*Cenchrus ciliaris</i> , <i>Eulalia aurea</i> and <i>Themeda triandra</i> on brown clay loam on banks of major drainage lines	Ecosystem at risk (Major ephemeral watercourse), potential GDV, Riparian	25.9
MA EcrEvEx ApypAtpGoro TtEuaCyp	Eucalyptus Low Open Forest	Low Open Forest of <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Eucalyptus xerothermica</i> over	Ecosystem at risk (Major ephemeral	32.8

Vegetation Association	Broad Floristic Formation	Description	Local significance	Area within 30 m wide wetting front (ha)
		High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Gossypium robinsonii</i> over Open Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Cymbopogon procerus</i> on red brown clay loam on major drainage lines	watercourse), potential GDV, Riparian	
MA EcrEvMa AcpAamAh TydCyy	Eucalyptus open forest	Open Forest of <i>Eucalyptus camaldulensis</i> var. <i>refulgens</i> , <i>Eucalyptus victrix</i> and <i>Melaleuca argentea</i> over Low Open Forest of <i>Acacia coriacea</i> subsp. <i>pendens</i> , <i>Acacia ampliceps</i> and <i>Atalaya hemiglaucula</i> over Open Sedges of <i>Typha domingensis</i> and <i>Cyperus vaginatus</i>	Riparian	<0.1
ME TpTlo ExAciCh PIAppGoro	Triodia Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia longiceps</i> with Low Woodland of <i>Eucalyptus xerothermica</i> , <i>Acacia citrinoviridis</i> and <i>Corymbia hamersleyana</i> over High Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> and <i>Gossypium robinsonii</i> on red brown clay loam on medium drainage lines and surrounding floodplains	Riparian	4.9
ME TtChfEua ExEvCh PIAppApy	Themeda Tussock Grassland	Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Eulalia aurea</i> with Low Open Woodland of <i>Eucalyptus xerothermica</i> , <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> and Shrubland of <i>Petalostylis labicheoides</i> , <i>Acacia pachyacra</i> and <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> on red sandy loam on medium drainage lines	Riparian	1.0
ME TtEuaEte AppAtpPI EvCh	Eucalyptus Low Woodland	Tussock Grassland of <i>Themeda triandra</i> , <i>Eulalia aurea</i> and <i>Eriachne tenuiculmis</i> with High Shrubland of <i>Acacia pyrifolia</i> var. <i>pyrifolia</i> , <i>Acacia tumida</i> var. <i>pilbarensis</i> and <i>Petalostylis labicheoides</i> and Open Woodland of <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> on red brown silty loam on medium drainage lines and flood plains	Riparian	5.7
MI AadsAnlDop Tp ElCh	Acacia open heath	Open Heath of <i>Acacia adsurgens</i> , <i>Androcalva luteiflora</i> and <i>Dodonaea pachyneura</i> over Open Hummock Grassland of <i>Triodia pungens</i> with Low Open Woodland of <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Corymbia hamersleyana</i> on brown loamy sand on minor drainage lines	Riparian	0.6
SP AaApr TmTwTp TtChfAri	Acacia Low Open Forest	Low Open Forest of <i>Acacia aptaneura</i> and <i>Acacia pruinocarpa</i> over Open Hummock Grassland of <i>Triodia melvillei</i> , <i>Triodia</i>	Ecosystem at risk (Valley floor Mulga)	0.5

Vegetation Association	Broad Floristic Formation	Description	Local significance	Area within 30 m wide wetting front (ha)
		<i>wiseana</i> and <i>Triodia pungens</i> over Tussock Grassland of <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> and <i>Aristida inaequiglumis</i> on red brown loam on stony plains		
SP TpTm AaExAcao ApaErffAads	Triodia Open Hummock Grassland	Hummock Grassland of <i>Triodia pungens</i> and <i>Triodia melvillei</i> with Low Open Woodland of <i>Acacia aptaneura</i> , <i>Eucalyptus xerothermica</i> and <i>Acacia catenulata</i> subsp. <i>occidentalis</i> and Open Shrubland of <i>Acacia pachyacra</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and <i>Acacia adsurgens</i> on red brown clay loam or silty loam on stony plains and floodplains	None	0.3
TOTAL				75

Lower Marillana Creek Discharge

Discharge to Lower Marillana Creek is currently approved under EP Act licence L6168/1991/11 and has been operating for approximately 15 years as part of the Yandi mine. Additional discharge of surplus water at this existing discharge point is planned as part of the Proposal and has the potential to impact riparian vegetation from changes in surface water volumes along the discharge route. The licence for this discharge location authorises 41.1 ML/day (L6168/1991/11). No changes to the licence allocation are required for the Proposal as a maximum of 30 ML/day limited to a 5 year period will be discharged from the Proposal, and up to 11 ML/day from the existing Yandi mine. Wetting front limits have not previously been set for this location, however the maximum recorded was 9 km in 2008, and more recently 2.5 km in 2023 (Section 7.5.5). There is anecdotal evidence from recent site flyovers that riparian vegetation downstream and off BHP tenure, has declined in heath and composition since discharge volumes and the wetting front have decreased. The surface discharge from the Proposal will increase the flow of water along Marillana Creek causing permanent/semi-permanent flow for up to 9 km during the time where the discharge point is utilised. It is not anticipated that flows will increase past the existing 9 km wetting front due to the Proposal.

Construction of pipelines and GCOSA diversion structure

The construction of pipelines and diversion infrastructure for the Proposal have the potential to obstruct the natural sheetflow of water across the landscape and increase erosion and sedimentation. In relation to flora and vegetation, this can impact Mulga sheetflow vegetation associations. The disruption of sheetflow (particularly via linear infrastructure) may result in impacts to Mulga vegetation by reducing water availability in areas downslope, or ponding of water upslope, resulting in declined vegetation health or potential loss of individual plants.

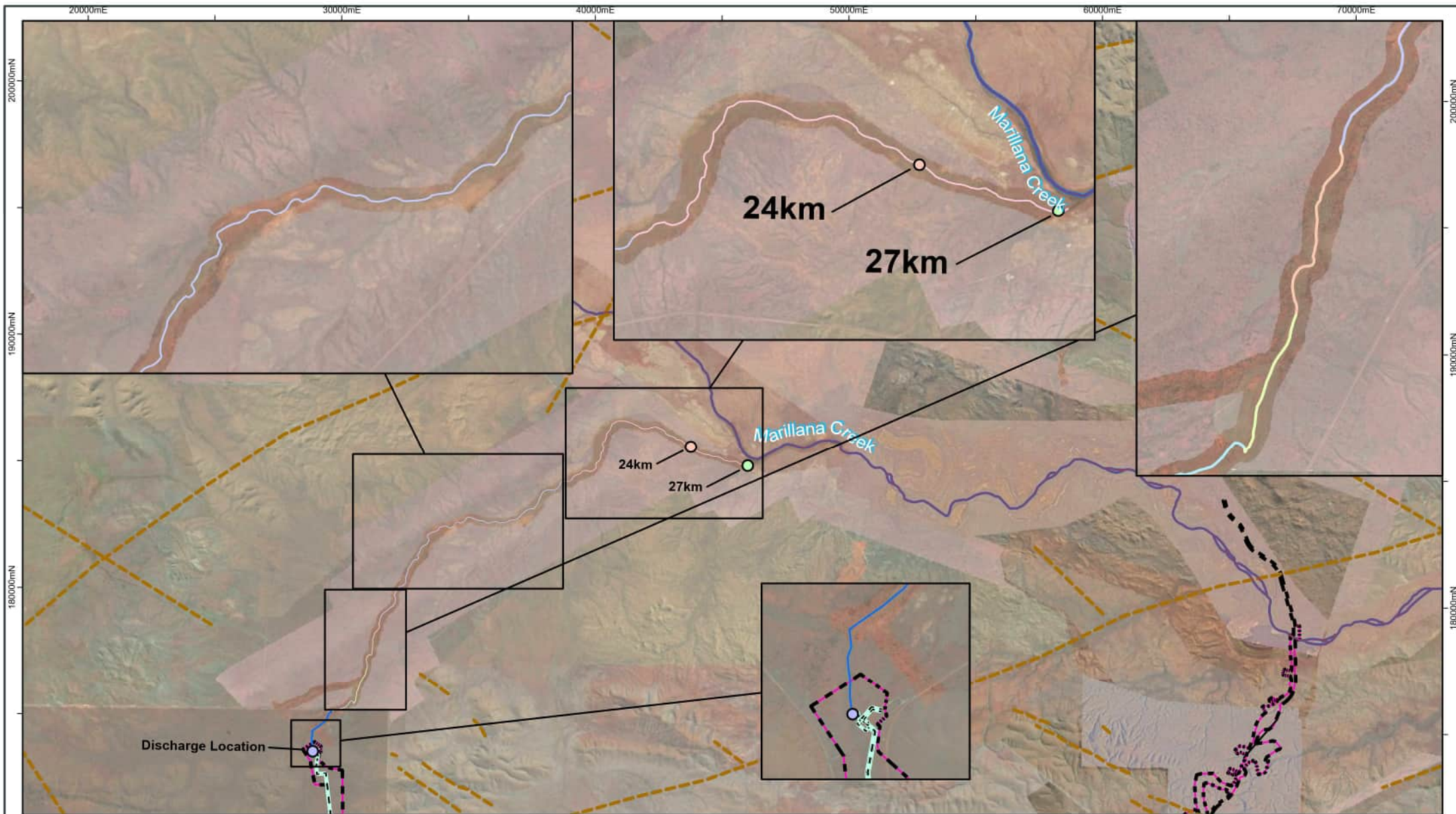
There are three areas in the Indicative Footprint which could potentially impact sheetflow vegetation; the north-west and north-east pipeline routes and the construction of diversion channels upstream of the GCOSA. The north-east pipeline route and the new diversion channels do not intersect any sheetflow vegetation. The north-west pipeline route however, intersects one Mulga vegetation association; SP AaApr TmTwTp TtChfAri. This vegetation association is identified as valley floor Mulga which is unlikely to be reliant on sheetflow based on its position in the landscape. Therefore, no impacts to sheetflow vegetation are predicted from the construction of pipelines and diversion structures for the Proposal.

Construction of the north-eastern pipeline to support the Yandicoogina GDE Supplementation Scheme is required to cross the Yandicoogina Creek waterway and infrastructure is required to be built adjacent to the creek. This will require an increase in construction traffic to this location for a short period of time, which may increase mechanical erosion of the existing waterway crossing. Land will also need to be cleared of vegetation and soil structure disturbed along the pipeline corridor, potentially temporarily increasing sediment load entering into the creek during heavy rainfall events. These sediments may be carried downstream to the Yandicoogina Gorge and Pilbara Pools PEC.

Combined Proposal

Changes to surface water regimes associated with the Combined Proposal are described in Section 7.4. Discharge to one creekline (Pebble Mouse Creek) is authorised under EP Act Licence L7851/2002/6, and has a wetting front limited to 12 km from the discharge point and must not extend beyond the Approved Proposal Development Envelope. This discharge is managed under Part V processes and is used for emergency releases only. The proposed locations for the new discharges including Upper and Lower Marillana Creek schemes provide sufficient separation that there is limited combined effect on surface water as they are discharges to different catchments to the existing licensed discharge, and will therefore potentially impact different areas of riparian vegetation. The Yandi mine (licence L6168/1991/11) authorised discharge (41.1 ML/day) will not change due to the Proposal. The existing maximum discharge will be balanced between the two operations and will not exceed the licensed amount.

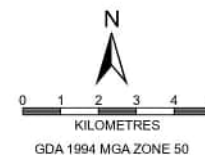
Potential impacts to sheetflow dependent Mulga and the potential change in vegetation composition (including the potential for increased weeds) from the alteration of existing surface water regimes by project infrastructure, were assessed for the Approved Proposal and determined to not be significant, and therefore the combined effect is the same as the Proposal.



- Development Envelope
- Indicative Footprint
- Marillana Creek
- Discharge Location
- Threshold (UMC2)
- Trigger (UMC1)
- Regional Dykes
- Northwest Scheme Pipeline

- Vegetation Association Code**
- CP TwTrag Ese AbPIApyp
 - FP TtEua ExAa AprAtpErl
 - FP TtEuaCc ChEx AdAacAmc
 - HC Tw AiAb InrSeao
 - MA EcrEv AciApypMg CcEuaTt
 - MA EcrEvEx ApypAtpGoro TtEuaCyp
 - MA EcrEvMa AcpAamAh TydCyy

- ME TpTlo ExAciCh PIApypGoro
- ME TtChfEua ExEvCh PIAPApy
- ME TtEuaEte ApypAtpPI EvCh
- MI AadsAnIDop Tp EllCh
- SP AaApr TmTwTp TtChfAri
- SP TpTm AaExAcao ApaErffAads



PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT

PREDICTED DISCHARGE WETTING FRONT AND VEGETATION

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3: 1:200,000	REQUESTOR: ENVIRONMENT	FIGURE: 8-20
DATE: 17/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-032 RevE

8.4.4 Changes to vegetation from dust, fire and weeds

8.4.4.1 Dust

Increased levels of airborne dust have the potential to impact on vegetation health in instances where leaf physiology is affected. This could occur along unsealed roads and is pronounced during dry seasonal conditions.

Studies from the Pilbara, such as Butler (2009), have not recorded evidence of negative impacts on plant function resulting from inert particulate matter deposition. Most arid plant species have much of their stomata closed during dry periods, when the potential for dust is greatest. This would limit the potential for dust generated during the dry season to have effects on the stomatal conductance of the plants (i.e. plant function) and therefore on the health of the plant. In high rainfall periods, when most species put on new growth and stomata are open, dust levels tend to be significantly less due the wet conditions (Grierson 2015). Long-term observations of vegetation in close proximity to mine sites across the Hamersley Ranges have demonstrated repeatedly the overall resilience of vegetation to extremely high levels of dust exposure (Grierson 2015).

Proposal

The Proposal will result in an increase in dust due to vegetation clearing, earthworks and installation of infrastructure associated with the Proposal during construction. An increase in dust during construction will be temporary and likely highly localised given that the pipeline construction will be mostly above-ground and low impact. An increase in dust may also occur as a result of ongoing operation, mostly associated with the use of unsealed roads for pipeline maintenance activities; however, given that the pipeline route occurs along existing rail line and/or roads and tracks, any increase during operation is expected to be minimal.

Combined Proposal

The Proposal is located within existing operational/infrastructure areas and therefore the increase in dust will be negligible. The processing limit for the Approved Proposal is not increasing as a result of the Proposal and dust levels are not predicted to increase beyond the limit already approved in the licence. Therefore, the potential impact on vegetation from dust resulting from the Combined Proposal is expected to be negligible, and within the range that was previously assessed for the Approved Proposal.

8.4.4.2 Fire

There is the potential to change the frequency of fire by actively extinguishing fires or by causing fires through mining or construction activities. This may result in fire in certain parts of the landscape being too frequent or in other parts being not frequent enough, which may result in fire being intensified when it does occur. Altered fire regimes can encourage the growth of weeds at a landscape level and alter the ecological characteristics of communities through the dominance of early successional species.

Proposal

Some of the Gorge and Gully vegetation associations in the Development Envelope have the potential to contain fire sensitive species. However, the Indicative Footprint intersects a small portion of Gorge and Gully vegetation associations and these are only in the north-east scheme pipeline corridor. Therefore, BHP considers that the Proposal will have a negligible impact to vegetation or flora from the potential alteration of fire regimes.

Combined Proposal

The Proposal is not expected to change the frequency of fire within the Development Envelope. The impact of the Combined Proposal is therefore expected to be the same as for the Approved Proposal. As mentioned above, no fire sensitive species or communities have been identified from within the Development Envelope, and the Combined Proposal is predicted to have a negligible impact to vegetation or flora from the potential alteration of fire regimes.

8.4.4.3 Weeds

A total of 23 introduced flora (weed) species have been recorded within the Development Envelope (Section 8.3.2.2). Domestic stock such as cattle are significant vectors for weeds within lowland areas of the Pilbara, including the Development Envelope where there is evidence of cattle grazing. Another factor influencing weed establishment is access. Increasing vehicular access combined with disturbance such as clearing for roads and other infrastructure, has the potential to introduce and/or spread weed species. The current distribution of introduced flora species within the Development Envelope largely reflect this, with higher weed occurrences present along drainage areas and existing infrastructure.

The presence of introduced flora species within the Development Envelope has the potential to impact on the condition and structure of native vegetation present, with operational activity potentially increasing the occurrence and spread of weeds. The occurrence of weeds within the Development Envelope is not expected to impact on any regionally significant vegetation (as none occur within or adjacent to the Development Envelope), or the regional representation of significant flora species.

Proposal

The Proposal may result in the spread of weeds into areas of proposed new disturbance (mainly via vehicle movement); however, the Proposal is largely nearby, or within areas of existing disturbance or operations, and therefore not expected to significantly increase the occurrence of weeds within the Development Envelope. It is expected that the Proposal will have a negligible impact to vegetation from the potential spread of weeds.

Combined Proposal

The impact of the Combined Proposal on native vegetation from the presence of introduced flora species (weeds), is expected to be the same as the existing impacts from the Approved Proposal.

8.5 Mitigation

8.5.1 Avoid

The Proposal has been designed to avoid impacts to significant flora and vegetation as far as practical. The Indicative Footprint location has been selected to prioritise the use of existing cleared land where possible, or to construct immediately adjacent to existing cleared land.

8.5.2 Minimise

The Proposal has been designed to minimise clearing of flora and vegetation by placing infrastructure within or adjacent to existing disturbed areas as far as practical. The majority of the pipeline route follows existing roads, tracks or rail lines. However, in some areas, avoidance of clearing is not possible, including areas of locally significant flora and vegetation.

BHP proposes to continue to manage surplus water from the Combined Proposal in accordance with the CPWRMP, which now includes the Proposal (Appendix 8). The CPWRMP is both an outcomes-based and a management-based environmental management plan (EMP) specific to different environmental values and includes Coondewanna Flats bi-annual tree health monitoring (both on-ground and via remote sensing), and monitoring of water levels and vegetation health at Weeli Wolli Spring. If tree health trigger or threshold levels are met, a number of actions may be implemented including (but not limited to); investigate the source of canopy decline, increase frequency of monitoring, alter surplus discharge regime including suspending groundwater drawdown and/or surplus water discharge. This monitoring will continue to be undertaken for the Combined Proposal. New monitoring locations will also be included in the vicinity of Ben's Oasis, where groundwater drawdown could potentially impact GDV in this area.

For the Northern RAV MAR scheme, BHP is committed to ensuring groundwater levels do not rise above 10 mbgl. BHP will monitor the tree health of *Eucalyptus xerothermica*, *Eucalyptus leucophloia* subsp. *leucophloia* and *Eucalyptus victrix* trees within the 0-20 mbgl mounding zone, commencing at the cessation of injection of surplus water into the Northern RAV MAR to assess potential decline in health of the trees while the mounded groundwater gradually recedes. The Northern RAV MAR Scheme will be managed through the Part V licence (L7851/2002/6) of the EP Act.

The trial of the Yandicoogina GDE Supplementation Scheme commenced in the 2024 dry season. The objective of the trial is to assess whether stabilisation of groundwater levels at the head of the Gorge is achievable via reinjection, defined as groundwater levels not continuing to decline during the trial at nearby monitoring locations. Supplementation is planned to cease at the commencement of the wet season (typically December) to enable natural seasonal responses and avoid creation of artificial environmental conditions. Although the supplementation scheme is intended to benefit the environmental values of the gorge, a Trigger Action Response Plan (TARP) has been prepared and is being implemented during the trial to mitigate any potential adverse environmental impacts. The TARP provides risk-based triggers and actions to enable operational responses to be applied without extensive consultation with subject matter experts (SMEs), reducing the time between discovering an exceedance of TARP management criteria and implementing the required mitigation. The supplementation trial is being closely monitored, including live monitoring of reinjection rates and groundwater levels to mitigate the potential risk of flooding or surface water expression. The live telemetered monitoring is supported by routine water quality and biodiversity monitoring, including monitoring of GDV.

As described in Section 7.5.5, discharge to Upper Marillana Creek will be greatest when in the early stages of the Proposal where the schemes for beneficial use do not have sufficient capacity. Discharge to Upper Marillana Creek will occur at a maximum of 30 ML/d with 90 days of no flow during the dry season for a five-year operational period to reach a maximum of 8.2 GL/annum. During discharge, there may be continuous flows along the creek. The predicted wetting front for Upper Marillana Creek is up to 27 km downstream of the discharge point. The management intent is that the wetting front will not reach Flat Rocks or the Marillana Creek Pools such that impacts to riparian vegetation and potential GDV within these areas will be minimal.

BHP will monitor the wetting front, applying a trigger of 24 km and a threshold of 27 km (Figure 8-20). If surplus water discharge reaches the wetting front trigger, discharge will be switched off. Tree health sites and monitoring parameters have been established as described in the CPWRMP to monitor the health of the riparian vegetation along the Upper Marillana wetting front.

For the Lower Marillana Creek discharge, monitoring of the vegetation downstream of the discharge location to date, within the Yandi mine lease, has shown no significant negative impacts on riparian vegetation health from surplus water discharge since 2009, and this vegetation will continue to be monitored. A recent fire at the Yandi mine resulted in the deaths of numerous trees including downstream of the discharge location which is discussed further in Section 8.6.3.

8.5.3 Rehabilitate

Rehabilitation and closure for the Combined Proposal is addressed in the updated MCP (BHP 2024f) (Appendix 5). The MCP covers the Approved Proposal and has been updated to include this Proposal. The revised MCP addresses rehabilitation of the additional areas that will be disturbed. Management approaches relating to flora and vegetation for the Proposal include:

- The selection of plant species used in revegetation will be linked to the appropriate landforms and species lists identified from the baseline flora and vegetation surveys
- The Seed Management procedure describes the types of seed species mixes and seeding rates that BHP uses at its Pilbara mining operations. This mix can be adapted to suit the characteristics of the site through BHP's adaptive management approach

- Monitoring will be used to assess whether initial vegetation establishment has been successful, rehabilitation is developing satisfactorily
- Where monitoring results indicate vegetation establishment may not meet required standards (density, species diversity and plant age heterogeneity), additional seeding (in subsequent years) will be conducted, if required. Completion criteria are outlined in the MCP and include bare ground percentage, species richness, number of dominant common species, and percentage cover.

8.5.4 Other statutory decision-making processes

BHP's view is that there is no other statutory decision-making process to mitigate the potential environmental impacts of the Proposal on Flora and Vegetation, considering the EPA's *Taking decision making processes into account in EIA: Interim Guidance* (EPA 2021b).

8.6 Assessment and significance of residual impacts

BHP has considered the significance of flora and vegetation and relevant issues outlined in EPA's Flora and Vegetation Guideline (EPA 2016a) in assessing the significance of the impacts to Flora and Vegetation from the Proposal. The assessment of potential impacts discussed in this section are following the application of mitigation as documented in Section 8.5.

8.6.1 Loss of flora and vegetation from clearing

8.6.1.1 Vegetation

Regional vegetation

As discussed in Section 8.4.1.1, BHP estimates the Combined Proposal will clear 1.4% of Beard Association 18 and 0.5% of Association 82 impacted. Associations 18 and 82 will have 99.2% and 99.5% of their pre-European extent remaining following implementation of the Proposal respectively, and 97.9% and 99% remaining following implementation of the Combined Proposal. BHP considers that the impact on regional vegetation associations will not be significant.

Local vegetation

The Proposal will result in clearing no more than 1,076 ha of vegetation within a 1,482 ha Indicative Footprint. This includes clearing of up to 60 ha of riparian vegetation.

Of the 24 locally significant vegetation associations identified from the Development Envelope (Section 8.3.2.1), 15 occur in the Indicative Footprint and will be impacted from clearing for the Proposal (Section 8.4.1.1; Table 8-10). The impacts to all but one of these associations are considered not to be significant because the clearing will impact less than 1% of their mapped extent in the BHP database (10 associations), or less than 6% (four associations). One vegetation association; MA CcCs Aci EcrEv will be subject to 17.3% impact from the Proposal to its mapped extent in the BHP database. However, this impact is also not considered significant based on the small extent of this newly mapped vegetation association which is discussed further below.

When considering the impacts from the Combined Proposal, the majority of these vegetation associations will be subject to less than 10% impact to their mapped extent in BHP's database, however a total of five will be subject to between 17% and 80% impact (including MA CcCs Aci EcrEv discussed above). Two non-significant associations will also be subject to substantial impacts from the Proposal and Combined Proposal; FS Tp EgElI Aatk (33% for both) and FS TvTpTw ElI AbApaAanc (69% om the Proposal and 75% from the Combined Proposal). For these two, and four of the five highly impacted locally significant associations, these impacts are an overestimation as they have been newly mapped by Biologic (2024a) and have not yet been aligned with the consolidated mapping. Therefore, these associations currently have small extents that are not widely represented in the consolidated mapping, but they

are expected to occur more broadly as they align with landforms and/or creeklines that extend further within and outside of the Development Envelope. Impacts from the Proposal and Combined Proposal on these vegetation associations are therefore not considered significant. One locally significant association; MI AtpPIAm TpTs ChEll will have minimal impact from the Proposal (less than 0.1% impact), however impacts from the Combined Proposal will result in 23% impact to this association's consolidated mapped extent. This impact has been assessed and approved under the Approved Proposal.

While the impacts to individual vegetation associations from the Proposal are minor as discussed above, collectively the residual impact of up to 60 ha of riparian vegetation is considered to be significant due to the local significance of riparian vegetation in the Pilbara region.

Vegetation condition

As discussed in Section 8.4.1.1, over one quarter of the Development Envelope has already been cleared for the Approved Proposal. The majority of vegetation remaining in the Development Envelope is in Good to Excellent condition.

The Proposal will result in the clearing of up to 1,076 ha of native vegetation within the Pilbara bioregion, of which up to 1,043 ha is in Good to Excellent condition. The EPA considers that the clearing of vegetation in Good to Excellent condition is a significant residual impact due to the cumulative impacts of clearing in the Pilbara, based on the EPA's advice to the Minister under Section 16(e) of the EP Act (EPA 2014). Therefore, the clearing of Good to Excellent vegetation for the Proposal will be a significant residual impact.

8.6.1.2 Significant flora

Of the 14 Priority flora species occurring in the Development Envelope, seven occur within the Indicative Footprint and will be impacted by the Proposal.

Based on disturbance occurring within the Indicative Footprint for the Proposal, the potential impact to six of the seven impacted species is less than 10% based on known populations in the Pilbara and 5% or less of known records. One species; *Aristida Lazaridis* (P3) will have 11.1% of known populations and 11.9% of known records impacted by the Proposal. The Combined Proposal will impact six of the seven Priority flora species that will be impacted by the Proposal (all except *Lepidium catapycnon* (P4) which has not been affected by the Approved Proposal). The combined effect on five of the six impacted species will be 10% or less based on known populations and records, and the remaining species *Aristida Lazaridis* (P3) will have 14.3% and 31.3% of its known populations and records cleared respectively.

One of the Priority flora species proposed to be impacted will have approximately 5% or less of its known populations and/or records cleared by the Proposal and/or the Combined Proposal (Table 8-12, Section 8.4.1.2); *Lepidium catapycnon* (P4). These impacts are considered minor and are not discussed further. The remaining six impacted Priority flora species will have more than 5% of their known populations and/or records cleared by the Proposal and/or the Combined Proposal and are discussed further below.

Acacia bromilowiana (P4) is known from approximately 15 locations in the Pilbara region, including Karijini National Park (WAH 2024). This taxon is known from three populations (and four records) within the Development Envelope, one population in the west, one in the central and one in the north-eastern portion of the Development Envelope. The occurrence of this species was previously assessed for the Approved Proposal. The potential impact to this species from the Proposal alone will occur in the north-east pipeline scheme portion of the Indicative Footprint and will potentially impact 4.2% of known populations and 2% of known records. The potential impact to this species from the Combined Proposal will be 8.3% of populations and 3% of known records.

Aristida jerichoensis var. *subspinulifera* (P3) has been recorded in all mainland Australian states, and in WA, this species is known from the Pilbara, Gascoyne, Central Ranges and Murchison bioregions as well as within Karijini National Park (Biologic 2024a; WAH 2024). This taxon is known from seven populations (and 60 records) within the

Development Envelope, primarily in the far western portion. The occurrence of this species was previously assessed for the Approved Proposal. The potential impact to this species from the Proposal alone will occur in the north-west pipeline scheme portion of the Indicative Footprint and will potentially impact 2.2% of known populations and 3.6% of known records. The potential impact to this species from the Combined Proposal will be 5.6% of populations and 7.2% of known records.

Aristida lazaridis (P3) is widespread and distributed in tropical Queensland, the Northern Territory and Western Australia, where it is known from the Kimberley and the Pilbara; between Newman and Karijini National Park (WAH 2024). This taxon is known from 12 populations (and 161 records) within the Development Envelope, primarily in the far western portion. It occurs across a variety of landforms including floodplains, gorge gullies, hillslopes, medium drainage lines, and stony plains (Biologic 2024a). Impacts to this taxon from the Approved Proposal were previously assessed and approved under MS1072 for the Approved Proposal. The potential impacts to this taxon from the Proposal are 11.1% of populations and 11.9% of records, the majority of which occur in the proposed north-west pipeline scheme. The potential impact to this species from the Combined Proposal will be 14.3% of populations, and 31.3% of known records based on the BHP database, however the broader known records and populations of this species in Australia, and notably, populations that are protected in Karijini National Park indicate the percentage impact to known occurrences of this species in WA or Australia wide would be much less and the viability of this taxa is unlikely to be affected by the Proposal.

Rhagodia sp. Hamersley (M. Trudgen 17794) (P3) has been recorded within the Pilbara from the north-west of Tom Price to Jigalong (east of Newman) and within Karijini National Park (Biologic 2024a). This taxon is known from 21 populations (and 369 records) within the Development Envelope, in the western, north-western and southern portions. During the Biologic (2024a) survey this taxon was found across a variety of landforms (floodplains, gorge gullies, hillslopes, medium drainage lines, and stony plains). The impacts of the Approved Proposal on this species were previously assessed and approved under MS1072. The potential impacts to this taxon from the Proposal are 2.5% of populations and 1.3% of records, the majority of which occur in the proposed north-west pipeline scheme. The potential impact to this species from the Combined Proposal will be 10.1% of populations, and 7.6% of known records based on the BHP database, the majority of impacts being attributed to the Approved Proposal.

Rostellularia adscendens var. *latifolia* (P3) is found across Australia, Africa, India, and South-East Asia, however this variant (var. *latifolia*) is restricted to the Pilbara and has been recorded in several areas of the Pilbara region outside of BHP tenure, including in Karijini National Park (WAH 2024). This taxon is known from 10 populations (and 23 records) within the Development Envelope, primarily in the south, east and far north-eastern portions. The impacts of the Approved Proposal on this species were previously assessed and approved under MS1072. The majority of potential impacts from the Combined Proposal to this taxon (8.7% of known populations and 6.4% of known records) are from the Approved Proposal. The Proposal will only impact two records within one population of *Rostellularia adscendens* var. *latifolia* which equates to 2.2% of known populations and 0.5% of known records of this taxon. The two records proposed to be impacted lie within the Yandi mining lease, within the Indicative Footprint of the north-east pipeline alignment.

Sida sp. Barlee Range (S. van Leeuwen 1642) (P4) is known from many scattered locations throughout Western Australia, within the Gascoyne and Pilbara regions. It is especially common in the Brockman area west of Tom Price and has been recorded in Karijini National Park and Barlee Range Nature Reserve (Biologic 2024b). This taxon is known from three populations (and 34 records) within the Development Envelope, mostly in the north-eastern portion. During the Biologic (2024x) survey this taxon was found across gorge gullies, hillcrest/upper hillslopes, hillslopes, and drainage areas/ floodplains, within *Triodia* hummock grassland, *Themeda* tussock grassland, and mulga woodland. The impacts of the Approved Proposal on this species were previously assessed and approved under MS1072. The potential impacts to this taxon from the Proposal are 3.4% of populations and 5.4% of records, the majority of which occur in the proposed north-east pipeline scheme. The potential impact to this species from the Combined Proposal will be 5.1% of populations, and 8.1% of known records.

BHP will avoid as many records of Priority flora as possible through design of the pipeline route as well as through the standard internal Project Environmental and Aboriginal Heritage Review (PEAHR) process which requires avoiding disturbance of significant flora where possible when carrying out land disturbance. Therefore, the percentage impact to populations and records of the impacted significant flora discussed above will likely reduce further. Based on this, as well as the broader distribution of the six species discussed above, their occurrence of protected populations within Karijini National Park and in some cases in other bioregions of WA and other states of Australia, BHP considers that the Proposal will not result in a significant impact to the Priority flora species locally or regionally. The representation and viability of the Priority flora known from the Development Envelope will be maintained in the Pilbara bioregion.

8.6.2 Changes to vegetation from changes to groundwater regimes

Flora and vegetation may be impacted by increased groundwater abstraction (reduced water availability) and groundwater injection for the Northern RAV MAR scheme and the Yandicoogina Gorge groundwater supplementation program (potential groundwater mounding) from the Proposal.

Confirmed GDV (containing *Melaleuca argentea*) which intersects the groundwater drawdown contours for the Combined Proposal occurs at two locations along Weeli Wolli Creek and are 'ecosystems at risk' as they represent major ephemeral watercourses in the Pilbara. These two locations are Weeli Wolli Spring and the vicinity of Ben's Oasis. These two locations also include Moderate likelihood GDV.

Additional impacts from the Combined Proposal to confirmed High and Moderate likelihood GDV at Weeli Wolli Spring and the surrounding area of Weeli Wolli Creek are not expected to occur as the Combined Proposal drawdown at this location and vicinity is within the approved limit of 3-14 m and is not expected to be greater than previously assessed. Furthermore, based on monitoring undertaken to date along Weeli Wolli Creek by Rio Tinto indicating there have been no significant or clearly attributable impacts to riparian vegetation and GDV from dewatering to date despite significant groundwater drawdown occurring in the vicinity (Rio Tinto 2024). BHP also commenced tree health monitoring within Weeli Wolli Spring in 2021 and there has been no indication of decline in tree health since this monitoring commenced (although the monitoring commenced a number of years after Hope Downs 1 dewatering started) (Biologic 2023g). Based on the above, potential impacts to these vegetation associations are not considered significant (see Section 7.5.1). However, these areas of GDV could potentially be impacted in future by cumulative impacts in the region and this is discussed in Section 16. The extent of groundwater change at Weeli Wolli Spring will continue to be monitored and managed using the mitigation measures outlined in the CPWRMP, which includes triggers and thresholds for monitoring of vegetation health.

The High and Moderate likelihood GDV closer to Ben's Oasis within Area F (south of the regional dyke) will be potentially impacted by the Combined Proposal from groundwater drawdown. This is primarily because this vegetation occurs in conjunction with shallow groundwater levels (at the same elevation as the creek based on monitoring from the bore HD0001M) indicating it is likely to be reliant on groundwater in some capacity; particularly the High likelihood GDV containing *Melaleuca argentea*. A potential minimising consideration is that hydrogeological modelling conducted by both RTIO (Rio Tinto 2024) and BHP suggests that a regional dyke could potentially be acting as a flow barrier between Ben's Oasis and the Hope Downs Aquifer which would reduce the risk of impact to this riparian system from the Combined Proposal. However, both RTIO and BHP consider that further work is required to confirm this. Tree health monitoring was established in 2021 at a site immediately upstream of the Ben's Oasis PEC boundary in an area of High likelihood GDV, where the vegetation association description aligns with the PEC description (Biologic 2023g). BHP plans to establish additional tree health monitoring locations within the GDV (Moderate and High likelihood) downstream of the PEC boundary that could potentially be impacted by the Combined Proposal (Section 8.5.2). Tree health monitoring within the vicinity of Ben's Oasis to date does not indicate significant declining trends, although increased weed cover and cattle disturbances to the understorey have been observed (Biologic 2023g); however, this monitoring was established several years after Hope Downs 1 dewatering commenced. Considering the potential for impacts to be minimised by the dyke to the north (acknowledging work is

still to be completed to confirm this), potential impacts to High and Moderate likelihood GDV in the vicinity of Ben's Oasis are not considered to be significant.

Areas of Moderate likelihood GDV occurring within areas A, B and C (Figure 8-19) are unlikely to be impacted by groundwater drawdown for the Combined Proposal, primarily due to pre-development groundwater levels being too deep to indicate any reliance of key GDV species on groundwater (*Eucalyptus camaldulensis* and *Eucalyptus victrix*) at those locations. Moderate likelihood GDV occurring in Area D is also unlikely to be impacted based on the proposed drawdown at this location being within the approved limit and is not expected to be greater than previously assessed as discussed above in relation to Weeli Wolli Spring.

The remaining area of Moderate likelihood GDV is the north-south stretch between Ben's Oasis and Weeli Wolli Spring within Area E. Pre-development groundwater levels along the stretch of Weeli Wolli creek within Area E range from 7 mbgl in the north, to between 46 mbgl in the south. However, as previously described, groundwater drawdown along this stretch of Weeli Wolli Creek from Hope Downs 1 has been significant, to the point where the regional aquifer is no longer accessible below an 8 to 10 km portion of this part of the creek adjacent to the mine (Rio Tinto 2024). In some areas, directly east of the Hope Downs 1 pits, groundwater has dropped to as low as 70 mbgl. Despite such significant reductions in groundwater levels, Rio Tinto (2024) stated that monitoring results to date through this area don't show a significant or clearly attributable impact from dewatering apart from general but not substantial reductions in canopy cover in low flow phreatophytes. Furthermore, a census of the condition of every facultative phreatophytic species individual in a 4 km stretch of Weeli Wolli Creek directly adjacent to the mine found that in 2018 only 15 trees were detected to have died since mining began in 2007. Rio Tinto concluded these deaths to be in the realm of natural attrition given that it was out of approximately 2000 individuals assessed (Rio Tinto 2024).

Potential impacts to this stretch of Weeli Wolli Creek are considered unlikely based on minimal impacts to GDV to date and that a large portion of this stretch of creek lies in areas of deep pre-development groundwater levels.

Although drawdown in Coondewanna Flats is expected to increase by up to another 64 m as a result of the Combined Proposal, and the Coondewanna Flats PEC is known to be a surface water dependent ecosystem and is therefore not predicted to be impacted by groundwater drawdown (Section 8.3.2.1 and Section 8.4.1.1). In addition, potential impacts to the Coondewanna Flats PEC will continue to be managed through implementation of the CPWRMP (Appendix 8; see Section 8.5.2). The effectiveness of the water management will be confirmed by ongoing monitoring of tree health and associated GDV.

Northern RAV MAR

Groundwater mounding is predicted to occur in and around the Northern RAV MAR scheme location within the Development Envelope. The vegetation associations at this location comprises mostly low shrubs and mixed grasses with no local significance. The existing groundwater levels in the Northern RAV MAR area are approximately 40 mbgl, and there is uncertainty in the aquifer geometry and hydraulic parameters in that area (Section 7.5.2). The modelling was therefore based on conservative parameters and shows that at continuous injection rates there is a high probability that the water level will increase (mound) to within 10 m of the ground surface. At 20 and 30 ML/d there is a 50% probability that this will happen after 5 years and 2 years respectively and the total duration of mounding impacts is predicted to be 20 years (Section 7.5.2, Figure 8-18).

Five of the vegetation associations within the 0-20 mbgl mounding band (Section 8.4.2) covering an area of approximately 162 ha may be negatively impacted by the rise in groundwater levels. These associations contain potentially deep-rooted species (*Eucalyptus xerothermica*, *Eucalyptus leucophloia* subsp. *leucophloia* or *Eucalyptus victrix*) that may be impacted both while mounding is occurring and after it has receded. If groundwater rises to be persistently above the baseline rooting depth of these tree species, deep roots may be waterlogged and die. This may not be deleterious while mounding is occurring, as water availability is likely to increase in the unsaturated zone above the water table and/or there may be groundwater uptake by vegetation when the water table rises (e.g. *E. victrix* is known as a facultative phreatophyte). When mounding recedes, the rooting depth and therefore effective plant available water may be lower than at baseline; depending on the rate of groundwater level decline following

completion of the MAR. New root growth may not be sufficient to meet ecological water requirements of these tree species, particularly if there has been increased canopy growth during mounding. Negative impacts may follow through the creation of drought-like conditions which may cause a decline in health or even death of some trees. The potential impacts to vegetation depend in part on whether the baseline root depth is within the level of predicted mounding; this is uncertain, due to limited knowledge of the localised geology and potential restrictions to root growth.

The vegetation associations potentially impacted are not locally or regionally significant, do not contain obligate GDV and are considered to be well represented in BHP's consolidated vegetation mapping and are likely to occur more broadly in the Pilbara. Despite this, the residual impact of decline or death which may occur to the *Eucalyptus* species in the 0-20 mbgl mounding zone is considered significant and BHP commits to offset this impact if it does eventuate in future. BHP will monitor the tree health of *Eucalyptus xerothermica*, *Eucalyptus leucophloia* subsp. *leucophloia* and *Eucalyptus victrix* trees within the 0-20 mbgl mounding zone, commencing at the cessation of injection of surplus water into the Northern RAV MAR to assess potential decline in health of the trees while the mounded groundwater gradually recedes. The Northern RAV MAR Scheme will be also managed through the Part V licence of the EP Act.

Based on the discussion in this section, BHP considers there will be a significant residual impact to flora and vegetation from changes to groundwater regimes in the form of potential vegetation health decline or death of *Eucalyptus* trees in the 162 ha of vegetation within the 0-20mbgl mounding contours from the Northern RAV MAR.

Yandicoogina GDE Supplementation Scheme

The Yandicoogina GDE Supplementation Scheme is intended for environmental water requirements for an ecosystem of value. It represents the highest water use priority in the surplus water hierarchy (Section 7.4). This scheme is being implemented to mitigate recent declines in local groundwater levels and tree health as discussed in Section 7.3.4.4. It is proposed to increase groundwater levels to those observed in 2018.

The scheme has been designed to increase and then maintain groundwater levels at previously observed values, and mounding is not anticipated to negatively impact riparian vegetation/GDV within Yandicoogina Gorge but should provide positive impacts as groundwater levels are returned to pre-2018 levels. This is expected to prevent any further decline in the permanent pools or vegetation health or condition and allow for the continued persistence of these values within the gorge. Specifically, based on the presence of several ecological values which indicate groundwater dependence of vegetation and flora in parts of the gorge, and the recent decline in health of riparian vegetation/GDV, the link to the decline in groundwater levels suggests the restoration of groundwater levels in the gorge is likely to benefit these features. The results of the supplementation trial will indicate whether the vegetation in the gorge responds positively to the mitigation. As a safeguard, the TARP will be implemented during the trial as described in Section 8.5.2. It includes the requirement for close monitoring of reinjection rates, groundwater levels and biodiversity values to mitigate the potential risk of flooding, surface water expression or further vegetation health decline. The results of the trial will inform the long-term plan for supplementation at the gorge (the subject of this Proposal), including the development of a dataset which will indicate appropriate future reinjection rates to provide the best outcome for vegetation and other ecological values in the gorge. Therefore, future potential negative impacts to vegetation/GDV at the gorge from long-term supplementation are considered unlikely.

8.6.3 Changes to vegetation from changes to surface water regimes

Flora and vegetation may be impacted by surplus water discharge along Marillana Creek from two locations (altered surface water regimes) or by construction of pipelines and diversion infrastructure for the GCOSA for this Proposal (potential interference with sheetflow and increased erosion and sedimentation).

A total of 75 ha of vegetation occurs along the Upper Marillana wetting front extent (Table 8-15), comprised of 71 ha of riparian vegetation, 0.5 ha of SP AaApr TmTwTp TtChfAri which represents Valley Floor Mulga (ecosystem at risk) and 3.5 ha of other non-significant grasses and shrublands (Figure 8-20, Table 8-15). A total of six of the riparian vegetation associations, totalling 70.5 ha within the wetting front extent contain one or more of the species *Eucalyptus*

victrix, *Eucalyptus camaldulensis* or *Acacia citrinoviridis* which are susceptible to impacts from continuous discharge of water for long periods.

The discharge to Upper Marillana Creek will be periodic and will occur at a maximum of 30 ML/d for 9 months of the year, followed by a 90 day 'no flow' period each year during the dry season, with a maximum an operational life of five-years, and a maximum discharge of 8.2 GL/annum. These limits will ensure that the wetting front will not extend to Flat Rocks or the Marillana Creek Pools. As a safeguard, a trigger of 24 km and a threshold of 27 km will be in place and as described in Section 8.5.2, if surplus water discharge reaches the wetting front trigger, the discharge to Upper Marillana Creek will be switched off.

The creek discharge is still likely to have some impact on the water available at Flat Rocks after rainfall events. The inundated low flow channel area is likely to reduce the recharge rates during creek flow events as it will be saturated so will result in higher creek flow (AQ2 2019). BHP will monitor the wetting front extent as outlined in Section 8.5.2 and the CPWRMP. The CPWRMP will also include commitments for monitoring tree health and weeds along the wetting front.

Based on the management and mitigation proposed for the Upper Marillana discharge, the riparian and other vegetation present along the wetting front is unlikely to be significantly impacted by the Proposal.

Discharge to Lower Marillana Creek will occur at the existing discharge location in use at the Yandi mine which has shown no significant negative impacts on riparian vegetation health from surplus water discharge since its establishment in 2009 (Astron 2024b). A recent fire at the Yandi mine however, resulted in a total of 23 new potential tree deaths recorded in the 2023-2024 monitoring period including *Eucalyptus camaldulensis*, *Eucalyptus victrix* and *Melaleuca argentea*. Five of these were recorded at the discharge location (Astron 2024b). Aside from the recent tree deaths from fire, in the years leading up to 2023 the monitoring showed positive trends for the health of riparian vegetation and GDV along Marillana Creek within the Yandi mine lease, including at the discharge monitoring location MC1. There is anecdotal evidence that riparian vegetation (and the associated fauna habitats) downstream and off BHP tenure, has declined in health and composition since discharge volumes and the wetting front have decreased. The Proposal is not anticipated to result in decline of riparian vegetation from discharge, as there will be no changes to the existing maximum wetting front reached (9 km), and the proposed discharge rate for the Proposal will be within the licence requirements (L6168/1991/11) and will be limited to a period of 5 years. Discharge for the Proposal may assist in restoring GDV/riparian vegetation health downstream off BHP tenure due to increasing the wetting front from the recently observed 2.5 km back up to 9 km. The potential for future decline in health of riparian vegetation following cessation of discharge for the Yandi mine is addressed in the Yandi mine Closure Plan (BHP 2024c) and includes reference to the potential opportunity to support the riparian vegetation downstream of the discharge location which is currently being explored with Traditional Owners, and if feasible, will be incorporated into future updates to the Yandi mine Closure Plan (BHP 2024c).

Potential impacts to flora and vegetation associated with the potential sedimentation from construction of the north-eastern pipeline will be temporary and localised. Both pipelines for the Proposal will be installed in areas where existing tracks and rail lines exist.

Based on the above, BHP considers there are unlikely to be any significant residual impacts to vegetation from changes to surface water regimes. BHP acknowledges that the use of creek discharge is considered significant to Banjima People and the implementation of mitigation measures will reduce any potential impacts to impacts to culturally significant areas (further discussed in Section 11).

8.6.4 Changes to vegetation and flora from dust, fire and weeds

An increase in dust during the Proposal will be from clearing and construction only and will be temporary and likely highly localised. Any increase during operation is expected to be negligible given the nature of the operation of the water infrastructure (i.e. pipelines).

The Proposal is not expected to change the frequency of fire within the Development Envelope and minimal Gorge and Gully vegetation associations (with the potential to contain fire sensitive species) intersect the Indicative Footprint. BHP considers that the Proposal will have a negligible impact to vegetation or flora from the potential alteration of fire regimes.

The Proposal may result in the spread of weeds into areas of proposed new disturbance (mainly via vehicle movement); however, the Proposal is largely located nearby or within areas of existing disturbance, and therefore not expected to significantly increase the occurrence of weeds within the Development Envelope.

8.6.5 Significant residual impacts

Following the application of the mitigation hierarchy (Section 8.5) and applying the Residual Impact Significance Model in the WA Offsets Guidelines (Government of Western Australia 2014), BHP considers that there will be significant residual impacts to Flora and Vegetation from the Proposal through the following:

- Clearing of 1,043 ha of vegetation in Good to Excellent condition (due to the cumulative impacts of clearing in the Pilbara, based on the EPA's advice to the Minister under Section 16(e) of the EP Act (EPA 2014))
- Clearing of up to 60 ha riparian vegetation
- Potential vegetation health decline or death of Eucalyptus trees in the 162 ha of vegetation within the 0-20 mbgl mounding contours from the Northern RAV MAR.

BHP proposes to offset the above to counterbalance the impacts to ensure the EPA's objective for Flora and Vegetation can be met. The detailed assessment of offsets is discussed in Section 14, including how the proposed offset/s will counterbalance the significant residual impact on Flora and Vegetation.

For the other impacts assessed, BHP considers that the residual impacts are not significant. See Section 8.7 for the discussion on the outcomes relating to the identified residual impacts and BHP's proposed assurance (regulation) and monitoring, where required.

8.7 Environmental outcomes

Table 8-16 summarises the environmental outcomes, proposed assurance (regulation) and proposed monitoring (if required) for each residual impact for Flora and Vegetation for the Proposal. Detail of the proposed monitoring is set out in the Part IV environmental management plans as discussed in Section 8.5. Table 8-16 demonstrates how the proposed environmental outcomes for the Proposal, together with the proposed regulation and monitoring, are consistent with the EPA's objective for Flora and Vegetation (Section 8.1).

As required by the EPA's ERD Instructions, for Significant Amendments, BHP has included information about the existing implementation conditions for the Approved Proposal (Appendix 2). BHP considers that the EPA should inquire into the Approved Proposal implementation conditions (relating to Flora and Vegetation), as provided for under s40AA(3), as part of the assessment of the Proposal under s40 and in the EPA's assessment report required under s44, for the following reasons:

- to contemporise the conditions to reflect the contemporary condition setting approach (in recommended conditions in EPA Reports and Ministerial Statement since early 2023).

As provided for as an option in the EPA's ERD Instructions, BHP has proposed conditions (including outcome-based conditions) for the EPA's consideration, in Appendix 6.

Table 8-16: Flora and Vegetation - environmental outcomes and proposed assurance and monitoring

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process) ¹	Proposed Monitoring	Consistency with EPA objective
1. Clearing of up to 1,043 ha of native vegetation in Good to Excellent condition (in the Pilbara IBRA region)	Contributes to the cumulative clearing of Good to Excellent condition vegetation in the Pilbara bioregion (Section 8.6.1.1)	Condition A1: The proponent must ensure that the proposal is implemented in such a manner that the following limitation or maximum extents / capacities / ranges are not exceeded including: - Clearing of no more than 1,076 ha of vegetation for this Proposal - Clearing of no more than 22,900 hectares of vegetation for the Combined Proposal Condition B6: Offsets - Offsets via contribution to the PEOF Condition B5: Decommissioning and Rehabilitation - Implement the MCP (BHP 2024f)	Standard management practices: - internal land disturbance approval process to manage ground disturbance - annual land disturbance reporting against approved limits/extents Condition B6: Offsets - Impact Reconciliation Procedure and Impact Reconciliation Report Condition B5: Decommissioning and Rehabilitation - Implement monitoring outlined in the MCP (BHP 2024f)	The potential significant residual impact of the proposed clearing to cumulative clearing in the Pilbara bioregion can be counterbalanced by offsets, so that the environmental outcome is consistent with EPA's objective.
2. Clearing of up to 60 ha of riparian vegetation	No impacts to regionally significant vegetation (TECs and PECs) The representation of locally significant vegetation will be maintained in the local area to an extent that ecological integrity is not threatened	Condition A1: Limit on extent of proposal element - Up to 60 ha of riparian vegetation clearing within the Development Envelope Condition B6: Offsets - Offsets via contribution to PEOF	Standard management practices: - internal land disturbance approval process to manage ground disturbance - annual land disturbance reporting against approved limits/extents Condition B6: Offsets	The potential significant residual impact of the proposed clearing of riparian vegetation can be counterbalanced by offsets, so that the environmental outcome is consistent with EPA's objective.

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process) ¹	Proposed Monitoring	Consistency with EPA objective
		Condition B5: Rehabilitation and decommissioning Implement the MCP (BHP 2024f)	Impact Reconciliation Procedure and Impact Reconciliation Report Condition B5: Rehabilitation and decommissioning Implement monitoring outlined in the MCP (BHP 2024f)	
3. Potential decline or death of Eucalypt trees within 162 ha of vegetation impacted by groundwater mounding for the Northern RAV MAR scheme	Potential loss of an additional 162 ha of vegetation (if vegetation decline or death occurs).	Condition B6: Offsets Offsets via contribution to the PEOF	BHP will monitor the tree health of <i>Eucalyptus xerothermica</i> or <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> trees within the 0-20 mbgl mounding zone commencing at the cessation of injection of surplus water into the Northern RAV MAR..	The potential future significant residual impact of the decline in health/death of vegetation can be counterbalanced by offsets, so that the environmental outcome is consistent with EPA's objective.
4. Clearing of less than 0.1% of two Beard vegetation associations (18 and 82)	The representation of both Beard vegetation associations in the Pilbara bioregion will be maintained (Section 8.6.1.1)	Condition A1: Limit on extent of proposal element	Standard management practices: internal land disturbance approval process to manage ground disturbance	The representation of regional vegetation and locally significant vegetation will not be significantly impacted, and the local and regional extent of significant flora

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process) ¹	Proposed Monitoring	Consistency with EPA objective
5. Clearing of no more than 15% of known populations and no more than 32% ² of records of Priority flora species in the Pilbara region	No impacts to Threatened flora. The viability of the Priority flora known from the Development Envelope will be maintained in the Pilbara bioregion (Section 8.4.1.2)	Up to 1,076 ha of native vegetation clearing within the Development Envelope	annual land disturbance reporting against approved limits/extents	will be maintained which is consistent with EPA's objective

¹ See the Proposal Content Document (Appendix 1) and the proposed implementation conditions (Appendix 6) for the regulation for the Combined Proposal.

² Only one taxon has impacts >10% to known populations and records in the Pilbara region; *Aristida Lazaridis* (P3) (14.3% and 31.3% of known BHP populations and records will be impacted from the Combined Proposal respectively). However the broader known records and populations of this species in Australia, and notably, populations that are protected in Karijini National Park indicate the percentage impact to known occurrences of this species in WA or Australia wide would be much less and the viability of this taxa is unlikely to be affected by the Proposal (Section 8.6.1.2).

9 Terrestrial Fauna

9.1 EPA environmental factor and objective

The EPA's objective for the Terrestrial Fauna factor is:

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

9.2 Relevant policy and guidance

BHP assessed this environmental factor considering the following relevant EPA policies and guidance, outlined in Table 9-1.

Table 9-1: Terrestrial Fauna - policy and guidance

EPA policy and guidance	Consideration of EPA policy and guidance
EPA policy and guidance	
<i>Statement of environmental principles, factors, objectives and aims of EIA (EPA 2023c)</i>	- Identified the relevant environmental factor and objectives to guide the EIA process - Followed the aims of the EIA process - Considered cumulative effects when assessing potential impacts on terrestrial fauna - Applied the mitigation hierarchy for terrestrial fauna.
<i>Environmental Factor Guideline - Terrestrial Fauna (EPA 2016d)</i>	- Identified the EPA's objective for Terrestrial Fauna - Applied the relevant considerations for environmental impact assessment - Identified the values of terrestrial fauna, and their significance - Identified activities that can impact on terrestrial fauna - Considered the links with other environmental factors.
<i>Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020b)</i> <i>Technical Guidance - Sampling of short range endemic invertebrate fauna (EPA 2016i)</i>	- Surveys described in Section 9.3.1 were undertaken in accordance with these guidance documents - Considered in the design (methods and approach) of the fauna surveys or previous guidance (if survey undertaken before current guidelines).
<i>WA Environmental Offsets Policy (Government of WA 2011)</i>	- Applied avoidance and mitigation measures to the Proposal - Considered cumulative impacts in a regional context for determining significant residual impact - Quantified the significant residual impact.
<i>WA Environmental Offsets Guidelines (Government of WA 2014)</i>	

9.3 Receiving environment

9.3.1 Studies and surveys

Twenty-one terrestrial fauna surveys and eight SRE invertebrate fauna surveys have been wholly or partially undertaken in the Development Envelope between 1997 and 2016 (BHP 2017b; Appendix 11). Since 2016, a further seven vertebrate fauna and four SRE invertebrate fauna surveys have been undertaken within the Development Envelope (Table 9-2; Appendix 11). Surveys include desktop assessments, basic (Level 1) surveys, detailed (Level 2) surveys, and targeted significant fauna surveys. A summary of the historical surveys is provided in Appendix 11, with contemporary surveys (i.e. surveys undertaken within the last five years) described in Table 9-2. Collectively, these surveys cover the entire Development Envelope including the Indicative Footprint (Figure 9-1 and Figure 9-3).

Sampling effort for vertebrate and SRE invertebrate fauna has been extensive with 1,518 sample sites within the Development Envelope, including 44 sites within the Indicative Footprint, and over 4,000 sample sites in regional locations (within 15 km) (Figure 9-2 and Figure 9-4). This includes 66 SRE sample sites within the Indicative Footprint (Figure 9-2 and Figure 9-4). Additional SRE surveys have recently been completed to ensure full coverage across the Indicative Footprint, with results expected 2025 (Biota 2025 *in prep*; Table 9-2). Some areas within the north-east scheme of the Indicative Footprint lack SRE data; however, these areas mostly align with existing tracks, rail-line and highly disturbed areas which would be unlikely to provide suitable habitat for SREs or potentially restricted species (Figure 9-2 and Figure 9-4).

In addition, at least 11 aquatic ecosystem surveys have been undertaken either within the Development Envelope, or in regional areas that may be subject to impacts from the Proposal (i.e. Yandicoogina Gorge, Weeli Wolli Springs, Coondewanna Flats and Upper Marillana Creek; Table 9-2; Appendix 11). Surveys undertaken within the last five years are summarised in Table 9-2, whilst older historical surveys are described in Appendix 11. Sampling effort for aquatic fauna has included eight sample sites at Yandicoogina Gorge, 12 sample sites along Marillana Creek including the Marillana Creek Pools, 16 sample sites along Weeli Wolli Creek including Weeli Wolli Springs and three sample sites at Lake Robinson in Coondewanna Flats (Figure 9-5). Monitoring within Marillana Creek, Weeli Wolli Springs and Creek and Yandicoogina Gorge is undertaken on an on-going basis, with surveys undertaken during the dry and wet seasons (Appendix 12).

BHP has provided the recent survey terrestrial and aquatic fauna reports in Appendix 12 and the survey data as part of the IBSA data package (Appendix 19). All surveys were completed in accordance with the EPA requirements relevant at the time of surveying (EPA 2002, 2004, 2009, 2016e, 2016f, 2016i, 2020b).

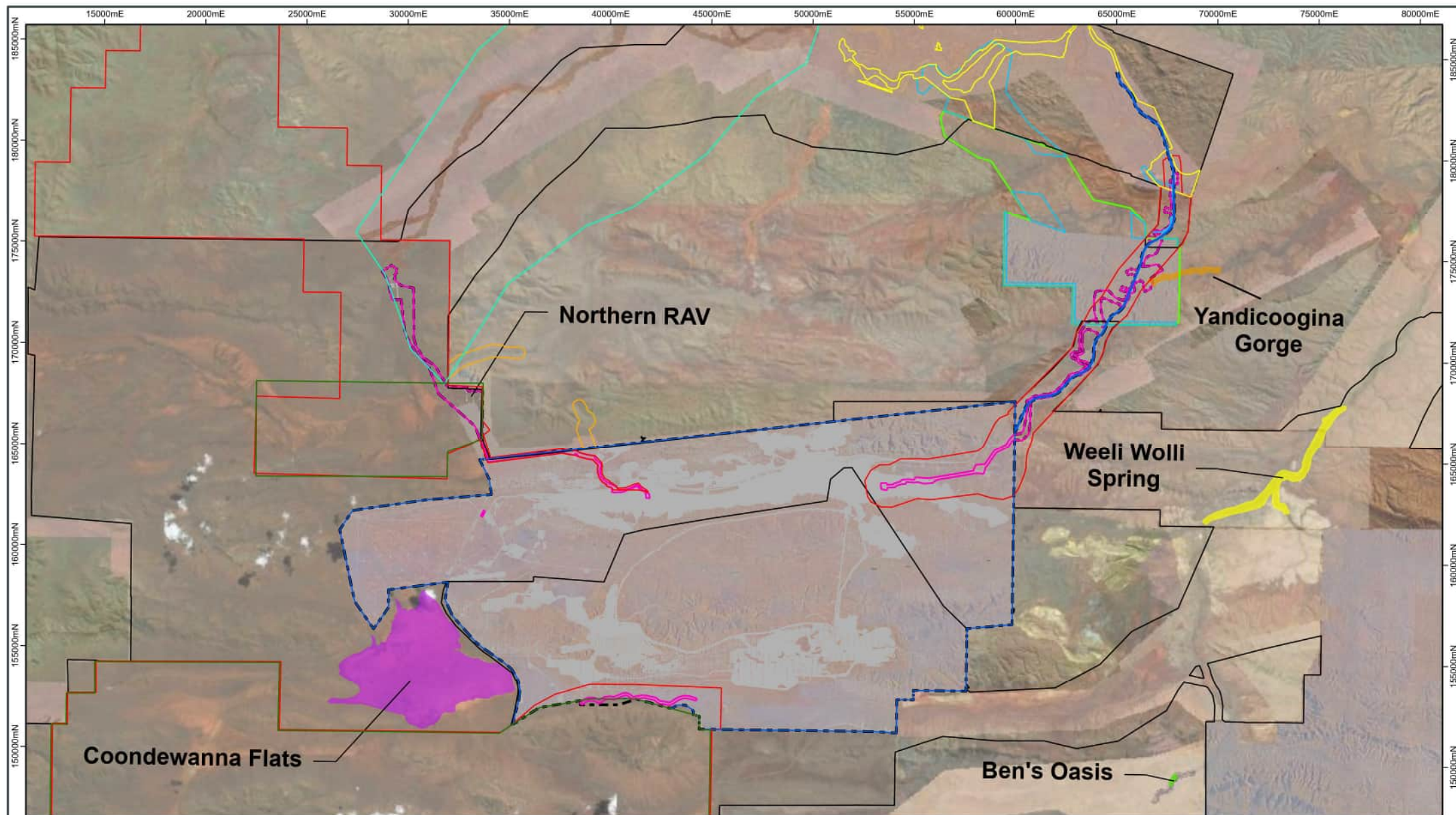
Table 9-2: Terrestrial Fauna - supporting studies and surveys

Title	Survey Date	Summary	Appendix
Vertebrate Fauna			
Central Pilbara Hub Stage 2 Targeted MNES Vertebrate Fauna Survey (Biologic 2025a)	April 2022 April – May 2022 May 2022 February 2023 March 2023	A targeted vertebrate fauna survey of the Central Pilbara Hub (CPH) Stage 2 area. The survey was completed over two phases during 2022 (phase 1) and 2023 (phase 2). Species specific targeted sampling during the field survey comprised habitat and habitat feature assessments, ultrasonic and acoustic sound recordings, camera trap transects, targeted searches and nocturnal searches.	Appendix 12
Ministers North Targeted Significant Vertebrate Fauna Survey (Astron 2025 <i>in prep</i>)	April 2023	A single season targeted survey for significant vertebrate fauna. Sampling methods included habitat assessments, motion cameras, acoustic bat surveys, Night Parrot survey, Greater Bilby plots, nocturnal searches, cave assessments, and transect searches. Survey covers 160 ha of both the Development Envelope and Indicative Footprint.	Not attached – will be provided at a later date
CPH Targeted Matters of National Environmental Significance Vertebrate Fauna Survey (Biologic 2023a)	Nov 2021 Apr – May 2022	Targeted field surveys for significant vertebrate fauna, with a specific focus on MNES. Five separate field trips undertaken over two seasons. Sampling methods included habitat and habitat feature (i.e. cave and water features) assessments, ultrasonic and acoustic sound recordings, camera trap transects, targeted searches and nocturnal searches. The survey covers 3,991 ha of the proposed Development Envelope including 1,429 ha of the Indicative Footprint.	Appendix 12
Targeted Pilbara Olive Python Survey: South Flank and Mining Area C (Biologic 2023d)	March 2023	A single season targeted Pilbara Olive Python survey within the Development Envelope, including regional areas surrounding the Development Envelope. Sampling methods included diurnal and nocturnal targeted transects, and nocturnal vehicle transects. The survey covers 38,901 ha of the proposed Development Envelope including 382 ha of the Indicative Footprint.	Appendix 12
Yandi 45C Targeted Significant Vertebrate Fauna Survey (Astron 2023)	23 Sept – 2 Oct 2022	A targeted significant vertebrate fauna survey, focussing on MNES within parts of the Development Envelope. The study included a desktop assessment, targeted vertebrate fauna survey and mapping of fauna habitats. The survey covered a total area of 1,596 ha including 19 ha of the Indicative Footprint.	Appendix 12

Title	Survey Date	Summary	Appendix
MAC Phase 4 Marillana Creek Targeted MNES Fauna Survey (Biota 2022)	Nov 2020 Mar 2021 Jan 2021	Two-phase survey targeting significant fauna species, with a particular focus on MNES. Sampling methods included motion cameras, targeted searches, nocturnal searches, habitat assessment. hair traps (if active burrows detected) and echolocation call recorders. The survey covers 267 ha of the proposed Development Envelope, all of which occurs within the Indicative Footprint.	Appendix 12
Ministers North Level 1 Fauna Survey (GHD 2021)	9-20 Sept 2019	A Level 1 vertebrate fauna survey undertaken for the Ministers North Project intersecting the north-east scheme of the Development Envelope. The purpose of the survey was to identify ecological values, further add to the biodiversity knowledge within the areas surveyed and support future approvals documentation. The study included habitat mapping, opportunistic species list, and bird and bat acoustic data. The survey covered a total area of 2,507.7 ha, including 60 ha of the Indicative Footprint.	Appendix 12
MAC4 Pipeline Level 1 Vertebrate Fauna Assessment (Biologic 2019a)	20-22 Nov 2018	A Level 1 vertebrate fauna survey of two alternative pipeline routes north of Mining Area C to provide updated information from previous fauna assessments and to assess the likelihood of significant conservation species and habitats occurring within the Study Area. This survey covers 3 ha of the proposed Development Envelope, all of which occurs in the Indicative Footprint.	Appendix 12
Consolidated Fauna Habitat Mapping (Biologic 2014c and 2018)	2014 and updated in 2018	This study combined all available and relevant fauna habitat mapping into one consolidated regional dataset that provides consistency in naming across BHP tenure. Analysis of aerial photography, previous fauna habitat mapping, vegetation mapping available at the time (Onshore 2014a) and information gathered during site visits, was conducted to create the consolidated fauna habitat dataset. The dataset was updated in 2017 where errors were corrected, and additional areas of mapping incorporated. The survey covers 19,220 ha of the proposed Development Envelope, including 1,122 ha of the Indicative Footprint.	Not attached
Short-range Endemic Invertebrate Fauna			
Pineapple Hill and Runaway Valley North Detailed SRE Survey (Biota 2025 <i>in prep</i>)	March 2024 August/Sept 2024	Phase 1 of a Detailed SRE invertebrate fauna survey was completed in March 2024 with the second phase of the trip planned for August 2024. The survey comprised 23 sample sites at Pineapple Hill and six sites at Runaway Valley	Not attached – will be provided at a later date

Title	Survey Date	Summary	Appendix
		North and included soil raking, leaf litter sifting, excavating burrows, hand foraging and nocturnal searches using UV lights.	
Ministers North SRE Invertebrate Fauna Desktop and Field Survey (Bennelongia 2024a)	April 2023	A single season detailed field survey undertaken in April 2023. Survey comprised 30 sites and included dry trapping, active foraging, litter collection and habitat assessment, and nocturnal foraging/searching.	Appendix 12
Yandi Operations Short-Range Endemic Fauna Survey Report (Bennelongia 2024c)	August 2023	A two-season SRE invertebrate field survey as well as a desktop assessment to identify possible SRE taxa and habitats within the Development Envelope. The survey covered a total area of 32 ha of the proposed Development Envelope, all of which occurs within the Indicative Footprint.	Appendix 12
Ministers North and Yandicoogina Creek SRE Invertebrate Fauna Survey (Biologic 2021)	9-13 Sept 2019 3-10 April 2020	A single season targeted SRE invertebrate fauna survey covering the Ministers North Miscellaneous Licence area and a two season Level 2 SRE invertebrate fauna survey within a Groundwater Dependent Ecosystem (GDE) in Yandi Creek. The survey covered approximately 60 ha of the proposed Development Envelope, all of which occurs within the Indicative Footprint.	Appendix 12
Aquatic Fauna			
Ministers North Yandicoogina Creek Aquatic Ecosystem Survey Dry 2022 and Wet 2023 (Biologic 2024c)	September 2022 (dry season) March 2023 (wet season)	The fourth round of sampling for the two-season aquatic ecosystem survey along Yandicoogina Creek. Ecosystem sampling methods included habitat assessments and sampling of water quality, wetland flora (submerged and emergent macrophytes), zooplankton, hyporheos, macroinvertebrates and fish.	Appendix 12
MAC Phase 4: Aquatic monitoring Dry 2022 and Wet 2023 (Biologic 2024b)	September 2022 (dry season) March - April 2023 (wet season)	The third aquatic ecosystem survey of the two season, baseline aquatic fauna survey of the semi-permanent pools of Upper Marillana Creek. The surveys included habitat assessments and sampling of water quality, wetland flora and dominant riparian vegetation, and aquatic fauna.	Appendix 12
Weeli Wolli Spring: Aquatic Monitoring Wet and Dry 2022 (Biologic 2024d)	Nov 2022 (dry season) May 2022 (late wet season)	A two-season survey of the aquatic ecosystems within Weeli Wolli Spring, including Ben's Oasis and a reach of Weeli Wolli Creek downstream of the historic springs area. The aquatic survey included habitat assessments and sampling of water quality, macrophytes (submerged macrophytes, emergent macrophytes, and dominant riparian vegetation), zooplankton, hyporheos fauna, macroinvertebrates, and fish.	Appendix 12

Title	Survey Date	Summary	Appendix
Weeli Wolli Spring: Aquatic Monitoring 2021 (Biologic 2023h)	October to November 2021 (dry season) April to May 2021 (wet season)	A two-season survey of the aquatic ecosystems within Weeli Wolli Spring, including Ben's Oasis and a reach of Weeli Wolli Creek downstream of the historic springs area. The aquatic survey included habitat assessments and sampling of water quality, macrophytes (submerged macrophytes, emergent macrophytes, and dominant riparian vegetation), zooplankton, hyporheos fauna, macroinvertebrates, and fish.	Appendix 12
MAC Phase 4: Marillana Creek Baseline Aquatic Ecosystem Survey Dry 2021 & Wet 2022 (Biologic 2023b)	October 2021 (dry season) April 2022 (wet season)	The second round of the two season, baseline aquatic fauna survey of the semi-permanent pools of Upper Marillana Creek. The surveys included habitat assessments and sampling of water quality, wetland flora and dominant riparian vegetation, and aquatic fauna.	Appendix 12
MAC Phase 4: Marillana Creek Baseline Aquatic Ecosystem Survey Dry 2020 & Wet 2021 (Biologic 2022a)	September 2020 (dry season) April 2021 (wet season)	The first round of a two season, baseline aquatic ecosystem survey undertaken within Upper Marillana Creek, focussing on the semi-permanent pools to the west of the area known as Flat Rocks. The surveys included habitat assessments and sampling of water quality, wetland flora and dominant riparian vegetation, and aquatic fauna.	Not attached – most recent monitoring report attached (see above)
Ministers North Aquatic Ecosystem Survey: Dry 2021 – Wet 2022 (Biologic 2023c)	October 2021 (dry season) April 2022 (wet season)	The third round of sampling for the two-season aquatic ecosystem survey along Yandicoogina Creek. Ecosystem sampling methods included habitat assessments and sampling of water quality, wetland flora (submerged and emergent macrophytes), zooplankton, hyporheos, macroinvertebrates and fish.	Not attached – most recent monitoring report attached (see above)
Ministers North: Yandicoogina Creek Aquatic Ecosystem Surveys Dry 2020 and Wet 2021 (Biologic 2022b)	October 2020 (dry season) April 2021 (wet season)	The third round of sampling for the two-season aquatic ecosystem survey of the pools at Yandicoogina Creek. Sampling methods included habitat assessments and sampling of water quality, wetland flora (submerged and emergent macrophytes), zooplankton, hyporheos, macroinvertebrates and fish.	Not attached – most recent monitoring report attached (see above)
Ministers North: Yandicoogina Creek Aquatic Ecosystem Surveys (Biologic 2020b)	October 2019 (dry season) April 2020 (wet season)	The first round of sampling for a two-season (baseline) aquatic ecosystem survey of the perennial and semi-permanent pools located along a 3 km stretch of Yandicoogina Creek. Ecosystem sampling methods included habitat assessments and sampling of water quality, wetland flora (submerged and emergent macrophytes), zooplankton, hyporheos, macroinvertebrates and fish.	Not attached – most recent monitoring report attached (see above)

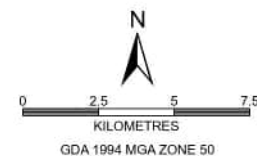


- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge

Terrestrial Vertebrate Fauna Surveys

- Ministers North Targeted Significant Vertebrate Fauna Survey (Astron 2025 *in prep*)
- Central Pilbara Hub Stage 2 Targeted MNES Vertebrate Fauna Survey Biologic Environmental Survey (Biologic 2025a)
- Targeted Pilbara Olive Python Survey: South Flank and Mining Area C (Biologic 2023d)
- Yandi 45C Targeted Significant Vertebrate Fauna Survey (Astron 2023)
- CPH Targeted Matters of National Environmental Significance Vertebrate Fauna Survey (Biologic 2023a)

- Ministers North Fauna Survey Level (GHD 2021)
- MAC Phase 4 Marillana Creek Targeted MNES Fauna Survey (Biota 2022)
- MAC 4 Pipeline Level 1 Vertebrate Fauna Survey (Biologic 2019a)
- Consolidated Fauna Habitat Mapping 2017 (Biologic 2018)



BHP

PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
KEY TERRESTRIAL VERTEBRATE
FAUNA SURVEYS**

WAO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A1: 1:250,000

DATE: 17/02/2025

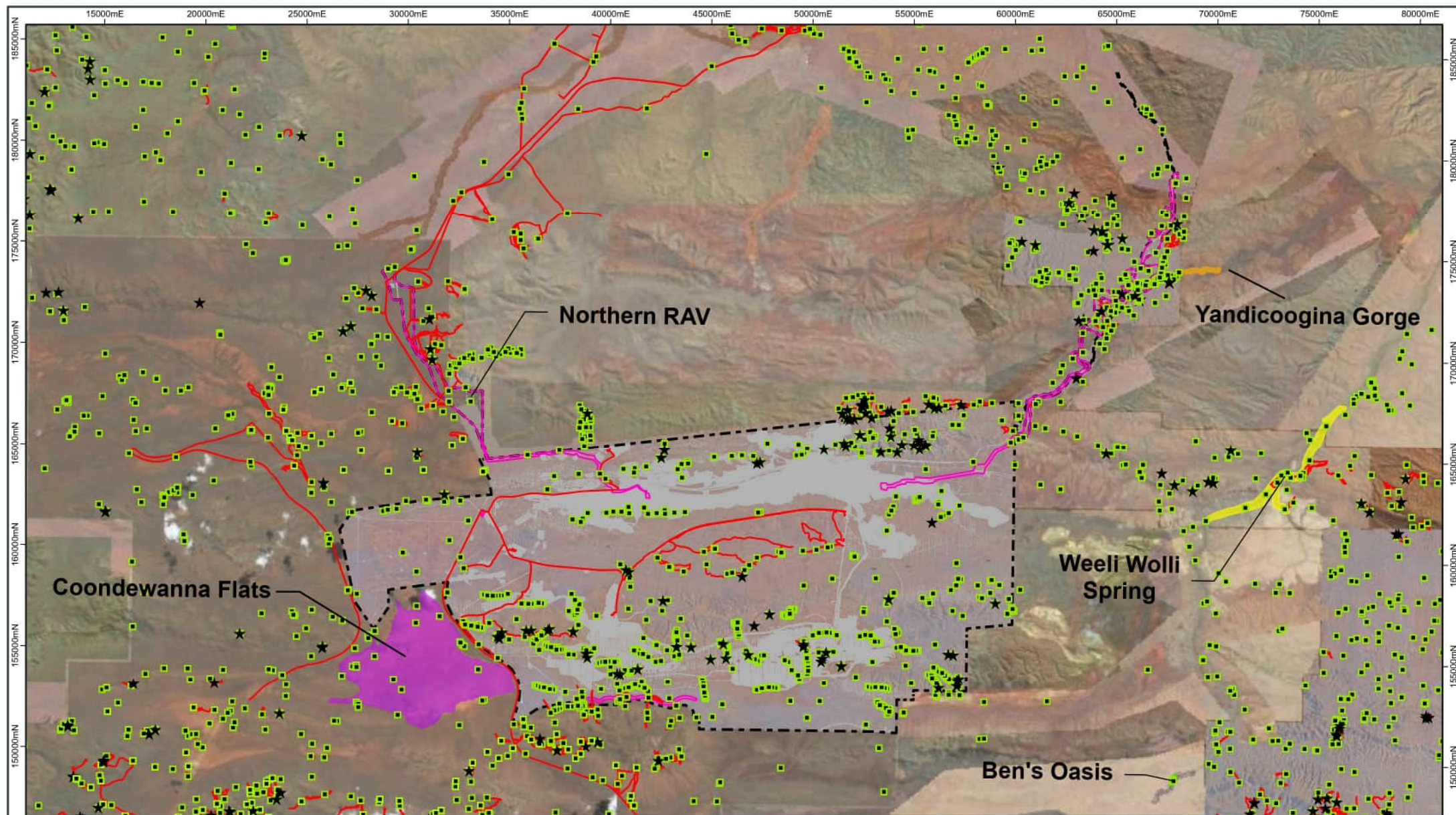
REQUESTOR: ENVIRONMENT

PREPARED: GEOMATICS

REVIEWED:

FIGURE: **9-1**

NO: **A1285-001 RevG**



Development Envelope

Indicative Footprint

Existing Disturbance

Coondewanna Flats

Weeli Wolli Spring

Ben's Oasis

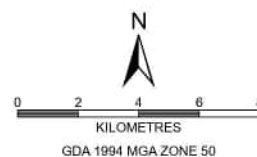
Yandicoogina Gorge

Vertebrate Fauna Sampling Effort

★ Targeted Bat Cave

■ Vertebrate Fauna Sample Sites

— Transect



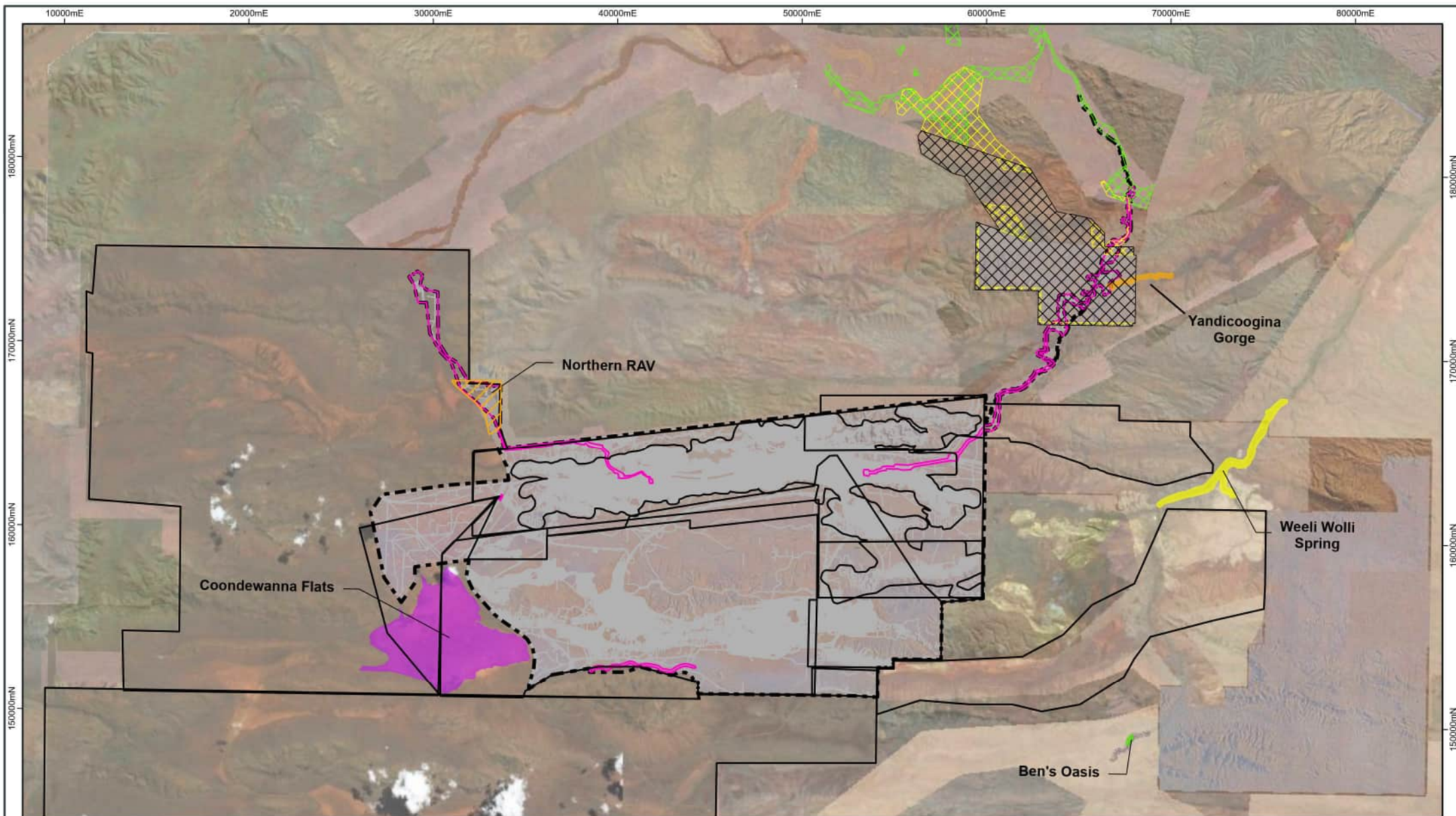
BHP

PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
TERRESTRIAL VERTEBRATE FAUNA
SAMPLING EFFORT**

WAO PLANNING, TECHNICAL AND ENVIRONMENT

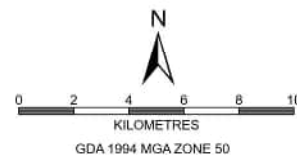
SCALE @ A3: 1:250,000 REQUESTOR: ENVIRONMENT FIGURE: 9-2
DATE: 18/02/2025 PREPARED: GEOMATICS
REVIEWED: NO: A1285-055_RevE



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge

Key SRE Surveys

- Pineapple Hill and Runaway Valley North Detailed SRE Survey (Biota 2025 *in prep*)
- Ministers North Short-Range Endemic (SRE) Invertebrate Fauna Desktop and Field Survey (Bennelongia 2024a)
- Yandi Operations Short-Range Endemic Fauna Survey Report (Bennelongia 2024c)
- Ministers North and Yandicoogina Creek Short Range Endemic Invertebrate Fauna Survey (Biologic 2021)
- Historical SRE Surveys pre-2019



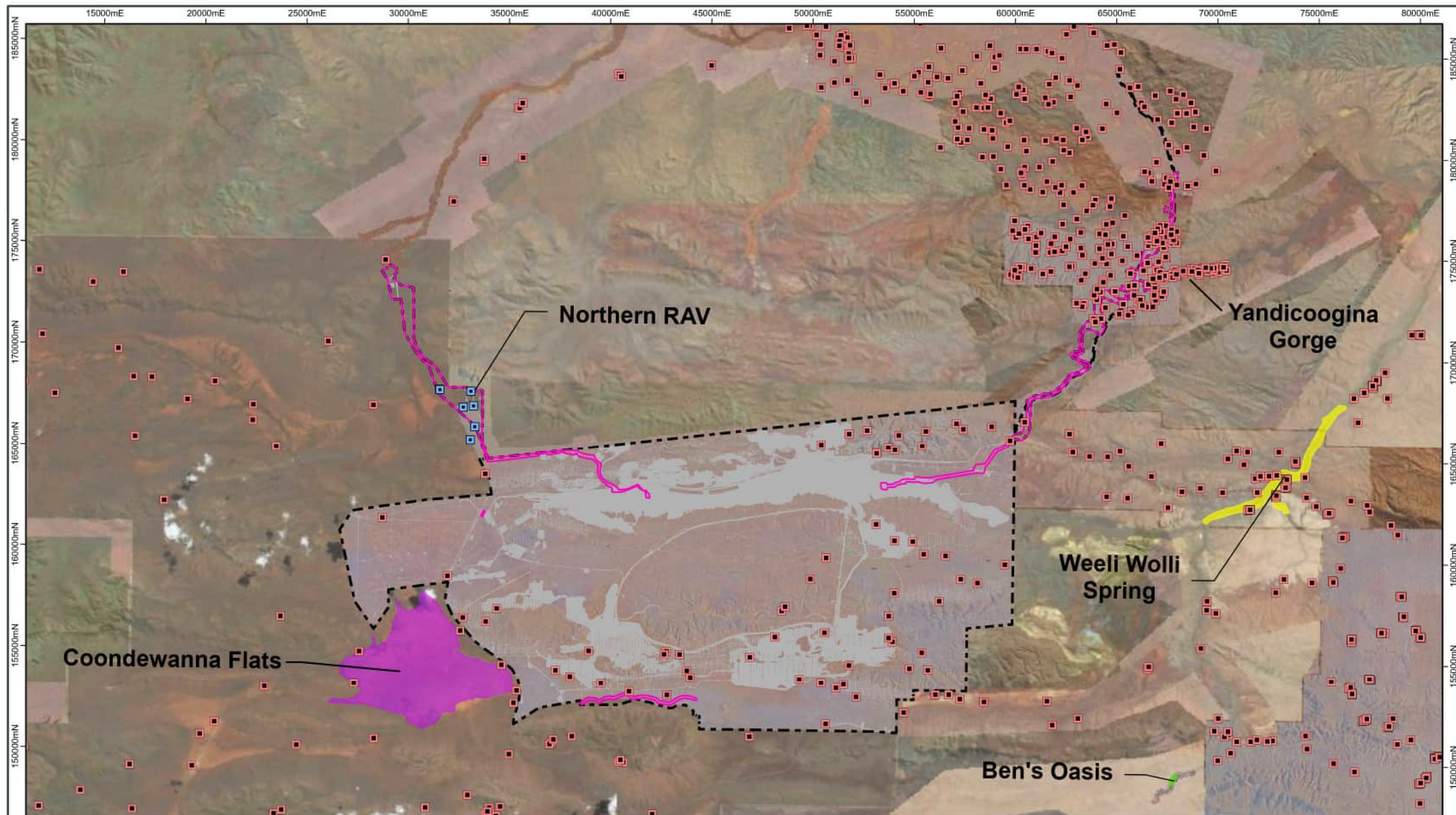
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PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT KEY SRE INVERTEBRATE FAUNA SURVEYS

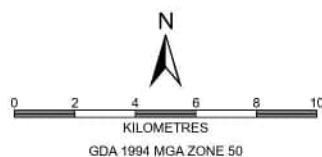
WAIO PLANNING, TECHNICAL AND ENVIRONMENT

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DATE: 17/02/2025	PREPARED: GEOMATICS		
	REVIEWED:		NO: A1285-002 RevE



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge

- SRE Sampling Sites (pending survey outcomes)
- SRE Sampling Sites



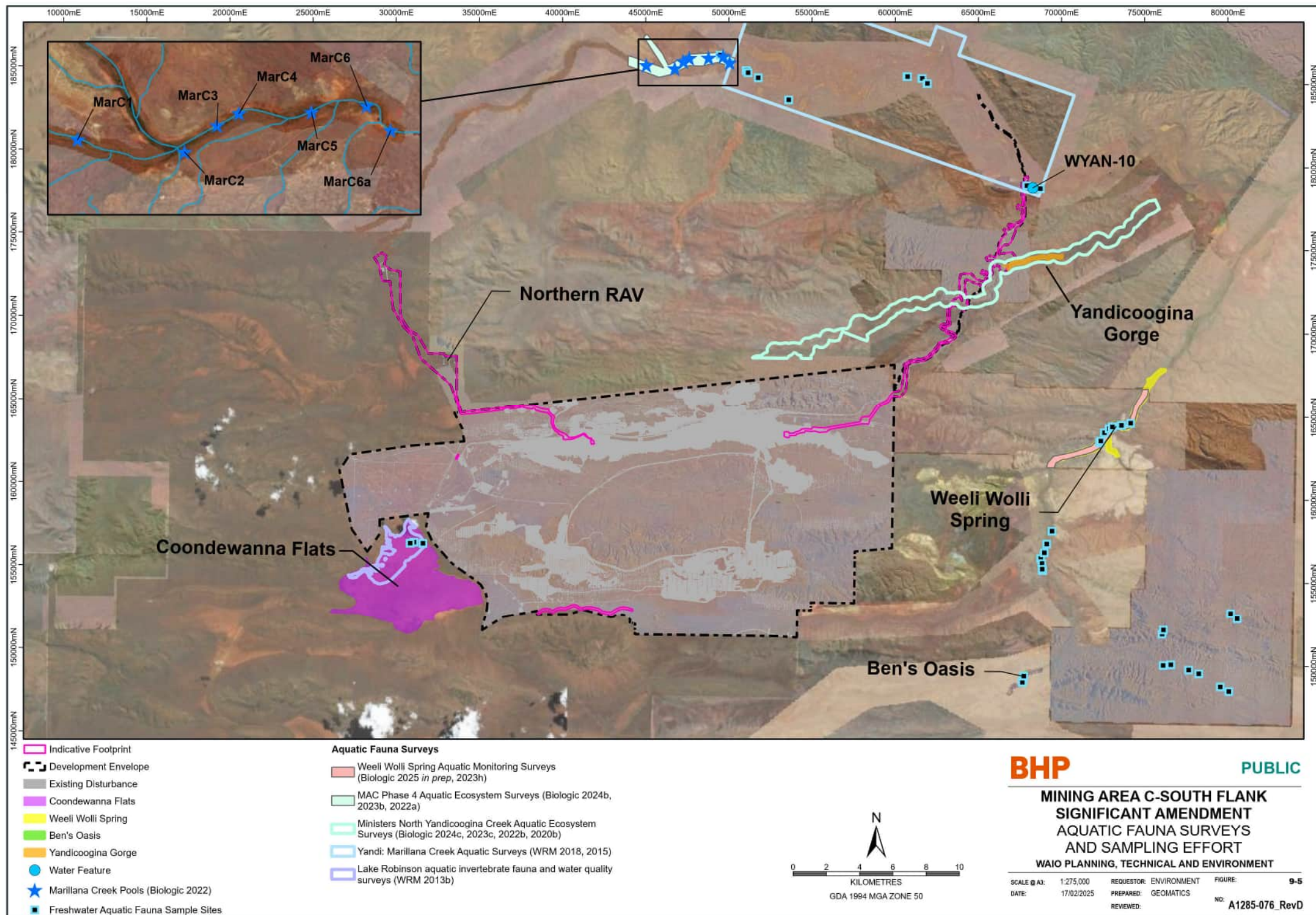
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**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
SRE INVERTEBRATE FAUNA
SAMPLING EFFORT**

WAO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:250,000	REQUESTOR: ENVIRONMENT	FIGURE: 9-4
DATE: 17/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-056_RevF



9.3.2 Environmental values

9.3.2.1 Fauna habitats

Detailed fauna habitat mapping of the Development Envelope and wider region has been completed as part of the numerous surveys undertaken for the area. Fauna habitats within the Development Envelope are described below whereas fauna habitats in regional areas outside the Development Envelope are described in Section 9.3.2.3.

Habitat mapping was reviewed and consolidated across BHP tenements, with habitat descriptions aligned between surveys undertaken across the Pilbara in 2014 (Biologic 2014). Since this time, the consolidated habitat mapping has been revised and updated as new survey data has become available (Biologic 2025a, 2023a, 2018, 2019a; Biota 2022; Astron 2023 and 2025 *in prep*).

Based on recent surveys and the consolidated habitat mapping, a total of 15 fauna habitat types have been mapped within the Development Envelope (Table 9-3; Figure 9-6). Nine of the 15 mapped habitat types occur within the Indicative Footprint including Stony Plain, Minor Drainage Line, Breakaway/ Cliff, Artificial Wetland, Sand Plain, Gorge/ Gully, Major Drainage Line, Hillcrest/ Hillslope and Drainage Area/ Floodplain (Figure 9-6; Figure 9-7 and Figure 9-8). Cleared/ Disturbed areas also occur throughout the Development Envelope and Indicative Footprint but provide little to no value for terrestrial fauna.

The most common habitat types within the Development Envelope are Stony Plain, Hillcrest/ Hillslope and Drainage Area/ Floodplain whereas Stony Plain is the dominant habitat type within the Indicative Footprint (Table 9-3; Figure 9-6; Figure 9-7 and Figure 9-8). The majority of the mapped fauna habitats are broadly distributed and well represented across the Pilbara bioregion and surrounding regions, and support fauna assemblages which are generally common and widespread.

All of the mapped fauna habitats, except for Hardpan Plains, Gilgai Plain (Cracking Clay) and Sand Plain are considered to be high or moderate value for terrestrial vertebrate fauna as they provide critical and/or supporting habitat for significant fauna species (Table 9-3). Significant habitat features such as caves and surface water pools are also present within the Development Envelope (see Section 9.3.2.2) and are most often associated with Gorge/Gully habitat (caves) or Drainage Line habitats (water pools). Hardpan Plains, Gilgai Plain (Cracking Clay) and Sand Plain are considered low value for vertebrate fauna due to containing low vegetation complexity and/or a lack of microhabitats or features utilised by fauna.

The majority of the mapped fauna habitat types are likely to be somewhat prospective for SREs due to containing suitable microhabitats, levels of shade and/or humidity, or suitable soils for burrowing species (Table 9-3; Bennelongia 2024a; BHP 2017b). Habitat features that retain moisture such as Gorge/Gully habitats, Major Drainage Lines, south-facing slopes within Hillcrest/Hillslope habitats, Breakaway/Cliff and Artificial Wetland habitats are particularly prospective for SREs requiring high humidity and shade, including millipedes, spiders and molluscs, as well as SREs such as pseudoscorpions that live amongst leaf litter and vegetation. Gorge/Gully and Major Drainage Line habitats are particularly high value for SREs as they provide many of the above-mentioned characteristics. Habitats such as Stony Plain, Hardpan Plain and Sand Plain generally have lower complexity, shelter and isolation; however, may still provide suitable habitat types for burrowing species such as mygalomorph spiders and scorpions (Bennelongia 2024a; BHP 2017b).

Table 9-3: Terrestrial Fauna - fauna habitat types within the Development Envelope

Habitat Type	Description	Extent in Development Envelope	Value to significant fauna*	Value to SRE invertebrate fauna
Gorge/Gully	Gorges and gullies are rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Minor Drainage Lines). Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	806.9 ha	Critical breeding, roosting, denning (where suitable caves and overhangs exist) and/or foraging and dispersal habitat for Northern Quoll, Pilbara Olive Python and Ghost Bat. Where no suitable caves or overhangs exist, supporting foraging and dispersal habitat for Ghost Bat and Pilbara Leaf-nosed Bat.	High value. Gullies tend to contain a complex and diverse set of microhabitats such as leaf litter, boulders, outcropping rock and shrubs and trees which provide shade, moisture and protection.
Major Drainage Line	The Major Drainage Line habitat supported an upper story of relatively tall Eucalyptus. The habitat is prone to flooding and is more likely to retain water when inundated. The structure and condition of vegetation often varies seasonally, particularly following rainfall events. Vegetation condition is often subject to heavy cattle grazing.	103.4 ha	Provides critical foraging and dispersal habitat for Ghost Bat (when within 12 km of critical roosting habitat), Northern Quoll, and Pilbara Olive Python. Provides critical roosting, breeding and foraging habitat for Grey Falcon. Provides supporting habitat for Pilbara Leaf-nosed Bat	High value. Provide important corridors for the dispersal of SREs. Contains dense taller vegetation providing microhabitats under bark, fallen logs and in deep complex leaf litter whereas the deeper friable sandy and clay-based soils provide suitable habitat for burrowing invertebrates. Residual seasonal moisture from drainage lines combined with deeper leaf litter provides humid, microclimates suitable for gastropods, isopods, and millipedes.
Breakaway/ Cliff	The Breakaway/ Cliff habitat comprised a single sided rock face, within the steep mid-upper slope comprising bare rock outcrops or cliffs. Does not comprise the entire slope.	3.8 ha	Provides critical breeding roosting, denning (where suitable caves or overhangs exist) and/or foraging and dispersal habitat for Northern Quoll, Ghost Bat, and Pilbara Olive Python Provides supporting habitat for Pilbara Leaf-nosed Bat	Moderate to high value. Often rocky, with shaded and higher humidity microclimates at the base of declivities which hosts various plant species and humidity-dependent SRE Groups such as millipedes and isopods. Often contains vegetation providing thicker and structurally diverse leaf litter microhabitats.

Habitat Type	Description	Extent in Development Envelope	Value to significant fauna*	Value to SRE invertebrate fauna
Artificial Wetland	The dewatering discharge outlet, located on the northern extent of the proposed Development Envelope within Lower Marillana Creek (Yandi tenement) where excess water discharging into this section of the creek has created a permanent artificial pool.	1.03 ha	Provides critical foraging and dispersal habitat for Pilbara Olive Python and supporting habitat for Northern Quoll. Also provides suitable habitat for some Migratory listed bird species.	Moderate value. Wetland habitats tend to be isolated within the broader landscape; accordingly, SREs dependent on more moist and humid environments may not have distribution corridors away from wetlands. Denser vegetation producing thicker leaf litter at this site, combined with rocks and boulder piles provide sheltered microhabitats for invertebrates.
Medium Drainage Line	Medium Drainage Line habitat comprised scattered Eucalyptus and Acacias, or Mulga woodland, with an understory dominated by tussock grasses. The structure and condition of vegetation often varies seasonally, particularly following rainfall events. Vegetation condition often subject to heavy cattle grazing. This habitat type is prone to pooling and ponding in area.	1.14 ha	Provides critical foraging and dispersal habitat for Ghost bat (when within 12 km of critical roosting habitat), Grey Falcon and Pilbara Olive Python. Provides supporting habitat for Pilbara Leaf-nosed Bat and Northern quoll,	Moderate value. Medium Drainage Lines tend to contain a rocky bed with gravel to large rocks. These habitats support a variety of shrubs and often contain scattered trees along the bank. These trees have litter at their base with occasional fallen logs which provide microhabitats for SREs.
Hardpan Plains	Hardpan Plain habitat comprised flat low-lying clay based plain dominated by stands of mulga, with a high proportion of the substrate comprising bare soil. Often sparsely vegetated with large areas often void of vegetation.	868.8 ha	Does not provide critical or supporting habitat for any significant species due to the high proportion of this habitat type that comprises bare soil.	Moderate to low value. Leaf litter from Acacia and Eucalyptus provide suitable microhabitat for invertebrates in this habitat type. Hardpan plains are prospective for mygalomorphs in the genus Conothele, which prefer to burrow in supportive clay-based substrates Centipedes, including the SRE-rich families Geophilidae and Cryptopidae, are also often more abundant in this habitat type.

Habitat Type	Description	Extent in Development Envelope	Value to significant fauna*	Value to SRE invertebrate fauna
Mulga Woodland	Mulga Woodland habitat comprises stands of Mulga (<i>Acacia aneura</i>) over clay or stony substrates. Differs from other plains by having a monoculture of mulga compared to a diversity of other <i>Acacia</i> species.	754.03 ha	May provide critical foraging and dispersal habitat for Ghost Bat where it occurs within 12 km of critical roosting habitat. Otherwise, provides supporting habitat for Pilbara Leaf-nosed Bat.	Moderate to low. Leaf litter from <i>Acacia</i> provides suitable microhabitat for invertebrates at this site. May be prospective for species which prefer to burrow in claypan such as <i>Conothele</i> spiders.
Drainage Area/Floodplain	Lower lying plain often subjected to sheet flow following large rainfall events. Vegetation and substrates of this habitat was variable, often comprising scattered Eucalyptus over <i>Acacia</i> and/or <i>Grevillea</i> shrubs with an understory dominated by <i>Triodia</i> hummock grasses and/or mixed tussock grasses on alluvial substrates, often comprising heavy clays and gravel.	1,561 ha	Provides critical foraging habitat for Ghost Bat where it occurs within 12 km of critical roosting habitat. Otherwise, provides supporting habitat for Pilbara Leaf-nosed Bat and Grey Falcon.	Low value. Some microhabitats may be present but due to being seasonally inundated, are generally considered low value for SREs.
Stony Plain	Stony Plain comprise low-lying open plains and the rolling hills below upland areas, with very slight to no gradient. The substrate consists of gravel and pebbles, with vegetation dominated by <i>Triodia</i> , although scattered trees also occur. Vegetation within this habitat varied in composition but was generally dominated by scattered Mulga and <i>Acacia</i> forming an over-storey, with patches of various small to medium shrub species, over low hummock grasslands of <i>Triodia</i> . Scattered <i>Corymbia</i> and <i>Eucalyptus</i> are usually present.	2,446.31 ha	Provides critical foraging habitat for Ghost Bat where it occurs within 12 km of critical roosting habitat. Provides supporting habitat for Pilbara Leaf-nosed Bat and Grey Falcon. Also provides suitable habitat for Western Pebble-mound Mouse.	Low value although may provide habitat for burrowing SREs requiring firmer soils (e.g. most mygalomorph spiders) but not for burrowing SREs requiring looser soils (e.g. some <i>Urodacus</i> scorpions). The presence of rocks and vegetation throughout stony plains provides suitable microhabitat SRE taxa which may occur beneath rocks, under bark, and/or in leaf litter; rocks and vegetation may also retain enough humidity to support isopods.

Habitat Type	Description	Extent in Development Envelope	Value to significant fauna*	Value to SRE invertebrate fauna
Hillcrest / Hillslope	The Hillcrest/ Hillslope habitat comprised a rocky substrate, often with exposed bedrock, on moderate to steep slopes leading into lower footslopes. This habitat was characterised by steep slopes with a high proportion of coarse fragments dominated by ironstone. These can contain cracks and crevices. This habitat is usually dominated by open <i>Eucalyptus</i> woodlands, <i>Acacia</i> and <i>Grevillea</i> scrublands and <i>Triodia</i> low hummock grasslands.	8,203.9	Provides critical foraging and dispersal habitat for the Ghost Bat where it occurs within 12 km of critical roosting habitat. Provides supporting habitat for Ghost Bat, Pilbara Leaf-nosed Bat, Northern Quoll and Grey Falcon.	Generally low value , except for south facing slopes which provide high value habitat as they contain suitable moisture and shade for SREs. Rocks and within leaf litter at the base of trees and shrubs provide suitable microhabitats within this habitat type. This highlights the importance of the isolated trees and shrubs scattered throughout this landscape harboring small invertebrate species.
Minor Drainage line	Minor Drainage Line habitat usually lacks a tall dense upper storey, but with a dense mid storey, including sparse <i>Eucalyptus</i> sp., and <i>Acacia</i> sp. over tussock grasses and <i>Triodia</i> sp. hummock grasses. Is a common habitat type, primarily surrounding areas of higher elevation, particularly within the Hillcrest/ Hillslope habitat.	1,151.74 ha	Provides critical foraging and dispersal habitat for Ghost bat where proximal (<12 km) to roosting habitat. Otherwise, provides supporting habitat for Ghost Bat (>12km from critical roosting habitat), Northern quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Grey falcon.	Low value. Minor Drainage Lines tend to have sandy or silty beds with scattered rocks and gravel. They often support a dense shrub layer dominated by <i>Acacia</i> sp. Trees are present, however they are smaller and more scattered in distribution. Leaf litter build up is common amongst the shrub layer and at the base of isolated trees
Sand Plain	Sand Plain habitat is characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse shrubs. This habitat often occurs as terraces along Major Drainage Lines.	926.50 ha	Does not provide critical or supporting habitat for any significant species. May provide suitable burrowing habitat for a number of fauna species, but does not support any significant species that occur within the Development Envelope.	Low value although may provide suitable habitat for <i>Urodacus</i> scorpions and anamid mygalomorphs lacking a rastellum.

Habitat Type	Description	Extent in Development Envelope	Value to significant fauna*	Value to SRE invertebrate fauna
Sandy/Stony Plain	This habitat is characterised by large hummock <i>Triodia</i> grasses or stands of <i>Acacia</i> or other shrubs over clay or stony substrates. Common throughout the Pilbara region and has value to a wide spectrum of fauna species. Contains logs, tree hollows, thick undergrowth, leaf litter, soft soil (burrows), and old <i>Triodia</i> .	0.01 ha	Provides critical foraging habitat for Ghost Bat where it occurs within 12 km of critical roosting habitat. Otherwise, provides supporting habitat for Northern Quoll, Ghost bat and Grey Falcon.	Low value although may provide burrowing habitat for SREs requiring firmer soils as well as areas containing loose soil more suitable for species such as <i>Urodacus</i> scorpions and anamid mygalomorphs lacking a rastellum. Some areas contain rocks and vegetation which provides suitable microhabitat for <i>Lychas</i> scorpions, centipedes, millipedes, and pseudoscorpions, and areas with vegetation may also retain enough humidity to support isopods.
Gilgai Plain (Cracking Clay)	Often associated with tussock grasses, cracking clay soils usually contain weak crabhole (gilgai) microrelief, which are generally saline at depth. Surface mantles can be absent or common to abundant and occur as pebbles and cobbles of ironstone, basalt and other rocks. This habitat type is uncommon and low in the landscape.	7.56 ha	Provides limited value to fauna; however, does provide suitable habitat for the Short-tailed mouse (<i>Leggadina lakedownensis</i>).	Low value. Provides limited value to SREs due to low complexity, lack of shelter and limited microhabitats.
Undulating Low Hills	The Undulating Low Hills habitat comprises low hills and undulating stony plains of higher elevation than Stony Plain. The habitat supports hard spinifex with a mantle of gravel and larger rocks with occasional outcropping or minor breakaway. Vegetation is dominated by hard <i>Triodia</i> hummock grasslands with scattered <i>Eucalyptus</i> trees and <i>Acacia</i> , <i>Eremophila</i> and/or <i>Grevillea</i> shrubs.	0.2 ha	Provides supporting habitat for Ghost bat and Pilbara Leaf-nosed Bat. Provides critical foraging and dispersal habitat for Ghost Bat where it occurs within 12 km of critical roosting habitat.	Moderate to low value. Undulating Low Hills provide different microhabitats for a variety of SREs including burrowing species or those found beneath rocks, under bark, and/or in leaf litter; rocks and vegetation may also retain enough humidity to support isopods.

Sources: Astron 2025 *in prep*, Biologic 2023a, 2014 and 2018; Astron 2023; Biota 2022; Bennelongia 2024a

* Value to significant vertebrate fauna relates to those species that have been recorded or which are considered to have a high or moderate likelihood of occurrence within the Development Envelope and is discussed further for each fauna species in Section 0.

9.3.2.2 Fauna habitat features

Surface water features

Two permanent and four semi-permanent pools, plus one artificial water pool have been recorded in the Development Envelope (Figure 9-6). In addition, a number of seasonal water pools have also been recorded; however, the observed number of distinct pools has varied in reporting over biodiversity and water monitoring surveys due to seasonal and temporal fluctuations of the hydrology of the pools.

Four water pools occur wholly or partially within the Indicative Footprint including one permanent water pool (WMIN-04), two semi-permanent water pools (WMIN-02 and WMIN-03) and one artificial pool associated with the Yandi mine discharge point (WYAN-10; Figure 9-8). All of these water pools are surface water fed and are not dependent upon groundwater. The water pools all occur within Major Drainage Line habitat and provide critical foraging and dispersal habitat for the Pilbara Olive Python.

Regional surface water features outside the Development Envelope are described in further detail in Section 9.3.2.3.

Cave features

A total of 64 potentially suitable Ghost Bat and/or Pilbara Leaf-nosed Bat caves have been recorded in the Development Envelope, including an artificial Ghost Bat roost (Figure 9-6; Appendix 14). The 64 caves include 10 potential or confirmed Category 2 Ghost Bat caves (maternity/diurnal roosts with regular occupancy) which occur across the Development Envelope. Of the 64 caves present within the Development Envelope, 55 caves are currently monitored including 11 caves that will be retained as part of the Approved Proposal (Appendix 14). Of the caves that are potentially suitable for the Pilbara Leaf-nosed Bat, all are Category 4. None of these caves occur within the Indicative Footprint.

In addition, there are 12 regional caves (i.e. caves which occur outside the Development Envelope) which occur within 450 m of the Indicative Footprint (Table 9-4; Figure 9-6; Figure 9-7 and Figure 9-8). These caves are within the 450 m blast management zone defined in the MAC-SF Fauna Management Plan (Appendix 16). These include six Category 3 caves and six Category 4 caves (Table 9-4; Figure 9-6, Figure 9-7 and Figure 9-8). Four of these caves occur within 150 m of the Indicative Footprint, which is within the Trigger buffer zone defined in the Fauna Management Plan (Appendix 16).

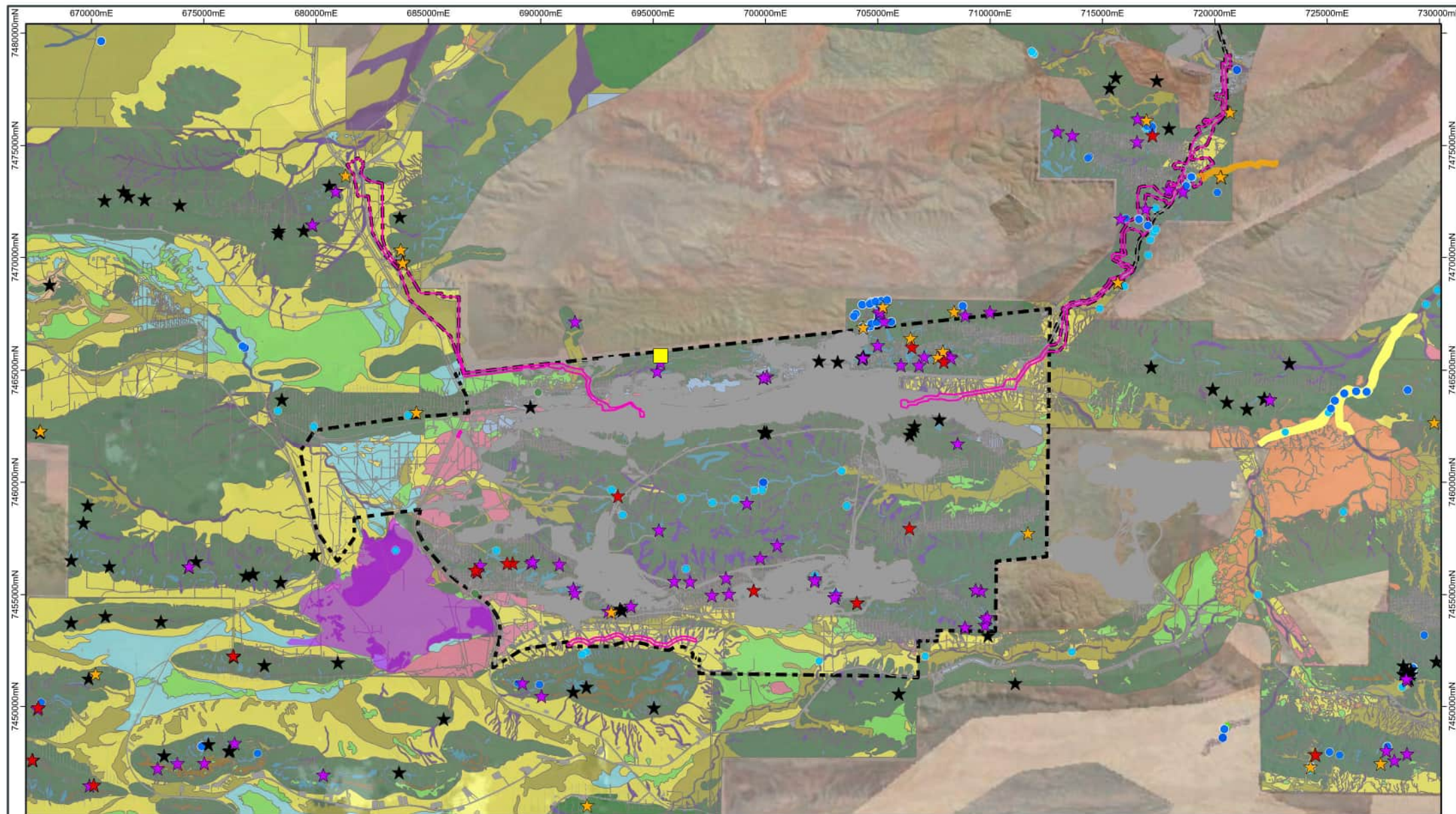
Whilst Ghost Bats are known to forage and roost within the Development Envelope, Pilbara Leaf-nosed Bats have only been historically recorded (i.e. 2011) from two individual calls, captured at the entrance of caves in the Development Envelope (Biologic 2023a). This is despite extensive baseline and targeted surveys for significant bats in the area. As such, the Pilbara Leaf-nosed Bat is considered to only be present on a transient or 'foraging only' basis and is unlikely to be roosting in the area.

A full list of significant bat caves recorded within the Development Envelope is provided in Appendix 14 (noting that none of these caves occur within, or in proximity to, the Indicative Footprint). Regional caves that occur outside the Development Envelope but within 450 m of the Indicative Footprint are summarised in Table 9-4 and shown in Figure 9-6.

Table 9-4: Terrestrial Fauna - caves within 450 m of the Indicative Footprint

Cave ID	Description and evidence of use	Fauna habitat type	Distance from Indicative Footprint	Category [#]	
				Pilbara Leaf-nosed Bat	Ghost Bat
North-west scheme					
CACW-12	Ghost Bat scats recorded Feeding cave	Gorge/Gully	0.172 km - north-east	Not suitable*	Category 4
CACW-13	-	Gorge/Gully	0.165 km - north-east	Category 4	Category 4
CACW-01	Night roost (shallow) 500 fresh to old Ghost Bat scats recorded in 2012	Gorge/Gully	0.123 km - north-east	Category 4	Category 3
CACW-11	-	Gorge/Gully	0.126 km - north-east	Category 4	Category 3
ACW-26	-	Hillcrest/Hillslope	0.323 km - west	Not suitable*	Category 3
CTAN-01	Ghost bat scats recorded	Gorge/Gully	0.176 km - north-east	Not suitable*	Category 3
North-east scheme					
CMN-03	No evidence recorded South facing, sheltered	Gorge/Gully	0.177 km - south-east	Not suitable*	Category 4
CMIN-03	Ghost Bat scats recorded in 2011 No evidence of use recorded during recent monitoring surveys (Astron 2025 <i>in prep</i>)	Breakaway/Cliff	0.13 km - south	Category 4	Category 3
CMIN-01	Potential feeding cave for Ghost Bat and Pilbara Leaf-nosed Bat	Gorge/Gully	0.148 km - south	Category 4	Category 4
CMIN-02	Currently under investigation South-east facing overhang No evidence of use to date	Hillcrest/Hillslope	0.223 km - east	Not suitable*	Category 3
CMN-06	No evidence of use to date South-west facing, semi-exposed overhang	Hillcrest/Hillslope	0.015 km east	Category 4	Category 4
CMN-04	No evidence of use to date South facing, exposed overhang	Gorge/Gully	0.383 km west	Category 4	Category 4

[#] as defined in Bat Call WA 2021a* cave is considered unsuitable for usage by Pilbara Leaf-nosed Bats or Ghost Bats due to a restricted entrance or the dimensions of the cave.
No evidence of usage has been recorded.



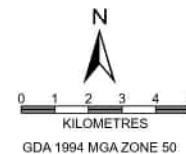
- Indicative Footprint
- Development_Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge

- Bat Cave Category**
- ★ Artificial Roost
 - ★ Category 2
 - ★ Category 3
 - ★ Category 4
 - ★ Category TBC

- Water Feature Type**
- Dam
 - Waterhole
 - Water Feature

- Habitat Type**
- Basalt Outcrops
 - Breakaway/ Cliff
 - Calcrete Plain
 - Cleared
 - Drainage Area/ Floodplain
 - Gilgai Plain
 - Gorge/ Gully
 - Hardpan Plain
 - Hillcrest/ Hillslope

- Major Drainage Line
- Medium Drainage Line
- Minor Drainage Line
- Mulga Woodland
- Rehabilitated Area
- Sand Plain
- Stony Plain
- Undulating Low Hills
- Wetland



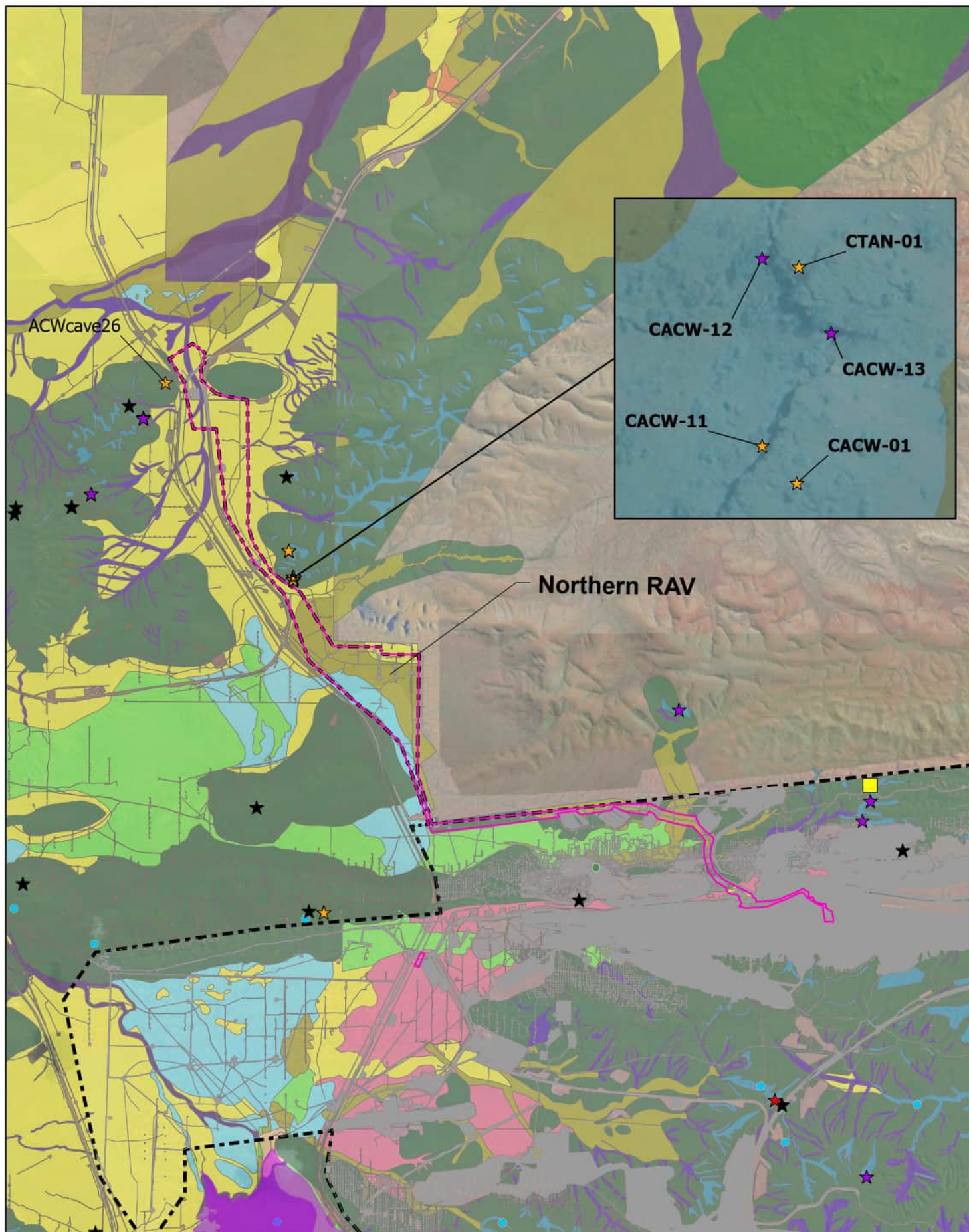
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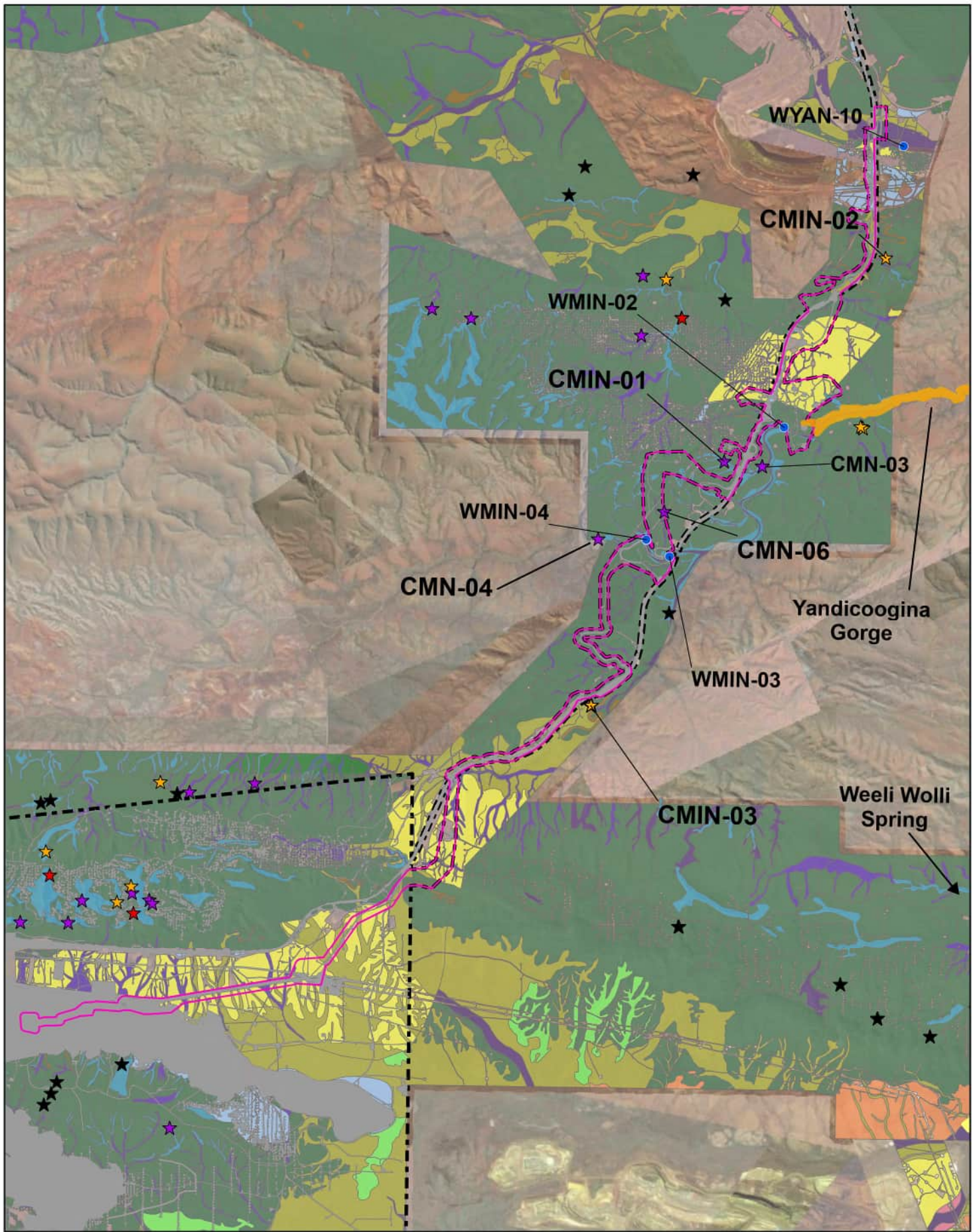
PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
FAUNA HABITAT TYPES AND
HABITAT FEATURES**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

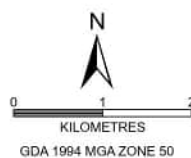
SCALE @ A3: 1:225,000 REQUESTOR: ENVIRONMENT FIGURE: **9-6**
DATE: 17/02/2025 PREPARED: GEOMATICS NO: **A1285-003 RevG**
REVIEWED:





- Indicative Footprint**
- Development Envelope
 - Existing Disturbance
 - Weeli Wolli Spring
 - Yandicoogina Gorge
 - Water Feature
- Bat Cave Category**
- Category 2
 - Category 3
 - Category 4
 - Category TBC

- Habitat Type**
- Basalt Outcrops
 - Breakaway/Cliff
 - Coloured Plain
 - Drainage Area/Floodplain
 - Gorge/Cully
 - Hillcrest/Hillslope
 - Major Drainage Line
 - Medium Drainage Line
 - Minor Drainage Line
 - Mulga Woodland
 - Sand Plain
 - Stony Plain
 - Wetland
 - Cleared
 - Undulating Low Hills



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PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
FAUNA HABITAT TYPES AND HABITAT
FEATURES WITHIN THE INDICATIVE
FOOTPRINT (NORTH-EAST SCHEME)
WAIO PLANNING, TECHNICAL AND ENVIRONMENT**

SCALE @ A4: 1:85,000 REQUESTOR: ENV APPROVALS FIGURE: 9-8
DATE: 17/02/2025 PREPARED: GEOMATICS NO: A1285_003c_RevF
REVIEWED:

9.3.2.3 Regional significant fauna values

Four regional areas of environmental significance occur outside, but in proximity to, the Development Envelope: Coondewanna Flats, Weeli Wolli Springs, Yandicoogina Gorge and Marillana Creek Pools (Figure 9-6). All four areas contain significant habitat values for terrestrial and aquatic fauna that have the potential to be impacted by the Combined Proposal. These values are described below.

Coondewanna Flats

Coondewanna Flats is a P3 PEC that occurs immediately adjacent to the western boundary of the Development Envelope (Figure 9-6). While this PEC is recognised for its unique flora values, Lake Robinson (a component of the PEC) is a large ephemeral water body that provides habitat for migratory water birds and aquatic fauna during periods of inundation (Biologic 2023a). This PEC comprises of Major Drainage Line and Mulga Woodland that provide critical foraging and dispersal habitat and supporting habitat for significant fauna species such as the Pilbara Olive Python, Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, and Grey Falcon. All of these species, except the Northern Quoll, have been recorded in the buffer of the PEC.

Weeli Wolli Springs and Ben's Oasis

Weeli Wolli Springs is a P1 PEC that occurs approximately 12 km east of the proposed Development Envelope (Figure 9-6). The Weeli Wolli Spring community mainly comprises Major Drainage Line habitat that contains riparian vegetation and numerous permanent and semi-permanent pools. The habitats in and around the pools provide critical foraging and dispersal habitat for the Northern Quoll, Grey Falcon, Pilbara Olive Python and Ghost Bat, the latter two of which have both been recorded, and supporting habitat for the Pilbara Leaf-nosed Bat (Biologic 2025a). In addition, Weeli Wolli Springs provides suitable habitat and supports a high diversity of aquatic fauna (see Section 9.3.2.6; Biologic 2023h, 2024d).

Ben's Oasis is a perennial pool on Weeli Wolli Creek located approximately 20 km upstream from Weeli Wolli Spring (Figure 9-6). Ben's Oasis also hosts the Weeli Wolli PEC and provides critical and supporting habitat for significant fauna, particularly the Pilbara Olive Python and provides habitat for aquatic fauna (see Section 9.3.2.6; Biologic 2025a, 2023c, and 2024d).

Yandicoogina Gorge

Yandicoogina Gorge is a gorge system associated with Yandicoogina Creek, that occurs directly adjacent to the east of the Indicative Footprint (north-east scheme). Yandicoogina Gorge supports a GDE as well as a number of permanent and semi-permanent pools which occur along a 3 km stretch of the gorge. Recent surveys have mapped three fauna habitat types within and surrounding the gorge: Major Drainage Line, Gorge/Gully and Hillcrest/Hillslope (Astron 2025 *in prep*; Figure 9-7). These habitats provide high value habitat for terrestrial fauna as well as critical and/or supporting habitat for significant fauna species such as the Pilbara Olive Python, Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Grey Falcon (Astron 2025 *in prep*). A Pilbara Olive Python scat has previously been recorded at a permanent water pool within Yandicoogina Gorge (GHD 2021). In addition, at least four potentially suitable Ghost Bat caves have been recorded within or directly adjacent to the gorge (GHD 2021). Evidence of the Ghost Bat (scats) has also been recorded in caves in proximity to Yandicoogina Gorge and it is likely that the species utilises the gorge for foraging (Astron 2025 *in prep*).

Yandicoogina Gorge also provides suitable habitat for a number of Priority listed species such as Gane's Blind Snake which has previously been recorded in the GDE of the Gorge (GHD 2021), as well as providing habitat for Migratory birds and habitat for aquatic fauna including invertebrate taxa and freshwater fish (Biologic 2020b; see Section 9.3.2.6).

Marillana Creek Pools

The Marillana Creek Pools are a series of connected or disconnected refuge pools located along Upper Marillana Creek, approximately 28 km north of the Indicative Footprint (described in Section 7.3.4.3; Figure 7-14). The Marillana Creek Pools are not formally recognised as a TEC or PEC but contain significant ecological values (Biota 2022; Biologic 2023b, 2022b). The pools provide critical foraging and dispersal habitat for the Pilbara Olive Python and Grey Falcon, and supporting habitat for the Northern Quoll, Ghost Bat, and Pilbara Leaf-nosed Bat, and also provide habitat for aquatic fauna including invertebrate taxa and freshwater fish (Biota 2022; Biologic 2023b, 2022b).

9.3.2.4 Significant vertebrate fauna

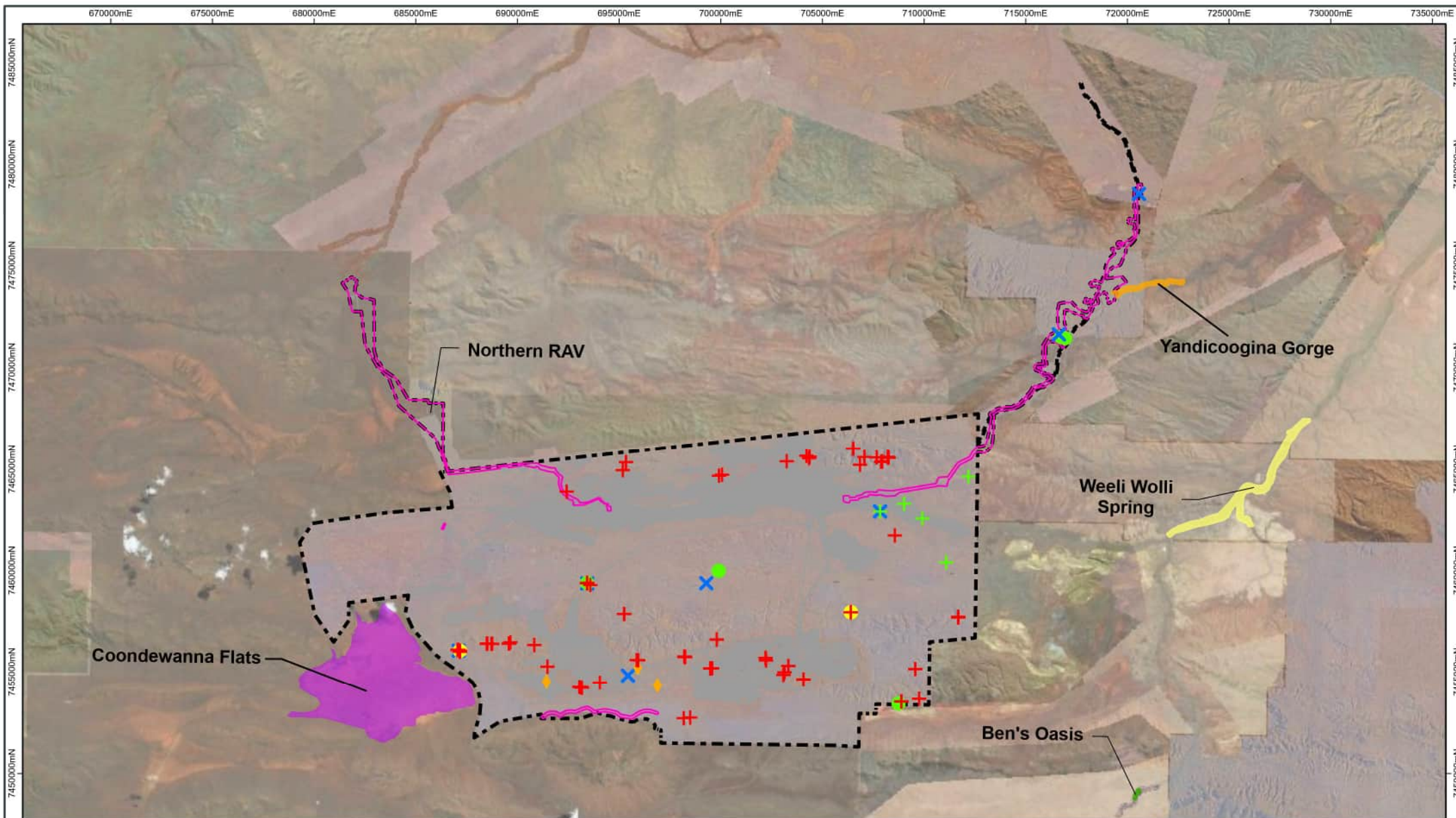
Overview

Ten significant fauna species have previously been recorded within the Development Envelope including (Figure 9-9 and Figure 9-10):

- Northern Quoll (*Dasyurus hallucatus*) – listed as Endangered under the BC Act and EPBC Act
- Ghost Bat (*Macroderma gigas*) – listed as Vulnerable under the BC Act and EPBC Act
- Pilbara Leaf-nosed Bat (*Rhinonictis aurantius* [Pilbara form]) – listed as Vulnerable under the BC Act and EPBC Act
- Pilbara Olive Python (*Liasis olivaceus barroni*) – listed as Vulnerable under the BC Act and EPBC Act
- Grey Falcon (*Falco hypoleucos*) – listed as Vulnerable under the BC Act and EPBC Act
- Fork-tailed Swift (*Apus pacificus*) – listed as Migratory under the BC Act and EPBC Act
- Peregrine Falcon (*Falco peregrinus*) – listed as ‘Other Specially Protected Fauna’ under the BC Act
- Gane’s Blind Snake (*Anilius ganei*) - listed as Priority 1 by DBCA
- Pilbara Barking Gecko (*Underwoodisaurus seorsus*) – listed as Priority 2 by DBCA
- Western Pebble-mound Mouse (*Pseudomys chapmani*) – listed as Priority 4 by DBCA.

These species are described in further detail below.

A further 22 significant fauna species were identified as possibly occurring from database searches (Appendix 13; DCCEEW 2024a; GHD 2021, Biologic 2019a). However, all of these species are considered to have a low likelihood of occurring within the Development Envelope and are not discussed further (Appendix 13).



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge

Significant Fauna Species

- Northern Quoll (En)
- + Ghost Bat (Vu)
- Pilbara Leaf-nosed Bat (Vu)
- X Pilbara Olive Python (Vu)
- ◆ Grey Falcon (Vu)
- + Fork-tailed Swift (Mi)

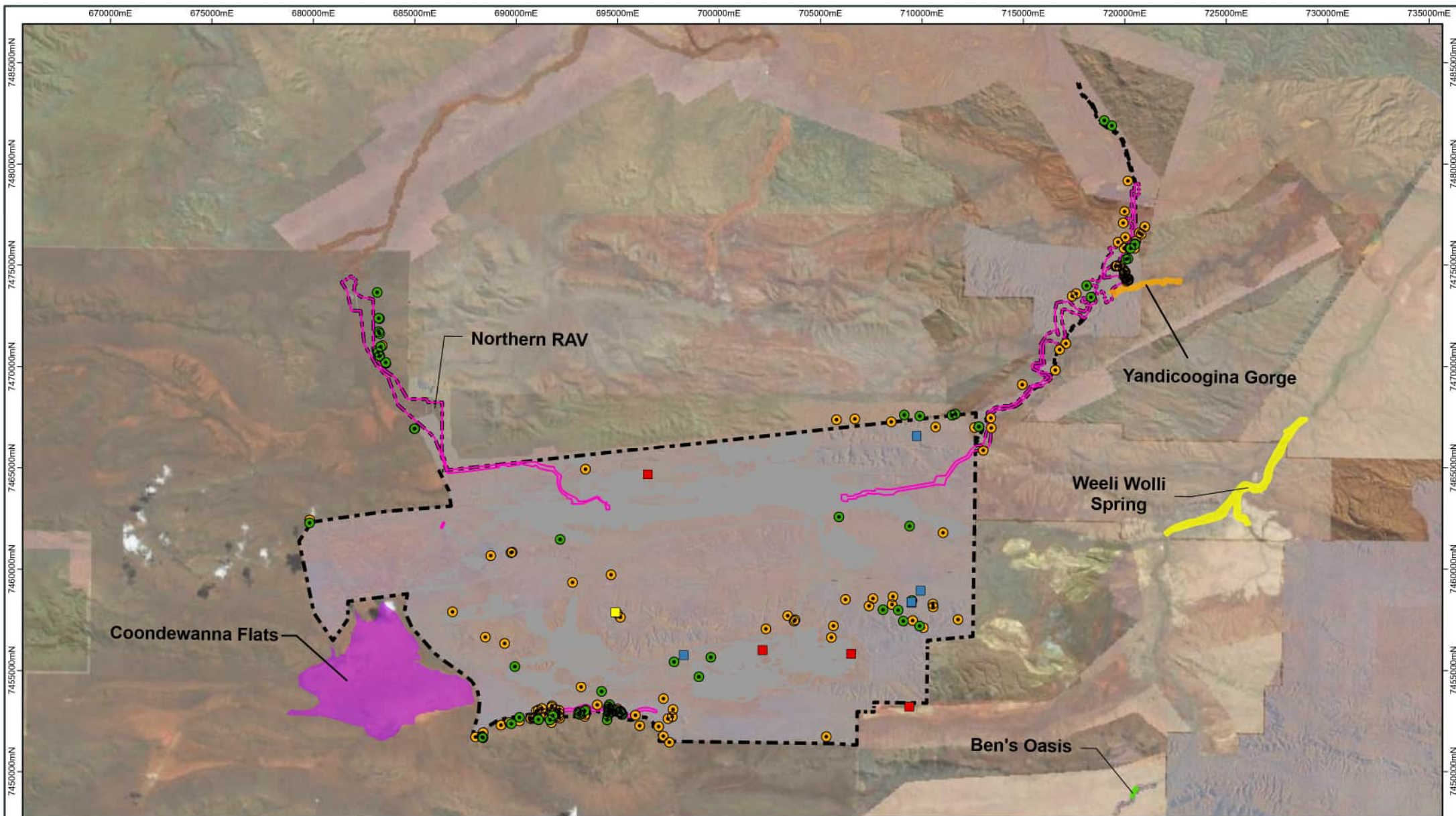


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MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
THREATENED AND MIGRATORY
VERTEBRATE FAUNA SPECIES RECORDS

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

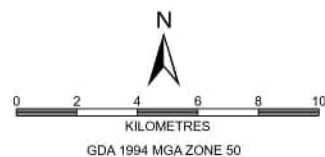
SCALE @ A3:	1:250,000	REQUESTOR:	ENVIRONMENT	FIGURE:	9-9
DATE:	18/02/2025	PREPARED:	GEOMATICS		
		REVIEWED:		NO:	A1285-004 RevF



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge

Significant Fauna Species

- Peregrine Falcon (OS)
- Pilbara Barking Gecko (P2)
- Gane's Blind-snake (P1)
- Western Pebble-mound Mouse or Ngadgi
- Mound (active)
- Mound (inactive)



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PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
OTHER SPECIALLY PROTECTED AND
PRIORITY LISTED SIGNIFICANT SPECIES**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A3: 1:250,000	REQUESTOR: ENVIRONMENT	FIGURE: 9-10
DATE: 18/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-005 RevH

Significant vertebrate fauna species recorded in the Development Envelope

Significant fauna species recorded in the Development Envelope and their occurrence (or likelihood of occurring) within the Indicative Footprint are described in detail below.

Northern Quoll

The Northern Quoll is both arboreal and terrestrial, inhabiting a wide variety of habitats including ironstone and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats, dissected rocky escarpments, open forest of lowland savannah and woodland habitats. Pilbara Northern Quolls appear to depend on complex rocky habitat, which are generally favoured for foraging, sheltering and denning, and gullies and drainage lines for foraging and dispersal (Hill and Ward 2010).

There are eight records of Northern Quoll within the Development Envelope. Existing records include three historical records previously assessed for the Approved Proposal (2011 and 2012), a recent eDNA record in the central portion of the Development Envelope located outside of the Indicative Footprint, and three motion camera records and one scat record located within the north-east scheme of the Indicative Footprint (Figure 9-9; Astron 2025 *in prep*; Biologic 2023d; BHP 2017b). The recent records within the Indicative Footprint occur within the same Major Drainage Line and Gorge/Gully system (Astron 2025 *in prep*; Figure 9-9). The motion camera records are considered likely to be the same individual, based on spot pattern; however, this is yet to be confirmed (Astron 2025 *in prep*).

The number of records within the proposed Development Envelope and the Indicative Footprint indicates that the species only occurs at very low densities. The records within the Development Envelope are likely to represent transient or dispersing individuals (Biologic 2023a). It is considered that the species would be unlikely to be reliant on the habitats within the Development Envelope for long-term persistence at a local scale or population abundance at a regional scale and that an important population is unlikely to occur based on scarcity of records and lack of breeding habitat (Biologic 2023a). Despite this, critical foraging and dispersal habitat does occur within the Gorge/Gully, Breakaway/ Cliff and Major Drainage Line habitats within the Development Envelope and Indicative Footprint, with supporting habitat also being present within the Hillcrest/ Hillslope and Medium and Minor Drainage Line habitats (Biologic 2023a).

Ghost Bat

The distribution of the Ghost Bat is influenced by the availability of suitable caves and/or disused mines of varying shapes and sizes for roost sites with the species being dependent upon physiologically benign day roosts found deep underground in humid, temperature stable caves (TSSC 2016a). The species require a group of caves/shelters including maternity, day and night roosts that open onto a plain or riparian line that provide good foraging opportunities.

Four categories of roosting habitat have been defined for the Ghost Bat, with maternity/diurnal roost caves with permanent occupancy (Category 1) and maternity/diurnal roost caves with regular occupancy (Category 2) being defined as critical roosting habitat (Bat Call WA 2021a). Diurnal roost caves with occasional occupancy (Category 3) may also represent critical habitat when located close to Category 2 caves as these form part of an 'apartment block' (when located in the same gorge/gully) that enables the long-distance movement of individuals across the landscape (Bat Call WA 2021a). Foraging habitat that occurs within 12 km of critical roosting habitat also represents critical habitat (Bat Call WA 2021a). Category 4 nocturnal roost caves with opportunistic usage are not considered critical roosting habitat for the Ghost Bat (Bat Call WA 2021a).

There are at least 289 records of Ghost Bat within the Development Envelope (Figure 9-9). Records include direct sightings of individuals, records of scats, and/or ultrasonic call recordings and include records of breeding/pregnant females (BHP 2024d; Appendix 16). These records were previously assessed for the Approved Proposal. There are no Ghost Bat records within the Indicative Footprint for the Proposal; however, there are over 460 regional records of the species within 12 km of the Indicative Footprint (Biologic 2023a).

In addition to species' records, there are 64 confirmed or potentially suitable Ghost Bat caves within the Development Envelope. This includes nine Category 2 caves (potential maternity/ diurnal roost caves with regular occupancy). These caves were previously assessed for the Approved Proposal. Under condition 7-9 of MS1072, BHP subsequently undertook a three-year study on the ecology of Ghost Bats in the Hamersley sub-region as part of the Western Australian Iron Ore Ghost Bat Research Plan (BHP 2017c). The overarching objective of this study was to provide key information on certain aspects of the Ghost Bat's ecology in the Pilbara to inform on-ground management and thereby demonstrate that the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope would be maintained. The findings of this research were used to develop the Mining Area C Fauna Management Plan (BHP 2021d), required under Condition 7 of MS1072. The FMP has been updated to include this Proposal and is provided in Appendix 16 (BHP 2025d). Monitoring of 33 high value and low value bat caves has been undertaken on a bimonthly or triannual basis since 2018, with at least 33 caves having been monitored since 2018 (Appendix 16). None of the caves present within the Development Envelope occur within the Indicative Footprint; however, there are 12 regional caves within 450 m of the Indicative Footprint including one Category 2 cave, five Category 3 caves and six Category 4 caves (Table 9-4; Figure 9-6; Figure 9-7 and Figure 9-8 (Biologic 2023a).

Gorge/Gully, Breakaway/Climb, Hillcrest/Hillslope, Major, Medium and Minor Drainage Lines, Drainage Area/Floodplain, Stony Plain, Mulga Woodland, and Undulating Low Hills habitats present in the Development Envelope provide suitable foraging and dispersal habitat for the Ghost Bat (Astron 2025 *in prep*; Biologic 2023a). Given the proximity to known and potential maternity roosting caves (i.e. less than 12 km), all of the above-mentioned habitats present within the Development Envelope and Indicative Footprint represent critical foraging and dispersal habitat for the species (Astron 2025 *in prep*; Biologic 2023a).

Pilbara Leaf-nosed Bat

The Pilbara Leaf-nosed Bat is a distinct form of the Orange Leaf-nosed Bat that is endemic to the Pilbara region of WA. The species occurs throughout the Pilbara and upper Gascoyne regions of WA where it comprises a single interbreeding population of national significance that is regarded as an 'important population' (TSSC 2016b; Bat Call WA 2021b).

Pilbara Leaf-nosed Bats typically roost in undisturbed caves, deep fissures or abandoned mine shafts. The species' limited ability to conserve heat and water means they require warm and very humid roost sites to persist in arid and semi-arid climates, in proximity to permanent surface water. Roost sites with such attributes are relatively uncommon in the Pilbara and are the limiting factor of the species' distribution.

Habitat critical to the survival of the Pilbara Leaf-nosed Bat is defined as maternity roosts (Category 1), non-permanent breeding roosts (Category 2) and semi-permanent/transitory diurnal roosts (Category 3) (TSSC 2016b; Bat Call WA 2021b). Nocturnal caves (Category 4) that are utilised at night for resting and/or feeding are not considered critical habitat but are important for the persistence of the species in a local area (Bat Call WA 2021b). Foraging habitat within a 10 km (1,000 ha) radius of Category 1-3 caves, as well as permanent water sources within 8.7 km of known Category 1-3 roosts provide habitat critical to the survival of the species. In addition, Priority 1 foraging habitat (Gorges with pools) also provides critical habitat, regardless of distance from known roosts (TSSC 2016b; Bat Call WA 2021b).

The Pilbara leaf-nosed bat was recorded at four locations during the recent survey and has historically been recorded three times within the Development Envelope (Biologic 2023a). In addition, there are at least 10 regional records of the species within 10 km of the Development Envelope. As such, the records within the Development Envelope are considered likely to be transient or foraging individuals (Biologic 2023a). There are no records of the species within the Indicative Footprint; however, given the presence of suitable foraging habitat and proximity of nearby records the species is considered to possibly occur within the Indicative Footprint, at least on a foraging basis (Biologic 2023a). There are 34 caves in the development Envelope that have the structure and characteristics to be potential Category 4 Pilbara Leaf-nosed Bat roosts; however, there has been no evidence of the species utilising any of these caves to date (Biologic 2023a). None of these caves occur within the Indicative Footprint; however, there is one suitable Category 4 cave located approximately 177 m south-east of the Indicative Footprint (CMN-03; Table 9-4; Figure 9-8).

There are no Category 1, 2 or 3 caves present within the Development Envelope, and none are currently known to occur within 10 km of the Development Envelope. The closest known permanent roost sites are East Turee Creek roost, which is located 20 km west of the western most boundary of the Development Envelope, and the Koodaideri roost which is approximately 25 km north of the Development Envelope.

Based on the above definitions, there is no critical roosting or critical foraging habitat for the Pilbara Leaf-nosed Bat present within the Development Envelope; however, supporting foraging and dispersal habitat is present within the Gorge/ Gully, Breakaway/ Cliff, Major Drainage Line habitats, Stony Plain, Hillcrest/ Hillslope, Drainage Area/ Floodplain, Mulga Woodland, Undulating Low Hills, Minor Drainage Line and Medium Drainage Line habitats.

Pilbara Olive Python

The Pilbara Olive Python is endemic to the Pilbara region, distributed from the Pilbara coast south to Newman. The species is primarily nocturnal and tends to shelter in small caves or under vegetation during the day. The Pilbara Olive Python commonly inhabits rocky areas in proximity to water such as gorges, rivers, pools and surrounding hills, but can be found in a range of habitats including caves and rock crevices away from water sources (DCCEEW 2024b). In the Hamersley subregion, this species is most often encountered in the vicinity of permanent water features in rocky ranges or among riverine vegetation. As such, there is a common misconception that the species is reliant and restricted to areas near permanent water; however, it is more likely that the species is attracted to these areas due to the productivity and abundance of suitably sized prey (Biologic 2023d). Individuals occupy distinct home ranges up to 449 ha, with males capable of travelling distances up to 4 km during the breeding season (June to August; DCCEEW 2024b).

The Pilbara Olive Python has been recorded eight times within the proposed Development Envelope including five historical records which were previously assessed as part of the Approved Proposal (BHP 2017b), one recent eDNA record within the Development Envelope but outside the Indicative Footprint, one recent scat record at within the north-east scheme of the Indicative Footprint and a direct sighting of the species at the discharge point at Yandi mine within the Indicative Footprint (Astron 2025 *in prep*, 2023; Biologic 2023a; Figure 9-9). The species is considered likely to be resident within the Development Envelope (Biologic 2023a).

Gorge/ Gully and Major Drainage Line habitats and associated waterbodies (in particular those that are persistent or semi-persistent) provide critical breeding, foraging and dispersal habitat for the species, whereas Medium Drainage Line and Drainage Area/ Floodplain habitats provide supporting foraging and dispersal habitat (Biologic 2023a).

Grey Falcon

The Grey Falcon is distributed throughout arid and semi-arid regions of Australia, including the Pilbara region of WA, where it is restricted to areas of high annual average temperatures and average rainfall of less than 500 mm. The species nests in tall trees along watercourses, as well as in telecommunication towers and hunts throughout timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined water courses. There are an estimated 500 Grey Falcon pairs throughout Australia, with at least 152 known records of the species in Western Australia (Birdlife 2024).

The Grey Falcon has been recorded from five locations within the Development Envelope in 2004 and 2008 (Figure 9-9). All five records were previously assessed as part of the Approved Proposal (BHP 2017b). No new records have been recorded since this time and there are no records within the Indicative Footprint; however, suitable habitat for this species is present with Major and Medium Drainage Line habitat representing critical habitat and Drainage Area/Floodplain, Stony Plain, and Hillcrest/ Hillslope habitats representing supporting habitat for the species.

Fork-tailed Swift

The Fork-tailed Swift has been recorded five times within the Development Envelope (Figure 9-9); however, whilst the species may sporadically fly over the Development Envelope, it is unlikely be dependent on any of the fauna habitats within the Development Envelope given that it exclusively forages in the air. Due to its extensive foraging

range, aerial foraging habits and its non-breeding status within Australia, it is considered that there will be no impact to this species from the Proposal. As such, this species is not discussed further.

Peregrine Falcon

The Peregrine Falcon is widespread, but relatively uncommon, across the whole of WA. The species specifically requires cliffs, rocky outcrops or large tree hollows, usually close to a water source, for breeding and nesting.

There is one historical record of the Peregrine Falcon within the Development Envelope, outside the Indicative Footprint (Figure 9-10). This record occurred within areas cleared as part of the Approved Proposal and was previously assessed as part of the Approved Proposal. There are no additional records of the Peregrine Falcon within the Development Envelope or Indicative Footprint; however, suitable shelter and foraging habitat occurs within the Major and Medium Drainage Line fauna habitats within the Indicative Footprint.

Gane's Blind Snake

Ganes Blind Snake is endemic to the Pilbara region; however, little is known about its ecology. Whilst it is mostly associated with Gorge/Gully habitat, it is considered likely to also occur within Calcrete Areas, Mulga, Crest/Slope and Drainage Area/ Floodplain habitats.

There are five historical records of this species within the Development Envelope (Figure 9-10). All five records were previously assessed as part of the Approved Proposal (BHP 2017b). No new records have been recorded since this time and there are no records within the Indicative Footprint. The closest record is a historic record from 2011 located approximately 2.7 km west of the Indicative Footprint (Figure 9-10). Despite there being no new records, given the presence of suitable habitat (i.e. Drainage Area/Floodplain and Gorge/Gully habitats) and proximity of nearby records, the species is considered to potentially occur within the Indicative Footprint (Astron 2025 *in prep*).

The Pilbara Barking Gecko

The Pilbara Barking Gecko is endemic to the Pilbara where it is confined to the Hamersley Ranges from Tom Price to Newman. It generally inhabits rocky areas with spinifex and low tree cover; however, very little is known about the species ecology (Biologic 2023a).

There are six historical records of the Pilbara Barking Gecko within the Development Envelope, none of which occur within the Indicative Footprint (Figure 9-10; Biologic 2023a). All six records were previously assessed as part of the Approved Proposal (BHP 2017b). No new records have been recorded since this time and there are no records within the Indicative Footprint; however, suitable habitat (i.e. Gorge/Gully, Hillcrest/ Hillslope and Minor Drainage Line habitats) is present within the Indicative Footprint and the species is considered to potentially occur (Astron 2025 *in prep*).

Western Pebble-mound Mouse

The Western Pebble-mound Mouse is native to WA where it is restricted to the non-coastal, central and eastern parts of the Pilbara. It generally occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs.

There are 158 records of Western Pebble-mound Mouse within the Development Envelope, including 113 records which occurred within areas previously assessed as part of the Approved Proposal (BHP 2017b). Of the 158 records, 17 records occur within the Indicative Footprint (Figure 9-10; Table 9-5). This includes eight active mounds and nine inactive mounds (Table 9-5). The majority of mounds recorded within the Indicative Footprint occur in Stony Plain habitat; however, Hillcrest/Hillslope habitat also provides suitable habitat for this species.

Table 9-5: Terrestrial Fauna - Western Pebble-mound Mouse recent records

Mound ID	Mound status	Habitat type
1003_09_05150	Mound (inactive)	Stony Plain
1003_09_05193	Mound (inactive)	Stony Plain
10082_09_00351	Mound (active)	Hillcrest/ Hillslope
1021_09_06475	Mound (inactive)	Stony Plain
10437_09_01295	Mound (active)	Stony Plain
10437_09_01296	Mound (active)	Minor Drainage Line
10437_09_01313	Mound (active)	Stony Plain
10437_09_01314	Mound (active)	Stony Plain
10437_09_01315	Mound (active)	Stony Plain
10437_09_01318	Mound (active)	Stony Plain
10437_09_01319	Mound (active)	Stony Plain
10437_09_01362	Mound (inactive)	Stony Plain
10437_09_01364	Mound (inactive)	Stony Plain
10437_09_01373	Mound (inactive)	Stony Plain
10437_09_01387	Mound (inactive)	Stony Plain
1068_09_00009	Mound (inactive)	Stony Plain
1068_09_00249	Mound (inactive)	Stony Plain

9.3.2.5 SRE invertebrate fauna

The SRE status categories used for this assessment follow BHP's technical process instructions for SRE assessment methods (BHP 2022d) as follows:

- **Confirmed SREs:** species with a thoroughly surveyed range <10,000 km².
- **Potential SRE:** species for which there is some evidence of short-range endemism (e.g. closely related to Confirmed SREs, occurrence in limited habitat, etc.) and the known range is <10,000 km², but sampling and/or taxonomy are not sufficiently robust to assign to the Confirmed SRE category. The Potential SRE category includes species that are likely to be SREs.
- **Uncertain:** specimens from SRE Groups with known ranges <10,000 km², including specimens that may be fragmentary or otherwise unidentifiable to species, for which more evidence is required to ascertain the species' true distribution. For example, a species collected only once, or a species collected multiple times from multiple different habitats, would be categorised as Uncertain; further sampling of that species would likely resolve its distribution, but in the absence of that sampling, its true distribution remains unknown and difficult to estimate. The Uncertain category includes species that are Data Deficient.
- **Not SRE (=Widespread):** species with known ranges >10,000 km².

Historically, 25 Confirmed SRE species and four potential SREs have been recorded within the Development Envelope (Appendix 15). These species were assessed as part of the Approved Proposal (BHP 2017b). None of the previously recorded named Confirmed or Potential SRE species occur within the Indicative Footprint.

During recent SRE surveys, one Potential SRE, and three Uncertain SRE species were recorded within the Development Envelope, including records from sites within the Indicative Footprint (Bennelongia 2024a). These species are described in Table 9-6 with locations shown in Figure 9-11. The pseudoscorpion *Beierolpium* 8/3 'BPS527' is a new species of pseudoscorpion only known from the Ministers North Tenement; however, it was recorded from multiple sites including sites outside the Development Envelope and Indicative Footprint. *Buddelundia* 'BIS520' is an isopod that is data deficient and therefore SRE status is Uncertain; however, it is known from multiple

sites including those outside the Development Envelope and Indicative Footprint. Two taxa (*Karaops* sp. indet and *Scolopendra* 'sp. indet') could not be identified to species level due to comprising juvenile specimens (Bennelongia 2024a).

None of the SRE taxa recorded, either recently or historically, are listed as Threatened fauna under the EPBC Act or BC Act or listed as Priority fauna by DBCA.

Additional SRE invertebrate fauna surveys are currently in progress for areas within the Indicative Footprint that have not previously been surveyed (Biota 2025 *in prep*). Survey results are expected early 2025 and will be used to further inform the impact assessment for SREs, particularly in and around the north-west scheme of the Indicative Footprint.

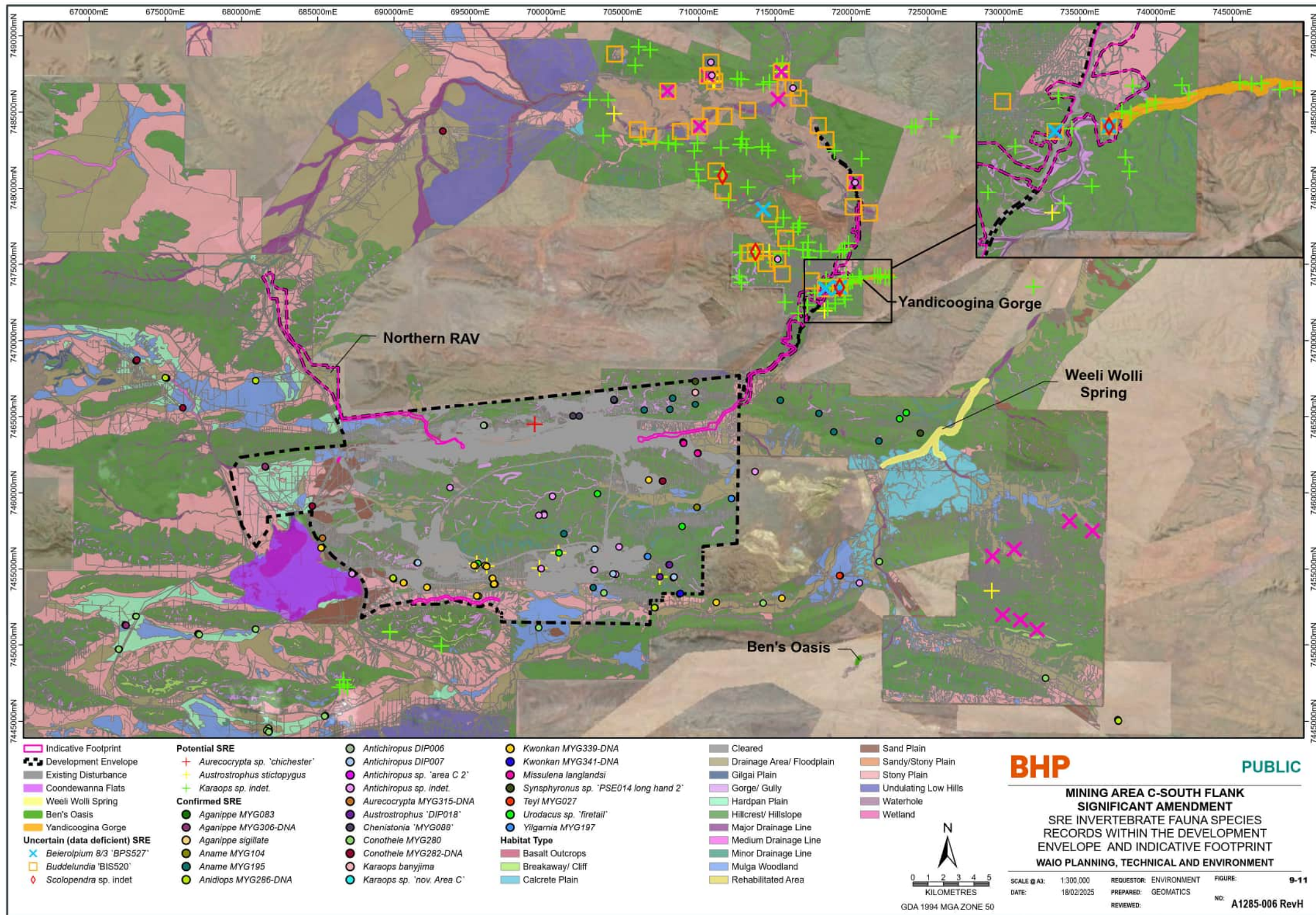
Table 9-6: Terrestrial Fauna – SRE taxa recorded within the Indicative Footprint

Higher Order Identification	SRE Status	Total number of Specimens recorded ¹	Habitat type	Location	Species Associations	Species comments and Linear Distribution
Pseudoscorpions						
<i>Beierolpium</i> 8/3 `BPS527`	Uncertain (Data Deficient)	5	Undulating Low Hills, Major Drainage Line, Minor Drainage Line	Development Envelope Indicative Footprint Reference sites outside impacts	<i>Eucalyptus</i> sp. and <i>Acacia</i> sp.	New species recorded from three sites in three different habitat types. Has a known linear distribution of 7.2 km and is only known from the Ministers North tenement; however, members of this genus tend not to be SRE. The species was recorded from one site within the Indicative Footprint as well as multiple sites outside the Development Envelope and Indicative Footprint.
Isopods						
<i>Buddelundia</i> `BIS520`	Uncertain (Data Deficient)	32	Undulating Low Hills, Hillslopes, Gully, Major, Medium and Minor Drainage Line habitats	Development Envelope Indicative Footprint Reference sites outside impacts	<i>Eucalyptus</i> sp., <i>Acacia</i> sp., <i>Hakea</i> sp.	Thirty-two specimens collected from 12 sites from both inside and outside the Indicative Footprint and Development Envelope. Has a known linear distribution of 21.3 km. Also collected from the Yandi mine area.
Spiders						
<i>Karaops</i> sp. indet.	Potential	31	Major Drainage Line, Gorge/Gully, Hillcrest/Hillslope, Breakaway/Cliff	Development Envelope Indicative Footprint Reference sites outside impacts	None	Historically recorded at locations throughout the Approved Proposal area. Juvenile specimens could not be identified to species level. Confirmed SREs and more widespread species from this genus are known to occur throughout the region. Recently recorded in the Indicative Footprint, as well as multiple locations outside the Development Envelope and Indicative Footprint.
Centipedes						
<i>Scolopendra</i> sp. indet.	Uncertain (Data Deficient)	4	Major Drainage Line	Development Envelope Indicative Footprint	None	Four specimens collected from three sites both inside and outside the Indicative Footprint. Juvenile specimens could not be identified to species level. SRE status uncertain.

Higher Order Identification	SRE Status	Total number of Specimens recorded ¹	Habitat type	Location	Species Associations	Species comments and Linear Distribution
				Reference sites outside impacts		

Source: Bennelongia 2024a)

¹ total number of specimens recorded represents total number recorded during the survey, not just those present within the Indicative Footprint



9.3.2.6 Aquatic fauna

The aquatic fauna values within the Development Envelope and regional areas in proximity to the Development Envelope including Yandicoogina Gorge, Coondewanna Flats, Weeli Wolli Springs and Marillana Creek Pools, are described below.

Development Envelope

A diverse aquatic fauna assemblage including vertebrates, microinvertebrates, hyporheos fauna and macroinvertebrates have been recorded within the artificial water feature associated with the Yandi discharge point (WYAN-10) which occurs within the Development Envelope (WRM 2015, 2018). The majority of invertebrate species recorded within the artificial water feature are common and widespread throughout the Pilbara; however, at least five stygal SREs have been recorded including the amphipods *Paramelitidae* sp. B, *Paramelitidae* sp. D and *Chydaekata* sp., the isopod *Pygolabis weeliwolli*, and the ostracod *Gomphodella* n. sp. 'BOS334' (WRM 2018). All recorded stygal SREs have distributions which extend outside the Development Envelope and predicted groundwater drawdown and/or mounding contours of the Proposal. As such, none of the stygal SREs or epigeal species are considered to be locally restricted (WRM 2015, 2018).

Three freshwater fish species were recorded within the artificial water feature: Western Rainbowfish (*Melanotaenia australis*), Spangled Perch (*Leipotherapon unicolor*) and Pilbara Tandan (*Neosilurus* sp.) (WRM 2015, 2018). All three species are common and widespread and have distributions that extend beyond the boundaries of the Development Envelope.

None of the aquatic fauna recorded within the Development Envelope are listed as threatened under state or national legislation (WRM 2015, 2018).

No aquatic fauna surveys have been undertaken at the permanent water pool WMIN-04; however, no vertebrate aquatic fauna species were observed in the pool during recent terrestrial fauna surveys (Biologic 2023a). No aquatic fauna sampling has been undertaken within WMIN-02 and WMIN-03; however, these are semi-permanent river pools which only provide temporary habitat and would therefore be unlikely to harbour species with local adaptations or speciation, or species which would be locally restricted.

Coondewanna Flats

Lake Robinson is a vegetated, highly ephemeral wetland within Coondewanna Flats that only holds water for short periods following intense rainfall events associated with cyclonic activity. A total of 55 invertebrate taxa have historically been recorded from Lake Robinson including micro and macroinvertebrates (WRM 2013b). Of the taxa recorded from Lake Robinson, the majority were classified as permanent residents (65%) indicating they have specific mechanisms for surviving drought periods, i.e. they have drought resistant eggs, can undergo cryptobiosis, or have the ability to burrow into damp sediments or take refuge in the hyporheic zone (WRM 2013b). The remaining taxa (35%) were temporary residents which likely invade the wetland each time it fills, usually by aerial invasion directly as adult stages (i.e. beetles, water bugs) or by adults ovipositing in the wetland, and establishing a population following development of eggs (i.e. midges, dragonflies, damselflies, mosquitoes, beetles, mayflies). The aquatic invertebrate fauna assemblage inhabiting Lake Robinson is widely distributed and capable of easy dispersal. The temporary and ephemeral nature of the water body at Lake Robinson is likely to preclude local adaptations and thus speciation (WRM 2013b).

Weeli Wolli Springs and Ben's Oasis

A diverse range of aquatic fauna has been recorded throughout Weeli Wolli Creek including Weeli Wolli Springs and Ben's Oasis (Biologic 2023h). Ongoing monitoring during the wet and dry seasons has recorded a total of 357 native invertebrate taxa (across zooplankton, hyporheic and macroinvertebrate lists) and three freshwater fish species (Spangled Perch, Western Rainbowfish, and Pilbara Tandan; Biologic 2023h, 2024d). This includes three damselflies

or dragonflies listed as either Vulnerable or Near Threatened on the International Union for Conservation of Nature's (IUCN) Redlist of Threatened Species (Biologic 2023h, 2024d; Appendix 12).

Weeli Wolli Springs supports a relatively high invertebrate taxa richness in surface waters and a high number of groundwater dependant taxa within the hyporheic zones. Macroinvertebrate richness is variable and found to be greatest at Ben's Oasis. While the majority of invertebrates recorded from Weeli Wolli Springs and Ben's Oasis are common, ubiquitous species, 23 species were considered to be of potential significance due to being restricted and/or only known from a few records (Biologic 2023h, 2024d; Appendix 12). Seventeen of these species occur in regional areas and/or have linear distribution that extend beyond the predicated impact areas of the Proposal. However, six species represent SREs or stygal species that are currently only known from Weeli Wolli Creek and occur in areas that could potentially be impacted by the Proposal, including:

- Cyprididae `sp. Biologic-OSTR049` – a potential new ostracod species recorded from surface waters at site WWUD5 and Ben's Oasis. Is currently considered a Potential SRE, currently known only from Weeli Wolli Creek. Known from outside the groundwater drawdown contours at Ben's Oasis.
- Paramelitidae `sp. Biologic-AMPH024` - a potential new amphipod species recorded from the hyporheos zone and surface waters at sites WWUD3, WWDD2 (hyporheos) and WWUD1 (surface waters). Is currently considered a Potential SRE known only from Weeli Wolli Creek. Currently only known from sites within the groundwater drawdown contours.
- Parabathynellidae `sp. Biologic-PBAT038` - a potential new syncarid species recorded from WWUD2 (hyporheos) and WWDD3 (hyporheos). Currently considered a Potential SRE known only from Weeli Wolli Creek. Only known from sites within the groundwater drawdown contours.
- *Rutacarus* `sp. Biologic-ACAR005` - a potential new species of water mite recorded from WWUD5 and WWDD2 (hyporheos). Is currently considered Potential SRE currently only known from Weeli Wolli Creek. Only known from sites within the drawdown contours.
- *Rutacarus* `sp. Biologic-ACAR006` - a potential new species of water mite recorded from WWUD2, WWDD4, WWDD5 (hyporheos) and WWDD2. Currently considered a Potential SRE. Is known from Weeli Wolli Creek and Marillana Creek. Known from sites outside the groundwater drawdown contours.
- *Wandesia* `sp. Biologic-ACAR009` - a water mite recorded from the hyporheos of WWUD4. This genus is not well understood and there is little taxonomic information available. This is the first record of this species, and it is not currently known whether it represents a Potential SRE (Data Deficient). It is currently only known from sites within the groundwater drawdown contours.

A further four macroinvertebrate species are listed as Vulnerable on the ICUN Redlist:

- *Eurysticta coolawanyah* (Pilbara pin damselfly) - listed on the IUCN Red List of Threatened Species as Vulnerable. Known from sites outside the groundwater drawdown contours including Yandicoogina Gorge and Marillana Creek.
- *Austroagrion pindrina* (Pilbara billabongfly) - listed on the IUCN Red List of Threatened Species as Vulnerable. Known from sites outside the groundwater drawdown contours.
- *Ictinogomphus dobsoni* (Pilbara tiger) - - listed on the IUCN Red List of Threatened Species as Near Threatened. Known from sites outside the groundwater drawdown contours including Yandicoogina Gorge and Marillana Creek.
- *Nososticta pilbara* (a damselfly) - recorded from all WWUD sites, WWDD3 and WWDD4. This species is endemic to the Pilbara and listed on the IUCN Red List of Threatened Species as Endangered. Known from sites outside the groundwater drawdown contours.

None of the above-mentioned species are listed as threatened under the EPBC or BC Act or as Priority listed fauna by DBCA.

Yandicoogina Gorge

A diverse range of aquatic fauna has been recorded at the pools within Yandicoogina Gorge including 250 invertebrate taxa and three freshwater fish species (Western Rainbowfish, Pilbara Tandan and Spangled Perch; Biologic 2023c). Two sites (YC3 and YC4) are considered to be of high ecological value (Biologic 2023c). These sites generally recorded high macroinvertebrate diversity, high richness of hyporheos fauna, and high Pilbara endemic taxa richness. The percentage of stygobitic taxa recorded (19%) was considerably greater than that reported previously for Pilbara hyporheic zones (i.e. 5%), highlighting the strong groundwater connection across the pools at Yandicoogina Gorge.

While most aquatic invertebrates recorded from Yandicoogina Gorge pools were common, ubiquitous species, or are species known from multiple creeks or sub-catchments, at least eight species are of conservation interest as they are either potentially restricted or are listed on the ICUN Redlist including:

- *Gomphodella* `sp. Biologic-OSTR077` – a potential new species of ostracod recorded from YC7H. Currently not known from elsewhere.
- Bathynellidae sp. BES7547 (YC9H) – a potentially new species of syncarid. Currently not known from elsewhere.
- *Atopobathynella* `sp. Biologic-PBAT042` - a potential new species of syncarid. Is considered a Potential SRE (Data Deficient) that is currently not known from elsewhere.
- Bathynellidae `sp. Biologic-BATH019` - a potential new species of syncarid. Is considered a Potential SRE (Data Deficient) that is currently not known from elsewhere.
- *Pygolabis* `sp. Biologic-ISOP035` - potentially restricted isopod currently not known from elsewhere.
- Pilbara Emerald, - Vulnerable on the IUCN Red List.
- Pilbara Pin Damselfly - Vulnerable on the IUCN Redlist.
- Pilbara Tiger– Near Threatened on the IUCN Red List.

In addition, three troglafauna taxa were recorded from the hyporheic zone including the pseudoscorpion Chthoniidae `sp. Biologic-PSEU083`, the dipluran Projapygidae `sp. Biologic-DIPL053`, and the symphylan *Hanseniella* `sp. Biologic-SYMP054` (Biologic 2023c). All troglafauna taxa were recorded in the wet season in 2022 from sites which do not always have an inundated hyporheic zone (i.e., YC6H, YC8H and YC9H). These locations would likely represent a humid, subterranean environment, that is not often inundated in comparison to the other sites sampled for hyporheos fauna within Yandicoogina Creek, which may provide temporary habitat for troglafauna (Biologic 2023c).

None of the invertebrate or vertebrate aquatic fauna recorded at Yandicoogina Gorge are listed under the EPBC Act or BC Act, or listed as Priority fauna by DBCA.

Marillana Creek Pools

A diverse range of aquatic fauna has been recorded within the Marillana Creek Pools including at least 87 zooplankton taxa, 208 macroinvertebrate taxa, and two freshwater fish species (Spangled Perch and Pilbara Tandan; Biologic 2023b). Three of the pools in particular have a high ecological value for invertebrate fauna: MarC2, MarC4 and MarC5; Figure 9-6).

Zooplankton richness within the Marillana Creek Pools was greater than other creeks included in recent studies (i.e. Munjina Creek, Yandicoogina Creek, Weeli Wolli Spring, Weeli Wolli Creek), although this was found to not be statistically significant (Biologic 2023b).

The hyporheic zone generally recorded a high richness of hyporheos and groundwater-dependent fauna, especially at MarC2, including several potentially restricted taxa. This highlights the strong connection to groundwater beneath Marillana Creek (Biologic 2023b).

While most invertebrates recorded from the Marillana Creek Pools were common, widespread species, five species are of conservation interest as they are potentially restricted species or are listed on the ICUN Redlist, including:

- *Guineaxonopsis* `sp. Biologic-ACAR013` – a permanent hyporheos stygophile water mite recorded from the hyporheic zone at MarC2 and MarC4. Has a linear range of 1 km and isn't known from elsewhere.
- *Hanseniella* `sp. Biologic-SYMP055` - a singleton, troglotauna specimen recorded from the hypoheic zone at MarC4 during the dry season. Currently not known from elsewhere.
- *Parastenocaris* `sp. Biologic-HARP037` - a singleton, copepod recorded MarC2; however, additional morphological and molecular work will likely increase the known distribution of this taxa in the future.
- Pilbara Pin Damselfly - Vulnerable IUCN Redlist.
- *Hemicordulia koomina* (a dragonfly) - Vulnerable IUCN Redlist.

None of the aquatic fauna recorded at Marillana Creek Pools are listed under the EPBC Act or BC Act, or listed as Priority fauna by DBCA.

9.4 Potential environmental impacts

BHP has considered the potential impacts outlined in the EPA's *Terrestrial Fauna Factor Guideline* (EPA 2016d) and considers that those relevant to the Proposal are:

- loss of fauna habitat and/or fauna individuals/species records from clearing (direct)
- fragmentation of fauna habitats (direct)
- habitat degradation or loss from altered groundwater regimes (indirect)
- habitat degradation or loss from altered surface water regimes (indirect)
- mortality or injury from vehicle strike/interactions with machinery (indirect)
- habitat degradation or species disturbance due to increased dust, noise, vibration or light (indirect)
- disturbances to fauna from invasive or introduced species (indirect).

BHP has focused the discussion of potential direct impacts of the Proposal within the Indicative Footprint of the Development Envelope, where impacts that have not previously been assessed could occur. Indirect impacts, or those impacts that extend beyond the boundaries of the Development Envelope or Indicative Footprint (i.e. Coondewanna Flats and Weeli Wolli Springs), have also been discussed and assessed (where relevant). BHP has also outlined the potential combined effects of the Combined Proposal on the environment. Information about impacts associated with the Approved Proposal have been provided for context but have not been reassessed.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation measures are applied, if required).

Cumulative impacts to Terrestrial Fauna are addressed in Section 16.3.

9.4.1 Loss of fauna habitat and/or fauna individuals/species records from clearing

9.4.1.1 Fauna habitats

Proposal

The Proposal will result in clearing no more than 1,076 ha of fauna habitat within a 1,482 ha Indicative Footprint, which represents 6.4% of the mapped fauna habitats currently remaining within the Development Envelope and 0.3% of BHP's mapped fauna habitats within the region (Table 9-7).

Clearing for the Proposal includes clearing up to 1,045 ha of critical and/or supporting habitat for significant fauna including Pilbara Olive Python, Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and/or Grey Falcon. This includes clearing of a total of 810 ha of critical habitat and 1,045 ha of supporting habitat within the Indicative Footprint (noting that these habitats overlap and are species-specific). Species-specific impacts associated with clearing are discussed in Section 9.6.8.

The fauna habitats that will be subject to the greatest amount of clearing for this Proposal include Stony Plain, Drainage Area/Floodplain and Hillcrest/Hillslope habitats. All three habitat types extend beyond the boundaries of the Indicative Footprint and are generally well represented in the Pilbara.

The Proposal includes some flexibility to modify the final location of elements of the Proposal within the Indicative Footprint; however, no more than 1,076 ha of fauna habitat will be cleared (as an authorised extent limit) additional to what has previously been approved for clearing for the Approved Proposal (21,824 ha).

Combined Proposal

The combined effect will be clearing up to a total of 22,900 ha of fauna habitat within a 40,060 ha Development Envelope. This includes 21,824 ha currently approved for clearing for the Approved Proposal and 1,076 ha proposed to be cleared for this Proposal. Clearing for the Combined Proposal represents 6.5% of BHP's mapped fauna habitats within the region (Table 9-7).

The Combined Proposal will include clearing up to 10,134 ha of critical habitat and 6,882 ha of supporting habitat for significant fauna species including Pilbara Olive Python, Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Grey Falcon. Species-specific impacts associated with clearing are discussed in Section 9.6.8.

The fauna habitat that will be subject to the greatest amount of clearing from the Combined Proposal will be the Hillcrest/Hillslope habitat (11,154.99 ha). This habitat provides critical foraging and dispersal habitat for the Ghost Bat where it occurs within 12 km of critical roosting habitat and provides supporting habitat for Pilbara Leaf-nosed Bat, Northern Quoll and Grey Falcon.

Table 9-7: Terrestrial Fauna - potential impacts to fauna habitat types

Habitat Type	Area within BHP Consolidated Mapping ¹	Total area mapped in DE	Approved Proposal	Proposed additional clearing within Indicative Footprint (this Proposal)		Total Combined proposal ² clearing	
	ha	ha	ha	ha	% of regional habitat	ha	% of total consolidated habitat mapping
Gorge/ Gully	3,104.19	1,623.49	809.4	14.96	0.48	824.36	26.56
Major Drainage Line	12,900.29	107.12	1.54	10.14	0.08	11.68	0.09
Breakaway/ Cliff	37.4	9.83	6.04	2.19	5.87	8.24	22.02
Artificial Wetland	72.12	1.05	0	1.03	1.43	1.03	1.43
Medium Drainage Line	626.89	1.17	0	0	0	0	0
Hardpan Plain	6,322.13	903.43	1.58	0	0	1.58	0.02
Mulga Woodland	33,605.56	1,471.84	691.06	0	0	691.06	2.06
Drainage Area/ Floodplain	28,854.46	2,894.96	1,200.43	356.53	1.24	1,556.96	5.4
Stony Plain	41,533.53	4,169.67	1,624.20	387.24	0.93	2,011.44	4.84
Hillcrest/ Hillslope	171,607.27	19,643.76	10,920.69	234.3	0.14	11,154.99	6.5
Minor Drainage Line	7,634.59	3,016.75	1,831.86	38.87	0.51	1,870.72	24.5
Sand Plain	53,822.11	1,441.90	330.73	1.65	0	332.38	0.62
Sandy/Stony Plain	3,683.11	0.01	0	0	0	0	0
Gilgai Plain	2,374.04	7.56	0	0	0	0	0
Undulating Low Hills	10,697.10	0.2	0	0	0	0	0
Cleared/ Disturbed	6,405.00	4,732.93	4,308.28	28.08	0.44	4,336.36	67.7

Habitat Type	Area within BHP Consolidated Mapping ¹	Total area mapped in DE	Approved Proposal	Proposed additional clearing within Indicative Footprint (this Proposal)		Total Combined proposal ² clearing	
	ha	ha	ha	ha	% of regional habitat	ha	% of total consolidated habitat mapping
No Survey Data	0	33.9	1.13	1.03	0	2.16	n/a
Total (rounded)	383,280	40,060	21,727³	1,076	0	22,803⁴	6

1 Biologic 2018

2 Total area to be cleared in proposed DE for the Approved Proposal plus area proposed for clearing within Indicative Footprint

3. The Approved Proposal indicative footprint spatial file differs slightly from the amount of clearing approved under MS 1072 by 97 ha (<1% of the 21,824 ha approved to be cleared).

4. The Combined Proposal impact will be 22,900 ha when including the 97 ha not captured in the Approved Proposal spatial footprint

9.4.1.2 Habitat features

Proposal

There are no caves located within the Indicative Footprint, therefore, there will not be any direct impacts to caves as a result of the Proposal. Potential indirect impacts to caves are addressed in Section 9.4.6.

There are three water features located either within or on the boundaries of the Indicative Footprint including the artificial water pool (WYAN-10) associated with the discharge point at Lower Marillana Creek, as well as water pools WMIN-03 and WMIN-04 (Section 9.3.2.2). All three pools provide critical foraging and dispersal habitat for the Pilbara Olive Python and habitat for aquatic fauna; however, the pools are unlikely to be directly impacted by the Proposal as the pipeline will be buried at the creek crossings where the pools occur (i.e. will go underneath the pools) and these pools are not groundwater-dependant. Indirect impacts to the three pools could occur as a result of clearing activities, earthworks and the placement of infrastructure which can alter surface water regimes which are discussed in Section 9.4.4.

Combined Proposal

Direct impacts to caves as a result of the Combined Proposal will be no different to those previously assessed and currently managed under the Approved Proposal. Potential indirect impacts to caves are addressed in Section 9.4.6.

The Combined Proposal will not result in direct impacts to surface water features, as described above for the Proposal. Indirect impacts to surface water pools as a result of the Combined Proposal are discussed in Section 9.4.4.

9.4.1.3 Fauna records

Proposal

The Proposal has the potential to affect the representation and distribution of significant fauna species as a result of loss of individuals or species records during clearing activities. Table 9-8 shows the potential impact on each species, with consideration of all identified records from the Pilbara bioregion; however, it should be noted that the majority of species records are of mobile species or comprise records such as scats, tracks or skin sloughs and do not represent stationary individuals.

As described in Section 0, 10 significant fauna species have been recorded in the Development Envelope. Of these, three species have been recorded within the Indicative Footprint: Northern Quoll, Pilbara Olive Python and Western Pebble-mound Mouse. Based on the Indicative Footprint, two records of the Pilbara Olive Python (scat), four records of Northern Quoll (motion camera records and scats) and 17 records of the Western Pebble-mound Mouse (mounds) will be cleared as part of the Proposal (Table 9-8; noting that Northern Quoll and Pilbara Olive Python are mobile species). This represents 0.07%, 0.4% and 0.5% respectively of the known species records within the Pilbara bioregion (Table 9-8). Species-specific impacts are discussed in further detail in Section 9.6.8.

As described in Section 9.3.2.5, four Potential or Uncertain SRE species have been recorded within the Indicative Footprint: *Beierolpium* 8/3 'BPS527', *Buddelundia* 'BIS520', *Karaops* sp. indet. and *Scolopendra* sp. indet. Given the lack of taxonomic knowledge for the two higher level identifications (*Karaops* sp. indet. and *Scolopendra* sp. indet.), it is not possible to determine % impacts to these species as they could represent one or more different species. For *Beierolpium* 8/3 'BPS527' and *Buddelundia* 'BIS520', 33.3% and 8.3% of known records respectively have the potential to be impacted by the Proposal (Table 9-8).

Combined Proposal

The combined effect of the Combined Proposal will be direct impacts to known records of all of the significant vertebrate fauna species listed in Table 9-8. The combined effect for most species will be impacts to less than 1% of known records, except for the Grey Falcon, Ganes Blind Snake, the Pilbara Barking Gecko and the Western Pebble-mound Mouse, where impacts are greater than 1% (Table 9-8). Of these species, only the Western Pebble-mound

Mouse will be subject to additional impacts associated with the Combined Proposal where a total of 2% of known species records will be impacted (Table 9-8). Species-specific impacts are discussed in further detail in Section 9.6.8.

The combined effect on Confirmed SREs previously assessed for the Approved Proposal will be no different given that none of the previously recorded Confirmed SRE species have been recorded in the Indicative Footprint. However, the Combined Proposal will result in impacts to four Potential or Uncertain SRE species that have been recorded in the Indicative Footprint (described above for the Proposal; Table 9-8). Species-specific impacts to SREs are discussed in further detail in Section 9.6.8.

Table 9-8: Terrestrial Fauna - potential impacts to significant fauna records

Species	Known records within Pilbara ¹	Records within DE	% of known Pilbara ¹ records within DE	Records within Approved Proposal	Records within Indicative Footprint	% of known records within additional proposed clearing	% of known records within Combined Proposal areas
Threatened fauna							
Northern Quoll	5,537	8	0.1%	0	4	0.05%	0.07%
Pilbara Olive Python	527	8	1.5%	3	2	0.4%	0.9%
Pilbara Leaf-nosed Bat	3,624	7	0.2%	0	0	0	0.2%
Ghost Bat	3,499	289	8.3%	15	0	0	0.42%
Grey Falcon	13	3	23.1%	2	0	0	15.4%
Priority fauna							
Gane's blind snake	23	5	21.7%	3	0	0	13%
Pilbara Barking Gecko	27	6	22.2%	5	0	0	18.5%
Western Pebble-mound Mouse	3,684	158	4.3%	54	17	0.5%	2.0%
Other specially protected fauna							
Peregrine Falcon	207	1	0.5%	1	0	0	0.5%
SRE invertebrate fauna							
<i>Buddelundia</i> 'BIS520'	12	1	8.3	0	1	8.3%	8.3%
<i>Beierolpium</i> 8/3 'BPS527'	3	1	33.3	0	1	33.3%	33.3%

1. Records are based on the BHP database current as at the time of writing, comprising of BHP survey data and publicly available data. Records comprise direct sightings as well as indirect evidence such as scats, tracks, dens, mounds etc. and indicate location rather than number of individuals.

9.4.2 Fragmentation of fauna habitats

Habitat fragmentation can cause division and isolation of local populations of animals through disruption of movement patterns, increased competition for resources, reduced species richness and habitat degradation. Species most likely to experience such isolation would be those inhabiting continuous stretches of habitat, those with less mobility such as SRE invertebrate fauna, fossorial herpetofauna and small terrestrial mammals (e.g. Western Pebble-mound Mouse, Pilbara Barking Gecko, and Gane's Blind Snake). However, even highly mobile species, such as bats, may experience disruptions if large, cleared areas create a barrier to movement/dispersal.

Proposal

The Proposal will result in some local, additional fragmentation throughout the north-east and north-west schemes of the Indicative Footprint. Fragmentation of fauna habitats will occur due to vegetation clearing as well as the placement of above-ground linear infrastructure (i.e. the pipelines). Whilst the pipeline will be buried at creek crossings, it will be above-ground for most of its length where it has the potential to create a barrier to movement and fragment critical and supporting habitat for significant fauna within these areas. Both the north-east and north-west schemes are already somewhat fragmented by roads, tracks or rail lines; however, some additional fragmentation may occur in areas where the pipeline route deviates from established roads or rail lines (Figure 9-7 and Figure 9-8). Whilst most fauna are capable of crossing roads, tracks or cleared areas, the placement of an above-ground pipeline has the potential to create a barrier to movement. Locations where the pipelines are buried (i.e. creek crossings) will continue to allow for movement of fauna.

Combined Proposal

The combined effect of the Combined Proposal will be fragmentation of fauna habitats, including critical and supporting habitat, within the Development Envelope. Areas subject to the greatest fragmentation likely occur around the eastern section of the Approved Proposal where disturbance has created a barrier for fauna dispersal between the northern and eastern parts of the Jirrapur Range (BHP 2017b). This was previously assessed for the Approved Proposal. The additional fragmentation that will occur, is unlikely to increase habitat fragmentation in this area and will be mostly limited to the north-east and north-west schemes of the Indicative Footprint, where habitats are already fragmented by the Great Northern Highway, BHP rail lines or tracks or unsealed roads (Figure 9-7 and Figure 9-8).

9.4.3 Changes to fauna habitat from altered groundwater regimes

Altered groundwater regimes have the potential to cause a decline in the health, composition and/or extent of potential GDV/riparian vegetation or cause surface water pool levels to decline if they are groundwater dependant. This can result in a subsequent decline in the health, composition and/or extent of the associated fauna habitats (i.e. Major and Medium Drainage Lines and/or surface water features associated with these habitat types), which can reduce the ecological integrity and biological diversity of these habitats. Degradation of fauna habitats can reduce the foraging capacity which in turn can affect predator-prey relationships and the carrying capacity of surrounding habitats as fauna have to move into adjacent territories.

The Proposal involves additional mine dewatering and a water management strategy with several components to manage surplus water (Section 7.4). The following components have the potential to impact terrestrial and aquatic fauna habitats:

- Changes to groundwater regimes from groundwater abstraction (drawdown) for mine dewatering
- Changes to groundwater regimes from groundwater mounding due to the Northern RAV MAR scheme and/or the Yandicoogina GDE Supplementation Scheme
- Changes to groundwater quality due to surplus water discharge and/or the MAR scheme and/or the Yandicoogina GDE Supplementation Scheme.

Potential changes to groundwater quality due to the Northern RAV MAR and the Yandicoogina GDE Supplementation Scheme are not expected to occur based on the analysis of source water from the Development Envelope which determined that all analytes outside of the 80th percentile were considered negligible (Section 7.5.4). In addition, it is a requirement under the Part V licence of the EP Act for the schemes to ensure that there is no significant deterioration of water quality and that there are no adverse impacts on associated environmental values. Regular monitoring and reporting of water quality at Yandicoogina Gorge and the Northern RAV MAR will be undertaken, and results be provided to DWER as part of the AER process which will ensure that this requirement is fulfilled. Any changes to water quality as a result of surplus management will be detected (if they were to occur); however, this is considered unlikely to occur based on the water quality analysis results (see Section 7.5.4 and 7.5.11). Therefore, potential impacts to terrestrial or aquatic fauna habitats associated with changes to groundwater quality are not discussed further.

Proposal

The proposed increase in dewatering from 102 ML to 180 ML/day will lower groundwater levels. The increase in dewatering is required for implementation of the Combined Proposal rather than the Proposal alone. As such, indirect impacts to terrestrial and aquatic fauna habitats resulting from groundwater drawdown are assessed as part of the Combined Proposal below.

Aquifer reinjection as part of MAR schemes can cause groundwater levels to rise (mounding) which can also cause a decline in the availability, health or condition of terrestrial fauna habitats associated with GDV/riparian vegetation due to waterlogging roots or from creating periods of inundation which can lead to vegetation dependency and changes to vegetation composition and/or fauna species assemblages. BHP currently operates two MAR schemes in the Development Envelope which will not change as part of the Proposal (Section 7.5.2). Two new schemes are proposed as part of the Proposal: the Northern RAV MAR scheme and the Yandicoogina GDE Supplementation Scheme (Section 7.3.4.4). These are described below.

Northern RAV MAR scheme

The Northern RAV MAR scheme is located within the north-west scheme of the Indicative Footprint (Figure 9-8). Groundwater mounding up to 30 mbgl, 20 mbgl and 10 mbgl is predicted to occur at the Northern RAV MAR location with the 10 mbgl contours mostly being confined to the Indicative Footprint and extending 1 km west, whilst the 20 mbgl and 30 mbgl contours extend less than 1 km east and approximately 2 km and 12 km west, of the Northern RAV scheme location with another isolated patch of mounding up to 20 mbgl occurring approximately 7 km west of the Northern RAV MAR location (Figure 9-8). Mounding less than 20 mbgl has the potential to alter the extent or composition of vegetation (and associated fauna habitats) within these areas, either due to waterlogging and depriving roots of oxygen or from increasing water availability and therefore dependency, which can have negative consequences when the MAR scheme ceases and groundwater levels decrease (see Section 8.4.2). Fauna habitats present within the 10-20 mbgl mounding contours at Northern RAV include Stony Plain, Mulga Woodland, Medium Drainage Line, Hardpan Plains and Drainage Area/Floodplain (Table 9-9). All of these habitat types, except for Hardpan Plains, provide critical and/or supporting habitat for Ghost Bat, Pilbara Olive Python, Pilbara Leaf-nosed Bat and/or Grey Falcon (Table 9-9). These habitat types contain scattered *Eucalyptus xerothermica* and/or *Eucalyptus leucophloia* subsp. *leucophloia* trees which have deep roots capable of accessing groundwater (see Section 8.4.2). These species may be positively impacted while mounding is occurring due to increased availability of water; however, once the mounding recedes, these trees could become water stressed and suffer negative impacts from the creation of drought-like conditions. The degradation or loss of these trees could subsequently result in the degradation or loss of up to 161.8 ha of fauna habitat, including up to 160.7 ha of critical and/or supporting habitat for significant fauna (Table 9-9).

Table 9-9: Terrestrial Fauna - critical and supporting habitat potentially impacted by mounding at Northern RAV

Fauna habitat	Critical habitat	Supporting habitat	Area within 0-20 mbgl contours (ha)
Drainage Area/ Floodplain	Ghost Bat	Pilbara Leaf-nosed Bat Grey Falcon	30.5
Medium Drainage Line	Ghost Bat Pilbara Olive Python Grey Falcon	Pilbara Leaf-nosed Bat Northern Quoll	35.8
Mulga Woodland	Ghost Bat	Pilbara Leaf-nosed Bat	4.1
Stony Plain	Ghost Bat	Pilbara Leaf-nosed Bat	90.0
Total critical or supporting habitat (ha)			160.7
Hardpan Plains	N/A	N/A	1.1
Total fauna habitats within mounding contours (ha)			161.8

Note: Hardpan Plains does not represent critical or supporting habitat for significant fauna

Yandicoogina GDE Supplementation Scheme

The Yandicoogina GDE Supplementation Scheme is located directly adjacent to the north-east scheme of the Indicative Footprint (Figure 9-8). The scheme is being implemented to mitigate recent declines in local groundwater levels which have resulted in a decline in terrestrial fauna values including a decline in the condition of GDV and a decline in the water levels of one of the permanent pools present within the gorge (discussed in Section 7.3.4.4). The reinjection bores have already been constructed and will be operational for the trial of the program which is planned to begin in late 2024 (see Section 7.3.4.4). The proposed north-east pipeline will provide a larger water supply to this existing infrastructure for the longer-term supplementation program, which will be further informed by the trial (see Section).

The supplementation scheme is intended to increase and then maintain groundwater levels at Yandicoogina Gorge, to those observed in 2018. As a result, mounding is not anticipated to negatively impact terrestrial fauna habitats within Yandicoogina Gorge, but should prevent any further decline in the permanent pools or vegetation health or condition which will allow for the continued persistence of these values within the gorge. Given that these values provide critical and/or supporting habitat for significant fauna and habitat for aquatic fauna, including potentially restricted species, this program is predicted to result in a positive impact and is the overarching objective of the program.

Combined Proposal

As discussed in Section 7.4.2, an increase in dewatering of 77.8 ML/d (28.4 GL/a) is required for implementation of the Combined Proposal compared to the Approved Proposal. A summary of groundwater level change as a result of the Approved Proposal compared to the Combined Proposal is provided in Section 7.7.1 and shown in Figure 7-16. Overall, the predicted lateral drawdown extent (as defined by the 1 m drawdown contour) of the Combined Proposal is similar to the Approved Proposal (BHP 2016b); however, there are several local differences due to the deeper dewatering levels predicted in the 2024 model and the uncertainty in hydraulic parameters. The key differences are summarised below:

- The combination of greater dewatering depth and changes in hydraulic parameters result in an increased drawdown in Coondewanna Flats by an additional 10 to 60 m beyond the Approved Proposal
- The southern extent of 1 m drawdown of the Combined Proposal is reduced by approximately 2.5 km (i.e. the Combined Proposal contours are within the Approved Proposal extent)
- A general reduction in drawdown (laterally and vertically) is predicted in the eastern extent beyond the Development Envelope towards Weeli Wolli Springs (i.e. the Combined Proposal is within the Approved Proposal extent)
- The lateral extent to the north is within the approved extent.
- Drawdown is expected to extend laterally by 1.6 km and vertically by 2.5-5 m in the north-west corner beyond the approved extent.
- The lateral extent of the 2.5 m drawdown contours extend 4.2 km to the south-west.

Note that the groundwater drawdown contours do not extend into Yandicoogina Gorge or the Marillana Creek Pools and so groundwater drawdown impacts to these environmental receptors and their associated terrestrial and aquatic fauna habitats are not discussed further.

Groundwater drawdown impacts at Coondewanna Flats are also not considered further as this is a surface water dependant ecosystem and so impacts to terrestrial and/or aquatic fauna habitat associated with drawdown are unlikely to occur at this location (see Section 7.3.4.1).

Areas of confirmed GDV (presence of *Melaleuca argentea*) which intersect the groundwater drawdown contours for the Combined Proposal occur at two locations along Weeli Wolli Creek; Weeli Wolli Spring and vegetation in the vicinity of Ben's Oasis (Figure 8-10 in Section 8.3.2.1). In addition, Weeli Wolli Springs (a permanent groundwater-fed spring) and its associated semi-permanent pools also occur within the predicted groundwater drawdown contours of the Combined Proposal (Figure 9-6; see Section 7.3.4.2). Weeli Wolli Spring and the area of Weeli Wolli Creek in the vicinity of the spring, are cumulatively impacted by the surrounding mining operations, including the Approved Proposal and RTIO Hope Downs. RTIO are currently mitigating impacts from their Hope Downs operation to Weeli Wolli Spring and the creek. Cumulative groundwater drawdown modelling predicts that up until 2045, a decline in groundwater levels of approximately 2.4-5.6 m could occur at Weeli Wolli Spring as a result of drawdown associated with the Combined Proposal and RTIO Hope Downs (see Section 7.5.1). This is within the approved limit of 3-14 m and is not expected to be greater than previously assessed. Therefore, additional impacts to vegetation at Weeli Wolli Spring and the surrounding area of Weeli Wolli Creek from the Combined Proposal are not expected to occur. However, in 2045 when the RTIO Hope Downs mine closes and their mitigation measures cease, drawdown at Weeli Wolli Spring is predicted to increase to between 11-14 m (without mitigation). This has the potential to result in the degradation of terrestrial and/or aquatic fauna habitats associated with GDV/riparian vegetation or a decline in water level at the surface water pools along Weeli Wolli Creek which are groundwater-fed.

The confirmed and potential GDV which contain fauna habitat in the vicinity of Ben's Oasis will be potentially impacted by the Combined Proposal from groundwater drawdown. A potential minimising consideration is that hydrogeological modelling conducted by both RTIO (Rio Tinto 2024) and BHP suggests that a regional dyke could potentially be acting as a flow barrier between Ben's Oasis and the Hope Downs Aquifer which would reduce the risk of impact to this riparian system from the Combined Proposal. However, both RTIO and BHP consider that further work is required to confirm this (Section 8.6.2).

Other areas which contain fauna habitats associated with potential GDV and/or riparian vegetation that intersect the groundwater drawdown contours of the Combined Proposal occur within and outside of the western and southern sections of the Development Envelope, and to the east outside of the Development Envelope (Figure 8-19 in Section 8.4.2). These areas are mostly associated with the Major and Medium Drainage Line fauna habitats which provides critical and/or supporting habitat for significant fauna. There are no known groundwater-fed surface water features in

these areas. The combined effect of the Combined Proposal is the potential to result in a decline in the availability of terrestrial fauna habitats that contain GDV or riparian vegetation within areas subject to additional drawdown greater than previously assessed (Section 8.4.2).

9.4.4 Changes to fauna habitat from altered surface water regimes

Proposal

The Proposal involves surplus water discharge along creeklines as part of the water management strategy (Section 0). This has the potential to alter surface water regimes via changes to water quality, quantity, flow rates, and/or physical or biological attributes. The construction of pipelines and diversion infrastructure for the Proposal also have the potential to interfere with the natural sheetflow of water and increase erosion and sedimentation. These impacts have the potential to result in modification, degradation or even loss of critical and supporting habitat for significant fauna.

Dewatering for the Proposal will result in an increase in surplus water disposal by 58 ML/day. The discharge of surplus water via creek discharge for the Proposal will occur at two discharge points: one upstream (Upper Marillana Creek Discharge) and one downstream (Lower Marillana Creek Discharge) in Marillana Creek (see Figure 7-15 in Section 7). Proposed surplus water discharge along ephemeral creeklines may result in indirect impacts to GDV, riparian vegetation and/or surface water pools (and the associated fauna habitats) due to continuous or prolonged inundation or by creating a dependency on permanent surface water flow, which has the potential to alter the health, extent or composition of vegetation and the associated fauna habitat.

Upper Marillana Creek Discharge

As described in Section 8.4.3, surplus water discharge into Upper Marillana Creek may cause indirect impacts to riparian vegetation and associated fauna habitats including through water logging and inundation, or a change in vegetation composition from an increase in weeds or increase in abundance of riparian shrub, sedge, grass, weeds and/or mulga vegetation along the discharge pathway (see Section 8.4.3). The Upper Marillana Creek discharge point is proposed to have a maximum rate of 30 ML/day which is predicted to have a wetting front of up to 27 km, occupying the low flow channel of Marillana Creek tributary. The extent of the wetting front is likely to remain within the low flow channel of the creek which is estimated to be 15 m to 22 m in width (compared to the main channel width of 100 – 200 m) (AQ2 2019).

A total of 75 ha of fauna habitat occurs along the wetting front and includes Calcrete Plain, Drainage Area/Floodplain, Hillcrest/Hillslope, Major and Minor Drainage Lines, Stony Plains and Undulating Low Hills. These habitats contain 71 ha of riparian vegetation, 0.5 ha of Valley Floor Mulga (ecosystem at risk) and 3.5 ha of other non-significant grasses and shrublands (see Section 8.4.3). Tree species such as *Eucalyptus victrix*, *Eucalyptus camaldulensis* or *Acacia citrinoviridis* which occur within these areas may be susceptible to degradation from continuous discharge of water for long periods. The *Eucalyptus* trees are likely to provide habitat for significant fauna including potential breeding habitat for Grey Falcon.

Lower Marillana Creek

Discharge to Lower Marillana Creek is currently approved under EP Act licence L6168/1991/11 and has been operating for approximately 15 years as part of the Yandi mine. Discharges from the existing Yandi Operation have created a short section of permanent flow which has resulted in changes to the composition of riparian vegetation, created habitat for the Pilbara Olive Python and which supports a high diversity of aquatic fauna. Additional discharge of surplus water at this existing discharge point is planned as part of the Proposal and has the potential to impact riparian vegetation and the associated fauna habitats from changes in surface water volumes along the discharge route. The licence for this discharge location authorises 41.1 ML/day (L6168/1991/11). No changes to the licence allocation are required for the Proposal as a maximum of 30 ML/day limited to a 5-year period will be discharged from the Proposal, and up to 11 ML/day from the existing Yandi mine. Wetting front limits have not previously been set for this location, however the maximum recorded was 9 km in 2008, and more recently 2.5 km in 2023 (Section

7.5.5). There is anecdotal evidence from Traditional Owners that riparian vegetation (and the associated fauna habitats) downstream and off BHP tenure, has declined in health and composition since discharge volumes and the wetting front have decreased. The surface discharge from the Proposal will increase the flow of water along Marillana Creek, increasing the wetting front up to 9 km. It is not anticipated that flows will increase past the existing 9 km wetting front due to the Proposal.

Construction of pipelines and GCOSA diversion structure

Installation of the GCOSA diversion structure for the Proposal (described in Section 2.2.1) will cause a reduction in catchment area of 17% for the west Catchment and 24% for the east Catchment. The associated percentage reduction to regional catchments areas is 0.44% loss to the Coondewanna Catchment (west) and 0.05% to Weeli Wolli Catchment (east). The bunds are not expected to significantly impede flows to creek lines and therefore are unlikely to impact areas of vegetation and associated fauna habitats.

Impacts to Mulga sheetflow are described in Section 8.4.3. Overall impacts to fauna habitats associated with Mulga sheetflow would be unlikely to occur given the proposed management including burying pipelines and using culverts within sheetflow areas (see Section 8.5 and Section 8.6.4).

Construction of the north-east pipeline will cross the Yandicoogina Creek waterway and infrastructure is required to be built adjacent to the creek. This will lead to an increase in construction traffic throughout this location for a short period of time, which may increase mechanical erosion of the existing waterway crossing. Land will also need to be cleared of vegetation and soil structure disturbed along the pipeline corridor, increasing sediment load entering into the creek during heavy rainfall events. These sediments may be carried downstream to the Yandicoogina Gorge and Pilbara Pools PEC.

Water quality

Changes to surface water quality due to the discharge of surplus water along Marillana Creek could potentially result in the degradation of fauna habitats associated with creeklines (i.e. Major, Medium and Minor Drainage Lines). Calcite precipitation cements the creek bed, thereby reducing habitat availability and creating a barrier between the hyporheos and surface water which can impact aquatic fauna. However, as described in Section 7.6.3.3, to prevent the formation of a precipitate and scale forming in creek discharge locations due to calcium carbonate, BHP will treat water quality going to both the Upper Marillana and Lower Marillana Creek discharge points. In addition, the use of chemicals containing PFAS at the MAC-SF Operations were phased out at Mining Area C- Southern Flank in 2021 as part of BHP's WAIO PFAS Phase Out Program. A preliminary PFAS investigation was conducted by Cardno in 2022 in which 13 areas of potential concern (AoPC) were targeted for sampling (Section 7.6.3.3). No exceedances of the ecological 99% species protection limit (0.0091 µg/L) were recorded in groundwater monitoring and groundwater production bores within the Development Envelope. As such, potential impacts to fauna habitats in relation to changes to surface water quality are considered unlikely to occur, and therefore are not discussed further.

Combined Proposal

The combined effect will be potential changes to fauna habitats associated with GDV/riparian vegetation or surface water pools as a result of surface water discharge at Pebble Mouse Creek (authorised under the Approved Proposal), Upper Marillana Creek (this Proposal) and Lower Marillana Creek (this Proposal).

Discharge to Pebble Mouse Creek is authorised under the Approved Proposal, and has a wetting front limited to 12 km from the discharge point which must not extend beyond the Approved Proposal Development Envelope. This discharge is managed under by Part V of the EP Act, via Licence L7851/2002/6 and is used for emergency releases only. There is sufficient separation between the approved discharge location and the proposed new discharge locations at Upper and Lower Marillana Creek to result in limited combined effect as they discharge to different catchments. The Yandi mine (licence L6168/1991/11) authorised discharge (41.1 ML/day) will not change due to the Proposal. The existing maximum discharge will be balanced between the two operations and will not exceed the licensed amount. Therefore, the combined effect is the same as described for the Proposal above.

9.4.5 Mortality or injury from vehicle strike or interactions with machinery/infrastructure

Proposal

Injury or mortality of fauna can result from collisions with vehicles and machinery during construction and operation of the Proposal, especially with species that are attracted to cleared areas for basking or foraging activities, or at night when nocturnal fauna actively forage. Slow moving species such as the Pilbara Olive Python may be more susceptible to the increase in vehicle movement and activity, whereas the use of barbed wire fencing may result in injury or mortality from fauna becoming entangled, particularly for Ghost Bats which are low flying.

Combined Proposal

The combined effect will be an increase in the risk of injury or mortality from vehicle strike or interactions with machinery across the Development Envelope. However, given that the proposed infrastructure aligns with existing tracks, roads and/or rail lines, and that the majority of the Development Envelope occurs within operational areas, this impact is not considered to be significantly greater than that previously assessed for the Approved Proposal.

9.4.6 Habitat degradation or species disturbance due to increased dust, noise, vibration or light

An increase in noise and vibrations resulting from construction and operation of the Proposal has the potential to disturb fauna by altering behaviour including abandonment or flushing from an area including caves, dens or burrows or altering feeding/dispersal or breeding patterns, whilst exposure to artificial light can interfere with activities governed by the length of the day including reproduction, dormancy, foraging and migration. Artificial light can disorient flying birds (particularly during migration where it can cause them to divert from efficient migratory routes or collide with infrastructure) or alter the foraging behaviour of nocturnal species. Excess dust emissions have the potential to irritate the eyes or interfere with vision which can affect the ability of individuals to capture prey, as well as degrade foraging and roosting/denning habitat from dust deposition on vegetation or from accumulating around cave entrances or surface water pools.

Proposal

The Proposal will result in an increase in dust, noise, vibration and/or light, due to vegetation clearing, earthworks and installation of infrastructure associated with the Proposal during construction. An increase in these disturbances may also occur as a result of ongoing operation, mostly associated with pipeline maintenance activities; however, given that the pipeline route occurs along existing rail line and/or roads and tracks, any increase during operation is expected to be minimal.

An increase in dust, noise, vibration and/or light during construction will be temporary and will be localised given that the majority of the pipeline will be above ground and low impact. In areas where the pipeline will be buried (i.e. creek crossings), an increase in dust emissions may occur due to clearing and associated earthworks; however, the pipeline will be buried using horizontal directional drilling (HDD) which reduces surface disturbance compared to traditional vertical drilling. Given that most of the above-mentioned significant fauna species are present at low densities, any associated disturbances are expected to be minor. Ghost Bats are likely to be the most at risk of impacts from disturbances associated with an increase in dust, noise, vibration and light as they are known to forage and periodically roost within the proposed Development Envelope (Section 9.3.2.3).

Whilst there are no caves within the Indicative Footprint, there are 12 regional caves that occur outside the Development Envelope but within the 450 m of the Indicative Footprint, which is within the Blast Management buffer zone (450 m) of the Mining Area C Fauna Management Plan (Appendix 16). Whilst blasting is not required for the Proposal, excessive noise or dust caused by HDD, excavation or heavy vehicle movements could potentially flush or disturb bats roosting or breeding within caves located within these areas. The closest cave to the Indicative

Footprint is cave CMN-06 / CV-04 which is a Category 4 cave (Table 9-4 in Section 9.3.2.2). This cave is located approximately 15 m from the Indicative Footprint (**Figure 9-8**). Another three Category 3 caves and one Category 4 cave also occur within 150 m of the Indicative Footprint (Table 9-4; **Figure 9-7** and **Figure 9-8** in Section 9.3.2.2). Whilst these caves occur within the 150 m 'Trigger buffer zone', given that blasting is not required for the Proposal no additional management is required. Standard management practices to minimise dust, noise and light will ensure that impacts associated with excessive noise, vibrations and/or dust are minimised as far as practical (described in Section 9.5).

The Proposal also has the potential to indirectly impact surface water pools due to clearing activities and earthworks during construction. There are three water features located either within or on the boundaries of the Indicative Footprint including the artificial water pool associated with the discharge point at Yandi mine (WYAN-10), as well as water pools WMIN-03 and WMIN-04 (Section 9.4.1.2). All three pools provide critical and/or supporting habitat for significant fauna, particularly the Pilbara Olive Python. Construction activities have the potential to degrade surface water pools or disturb fauna utilising the pools through excessive noise, dust, vibrations or light.

Combined Proposal

The combined effect will be an increase in dust, noise, vibration and light in areas extending beyond the boundaries of the Approved Proposal. The majority of the Combined Proposal occurs within operational mining areas where existing impacts on fauna from mining activities which will not be greater than that previously assessed for the Approved Proposal; however, given the extension of the Development Envelope, these impacts will increase to the north-west and north-east where the Proposal elements are planned to occur. The majority of significant species recorded in the Development Envelope are present in low densities and therefore, should disturbances occur, the potential impacts would be limited to individuals only and is not expected to impact a population. However, the Ghost Bat may be more susceptible to potential impacts given that a population of the species is present within the Development Envelope.

There will be no additional impacts to the 64 caves located within the Development Envelope (Appendix 14 and Appendix 16). Nor will there be any additional impacts to surface water features, previously assessed for the Approved Proposal. However, the Combined Proposal has the potential to result in indirect impacts to Ghost Bats and caves located outside the Development Envelope but within 450 m of the Indicative Footprint, as well as three water pools not previously assessed as part of the Approved Proposal as described above for the Proposal.

9.4.7 Disturbances to fauna from invasive or introduced species

Proposal

Vegetation clearing, pipeline construction and surface water discharge associated with the Proposal, all have the potential to introduce and/or spread introduced flora (weeds) and feral fauna species. Introduced species can alter the condition of terrestrial and aquatic fauna habitats through changes in vegetation structure, health, and composition, changes in native fauna species composition, diversity or abundance, or result in increased fire frequency or intensity. Habitat clearing can enhance the ability of feral predators, such as feral cats (**Felis catus*), to move through the landscape which can increase the potential for predation on native fauna. The displacement of fauna into adjacent territories inhabited by other individuals can result in increased predation and competition for food resources, shelter and breeding sites until equilibrium in the surrounding areas is reached. Surface water discharge has the potential to spread weeds (see Section 8.4.4.3) and/or invasive aquatic species such as the Redclaw Crayfish (**Cherax quadricarinatus*), whilst construction activities may assist in the rate of spread of the Cane Toad (*Bufo marinus*) through vehicle movements and availability of surface water. Vehicle movements may also assist in the introduction or spread of weeds into areas of new disturbance associated with the Proposal.

There are 23 introduced flora (weeds) currently known from the Development Envelope, which are described in Section 8.3.2. Feral fauna currently known from the Development Envelope include feral cats, dogs (**Canis*

familiaris), cattle (*Bos taurus*), and the European rabbit (*Oryctolagus cuniculus*; Biologic 2023a; Astron 2025 *in prep*; Appendix 12). In addition, the Redclaw Crayfish is currently known from Weeli Wolli Springs, Weeli Wolli Creek and downstream of the Yandi mine discharge point (WYAN-10), but has not been recorded at the Marillana Creek Pools or the pools at Yandicoogina Gorge (Biologic 2024b, c; 2023c). The Cane Toad is currently not known from the Pilbara region; however, it is predicted to spread into the region in coming years.

The above-mentioned introduced fauna species may affect native fauna through direct predation, toxication from ingestion, competition for food and shelter, habitat destruction through vegetation trampling or grazing, and/or through the spread of weeds and/or diseases.

Combined Proposal

The combined effect of the Combined Proposal is the potential to introduce and/or spread weed or feral fauna species throughout the Development Envelope, extending into areas of new disturbance or into nearby regional areas of ecological significance such as Upper Marillana Creek Pools, Weeli Wolli Springs, Yandicoogina Gorge or Coondewanna Flats. Given that new areas of disturbance are proposed as part of the Combined Proposal, this has the potential to be greater than previously assessed for the Approved Proposal.

9.5 Mitigation

BHP considers that there are potentially significant impacts to Terrestrial Fauna requiring targeted management measures, specifically in relation to the loss of local fauna habitats that support Ghost Bat, Northern Quoll, Pilbara Olive Python, Pilbara Leaf-nosed Bat and Grey Falcon. The proposed mitigation (including standard management practices) for the Proposal is discussed below.

BHP will continue to implement the Mining Area C Fauna Management Plan (BHP 2024d; Appendix 16) which will be updated to include the Combined Proposal. Where possible, BHP will implement the same avoidance and minimisation measures to this Proposal as those currently being implemented for the Approved Proposal. The proposed management and mitigation measures for all terrestrial fauna are described below.

9.5.1 Avoid

The Proposal has been designed to avoid impacts to significant fauna and/or habitats as far as practical. The Indicative Footprint has been designed to avoid all confirmed and potential Ghost Bat caves and also avoids all caves within the Development Envelope that are currently managed under the Approved Proposal, in accordance with the Mining Area C Fauna Management Plan (Appendix 16; noting that this document will be updated to include the Combined Proposal). The Indicative Footprint has been designed to avoid high value habitat features such as surface water pools, south-facing slopes, Gorge/Gully and Breakaway/Cliff habitats as far as practical.

Vegetation clearing and earthworks outside the approved clearing boundaries will be avoided. BHP will also avoid the use of barbed wire fencing within the Development Envelope, as far as practicable, to avoid the potential impact to bats from entanglement in barbed-wire fencing.

9.5.2 Minimise

The Proposal has been designed to minimise clearing and fragmentation of fauna habitats by designing infrastructure within or adjacent to existing disturbed areas as far as practical. The majority of the pipeline route follows existing roads, tracks or rail lines. However, in some areas, avoidance of fauna habitat is not possible, including areas of critical and supporting habitat for significant fauna. To minimise impacts associated with clearing and fragmentation, and indirect disturbances associated with increased noise, dust, vibration and light, BHP proposes the following management measures:

- clearing for the Proposal will be limited to a maximum extent of 1,076 ha of native vegetation to minimise impacts to fauna habitats
- no clearing will occur outside the approved clearing areas
- suitably qualified fauna spotters will be utilised for clearing in areas where Pilbara Olive Python and/or Northern Quoll records are known to occur
- construction will be mostly undertaken during day-light hours which will minimise impacts to nocturnal fauna species
- BHP will design and construct infrastructure using best management practices in order to minimise indirect impacts to terrestrial fauna habitats (i.e. sediment control, dust suppression measures, utilising existing cleared areas etc)
- pipelines will be buried at creek crossings (see Section 8.5.2) to maintain flows and minimise impacts to fauna habitats or disruption to fauna dispersal along these corridors
- infiltration basins at Northern RAV will be designed to minimise disturbance to surface flows and subsequent indirect impacts to terrestrial or aquatic fauna habitats (see Section 8.5.2)
- BHP will install fauna underpasses along the pipeline route to minimise barriers to fauna dispersal and movement
- all sightings and events involving significant fauna will be identified and captured in WAIOS Event Management System
- implementation of mitigation strategies at Weeli Wolli Springs once RTIO Hope Downs operations moves into closure (see Section 7.6)
- the Proposal will be operated within the existing groundwater licence limits for surplus water discharge at the Lower Marillana Creek discharge point
- appropriate speed limits will be imposed on access roads and construction areas to minimise the risk of vehicle strike or fauna interactions with machinery
- top edges of trenches and borrow pits will be sloped to enable fauna egress
- excessive dust will be minimised as far as practical
- the presence of domestic pets or animals on site will be prohibited
- if feral cats are observed on site, a feral cat management program will be implemented
- if Cane Toads are observed on site, they will be reported to DBCA and humanely euthanised in accordance with DBCA guidelines
- standard hygiene practices will be implemented to minimise introduction and spread of weeds including annual weed control (if required) and vehicle hygiene measures when entering/leaving construction areas.

As described in Section 8.5 and 7.5, BHP proposes to continue to manage surplus water from the Combined Proposal in accordance with the outcomes-based and management-based CPWRMP, which has been updated to include this Proposal (Appendix 8). This will include managing the predicted wetting front using a trigger location at 24 km and a threshold of 27 km to ensure the wetting front does not reach Flat Rocks or the Marillana Creek Pools. As part of the CPWRMP, ongoing monitoring of the aquatic ecosystems at the Marillana Creek Pools will continue to be implemented. If Redclaw Crayfish are detected at Marillana Creek Pools during aquatic monitoring, a control program

will be implemented (if appropriate). In addition, bi-annual tree health monitoring (both on-ground and via remote sensing) will continue to be implemented as part of the CPWRMP at Coondewanna Flats. This monitoring will be undertaken for the Combined Proposal which will ensure impacts to terrestrial and aquatic fauna associated with changes to groundwater and surface water regimes are minimised as far as practical.

For the Northern RAV MAR scheme, BHP proposes to ensure that groundwater levels do not rise above 10 mbgl as per the CPWRMP. This will be informed by groundwater level monitoring and monitoring the tree health of *Eucalyptus xerothermica* or *Eucalyptus leucophloia* subsp. *Leucophloia* trees within the 0-10 mbgl mounding zone. The Northern RAV MAR Scheme will be managed through the Part V licence (L7851/2002/6) of the EP Act, and groundwater mounding will be managed under outcome and objective based commitments in the CPWRMP.

As described in Section 7.5 and 8.5, the trial of the Yandicoogina GDE Supplementation Scheme is planned to commence in the 2024 dry season. Implementation of a TARP (described in Sections 7.5 and 8.5) will ensure that the terrestrial fauna habitat values improve and are not further degraded.

9.5.3 Rehabilitate

Rehabilitation and closure are addressed in the updated Mining Area C MCP (Appendix 5). The MCP covers the Approved Proposal and has been updated to include this Proposal.

The revised MCP addresses rehabilitation of the additional areas that will be disturbed. Management approaches relating to terrestrial fauna for the Proposal, include (but are not limited to):

- integrating fauna habitats (e.g. large rocks) into landform design
- design the revegetation program to establish native vegetation using local provenance and plant species that are linked to the appropriate landforms and species lists identified from baseline surveys that provide habitat and foraging areas for native fauna
- choose appropriate surface treatments, including selective placement of logs or smaller woody debris and/or boulders (if available) across the re-profiled surface and/or constructing rocky cliff features (where potential exists) to provide additional habitat areas for fauna species.

9.5.4 Other statutory decision-making processes

BHP's view is that there is no other statutory decision-making process to mitigate the potential environmental impacts of the Proposal on Terrestrial Fauna, considering the EPA's *Taking decision making processes into account in EIA: Interim Guidance* (EPA 2021b).

Dust emissions, surplus water discharge and groundwater abstraction limits can all be regulated under Part V licence which can assist in managing potential impacts to Terrestrial Fauna (i.e. habitats); however, additional management, as outlined above, is required to ensure that ecological integrity is maintained.

9.6 Assessment and significance of residual impacts

9.6.1 Loss of fauna habitats and individuals/species records from clearing

9.6.1.1 Fauna habitats

The Proposal includes flexibility to modify the final location of elements within the Indicative Footprint; however, no more than 1,076 ha of fauna habitat will be cleared for this Proposal. This includes clearing of a total of 810 ha of critical habitat and 1,045 ha of supporting habitat within the Indicative Footprint (noting these habitats overlap), which represents a significant residual impact requiring an offset (Section 14). Clearing of critical and/or supporting habitat for the Proposal is discussed for each significant fauna species in Section 9.6.8.

When considering the Combined Proposal, a total of 22,871 ha of fauna habitat will be cleared within a 40,060 ha Development Envelope. This represents a total of 6.5% of fauna habitats mapped within the wider region. All of the fauna habitats present within the Development Envelope are widespread in the Pilbara and are considered well represented regionally.

The Combined Proposal will result in total clearing no more than 10,134 ha of critical habitat and 6,882 ha of supporting habitat. Clearing of critical and supporting habitat for the Approved Proposal has previously been offset (see Section 14). Offsets are proposed for the additional clearing of 810 ha of critical habitat and 1,045 ha of supporting habitat as this represents a significant residual impact (see Section 14). Clearing of critical and/or supporting habitat for the Combined Proposal is discussed for each significant fauna species in Section 9.6.8.

9.6.1.2 *Habitat features*

As discussed in Section 9.4.1.2, there are no caves located within the Indicative Footprint and no blasting is required for the Proposal. As such, there are no predicted direct impacts to caves as a result of the Proposal. Indirect impacts to caves located in proximity to the Indicative Footprint are discussed in Section 9.6.6.

The Proposal has been designed to avoid pools as far as practical; however, there are three pools located either within or on the boundaries of the Indicative Footprint including the artificial water pool associated with the discharge point at Yandi, as well as water pools WMIN-03 and WMIN-04. The Proposal elements will largely avoid all of these pools and will not impact the extent or availability of the pools. As such, the Proposal is unlikely to result in a significant residual impact to any surface water pools wholly or partially present within the Indicative Footprint.

Direct impacts to caves or pools as a result of the Combined Proposal are not expected to be greater than those previously assessed for the Approved Proposal. There will be no additional impacts to the 55 caves currently being monitored as part of the Approved Proposal (Appendix 14; Appendix 16).

9.6.1.3 *Fauna individuals/species records*

Vegetation clearing for the Proposal has the potential to result in direct impacts to significant species records including Pilbara Olive Python (two records), Northern Quoll (three records) and Western Pebble-mound Mouse (17 records; Table 9-8). Both the Pilbara Olive Python and Northern Quoll are mobile species, and so clearing of records would be unlikely to impact any individuals; however, impacts to Western Pebble-mound Mouse mound records could potentially result in injury or mortality of individuals where mounds are active as clearing could potentially result in injury or mortality of individuals inhabiting the mounds. Species-specific impacts are discussed in Section 9.6.8.

Direct impacts to species records from the Proposal represents less than 1% of known records for all three species. Management measures will be implemented to reduce the risk of clearing to significant fauna species. Dedicated fauna spotters will be present during clearing activities. In the event that significant fauna species are observed within the clearing area, clearing will cease until it is confirmed that the individual has moved on. As such, impacts to significant species records associated with clearing for the Proposal are not expected to be significant.

When considering the Combined Proposal, there will be direct impacts to records of all of the significant vertebrate fauna species listed in Table 9-8; however, the majority of these records represent less than 1% of known Pilbara records and are mobile species. Impacts to species records are usually limited to individuals and are not expected to affect populations at a regional or species level and are therefore not expected to be significant.

There will be no direct impacts to Confirmed or Potential SREs historically recorded in the Development Envelope; however, there potential direct impacts to four Potential and/or Uncertain SRE species within the north-east scheme of the Indicative Footprint. All four species are known from multiple sites inside and outside the Indicative Footprint and impacts associated with the Proposal alone and the Combined Proposal are therefore not expected to be significant. Species-specific impacts are discussed in Section 9.6.8.

Additional survey work is currently in progress to understand the SRE values in the north-west scheme of the Indicative Footprint and to further inform the impact assessment (see Table 9-2; Biota 2025 *in prep*).

Clearing will not result in direct impacts to aquatic fauna given that no permanent or semi-permanent water pools are proposed for clearing.

9.6.2 Fragmentation of fauna habitats

Fragmentation of fauna habitats will occur due to additional vegetation clearing and the placement of above-ground linear infrastructure which can create a barrier to movement.; however, this would not be expected to limit movement for most fauna species given that the pipeline is relatively small (i.e. <1 m height) and close to the ground.

The Approved Proposal has previously resulted in large amounts of habitat fragmentation, particularly between the northern and eastern parts of the Jirrapur Range; however, large areas of habitat remain connected through the central section of the Development Envelope, as well around the east and western sections, and continue to provide habitat and dispersal corridors for fauna.

To reduce additional fragmentation and barriers to dispersal, BHP propose to install fauna underpasses, culverts and/or egress structures along the proposed pipeline route of the Proposal (Section 10.5.2). The fauna underpasses will allow for the retention of corridors or linkages between habitats to allow fauna to move between different habitats. Through the installation of fauna underpasses/culverts, BHP considers that this impact can be mitigated and is not anticipated to result in a significant residual impact.

Impacts to SRE species from habitat fragmentation are also not expected to be significant given the area in and around the Indicative Footprint is already highly fragmented from existing rail lines and rail access corridors. The Proposal will not fragment any highly prospective habitat features for SREs such as gorges/gullies or south facing slopes and impacts are considered to be minor.

9.6.3 Changes to fauna habitat from altered groundwater regimes

As discussed in Section 9.4.3, indirect impacts to terrestrial and/or aquatic fauna habitats associated with altered groundwater regimes have the potential to occur due to either a decline in groundwater levels (groundwater drawdown) caused by dewatering or from a rise in groundwater levels (mounding) caused by aquifer recharge.

Groundwater mounding at Northern RAV MAR

Groundwater mounding associated with the Northern RAV MAR has the potential to result in the loss or modification of up to 160.7 ha of critical and/or supporting habitats that contain *Eucalyptus xerothermica* and/or *Eucalyptus leucophloia* subsp. *leucophloia* trees present within the mounding contours (Figure 8-18). To mitigate impacts associated with inundation from rising groundwater levels, BHP has proposed to limit mounding to 10 mbgl (Section 9.5). Whilst this will prevent roots from being inundated, when reinjection and recharge at the Northern RAV MAR cease, the groundwater levels will decline which can potentially leave these trees exposed to drought-like conditions. This can cause a decline in the health or condition of these trees if they have become dependent on the water source. The *Eucalyptus xerothermica* and/or *Eucalyptus leucophloia* subsp. *leucophloia* trees present in the mounding contours are largely scattered or isolated trees in the landscape and are not a dominant feature of any of the mapped fauna habitats; however, they do form part of habitat defined as critical or supporting habitat for significant fauna and may provide suitable nesting habitat for significant species such as the Grey Falcon. As such, BHP consider that the potential impacts to approximately 160.7 ha of habitats that contain these trees within the 10-20 mbgl mounding contours could be potentially significant and as such, will require an offset (see Section 14).

As part of the mitigation hierarchy, BHP will commit to ongoing monitoring of vegetation and tree health, implemented as part of the CPWMP, as well as avoidance of mounding above the 10 mbgl limit (see Section 9.5).

Yandicoogina GDE Supplementation Scheme

Given that the Yandicoogina GDE Supplementation Scheme is intended to increase and then maintain groundwater levels at previously observed levels, mounding is not anticipated to negatively impact terrestrial fauna habitats within

Yandicoogina Gorge. Allowing the groundwater levels to rise should prevent any further decline in the permanent pools or vegetation health or condition which will allow for the continued persistence of these values within the gorge. Given that these values provide critical and/or supporting habitat for significant fauna, preventing further decline and where possible, recovering these habitats to their former levels/condition, is considered to represent a positive impact and is the overarching objective of the program. The TARP described in Section 9.5.2 provides risk-based triggers and actions to be implemented in the event that monitoring demonstrates that triggers or thresholds are being exceeded. Based on this, impacts associated with groundwater mounding at Yandicoogina Gorge are unlikely to be significant.

Groundwater drawdown

The increase in dewatering is required for implementation of the Combined Proposal rather than the Proposal alone. As such, indirect impacts to fauna habitats resulting from groundwater drawdown have been assessed as part of the Combined Proposal.

Additional impacts from the Combined Proposal to fauna habitats containing confirmed High and Moderate likelihood GDV (i.e. Major and Medium Drainage Lines) at Weeli Wolli Spring and the surrounding area of Weeli Wolli Creek (including groundwater-dependant pools or springs) are not expected to occur as the Combined Proposal drawdown at this location and vicinity is within the approved limit of 3-14 m and is not expected to be greater than previously assessed. Following mitigation, impacts to terrestrial and/or aquatic fauna habitats at Weeli Wolli Springs as a result of groundwater drawdown are not expected to be significant.

The fauna habitats containing High and Moderate likelihood GDV near Ben's Oasis (i.e. Major and Medium Drainage Lines) will be potentially impacted by the Combined Proposal from groundwater drawdown. Considering that the potential for impacts to be minimised by the presence of a regional dyke to the north (acknowledging work is still to be completed to confirm this), potential impacts to High and Moderate likelihood GDV in the vicinity of Ben's Oasis are unlikely to be significant (Section 8.6.2).

Areas of fauna habitat containing Moderate likelihood GDV occurring to the west, south and east of the Development Envelope are unlikely to be impacted by groundwater drawdown for the Combined Proposal, primarily due to pre-development groundwater levels being too deep to indicate any reliance of key GDV species on groundwater (*Eucalyptus camaldulensis* and *Eucalyptus victrix*) at those locations. Further detail is provided in Section 8.6.2).

Impacts to aquatic fauna habitats (i.e. surface water pools) are not expected to be significant given that the only ground-water dependant surface water pools occur at Weeli Wolli Springs where drawdown is within the approved limit of 3-14 m and is not expected to be greater than previously assessed. (see Sections 7.6.4.1 and 7.7.1).

Drawdown of groundwater in areas of significant ecosystems (including areas of potential GDV or riparian vegetation and surface water pools) will be managed under outcome-based and objective-based plans in the CPWRMP and will include trigger and threshold criteria to manage impacts to riparian vegetation, GDV and surface water pools. The CPWRMP will include contingency measures if vegetation is found to be declining in condition, health or composition or if surface water pool levels are found to decline, which can be attributed towards drawdown associated with the Combined Proposal. Based on the above, impacts to terrestrial and aquatic fauna values from altered groundwater regimes can be managed and are unlikely to represent as significant residual impact.

9.6.4 Changes to fauna habitat from altered surface water regimes

The Proposal has the potential to change fauna habitats by altering surface water regimes from surplus water discharge and/or from the installation of infrastructure (i.e. pipelines and/or the GCOSA diversion structure), additional to those previously assessed for the Approved Proposal. This includes additional surplus water discharge of up to 30 ML/day at both the Upper Marillana Creek and Lower Marillana Creek discharge points, as well as the installation of pipeline infrastructure and the GCOSA diversion structure.

BHP has applied limits to the proposed discharge to Upper Marillana Creek which will minimise potential impacts to fauna habitat along the wetting front. Periodic discharge to Upper Marillana Creek will occur at a maximum of 30 ML/d over a five-year operational period to reach a maximum of 8.2 GL/annum. BHP will implement a 90 consecutive day drying period in the dry season, which will assist in maintaining the drying phase of Marillana Creek and minimise impacts associated with inundation. The wetting front will be up to 27 km, with a trigger location at 24 km to ensure that the wetting front does not reach Flat Rocks or the Marillana Creek Pools. All water monitoring and management commitments are described in the updated CPWRMP (Appendix 8).

Discharge to Lower Marillana Creek will occur at the existing discharge location in use at the Yandi mine which has shown no significant negative impacts on riparian vegetation health on BHP tenure associated with surplus water discharge since its establishment in 2009 (see Section 8.4.3). However, there is anecdotal evidence that riparian vegetation downstream and off BHP tenure, has declined in health and composition since discharge volumes and the wetting front have decreased. In addition, a recent fire at the Yandi mine resulted in a total of 23 tree deaths recorded in the 2023-2024 monitoring period including GDV/riparian vegetation species such as *Eucalyptus camaldulensis*, *Eucalyptus victrix* and *Melaleuca argentea* (see Section 8.6.3). The Proposal is not anticipated to result in any further decline of riparian vegetation (and the associated fauna habitats) from discharge for the Proposal, and may assist in restoring GDV/riparian vegetation (and the associated fauna habitats) health downstream due to increasing the wetting front from 2.5 km back up to 9 km. The potential for future decline in health of riparian vegetation following cessation of discharge for the Yandi mine is addressed in the Yandi mine Closure Plan (BHP 2024c) and includes potential opportunities to support riparian vegetation (and the associated fauna habitats) downstream of the discharge location. This is currently being explored with Traditional Owners, and if feasible, will be incorporated into future updates to the Yandi mine Closure Plan (BHP 2024c).

Impacts associated with placement of the GCOSA diversion structure will be localised and occur in an area that is already cleared or approved for clearing. At a regional scale, the associated percentage reduction to regional catchments (i.e. less than 1%) is not considered significant.

Potential impacts to fauna associated with the construction of the pipelines will be temporary and localised. The pipelines will be installed in areas where existing tracks and rail lines exist. The pipelines will be buried at creek crossings and areas of sheet flow to minimise impacts to surface water flows. Overall, impacts to terrestrial fauna habitats associated with altered surface water regimes as a result of pipeline installation are not expected to be significant.

The combined effect of the Combined Proposal is no different to that assessed for the Proposal above due to the discharge locations being in different catchments to the existing approved discharge locations (see Section 9.4.4).

Overall, based on the proposed management and mitigation described above and in Section 9.5, BHP considers there are unlikely to be any significant residual impacts to terrestrial fauna from changes to surface water regimes as a result of the Proposal alone or Combined Proposal.

9.6.5 Mortality or injury from vehicle strike or interactions with machinery

The Proposal will result in an increase in vehicle and machinery activity and movement, which may subsequently result in an increase in the risk of interactions with fauna, resulting in injury or death. However, existing roads, tracks and rail lines are already present throughout the Indicative Footprint. Therefore, any potential impacts on fauna are expected to be minimal. Whilst some individuals may be injured or killed due to the temporary increase in traffic and vehicle/machinery activity, given the low number of significant fauna individuals that occur within the Indicative Footprint, any impacts would be highly localised and unlikely to affect any species at a regional level. For slow-moving species that may be more susceptible to vehicle strike such as the Pilbara Olive Python, impacts would be limited to individuals and unlikely to significantly impact the species at a regional or species level. Management measures will be implemented to reduce the risk to significant fauna species, including restricting construction activities to daylight hours and imposing appropriate speed limits on all access tracks, roads and construction areas to minimise interactions with fauna that would result in injury or mortality.

The majority of the Development Envelope consists of operational areas, or occurs adjacent to existing roads, tracks and rail lines, and therefore any increase in vehicle activity or movement as result of the Combined Proposal is expected to be minimal.

The use of barbed wire fencing can result in entanglement and subsequent injury or mortality, particularly for Ghost Bats which are low flying; however, barbed wire fencing will not be used for the Proposal. When considering the Combined Proposal, barbed wire fencing is limited to areas required to comply with safety guidelines such as for use in explosive storage. The impacts associated with interactions from infrastructure are therefore considered minor.

Overall, the potential impacts on significant fauna due to increased risk of vehicle strike or from interactions with machinery or infrastructure as a result of either the Proposal alone or the Combined Proposal are unlikely to be significant.

9.6.6 Habitat degradation or species disturbance due to increased dust, noise, vibration or light

The Proposal has the potential to result in an increase in dust, noise, vibration and/or light associated with construction activities. Given that the majority of significant fauna species are only present at low densities and Proposal activities will take place within operational areas or areas with existing rail, roads and tracks, any impacts associated with species disturbance are expected to be minimal and unlikely to be significant. Impacts associated with species disturbance are most likely to be greatest for the Ghost Bat, which utilises the Development Envelope for foraging, breeding and roosting.

As described in Section 9.4.6, there are 12 caves located within the 450 m blast management zone of the Proposal, of which five caves occur within the 150 m Trigger buffer zone. Ghost Bats utilising these caves may be more susceptible to an increase in dust, noise, vibration or light as a result of Proposal activities. Standard management practices will apply to all caves within the 150 m Trigger buffer zone, to minimise disturbance to potentially suitable Ghost Bat caves (Section 9.5.2). Given that no blasting is required for the Proposal, no additional management is required for caves outside the 150 m Trigger area, but within the 450 m blast management zone.

High dust levels have the potential to affect foraging Ghost Bats through irritating the eyes, reducing visual acuity and reducing the effectiveness of ultrasonic calls, thereby affecting their ability to capture prey; however, BHP will continue to implement existing dust suppression strategies, to minimise any potential impacts associated with an increase in dust levels.

Ghost Bats are expected to be able to tolerate vibrations of up to 15 mm/s (R. Bullen *pers. comm*). Bullen and Creese (2014) suggested that sound levels up to 70 dB are unlikely to result in Ghost Bats leaving their roost. Noise modelling undertaken for the MAC-SF mining operations determined noise levels associated with mining activities were predicted to be below 70 dB at cave entrances (BHP 2017b). HDD, excavation activities and heavy vehicle movements associated with the Proposal would not be expected to exceed noise levels associated with mining and are therefore likely to be within these limits. As there is no blasting planned as a component of the Proposal, indirect impacts associated with noise and vibration are expected to be minor and do not require additional management.

Excessive light can potentially affect the natural foraging behaviour of Ghost Bats; however, construction will mostly be undertaken during the day, and so disturbance to roosting Ghost bats would be expected to be low.

Given that there will be no indirect impacts to the Ghost Bat caves managed under MS1072, impacts associated with the Combined Proposal are no different to those described above for the Proposal alone.

Following mitigation, it is anticipated that any impacts associated with increased dust, noise, vibration or light can be managed and are unlikely to be significant.

9.6.7 Disturbances to fauna from invasive or introduced species

As described in Section 9.4.7, there are four introduced fauna species currently known within the Development Envelope (feral cats, dogs, cattle and rabbits) and a further two introduced fauna species known from outside the Development Envelope (i.e. Cane toad and Redclaw Crayfish) which could potentially be introduced or spread by Proposal activities.

Vegetation clearing and pipeline construction activities associated with the Proposal have the potential to increase feral predators such as feral cats and dogs, or increase introduced grazers such as cattle and rabbits; however, given that the Proposal has been designed to utilise existing roads, rail lines and tracks, this is considered unlikely to occur. Management measures such as a feral cat management program will be implemented if feral cat sightings are found to increase.

Whilst the Cane Toad is not yet present within the Pilbara region, it is predicted to spread into the region in coming years (Biologic 2024a). The Cane Toad is considered a key threatening process to the Northern Quoll, and is also a significant threat to the Ghost Bat and Pilbara Olive Python, all of which can predate on cane toads and are susceptible to their toxicity. Whilst no methods are currently available to stop cane toads from spreading, BHP staff and contractors will remain vigilant and should any Cane Toads be identified within the Development Envelope or encountered during Proposal activities, they will be reported to DBCA and humanely euthanised in accordance with the DBCA Cane Toad Program (DBCA 2024).

Surface water discharge required for the Proposal has the potential to spread the invasive Redclaw Crayfish. This species is native to tropical Queensland and the Northern Territory within Australia, and south-eastern Papua New Guinea. It has been translocated broadly, and within Western Australia is known from the Ord River system in the Kimberley, and the Harding Dam in the Pilbara, the Fortescue River in Karijini National Park, George River within Millstream-Chichester National Park, and Weelamurra Creek, a tributary of the lower Fortescue River. The species was recently recorded at Weeli Wolli Springs in 2020 (Biologic 2023h).

The Proposal is located within and adjacent to existing operational areas, rail lines and access roads and would therefore not be expected to result in a significant increase in invasive or introduced species. Whilst placement of linear infrastructure can enhance the ability of feral predators to move through the landscape, given that the linear infrastructure has been designed to follow existing tracks and rail lines, this is unlikely to increase.

Surface water discharge has the potential to introduce or spread invasive species such as the Redclaw Crayfish; however, areas of environmental significance will continue to be monitored in accordance with the CRWRMP and appropriate management measures implemented if appropriate (see Section 10.5).

Neither the Proposal alone or the Combined Proposal would be expected to result in the introduction or spread of invasive or introduced species that would have a significant impact on terrestrial fauna given the level of existing disturbance within the Development Envelope and proposed management measures such as feral animal control (if required), hygiene management, and weed control measures described in Section 9.5.2.

9.6.8 Species-specific impacts

The potential impacts to significant vertebrate, SRE and aquatic fauna species recorded within the Development Envelope or from areas potentially subject to impacts, are described below. Significant residual impacts to the Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Northern Quoll and Grey Falcon are anticipated due to the loss of critical and/or supporting habitat from vegetation clearing and/or groundwater mounding and will require offsets (Section 14).

Ghost Bat

The Ghost Bat is known from 289 records within the Development Envelope; however, there are no records of the species within the Indicative Footprint and therefore no direct impact to species' records as a result of the Proposal. As described in Section 9.4.1.2, there are no potential or confirmed Ghost Bat caves within the Indicative Footprint and therefore no direct impacts to caves will occur as a result of clearing for the Proposal; however, there are 12 regional caves located within 450 m of the Indicative Footprint, including six Category 3 and six Category 4 caves. These caves do not represent critical roosting habitat and will not be subject to direct impacts. Potential indirect impacts to these caves associated with increased dust, noise and vibration can be managed using standard practices to ensure that any indirect impacts associated with the Proposal are minor (see Section 9.4.1.2).

The Proposal will result in clearing up to 808 ha of critical foraging and dispersal habitat for the Ghost Bat. Clearing of critical habitat represents a significant residual impact that will require an offset (see Section 14). In addition, an estimated 160.7 ha of critical habitat for the Ghosts Bat will potentially be degraded or lost as a result of indirect impacts associated with groundwater mounding and is also proposed to be offset (see Section 14).

Northern Quoll

The Northern Quoll has been recorded within the Development Envelope seven times. The low number of records despite extensive targeted survey effort demonstrates that there is unlikely to be a resident population present within the Development Envelope, with the seven records likely representing dispersing/foraging individuals. There will be additional direct impacts to three species' records based on the Indicative Footprint; however, given that the species is mobile, no individuals will be impacted.

Clearing will result in the loss of up to 27.3 ha of critical foraging and dispersal habitat (Gorge/Gully, Breakaway/Cliff and Major Drainage Line) and up to 40 ha of supporting habitat (Wetland and Minor Drainage Line) for the species. Clearing of critical and supporting habitat represents a significant residual impact to the Northern Quoll that will require an offset (see Section 14). In addition, an estimated 35.8 ha of supporting habitat for the Northern Quoll will potentially be degraded or lost as a result of indirect impacts associated with groundwater mounding and is also proposed to be offset (see Section 14).

Pilbara Leaf-nosed Bat

There are seven records of the Pilbara Leaf-nosed Bat within the Development Envelope, none of which occur within the Indicative Footprint. As such, there are no additional direct impacts to species records. Whilst there is no critical habitat for the species present within the proposed Development Envelope, the Proposal will result in clearing of up to 1,044 ha of supporting habitat for the species (Major and Minor Drainage Line, Breakaway/Cliff, Gorge/Gully, Hillcrest/Hillslope, and Drainage Area/Floodplain). This represents a significant residual impact to the Pilbara Leaf-nosed Bat that will require an offset (see Section 14). In addition, an estimated 160.7 ha of supporting habitat for the Pilbara Leaf-nosed Bat will potentially be degraded or lost as a result of indirect impacts associated with groundwater mounding and is also proposed to be offset (see Section 14).

Pilbara Olive Python

The Pilbara Olive Python has been recorded eight times within the Development Envelope including one record within the Indicative Footprint. The Proposal will result in clearing up to 28.3 ha of critical foraging and dispersal habitat (Wetland, Major Drainage Line, Gorge/Gully and Breakaway/Cliff) and 39 ha of supporting habitat (Minor Drainage Line) for the Pilbara Olive Python. Clearing of critical and supporting habitat represents a significant residual impact to the Pilbara Olive Python that will require an offset (see Section 14). In addition, an estimated 35.8 ha of critical habitat for the Pilbara Olive Python will potentially be degraded or lost as a result of indirect impacts associated with groundwater mounding and is also proposed to be offset (see Section 14).

Grey Falcon

The Grey Falcon has been recorded three times within the Development Envelope, but not within the Indicative Footprint. The Proposal will result in clearing approximately 10.14 ha of critical habitat (Major Drainage Line and Drainage Area/Floodplain) and 395 ha of supporting habitat (Medium Drainage Line habitat) for the Grey Falcon. Clearing and loss of critical and supporting habitat is anticipated to represent a significant residual impact to the Grey Falcon that will require an offset (see Section 14). In addition, an estimated 66.3 ha of critical and/or supporting habitat for the Grey Falcon will potentially be degraded or lost as a result of indirect impacts associated with groundwater mounding and is also proposed to be offset (see Section 14).

Fork-tailed Swift

The Fork-tailed Swift has been recorded five times within the proposed Development Envelope but not within the Indicative Footprint. Given that the species is exclusively forages in the air and does not breed in Australia, it is considered that there will be no significant residual impact to this species from either the Proposal alone or the Combined Proposal.

Gane's Blind Snake

There are five records of the Gane's blind snake within the proposed Development Envelope, none of which occur within the Indicative Footprint. The Combined Proposal will not result in any additional impacts to species records.

Based on the Indicative Footprint, up to 371.5 ha of suitable habitat for this species (Gorge/Gully and Drainage Area/Floodplain) will be cleared. In addition, an additional 30.1 ha of Drainage Area/Floodplain habitat will potentially be lost or degraded from impacts associated with mounding at the Northern RAV MAR scheme. A further 1,997 ha of suitable habitat will remain throughout the proposed Development Envelope, with these habitat types extending beyond the boundaries proposed for impact. Impacts to the Gane's Blind Snake arising from implementation of the Proposal or Combined Proposal are considered to be minor and unlikely to be significant.

Pilbara Barking Gecko

The Combined Proposal will not impact any records of this species. Based on the Indicative Footprint, up to 14.96 ha of suitable habitat for this species (Gorge/Gully habitat) will be cleared. This represents 1.9% of Gorge/Gully habitat that will remain throughout the proposed Development Envelope. Impacts to the Pilbara barking gecko arising from implementation of the Proposal are considered to be minor and unlikely to be significant.

Western Pebble-mound Mouse

There are approximately 158 records of the Western Pebble-mound Mouse in the proposed Development Envelope, of which 17 additional records will be impacted by the Proposal. This includes eight active mounds and nine inactive mounds and represents 0.5% of known records in the Pilbara. When considering the Combined Proposal, a total of 2% of records will be cleared. The Proposal will also result in clearing 621.5 ha of Stony Plain and/or Hillcrest/Hillslope habitat, which are the preferred habitat types for the species. However, a further 10,082 ha of preferred habitat will remain within the Development Envelope, with both habitat types extending beyond the boundaries of the Development Envelope. There are numerous regional records of this species outside the Development Envelope (including records from within conservation reserves), with over 3,600 records of this species known from the Pilbara region (**Table 9-8**). Overall, impacts to the Western Pebble-mound Mouse are not expected to be significant at a local or regional scale, particularly when considering the extensive occurrence of this species' preferred habitat remaining in the Development Envelope and in the wider region.

Peregrine Falcon

The Combined Proposal will not result in any additional impacts to species' records. Based on the Indicative Footprint, the Proposal will result in the direct removal of approximately 10.14 ha of suitable habitat within the Major Drainage Line habitat; however, this is not considered to represent a significant residual impact for this species given it is

capable of utilising a wide variety of habitats throughout the wider region. Given the species high mobility, indirect impacts are also unlikely to be significant for the Peregrine Falcon.

SRE invertebrate fauna

The Proposal will not result in additional impacts to Confirmed and Potential SREs previously assessed as part of the Approved Proposal.

The Combined Proposal will result in direct impacts to additional SRE taxa recorded within the Indicative Footprint, including one Potential SRE (*Karaops* sp. indet) and three Uncertain SRE species: *Beierolpium* 8/3 `BPS527`, *Buddelundia* `BIS520` and *Scolopendra* sp. indet. All four species are known from multiple sites inside and outside the Indicative Footprint and were recorded in different habitat types, indicating they are not restricted. *Buddelundia* `BIS520` is also known from BHP's Yandi mining area, whilst *Beierolpium* 8/3 `BPS527` is a new species only known from the Ministers North tenement, but which has a linear range of at least 7.2 km. Members of this genus also tend not to be SRE. Given that all four taxa are known from areas outside those to be impacted and occur in habitats that are widespread, impacts to all four species are unlikely to be significant.

Additional survey work is currently being undertaken to further understand SRE invertebrate fauna values within the north-west scheme of the Indicative Footprint. However, given that the Proposal has been designed to avoid areas of high value SRE habitat or habitat features such as gorges/gullies and south facing slopes, impacts to SREs as a result of the Combined Proposal are considered unlikely to be significant.

Aquatic fauna

The Proposal and the Combined Proposal will potentially result in impacts to aquatic fauna located within areas that will be subject to groundwater drawdown and/or groundwater mounding.

Development Envelope

Whilst a diverse aquatic fauna assemblage has been recorded within the artificial water feature associated with the Yandi discharge point (WYAN-10) within the Development Envelope, none are considered to be locally restricted and none are listed as threatened under state or national legislation (WRM 2015, 2018). Impacts to aquatic fauna within the Development Envelope are therefore not expected to be significant.

Coondewanna Flats

The aquatic invertebrate fauna assemblage inhabiting Lake Robinson at Coondewanna Flats are widely distributed and capable of easy dispersal. Of the 55 invertebrate taxa that have been recorded from Lake Robinson, 65% are permanent residents capable of surviving drought periods, whilst the remaining taxa (35%) are temporary residents which are not dependant on the surface water features periodically present at the flats. There are no restricted species or species listed under the EPBC Act or BC Act present (WRM 2013b). Impacts to aquatic fauna at Coondewanna Flats are therefore not expected to be significant.

Weeli Wolli Springs and Ben's Oasis

Six potentially restricted SRE or stygal species have been recorded at Weeli Wolli Creek and occur within the groundwater drawdown contours of the Combined Proposal (see Section 9.3.2.6). Of these, two species are currently only known from the drawdown contours: the amphipod Paramelitidae `sp. Biologic-AMPH024` and the water mite *Wandesia* `sp. Biologic-ACAR009. Whilst both species are only known from sites located within the drawdown contours, they occur within the drawdown limits of the Approved Proposal (i.e. 3-14 m). They will not be subject to additional impacts associated with the Combined Proposal until post closure of RTIO Hope Downs when an additional 11-14 m of drawdown could occur. BHP propose to take over mitigation of Weeli Wolli Springs once RTIO Hope Downs operations moves into closure, with the objective of no additional drawdown. Prior to this event, BHP will take over mitigation of Weeli Wolli Springs to ensure that groundwater levels at the spring are maintained in accordance

with the CPWRMP (see Sections 7.6 and 10.5; Appendix 8). As such, impacts to aquatic fauna at Weeli Wolli Springs as a result of the Combined Proposal are unlikely to be significant.

Impacts to the four species listed on the ICUN Redlist are not expected to be significant given that all four species are known from sites outside the impacts areas of the Combined Proposal.

Yandicoogina Gorge

There will be no negative impacts to aquatic fauna at Yandicoogina Gorge, given that this area occurs outside the drawdown contours of the Combined Proposal.

The Yandicoogina Gorge Supplementation Program aims to re-establish groundwater levels to those observed pre-2018 and will assist in maintaining aquatic fauna habitats throughout the gorge. Mounding will occur as part of the program, but will be monitored to ensure it doesn't inundate subterranean habitats that are above the historical water table. Whilst three potentially restricted troglofauna taxa were recorded from the hyporheic zone at three pools within the gorge, these locations are not inundated as often as some of the other sites within the gorge and therefore likely provide suitable troglofauna habitat on a temporary basis. Impacts to aquatic fauna at Yandicoogina Gorge associated with the Combined Proposal are therefore unlikely to be significant.

Marillana Creek Pools

Three potentially restricted aquatic fauna and two species listed on the International Union for Conservation of Nature (IUCN) Redlist have been recorded at the Marillana Creek Pools. The potentially restricted aquatic fauna at Marillana Creek Pools were recorded from sites MarC4 and MarC2. These pools occur beyond the trigger and threshold zones identified in the CPWRMP. As such, the potentially restricted aquatic fauna of Marillana Creek Pools is unlikely to be impacted by the Proposal alone or the Combined Proposal.

9.6.9 Significant residual impacts

Following the application of the mitigation hierarchy (Section 9.5) and the Residual Impact Significance Model in the WA Offsets Guidelines (Government of WA 2014), BHP considers that there will be significant residual impacts to Terrestrial Fauna associated with clearing critical and supporting habitat for significant fauna in the Pilbara bioregion. See Section 9.7 for the discussion on the outcomes relating to the identified residual impacts and BHP's proposed assurance (regulation) and monitoring, where required.

9.7 Environmental outcomes

Table 9-10 identifies the proposed environmental outcomes. This includes how the proposed environmental outcomes are consistent with the EPA's objective for Terrestrial Fauna and whether (and if so how) a proposed environmental outcome can be assured by a limit on the extent of a proposal element/s and/or other condition, or another statutory decision-making process which can mitigate the specific potential impacts of the proposal on Terrestrial Fauna.

As required by the EPA's ERD Instructions, for Significant Amendments, BHP has included information about the existing implementation conditions for the Approved Proposal (Appendix 2). BHP considers that the EPA should inquire into the Approved Proposal implementation conditions (relating to Terrestrial Fauna), as provided for under s40AA(3), as part of the assessment of the Proposal under s40 and in the EPA's assessment report required under s44, for the following reasons:

- BHP has identified potential impacts to new values that are not controlled by the Ministerial Statements for the Approved Proposal

- to contemporise the conditions to reflect the contemporary condition setting approach (in recommended conditions in EPA Reports and MS since early 2023).

Table 9-10: Terrestrial Fauna - environmental outcomes and proposed assurance and monitoring

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
1. Clearing up to 810 ha of critical foraging and dispersal habitat for significant fauna: • Ghost Bat • Northern Quoll • Pilbara Olive Python • Grey Falcon.	Clearing of critical foraging and dispersal habitat for significant fauna in the Pilbara bioregion. No disturbance to critical foraging and dispersal habitat for significant fauna outside the Development Envelope as a result of the Proposal.	Condition A1-1: The proponent must ensure that the proposal is implemented in such a manner that the following limitation or maximum extents / capacities / ranges are not exceeded including: • Clearing of no more than 1,076 hectares of vegetation for this Proposal • Clearing of no more than 22,900 hectares of vegetation for the Combined Proposal	Standard management practices: • internal land disturbance approval process to manage ground disturbance • annual land disturbance reporting against approved limits/extents. Condition B2-1 The proponent must implement the proposal to achieve the following environmental outcomes:	The potential significant residual impact of the proposed clearing to critical habitat for the Pilbara Olive Python, Ghost Bat and Grey Falcon can be counterbalanced by offsets via contribution to PEOF, so that the environmental outcome is consistent with EPA's objective (Section 9.1).
2. Clearing up to 1,045 ha of supporting habitat for significant fauna: • Northern Quoll • Pilbara Olive Python • Pilbara Leaf-nosed Bat • Grey Falcon.	Clearing of supporting habitat for significant fauna in the Pilbara bioregion. No disturbance to supporting habitat for significant fauna outside the Development Envelope as a result of the Proposal.	Condition B2-1 The proponent must implement the proposal to achieve the following environmental outcomes: (1) maintain the long-term viability of the Ghost Bat population in the Development Envelope as defined in Figure 1 of Schedule 1. (2) no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1	(1) maintain the long-term viability of the Ghost Bat population in the Development Envelope as defined in Figure 1 of Schedule 1. (2) no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1	The potential significant residual impact of the proposed clearing of supporting habitat for the Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Grey Falcon can be counterbalanced by offsets via contribution to PEOF, so that the environmental outcome is consistent with EPA's objective (Section 9.1).
3. Potential degradation and/or loss of up to 160.7 ha of Eucalypt trees that provide critical or supporting fauna habitat within the groundwater mounding contours of the Northern RAV MAR scheme	No loss or degradation of critical and/or supporting habitat outside the predicted groundwater mounding contours of the Proposal.	Condition B6: Offsets: • Offsets via contribution to PEOF.	Condition B6: Offsets:	The potential significant residual impact to critical or supporting habitat from groundwater mounding can be counterbalanced by offsets via contribution to PEOF, so that the environmental outcome is consistent with EPA's objective (Section 9.1).

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
4. Potential indirect impacts to Ghost Bat caves located within 450 m of the Indicative Footprint as a result of increased dust, light, noise and vibration	No loss or degradation of Ghost Bat caves either within the Development Envelope or within 450 m of the Development Envelope as a result of the Proposal. The availability of caves and connecting habitat will be maintained within the Development Envelope.	Condition B5: Decommissioning and Rehabilitation Implement the MCP (BHP 2024f)	- Impact Reconciliation Procedure and Impact Reconciliation Report. Condition B5: Decommissioning and Rehabilitation - Implement the MCP (BHP 2024f)	The biological diversity and ecological integrity of significant fauna values will be maintained, which is consistent with the EPA's objective for Terrestrial Fauna (Section 9.1).
5. Clearing significant fauna records including: - Northern Quoll - four records (0.05% of known records in Pilbara) - Pilbara Olive Python - two records (0.4% of known records in Pilbara) - Western Pebble-mound Mouse – 17 records (0.5% of known records in Pilbara)	The viability of significant fauna populations known from the Development Envelope will be maintained.			
6. Clearing records of four Potential / Uncertain SRE species	The viability of the SRE fauna assemblage known from within the Development Envelope will be maintained.			

¹ see the Proposal Content Document (Appendix 1) and the proposed implementation conditions (Appendix 6) for the regulation for the Combined Proposal.

10 Subterranean Fauna

10.1 EPA environmental factor and objective

The EPA's objective for the Subterranean Fauna factor is:

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

10.2 Relevant policy and guidance

BHP assessed this environmental factor consistent with the following relevant EPA policies and guidance, as outlined in Table 10-1.

Table 10-1: Subterranean Fauna - policy and guidance

EPA policy and guidance	Consideration of EPA policy and guidance
<i>Statement of environmental principles, factors, objectives and aims of EIA (EPA 2023c)</i>	- Identified the relevant environmental factor and objectives to guide the EIA process - Followed the aims of the EIA process - Considered cumulative effects when assessing potential impacts on subterranean fauna - Applied the mitigation hierarchy for subterranean fauna.
<i>Environmental Factor Guideline - Subterranean Fauna factor (EPA 2016b)</i>	- Identified the EPA's objective for subterranean fauna - Applied the relevant considerations for environmental impact assessment - Identified the values of subterranean fauna, and their significance - Identified activities that can impact on subterranean fauna - Considered the links with other environmental factors.
<i>Technical guidance – Subterranean fauna surveys for environmental impact assessment (EPA 2021c)</i>	Surveys described in Table 10-2 were undertaken in accordance with the guidance.

10.3 Receiving environment

Impacts to subterranean fauna are related to the areas of groundwater drawdown and/or groundwater mounding associated with the Combined Proposal, additional to those previously assessed and approved under the Approved Proposal (Figure 10-1 and Figure 10-2). These areas extend beyond the boundaries of the Development Envelope and/or Indicative Footprint (Figure 10-1 and Figure 10-2). As such, subterranean fauna are discussed in terms of either the groundwater drawdown contours, the groundwater mounding contours or both (i.e. groundwater impact areas), with impacts outside these areas also being considered where relevant.

10.3.1 Studies and surveys

At least 17 subterranean fauna surveys have historically been undertaken within the groundwater impact areas of the Combined Proposal (Appendix 17). This includes subterranean fauna surveys undertaken across the MAC-SF Development Envelope, groundwater drawdown areas used in the assessment of the Approved Proposal, and

throughout the Coondewanna Flats and Weeli Wolli Creek sub-catchments between 2007 and 2016 (Figure 10-1; Figure 10-2; Bennelongia 2025, 2018, 2016b; BHP 2017b; Appendix 17). Since 2016, a further four studies have been undertaken (Table 10-2). These surveys intersect the groundwater drawdown contours of the Combined Proposal or provide regional information that has been used to support the assessment of Subterranean Fauna for the Proposal. Table 10-2 summarises the recent studies undertaken by BHP since 2016 whilst historical pre-2016 surveys are summarised in Appendix 17.

All historical and recent subterranean fauna surveys have been completed in accordance with the EPA requirements relevant at the time of surveying. BHP has provided the most relevant survey reports in Appendix 18 and the survey data (for any survey data not previously provided) as part of the IBSA data package (see Appendix 19).

In addition, BHP has commenced a number of drilling programs to facilitate further subterranean fauna investigations and future studies (Figure 10-1 and Figure 10-2). The future studies will assist in determining impacts from the predicted groundwater mounding of the Northern RAV MAR, and investigate species distributions and extent of suitable habitat to the west and south of the predicted groundwater drawdown contours. Additional and ongoing subterranean fauna sampling work is planned to commence mid-2025 and throughout 2026 with final results expected 2027. Indicative sampling sites and proposed drill hole locations for the additional subterranean fauna sampling work are shown on Figure 10-1 and Figure 10-2. Within the predicted groundwater mounding contours there are an additional 17 drill holes for stygofauna and 33 drill holes for troglofauna proposed, whereas outside the groundwater mounding impact area there are an additional 26 drill holes for troglofauna and two drill holes for stygofauna (noting that stygofauna survey effort within areas outside the mounding impact areas is already adequate) proposed (Figure 10-1 and Figure 10-2).

Sampling effort for troglofauna to date includes at least 3,884 samples taken from 1,244 sample sites within the groundwater impact area (Table 10-3; Figure 10-1; BHP 2017b). Future surveys will include an additional 33 sample sites within the mounding contours, and an additional 26 sample sites outside the mounding contours (Figure 10-1).

Sampling effort for stygofauna to date includes at least 1,214 samples⁴ collected from 486 sample sites within the groundwater impact area (Table 10-3; Figure 10-2). This includes 460 sample sites located within the groundwater drawdown contours and 26 sample sites located within the groundwater mounding contours (Table 10-3; Table 10-4; Figure 10-2). A further 321 samples from 137 sample sites have been collected from regional areas, within 5 km of the drawdown area (Table 10-3; Table 10-4; Figure 10-2). This includes sample sites from the Coondewanna Flats, Weeli Wolli Springs and Ben's Oasis PEC and buffer areas, as well as samples from the Development Envelope (Table 10-4; Figure 10-2; Biologic 2025b; Bennelongia 2016b, 2018; BHP 2017b). Future surveys will include an additional 20 stygofauna sample sites within the groundwater mounding contours (Figure 10-2), as well as additional sampling sites throughout the west, south and south-west of the drawdown contours (currently in progress).

Table 10-2: Subterranean Fauna – recent studies and surveys

Title	Survey Date	Summary	Appendix
East Packsaddle Subterranean Fauna Baseline Survey Report (Biologic 2025b)	2021-2024	A detailed three phase survey that sampled a total of 130 sites for troglofauna and 50 sites for stygofauna. The purpose of this survey was to increase knowledge of the subterranean fauna values present within and surrounding the Development Envelope	Appendix 18

⁴ One sample = 6 net hauls for stygofauna

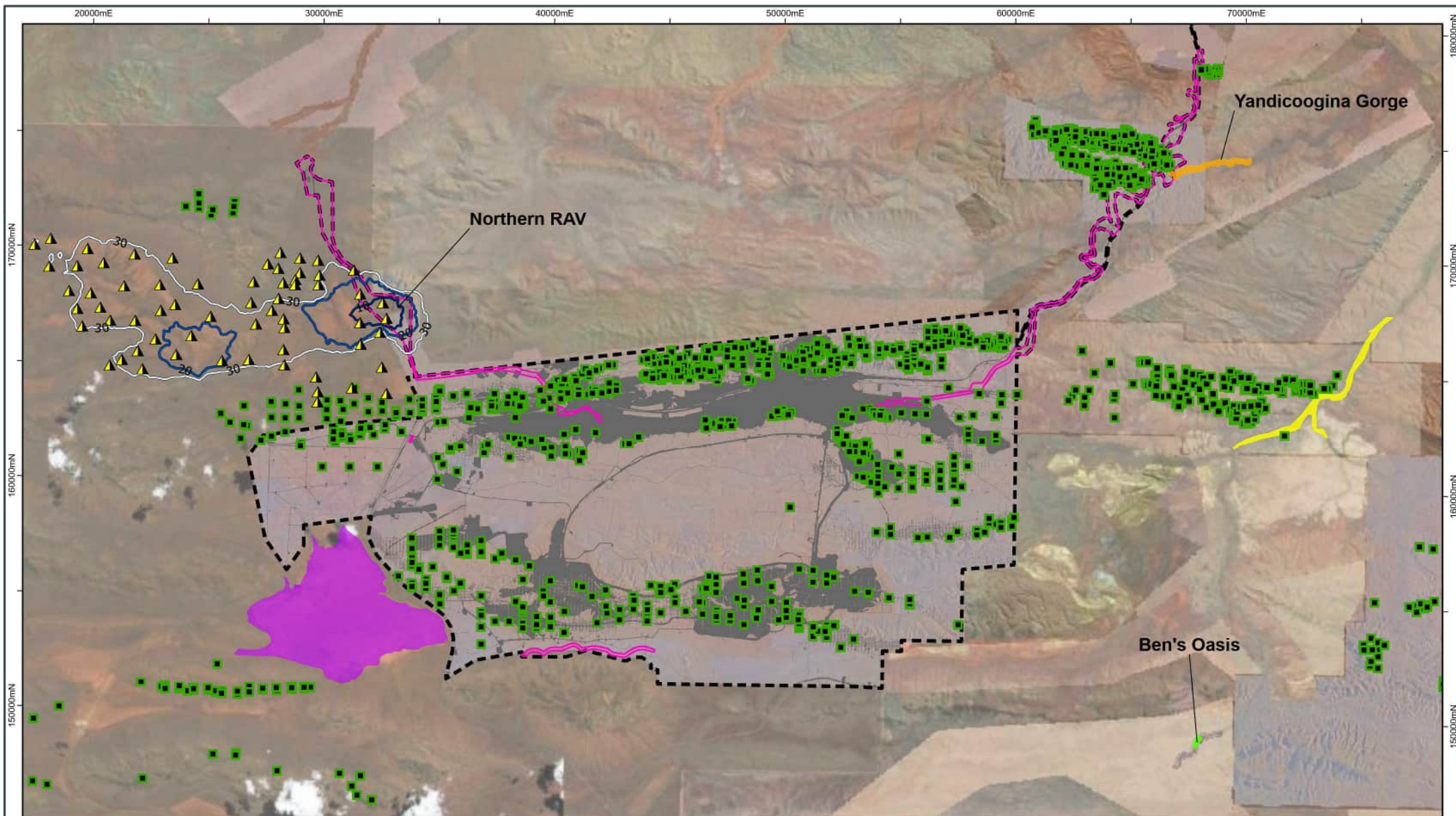
Title	Survey Date	Summary	Appendix
		to inform and support future environmental approvals.	
Northern RAV subterranean fauna assessment (Bennelongia 2025 <i>in prep</i>)	Three phases undertaken throughout 2024	A total of 52 stygofauna and 35 troglofauna sites were sampled. Methods used include troglofauna scrapes and traps and stygofauna net hauls.	Not attached – will be provided at a later date
South Flank MAR subterranean fauna desktop assessment (Bennelongia 2018)	2018	A desktop study presenting available biological, geological and hydrogeological information and providing a preliminary assessment of potential conservation issues surrounding subterranean fauna species in relation to managed aquifer recharge (MAR) at South Flank.	Appendix 18
Mining Area C Southern Flank: Stygofauna Assessment (Bennelongia 2016b)	2016	Desktop assessment to identify stygofauna species present within the Groundwater Assessment Area of the Approved Proposal, and assess the potential impacts on stygofauna from implementation of the MAC-SF Proposal.	Appendix 18

Table 10-3: Summary of subterranean fauna sampling effort

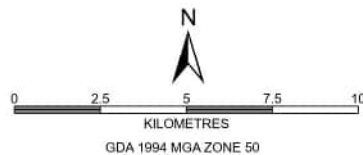
Area	Stygofauna sampling effort		Troglofauna sampling effort	
	Number of samples	Number of sample sites	Number of samples	Number of sample sites
Combined Proposal drawdown contours	1,128	460	3,884	1,244
Mounding contours (total number)	86	26	0	0
- 10 mbgl contours	0	0	0	0
- 20 mbgl contours	26	9	0	0
- 30 mbgl contours	60	15	0	0
Regional sites within 5 km of drawdown area	321	137	397	149
Total	1,621	647	4,281	1,393

Table 10-4: Breakdown of stygofauna sampling effort within the groundwater drawdown area

Area	Number of stygofauna samples	Number of stygofauna sample sites
Coondewanna Flats PEC and buffer	196	83
Weeli Wolli Springs PEC and buffer	264	76
Ben's Oasis and buffer	28	10
West and south-west of Coondewanna Flats buffer	26	20
Development Envelope	556	260
Other areas within the drawdown contours	58	11
Total	1,128	460



- Indicative Footprint
 - Development Envelope
 - Existing Disturbance
 - Weeli Wolli Spring
 - Coondewanna Flats
 - Ben's Oasis
 - Yandicoogina Gorge
 - Indicative Future Troglofauna Sampling Sites (TBC)
 - Troglofauna Sample Site
- Groundwater Mounding Contours**
- 10 mbgl
 - 20 mbgl
 - 30 mbgl



MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

TROGLOFAUNA SAMPLING EFFORT AND

GROUNDWATER MOUNDING CONTOURS

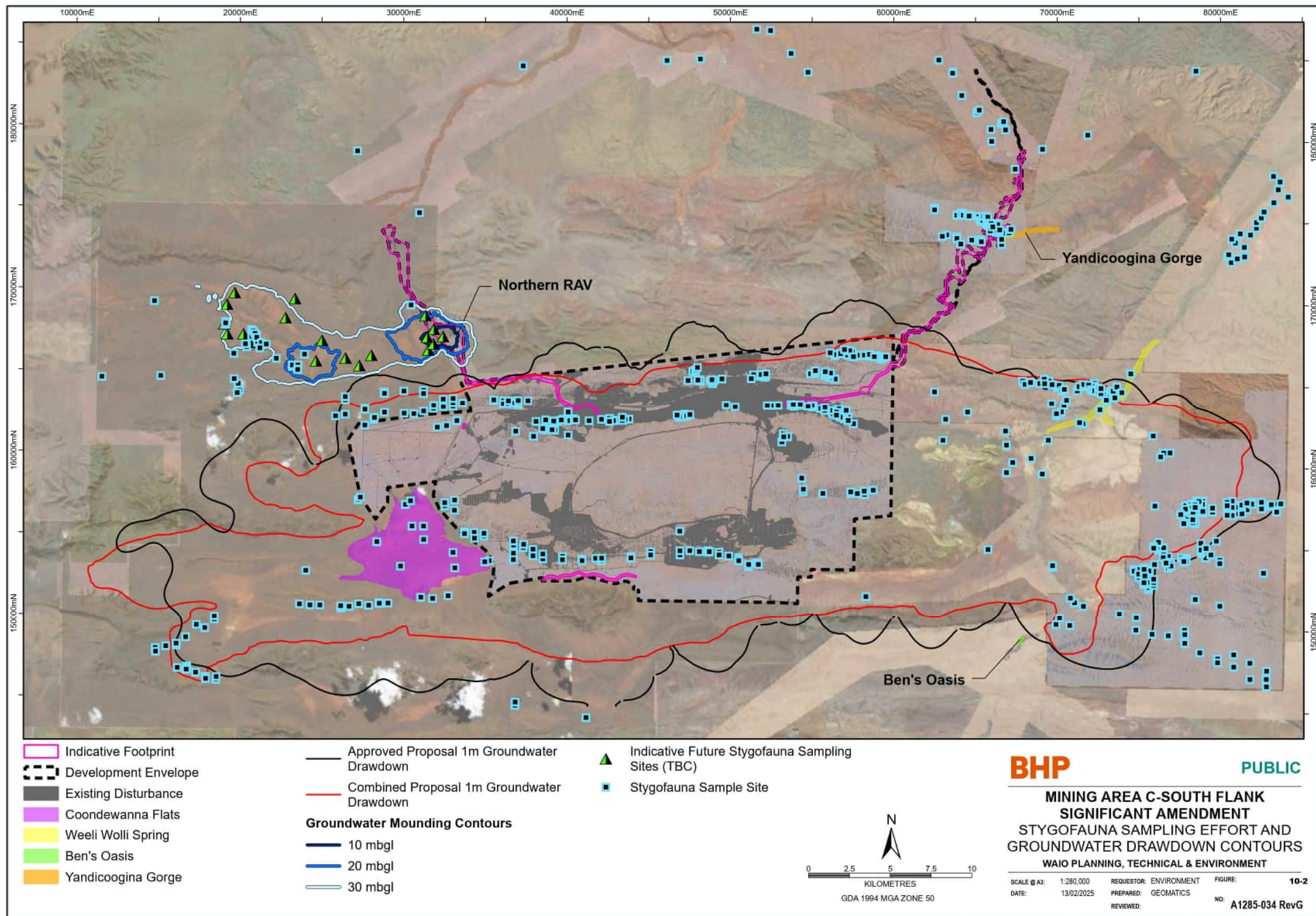
WAIO PLANNING, TECHNICAL & ENVIRONMENT

PUBLIC

SCALE @ A3: 1:220,000 **REQUESTOR:** ENVIRONMENT **FIGURE:** 10-1

DATE: 18/02/2025 **PREPARED:** GEOMATICS **NO:** A1285-030 RevG

REVIEWED:



10.3.2 Environmental values

10.3.2.1 Troglofauna

Troglofauna habitats

The types of geology known to support troglofauna occur above the water table, within the vadose or unsaturated zone, within karst limestone, CID, BIF, alluvium/colluviums in valley-fill areas, calcretes and weathered or fractured sandstone (EPA 2016b, h).

The Northern RAV MAR scheme and infiltration ponds are located approximately 3 km north-west of the Approved Proposal in the Mick Bore tenure area where groundwater flows to the west (Figure 10-1; Advisian 2024). The elevation of the proposed MAR area is between 725 and 738 mAHD. Surface geology shows that this area comprises mostly of alluvium and colluvium-red-brown sandy and clayey soil which extend to the north, south and west as well as some smaller areas of colluvium which extend to the east and west beyond the boundaries of the mounding contours (Figure 10-3). Alluvium and colluvium generally provide suitable habitat for troglofauna (Bennelongia 2016b).

Recent hydrogeological assessments determined that the valley floor is generally covered with Quaternary sediments (Advisian 2024). These units consist of surface scree, and three Cainozoic Tertiary Detrital (TD) units TD3, TD2 and TD1. Upper and middle TD units are generally considered to provide usually suitable for troglofauna whereas the deepest TD units generally provide limited habitat to support troglofauna (BHP 2017b).

The TD1 unit comprises red haematitic silt and clay, scree on valley sides. Aquifer potential within this unit depends on lithology and clast-size. TD2 comprises bleached and mottled clay / channel iron deposits (CID) / calcrete / silcrete with aquifers in CID/Calcrete/Silcrete. The TD3 unit comprises magnetite and haematite dominated pisolites, red ochre detrital / scree on valley sides. There is some aquifer potential within this unit, but this depends on clast-size (Advisian 2024).

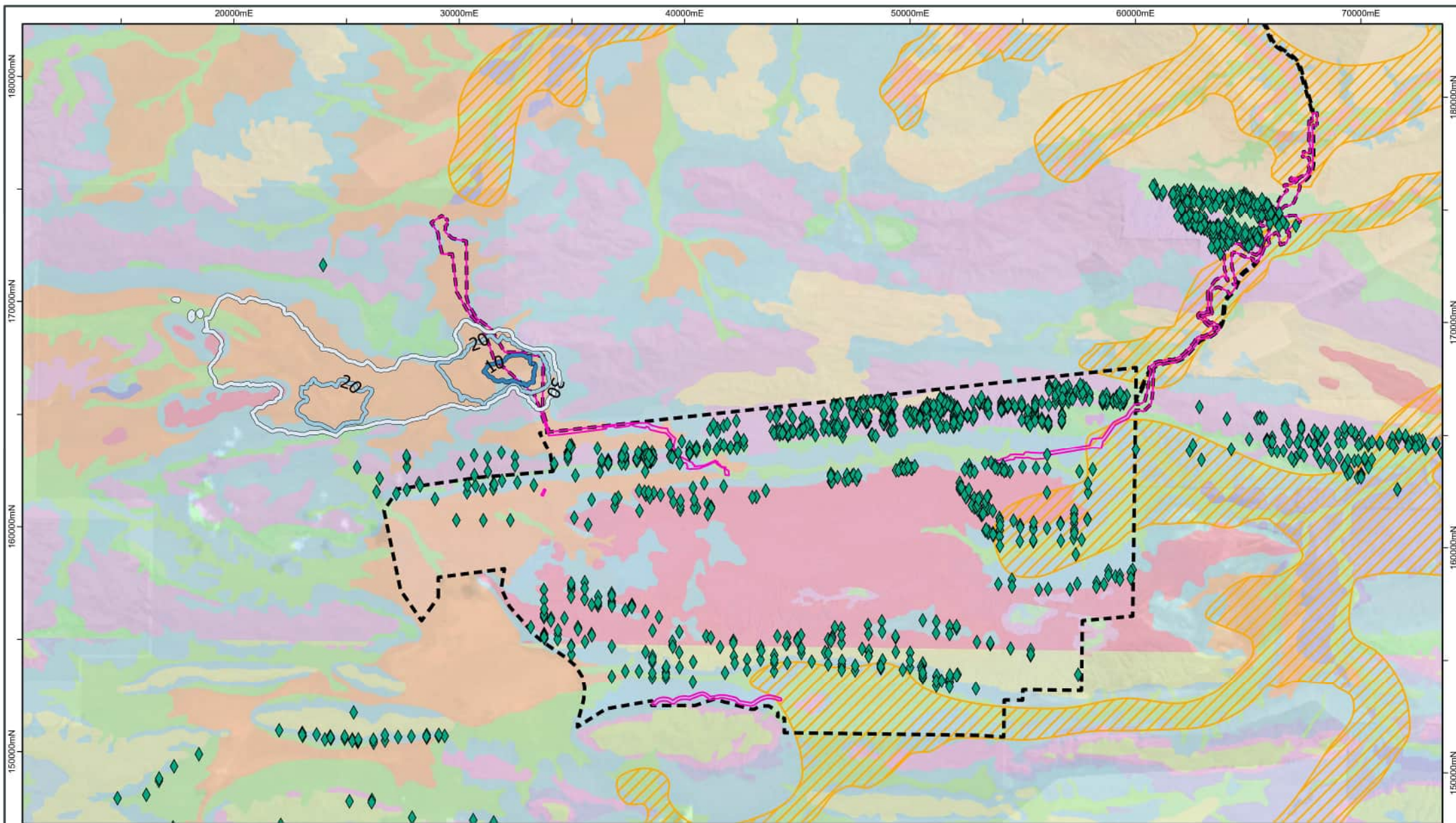
Groundwater levels generally range from 40-70 mbgl at the Northern RAV MAR location, decreasing to 30 mbgl to the west and increasing to 70 mbgl to the south (Advisian 2024; Appendix 7). Bores in the east can be divided into two groups. Those in the north-east have heads around 40 to 50 mbgl, whilst those in the south-east have heads around 50 to 80 mbgl (which is generally within the basement; Advisian 2024).

Whilst it can be inferred that there is likely to be suitable habitat for troglofauna within the Tertiary Detritals, alluvium and colluvium throughout the predicted groundwater mounding contours at the Northern RAV MAR, the actual occurrence and extent of suitable habitat and the troglofauna assemblage within this area will be further informed by the ongoing and additional subterranean fauna survey work being undertaken in this area (Bennelongia 2025 *in prep*; see Section 10.3.1; Figure 10-1).

Troglofauna assemblages

An overview of troglofauna records within and surrounding the groundwater impact assessment area is shown in Figure 10-3. A rich troglofauna assemblage is known to occur within the Development Envelope where at least 3,585 specimens of troglofauna representing 126 species from 19 orders have historically been collected (Bennelongia 2016c; BHP 2017b). These species were previously assessed as part of the Approved Proposal, with eleven species considered to be potentially restricted to the areas of impact (i.e. pit boundaries of the Approved Proposal; Bennelongia 2016c).

No historical sampling for troglofauna has been undertaken within and around the groundwater mounding contours of the Northern RAV MAR (Figure 10-1). The actual occurrence and extent of suitable habitat and the troglofauna assemblage within this area will be further informed by the ongoing and additional subterranean fauna survey work being undertaken in this area (Bennelongia 2025 *in prep*; see Section 10.3.1; Figure 10-1).



See associated figure for geology legend (Fig. 10-3b)

- Indicative Footprint
- - - Development Envelope
- ▨ Yandicoogina Palaeovalley
- ◆ Troglofauna Observations
- Groundwater Mounding Contours**
- 10 mbgl
- 20 mbgl
- 30 mbgl



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MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

OVERVIEW OF GEOLOGY AND

POSITIVE TROGLOFAUNA RECORDS

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3: 1:225,000	REQUESTOR: ENVIRONMENT	FIGURE: 10-3
DATE: 18/02/2025	PREPARED: GEOMATICS	
REVIEWED:		NO: A1285-020 RevH

Geological Description

AFd - JEERINAH FORMATION: pelite, chert, and thin-bedded metasandstone; intruded by metadolerite sills in the Hamersley Range
AFj - JEERINAH FORMATION: pelite, chert, and thin-bedded metasandstone; intruded by metadolerite sills in the Hamersley Range
AHd - WITTENOOM FORMATION: thin- to medium-bedded metadolomite, dolomitic pelite, chert, and metamorphosed volcanic sandstone
AHm - MARRA MAMBA IRON FORMATION: chert, banded iron-formation, and pelite
AHs - MOUNT McRAE SHALE and MOUNT SYLVIA FORMATION: pelite, chert, and banded iron-formation
Cza - Alluvium-partly consolidated silt, sand, and gravel; old alluvium dissected by present-day drainage
Czc - Colluvium - partly consolidated valley-fill deposits
Czc - Colluvium-partly consolidated quartz and rock fragments in silt and sand matrix; old valley-fill deposits
Czk - Calcrete - sheet carbonate usually formed in major drainage lines
Czk - Calcrete-sheet carbonate; found along major drainage lines
Czl - Lateritic deposits-massive and pisolitic ferruginous duricrust
Czp - ROBE PISOLITE: pisolitic limonite deposits developed along river channels
Czr - Hematite-goethite deposits on banded iron-formation and adjacent scree deposits
Czr - Laterite, includes surficial hematite-goethite deposits on banded iron-formation; forms Hamersley Surface

Fj - JEERINAH FORMATION: interbedded mudstone, siltstone and chert with minorfelsic tuff, dolomite and sandstone
Hb - BROCKMAN IRON FORMATION: banded iron-formation, chert and minor shale (2490+/-20 Ma, U-Pb)
Hd - WITTENOOM DOLOMITE: dolomite; interbedded thin chert, shale and dolomite in upper part
Hm - MARRA MAMBA IRON FORMATION: chert, ferruginous chert and banded iron-formation with minor shale
Hs - MOUNT McRAE SHALE and MOUNT SYLVIA FORMATION: interbedded shale, chert and banded iron-formation
PLHb - BROCKMAN IRON FORMATION: banded iron-formation, chert, and pelite
PLHj - WEELI WOLLI FORMATION: banded iron-formation (commonly jaspilitic), pelite, and numerous metadolerite sills
PLHt - Medium- to coarse-grained metadolerite sills intruded into Hamersley Group
Qa - Alluvium - unconsolidated silt, sand and gravel
Qa - Alluvium_unconsolidated silt, sand, and gravel; in drainage channels and on adjacent floodplains
Qc - Colluvium-unconsolidated quartz and rock fragments in soil; locally derived soil, and scree, and talus deposits
Qw - Alluvium and colluvium - red-brown sandy and clayey soil
Qw - Alluvium and colluvium-red-brown sandy and clayey soil; on low slopes and sheetwash areas

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MINING AREA C SIGNIFICANT AMENDMENT
OVERVIEW OF GEOLOGY AND
TROGLOFAUNA RECORDS (GEOLOGY LEGEND)

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3: 1:153,923 REQUESTOR: ENV. APPROVALS FIGURE: 10-3b
DATE: 28/01/2025 PREPARED: GEOMATICS NO. A1285-020b_RevB
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10.3.2.2 Stygofauna

Stygofauna habitats

The hydrogeology of the Development Envelope is described in detail in Section 7.3.3.3.

The Development Envelope and groundwater drawdown contours of the Combined Proposal predominantly occur in the catchment of Weeli Wolli Creek and the Coondewanna subcatchment to the west (Figure 10-4). The Weeli Wolli catchment is further divided into three subcatchments including the Upper Weeli Wolli Creek subcatchment, the Marillana Creek subcatchment and the Lower Weeli Wolli Creek subcatchment into which the first two flow. The groundwater drawdown contours of the Combined Proposal extend throughout the Upper Weeli Wolli Creek subcatchment, west into the Coondewanna subcatchment, north into the Marillana Creek subcatchment and east into the Lower Weeli Wolli subcatchment (Figure 10-4). Suitable habitat for stygofauna occurs within all the subcatchments with the most suitable habitat likely occurring within geological units that contain vugs or cavities (e.g. calcrete) in areas where depth to groundwater is less than 40 m (Bennelongia 2016b).

Weeli Wolli Creek catchment

The Weeli Wolli Creek catchment is described as primarily dominated by Hamersley Group rocks alongside areas of TD units and calcrete in the palaeochannel creeklines which are well known as prospective stygofauna habitat (Rio Tinto 2022).

The Hamersley Group makes up the following main aquifers in the groundwater drawdown area:

- Orebody aquifers, which are made up of mineralised and sub mineralised material of the:
 - Marra Mamba Formation which hosts the North Flank Deposits (A, B, C, E, F, R and Dead End); the South Flank Deposits (Highway, Grand Central and Vista Oriental) and the RTIO Hope Downs 1 deposits
 - Brockman Iron Formation, which forms east/west striking aquifers in the north, hosted in the Packsaddle orebodies.

Regional aquifers are located through the valley between North Flank and Packsaddle, the South Flank paleochannel, west near Coondewanna Flats and east near Weeli Wolli Spring, and are made up of:

- Weathered Paraburdoo (and Bee Gorge) Members of the Wittenoom Formation. The Paraburdoo dolomite in particular, can be karstic and highly permeable
- Sand, gravel, and calcrete occurrences in the TD units. The TD units are very thick in places, reaching >100 m in some regional aquifers (e.g., South Flank Valley paleochannel).

The orebody and regional bedrock aquifers are separated by the various shale members of the Mt McRae / Mt Sylvia Formations and Wittenoom Formation. The Mt McRae and Mt Sylvia shales are present to the south of the Brockman orebodies and the West Angela Shale is found to the north of the Marra Mamba orebodies. In some areas, the regional aquifers are in direct contact with the orebody aquifers (e.g. A and C deposit) whereas in others they are hydraulically disconnected by the shale formations (e.g. most of the Packsaddle orebodies).

At South Flank, the northern orebodies are separated from the southern orebodies in the west and east but do come together in the central area (and in the far western margin). Generally, the northern orebodies are at a higher elevation and have a lower proportion of BWT ore. The southern orebodies are likely well connected to the regional aquifers at least along some of their strike length (BHP 2025a).

Bennelongia (2016b) indicate that the central portion of the Development Envelope and groundwater drawdown area has a relatively deep water table (i.e. greater than 40 mbgl) and therefore may be less prospective for stygofauna. A higher number of stygofauna records are generally observed throughout the Weeli Wolli PEC and Coondewanna Flats areas to the east and west of the Development Envelope (Bennelongia 2016b; Figure 10-5).

Upper Weeli Wolli subcatchment

Three primary aquifers exist within the Upper Weeli Wolli subcatchment:

- the orebody aquifer developed through mineralisation of BIF
- the Wittenoom dolomite which is located within the topographic low areas
- the overlying alluvial TD and calcretes

The permeability and storage volumes of the aquifers vary laterally and vertically through each aquifer unit and the hydraulic connection between the systems is considered to be variable and constrained by structural controls, mineralisation and vertical permeabilities. Recharge of the groundwater system primarily occurs in the Coondewanna Flats area with groundwater moving through the southern flank and north flank valleys to ultimately discharge at Weeli Wolli Spring.

The Priority 1 Weeli Wolli Springs PEC occurs within the Upper Weeli Wolli Creek subcatchment and is noted for its high diversity of stygofauna which is likely due to the large-scale calcrete and alluvial aquifer system associated with the creek (DBCA 2023). Ben's Oasis, also part of the PEC, is located about 20 km further upstream and south of Weeli Wolli Spring (Figure 10-4). This portion of the PEC occurs outside the groundwater drawdown area. Habitat extent and connectivity throughout the PEC and extending along Weeli Wolli creek is likely to be high for all stygofauna species, evident by the number of shared species between Lower Weeli Wolli Creek and Marillana subcatchments (Bennelongia 2016b; Figure 10-4).

Pre-mining, the depth to groundwater was deep (>50m) in the upstream catchment, decreasing with distance towards the spring. Levels were typically within at least 5 m of the ground surface closer to the spring.

In the vicinity of Weeli Wolli Springs and immediately beyond, Weeli Wolli Creek is underlain by a limited thickness of alluvium overlying low permeability shales and ironstone. Before mining commenced in the area, groundwater was shallow, within the root zone of riparian vegetation close to the creek bed.

As described in Section 7.3.4.2, groundwater levels in Weeli Wolli Spring PEC have been influenced by RTIO Hope Downs dewatering operations and are maintained through artificial discharge through a series of spigots. In the southern extent of Weeli Wolli Spring (closest to the Hope Downs Operations) groundwater levels were approximately 570 mAHD and either at or near ground surface prior to commencement of dewatering. From 2007 (when Hope Downs dewatering commenced) to 2024, groundwater levels at bore GWB0015, located near the confluence with Pebble Mouse Creek, have declined approximately 20 m (BHP 2025a). In the northern extent of Weeli Wolli Springs, groundwater levels have decreased by approximately 2.5 to 3 m where groundwater was historically at or near the natural surface. Time series data for bores at Weeli Wolli Springs is provided in Figure 3.31 of the Central Pilbara Hydrogeological assessment provided in Appendix 7 (BHP 2025a).

Coondewanna subcatchment

The western portion of the Development Envelope and groundwater drawdown area occur within the Coondewanna subcatchment which is part of the Ashburton River catchment (Figure 10-4). The Coondewanna subcatchment operates as an internally draining system. However, it is hydraulically connected to the regional aquifer systems and overflows to the east during extreme flood events. According to site-specific data and modelling, except during flood events, the local aquifers in and around the Coondewanna subcatchment mostly act as discrete or semi-discrete compartments controlled by structure and stratigraphy (BHP 2017b). The key hydrogeological units present in the Coondewanna subcatchment comprise TD valley-fill, calcrete/silcrete and dolomite. Overall, the structure of the aquifers within the Coondewanna subcatchment are highly variable and not well documented. Weathered, vuggy and karstic formations associated with hydrated zones, dolomite in the Wittenoom Formation, and alluvial successions may act as locally significant aquifers. Calcrete/silcrete horizons show only small cavities and vugs, which may mean the upper detrital zone contains perched aquifers with which calcrete is associated (BHP 2017b). The north-east to southwest striking dolerite dykes in the southeast of the catchment form hydraulic barriers and impede groundwater

flow, causing local mounding and shallow water tables upstream of the dykes; however, these areas are unlikely to act as barriers to stygofauna dispersal (BHP 2017b).

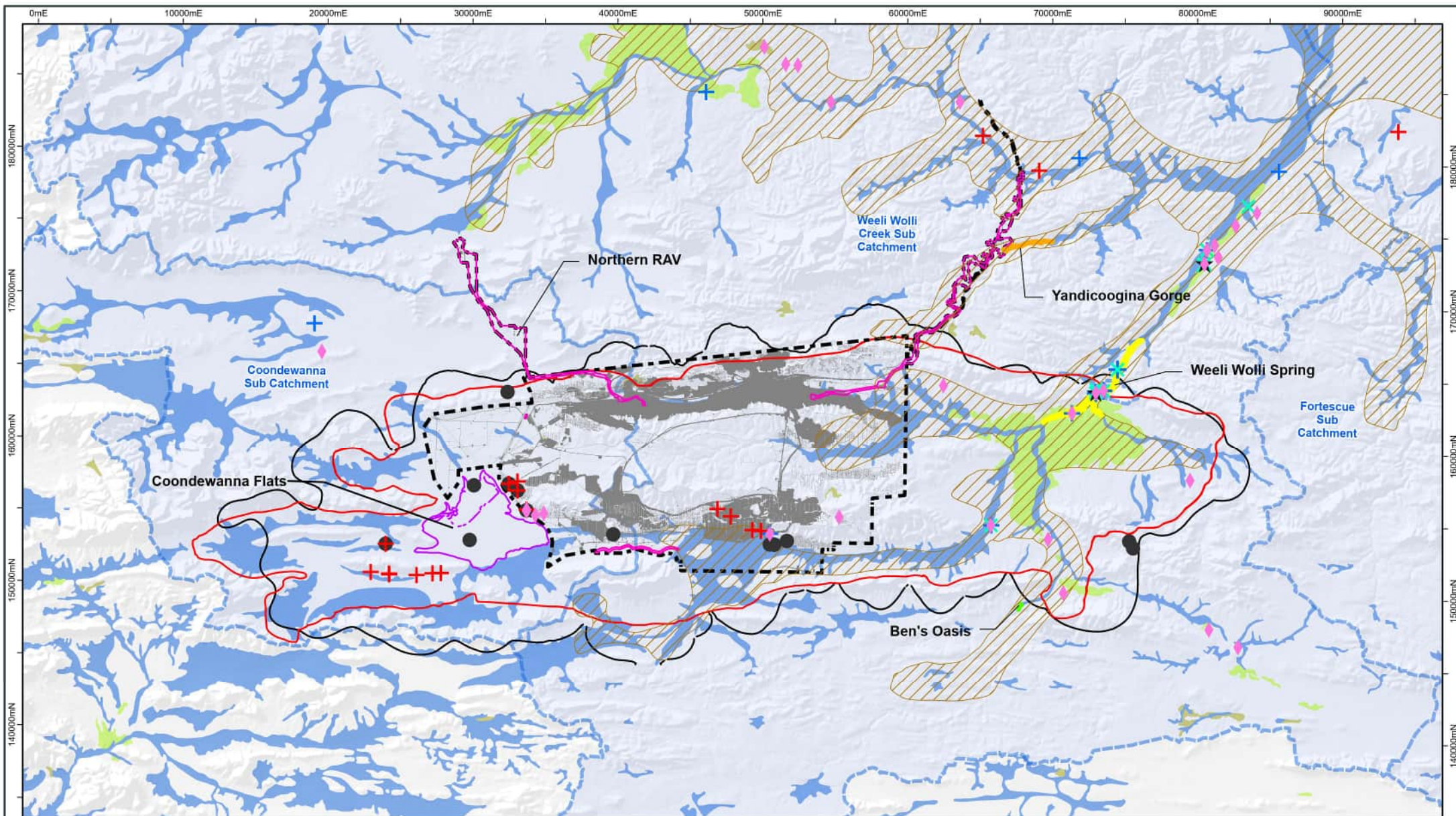
The pre-mining depth to water table varied based on topography but was generally closer to the land surface in low-lying areas. The water table is around 18 to 23 mbgl in most of the subcatchment. There is a drop of around 30 m in groundwater levels (to greater than 50 mbgl) in the southeast, where habitat for stygofauna may become less prospective due to depth to groundwater (Bennelongia 2016b).

As described in Section 7.3.4.1, groundwater levels in Coondewanna Flats have been influenced by the operation of the Juna Downs MAR and dewatering as part of the Approved Proposal. In the northern extent of Coondewanna Flats (near the Juna Downs MAR scheme), groundwater levels increased by approximately 3-4 m until 2022 which corresponds to 20 mbgl. Since 2022, groundwater levels near the Juna Downs MAR have reduced slightly due to the reduced use of the MAR. In the remaining areas of Coondewanna Flats, groundwater has shown a gradual decline of approximately 1 m between 2012 and 2024. Time series data for bores in the Coondewanna Flats area are provided in Figure 3.30 of the Central Pilbara Hydrogeological assessment in Appendix 7 (BHP 2025a).

Marillana Creek subcatchment

The northern portion of the groundwater drawdown contours extend slightly into the lower part of the Marillana Creek subcatchment (Figure 10-2). In addition, the north-east scheme of the Development Envelope and Yandicoogina Gorge both occur within this subcatchment, beyond the boundaries of the groundwater drawdown contours (Figure 10-4).

Groundwater yields occur within both mineralised and fractured unmineralized lithologies. The dominant regional aquifer system occurs in the bedrock Dales Gorge Formation. The hydrogeology in and around the north-east scheme, particularly through the Ministers North tenement, is not considered to be prospective for stygofauna, likely due to the depth to groundwater which exceeds 60 m across most of the Ministers North deposit (Bennelongia 2024b); however, areas to the east of the deposit, in areas associated with Yandicoogina Creek and Yandicoogina Gorge where the groundwater is shallower, are more prospective (Biologic 2023b). Suitable geological and hydrogeological units within the Yandicoogina Gorge area likely provide highly suitable habitat for stygofauna; in particular, the valley fill alluvial deposits and extensive calcretes, and shallow alluvial aquifers, associated with major drainages are highly conducive to stygofauna inhabitation (Biologic 2023b). The shallow and seasonally variable water table associated with Yandicoogina Gorge may assist in aiding stygofauna dispersal throughout this area (Biologic 2023b).

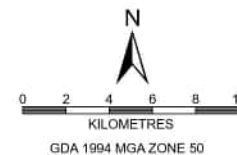


- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge
- Yandicoogina Palaeovalley
- Approved Proposal 1m drawdown
- Combined Proposal 1m drawdown

Stygofauna Species

- + *Maarrka weeliwollii*
- *Paramelitidae* sp. B03
- + *nr Billibathynella* sp. B02
(=*Parabathynellidae* sp. S03)
- ◆ *Paramelitidae* Genus 2 sp. B02
- ★ *Paramelitidae* Genus 2 sp. B03
- × *Pylogabis weeliwolli*

- WA Hydrographic Subcatchment
- Alluvium - unconsolidated silt, sand and gravel
- Colluvium - unconsolidated quartz and rock fragments in soil
- Calcrete - sheet carbonate usually formed in major drainage lines



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MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT

OVERVIEW OF SUITABLE STYGOFAUNA HABITAT
AND SHARED SPECIES INDICATING CONNECTIVITY

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3:	1:350,000	REQUESTOR:	ENVIRONMENT	FIGURE:	10-4
DATE:	19/02/2025	PREPARED:	GEOMATICS	NO:	A1285-052 Rev1
		REVIEWED:			

Stygofauna assemblage

A rich stygofauna assemblage is known to occur within the Weeli Wolli Creek and Coondewanna subcatchments where at least 68 named species from 10 higher level groups (flatworms, nematodes, rotifers, segmented worms, mites, ostracods, copepods, syncarids, amphipods and isopods) have been collected (Table 10-5; Figure 10-5 and Figure 10-5; BHP 2017b; Bennelongia 2016b).

A total of 11 stygofauna species are currently only known from the groundwater drawdown area of the Combined Proposal (Table 10-5; Figure 10-6; Biologic 2025b; Bennelongia 2016b). This includes four species recorded within the Coondewanna Flats PEC and buffer area, two species recorded within the Development Envelope, two species recorded from East Packsaddle and three species recorded from Weeli Wolli Springs (Table 10-5; Figure 10-6; Biologic 2025b).

A relatively rich stygofauna assemblage has previously been recorded in the western section of the predicted groundwater mounding contours of the Northern RAV MAR (Figure 10-5). Historical surveys in this area recorded two potentially restricted species: *Paramelitidae* sp. B04 and *Chydaekata* sp. B01, both of which occur outside the predicted groundwater mounding contours of the Northern RAV MAR (Figure 10-6; Bennelongia 2011c). The additional subterranean fauna survey work being undertaken will further enhance the knowledge of the stygofauna habitats and assemblages within this area (see Section 10.3.1; Figure 10-2).

Sampling of the hyporheic zone within Yandicoogina Gorge and along Yandicoogina Creek has yielded over 20 stygal species, including at least eight species that are unique to the gorge, highlighting a high level of connection between ground and surface waters (Biologic 2023b).

Recent and historical studies have shown that the Weeli Wolli Creek subcatchment has a high richness of stygofauna (Biologic 2025b, 2023h). The highly diverse and ecologically significant stygofauna community within the Marillana and Weeli Wolli Creek catchment areas, in comparison to other similarly sized areas in the Pilbara region, is due to the high percentage of suitable geological and hydrogeological units of the area (Bennelongia 2016b). In particular, the valley-fill alluvial deposits and extensive calcretes, and shallow alluvial aquifers, associated with major drainages are highly conducive to stygofauna inhabitation. The shallow and seasonally variable water table is likely to aid stygofauna dispersal throughout this area (Biologic 2023h).

Stygofauna assemblages within the Coondewanna subcatchment do not appear to be as rich compared to those of the Weeli Wolli Creek subcatchment, but are still considered important nonetheless (Bennelongia 2016b). The considerable extent and habitat connectivity of the Tertiary Detrital valley-fill successions in the Coondewanna subcatchment likely provides suitable habitat and aid in dispersal of stygofauna across the subcatchment and potentially into wider areas (Bennelongia 2016b). Future survey work is currently in progress to further enhance the knowledge of stygofauna values within this area (see Section 10.3.1).

Table 10-5: Stygofauna species recorded during recent and historical surveys

Lowest ID	Approved Proposal groundwater drawdown contours	Combined Proposal groundwater drawdown contours	Occurs in PEC buffer	Other Occurrences, Comments
Species known from outside the groundwater drawdown contours (Combined Proposal)				
<i>Aeolosoma</i> sp. 1 (PSS)	✓	✓		Pilbara-wide. Also recorded from Ministers North.
<i>Pristina longiseta</i>	✓	✓		Cosmopolitan. Known from outside the impact areas.
<i>Pristina jenkiniae</i>	✓	✓		Stygophile/xene, Regionally widespread.
Naididae `sp. N1 LB-2015`	✓	✓		Stygophile/xene, Potential SRE. Locally restricted (13.1 km), also known from Yandicoogina.
<i>Nais variabilis</i>	✓	✓		Stygophile/xene, Regionally widespread.
Phreodrilidae sp. S06	✓	✓		Pilbara-wide
Phreodrilidae with dissimilar ventral chaetae	✓	✓	WWS, BO	Pilbara-wide
Phreodrilidae with similar ventral chaetae	✓	✓		Pilbara-wide
Phreodrilidae `sp. P11 LB-2015`	✓	✓		Stygophile/xene, Regionally widespread.
<i>Ainudrilus</i> sp. WA26 (PSS)	✓	x	WWS	Known only from these records at Weeli Wolli Springs. Considered likely that this species occurs within the wider local area or catchment given distributions of other oligochaete taxa.
Enchytraeidae sp. S01	✓	✓		Packsaddle Range in approved drawdown, previously assessed.
Enchytraeidae `sp. E1 LB-2015`	✓	✓		Stygophile/xene, Regionally widespread.
Enchytraeidae `sp. E6 LB-2015`	✓	✓		Stygophile/xene, Regionally widespread.
<i>Enchytraeus</i> sp. 1 (PSS) Pilbara	✓	✓	WWS	Species complex, Pilbara-wide.
<i>Enchytraeus</i> sp. 2 (PSS) Pilbara	✓	✓	WWS	Species complex, Pilbara-wide.
Halacaridae sp. B01	✓	x	WWS	Known only from these records. Occurs at Weeli Wolli Springs.
<i>Recifella</i> sp. P1 (nr <i>umala</i>) (PSW)	✓	✓	WWS	Hamersley Range.
<i>Gomphodella yandii</i>	✓	x	WWS	Regionally widespread (100+ km)

Lowest ID	Approved Proposal groundwater drawdown contours	Combined Proposal groundwater drawdown contours	Occurs in PEC buffer	Other Occurrences, Comments
<i>Areacandona</i> cf. <i>mulgae</i>	✓	✓	WWS	Near West Angelas.
<i>Meridiescandona</i> <i>facies</i>	✓	✓	WWS	Weeli Wolli catchment.
<i>Meridiescandona</i> <i>lucerna</i>	✓	✓	WWS	Weeli Wolli catchment, eastern Fortescue.
<i>Meridiescandona</i> <i>marillanae</i> *	✓	✓	WWS	Lower Weeli Wolli, Marillana catchments. Locally widespread (33.7 km).
<i>Meridiescandona</i> `sp. Biologic-OSTR057`	✓	✓		Stygobite, Potential SRE. Locally restricted (18.4 km).
<i>Notacandona</i> <i>boultoni</i>	✓	✓	WWS	Weeli Wolli catchment. Locally widespread (38.9 km)
<i>Notacandona</i> <i>modesta</i>	✓	✓	WWS	Eastern Upper Weeli Wolli catchment. Locally restricted (12.1 km). Also found at Pebble Mouse Creek.
<i>Cypretta</i> <i>seurati</i>	x	✓	WWS	Cosmopolitan.
<i>Gomphodella</i> <i>yandii</i>	✓	✓	WWS	Eastern Weeli Wolli catchment.
<i>Gomphodella</i> sp. Biologic-OSTR078	✓	x	WWS	Singleton recorded from one site outside the 1 m drawdown contour of the Combined Proposal at Weeli Wolli Springs. Stygofauna, Potential SRE. Wider distribution currently unknown. Locally restricted (1.5 km).
<i>Stygorigedwayia</i> <i>trispinosa</i>	✓	✓		Pilbara-wide. Regionally widespread (100+ km).
<i>Diacyclops</i> <i>cockingi</i>	✓	✓	WWS	Pilbara-wide. Regionally widespread (100+ km).
<i>Diacyclops</i> <i>humphreysi</i>	✓	✓	WWS	Pilbara-wide. Regionally widespread (100+ km).
<i>Diacyclops</i> <i>sobeprolatus</i>	✓	✓		Pilbara-wide. Regionally widespread (100+ km).
<i>Diacyclops</i> `sp. Biologic-CYCL037`	✓	✓		Stygobite, Potential SRE. Locally widespread (29.3 km)
<i>Mesocyclops</i> <i>brooksi</i>	✓	✓	WWS	Southern Australia.
<i>Metacyclops</i> <i>pilbaricus</i>	✓	✓		Pilbara-wide.
<i>Metacyclops</i> sp. B01 (nr <i>pilbaricus</i>)	✓	✓		Central Pilbara.
<i>Microcyclops</i> <i>varicans</i>	✓	✓		Cosmopolitan.
<i>Pilbaracyclops</i> sp. B03 (nr <i>frustratio</i>)	✓	✓		Central Pilbara.

Lowest ID	Approved Proposal groundwater drawdown contours	Combined Proposal groundwater drawdown contours	Occurs in PEC buffer	Other Occurrences, Comments
<i>Thermocyclops decipiens</i>	✓	✓		Cosmopolitan.
<i>Gordanitocrella</i> sp. Biologic-HARP030	✓	✓	WWS	Recorded from three sites at Weeli Wolli Springs including one site outside the 1m drawdown contours of the Combined Proposal. Stygobite, Potential SRE. Locally restricted (2.8 km).
<i>Gordanitocrella trajani</i>	✓	✓	WWS	Eastern Weeli Wolli catchment. Locally widespread (31.5 km).
<i>Parastenocaris</i> sp. Biologic-HARP032	✓	x	WWS	Singleton recorded from one site outside the 1 m drawdown contour of the Combined Proposal at Weeli Wolli Springs. Stygobite, Potential SRE. Considered likely to be restricted to the local groundwater habitats.
<i>Schizopera</i> sp. Biologic-HARP031	✓	x	WWS	Singleton recorded from one site outside the 1 drawdown contour of the Combined Proposal at Weeli Wolli Springs. Stygobite, Potential SRE. Locally restricted (2.9 km)
<i>Australocamptus</i> sp.	✓	✓		Coondewanna catchment.
<i>Schizopera</i> sp. B02	✓	x	WWS	Known only from these records.
<i>Atopobathynella</i> `sp. Biologic-PBAT019`	✓	✓		Stygobite, Potential SRE. Known linear distribution over 80 km. Locally widespread (81.4 km).
<i>Notobathynella</i> sp.	✓	✓		Recorded from two locations including one outside the drawdown area.
nr <i>Billibathynella</i> sp. B02 (=Parabathynellidae sp. S03)	✓	✓		Weeli Wolli and Coondewanna catchments.
<i>Chydaekata</i> sp. E	✓	✓	WWS, BO	Lower Weeli Wolli catchment.
<i>Chydaekata</i> `sp. E TLF-2008`	✓	✓		Stygobite, Potential SRE. Known linear distribution over 50 km.
<i>Maarrka weeliwollii</i>	✓	✓	WWS	Lower Weeli Wolli and Marillana catchments. Locally widespread (84.1 km).
Paramelitidae Genus 2 sp. B02	✓	✓	WWS, BO	Lower Weeli Wolli Creek, Marillana Creek and Coondewanna Flats catchments.
Paramelitidae Genus 2 sp. B03	✓	✓	WWS	Lower Weeli Wolli and Marillana catchments.
Paramelitidae sp. B03	✓	✓		Weeli Wolli and Coondewanna catchments. Known from Jinidi, Jirrapalpur Ranges and Packsaddle Range, as well as Coondewanna Flats and Boundary Ridge.
Paramelitidae `sp. Biologic-AMPH024`	✓	✓		Stygobite. Potential SRE. Known linear distribution over 20km. Locally widespread (22.3 km).
Paramelitidae `sp. Biologic-AMPH070`	✓	✓		Stygobite. Potential SRE. Locally restricted (14.8 km)
<i>Pygolabis weeliwolli</i>	✓	✓	WWS	Known from both the Lower Weeli Wolli and Marillana catchments. Locally widespread (28.3 km).

Lowest ID	Approved Proposal groundwater drawdown contours	Combined Proposal groundwater drawdown contours	Occurs in PEC buffer	Other Occurrences, Comments
Pezidae `sp. Biologic-ACAR003`	✓	✓		Stygofauna, potential SRE. Considered locally restricted (11.3 km) but is also known from Ministers North.
Species only known from the groundwater drawdown contours (Combined Proposal)				
<i>Dussartcyclops</i> sp. B10	✓	✓	CF	Known only from this record within the Coondewanna Flats PEC. Previously assessed for the Approved Proposal.
nr <i>Epactophanes</i> sp. B01	✓	✓	-	Known only from this record. Previously assessed in the Approved Proposal.
<i>Bathynella</i> sp. 1	✓	✓	WWS	Known only from this record at Weeli Wolli Springs. Previously assessed in the Approved Proposal.
<i>Bathynella</i> sp. 2	✓	✓	-	Four individuals recorded from one location within South Flank. Known only from these records. Previously assessed in the Approved Proposal.
<i>Billibathynella</i> `sp. S1`	✓	✓	CF	Eight records of this species within the Coondewanna Flats buffer area. Only known from these records.
nr <i>Notobathynella</i> sp. S01	✓	✓	CF	Recorded from two locations south-east of Coondewanna Flats. Known only from these records. Previously assessed in the Approved Proposal.
Paramelitidae sp. S04 (BR South)	✓	✓	CF	Recorded from 12 locations (88 individuals) within the Coondewanna subcatchment. Known only from these records. Previously assessed in the Approved Proposal.
<i>Isopoda</i> sp. Biologic-ISOP153	x	✓	-	Singleton recorded from east Packsaddle. Stygofauna, potential SRE. Wider distribution currently unknown.
<i>Nais</i> sp. Biologic-OLIG117	✓	✓	WWS	Singleton. Stygophile/xene, Potential SRE. Considered likely that this species occurs within the wider local area or catchment given it is a stygophile/xene.
Enchytraeidae sp. Biologic-OLIG159	✓	✓		Singleton recorded at East Packsaddle. Considered likely that this species occurs within the wider local area or catchment given it is a stygophile/xene.
<i>Vestalenula</i> sp. indet.	✓	✓	WWS	Singleton only known from Weeli Wolli Springs. Treated as being potentially unique as no other species of this genus have been recorded in the area.

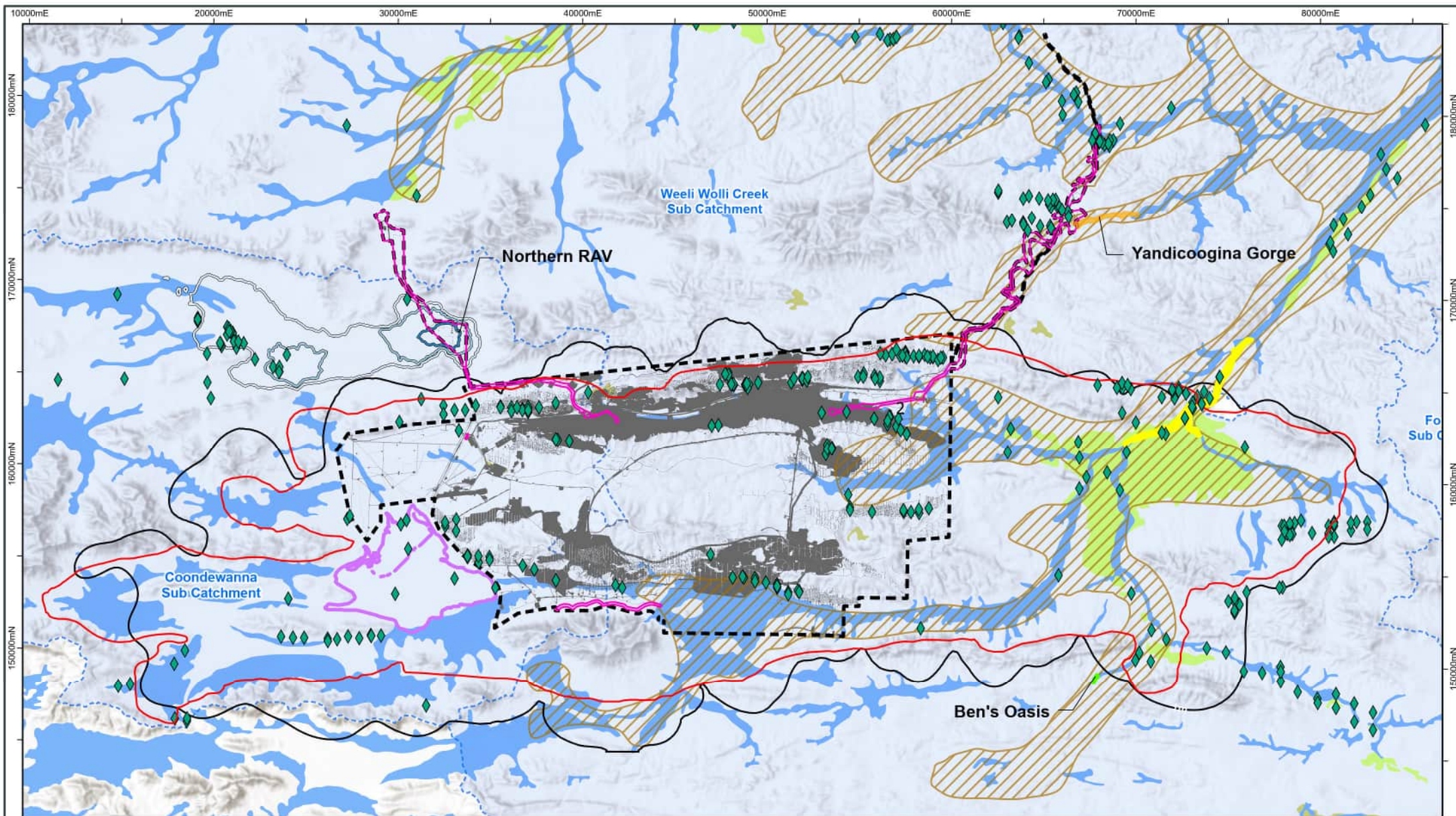
Source: Bennelongia 2016b, Biologic 2025b

* There is some uncertainty around this morphological identification, as it has been found to represent at least 3 unique OTUs (Biologic 2025b)

WWS = Weeli Wolli Springs, BO = Ben's Oasis, CF = Coondewanna Flats

✓ = recorded

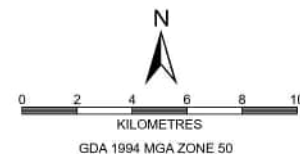
X = not recorded



- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wolli Spring
- Ben's Oasis
- Yandicoogina Gorge
- Yandicoogina Palaeovalley

- ◆ Stygofauna Observations
- Approved Proposal 1m drawdown
- Combined Proposal 1m drawdown
- Groundwater Mounding Contours**
- 10 mbgl
- 20 mbgl
- 30 mbgl

- WA Hydrographic Subcatchment
- Alluvium - unconsolidated silt, sand and gravel
- Colluvium - unconsolidated quartz and rock fragments in soil
- Calcrete - sheet carbonate usually formed in major drainage lines

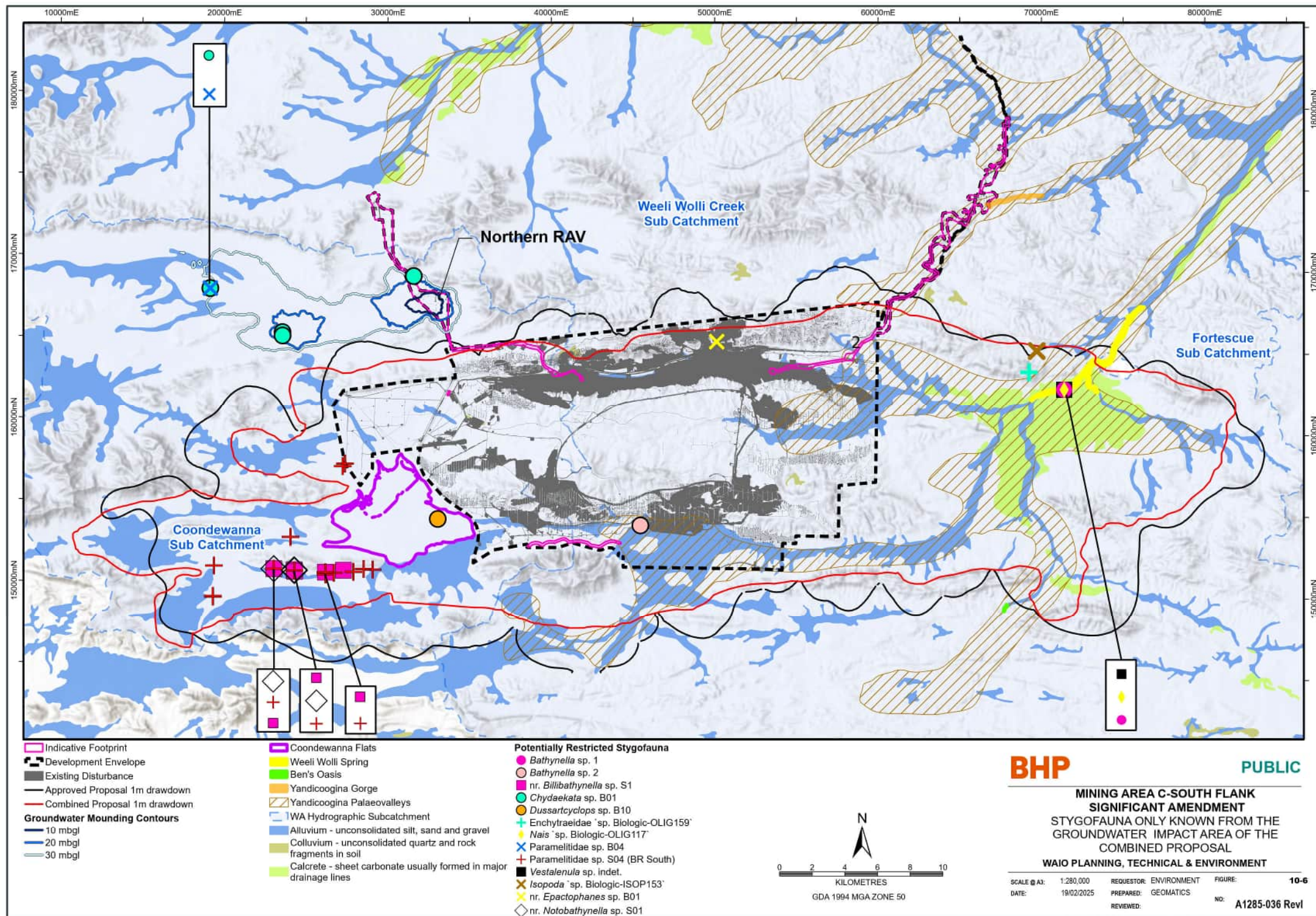


BHP

PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
OVERVIEW OF STYGOFAUNA
RECORDS AT CPH
WAO PLANNING, TECHNICAL & ENVIRONMENT**

SCALE @ A3: 1:275,000 REQUESTOR: ENVIRONMENT FIGURE: 10-5
DATE: 19/02/2025 PREPARED: GEOMATICS NO: A1285-035 Rev1
REVIEWED:



10.4 Potential environmental impacts

BHP has considered the potential impacts outlined in the EPA's Environmental Factor Guideline for Subterranean Fauna (EPA 2016b) and considers that those relevant to the Proposal are:

- loss or modification of troglofauna habitat and species assemblages from groundwater mounding associated with the Northern RAV MAR scheme (direct)
- loss or modification of stygofauna habitat and species assemblages from groundwater drawdown (direct)
- modification of stygofauna habitat or assemblages from changes to groundwater quality (direct).

Indirect impacts associated with vegetation clearing within the Indicative Footprint of the Proposal are expected to be minimal due to lack of major excavation or blasting and are not discussed further.

Localised mounding associated with surface water discharge within Upper Marilla Creek is considered unlikely to impact troglofauna, given that these habitats are seasonally inundated and would be unlikely to provide highly suitable, stable troglofauna habitat or support a rich troglofauna assemblage.

BHP has focussed the discussion of potential impacts to subterranean fauna based on the Proposal alone as well as the Combined Proposal. Information about impacts associated with the Approved Proposal have been provided for context but have not been reassessed.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation measures are applied, if required).

Cumulative impacts to Subterranean Fauna have been considered and are addressed in Section 16.4.

10.4.1 Loss or modification of troglofauna habitat and species assemblages from groundwater mounding at the Northern RAV MAR scheme (direct)

Groundwater mounding is predicted to occur as a result of aquifer reinjection and recharge as part of the Northern RAV MAR scheme and the Yandicoogina GDE Supplementation Scheme. Aquifer recharge at the Yandicoogina Gorge scheme is being implemented to mitigate recent declines in local groundwater levels (discussed in Section 7.3.4.4). It is proposed to increase groundwater levels at the head of Yandicoogina Gorge to pre-2018 levels (0.5 mbgl). As the scheme has been designed to increase and then maintain groundwater levels at previously observed values, mounding is not anticipated to result in negative impacts to troglofauna at Yandicoogina Gorge, as these habitats are naturally inundated and therefore unlikely to provide suitable troglofauna habitat. Regular monitoring of both the Yandicoogina Gorge aquifer and the Ministers North aquifer will be undertaken in accordance with the CPWRMP to ensure that mounding does not extend beyond historically recorded values (Appendix 8). Mounding impacts at Yandicoogina Gorge are therefore not considered further for troglofauna.

Proposal

Aquifer recharge is predicted to result in groundwater mounding in areas around the Northern RAV MAR scheme (see Section 7.5.2 and Figure 10-1). Groundwater mounding will result in inundation of the subterranean environment between 10-40 mbgl. Groundwater mounding up to 10 mbgl is predicted to occur at the Northern RAV MAR location with the 20 mbgl and 30 mbgl contours extending approximately 2 km and 12 km west of the Northern RAV scheme location, and another isolated patch of mounding up to 20 mbgl located approximately 7 km west of the Northern RAV MAR location (Figure 10-1). The 10 mbgl contours equate to approximately 205 ha of surface area, whereas the 20 mbgl and 30 mbgl equate to 1400 ha and 5000 ha surface area respectively (Figure 10-1). Given that the pre-MAR water levels in the Northern RAV MAR area are approximately 40 mbgl and that suitable habitat for troglofauna is likely to be present within the surface scree, the Tertiary Detritals and potentially the basement rock, the predicted

groundwater mounding will potentially reduce and/or directly remove suitable troglofauna habitat and individuals within these areas.

Additional sampling and studies are currently being progressed throughout this area to enhance the knowledge and understanding of the troglofauna values within, and extending beyond, the predicted groundwater mounding contours with results expected to be completed by early 2027 (see Section 10.3.1; Figure 10-1).

Combined Proposal

The combined effect of the Combined Proposal will be loss or modification of troglofauna habitat associated with mine pit excavation and groundwater mounding associated with the Approved Proposal and this Proposal. Groundwater mounding associated with the two existing MAR schemes at Juna Downs and South Flank has previously been assessed and approved as part of the Approved Proposal. The existing schemes are currently managed under Part V processes including the EP Licence L7851/2002/6. These schemes are currently functional and do not require any expansion, changes or increases in production. Mine pit excavation was also assessed and approved as part of the Approved Proposal. No expansion or changes to mine pit excavation are required for this Proposal.

Eleven potentially restricted troglofauna species were previously recorded within the predicted mounding contours of the existing MAR schemes and/or the proposed mine pits (BHP 2017b). Given that the proposed Northern RAV MAR scheme is located approximately 4.7 km north of Juna Downs and 23 km north-west of the South Flank MAR schemes, mounding associated with the Northern RAV MAR would be unlikely to significantly impact any of the 11 potentially restricted troglofauna species previously assessed. As described in Section 7.5.2, there is sufficient separation and limited hydraulic connectivity between the existing and proposed MAR schemes and so it is assumed that the troglofauna assemblages and habitats between these areas will be somewhat different. This will be further informed by the ongoing and additional troglofauna sampling work currently being undertaken (see Section 10.3.1; Figure 10-1).

10.4.2 Loss or modification of stygofauna habitat and species assemblages from groundwater drawdown (direct)

Groundwater abstraction (for mine dewatering) for the Proposal has the potential to change the groundwater regime by decreasing groundwater levels (groundwater drawdown) resulting in the reduction or loss of potential stygofauna habitat and/or species assemblages within the predicted groundwater drawdown contours.

For the purposes of this impact assessment, given that the area is already subject to groundwater drawdown as part of the Approved Proposal, stygofauna habitats and assemblages within areas subject to additional vertical or lateral drawdown as a result of the Proposal and Combined Proposal have been assessed. A conservative approach has been adopted by assessing impacts associated with the predicted worst-case (2050) scenario for groundwater drawdown; however, this is likely to be an overestimation of the actual drawdown and the potential impacts to stygofauna.

Proposal

The 2025 groundwater modelling predicts a peak dewatering rate of 180 ML/d (65.7 GL/a), representing an increase of 78 ML/d (28.4 GL/a) for the Proposal, compared to the Approved Proposal groundwater abstraction rate of 102 ML/d (37.3 GL/a). The increase in dewatering is required for implementation of the Combined Proposal rather than the Proposal alone and supersedes the 2016 groundwater model (BHP 2025a). As such, potential impacts are described below for the Combined Proposal.

Combined Proposal

As discussed in Section 7.5.1.1, an increase in dewatering of 77.8 ML/d (28.4 GL/a) is required for implementation of the Combined Proposal compared to the Approved Proposal. A summary of groundwater level change as a result

of the Approved Proposal compared to the Combined Proposal is provided in 7.7.1 and shown in Figure 7-16. Overall, the predicted lateral drawdown extent (as defined by the 1 m drawdown contour) of the Combined Proposal is similar to the Approved Proposal (BHP 2016b); however, there are several differences with the vertical drawdown extent predicted in the 2024 model due to the increase in dewatering and the uncertainty in hydraulic parameters. The key differences are summarised below:

- Increased drawdown in Coondewanna Flats by an additional 10 to 60 m beyond the Approved Proposal
- The southern extent of 1 m drawdown of the Combined Proposal is reduced by approximately 2.5 km (i.e. the Combined Proposal contours are within the Approved Proposal extent)
- A general reduction in drawdown (laterally and vertically) is predicted in the eastern extent beyond the Development Envelope towards Weeli Wolli Springs (i.e. the Combined Proposal is within the Approved Proposal extent)
- The lateral extent to the north is within the approved extent
- Drawdown is expected to extend laterally by 1.6 km and vertically by 2.5-5 m in the north-west corner beyond the approved extent.
- Drawdown in the south-west corner extends laterally by approximately 4.2 km and vertically by 2.5-30 m.

Stygofauna habitats and assemblages throughout the Coondewanna Flats PEC and buffer area, the south-west corner and the north-west corner of the drawdown contours will be subject to additional lateral and/or vertical drawdown as a result of the Combined Proposal (Figure 10-6). Stygofauna habitats and assemblages at Weeli Wolli Springs will not be subject to additional drawdown until post 2045 when RTIO Hope Downs Operation goes into closure (see Section 7.6.4.1; BHP 2025a; Appendix 7). At this time, drawdown between 11-14 m could occur if not mitigated.

A total of 11 stygofauna species are currently only known from within the drawdown area of the Combined Proposal (Table 10-5; Figure 10-6 and Figure 10-7). Six species were previously assessed as part of the Approved Proposal, three of which will be subject to additional groundwater drawdown associated with the Combined Proposal: nr *Billibathynella* sp. S1, Paramelitidae sp. S04 (BR South) and nr *Notobathynella* sp. S01 (Table 10-6; Figure 10-6 and Figure 10-7). The other three stygofauna species previously assessed are within areas that have been approved to be dewatered by 20-50 m (*Dussartcyclops* sp. B10, nr *Epactophanes* sp. B01 and *Bathynella* sp. 2; Table 10-6) which has likely resulted in complete loss of habitat within these areas. As such, these three species will not be subject to additional impacts associated with this Proposal and are not considered further.

A further five stygofauna species are only known from the groundwater drawdown contours of the Combined Proposal at East Packsaddle or Weeli Wolli Springs where they may be subject to additional drawdown (Table 10-6; Figure 10-6 and Figure 10-7; noting that drawdown at Weeli Wolli Springs will be within the previously approved limits until post-2045 when drawdown of 11-14 m could potentially occur following closure of RTIO Hope Downs operation; BHP 2025a).

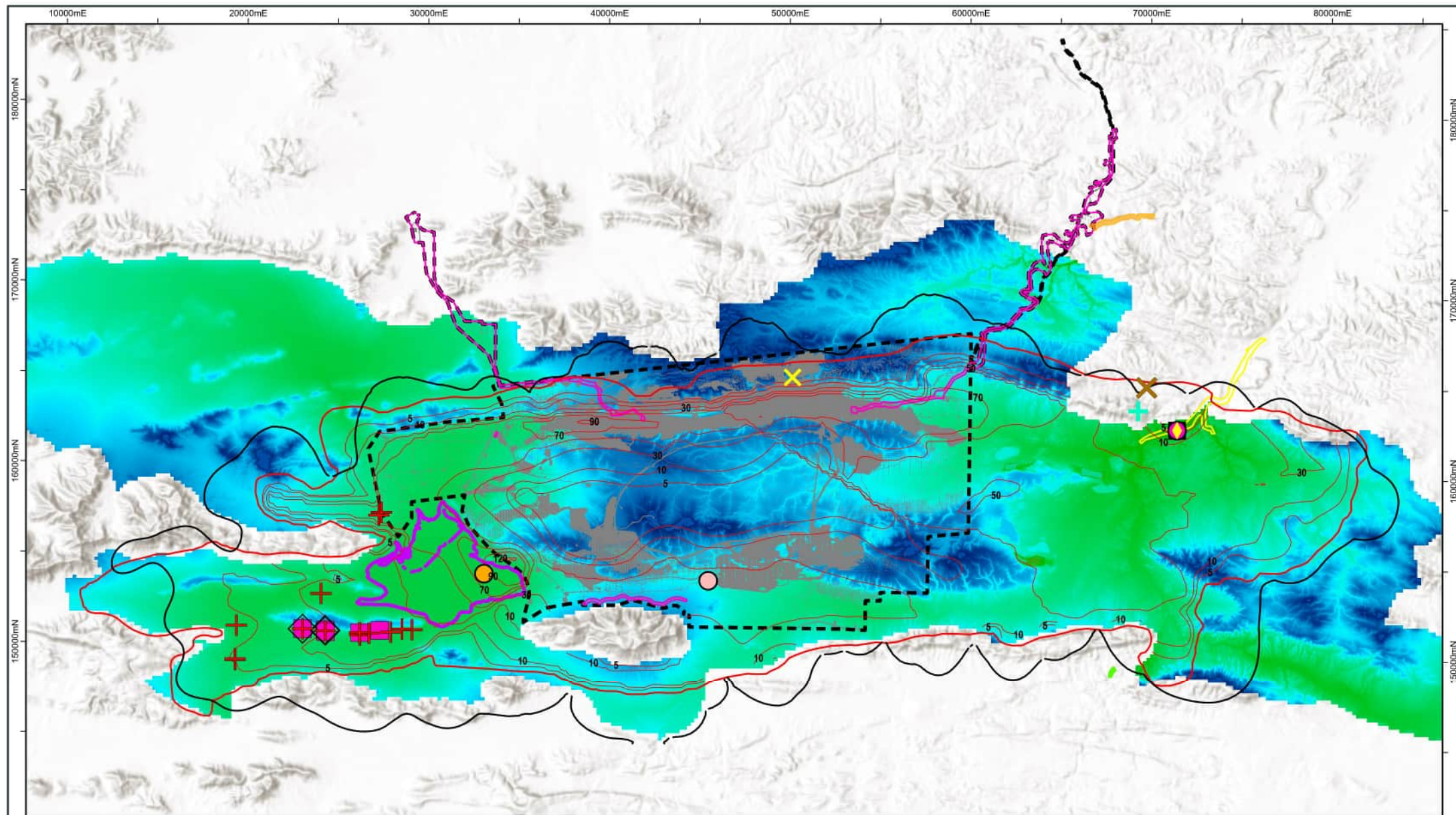
The assessment of potential impacts to each of the eight potentially restricted stygofauna species that have not been previously assessed and which may be subject to additional impacts associated with groundwater drawdown is provided in Section 10.6.2, following consideration of mitigation (Section 10.5).

Table 10-6: Potentially restricted stygofauna species and predicted additional groundwater drawdown

Taxa	Pre-mining depth to groundwater (mbgl)	Groundwater drawdown contour locations where species recorded (mbgl)			Subject to additional groundwater drawdown (worse-case*)
		Approved Proposal	Combined Proposal (base case)	Combined Proposal (worse-case)	
Weeli Wolli Springs					
<i>Bathynella</i> sp. 1	0-10 mbgl	20-50 m contours	2.5-5 m contours	2.5-5 m contours (within Approved limits) 11-14 m post 2045	After 2045
<i>Nais</i> 'sp. Biologic-OLIG117'	0-10 mbgl	20-50 m contours	2.5-5 m contours (within Approved limits)	2.5-5 m contours (within Approved limits) 11-14 m post 2045	After 2045
<i>Vestalenula</i> sp. indet.	0-10 mbgl	20-50 m contours	2.5-5 m contours (within Approved limits)	2.5-5 m contours (within Approved limits) 11-14 m post 2045	After 2045
East Packsaddle					
<i>Isopoda</i> sp. Biologic-ISOP153	21-30 mbgl	N/A	1-2.5 m contours	1-5 m contours	5 m drawdown
Enchytraeidae sp. Biologic-OLIG159	>60 mbgl	5-10 m	5-10 m contours (within Approved limits)	5-10 m contours (within Approved limits)	10 m drawdown
Coondewanna Flats and west/south-west area					
<i>Dussartycyclops</i> sp. B10	31-40 mbgl	20-50 m contours	80-90 m contours	100-110 m contours	No Within approved dewatering limit (previously assessed)
Paramelitidae sp. S04 (BR South)	30-80 mbgl	2-20 m contours (multiple records)	2.5-50 m contours (multiple records)	5-80 m drawdown (multiple records)	Possibly subject to an additional 3 m to 60 m drawdown at various locations
nr <i>Billibathynella</i> `sp. S1`	40-80 mbgl	2-20 m contours (four records)	5-10 m contours (four records)	10-30 m contours (four records)	Possibly subject to an additional 8-10 m drawdown
nr <i>Notobathynella</i> sp. S01	40-80 mbgl	2 -10 m contours (two locations)	5-10 m contours (two locations)	10-20 m contours	Possibly subject to an additional 10-15 m drawdown

Taxa	Pre-mining depth to groundwater (mbgl)	Groundwater drawdown contour locations where species recorded (mbgl)			Subject to additional groundwater drawdown (worse-case*)
		Approved Proposal	Combined Proposal (base case)	Combined Proposal (worse-case)	
Development Envelope					
nr <i>Epactophanes</i> sp. B01	>100 mbgl	20-50 m contours	2.5-5 m contours (within Approved limits)	2.5-5 m contours (within Approved limits)	No Within approved dewatering extents
<i>Bathynella</i> sp. 2	90 mbgl	50 m contours	30 m contours	30 m contours	

* the worse-case scenario has been used in the assessment of potential impacts to stygofauna but is considered to be an overestimate of the likely impact.

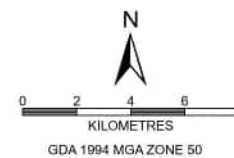


- Indicative Footprint
- Development Envelope
- Existing Disturbance
- Coondewanna Flats
- Weeli Wollli Spring
- Ben's Oasis
- Yandicoogina Gorge

- Approved Proposal 1m drawdown
- Combined Proposal 1m drawdown
- Combined Proposal drawdown contours (m)
- Pre-mining Depth to Groundwater**
- 255 mbgl
- 0 mbgl

Potentially Restricted Stygofauna

- *Bathynella* sp. 1
- *Bathynella* sp. 2
- nr. *Billibathynella* sp. S1
- *Dussarticylops* sp. B10
- + *Enchytraeidae* 'sp. Biologic-OLIG159'
- + *Nais* 'sp. Biologic-OLIG117'
- + *Paramelitidae* sp. S04 (BR South)
- *Vestalenula* sp. indet.
- X *Isopoda* 'sp. Biologic-ISOP153'
- X nr. *Epactophanes* sp. B01
- ◇ nr. *Notobathynella* sp. S01



BHP **PUBLIC**

MINING AREA C SIGNIFICANT AMENDMENT POTENTIALLY RESTRICTED STYGOFAUNA SPECIES, PRE-MINING DEPTH TO GROUNDWATER AND COMBINED PROPOSAL DRAWDOWN

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A3: 1:280,000 REQUESTOR: ENVIRONMENT FIGURE: 10-7
DATE: 19/02/2025 PREPARED: GEOMATICS NO: A1285-082 RevF
REVIEWED:

10.4.3 Modification of stygofauna habitat or assemblages from changes to groundwater quality (direct)

Proposal

As described in Section 10.4.3, there is potential to impact groundwater quality in proximity to the MAR and/or supplementation schemes located at the Northern RAV MAR and at Yandicoogina Gorge. Where there are significant differences in physical and chemical stressors between the source water and the receiving environment, deterioration of water quality could potentially occur (Biologic 2023f). This may relate to differences in geochemistry, or it may be a result of water quality issues affecting the source water such as oxidation as a result of extraction. Depending on the quality of the recharge water compared to the quality of receiving aquifer water, aquifer recharge has the potential to either improve or degrade water quality which may subsequently impact stygofauna (Biologic 2023f).

Groundwater chemistry changes are considered a secondary threat to stygofauna (Bennelongia 2018). Shifts in ionic composition are thought to have little influence on stygofauna richness or abundance, with key analytes relevant to stygofauna being salinity and proportions of major ions (Halse et al., 2014; Biologic 2023f). Stygofauna can somewhat tolerate changes in groundwater quality but may be susceptible to increases in salinity, particularly greater than 2,000 mg/L (Halse et. al. 2014). Some species of stygofauna, such as *Diacyclops humphreysi*, *Archinitocrella newmanensis*, *Pygolabis humphreysi* and *Chydaekata acuminata*, have been shown to tolerate higher TDS values (approximately 3,350 mg/L TDS) and available scientific knowledge suggests that many stygofauna species can tolerate a variable salinity regime (Halse et. al. 2014). However, less resilient species may be vulnerable to salinity increases beyond the range of natural variability. In studies at Ethel Gorge, approximately 60 km south-east of MAC-SF, stygofauna were generally found to be most abundant at salinities (as electrical conductivity, EC) ranging between 1,000 and 2,000 $\mu\text{S}/\text{cm}$ (approximately 670 and 1,340 mg/L TDS; Stantec 2023), whilst other studies indicate that overall stygofauna richness and abundance reduces with increasing salinity above 1,500 mg/L (Halse et. al. 2014). To be conservative, salinity above 1,500 mg/L has been used to inform potential negative impacts to stygofauna.

Based on the water quality assessment conducted for Yandicoogina Gorge (see Section 7.5.11; Biologic 2023f), all predicted values of TDS (the analogue for salinity) will remain well below 1,500 mg/L. The remaining analytes of concern (pH, hardness as CaCO_3 , Mg, SO_4 , N-NO_3 , B and EC) outside of the 80th percentile are considered to have negligible risk to stygofauna (Biologic 2023f; see Section 7.5.4 and 7.7.6).

Potential change in groundwater quality due to the Northern RAV MAR scheme has been assessed through analysis of groundwater quality results at the Northern RAV MAR location (receiving aquifer) in comparison with groundwater quality results from production (dewatering) bores within the Development Envelope (source aquifer; see Table 7-7 in Section 7.5.4). Based on this, all predicted values of TDS (the analogue for salinity) will remain well below 1,500 mg/L (concentration at which impacts to stygofauna are expected), and most ions within Northern RAV are comparable or slightly higher than those observed in the production bores, indicating there is unlikely to be any increase in hardness. Water quality results and relevance to stygofauna can be summarised as follows:

- pH at Northern RAV is slightly basic between 8.3-8.4 and is comparable to the water quality in the Approved Proposal with mean pH of 7.6 and results ranging from 5.6-8.8. Stygofauna have been shown to occur at higher abundances and richness with a pH range of 7.2-8.2, but can tolerate minimum pH of 5.5 and up to 8.5 (Stantec 2023).
- EC at Northern RAV is between 930-1200 $\mu\text{S}/\text{cm}$ whereas the Approved Proposal EC is between 70 - 1,100 $\mu\text{S}/\text{cm}$ with a mean of 610 $\mu\text{S}/\text{cm}$ – all of which are within suitable ranges for stygofauna (Stantec 2023; Halse et al. 2014). Results indicate that all groundwater quality is fresh.
- Most ions within Northern RAV are comparable or slightly higher than those observed in the Approved Proposal, indicating there is unlikely to be any increase in hardness. In relation to calcium, stygofauna

abundance and species richness has been observed to be highest at moderate calcium levels, although less is known about trends in relation to magnesium or other metals.

- Concentrations of metals are comparable between the Approved Proposal and Northern RAV with no values (where available) exceeding ANZG (2018).
- Nitrates (as N) are higher in the Northern RAV area in comparison to the Approved Proposal area with both exceeding the ANZG (2018). Recent studies have shown no clear trends in stygofauna species richness or abundance relative to nitrogen (Stantec 2023). In addition, all concentrations of nitrate are within the 99% value for the protection of species (ANZG 2024).

Based on the above, BHP considers that the risk of impacts to stygofauna from changes to water quality from aquifer reinjection at the Northern RAV MAR to be low.

Combined Proposal

There are two existing MAR schemes operating in the Approved Proposal, which are managed as part of Part V processes including the EP Act Licence L7851/2002/6. These are Juna Downs and South Flank MAR. The proposed locations for the new schemes compared to the existing schemes provide sufficient separation that there is limited combined effect of groundwater quality changes as a result of the new and existing schemes, the schemes target areas of groundwater that have limited hydraulic connectivity. There is no anticipated difference between the potential impact of the Proposal to the combined effect of the Combined Proposal.

10.5 Mitigation

BHP considers that there are potentially significant impacts to Subterranean Fauna requiring targeted management measures, specifically in relation to subterranean fauna habitats and potentially restricted subterranean fauna species, for both stygofauna and troglafauna. The proposed mitigation (including standard management practices) for the Proposal is discussed below. In addition to the proposed mitigation, BHP is currently undertaking additional survey work to address gaps in knowledge regarding the presence and extent of subterranean fauna within the groundwater mounding contour areas of the Proposal.

10.5.1 Avoid

Avoidance of subterranean fauna habitat and individuals is not possible given that dewatering and MAR are key components of this Proposal. However, BHP shall not commence aquifer recharge at the Northern RAV MAR until the troglafauna habitats and assemblages within the groundwater mounding contours can be verified to occur outside the predicted impact areas. This has been included as a proposed implementation condition as described in Appendix 6.

BHP will not exceed groundwater drawdown beyond the Approved Proposal limits at Coondewanna Flats until such a time that either the potentially restricted species at Coondewanna Flats are located outside the area of impact or habitat connectivity beyond the areas of impact can be confirmed (see condition B3-2; Appendix 6).

10.5.2 Minimise

A detailed description and rationale for how impacts associated with water (and subsequently subterranean fauna) will be managed is provided in Section 7.4 and Section 7.6. BHP proposes to continue to manage potential impacts from dewatering and MAR in accordance with the updated CPWRMP (Version 5.0; Appendix 8). Monitoring of groundwater quality will continue to be undertaken in accordance with groundwater licencing requirements or under Part V (for discharge). The management measures outlined in the CPWRMP and required under Part V or as part of the groundwater licencing (described in detail in Section 7.6.3.2), will also assist in ensuring that impacts to subterranean fauna are not greater than predicted

Other minimisation strategies that will be implemented as part of the Combined Proposal for subterranean fauna include (but are not limited to):

- groundwater abstraction will be minimised to that which is required for implementation of the Proposal and will be compliant with existing licence GWL89501
- once aquifer recharge at the Northern RAV MAR commences, mounding will be kept below 10 mbgl (pending outcomes of additional troglofauna survey work, this may be revised if necessary)
- BHP will investigate a reduced dewatering duration for the hydraulically connected pits to Coondewanna Flats
- towards the end of mine life, MAR at B and R deposit will be optimised to increase water levels in the Weeli Wolli Springs catchment.

Mitigation at Weeli Wolli Springs is complex and dependent on third-party operations and is described in detail in Section 7.6.4.1. BHP will implement mitigation of Weeli Wolli Springs for drawdown post closure of RTIO's Hope Downs with the aim of maintaining groundwater levels at the springs and preventing any further decline in groundwater levels in this area (Section 7.6.4.1).

10.5.3 Rehabilitate

Rehabilitation at the Central Pilbara Hub is addressed in the Mining Area C MCP which has been revised to include this Proposal (Appendix 5). BHP will implement the MCP to ensure that the Combined Proposal is decommissioned, and the site rehabilitated to be safe, stable and non-polluting and in an ecologically appropriate and sustainable manner. Areas that are no longer in use will be rehabilitated as soon as practicable, and progressive rehabilitation will be undertaken which will assist in re-establishing nutrient flows into the subterranean environment.

Once mining is complete and there is no more surplus water, the Northern RAV MAR scheme will cease and mounding will recede, potentially allowing troglofauna assemblages within the area to recover (if present).

Rehabilitation of water features and backfilling of pits to maintain suitable surface and groundwater quality and flow regimes at closure is described in detail in Section 7.6.4 and will be relevant to subterranean fauna values, particularly stygofauna.

10.5.4 Other statutory decision-making processes

BHP's view is that there are no other statutory decision-making processes (specifically related to subterranean fauna habitat and species) to mitigate the potential environmental impacts of the Combined Proposal on Subterranean Fauna considering the EPA's *Taking decision making processes into account in EIA: Interim Guidance* (EPA 2021b). Management of groundwater levels is the main mechanism BHP uses to manage the potential impacts to stygofauna in the Development Envelope. Therefore, the other statutory decision-making processes that can manage the potential impacts on groundwater levels in the aquifer (Table 7-16) may also be applicable to subterranean fauna.

10.6 Assessment and significance of residual impacts

BHP has considered the significance of subterranean fauna and relevant issues outlined in EPA's Subterranean Fauna Guideline (EPA 2016b) in assessing the significance of the impacts to Subterranean Fauna from the Proposal and combined effects of the Combined Proposal. The assessment of potential impacts discussed in this section are following the application of mitigation as described in Section 10.5.

10.6.1 Loss or modification of troglofauna habitat and species assemblages from groundwater mounding at the Northern RAV MAR scheme (direct)

The Proposal has the potential to result in the loss or modification of troglofauna habitat and/or species assemblages from groundwater mounding associated with the Northern RAV MAR. The combined effect of the Combined Proposal will be loss or modification of troglofauna habitat within the previously assessed mine pit areas, and the groundwater mounding areas at Juna Downs MAR, South Flank MAR and Northern RAV MAR. However, given the distances between the existing and new MAR schemes, and distances between the mine pits and the Northern RAV MAR scheme, troglofauna habitats and assemblages are likely to differ. Whilst it is anticipated that there will be no additional impacts to the troglofauna habitats and species assemblages previously assessed for the Approved Proposal, impacts to troglofauna from either the Proposal alone or the Combined Proposal will be further informed by pending additional surveys planned to commence in 2025.

To mitigate any potential impacts to troglofauna within the groundwater mounding contours of the Northern RAV MAR area, BHP will commit to not undertaking aquifer recharge at the Northern RAV MAR until it can be confirmed that the troglofauna habitats and assemblages within the mounding contours occur outside the areas of impact (see Section 10.5.1; condition B3-1 in Appendix 6). Following the additional troglofauna survey work described above, BHP will consider appropriate mitigation options (if necessary). Currently BHP have committed to no mounding above 10 mbgl; however, this may be increased (i.e. to 20 mbgl) if studies demonstrate that suitable troglofauna habitat occurs deeper than this. Based on the proposed implementation conditions and subsequent mitigation, potential impacts to troglofauna associated with the Proposal and the Combined Proposal are not expected to be significant.

10.6.2 Loss of stygofauna habitat and species assemblages from groundwater drawdown (direct)

10.6.2.1 Loss or modification of stygofauna habitat from groundwater drawdown

Areas subject to additional drawdown, greater than previously assessed, have been used to assess potential impacts to stygofauna within the groundwater drawdown area of the Combined Proposal. Additional groundwater drawdown will further modify or completely remove stygofauna habitat in areas already subject to drawdown, as well as introducing drawdown into new areas to the west, south-west and north-west of the previously approved drawdown (Figure 10-7).

Additional drawdown is predicted to mostly occur in and around the Coondewanna Flats area, and areas to the west, south-west and the north-west corner of the drawdown contours (Figure 10-7). Groundwater drawdown at Weeli Wolli Springs is more complex as it is predicted to be within the Approved Proposal limits until post 2045 when RTIO Hope Downs goes into closure. Prior to this event, BHP will take over mitigation in order to maintain groundwater levels at the springs. As such, there will be no additional drawdown at Weeli Wolli Springs associated with the Combined Proposal.

As described in Section 10.3.2, the regional aquifers located through the valley between North Flank and Packsaddle, the South Flank paleochannel, west near Coondewanna Flats and east near Weeli Wolli Spring, provide suitable, connected habitat for stygofauna (Bennelongia 2016b). Mapping of shared species with distributions less than 50 km, such as Paramelitidae Genus 2 sp. B03 (range of 11.6 km), *Pygolabis weeliwolli* (range of 28.3 km), and Paramelitidae sp.B02 (range of 47.8 km), as well as locally widespread species with known ranges over 50 km such as *Maarrka weeliwolli*, nr *Billibathynella* sp. B02 and Paramelitidae sp B03 within the Upper Weeli Wolli and Coondewanna catchments suggests that suitable habitat occurs throughout and that there are few barriers to movement for stygofauna across the subcatchments (Figure 10-4; Bennelongia 2016b). The considerable extent and habitat connectivity of the alluvial aquifers (and to a lesser extent the calcrete deposits) of the Tertiary Detrital valley-fill successions in the Weeli Wolli and Coondewanna subcatchments are likely to provide for easy dispersal of stygofauna species between areas of groundwater drawdown and surrounding regional aquifers (Bennelongia

2016b). This is further demonstrated by the occurrence of over 95% of the stygofauna assemblage being known from areas outside the drawdown contours (Table 10-5).

Habitats within the Development Envelope have been subject to drawdown of 20-50 m, as previously approved under MS1072, likely resulting in habitats close to the orebodies being dewatered completely. No additional impacts are expected within these areas as drawdown associated with the Combined Proposal is within the Approved Proposal limits.

Beneath Juna Downs and Coondewanna Flats the regional aquifer is extensive (BHP 2025a). Suitable connected stygofauna habitat is likely to be present within aquifers throughout the Coondewanna subcatchment including the Coondewanna Flats PEC and buffer, and through the wider area. The considerable extent and habitat connectivity of the alluvial aquifers and calcrete deposits of the Tertiary Detritals valley fill successions in the Coondewanna subcatchment likely provide easy dispersal of stygofauna species between areas of drawdown and surrounding aquifers (Bennelongia 2016b). However, BHP propose additional sampling to further investigate the extent of suitable habitat and wider distributions of potentially restricted species in and around the Coondewanna Flats PEC and buffer area. Until suitable stygofauna habitat and/or potentially restricted species can be confirmed to occur outside the areas of impact, BHP will not exceed groundwater drawdown beyond the Approved Proposal limits within the Coondewanna Flats area (see condition B3-2; Appendix 6). Following this, impacts to stygofauna habitat are not expected to be significant and it is anticipated that the EPA's objective for this factor can be met.

10.6.2.2 Loss of stygofauna assemblages from groundwater drawdown

Groundwater drawdown has the potential to result in the loss of individuals and/or modify species assemblages. There is limited information on how stygofauna respond to alterations in groundwater levels. Studies at BHP's Yandi mine have shown that groundwater drawdown associated with dewatering reduces stygofauna populations and/or alters assemblage composition, but that this reduction is often temporary, with assemblages returning, to some extent, once groundwater levels recover (Bennelongia 2013c). Stygofauna of the Pilbara have evolved in an environment where groundwater levels have shown considerable changes over both short and long timeframes and therefore, the local stygofauna assemblages are likely to have adapted to this environment and fluctuating water levels (Bennelongia 2013c). At Coondewanna Flats, a 5 m change in groundwater levels has been observed following inundation of the Flats (AQ2 2016) and so the stygofauna assemblages in and around this area are likely to have adapted to the changing environment.

A total of 11 stygofauna species are currently not known from areas outside the groundwater drawdown area, eight of which may be subject to additional vertical and/or lateral drawdown as a result of the Combined Proposal (Table 10-6; Figure 10-7). The potentially restricted ranges of these stygofauna species are likely to be an artefact of sampling rather than an indication of their true distributions. The eight stygofauna species that may be subject to additional impacts as a result of the Combined Proposal are discussed in further detail below.

Weeli Wolli Springs

There are three potentially restricted stygofauna species recorded within the drawdown contours at Weeli Wolli Springs (Table 10-6; Figure 10-7). These species occur in areas where the predicted drawdown associated with the Combined Proposal will remain within the previously approved limits. Additional drawdown could occur at Weeli Wolli Springs post-2045, following closure of RTIO Hope Downs operations. Prior to this event, BHP will take over mitigation of Weeli Wolli Springs to ensure that groundwater levels at the spring are maintained in accordance with the CPWRMP (see Sections 7.6 and 10.5; Appendix 8). In addition, suitable habitat for stygofauna occurs downstream of Weeli Wolli Spring and outside the predicted drawdown area. Given the extent and connectivity of suitable habitat throughout Weeli Wolli Springs, and the proposed mitigation described in Section 7.6 and 10.5, impacts to the potentially restricted species recorded at Weeli Wolli Springs are unlikely to be significant. Each species is described in further detail below.

One record of *Bathynella* sp. 1 exists within the 2.5-5 m drawdown contours at Weeli Wolli Springs (Biologic 2025b; Figure 10-7). It is likely that this species occurs further downstream based on the inferred extent and connectivity of

habitat at Weeli Wolli Springs (Biologic 2025b). Given the extent and connectivity of suitable habitat, as well as the proposed mitigation and limited additional drawdown, impacts to this species are unlikely to be significant.

Nais sp. Biologic-OLIG117 is an oligochaete worm recorded as a singleton from one location at Weeli Wolli Springs (Biologic 2025b; Figure 10-7). This species is considered a stygophile or stygoxene which is capable of utilising both surface and ground waters. It is considered to be a Potential SRE; however, most oligochaete worms do have wider linear distributions and as such, it is considered likely that this species occurs within the wider local area or catchment (Biologic 2025b). Given this, as well as the mitigation and limited additional drawdown, impacts to this species are unlikely to be significant.

Vestalenula sp. indet. is a singleton recorded from Weeli Wolli Springs (Biologic 2025b; Figure 10-7). It has been included here as is the only specimen from this genus collected during the recent survey. However, this specimen likely represents either *Vestalenula marmonieri* or *Vestalenula matildae*, as all *Vestalenula* sequenced by Biologic to date (22 specimens) have represented these two species; both of which are widespread throughout the Pilbara (Biologic 2025b). Based on this, as well as the proposed mitigation and limited additional drawdown, impacts to this species are unlikely to be significant.

East Packsaddle

Isopoda 'sp. Biologic-ISOP153' is a stygofaunal isopod, recorded as a singleton at East Packsaddle (Biologic 2025b; Figure 10-7). It was recorded in an area that may be subject to 1-5 m drawdown where pre-mining depth to groundwater is approximately 21-30 mbgl (Figure 10-7). Stygofaunal isopods are known to have varying distribution ranges across the Pilbara, comprising both locally and regionally widespread species as well as more restricted species (Biologic 2025b). All other stygofaunal isopods recorded during the recent survey were recorded in areas both inside and outside the Study Area. Using these other stygofaunal isopods as surrogates, it is considered likely that *Isopoda* 'sp. Biologic-ISOP153' is also known from outside the drawdown area (Biologic 2025b). As such, impacts to this species are unlikely to be significant.

Enchytraeidae 'sp. Biologic-OLIG159' is a stygophile/xene recorded at a single location at East Packsaddle where depth to groundwater is relatively deep (i.e. 80 mbgl; Figure 10-7). Oligochaete worms in the families Phreodrilidae and Naididae are regularly collected in groundwater throughout the Pilbara and Yilgarn regions where they are often recorded as singletons. The average linear range of many species is in excess of 50 km, and as such, it is considered likely that Enchytraeidae 'sp. Biologic-OLIG159' occurs more widely than currently known (Biologic 2025b). Based on the above, impacts to this species are unlikely to be significant.

Coondewanna Flats and west/south-west area

There are three potentially restricted stygofauna species in the Coondewanna Flats buffer area and south west drawdown contours, which may be subject to additional groundwater drawdown associated with the Combined Proposal: *Paramelitidae* sp. S04 (BR South), nr *Billibathynella* 'sp. S1' and nr *Notobathynella* sp. S01 (Table 10-6; Figure 10-6 and Figure 10-7). Impacts to these stygofauna species could be potentially significant due to uncertainties over the extent of suitable habitat beyond the drawdown area, the species wider distributions and given the extent of additional drawdown these species may be subject to. Whilst it is considered likely that these species have wider distributions than is currently known given the likely extent of suitable habitat and given that singleton records are often an artefact of sampling rather than a true indication of a species distribution, BHP are in the process of undertaking additional sampling to further inform these assumptions, with results expected 2027. In the interim, BHP propose to not exceed groundwater drawdown beyond the Approved Proposal limits throughout the Coondewanna Flats PEC and buffer area until it can be confirmed that suitable stygofauna habitat and/or the potentially restricted species occur in areas outside the area of impact (see condition B3-2; Appendix 6). Following this, impacts to stygofauna assemblages as a result of the Combined Proposal are not expected to be significant and the EPA's objective for this factor can be met. Each species is described in further detail below.

Paramelitidae sp. S04 (BR South) is an amphipod recorded from 21 holes over 11 km apart including locations within the Coondewanna Flats buffer area, and extending to the west and south-west of the drawdown contours (Figure

10-6). These records may be subject to an additional 2.5-80 m drawdown (Figure 10-6). Some of these records occur in areas where the pre-mining depth to groundwater is over 40 mbgl – depths at which stygofauna habitat is considered to become less suitable (Bennelongia 2016b). While there is no hydrological barrier, such as a dyke, to prevent a broad western extension of the range of *Paramelitidae* sp. S04 (BR South), the depth to groundwater increases in the west and the south, and the effect of greater depth on the suitability of habitat for *Paramelitidae* sp. S04 (BR South) is not well understood, although some records do occur in areas where the depth to groundwater is relatively deep (~82mbgl; Figure 10-7). While estimates of the size of home ranges of stygofauna species within an aquifer are unknown, larger, active stygofauna species such as amphipods generally tend to have larger home ranges over hundreds of metres, if not further (Bennelongia 2016b). Locally, *Paramelitidae* sp. S04 (BR South) is considered unlikely to be restricted (Bennelongia 2016b). However, no records are currently known from outside the area of additional vertical or lateral drawdown. The extent and connectivity of habitat, as well as the likely wider distribution of *P. sp. S04* (BR South) will be further informed by the additional survey work currently in progress. Given that BHP propose to maintain drawdown within the Approved Proposal limits within the Coondewanna Flats buffer area until habitat extent and connectivity and/or the wider distribution of *Paramelitidae* sp. S04 (BR South) can be confirmed, impacts to this species are unlikely to be significant.

There are eight records of nr *Billibathynella* `sp. S1` over 4 km apart, within the Coondewanna Flats buffer area where it may be subject to 8-10 m of drawdown (Figure 10-6 and Figure 10-7). Little is known about this species or the origin of these records; however, they were not previously assessed for the Approved Proposal. It is currently unknown if this species distribution would be likely to extend beyond the area of impact. However, given that BHP propose to maintain drawdown within the Approved Proposal limits within the Coondewanna Flats buffer area until habitat extent and connectivity and/or the wider distribution of nr *Billibathynella* `sp. S1` can be confirmed, impacts to this species are unlikely to be significant.

nr *Notobathynella* sp. S01 has previously been recorded from two locations to the south-west of Coondewanna Flats, in an area that may be subject to an additional 5-20 m drawdown (Table 10-6; Figure 10-7). The full extent and connectivity of suitable stygofauna habitats throughout this area, and extending beyond the drawdown area, are not well understood; however, positive stygofauna records do exist beneath the valleys to the south west of the drawdown contours (Figure 10-5). In addition, the occurrence of *Notobathynella* sp. outside the contours also demonstrates habitat connectivity, as well as the potential wider distribution of species from this genus. Given that BHP propose to maintain drawdown within the Approved Proposal limits within the Coondewanna Flats buffer area until habitat extent and connectivity and/or the wider distribution of nr *Notobathynella* sp. S01 can be confirmed, impacts to this species are unlikely to be significant.

10.6.3 Modification of stygofauna habitat or assemblages from changes to groundwater quality (direct)

Based on the water quality assessment undertaken for Yandicoogina Gorge (see Section 7.5.4 and 10.4.3), there will be minimal changes to water quality as a result of aquifer recharge and reinjection. The predicted values of TDS (the analogue for salinity) will remain below 1,500 mg/L (concentration above which stygofauna abundance and richness has been known to decline) and the remaining analytes are considered to have a negligible risk (Biologic 2023f). In addition, it will be a requirement under the Part V licence of the EP Act for the scheme to ensure that there is no significant deterioration of water quality and that there are no adverse impacts on associated environmental values. Regular monitoring and reporting of water quality at Yandicoogina Gorge will be undertaken in accordance with the TARP (see Section 10.5) and results will be provided to DWER as part of the AER process which will ensure that this requirement is fulfilled. Any changes to water quality as a result of surplus management will be detected (if they were to occur); however, as discussed above, water quality between the source and receiver is similar, and any changes in chemical composition (if any) will be minor (see Section 7.5.2.4 and 7.5.3.4). As such, potential impacts to stygofauna associated with changes to groundwater quality at Yandicoogina Gorge are unlikely to be significant.

As described in Sections 7.5.4 and 10.4.3, potential changes in groundwater quality due to the Northern RAV MAR scheme are considered to be minor, if at all. All predicted values of TDS will remain well below 1,500 mg/L (concentration at which impacts to stygofauna are expected), and most ions within the receiving aquifer at Northern RAV are comparable or slightly higher than those observed in the source aquifer, indicating there is unlikely to be any increase in hardness. In addition, it is a requirement under the Part V licence of the EP Act for the schemes to ensure that there is no significant deterioration of water quality and that there are no adverse impacts on associated environmental values. Therefore, BHP considers that the risk of impacts to stygofauna habitat from changes to water quality from injection associated with the Northern RAV MAR is low and unlikely to be significant.

10.6.4 Significant residual impacts

Following the application of the mitigation hierarchy (Section 10.5), BHP considers that there are possible significant residual impacts to subterranean fauna from the Combined Proposal. BHP proposes to implement the mitigation and management strategies described in Section 10.5 and the proposed implementation conditions described in Appendix 6 so that the Proposal can be managed to meet the EPA's objective to protect subterranean fauna so that biological diversity and ecological integrity are maintained. See Section 10.7 for the discussion on the outcomes relating to the identified residual impacts and BHP's proposed assurance (regulation) and monitoring, where required.

10.7 Environmental outcomes

Table 10-7 summarises the environmental outcomes, proposed assurance (regulation) and proposed monitoring (if required) for each residual impact to Subterranean Fauna. Table 10-7 demonstrates how the environmental outcomes for the Combined Proposal, together with the proposed regulation and monitoring, are anticipated to be consistent with the EPA's objective for Subterranean Fauna, pending the outcome of the additional survey work currently being undertaken.

As required by the EPA's ERD Instructions for Significant Amendments, BHP has included information about the existing implementation conditions for the Approved Proposal (Appendix 2). As provided for as an option in the EPA's ERD Instructions, BHP has proposed conditions (including outcome-based conditions) for subterranean fauna for the EPA's consideration, in Appendix 6.

Table 10-7: Subterranean Fauna - environmental outcomes and proposed assurance and monitoring

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
1. Loss or modification of stygofauna habitat in areas subject to additional groundwater drawdown	No adverse impact to stygofauna habitats and/or assemblages in areas outside the drawdown contours No adverse impact to stygofauna habitat and/or assemblages at Weeli Wolli Springs	Refer to Inland Waters Section 7.8 (Table 7-16, Residual impact 1 – RiWI Act 5C licence regulation and monitoring) Condition B1-1 The proponent must ensure the implementation of the proposal achieves the following environmental outcomes: (2) no reduction in the extent of the Weeli Wolli Spring occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal (3) no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal (4) no increase to groundwater levels in Yandicoogina Gorge beyond historical recorded water levels.	Ongoing groundwater monitoring, as detailed in the CPWRMP (Version 5) once approved by the DWER, to ensure groundwater level and quality are maintained.	Whilst some stygofauna habitat will be modified or lost within the Groundwater Drawdown area and at Coondewanna Flats, areas of suitable, connected habitat will remain throughout the wider region. These areas will assist with providing refuge and dispersal pathways for stygofauna in areas outside those to be impacted. The ecological integrity of stygofauna habitat within the wider region will be maintained which is consistent with the EPA's objective
2. Loss or modification of individuals or species assemblages for three potentially restricted stygofauna species not known from outside the additional groundwater drawdown area: • Paramelitidae sp. S04 (BR South)	Maintenance of at least 95% of the stygofauna assemblage known from the local area	(4) no increase to groundwater levels in Yandicoogina Gorge beyond historical recorded water levels. Condition B3-2 The proponent must not exceed groundwater drawdown beyond the Approved Proposal limits at Coondewanna Flats until either: (1) the extent and connectivity of stygofauna habitat between the		The biological diversity of the stygofauna species assemblage will be maintained within the Groundwater Drawdown area and wider region, which is consistent with the EPA's objective

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
- nr <i>Billibathynella</i> `sp. S1` - nr <i>Notobathynella</i> sp. S01.		stygo fauna impact area with habitat outside that area is confirmed, and/or: (2) The distributions of potentially restricted stygo fauna species Paramelitidae sp. S04 (BR South), nr <i>Billibathynella</i> `sp. S1`, and nr <i>Notobathynella</i> sp. S01 are either confirmed, or considered likely, to occur outside the impact area. Condition B3-4 The proponent shall submit the results of the subterranean fauna survey and habitat assessment required by condition B3-2 to the CEO and shall not exceed previously approved dewatering drawdown thresholds until the CEO has confirmed by notice in writing.		
3. Temporary loss of potentially suitable troglo fauna habitat and/or species assemblages within the groundwater mounding contours at Northern RAV MAR	No adverse impact to troglo fauna values within the mounding contours of the Northern RAV MAR	Refer to Inland Waters Section 7.8 (Table 7-16, Residual impact 1 – RiWi Act 5C licence regulation and monitoring) Condition B3-1 The proponent must not undertake any operation of the Northern RAV managed aquifer recharge scheme until: (1) the survey results confirm troglo fauna habitat connectivity exists between the Northern Runaway	RiWi Act 5C licence to take water Groundwater Operating Strategy will set out monitoring requirements EP Act Part V licence Licence conditions will set out monitoring requirements	Troglo fauna habitat and assemblages will be maintained at a local and regional level (pending outcomes of additional survey work), which is consistent with the EPA's objective

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
		Valley impact area and troglofauna habitat outside that area and/or (2) the survey results confirm that the distribution of any potentially restricted troglofauna species is likely to occur outside of the Northern Runaway Valley impact area. Condition B3-3 The proponent shall submit the results of the subterranean survey required by condition 4-1 to the CEO and shall not commence managed aquifer recharge of surplus water at Northern Runaway Valley until the CEO has confirmed by notice in writing.		

¹ see the Proposal Content Document (Appendix 1) and the proposed implementation conditions (Appendix 6) for the regulation for the Combined Proposal.

11 Social Surroundings

11.1 EPA factor and objective

In accordance with the EPA Factor Guideline for Social Surroundings, the environmental impact assessment considered interactions between the Proposal, the Combined Proposal, and the surrounding biological environment, including potential impacts to a person's aesthetic, cultural, economic or social surroundings.

The EPA's objective for the Social Surroundings factor is:

To protect social surroundings from significant harm.

11.2 Relevant policy and guidance

BHP assessed this environmental factor consistent with the following relevant EPA policies and guidance, as outlined in Table 11-1.

Table 11-1: Social Surroundings - policy and guidance

EPA policy and guidance	Consideration of EPA policy and guidance
<i>Environmental factor Guideline – Social Surroundings</i> (EPA 2023b) <i>Technical Guidance EIA of Social Surroundings – Aboriginal Cultural Heritage</i> (EPA 2023d)	- Identified the values which may be impacted, and their significance - Identified activities that can impact social surroundings - Applied the mitigation hierarchy to avoid or minimise impacts on social surroundings, where possible - Undertaken consultation with the Banjima representatives through Banjima Native Title Aboriginal Corporation (BNTAC) on the Proposal.

BHP recognises that Aboriginal and Torres Strait Islander People have an intrinsic connection to land, water, culture, and heritage and is committed to agreement making with Traditional Owners and to facilitating local decision making by Traditional Owners. BHP has undertaken consultation and engagement with the Banjima Traditional Owners, facilitated through BNTAC, in relation to the Proposal, to understand the social, cultural and heritage values of the Development Envelope and surrounds, and to ensure that these values are managed in a consultative and holistic manner, in accordance with the current EPA social surroundings objective, legislative requirements, the Comprehensive Native Title Agreement in place between BHP and Banjima People (Comprehensive Agreement) and Traditional Owner expectations. These engagements are summarised in Section 11.3.2.

11.3 Traditional Owners and values

11.3.1 Native Title

The Banjima People are the Traditional Owners of the land that underlies the Combined Proposal. The Development Envelope sits mostly within the external boundaries of the Banjima Native Title determination area (WCD2014/001) but it also intersects Nyiyaparli Native Title Determination area (WCD 2018/008) (Figure 11-1). BHP has an ongoing relationship with the Banjima People which is formalised through the Comprehensive Agreement and associated registered Indigenous Land Use Agreement (ILUA). The Comprehensive Agreement covers the entire Banjima Native Title determination area, which spans an area of 8,263 square kilometres (826,300 ha) and includes a heritage protocol supporting the identification of heritage and cultural values within the determination area and the

management of BHP's activities to minimise impact on cultural heritage and protect cultural heritage values from significant harm.

Representatives from both BHP and the Banjima Traditional Owners meet regularly through the established Heritage Advisory Council (HAC). This forum is an important part of the relationship between BHP and the Banjima Traditional Owners which enables sharing of information, feedback from recent engagements and identification and discussion of concerns and decision making in relation to matters including heritage and environment. BNTAC represents the Banjima Traditional Owners, and BHP maintains an ongoing relationship with BNTAC through regular communication and the pathways prescribed in the Comprehensive Agreement.

11.3.2 Engagement with Banjima Traditional Owners

BHP consulted with the Banjima Traditional Owners in relation to the Proposal between June 2022 and November 2024, to better understand the broader social, cultural, heritage and environmental values of their lands in and around the Combined Proposal, to understand and respond to any concerns and questions in relation to the potential impacts of the Proposal and Combined Proposal, and to work together to identify priorities for avoidance and management. These engagements to date have included HAC meetings and visits on country. A summary of engagement undertaken to date is provided in Table 11-2.

Table 11-2: Record of engagement with Traditional Owners

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
13 November 2024	BNTAC review of MCP as part of the review of the draft Mining Area C-South Significant Amendment Referral Supporting Document (Version 0 of this document)	A draft copy of MCP Revision was provided to BNTAC for review as part of a broader review of the Significant Amendment Referral. Feedback on the draft MCP was provided by BNTAC in a letter to BHP dated 13 November 2024 (Pentium Water 2024).	Key issues raised by BNTAC included the requirement for more consultation on closure outcomes, post mining land use and final landforms, and alignment with the Banjima draft position statement on closure.	Key items raised by BNTAC have been considered by BHP and responses have been included in the forward work plan of this MCP, including: • Further assessment of mine plans to identify opportunities for backfill of pit voids to eliminate pit lake formation for South Flank • Identification of opportunities to trial geomorphic landforms in the Pilbara • Further refinement of risk assessments and completion criteria • Ongoing consultation with Banjima, particularly in relation to the draft position statement on closure outcomes BHP will provide a formal response to the feedback received by BNTAC. In summary, BHP acknowledged receipt of the draft position statement on closure outcomes and has committed to further consultation on those aspects in relation to progressing the closure strategy. With regards to post mining land use, BHP notes that Rio Tinto holds the underlying pastoral lease that MAC and South Flank

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
				currently operate on, and any change in post mining land use will require agreement with Rio Tinto.
1 November 2024	HAC Meeting undertaken at The Aloft Perth. Banjima Elders, BNTAC, and BHP were present.	During this HAC meeting BHP sought endorsement for the SCHEMP.	Endorsement was received by BHP by HAC representatives based on the following conditions: - At each HAC meeting updates are to be provided to the HAC, including all relevant monitoring required by BHP's Ministerial Statement, and the actions from Table 5-1 of the SCHEMP to the satisfaction of the HAC - BHP investigate the potential for regional impacts due to the dewatering activities particularly near Coondewanna Flats. - BHP investigate reinjection to mitigate regional aquifer drawdown impacts, particularly Coondewanna Flats. - BHP and HAC are aligned on the area 'Coondewanna Flats' to satisfy and protect the ethnographic values, and achieve the above conditions, which is to be agreed at the first HAC in 2025	BHP to update the SCHEMP with the conditions from the HAC and implement accordingly.
28 October 2024	Workshop at BHP Offices (BHP, BNTAC and BNTAC technical advisors) This workshop included BHP responses and discussion regarding	Prior to the workshop BNTAC consultants were provided a draft of the ERD for review and comment. Detailed written feedback from BNTAC was provided prior to	Subterranean fauna: The independent impact assessment to stygofauna as a result of dewatering should be provided prior to Banjima endorsement. Impacts to troglifauna from Upper Marillana Creek discharge and associated wetting front are not provided. Banjima may not be comfortable being asked by BHP for endorsement of the submission of this ERD before	BHP stipulated the company would not undertake an activity that had an unmitigated species extinction risk. Additional sampling and independent review are underway. Only if the additional sampling and independent review confirm species extinction risk is mitigated will dewatering drawdown and/or

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
	BNTACs comments on the provision of the Mining Area C-South Flank Significant Amendment Environmental Review Document (ERD)	the workshop. The agreed key issues are summarised here. BHP provided further information, explanation and commitments.	receiving results of the proposed troglofauna sampling at Northern RAV MAR.	mounding extend beyond already approved levels. Troglofauna studies at Northern RAV will be undertaken with findings provided to BNTAC. BHP anticipate that the EPA will condition that this work to be completed and demonstrate no adverse impact to troglofauna. BHP commits to seek independent view on internal assessment of troglofauna at Upper Marillana Creek. BHP committed to provide independent reports when available.
			SCHEMP not reviewed as part of the draft submission documentation review.	BHP shared the SCHEMP highlighting key updates during page turn. Final version updated with outcomes of this engagement to be provided to Banjima for endorsement.
			Banjima remain concerned about the use of Upper Marillana Creek discharge and would prefer that surplus water discharge to creeks is not undertaken. However, BHP has outlined a management framework for these discharges which Banjima HAC members are still considering.	BHP understands that Banjima People prefer not to have creek discharge. The proposed modifications were discussed including: limited operational period (5 years), a 90-day no discharge period, and triggers and thresholds. Controls and monitoring will be defined in the CPWRMP.

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			Mineral precipitation is of concern to Banjima. Banjima has observed undesired impacts at Weeli Wolli Creek where the creek bed has undergone change from loose gravels to solid calcium carbonate. Banjima does not support the uncontrolled discharge of waters that may change the geophysical characteristics of the watercourses downstream of the discharge point.	Further information was shared regarding the treatment of calcium carbonate within the Combined Proposal boundary to prevent scale occurring on creek beds. Controls and monitoring will be defined in the CPWRMP.
			Fauna underpasses should be included as part of the pipeline project.	Fauna underpasses/overpasses will be included as part of the pipeline project.
			Banjima are already concerned about impacts to Weeli Wolli Creek and Springs. The impacts predicted post 2045 are significantly more severe. Banjima will not support impacts that exceed the currently approved impacts.	BHP confirmed existing commitment to maintain the extent of the Weeli Wolli Spring (WWS) Priority Ecological Community. Proposed operational mitigations via MAR at R and B deposit were shared. BHP intention to develop regional strategy for WWS in collaboration with RTIO and Banjima was discussed. BHP agreed to continue discussions with Banjima through appropriate forums regarding long term custodian model for WWS.
			Banjima do not support pit lakes at MAC-SF.	BHP confirmed commitment to ongoing discussion regarding pit lakes through the Closure workshops.

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			CPWRMP not reviewed as part of submission documentation review as it had not been updated.	BHP committed to update the CPWRMP to align to the ERD and feedback during the session including; - Monitoring pools in Marillana Creek - Creek discharge triggers and thresholds and contingency actions. -Calcium precipitate visual monitoring along creek discharge. - Weeli Wooli Springs continued groundwater level monitoring, identification of tree health monitoring sites and vegetation monitoring methodology. -Coondewanna Flats continued monitoring of groundwater levels, tree health and wetting front (from RAV infiltration ponds) -Ben's Oasis continued monitoring of groundwater levels and identification of tree health monitoring sites.
May 2024	On-country Social Surroundings Engagement with Banjima People and BNTAC Consultants. BHP responses were provided to BNTAC consultants in a virtual	The engagement focused on the elements of the Proposal which had been changed since initial Social Surroundings engagements in 2022. Banjima feedback was provided through a report documenting the outcomes of	Yandicoogina Gorge injection should not be used as a “business as usual” disposal option, rather supplementation of gorge water levels should continue until water levels return to historical levels and are self-sustaining. BHP to provide written advice to BNTAC on supplementation program parameters, trigger and thresholds and associated commitments and	BHP will operate the Yandicoogina GDE Supplementation Scheme in accordance with the agreed TARP reviewed and supported by Banjima. The TARP details supplementation program parameters and includes triggers and thresholds for the Yandicoogina Gorge trial. The supplementation scheme at Yandicoogina Gorge to be integrated into the CPH Stage 1

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
	meeting on 14 August, 2024	the May 2024 On-Country Consultation for the Proposal was provided by ACHM (Connolly <i>et. al.</i> 2024)	management plan and procedures before seeking endorsement for Banjima HAC. Feedback on Surface Discharge at Upper and Lower Marillana Creek Creating artificially supported ecosystem along the wetting front similar to that of RTIOs Hope Downs 1 mine discharge at Weeli Wooli Creek (noting Lower Marillana already receiving approved surface discharge of up to 40ML/d). Banjima concerned that these will be utilised as a “business as usual” manner when capacity of other systems are over estimated. Commitment to have water not reach Flat Rocks is noted, however the Upper Marillana Discharge remain unacceptable to Banjima. RAV MAR Capacities Infiltration ponds - Clearing 2.6Ha native vegetation per pond = 20.8Ha. Efficacy of ponds is unclear. No empirical data to support capacity assumptions. Result of underperformance will be use of Creek discharge. Injection - Inadequate information provided on the number of bores, locations or how the anticipated 20ML/d (7.3GL/a) capacity has been determined	SCHMEP, EP Act Part V approval conditions & RiWI Act licensing. Upper and Lower Marillana Creek discharges will be operated as follows: Contingency (last resort), 5-year maximum operating life, with a maximum daily discharge of 30ML/d, 90 day no discharge period during dry season. For Upper Marillana Creek a wetting front limit, not to reach Flat Rocks. A TARP to be in place to limit wetting front (Trigger proposed at 24 km, Threshold at 27 km). Infiltration basin capacities are based on actuals from existing RAV scheme (infiltration 10-15ML/d). Total Return to Ground (RTG) for the existing Runaway Valley Scheme is ~70%. Northern RAV MAR will be combined system of injection and infiltration (injection preferentially used over the infiltration ponds) with a capacity of 20ML/d. Modelling results for combined injection and infiltration indicate that a rate of 20ML/d can be sustained for 5-6 years before breaching the 10mbgl trigger. 10mbgl mounding limit proposed as trigger to mitigate risk of unacceptable change.

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			Pipelines installed for the Proposals should be raised off the ground by at least 0.2 m at regular intervals (e.g. no less than every 50m) to allow for the passage of small fauna, water, seeds and other organic and inorganic matter and nutrients beneath the pipeline, as well as the pipeline being buried, or with earthen ramps built over the top of the pipeline also at regular intervals (e.g. no less than every 200 m) to allow for larger fauna to cross over pipelines.	BHP will consider the guidance regarding fauna and flora access across pipelines when assessing extended above ground pipeline runs that create new barriers to natural movement.
			Alternative to the north-west Scheme Remove north-west Scheme, increase capacity of eastern scheme pipelines and deposit water into pit voids at Yandi mine. Pit reservoir to act as MAR via infiltration and stored water resource available for beneficial use.	BHP commits to explore alternative ideas for surplus water disposal and Yandi Closure collaboratively with Banjima. Yandi mine voids are not yet available to receive water safely (geotech risk), backfill cannot be undertaken into wet pits. Placement of water into Yandi pits as interim or permanent closure beneficial use strategy is premature. Water Discharged to pit lakes will be highly exposed to evaporation with major losses (>50%) and minor infiltration benefit (2.5-15%) in comparison to Injection and Creek discharge options (70-100% RTG). BHPs water Stewardship principles of maximising preservation of water resources via return to ground are our priority for responsible water resource management.

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
24 April 2024	BNTAC meeting at BHP Offices	Change of scope to CPHSW Project Stage 1 since 2022 social surroundings engagements and discussion on further consultation with Banjima representatives.		BHP and BNTAC agreed to further engagement on country regarding Yandicoogina Gorge, volumes of discharge, dewatering drawdown, and communication towers. No Banjima People were present at the meeting.
7 December 2023	HAC Meeting Banjima representatives, BNTAC	CPHSW-1 scope change material included in pre-read to BNTAC/HAC members, but material not discussed at HAC meeting.	None	None
27 September 2023	HAC Meeting Banjima representatives, BNTAC	BHP presented an update of the MAC/South Flank Water Project (as per pre-read pages 69-73), including: Review of previous SCHEMP consultations. Proposal and scope included dewatering uplift and increased development envelope including a creek diversion at South Flank and revised modelling and ghost bat information. Investigating the short-term solution over coming weeks. Work is being undertaken by BHP to develop the SCHEMP and seek feedback from BNTAC consultants to work towards a Part 4 application.	BNTAC/Banjima sought clarification that BHP will be seeking endorsement of the SCHEMP at the next HAC	BHP confirmed endorsement of the SCHEMP will be sought at the next HAC

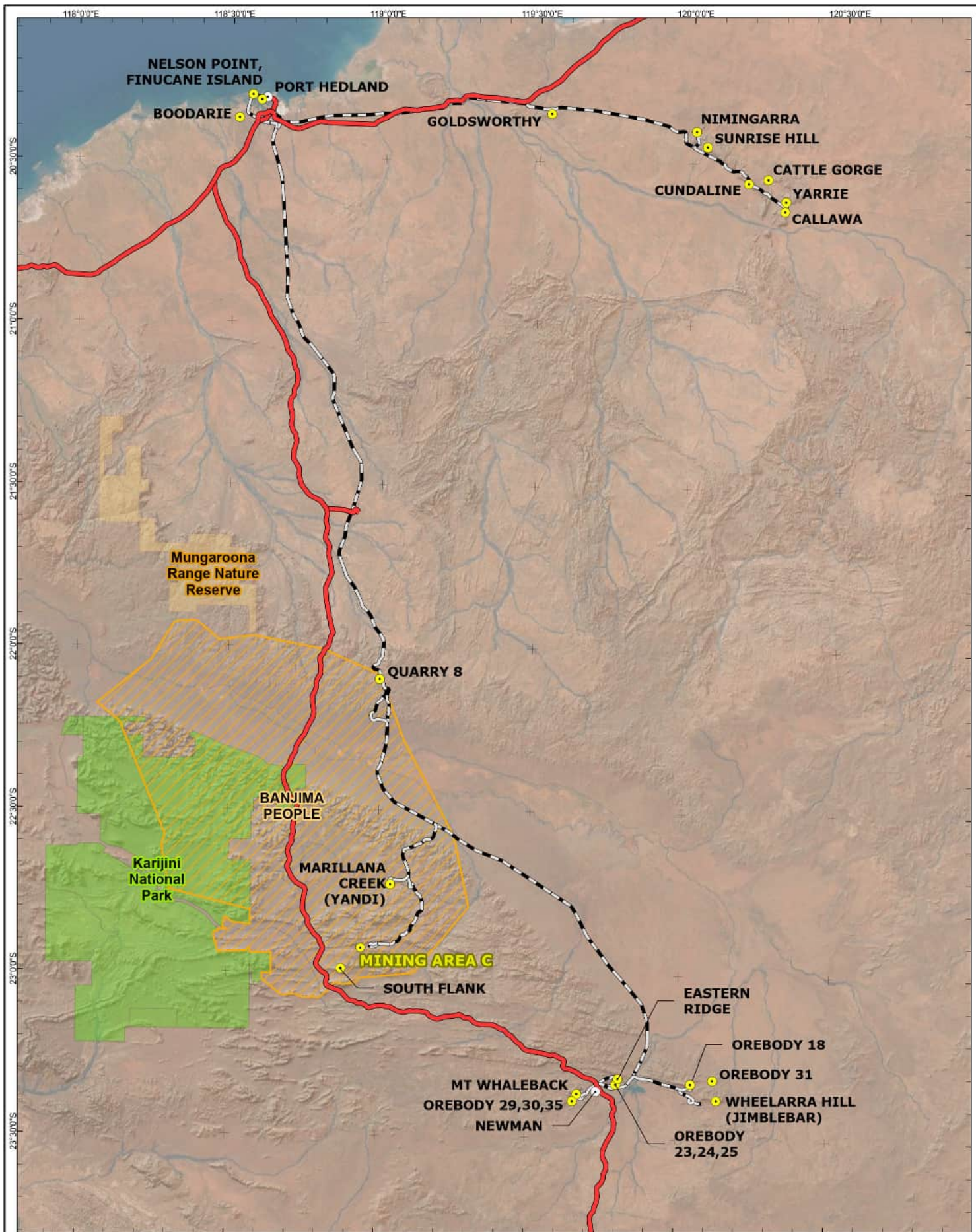
Date	Description of engagement	Summary	Banjima Feedback	BHP Response
		This will be finalised in October with view of endorsement at November HAC.		
21-22 November 2022	HAC Meeting Banjima representatives, BNTAC	Consultation on the Proposal. BHP presented the recommendations from two completed social surroundings in June and July 2022	None	None
18-22 July 2022	Social Surroundings On-Country engagement with Banjima representatives, BNTAC	Social Surroundings engagement including project overview, identification of existing values, potential impacts and proposed environmental management	The Banjima People who participated in Trip 2 of this Social Surroundings Assessment have the following recommendations: 1: Heritage surveys are conducted in the Development Envelope before the Proposal is implemented, (as is legally required under the <i>Aboriginal Heritage Act 1972</i> (WA)) 2: Monitoring of conservation significant flora and fauna, dust and water is undertaken throughout the life of the Proposal (as is legally required under the EPBC Act and the EP Act). 3: Flora and fauna which Banjima People hunt and collect for food and bush medicines such as kangaroos, emus and bush turkeys, should be monitored in the Development Envelope. 4: Banjima People and BHP's environmental officers should work together to design and implement monitoring programs for the Proposal, and BHP should keep Banjima People fully apprised of the results through relevant committees.	BHP committed to give due consideration to feedback from Banjima and providing Banjima feedback on those considerations. This is discussed in ongoing engagements.

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			5: Regeneration of the Development Envelope should commence from the outset of the Proposal, in consultation with Banjima People. Revegetation should use native seed stock from plants in the locality. 6: Managed Aquifer Recharge schemes (reinjection borefields) are developed and implemented as the preferred method for managing surplus water in the Proposal. It is acknowledged that this option takes time to develop. In the meantime, water may be managed through discharge into creeks and storage in ponds, as indicated in the Proposal. It is further recommended that: 1: For all consultations, BNTAC must nominate the rightful Banjima People who have the authority to speak for the place which is to be assessed. Top End Banjima assess the Top End and Bottom End Banjima assess the Bottom End. 2: Eight (8) Banjima men and women (4 Elders and 4 young people) should work together with BHP environmental officers on environmental monitoring and surveys. 3: Eight (8) Banjima men and women (4 Elders and 4 young people) should be engaged by BHP as Banjima Heritage Officers to support heritage surveys and share the value cultural heritage within BHP 4: One or more cultural awareness packages should be developed and implemented by Banjima Elders (men and women) to support BHP staff and contractors in their work. Packages should include an on-Country	

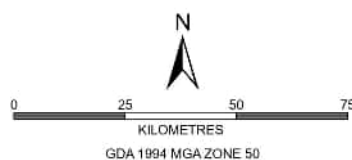
Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			component and address critical matters of cultural safety and respect for Banjima Culture and Country.	
13-17 June 2022	Social Surroundings On-Country engagement with Banjima representatives, BNTAC	Social surroundings engagement including CPH Surplus Water project overview, identification of existing values, potential impacts and proposed environmental management. On country discussion of Banjima cultural values	Proposal was supported. The following recommendations were made: 1: Design, implementation and management of the Proposal protects Banjima values, as embodied in flora, fauna, water, rocks and other features of the landscape. It is incumbent on BHP to ensure that these features retain their condition both within and beyond the Development Envelope, in accordance with the standards expected by Banjima People, as stipulated in the Proposal's CHMP. 2: Infrastructure (such as pipelines) do not impede or obstruct natural processes such as the movement of plants (seeds), animals and water within or beyond the Development Envelope. 3: Monitoring of flora, fauna, dust and water quality will be undertaken throughout the life of the Proposal, in close consultation with Banjima People. 4: Managed Aquifer Recharge schemes (reinjection borefields) are developed and implemented as the preferred method for managing surplus water. It is acknowledged that this option takes time to develop. In the meantime, water may be managed through discharge into creeks and storage in ponds, as indicated in the Proposal. 5: Drone footage of the confluence of Marillana Creek and the tributary into which BHP proposes surface discharge of surplus water is obtained and shown to Banjima People at the upcoming Consolidation Workshop.	BHP committed to give due consideration to feedback from Banjima and providing Banjima feedback on those considerations.

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			6: Banjima People have first rights to business opportunities associated with the Proposal. Further to the Proposal, it is recommended that Banjima People, BNTAC and BHP together or separately (as appropriate): 1: Re-name Pineapple Hill with a Banjima name. Bird-urula is suggested by the Banjima People who participated in Trip 1. 2: Culturally map Bird-urula and other important places in the Development Envelope. The Banjima People who participated in Trip 1 have shared considerable resources with the anthropologist to support a cultural mapping project. The results of this project should be held by BHP and shared with BHP staff and possibly others under the direction of the Banjima People who supplied the information. 3: Develop a Keeping Place for One Banjima culture (location to be determined via further consultation). 4: Review the Banjima Land Access Protocol. 5: Commission an independent review of the terms of reference and representation on BNTAC-BHP Implementation Committees. 6: Develop a long-term sustainability plan for Banjima Country. This should include identifying business opportunities for Banjima People on Country within and beyond mining, such as waste management, mine restoration work and cultural tourism. Adequate resourcing and clear and transparent protocols, processes and accountability are important to ensure the success of businesses.	

Date	Description of engagement	Summary	Banjima Feedback	BHP Response
			7: Focus on wealth generation and sustainable futures for Banjima People. On-Country communities (5-Mile, Youngaleena and Wirrilimarra) should be sustainable. 8: Record and acknowledge the location of the Federal Court sitting and handing down of Native Title as a significant place in modern Banjima history. 9: Where appropriate, recommendations (eg. #7 and #8) should be enshrined in the modernised BHP Comprehensive Agreements.	



- BHP WAIO operation
- Town
- National highway
- - - Rail
- ▨ WA Native Title Determinations (WAIO)



BHP

PUBLIC

MINING AREA C-SOUTH FLANK SIGNIFICANT AMENDMENT BANJIMA NATIVE TITLE AREA

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A4: 1:1,700,000 PREPARED: GEOMATICS FIGURE: 11.1
DATE: 11/02/2025 REQUESTOR: ENV APPROVALS NO:

A1285-043-RevA

11.3.3 Surveys, values and interests

BHP has undertaken numerous archaeological and ethnographic surveys in the Development Envelope as part of the Approved Proposal (Table 11-3). Collectively, these surveys have identified the location and type of potential heritage sites within the Development Envelope. The heritage values have been determined by BHP, heritage consultants and Traditional Owners by conducted over 200 ethnographic and archaeological heritage surveys within the Development Envelope (BHP 2017b).

The methodology of the heritage surveys is based on pedestrian transects that covered the entire Development Envelope. All heritage places determined through survey have been mapped and recorded. The information is then managed in a spatially enabled database. All surveys were conducted by qualified archaeologist and anthropologists in partnership with Banjima participants (BHP 2017b).

Archaeological surveys undertaken for the Proposal have identified over 1,500 places within the Development Envelope that show evidence of past human occupation and interaction with the environment, and these were discussed at the time with the relevant Traditional Owners. The Development Envelope specifically avoided the Mount Robinson significant site, as agreed with the Traditional Owners as an exclusion zone.

In addition to the surveys undertake for the Approved Proposal, the footprint for the Proposal has undergone several additional heritage surveys:

North-east Scheme

- More than 12 Archaeological Surveys have been completed over this area between 1994 to present
- Approximately eight Ethnographic Surveys have been completed over this area between 1990s to 2022
- Six Heritage Exclusion Zones identified inside or within 30 m of NE Scheme Footprint.

Yandicoogina Gorge

- More than 18 Archaeological Surveys have been completed over this area between 1994 and 2024
- Approximately eight Ethnographic Surveys have been completed over this area between 1990s and present
- 12 Heritage Exclusion Zones identified inside or within 30 m of Yandicoogina Gorge Footprint.

North-west Scheme

- More than 13 Archaeological Surveys have been completed over this area between 2000 and 2018
- Approximately eight Ethnographic Surveys have been completed over this area between 2001 and 2016
- Five Heritage Exclusion Zones identified inside or within 30 m of NW Footprint. One site is an Internally Protected Area. BHP has committed to protect this site for the Life of Asset.

GCOSA Diversion Structure

- More than two Archaeological Surveys have been completed over this area in 2012 and 2018 with further surveys ongoing
- Approximately two Ethnographic Surveys have been completed over this area in 2008 and 2019.

Overall, 23 Heritage Exclusion Zones were identified inside or within the Indicative Footprint. One of these sites is an Internally Protected Area. BHP has committed to protecting this site for Life of Asset (life of the Combined Proposal). Additional archaeological surveys are being undertaken within the 50 m GCOSA Diversion construction footprint, with ongoing engagement with Banjima Traditional Owners to determine if further surveys are required.

Throughout BHP's engagement and consultation with the Banjima Traditional Owners through BNTAC, and during heritage surveys, Banjima Traditional Owners have spoken of the significance of water. Water is considered central to Banjima People's belief systems and forms part of the broader cultural landscape. Water sources are considered by the Banjima People to be derived from the actions of beings from the Dreaming and are the most important

features of the Pilbara cultural landscape to the Banjima People. One of the key obligations for the Banjima Traditional Owners is the protection and stewardship of country, including culturally significant water sources.

The Proposal is located in the Pilbara-Gascoyne Drainage Division within two regional River basins, the Fortescue River and the Ashburton River. The Fortescue River flows west through the Fortescue Marsh, known as Manggurdu to the Banjima people and Martuyitha to the Nyiyaparli people, it is a place of great cultural significance and is considered the 'heart' of the region's water system. A number of important water features are situated near the Combined Proposal area.

The following areas and their associated water values are culturally significant to Banjima People are summarised below and detailed in Section 7:

- Marillana Creek
- Yandicoogina Gorge
- Coondewanna Flats and Lake Robinson
- Weeli Wolli Creek and associated Springs
- Ben's Oasis.

BHP considers that the studies outlined in Table 11-3 meet the relevant EPA guidance to support the assessment of Social Surroundings for the Proposal. The studies listed in Table 11-3 are confidential and so have not been appended to this ERD and the full citations are not provided in the reference list in Section 17.

Table 11-3: Ethnographic and heritage surveys

Title	Date	Summary
Report of a DGPS Survey of Stone Arrangements Banjima Country, Pilbara, Western Australia (Slack et. al. 2018)	2018	This report details the findings to verify, record, and assess 88 previously reported Aboriginal stone arrangement Heritage Sites across the Mudlark Well, Yandi, North Flank, Tandanya, East Packsaddle, Ministers North, Marillana, Packsaddle and South Flank project areas. The stone arrangements sit within Banjima Native Title Determination WC2011/006.
Central Pilbara Grinding Material Use-Wear and Residue Research Project (Stephenson 2017)	2017	This report details the findings of a residue analysis and cultural engagement workshop at the Mulla Mulla Camp in the Central Pilbara region of Western Australia between 16 and 18 May 2017.
Duffy & Bergin (2013) Archaeological Survey & Site Verification of Powerline between MAC & Yandi.	2013	This report details the findings of an archaeological survey of the proposed Yandi to MAC powerline corridor. In addition, Waru was required to verify 29 previously recorded sites and places occurring within or close to the project area.
Hook (2002). An Addendum Report to: Hook, F. (1999) A report of an Aboriginal Heritage Assessment of six archaeological sites located within BHP Iron Ore's Mining Area C Deposit, Hamersley Plateau, Pilbara, Western Australia	2002	This report details the methods employed in and results obtained from the Aboriginal archaeological site recording of two stone arrangement sites located within BHP Billiton's proposed Mining Area C and Yandi/MAC Railway Route, near Packsaddle and Yandi, Pilbara, Western Australia.
McGann (2001) A Report of an Archaeological Inspection of Areas within the Mining Area C Infrastructure Corridor.	2001	This report details of the Archaeological Inspection of Areas within the Mining Area C Infrastructure Corridor.
Green, McGrath (2001) Report on the Ethnographic Survey of the BHP Iron Ore Pty Ltd's Mining Area C Project in the Pilbara Region of Western Australia	2001	The purpose of the ethnographic survey was to assess the ethnographic significance of the land within the Mining Area C Project (the Project Area). This included locating and recording any previously unrecorded Aboriginal sites, and visiting previously recorded Aboriginal sites BHP wishes to disturb in order to determine the views of the Claimants regarding proposed mitigation.
Warren (2000) A Report of BHP Iron Ore's Archaeological and Ethnographic surveys of the Mining Area C project and section 18 and 16 application consultation (interim report October 2000)	2000	Archaeological and ethnographic heritage surveys for Aboriginal sites have been commissioned by BHP over lands proposed for the development of the proposed Mining Area C project. These surveys involved various Aboriginal stakeholders, including heritage custodians and spokespeople, as well as members of, and claimants for various native title claims that have an interest in the lands subject to the proposed development. These surveys resulted in the finding and recording of a number of unrecorded and previously recorded Aboriginal sites.
Harris (1996) Report on an archaeological survey for MAC rail, road, transmission line and associated infrastructure, west of Newman.	1996	An archaeological survey for Aboriginal heritage sites was conducted in the Weeli Wolli area, west of Newman. The archaeological survey was carried out by Jacqueline Harris on behalf of Quartermaine Consultants in two stages in the months of May and August 1996. Six archaeological sites were recorded in the course of the survey.
Tonkinson & Veth (1986) Anthropological Survey of the area surrounding BHP's Iron Ore Deposits (Marillana Creek)	1986	This report details the anthropological survey of the area surrounding BHP's Iron Ore Deposits (Marillana Creek) between 1982 - 1985.

11.4 Potential impacts

BHP has considered the potential impacts outlined in the EPA's *Environmental factor guideline – Social Surroundings* (EPA 2023b) and the EPA's *Technical Guidance - Environmental impact assessment of Social Surroundings – Aboriginal cultural heritage* (EPA 2023d). BHP understands that the following impacts have been identified by the Banjima as being relevant to the Proposal and the Combined Proposal:

- disturbance of cultural heritage sites and values (direct)
- impacts to access, landscape and amenity (direct)
- degradation of cultural heritage values (indirect).

Cumulative impacts to Social Surroundings are addressed in Section 16 and includes a discussion of cumulative impacts to Social Surroundings outside the Development Envelope where relevant.

BHP considers the effects of the Approved Proposal on Social Surroundings are greater than that of the Proposal. Therefore, BHP has focused the discussion of potential impacts within the Indicative Footprint but includes consideration of impacts within from the Combined Proposal where relevant.

11.4.1 Direct disturbance of social, cultural and heritage sites and values

Implementation of the Proposal will involve clearing of up to 1,076 ha of native vegetation for the creation of pipeline infrastructure, infiltration ponds and surplus water discharge infrastructure. The Proposal also has the potential to have an impact on surface water values such as Marillana Creek and Yandicoogina Gorge. The Proposal has the potential to directly disturb Aboriginal, social, cultural and heritage values located within the Development Envelope.

Marillana Creek is culturally significant to the Banjima Traditional Owners and will be impacted by surface water discharge locations in the Upper Marillana Creek (upper tributary of Marillana Creek) and Lower Marillana Creek (the current discharge point for the Yandi mine). Flat Rocks is a cultural and archaeological heritage site significant to the Banjima Traditional Owners and is located in the Marillana Creek downstream of the proposed discharge point to Upper Marillana Creek and has the potential to be impacted by the discharge of surplus water in the Upper Marillana Creek.

Yandicoogina Gorge is an archaeological heritage site significant to the Banjima Traditional Owners. As detailed in Section 7.3.4.4 a groundwater supplementation trial is currently underway within the Yandicoogina Gorge area to assist in determining an appropriate volume of water to return vegetation health to the GDE. The proposed maximum volume of 10 ML/day is subject to the implementation of a TARP to support the GDE. Changes in groundwater quality may potentially occur within Yandicoogina Gorge due to the proposed Yandicoogina GDE Supplementation Scheme. Deterioration of water quality within the Gorge may occur where there are significant differences in physical and chemical stressors between the source water and the receiving environment. A water quality assessment (Biologic 2023f) was conducted on the source water from MAC-SF and receiving environment (Yandicoogina Gorge) which is discussed further in Section 7.5.4. Vegetation in Yandicoogina Gorge has declined in recent years and the proposed supplementation trial may improve vegetation health. Potential impacts from groundwater mounding to vegetation in the Gorge are addressed in Section 8

As detailed in Section 11.3.3, significance assessments of known heritage sites within the Development Envelope have been undertaken for the Combined Proposal. Aboriginal Cultural Heritage will be managed in accordance with the AH Act. A Cultural Heritage Management Plan (CHMP) has been prepared in consultation with the Banjima Traditional Owners to address the management of the impacted sites. The CHMP is due to be reviewed and updated at least every two years to capture any changes or additional required management measures as the mine plan

progresses. Historic disturbance to heritage sites from the Approved Proposal have been previously managed through s. 18 of the AH Act.

11.4.2 Direct impacts to access, landscape and amenity

The installation of infrastructure and mine operations may alter the experience for Banjima Traditional Owners when on country, through altered access, landscape, and amenity.

Implementation of the Proposal may alter Banjima Traditional Owner access to heritage places or to conduct traditional practices, particularly to places and areas in proximity to active mining and related infrastructure within the Development Envelope. To ensure the safety and wellbeing of Traditional Owners when accessing areas in proximity to active mining and infrastructure, agreed access procedures have been established and such agreed measures include BHP escorts accompanying Banjima Traditional Owners, while on site. This has the potential to alter the timing or frequency of access and/or alter the experience when on country.

Aboriginal cultural heritage values extend beyond discrete identified Aboriginal cultural heritage places and are understood to be embedded in the combination of values which come together to form a landscape. The clearing of native vegetation and installation of infrastructure may alter the utilisation of the landscape across the Development Envelope. Progressive rehabilitation will be undertaken over the life of the Combined Proposal where practicable, however, permanent alteration of the landscape will occur because of the Combined Proposal as a result of mine pits. These impacts include those resulting from dewatering of mine pits and discharge of surplus water to Marillana Creek. As communicated to BHP by the Banjima Traditional Owners through BNTAC, it is the Banjima Traditional Owners preference for the avoidance of pit lakes. As part of the Approved Proposal for Mining Area C, BHP have an obligation to backfill all below water table pit voids (both North Flank and Packsaddle). For the pits at South Flank, BHP have committed to backfilling the Highway Deposit pits, and intend to work with the Banjima Traditional Owners on a final closure solution for the remaining South Flank pits.

Construction of the Proposal will result in noise and vibration. Noise and vibration are expected to be greatest during daylight hours, in relation to clearing and construction of infrastructure. Exposure to noise and vibration will be greatest near construction activities and will decrease with increasing distance from the construction operations. Noise and vibration have the potential to alter or obscure the natural background sounds of the local environment and impact the enjoyment and experience when on country in proximity to the Indicative Footprint. It is not anticipated the construction of the pipeline and reinjection/infiltration infrastructure will contribute significantly to the existing noise and vibration of the Approved Proposal. Additionally, once constructed, the noise and vibration impacts from the operation of the Combined Proposal will not be significantly different to the Approved Proposal.

11.4.3 Degradation of social, cultural and heritage values

Over many years, BHP has identified that heritage sites may be impacted by indirect disturbance if situated within:

- 100 m of a pit boundary (potential indirect impacts from blasting and fly rock)
- 30 m of all other infrastructure (e.g. roads, conveyors, pipelines, processing infrastructure etc.).

Nineteen sensitive receptor locations were identified by BHP as relevant to the Approved Proposal. BHP requested that visibility impacts from mine operations were to be assessed at receptors located along Great Northern Highway (BHP 2017b).

BHP acknowledges that there are a number of local and regional cultural heritage values that occur near the Combined Proposal. These include Mount Robinson, and water values such as Marillana Creek, Flat Rocks Spring, Yandicoogina Gorge, Yandicoogina Creek, Weeli Wolli Creek, Coondewanna Flats, Lake Robinson, and Weeli Wolli Spring.

These sites have the potential to be impacted by indirect impacts such as dust or changes to surface water and/or groundwater regimes. Potential impacts are discussed in the sections below.

11.4.3.1 Impact from dust emissions

The Combined Proposal has the potential to generate dust from vegetation clearing, vehicle and machinery use, mine operations and construction of infrastructure. Dust emissions from the construction of the pipelines and discharge infrastructure for the Proposal have the potential to cause visual disturbance and impact amenity and experience when on country. The potential impact to amenity from dust is greatest near dust sources such as active mining and operational areas. Potential impacts to amenity from dust will decrease with increasing distance from sources.

When dust is emitted into the air, it may subsequently deposit on surfaces including vegetation, with dust deposition decreasing with increasing distance from the source. Dust deposition has the potential to degrade Aboriginal social, cultural and heritage values including the condition of native vegetation including plants that may be used for bush tucker and bush medicine.

There may be a temporary increase in dust deposition during the construction period of the Proposal but should not be ongoing once infrastructure commissioned. Best management practices for dust control will be utilised, such as using water carts to control dust deposition. It is therefore not expected that dust emissions from the Proposal will indirectly impact plant health or survival; however, dust deposition has the potential to impact the desirability of plants that have ethnobotanical significance and therefore reduce the opportunity to utilise these plants.

The Weeli Wolli Creek area has cultural and heritage significance and the permanent pools and large trees in the area are valued by the Banjima people and Nyiyaparli people. Weeli Wolli occurs outside the Proposal boundary and holds considerable cultural heritage and visual amenity value. During the construction of the Proposal, it is anticipated that there is a potential for temporary dust impacts to visual amenity at some areas of cultural significance that may impact the experience of the Banjima Traditional Owners. BHP has reviewed the potential impacts of Social Surroundings (Amenity), considering the Environmental factor guideline – Social surroundings (EPA 2023b), and considers that any potential degradation of cultural heritage values from dust emissions during the construction of the pipelines and associated infrastructure is likely to be low due to the extent of the activity and the anticipated construction duration, and will not contribute significantly to the dust emissions for the Combined Proposal.

11.4.3.2 Changes to groundwater and surface water values

The Proposal is located in the Pilbara-Gascoyne Drainage Division within two regional River basins, the Fortescue River and the Ashburton River. The Fortescue River flows west through the Fortescue Marsh, known as Manggurdu to the Banjima people and Martuyitha to the Nyiyaparli people, it is a place of great cultural significance and is considered the 'heart' of the region's water system. The Fortescue Marsh is a Key Biodiversity Area as it provides habitat and feeding area for nationally significant numbers of waterbirds. The marshland and surrounding areas support habitat for several conservation significant fauna species, including the Night Parrot, the Northern Quoll, Greater Bilby and Pilbara Olive Python (see Section 9 for Terrestrial Fauna impacts). The Fortescue Marsh also has a high diversity of aquatic and terrestrial invertebrates and stygofauna and as part of an ancient and complex array of alluvial aquifers and groundwater systems, it is rich in plant species of high conservation value.

The Coondewanna Catchment is an internally draining catchment, which forms part of the Ashburton River Basin. Pebble Mouse Creek, Yandicoogina Creek and Marillana Creek are all sub-catchments of Weeli Wolli Creek which is located in the upper Fortescue River Basin.

Mining operations have resulted in disturbance to the Coondewanna and Pebble Mouse Creek catchments. These impacted areas have decreased the contributing catchment areas with corresponding decreases in peak discharge rates and volumes.

There are three Tier 2 ecological assets that were identified in the Ecohydrological Change Assessment from the Pilbara Strategic Proposal (BHP, n.d.) that may be affected by the Proposal. These include Coondewanna Flats, Weeli Wolli Spring and Ben's Oasis, and Fortescue Marsh.

The Proposal has the potential to impact Ben's Oasis, Coondewanna Flats and Weeli Wolli Springs due to groundwater abstraction. Increased groundwater abstraction for mine dewatering will lower groundwater levels at these surrounding significant ecosystems. The proposal has the potential to result in groundwater mounding within Upper Marillana Creek and Lower Marillana Creek beds and Yandicoogina Gorge. Potential for increased sediments in runoff from infrastructure and drainage resulting in adverse impacts to pools in Yandicoogina Gorge. New discharge locations for surplus water management will directly change flow regime of Upper Marillana Creek and may directly impact Marillana Creek Pools (Upper Marillana Creek) and associated aquatic ecosystem.

11.5 Mitigation

11.5.1 Avoid

The Indicative Footprint has been subject to multiple archaeological and ethnographic surveys. Areas that have not been sufficiently heritage surveyed have been identified across the Indicative Footprint. Activities within these areas will be restricted to previously disturbed or cleared land until the Banjima Traditional Owners confirm there are no heritage sites at risk of the Proposal's activities.

BHP has designed the Proposal to avoid all known heritage sites. Designing to avoid removes the requirement of a Ministerial Consent under the AH Act. Influential activities, such as water movement, have potential to disturb archaeological heritage sites and cultural landscapes. Separately, a detailed CHMP has been developed by BHP and Banjima representatives through BNTAC. The CHMP is a detailed document which identifies all Aboriginal cultural heritage sites and values within the Development Envelope, the significance of those sites and values, site specific avoidance, management and monitoring measures, and identification of the Proposal's interaction with sites and values, where appropriate. The CHMP remains confidential, due to the sensitive nature of sites, locations and values.

11.5.2 Minimise

BHP has prepared a Social Cultural Heritage Environmental Management Plan (SCHEMP) for review by the Banjima People (represented by BNTAC) to manage potential impacts of the Combined Proposal throughout the life of the operation (in addition to the other existing engagement channels between BHP and Banjima People). The SCHEMP is yet to be endorsed by the Traditional Owners. The SCHEMP outlines:

- The surveys and consultation completed by BHP to gain a comprehensive understanding of the Social Surroundings, including Aboriginal cultural heritage values.
- The key Social Surroundings and Aboriginal cultural heritage values identified.
- The framework for ongoing consultation with the Banjima People during the life of the Proposal.
- The processes for the ongoing protection and management of Aboriginal cultural heritage and related environmental values.
- Provisions for ongoing land access and management actions to be undertaken where additional Aboriginal cultural heritage values are identified.

Several recommendations in respect of the Proposal were developed during BHP's engagement with the Banjima Traditional Owners through BNTAC. All recommendations are provided in the SCHEMP (Appendix 20). Recommendations related to environmental aspects and management of the Proposal are discussed further in the following sections. All Aboriginal cultural heritage related recommendations will be managed under specific aspects of the CHMPs for the MAC SF Hub, including the CHMP specific to the Proposal. BHP will implement Environmental Management Plans to mitigate impacts to the environment and also impacts to cultural heritage values.

Table 11-4 below provides a summary of other supporting management plans that are in addition to the SCHEMP and CHMP which will assist in minimising potential indirect impacts to social surroundings and Aboriginal cultural heritage values.

Table 11-4: Social Surroundings - summary of other relevant management plans

Management Plan	Purpose
Fauna Management Plan (Appendix 16)	To maintain the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope, and no disturbance of the eleven (11) Retained High Value Ghost Bat Caves
Mining Area C Mine Closure Plan (Appendix 5)	To ensure that the proposed Development Envelope is rehabilitated in a manner that is safe, stable, and non-polluting and in an ecologically sustainable manner
Central Pilbara Water Resource Management Plan (Appendix 8)	To monitor the impacts to key water parameters; and to maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

11.5.3 Rehabilitate

BHP is committed to the rehabilitation of land no longer required for operational purposes and understands that mine closure is an important matter for Banjima Traditional Owners. In addition to mine closure commitments relevant to flora and vegetation, terrestrial fauna and inland waters, BHP commits to consulting with the Banjima representatives through BNTAC, to identify post-mining land uses.

BHP will work with Traditional Owners in relation to ethnobotanical values and this may include the use of ethnobotanical species in rehabilitation seed mixes and/or the propagation of ethnobotanical species for planting in rehabilitation areas. Following consultation with the Banjima Traditional Owners, BHP will expand the capacity of an existing local native species nursery at BHPs Yandi Operations over the next 2-3 years to ensure adequate resources and capacity are in place for rehabilitation of MAC SF once closure commences.

BHP will implement the Mining Area C MCP (Appendix 5) to meet the following environmental objectives:

- ensure that the Combined Proposal is decommissioned and rehabilitated to be safe, stable, and non-polluting and in an ecological sustainable manner
- undertake rehabilitation in a progressive manner, where practicable.

BHP acknowledges the Banjima Traditional Owners preference to avoid pit lakes and are reviewing the feasibility of avoiding pit lakes where possible. As detailed in the MCP and MS1072, BHP's progressive closure strategy includes backfilling of all pits in Mining Area C and Highway Deposit pits to a level that avoids the creation of a permanent mine pit lake; the management of waste rock including waste rock capable of generating AMD, and management of pit lakes. BHP will continue to work with the Banjima Traditional Owners on a final closure solution for the remaining South Flank pits.

11.5.4 Other statutory decision-making processes

Table 11-5 summarises whether another statutory decision-making process can mitigate the potential environmental impacts of the Proposal on Social Surroundings (Aboriginal cultural heritage), considering the EPA's *Taking decision making processes into account in EIA: Interim Guidance* (EPA 2021b) also provides reasons, including how, in relation to the specific potential impacts of the Proposal, the decision-making process takes the EP Act object and principles, and the EPA's objective for Social Surroundings, into account.

The AH Act is the relevant state legislation that governs the protection of registered Aboriginal cultural heritage sites. Under the AH Act it is an offence to damage or destroy a heritage site without first gaining appropriate approval. BHP has internal standards and approval requirements regarding the management of Aboriginal cultural heritage on BHP

Tenure. All activities and approvals must adhere to BHP's corporate standards, statutory obligations, and commitments made during consultations with the Banjima Traditional Owners.

Table 11-5: Social Surroundings – other statutory decision-making processes

Potential impact	Statutory decision-making process can mitigate impacts on the environment?	Reasons (if Yes)
Impacts to heritage sites	Yes	AH Act Approval under the AH Act is required prior to impact to registered heritage sites, BHP have prepared a CHMP to mitigate potential impact to heritage sites from the construction and operation of the Proposal, other than those that have approval to be impacted under s18 of the AH Act.

11.6 Assessment and significance of residual impacts

11.6.1 Direct disturbance of social, cultural and heritage values

BHP has considered the direct disturbance of social, cultural and heritage values for the Proposal and the Combined Proposal. As discussed in Section 11.4.1, the Proposal has the potential to directly impact social, cultural and heritage sites and values through clearing and construction of infrastructure BHP has undertaken archaeological and ethnographic surveys in the Development Envelope. Collectively, these surveys have identified the location and type of Aboriginal cultural heritage sites within the Development Envelope. BHP currently hold seven (7) section 18s over the Proposal area; however, BHP has designed the Proposal to avoid all known heritage sites and considers the construction of the pipelines and water management infrastructure will not significantly contribute to impacts to social surroundings beyond what was assessed as part of the Approved Proposal. Aboriginal cultural heritage sites within the Development Envelope will be managed in accordance with the CHMP and the SCHEMP as agreed with Banjima representatives through BNTAC.

The Proposal will result in changes to surface water regimes from discharge of surplus water to the tributary of Marillana Creek (Upper Marillana). Marillana Creek is considered significant to the Banjima Traditional Owners, as are all water sources. There are two proposed creek discharge locations for the Proposal - the Upper Marillana Creek discharge point and the Lower Marillana Creek discharge point. Discharge to the creeks (including current discharge to Pebble Mouse Creek) could result in changes in surface water flow and water chemistry, and result in temporary changes to riparian tree species, potentially increasing the abundance of riparian shrub, sedge, grass and weed species along the discharge pathway and Marillana Creek. Potential environmental impacts from the discharge of water to Upper and Lower Marillana Creek are further discussed in Section 7. No adverse impacts to water quality or riparian vegetation are likely as a result of the proposal. Management of water and associated cultural values will be managed in accordance with the CPWRMP.

BHP held engagements with Banjima representatives, facilitated through BNTAC in 2022, and in April and May 2024 including on-country visits to discuss the Proposal. The Banjima provided feedback on the proposal and considered that water disposal via reinjection bores at Yandicoogina Gorge should continue until the groundwater levels in the gorge system are restored. The Banjima Traditional Owners considered that water should be reinjected in pulses to replicate the natural seasonal variation in rainfall. Monitoring bores associated with the Yandicoogina Gorge reinjection should be telemetry-equipped with data feeding to a live online dashboard that can be accessed by the Banjima Traditional Owners and BNTAC. Banjima representatives requested to be present when the Yandicoogina GDE Supplementation Scheme commences.

During the on-country Social surroundings engagement in May 2024, the Banjima Traditional Owners expressed concern about the environmental implications for using Upper Marillana Creek as a surface disposal option for the Proposal. Based on feedback from Traditional Owners, BHP have committed to a 90-day drying period during the dry season to minimise potential impacts from the Upper Marillana Creek discharge.

The clearing of native vegetation and loss of plants and animals of cultural value represents an impact on social surroundings. Through co-development of the SCHEMP for the Proposal, BHP and BNTAC have proposed to continue ongoing engagement in relation to rehabilitation. The proposed SCHEMP details inclusion of bush tucker species in rehabilitation seed mixes where practicable and creation of fauna habitats during closure.

11.6.2 Impacts to access, landscape and amenity

The key potential direct impacts to identified Aboriginal cultural heritage values in respect of access, landscape and amenity are related to clearing for construction and operation of the Proposal, and installation of pipelines and diversions. Potential indirect impacts relate to loss of water values from active mining, impacts to amenity, access to country and cumulative impacts from mining. BHP has sought to address these matters through the preparation of an SCHEMP.

BHP's approach to creating this SCHEMP is to apply internal procedures and processes arising from BHP's agreements with the Banjima Traditional Owners to identify the outcomes, management actions, targets and monitoring that BHP and the Banjima representatives, through BNTAC, will implement to achieve the objective of minimising impact to Aboriginal social, cultural and heritage values.

The proposed GCOSA diversion will intercept runoff from various surrounding catchments, and particularly of note will intercept natural creeks which channel runoff from the Mount Robinson range, which lies to the south of the proposed OSA (WSP 2024). Mount Robinson is a site of cultural significance to the Banjima Traditional Owners. Surface water runoff from the Mount Robinson north slopes will be diverted away from the OSA and pit, while directing this runoff to its original catchment outlet. BHP have considered a diversion (drain and bund) upstream of the OSA which directs water westward toward the main channel and Coondewanna Flats; and a combined drain and bund in the East Catchment which directs water Eastwards towards the main channel in the valley, which subsequently reports to Pebble Mouse Creek.

BHP will undertake progressive rehabilitation, where practicable, including backfill of pit voids to minimise the extent of post-closure pit lakes where possible. While BHP acknowledges the Banjima Traditional Owner's preference to avoid all pit lakes, some pit lakes may remain at closure due to possible lack of overburden to enable the complete backfill of all of the voids. BHP will work with the Banjima Traditional Owners on a final closure solution for the Combined Proposal. Through the development and implementation of management plans (including the SCHEMP and CHMP) and closure and rehabilitation processes, it is expected that the Proposal will be appropriately managed such that Aboriginal cultural heritage values in respect of access, landscape, and amenity are not significantly impacted.

Implementation of management plans will support management of Aboriginal social, cultural and heritage values by:

- Managing impacts to key water parameters to ensure quantity and quality of water is maintained to protect existing and potential environmental values – CPWRMP
- Managing impacts to fauna values – Fauna Management Plan
- Managing impacts to access - SCHEMP and CHMP
- Ensuring that the Combined Proposal is rehabilitated in an ecologically sustainable manner –MCP.

No targeted noise management measures are proposed for the Proposal, given that the Proposal is located within an existing operational mine.

11.6.3 Degradation of social, cultural and heritage values

BHP will work with the Banjima representatives through BNTAC to manage impacts from the Proposal through the implementation of the CHMP.

Dust has the potential to indirectly impact social, cultural and heritage values through the degradation of native vegetation including plants that may be used for bush tucker and bush medicine and temporary surface water pools within the proposed Development Envelope.

To avoid and minimise dust emissions for the Proposal, BHP will implement appropriate dust controls in accordance with BHP internal standards. Water carts will be utilised to manage dust emissions from non-fixed infrastructure. It is anticipated that potential dust impacts to Marillana Creek, Weeli Wolli Spring, Ben's Oasis, Coondewanna Flats and Yandicoogina Gorge from the Proposal will be minimal and not significant to ecosystem health or cultural value.

Through the development and implementation of the SCHEMP and CHMP, it is expected that indirect impacts from the Combined Proposal will be appropriately managed so that social, cultural and heritage values are not significantly impacted.

11.6.4 Significant residual impacts

Following the application of the mitigation hierarchy BHP considers that there is no significant residual impact to Social Surroundings (Aboriginal cultural heritage) from the Proposal. See Section 11.7 for the discussion on the outcomes relating to the identified residual impacts and BHP's proposed assurance (regulation) and monitoring, where required. BHP considers through the development of a closure solution, implementation of the proposed mitigation measures, implementation of the EMPs, the CHMP, SCHEMP, through mitigation measures (Yandicoogina Gorge) and rehabilitation of affected areas at closure that a significant residual impact to Social Surroundings (Aboriginal cultural heritage) from the Combined Proposal will be avoided.

11.7 Environmental outcomes

Table 11-6 summarises the environmental outcomes, proposed assurance (regulation) and proposed monitoring (if required) for each residual impact for Social Surroundings (Aboriginal cultural heritage) from the Proposal. Detail of the proposed monitoring is set out in the Part IV environmental management plans and other relevant statutory decision-making documents discussed in Section 11-5. Table 11-6 demonstrates how the proposed environmental outcomes for the Combined Proposal, together with the proposed regulation and monitoring, are consistent with the EPA's objective for Social Surroundings (Aboriginal cultural heritage) (Section 11-1).

As required by the EPA's ERD Instructions, for Significant Amendments, BHP has included information about the existing implementation conditions for the Approved Proposal (Appendix 2). BHP considers that the EPA should inquire into the Approved Proposal implementation conditions (relating to Social Surroundings (Aboriginal cultural heritage)), as provided for under s40AA(3), as part of the assessment of the Proposal under s40 and in the EPA's assessment report required under s44, for the following reasons:

- conditions relating to Social Surroundings in the Ministerial Statement for the Approved Proposal are not contemporary.

Table 11-6: Social Surroundings - environmental outcomes, proposed regulation and monitoring for the Proposal

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
Potential direct and indirect impact to Aboriginal social, cultural and heritage values	No impacts to heritage sites and places of cultural significance from implementation of the Proposal Identification of potential impacts on values in consultation with the Banjima Traditional Owners	Condition B4 Social Surroundings Management of social, cultural, and heritage values and interests relevant to the Combined Proposal and through implementation condition B4. BHP will comply with the requirements of the <i>Aboriginal Heritage Act (WA) 1972</i> or it's replacement. - Implement the SCHEMP which includes measures to avoid, where practicable, and otherwise minimise impacts to Aboriginal social cultural heritage values within the Combined Proposal development envelope Condition B1 Inland Waters - Implement the Central Pilbara Water Resource Management Plan. - Implementation of management measures to ensure water quality and quantity is maintained. Minimising impacts to places of value to the Banjima Traditional Owners. Condition B2 Terrestrial Fauna Implement the Fauna Management Plan (Appendix 16) - Implementation of management measures to ensure impact to fauna species is minimised. Condition B5 Decommissioning and Rehabilitation	- Site-specific management measures pertaining to heritage sites are contained within the relevant Cultural Heritage Management Plans (CHMP) for the Combined Proposal and are therefore excluded from the SCHEMP - The SCHEMP details procedures and processes arising from BHP's agreements with the Banjima Traditional Owners to identify the outcomes, management actions, targets and monitoring that BHP and the Banjima representatives, through BNTAC, will implement to achieve the objective of minimising impact to Aboriginal social, cultural and heritage values. Condition B1 Inland Waters	BHP will continue to engage with Banjima representatives, through BNTAC, throughout the life of the Combined Proposal in relation to the management of cultural heritage values, surplus water management, closure and other matters related to social surroundings, via the SCHEMP and CHMP (where required) and considers this will protect cultural heritage values from significant harm, meeting the EPA's objective for Social Surroundings.

Residual impact	Environmental outcome	Proposed regulation (Condition ¹ or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
		Prepare and implement a Decommissioning and Rehabilitation environmental management plan: Implementation of management measures to ensure the MAC SF mine is decommissioned and rehabilitated in an ecologically sustainable manner Implement the Mining Area C Closure Plan (Appendix 5) required under the <i>Mining Act 1978</i>. Implementation of management measures to ensure the Mining Area C SF mine is safe, stable and non-polluting at closure	- Implement the Central Pilbara Water Resource Management Plan. - Implementation of monitoring measures to ensure water quality and quantity is maintained. Minimising impacts to a place of value to the Banjima Traditional Owners.	

¹ See Appendix 6 for proposed implementation conditions for the Combined Proposal

12 Greenhouse Gas Emissions

12.1 EPA environmental factor and objective

The EPA's objective for the Greenhouse Gas (GHG) emissions factor is:

To minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as far as practicable

12.2 Relevant policy and guidance

BHP assessed this environmental factor considering the following EPA policies and guidance, as outlined in Table 12-1.

Table 12-1: GHG Emissions – policy and guidance

EPA (and other State and Commonwealth) policy and guidance	Consideration of policy and guidance
<i>Environmental Factor Guideline - Greenhouse Gas Emissions</i> (EPA 2024e)	BHP has considered the guideline and has addressed the requirements as follows: - credible estimates of the expected Scope 1, Scope 2 and Scope 3 emissions associated with the Proposal, including breakdowns of GHG emissions by source, including land clearing emissions, grid-electricity, transport and domestic and international sources of Scope 3 emissions are presented in Section 12.4.4. - GHG emissions covered by the Safeguard Mechanism, the indicative emissions baseline consistent with the requirements of the Safeguard Mechanism and the anticipated net emissions over the life of the Proposal are provided in Section 12.4.4.2 and Section 12.4.4 - adoption and consideration of best practice measures to avoid or reduce Scope 1, Scope 2 and Scope 3 emissions are summarised in Section 12.5. - whether carbon offsets are proposed to be surrendered for more than 30% of the proposals baseline and BHP's offset strategy are summarised in Section 12.5.3 - the application of the Safeguard Mechanism and sectoral measures to reduce Scope 2 emissions, and the international regulatory context covering Scope 3 emissions are summarised in Section 12.5.2.
<i>Greenhouse Gas Emissions Policy for Major Projects</i> (Government of Western Australia 2024)	BHP has considered the <i>Greenhouse Gas Emissions Policy for Major Projects</i> and outlined alternative regulatory measures which require emission reductions associated with the Proposal, including the Safeguard Mechanism, to meet the EPA's objectives.
<i>Western Australian Climate Policy</i> (Government of Western Australia 2020)	BHP supports and is aligned with this policy to enable the business to transition to the goal of net zero emissions by 2050.

EPA (and other State and Commonwealth) policy and guidance	Consideration of policy and guidance
<i>National Greenhouse and Energy Reporting Act 2007</i> (NGER Act) (Government of Australia 2024)	This document details requirements of the NGER Act and Safeguard Mechanism, and application to the Combined Proposal. The NGER Act includes an emissions budget and 5-year rolling average reduction requirements to limit emissions from Safeguard Mechanism facilities through to FY2050. The emissions reduction for Safeguard Mechanism facilities will facilitate the EPA's objective of minimising the risk of environmental harm associated with climate change by reducing GHG emissions as far as practicable for the Combined Proposal.

12.3 Receiving environment

12.3.1 Studies

BHP has undertaken an assessment of GHG emissions associated with the Proposal utilising established methodologies to estimate GHG emissions consistent with methods developed and applied by the DCCEEW in National and State climate change inventory reporting, specifically the NGER Scheme and the Full Carbon Accounting Model (FullCAM) for land clearing emissions. BHP has included the outcomes of GHG modelling in this document including the methodologies, inputs and assumptions used to estimate GHG emissions associated with the Proposal. Other supporting information is referenced, where relevant. BHP considers that this information meets the EPA's *Environmental Factor Guideline - Greenhouse Gas Emissions* (EPA 2024) to support the assessment of GHG emissions for the Proposal.

12.3.2 Emissions calculation methodology

GHG emissions estimates in this Proposal have been calculated in accordance with DCCEEW emission factors and methods of the NGER Act and National Greenhouse Accounts, with the exception of land clearing emissions for which the NGER Act does not include a calculation. Consistent with the land-use change emission estimation methods adopted by the Australian Government, BHP has derived land-use change emissions using the Full Carbon Accounting Model (FullCAM) methodology, which is consistent with the National Inventory reporting used by DCCEEW to determine LULUCF emissions in both National and State emission inventory reporting.

Scope 1 emissions

The steps to determine diesel demand from the operation of mining equipment and dewatering to estimate Scope 1 emissions associated with the Proposal, including estimation of emissions from land use change, are summarised below:

- heavy haulage and ancillary equipment: Diesel consumed by haul trucks and other mining equipment, is derived from estimated equipment hours and work required to support iron ore and waste movements, and OEM fuel consumption rate estimates. These factors are routinely reviewed against business records and by subject matter experts (SMEs).
- other consumers of diesel have been considered and compared to estimates used in BHP Business Plans in conjunction with project specific assumptions from relevant SMEs.
- dewatering: Emissions associated with diesel use for dewatering infrastructure, have been derived by comparing estimates used in BHP Business Plans and project specific assumptions from relevant SMEs.

- land Clearing: Estimating GHG emissions associated with land use (clearing of vegetation) aligned with the FullCAM methodology, the model utilised by DCCEEW for modelling Australia's GHG emissions from the land sector, and for reporting Australia's GHG emissions and State and Territory GHG Inventories.

Consistent with the land-use change emission estimation methods adopted by the Australian Government, BHP has derived land-use change emissions using the FullCAM methodology. FullCAM is a calculation tool developed and utilised by DCCEEW to inform Land Use, Land Use Change and Forestry (LULUCF) emissions reporting in National and State Inventories and to support estimates for the generation of abatement and associated Australian Carbon Credit Units (ACCU) for vegetation methods under the Emissions Reduction Fund (ERF).

Land clearing emissions have been estimated for the Proposal using the FullCAM model, GHG emissions for each year of mine operations were estimated for two cases, a 'baseline case' wherein no anthropogenic clearing was assumed, and a 'progressive clearing' case. GHG emissions attributed to land clearing are defined as the difference between the two cases. Sequestration from revegetation associated with mine rehabilitation is not included in estimates, ensuring emissions estimates remain conservative.

Land clearing will be progressive through the life of the Proposal, with a total of 1,076 ha of clearing estimated to occur between 2026 and 2027, supporting the following key activities and elements of the Proposal:

- North-west Scheme: includes the MAC to Upper Marillana Creek pipeline, Northern RAV MAR and infiltration ponds and Upper Marillana Creek Discharge
- North-east Scheme: includes the MAC to Yandi East pipeline, Yandicoogina GDE Supplementation Scheme and Lower Marillana Creek Discharge
- GCOSA Diversion Structure: infrastructure to divert flows from Mount Robinson from inundating the OSA.
- increase in dewatering allocation from 102 ML to 180 ML/day
- increase in surplus water disposal from 95 ML to 154 ML/day
- water supply infrastructure
- communication towers to support mine process.

The FullCAM database identifies Acacia Shrubland and Eucalyptus Woodland as the dominant vegetation type associated with land clearing. Growth and other properties required by the FullCAM model are sourced from the FullCAM database. Estimated land-use change emissions are 92,812 t CO₂-e for the Proposal (additional clearing) and 400,626 t CO₂-e for the Combined Proposal (approved and additional clearing) which represent approximately 6.6% of the Proposal's and approximately 2.4% of the Combined Proposal's total Scope 1 emissions (Safeguard and land-use change).

12.3.3 Environmental values

The Proposal is located approximately 100 km north-west of the town of Newman in the Shire of East Pilbara. Iron ore mining is the dominant land use in the local area. Existing local contributors to GHG emissions include but are not limited to power generation for town and mine supply, and diesel consumption for vehicles and equipment used in iron ore mining.

12.4 Potential environmental impacts

BHP has considered the development activities that have the potential to contribute to GHG emissions, as outlined in the EPA's *Environmental Factor Guideline - Greenhouse Gas Emissions* (EPA 2024) when considering the potential impacts relevant to the Proposal.

BHP has provided information on GHG emissions for the Proposal, the Approved Proposal and the Combined Proposal. Consistent with the guideline, BHP has estimated the expected Scope 1 emissions covered by the Safeguard Mechanism for the Proposal, the Approved Proposal, and the Combined Proposal. Other sources of Scope 1 emissions from the Proposal summarised in Section 12.4.4.2 are not expected to exceed the EPA's Scope 1 information Option B threshold of 100,000 t CO₂-e emissions in any year. Accordingly, the Option A Safeguard Mechanism confirmation for the Proposal's assessment of GHG emissions approach has therefore been adopted.

The cumulative emissions from the Combined Proposal will contribute to WA's GHG emissions. Consistent with BHP's NGER Act reporting, GHG emissions from iron ore operations are primarily associated with diesel combustion emissions and therefore tend to comprise of predominantly carbon dioxide (CO₂). Other greenhouse gases emitted include methane (CH₄), nitrous oxide (N₂O) and sulphur hexafluoride (SF₆), however the quantities of these other greenhouse gases are immaterial compared to CO₂⁵.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation measures are applied, if required).

12.4.1 GHG emissions sources

12.4.1.1 Scope 1 emissions (Direct emissions from the Development Envelope)

BHP has adopted the NGER Act framework as a basis of identifying and estimating all sources of Scope 1 emissions generated for activities associated with the Proposal.

Scope 1 (direct emissions) from the Proposal will be generated through:

- diesel used for heavy haulage, primarily movement of ore and waste material using haul trucks
- diesel used for ancillary equipment such as excavators, drills, and other equipment used to support mine development
- diesel energy powering dewatering activities, including abstraction of groundwater and movement of water across the operation and surplus disposal
- oil and greases, primarily used by heavy equipment
- land clearing, made up of embodied emissions association with vegetation clearing⁶.

The largest source of Scope 1 GHG emissions is associated with diesel consumed by heavy haulage and ancillary equipment. Oils and greases will be consumed by heavy haulage and ancillary equipment use.

12.4.1.2 Scope 2 emissions (grid-connected electricity generation)

In the context of the Proposal, Scope 2 emissions are associated with electricity demand from grid-connected electricity sourced from Yarnima Power Station which is generated outside of the Development Envelope. Electricity supply from Yarnima Power Station is primarily generated by a combination of pre-existing natural gas fired power generation plant and waste heat recovery.

Scope 2 emissions associated with generation and transmission of electricity from Yarnima Power Station supporting the Proposal, include:

⁵ Aggregation of CH₄, N₂O and SF₆ emissions from Mining Area C represented 0.49% or 2,535 t CO₂-e of the NGER Facility's Scope 1 emissions in FY2024.

⁶ The NGER Act does not provide a calculation methodology for GHG emissions associated with land clearing. Estimates of land clearing emissions in this Proposal have been derived from the Full Carbon Accounting Model (FullCAM), consistent with the framework used in National Inventory reporting used by Department of Climate Change, Energy, the Environment and Water (DCCEEW) to determine land use, land use change and forestry (LULUCF) emissions.

- natural gas consumed for power generation
- diesel consumed for power generation, including backup and black-start operations
- fugitive emissions of sulphur hexafluoride used in electrical switchgear.

12.4.1.3 Scope 3 emissions sources (Domestic)

BHP's domestic sources of downstream emissions are associated with iron ore rail transport, and ship loading activities at Port Hedland, (other than a small section of a rail loop within the Development Envelope) these occur outside the Development Envelope and BHP has therefore considered iron ore rail transport and ship loading as Scope 3 emissions to the Proposal. This categorisation of GHG emissions is consistent with BHP's NGER, which excludes rail and port emissions from the Mining Area C's NGER facility.

Iron ore is transported to Port Hedland via BHP's owned and operated rail operations for export by sea. Rail operations generate GHG emissions outside of the Development Envelope and are considered a source of Scope 3 emissions to the Proposal.

Emissions associated with the transport of iron ore via rail from mining hub to Port Hedland, include:

- diesel consumed by locomotives and rail maintenance activities
- diesel power generation, supporting remote camps.

BHP's Port Hedland operations include GHG emissions from grid-connected electricity associated with unloading, stacking and reclaiming, and ship loading of iron ore.

12.4.1.4 Scope 3 emissions sources (International)

Scope 3 emissions are also associated with the iron ore value chain including the shipping of iron ore to BHP's customers and the emissions associated with the production of steel, using coal to reduce iron ore. Each of these activities is undertaken by third parties.

BHP estimates that the most significant contribution to Scope 3 emissions associated with the Combined Proposal will be from the shipping of products to customers and customer's processing of iron ore in steelmaking. Scope 3 estimates are not necessarily representative of the specific activities taking place within BHP's value chain, nor reflective of the quality of BHP's products, as they are based on industry average emission factors or proxy input data or assumptions.

12.4.1.5 Excluded sources of emissions

Scope 1 emissions for the Proposal have been determined in accordance with the NGER Act, which establishes a national emissions reporting framework. In accordance with the NGER framework, several minor sources of Scope 1 emissions have been excluded from emissions estimates from the Proposal, these are summarised below.

The following sources of emissions are not included in the scope of the Proposal:

- emissions of HFCs and PFCs, and wastewater effluent, which are below NGER reporting thresholds⁷.
- emissions associated with landfill have been considered as per NGER reporting methods⁷.

⁷ Annual GHG emissions inventory reporting required by the NGER Act of BHP's existing iron ore mining operations continue to validate these categories of GHG are below reporting thresholds under the NGER scheme or not applicable to iron ore mining. BHP's NGER reporting has been and continues to be independently assured to a reasonable assurance level.

- decommissioning and closure phase emissions have been excluded from Scope 1 estimates on the basis of assessment of limited materiality compared to operational emissions from the Proposal, activities considered include:
 - final landform, pit closure strategies and backfill designs will continue to be undertaken and optimised through progressive rehabilitation in the operational phase of the Proposal (~48 years), This includes consideration of waste haul distances and minimisation of rehandling of waste material where possible to reduce emissions.
 - removal of site infrastructure and rehabilitation post last ore. FullCAM revegetation and emission abatement are excluded from the Proposal's land clearing or land use, land change and forestry (LULUCF) estimates.
- Minor sources of Scope 3, including diesel value chain emissions have been excluded on the basis that they are immaterial to total Scope 3 estimates. By way of comparison the total upstream Scope 3 emissions associated with BHP's diesel consumption for the period equates to ~0.01% of the emissions associated with steelmaking and international shipping or iron ore.

Scope 2 emissions (Grid-connected electricity)

Electricity emissions are based on the recent average of BHP's NGER Act reported emissions associated with the megawatt hours of electricity generation from Yarnima Power Station. The electricity emissions for the Proposal have been calculated by apportioning estimated electricity demand associated with development scenarios to the unit emissions per megawatt hour based on NGER Act report emissions.

Scope 3 emissions (Domestic – Iron ore rail transport)

Rail transport emissions are based on the recent average of BHP's NGER Act reported emissions associated with iron ore transport activities. The average unit emissions per net tonne kilometre to transport iron ore from BHP's mines to Port Hedland has been calculated. Proposal specific rail emissions are determined through the apportionment of saleable production of iron ore and the average rail emissions per net tonne kilometre.

Scope 3 emissions (Domestic – Port Hedland ship loading)

Emissions associated with diesel and electricity use at BHP's Port Hedland operations, supporting iron ore ship loading activities have been estimated by apportioning the NGER Act reported emissions associated with BHP's Port Hedland activities required to support the forecasted production from the Proposal.

Scope 3 emissions (International – Shipping & steelmaking)

Emissions have been estimated based on the most material Scope 3 emissions sources (the dominant sources being the processing of sold products, and downstream shipping of sold products),. We outline below the industry average emission factors and key assumptions used in the calculations. These provide an estimate for material Scope 3 emissions sources, but because they are not customer, shipper or geography-specific, may only approximate the activities taking place within our value chain. Estimates exclude less material sources of Scope 3 emissions, such as upstream emissions associated with purchased goods and services, which do not have a material impact on the Scope 3 emission estimates. Therefore, the Proposal's Scope 3 estimates are aligned with downstream activities of the iron value chain.

GHG emissions associated with the downstream processing of BHP's iron ore products into steel has been estimated according to the same industry-average emissions factors used at BHP Group level reporting of Scope 3 Category 10 "Processing of Sold Products" emissions in FY2024 (BHP 2024a). GHG emissions relating to steelmaking from processing raw materials associated with the Proposals are estimated using global average emissions intensity factor (tonnes of CO₂ per tonne of crude steel) for the blast furnace to basic oxygen furnace (BF-BOF) process route sourced from the International Energy Agency (IEA). This emissions intensity factor for crude steel is assumed to be attributable to iron ore only and not scrap steel.

The emissions intensity factor is applied to an equivalent crude steel production volume assuming 100% of a Proposal's iron ore product is processed using this route (BHP 2024g). The crude steel equivalent is calculated assuming the average annual rate of output for the orebodies that are relevant to the Proposal and the average percentage iron (Fe) content across BHP's product portfolio in FY2022, converted to equivalent crude steel quantity assuming the global industry average iron content of crude steel (99.1% Fe) from the International Energy Association Iron and Steel CCS Study (International Energy Association Greenhouse Gas 2013). This estimate does not take into account site-specific production grades or fluctuations in production volumes anticipated from the Proposal.

This estimate is a straight-line extrapolation of the potential indirect emissions associated with the downstream processing of our iron ore products, holding all assumptions constant from FY2022. Shipping emissions have been estimated assuming 100% of production from the Proposal will be shipped over a distance reflecting a North Asia dispatch region using an industry average, historical emissions intensity factor per voyage. We assume this emissions intensity factor and distance travelled holds constant across the life of the Proposal.

Scope 3 emissions estimates do not contain any forward-looking views on potential emissions abatement measures that may occur in the value-chain that may impact future Scope 3 emissions.

12.4.2 Assessed emissions for the Approved Proposal

Environmental impacts of the original Mining Area C project (approved under MS 491) were assessed in November 1998 through a Public Environmental Review (PER) (Woodward-Clyde 1997). The impact of GHG emissions was not assessed in the 1998 PER.

The Revised Proposal to amend the Mining Area C operations subject of MS491 to include the Mining Area C – Southern Flank was assessed by the EPA via a PER in December 2017 and included cumulative assessment of the impact of GHG from the existing and proposed projects (BHP 2017b).

GHG emissions resulting from the Approved Proposal were identified as being generated through the combustion of hydrocarbons, clearing of native vegetation, the use of explosives during blasting operations and the use of electricity. Scope 1, 2 and 3 emissions were not individually specified, which was common practice at the time. The maximum annual cumulative CO₂-e emissions were estimated to be 1,975 kilotonnes of CO₂-e, with the average annual CO₂-e emissions over the life of the Approved Proposal being estimated at 1,200 kilotonnes of CO₂-e. At the time, the maximum cumulative emissions represented 0.48% of Australia's and 2.37% of Western Australia's financial year 2014 CO₂-e inventory (BHP Billiton 2017).

12.4.3 Historical emissions reporting

BHP reports GHG emissions from Mining Area C annually in accordance with requirements of the NGER Act. BHP is required to prepare and report emissions consistent with methodologies and emission factors associated with the NGER (Measurement) Determination 2008 every financial year, reporting emissions to the Clean Energy Regulator (CER) by the 31 October, following the relevant reporting period.

NGER facilities which have Scope 1 emissions which exceed 100,000 tCO₂-e will have their Scope 1 emissions published separately on the CER's website.

Table 12-2 summarises the Scope 1 emissions from the Mining Area C NGER facility reported through the NGER Act.

Table 12-2: Mining Area C recent NGER Act reported GHG emissions

Year	Scope 1 emissions tCO ₂ -e	Scope 2 emissions tCO ₂ -e ¹
FY2020	419,809	N/A
FY2021	406,944	N/A

Year	Scope 1 emissions tCO ₂ -e	Scope 2 emissions tCO ₂ -e ¹
FY2022	412,089	N/A
FY2023	470,614	N/A

¹ To avoid double-counting of Scope 1 and Scope 2 emissions, previous versions of the NGER Act required WAIO to report the Scope 1 emissions associated with electricity generation at Yarnima Power Station and in turn, electricity use at WAIO's mines was not reportable as Scope 2 emissions through NGER Act reporting obligations. From FY2025 updates to the NGER Act will allow for Yarnima's electricity supply to WAIO's individual mines to be reported as Scope 2, adjustments will be made to aggregated emissions reporting of BHP and BHP to avoid double-counting of Scope 1 and Scope 2 emissions from Yarnima Power Station.

12.4.4 Emissions estimates

12.4.4.1 GHG modelling scenarios

Three scenarios were modelled to support the assessment of the Proposal:

- **Approved Proposal Scenario:** This scenario is consistent with existing mining operations at Mining Area C and South Flank permitted by MS1072.
- **The Proposal Scenario:** This scenario seeks to increase the maximum rate of dewatering from 100 ML/ day units to 180 ML/ day and surplus water discharge from 95 ML/ day to 154 ML/ day, increasing the accessibility to below water table iron ore deposits and enhancing infrastructure associated with surplus water management schemes.
- **Combined Proposal Scenario:** Aggregation of approved and proposed scenarios.

12.4.4.2 Scope 1 emissions covered by the Safeguard Mechanism

BHP has estimated annual Scope 1 emissions for the Proposal, Approved Proposal and the Combined Proposal. A summary of modelled GHG emissions for the Proposal and Combined Proposal which are and are not covered by the Safeguard Mechanism is provided in Table 12-3 and Table 12-4 and includes the following:

- Estimated peak annual emissions
- Estimated total emissions
- Estimated average annual emissions.

The Proposal's average annual Scope 1 emissions not covered by the Safeguard Mechanism are 2,442 tCO₂-e and peak at 12,932 tCO₂-e in FY2028. When including currently approved activities the Combined Proposal's average annual Scope 1 emissions not covered by the Safeguard Mechanism are 10,543 tCO₂-e and peak at 25,377 tCO₂-e in FY2033. Scope 1 emissions which are not covered by the Safeguard Mechanism are not estimated to reasonably be likely to exceed 100,000 tCO₂-e in any year, supporting an Option A: Safeguard Mechanism confirmation assessment.

Table 12-3: Proposal Scope 1 Safeguard Mechanism covered emissions summary

Emissions estimate	Scope 1 emissions covered by the Safeguard Mechanism (t CO ₂ -e)	Scope 1 emissions <u>Not</u> covered by the Safeguard Mechanism (tCO ₂ -e) ¹	Scope 1 emissions Total (t CO ₂ -e)
Peak annual emissions	242,126 (FY45)	12,932 (FY28)	243,865 (FY45)

Emissions estimate	Scope 1 emissions covered by the Safeguard Mechanism (t CO ₂ -e)	Scope 1 emissions <u>Not</u> covered by the Safeguard Mechanism (tCO ₂ -e) ¹	Scope 1 emissions Total (t CO ₂ -e)
Total emissions over the life of the Proposal	1,313,404	92,812	1,406,216
Average annual emissions	34,563	2,442	37,006

¹ Land clearing emissions are the only source of Scope 1 emissions within the Development Envelope of the Proposal not covered by the Safeguard Mechanism.

Table 12-4: Combined Proposal Scope 1 Safeguard Mechanism covered emissions summary

Emissions estimate	Scope 1 emissions covered by the Safeguard Mechanism (t CO ₂ -e)	Scope 1 emissions <u>Not</u> covered by the Safeguard Mechanism (tCO ₂ -e) ²	Scope 1 emissions Total (t CO ₂ -e)
Peak annual emissions	1,032,246 (FY35)	25,377 (FY33)	1,050,515 (FY35)
Total emissions over the life of the Proposal	16,389,815	400,626	16,790,441
Average annual emissions	431,311	10,543	441,854

² Land clearing emissions are the only source of Scope 1 emissions within the Development Envelope of the Proposal not covered by the Safeguard Mechanism. Scope 1 emissions not covered by the Safeguard Mechanism are estimated to remain below the EPA's 100,000 t CO₂-e per annum threshold, supporting an Option A: Safeguard Mechanism confirmation assessment.

The peak, average and total Scope 1 emissions covered by the Safeguard Mechanism for the Approved Proposal, Proposal, and Combined Proposal are summarised in Table 12-5. Peak annual Scope 1 emissions are estimated to occur in FY2035 for the Combined Proposal. Increases of average annual Scope 1 GHG emissions from the Proposal are primarily associated with the extraction of groundwater and below water table mining activities. Section 12.5 provides a detailed summary of the measures included in this Proposal to reduce GHG emissions.

Table 12-6 provides a summary of the estimated annual Scope 1 emissions covered by the Safeguard Mechanism for activities within the Development Envelope for the Proposal, Approved Proposal and the Combined Proposal.

Emission sources of annual and lifetime Scope 1 emission for the Combined Proposal are presented in Table 12-7. The Scope 1 emissions profile (including by source) of the Combined Proposal is illustrated in Figure 12-1. Included are annual estimates of land-use change emissions, although land-use change emissions are not covered by the Safeguard Mechanism, their inclusion in Scope 1 emission source summaries illustrates they are estimated to remain below 100,000 tCO₂-e in any year.

Table 12-5: Scope 1 emissions summary – Proposal, Approved Proposal, and Combined Proposal⁸

Emissions estimate	Proposal	Approved Proposal	Combined Proposal
Peak annual emissions	242,126 (FY45)	974,595 (FY36)	1,032,246 (FY35)
Total emissions over the life of the Proposal	1,313,404	15,076,411	16,389,815
Average annual emissions ⁹	34,563	430,755	431,311

⁸ Excludes land clearing emissions, as this source of Scope 1 emissions is not covered by the Safeguard Mechanism

⁹ Annual average for the Proposal and Combined Proposal ranges for 38 years, FY2025 to FY2062. The Approved Proposal average emissions range for 35 years from FY2025 to FY2059.

Table 12-6: Scope 1 emissions by year¹⁰

Financial year	Scope 1 GHG emissions (tCO ₂ -e)		
	Proposal ¹¹	Approved Proposal	Combined Proposal
2025	11,540	535,810	547,350
2026	12,680	570,442	583,122
2027	17,101	597,328	614,430
2028	34,357	668,654	703,012
2029	33,130	474,013	507,143
2030	3,908	473,111	477,019
2031	28,249	578,889	607,138
2032	14,891	587,462	602,353
2033	-110,221	681,072	570,851
2034	-6,315	764,004	757,689
2035	108,635	923,611	1,032,246
2036	-30,498	974,595	944,098
2037	170,978	816,991	987,969
2038	26,098	757,463	783,561
2039	180,459	552,841	733,300
2040	112,858	563,879	676,737
2041	104,372	458,653	563,024
2042	214,570	293,345	507,915
2043	22,260	313,470	335,730
2044	45,028	426,333	471,361
2045	242,126	164,640	406,766
2046	13,942	210,776	224,718
2047	20,775	236,424	257,199
2048	-69,454	513,423	443,969
2049	-133,990	418,679	284,689
2050	-66,099	262,705	196,606
2051	-53,703	162,651	108,948
2052	21,967	189,074	211,040
2053	13,437	186,777	200,214

¹⁰ Excludes land clearing emissions, as this source of Scope 1 emissions is not covered by the Safeguard Mechanism¹¹ Negative emissions represent a reduction in emissions compared to the Approved Proposal Scenario. As the Combined Proposal increases the availability of iron ore, the mining method associated with the aggregation of the Proposal and Approved Proposal allows optimisation, this results in iron ore mining associated with only the Approved Proposal Scenario, being optimised in the Combined Proposal Scenario, leading to modelled reduction in emissions for Proposal Scenario in some years.

Financial year	Scope 1 GHG emissions (tCO ₂ -e)		
	Proposal ¹¹	Approved Proposal	Combined Proposal
2054	4,777	167,595	172,371
2055	120,001	183,852	303,852
2056	68,328	175,539	243,867
2057	52,859	123,562	176,421
2058	18,962	47,991	66,953
2059	2,616	20,757	23,373
2060	23,128	-	23,128
2061	28,641	-	28,641
2062	11,014	-	11,014
Annual Average¹²	34,563	430,755	431,311
Total	1,313,404	15,076,411	16,389,815

¹² Annual average for the Proposal and Combined Proposal ranges for 38 years, FY2025 to FY2062. The Approved Proposal average emissions range for 35 years from FY2025 to FY2059.

Table 12-7: Combined Proposal Scope 1 emissions by source

Year	Combined Proposal Scope 1 emissions estimates (tCO ₂ -e)				
	Heavy haulage & ancillary (diesel)	Dewatering (diesel)	Oils & greases	Land-use change ¹	Total (excluding land-use change) ²
2025	527,359	19,985	6	-	547,350
2026	560,561	22,554	7	93	583,122
2027	591,847	22,576	7	3,216	614,430
2028	679,742	23,262	8	15,155	703,012
2029	481,035	26,102	6	23,021	507,143
2030	448,313	28,701	5	16,217	477,019
2031	578,034	29,097	7	25,049	607,138
2032	567,233	35,113	7	19,203	602,353
2033	531,561	39,284	6	25,377	570,851
2034	716,105	41,576	8	20,166	757,689
2035	989,720	42,514	12	18,269	1,032,246
2036	902,911	41,176	10	16,604	944,098
2037	950,767	37,191	11	15,135	987,969
2038	747,162	36,390	9	14,011	783,561
2039	697,878	35,414	8	18,861	733,300
2040	643,791	32,939	7	15,136	676,737
2041	533,842	29,176	6	13,855	563,024
2042	484,722	23,187	6	12,717	507,915
2043	317,503	18,223	4	11,744	335,730
2044	455,387	15,969	5	12,333	471,361
2045	392,635	14,127	5	10,841	406,766
2046	211,032	13,684	2	10,012	224,718
2047	246,363	10,832	3	9,265	257,199
2048	435,734	8,230	5	8,591	443,969
2049	276,433	8,253	3	7,979	284,689
2050	188,347	8,256	2	7,423	196,606
2051	100,690	8,256	1	6,917	108,948
2052	202,782	8,256	2	6,455	211,040
2053	191,955	8,256	2	6,032	200,214
2054	164,113	8,256	2	5,643	172,371
2055	295,592	8,256	3	5,287	303,852
2056	235,608	8,256	3	4,958	243,867

Year	Combined Proposal Scope 1 emissions estimates (tCO ₂ -e)				
	Heavy haulage & ancillary (diesel)	Dewatering (diesel)	Oils & greases	Land-use change ¹	Total (excluding land-use change) ²
2057	168,163	8,256	2	4,655	176,421
2058	58,696	8,256	1	4,376	66,953
2059	15,116	8,256	0	4,117	23,373
2060	14,871	8,256	0	674	23,128
2061	20,384	8,256	0	638	28,641
2062	2,757	8,256	0	604	11,014
Average	411,230	20,076	5	10,543	431,311
Total	15,626,745	762,888	182	400,626	16,389,815

¹ Land-use change emissions are not covered by the Safeguard Mechanism

² Land-use change emissions are not covered by the Safeguard Mechanism and have been excluded from Scope 1 emission totals in this table.

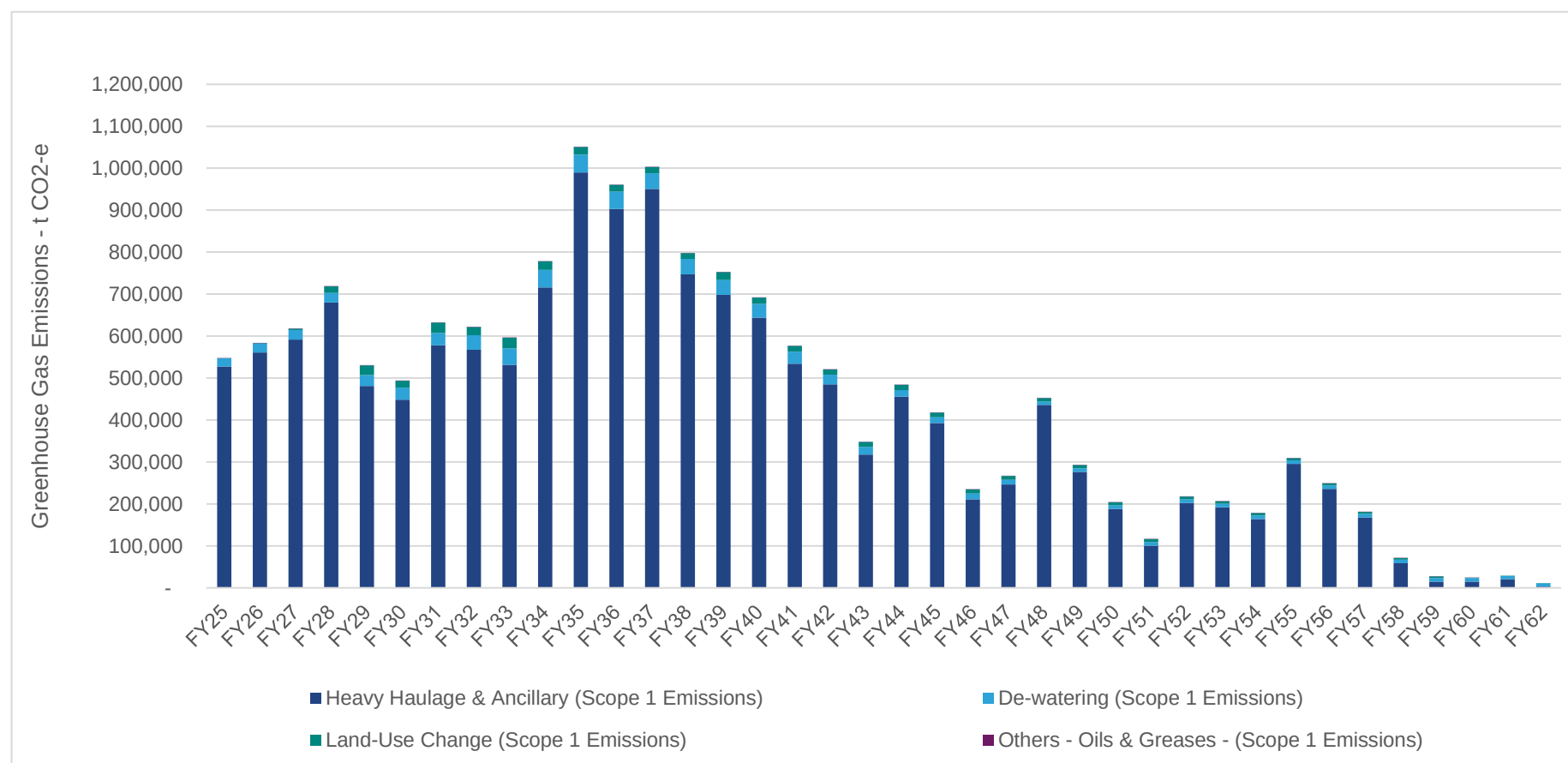


Figure 12-1: Combined Proposal Scope 1 GHG emissions profile¹³

¹³ Land-use change emissions are not covered by the Safeguard Mechanism

12.4.4.3 Scope 2 emissions estimates

BHP has estimated annual Scope 2 emissions for the Proposal, Approved Proposal and the Combined Proposal. A summary of modelled GHG emissions for the Proposal and Combined Proposal is provided in Table 12-8 and Table 12-9 and includes the following:

- estimated peak annual emissions
- estimated total emissions
- estimated average annual emissions.

Table 12-8: Scope 2 emissions summary –Proposal, Approved Proposal, and Combined Proposal

Emissions estimate	Proposal	Approved Proposal	Combined Proposal
Peak annual emissions	62,137 (FY41)	169,359 (FY50)	171,979 (FY50)
Total emissions over the life of the Proposal	392,045	4,183,472	4,575,517
Average annual emissions ¹⁴	10,317	119,528	120,408

Table 12-9: Scope 2 GHG emissions (Grid-connected electricity demand) by year

Financial year	Estimated Scope 2 emissions (tCO ₂ -e)		
	Proposal	Approved Proposal	Combined Proposal
2025	6,869	128,270	135,138
2026	7,247	131,690	138,937
2027	7,117	139,040	146,157
2028	7,011	148,408	155,419
2029	6,982	152,339	159,321
2030	8,153	153,997	162,150
2031	8,276	155,059	163,336
2032	9,699	151,714	161,413
2033	9,098	153,503	162,601
2034	7,837	155,252	163,089
2035	10,387	152,717	163,104
2036	8,066	154,391	162,458
2037	7,100	153,856	160,956

¹⁴ Annual average for the Proposal and Combined Proposal ranges for 38 years, FY2025 to FY2062. The Approved Proposal average emissions range for 35 years from FY2025 to FY2059.

Financial year	Estimated Scope 2 emissions (tCO ₂ -e)		
	Proposal	Approved Proposal	Combined Proposal
2038	6,023	154,550	160,574
2039	30,342	128,786	159,128
2040	41,355	119,399	160,753
2041	62,137	81,203	143,340
2042	48,049	88,124	136,173
2043	7,210	92,413	99,622
2044	1,542	95,083	96,626
2045	36,003	81,318	117,321
2046	-285	148,803	148,519
2047	-1,123	153,260	152,136
2048	2,612	148,685	151,296
2049	2,619	148,684	151,304
2050	2,620	169,359	171,979
2051	2,620	87,346	89,967
2052	2,623	87,346	89,969
2053	2,623	87,346	89,969
2054	2,623	87,346	89,969
2055	2,665	87,304	89,969
2056	2,665	87,304	89,969
2057	13,899	76,070	89,969
2058	-1,989	36,063	34,074
2059	2,685	7,441	10,126
2060	5,072	-	5,072
2061	9,920	-	9,920
2062	3,692	-	3,692
Annual Average¹	10,317	119,528	120,408
Total	392,045	4,183,472	4,575,517

¹ Annual average for the Proposal and Combined Proposal ranges for 38 years, FY2025 to FY2062. The Approved Proposal average emissions range for 35 years from FY2025 to FY2059.

12.4.4.4 Scope 3 emissions estimates

A summary of estimated Scope 3 GHG emissions is provided in Table 12-10 and includes the following for the Combined Proposal:

- estimated peak annual emissions
- estimated total emissions
- estimated average annual emissions.

Table 12-10: Combined Proposal Scope 3 GHG emissions summary

Emissions estimate	Steel-making (tCO ₂ -e)	Shipping (tCO ₂ -e)	BHP Port: Downstream (tCO ₂ -e)	BHP Rail Transport	Total (tCO ₂ -e)
Peak annual emissions ¹	205,035,485	1,950,157	172,392	282,624	207,440,658
Total emissions over the life of the Combined Proposal	4,494,944,816	43,125,134	3,812,663	6,250,586	4,548,133,199
Average annual emissions	119,422,893	1,134,872	100,333	164,489	120,822,587

1. Peak total Scope 3 emissions are estimated in 2029

The total downstream and Scope 3 emissions have been estimated to be 120,822,587 tCO₂-e (annual average) and 4,548,133,199 tCO₂-e (total life of the Combined Proposal). This is comprised of:

- domestic rail transport of iron ore from the Proposal to Port Hedland relevant to the Combined Proposal are estimated to average 164,489 tCO₂-e per year or total 6,250,586 tCO₂-e for the life of the Proposal¹⁵.
- domestic ship loading activities at Port Hedland relevant to the Combined Proposal are estimated to average 100,333 tCO₂-e per year or total 3,812,663 tCO₂-e for the life of the Proposal¹⁵.
- international shipping of iron ore associated with the Combined Proposal is estimated to average 1,134,872 tCO₂-e per year or total 43,125,134 tCO₂-e for the life of the Proposal.
- international steelmaking of products associated with the Combined Proposal is estimated to average 119,422,893 tCO₂-e per year or total 4,494,944,816 tCO₂-e for the life of the Proposal.

¹⁵ The CER defines "Scope 3 emissions as indirect GHG emissions other than Scope 2 emissions that are generated in the wider economy. They occur as a consequence of the activities of a facility, but from sources not owned or controlled by that facility's business". Although BHP's activities associated with rail iron ore transport and at Port Hedland, are controlled by BHP, from the perspective of the Proposal they occur outside the Development Envelope, and therefore are neither Scope 1 or Scope 2 emissions associated with the Proposal.

12.5 Mitigation

12.5.1 Avoid

The Scope 1 and Scope 2 emissions from the Combined Proposal are estimated to increase by 1,705,449 tCO₂-e as a result of the Proposal, which represents an 8.85% increase in emissions compared to the Approved Proposal. These increases in emissions include Scope 1 emission (1,313,404 t CO₂-e) sources within the Development Envelope¹⁶ and Scope 2 emissions associated with electricity generation outside the Development Envelope (392,045 t CO₂-e).

The Approved Proposal is a brownfields development, which includes established mining fleet and mine infrastructure which will be utilised by the Proposal, which limits the scope of GHG emission avoidance opportunities at commencement of the amended Proposal. The Proposal has been designed in disturbed areas to minimise additional clearing.

Figure 12-2 summarises the total Scope 1 emission sources within the Development Envelope excluding land-use change emissions not covered by the Safeguard Mechanism and Scope 2 emissions associated with electricity generation outside the Development Envelope for both the Combined Proposal and Approved Proposal, and the specific activities associated with the Proposal which result in the 8.85% increase in emissions from the Approved Proposal to the Combined Proposal.

Electrification of heavy mining equipment (Asset-wide Initiatives)

The most material source of Scope 1 emissions associated with the Combined Proposal are associated with diesel consumption from existing mining equipment (heavy haulage & ancillary). Section 12.5.2.2 summarises BHP's plans to avoid and reduce these diesel emissions through the adoption of battery-electric haul trucks and other electric equipment, including excavators and drills. Section 12.5.2.2 also provides summary of BHP's initiatives to decarbonise grid-connected electricity generation.

BHP is collaborating with Caterpillar through its Early Learner program to develop and deploy Cat zero-exhaust emission trucks, this includes planned battery-electric haul truck trials at BHP's Jimblebar mine. Subject to technology readiness and commercial viability, BHP expects to deploy electric haul trucks and excavators at selected BHP operations, displacing diesel emissions via electrification.

Diesel emissions from excavators are also a material source of BHP's Scope 1 emissions, BHP's Yandi mine has been trialling the operation of an electric excavator from February 2024 seeking to determine how tethered electrical heavy mining equipment may be effectively integrated into BHP's existing and future mining operations.

Dewatering & Other measures

Strategies to reduce emissions from dewatering at BHP include the trial and utilisation of high-efficiency pumps and motors, optimisation of bore location, piping layouts and pipe diameter to reduce operational energy demand and where feasible sourcing grid-based electricity to power dewatering operations. These strategies continue to be actively evaluated and implemented by BHP.

Additionally, BHP has avoided Scope 1 emissions where possible by minimising land clearing through the use of existing infrastructure where practicable to support the development and operation of the Proposal, including the use of existing cleared tracks and roads and mine processing infrastructure.

¹⁶ Excludes Scope 1 emissions sources not covered by the Safeguard Mechanism as this assessment is aligned with an Option A: Safeguard Mechanism confirmation



Figure 12-2: Combined Proposal GHG emissions comparison for operational scenarios

12.5.2 Reduce

BHP will reduce GHG emissions in accordance with the NGER Act and Safeguard Mechanism, as described below:

- BHP's contribution towards the Western Australian and Commonwealth Governments aspiration of net zero emissions by 2050
- the consideration given to evolving Western Australian and Commonwealth legislative and policy settings, including new international commitments, through which the net zero emissions by 2050 aspiration is intended to be delivered
- progressive reduction of Scope 1 emissions for the Combined Proposal through the setting of an indicative emissions reduction trajectory aligned with the Safeguard Mechanism and incorporates the enforceable annual baselines
- that all reasonable and practicable measures have been considered to avoid, reduce, and offset the Scope 1 emissions from the Combined Proposal
- that consideration has been given to opportunities for reducing BHP's downstream and other Scope 3 emissions associated with the Combined Proposal where reasonably practicable.

The activities associated with the Approved Proposal broadly align with the NGER facility (listed in Table 12-11), which is subject to NGER Act energy and emissions reporting. BHP is also required to report on both Scope 1 and Scope 2 emissions annually by NGER facility.

The NGER Act and Safeguard Mechanism provide contemporary, robust, transparent, and enforceable requirements to deliver GHG emissions reductions commensurate to Australia's international obligations. These mechanisms apply to GHG emissions associated with the Combined Proposal and enable the objectives of the EPA to be met (EPA 2024e), as well as the WA Government's Greenhouse Gas (GHG) Emissions Policy for Major Projects (Government of Western Australia 2024).

12.5.2.1 Scope 1 emission reduction trajectory

Figure 12-3 shows the Scope 1 emissions baseline and the indicative emission reduction trajectory for the combined Proposal.

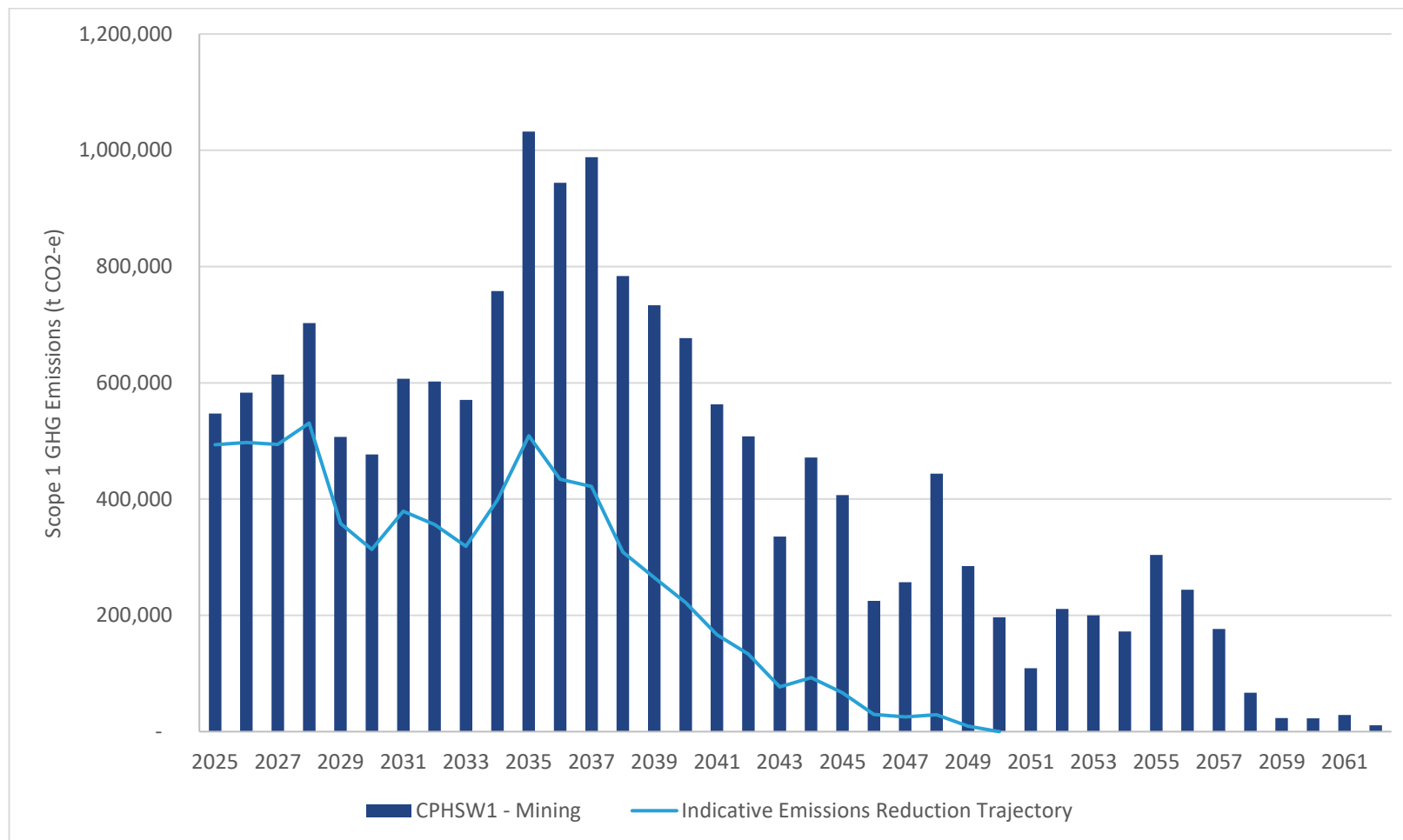


Figure 12-3: Combined Proposal Scope 1 emissions baseline and indicative emissions reduction trajectory

12.5.2.2 Reduction of Scope 1 emissions through fleet electrification

Displacing diesel as an energy source requires a transformation of mining operations through an integrated abatement program. The decarbonisation pathway is non-linear and will rely heavily on development of technologies that are not currently commercially available, with each component needing to reach maturity in line with the transformation program.

BHP is partnering with Caterpillar and Komatsu to develop commercially viable zero emissions trucks. The first trials began in 2024 (Caterpillar 2024), with full commercialisation expected to follow in subsequent years. BHP will continue to work with original equipment manufacturers (OEMs) to understand the availability timeline for electrified haul truck solutions. Subject to technology readiness and commercial viability, BHP expects to deploy electric haul trucks at selected BHP operations, displacing diesel emissions via electrification.

Replacing diesel as a fuel source requires a new operational ecosystem, impacting mine planning, haulage networks, and reconsideration of safety and operational factors. BHP is part of the 'Charge on Innovation Challenge', an initiative that has identified potential innovations to expedite the commercialisation of charging solutions for electric haul trucks. In FY2022, BHP became a founding member of the mining taskforce at CHARIN, an association dedicated to promoting interoperability of charging systems. The taskforce aims to ensure that any truck charging interfaces across the industry will be standard, regardless of the manufacturer.

BHP has also partnered with Toyota Australia to trial a new light electric vehicle at a site in Western Australia and BHP plans to eventually replace its diesel light vehicles with electric light vehicles across its Pilbara iron ore operations (BHP 2024h). Electric light vehicles have the potential to play a part in reducing the emissions associated with diesel powered light vehicles.

Studies of electric fleet at BHP will contribute to these industry decarbonisation initiatives. Replacement of mining and other equipment at Mining Area C is intended to be in line with any industry standards set.

12.5.2.3 Reduction of Scope 2 emissions through low carbon and renewable energy¹⁷

The Combined Proposal, together with the rest of BHP's Pilbara operations, will initially be powered by an islanded network that is supplied primarily by power from Yarnima Power Station. Yarnima is a highly efficient combined cycle gas turbine power station which emits approximately 35% less CO₂ than the Australian average, achieved through waste-heat recovery.

As BHP moves to displace diesel with electricity, an estimated further 900 MW of power will be required to support operations at WAIO by 2040 (BHP 2022c). BHP plans to source that additional power from renewable sources.

As the proportion of renewable power available to the Pilbara network grows, the Scope 2 emissions related to electricity generation for the Combined Proposal will decrease accordingly.

Yarnima Power Station is covered by a facility-specific Safeguard Mechanism emissions baseline, BHP is required to reduce emissions associated with electricity generation at Yarnima Power Station through compliance with the Safeguard Mechanism on a trajectory aligned with a 34.3% decline rate by 2030 and net-zero by 2050 on a production-adjusted basis. Additionally, Yarnima Power Station is subject to the Renewable Energy Target, which requires renewable energy certificates (RECs) to be surrendered for electricity consumed, purchase and surrender of RECs financially supports renewable electricity generation across Australia, contributing to a reduction in Australia's Scope 1 emissions from the electricity sector.

12.5.2.4 Reduction of domestic Scope 3 emissions¹⁷

BHP is pursuing the long-term goal of net zero Scope 3 GHG emissions by 2050. Achievement of this goal is uncertain, particularly given the challenges of a net zero pathway for our customers in steelmaking, and BHP cannot ensure the outcome alone. Due to the hard to abate emissions sources outlined below in steelmaking and shipping and the need to develop new low GHG emissions technology pathways, material decarbonisation opportunities in these sectors will take time to realise.

Scope 3 decarbonisation opportunities are managed primarily at the Group level by the functions of BHP's business with the technical expertise, accountability for decision making, and the greatest ability to influence segments of our value chain. BHP's global marketing team partners with our downstream customers in steelmaking on decarbonisation studies and pilots and ore quality trials, the maritime team works to reduce the emissions intensity of shipping, and the procurement team engages with suppliers to increase the proportion targeting net zero for their operational emissions by 2050. The Scope 3 emissions and mitigation measures for the Combined Proposal will be managed by these functions as part of the whole-of-company approach to Scope 3.

An exception to this approach is the downstream emissions which are the operational emissions of other BHP controlled facilities, such as Port Hedland.

Table 12-11: Summary of Safeguard Mechanism coverage of BHP's relevant operations

NGER Facility	Production Variable	Relevance to Proposal
ARC01 Mining Area C – MNG Facility	Iron ore default emissions intensity of 0.00476 tCO ₂ -e per tonne of iron ore applicable Megawatt hours of electricity generation default emissions intensity of 0.539 tCO ₂ -e applicable	Scope 1 activities generated by the Mining Area C NGER facility are aligned with the Proposal ¹⁸ .
Yarnima Power Station	Megawatt hours of electricity generation default emissions intensity of 0.539 tCO ₂ -e applicable	Source of Scope 2 emissions, Yarnima is the primary source of off-site electricity supply to the Proposal
PRL03 Rail – IOR Facility	Net-tonne-kilometres of bulk freight on a dedicated line default emissions intensity of 5.29 x 10 ⁻⁶ tCO ₂ -e per net-tonne-kilometre applicable	Source of Scope 3 emissions, rail transport of iron ore from the Proposal

ARC01 Mining Area C – MNG Facility (Mining Area C and South Flank)

BHP currently operates an iron ore hub and mining operations at Mining Area C (North Flank) including in respect of the Proposal, located approximately 100 km north-west of Newman in the Pilbara region of Western Australia, and a satellite ore body at South Flank which is included as part of the defined NGER facility, Mining Area C.

The Mining Area C NGER facility produces iron ore through conventional open-pit iron ore mining of the mineralised Marra Mamba Iron Formation. The Mining Area C NGER facility reports the energy and emissions from activities which support the production of iron ore up to where iron ore is loaded onto BHP's railway, which is a separate facility as discussed below.

¹⁸ With exception of the Mining Area C Power Station, which is not covered by MS1072. In FY2024 Mining Area C's NGER Scope 1 emissions associated with the Power Station were 1,536 t CO₂-e or 0.3% of the NGER facility's total Scope 1 emissions.

Yarnima Power Station

Yarnima is a combined cycle gas turbine (CCGT) power station located in Newman in the Pilbara region of WA. The power station operates gas turbines equipped with heat recovery steam generators to capture waste heat. Waste heat recovery generates additional power, reducing gas use for electricity generation and increasing the overall thermal efficiency and reducing carbon emissions intensity of the power station.

In the event of a gas supply interruption or shortfall, the power station is configured to allow normal operations to continue using diesel fuel. Yarnima supplies electricity to BHP's mines and the Newman township via BHP's inland electricity grid, including for the Proposal.

PRL03 Rail – IOR Facility

BHP's mining hubs are connected by more than 1,000 km of railway infrastructure in the Pilbara region of WA. This railway infrastructure is dedicated for BHP's sole use and rail transport activities are operated by BHP, which includes the transport of ore from the Combined Proposal. The NGER facility, PRL03 Rail – IOR Facility reports the energy and emissions from activities which support the transport of iron ore from BHP's mining hubs, where it is loaded, to Port Hedland where iron ore is unloaded for export.

12.5.3 Offset

BHP prioritises GHG emissions reduction at its operated assets to achieve our Scope 1 and 2 targets and goals, with investments in external carbon offset projects considered complementary to this 'structural abatement'.

The proposed GHG emissions reduction trajectory for the Combined Proposal aligns to the recently reformed Safeguard Mechanism. Although we prioritise structural abatement of the Combined Proposal, we acknowledge a role for the use of flexible compliance arrangements as allowed under the reformed Safeguard Mechanism.

This means that where structural abatement of emissions is insufficient to meet the Combined Proposal emissions reduction trajectory, BHP will ensure that these targets are met by either using banked SMC's from prior years, transferring SMCs from other BHP facilities (to allow decarbonisation to be optimised across BHP, for example displacing diesel trucks progressively by mine, rather than a smaller proportion of trucks at all mines in parallel), and/or retiring eligible carbon offsets in a temporary or transitional capacity while abatement options are being studied, as well as for 'hard to abate' emissions with limited or no current technological solutions, and where access to renewable energy is constrained.

In the context of BHP's operations in Western Australia, including at Mining Area C, our preference is to source offsets in line with our operational footprint in WA and in recognition of the WA state government's preference for locally generated offsets. We may also source offsets from international markets, in accordance with EPA guidance on the use of offsets within WA, if the use of international credits to meet Safeguard Mechanism obligations becomes allowed in the future, given the implementation of A6.4 of PA. Domestic sourcing of offsets may be from the domestic market or through offset generation from BHP's tenure or other locations in Australia, in partnership with reputable project developers under ERF methodologies.

BHP's procurement of carbon credits, includes due diligence so that we invest in carbon offsets that meet the following minimum quality standards:

- **Satisfies national carbon offset standards** for compliance offsets (i.e. ACCUs and other eligible regulatory offset instruments), including ACCUs that are established under (and meet the integrity standards of) the *Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth) and/or **Registered in an internationally recognised standard** that independently verifies and issues voluntary carbon credits (including but not limited to Verra and Gold Standard) that is accredited by and compliant to the International Carbon Reduction & Offset Alliance (ICROA) Code of Best Practice.
- **Adheres to a robust emissions reduction accounting methodology**, to provide assurance of the volume of emissions reduced through a project.
- **Meets additionally criteria** to ensure that the emissions reduction would not have occurred in the absence of a carbon offset market.
- **Has a high likelihood of permanence** to ensure that the emissions reduction is ongoing and not reversed (e.g. in the case of forestry projects, the trees are not cut down or destroyed by a natural disaster).
- **Provides robust mitigation against leakage**, ensuring an offsetting project does not increase emissions elsewhere (e.g. an area is protected from deforestation through offsetting but another forest area is destroyed).
- **Demonstrates high environmental and social integrity**, ensuring no broader social or environmental harm (e.g. hydropower projects that require forest clearing and community displacement).
- **Limit offset vintage to the last five years of offset generation**, to avoid claiming emissions reduction from activities that occurred a long time ago.

Whether surrender of carbon offsets may exceed 30% of the Proposal's expected baseline

BHP is committed to achieving net zero Scope 1 and 2 GHG emissions by 2050. BHP prioritises the 'structural abatement' to reduce GHG emissions at its operated assets to achieve our Scope 1 and 2 goals. The exact measures to be implemented to achieve net zero Scope 1 and 2 GHG emissions remains subject to uncertainty due to the long-time horizon of BHP's operations in the Pilbara, changing policy and regulation and the rapid evolution of availability and feasibility of technological solutions. The magnitude and timing of emissions reduction will be subject to a range of factors, some of which are outside the control of BHP, including:

- mine strategy and production may fluctuate in response to changes in the market or operational considerations, which may impact GHG emissions from the Proposals due to changes to forecast mining activities and power demand
- adoption, availability or effectiveness of decarbonisation technologies may change as new technologies emerge, or as complexities of implementation become clearer
- suitable sources of renewable energy may take longer to become available than forecasted, for example through delays in developing suitable regional energy infrastructure
- increased competition for decarbonisation expertise, services and technology may impact speed, effectiveness, or cost of implementation.

Acknowledging these uncertainties, there is potential that BHP's use of carbon offsets may exceed 30% of the Mining Area C's Safeguard Mechanism baseline¹⁹ in any given year. Under the Safeguard Mechanism:

- only ACCU and Safeguard Mechanism Credits may be used to offset emissions, which ensures only credible offsets and credits are used
- BHP is required to provide a statement to the CER setting out technological and regulatory barriers to decarbonisation in respect of facilities which surrender carbon offsets equal or greater than 30% of its annual baseline, as an accountability measure (DCCEE 2024d).

12.5.4 Other statutory decision-making processes

Table 12-12 summarises whether another statutory decision-making process can mitigate the potential environmental impacts of the Combined Proposal on Greenhouse Gas Emissions, considering the EPA's *Taking decision making processes into account in EIA: Interim Guidance* (EPA 2021f). Table 12-12 also provide reasons, including how, in relation to the specific potential impacts of the Proposal, the decision-making process takes the EP Act object and principles, and the EPA's objective for GHG emissions, into account.

Table 12-12: Greenhouse Gas Emissions – other statutory decision-making processes

Potential impact	Statutory decision-making process can mitigate impacts on the environment?	Reasons (if Yes)
Generation of GHG emissions	Yes	NGER Act • provides a framework for Nationally consistent reporting of Scope 1 and Scope 2 emissions and where Scope 1 emissions exceed

¹⁹ Mining Area C NGER Facility and the Proposals Scope 1 emission sources are broadly aligned.

Potential impact	Statutory decision-making process can mitigate impacts on the environment?	Reasons (if Yes)
		defined thresholds, BHP will be required to undertake action to manage these emissions NGER Safeguard Mechanism - imposes Scope 1 limits and annual reporting requirements on large GHG emitting facilities to keep net emissions below a defined baseline, consistent with Australia's emission targets Renewable Energy Target - aims to reduce greenhouse gas emissions in the electricity sector and increase renewable electricity generation through creation of market incentive for the generation and use of renewable energy through obligation for electricity consumers to surrender renewable energy credits for a proportion of their electricity use Emissions Reduction Fund - allows for the purchase and surrender of offsets to counterbalance GHG emissions.

12.6 Assessment and significance of residual impacts

12.6.1 Change in GHG emissions (unmitigated) as a result of the Proposal

Using the Scope 1 emissions forecasting data presented in Section 12.4.4.2, the:

- total Scope 1 emissions covered by the Safeguard Mechanism for the Approved Proposal are 15,076,411 tCO₂-e
- the Proposal is estimated by increase Scope 1 emissions covered by the Safeguard Mechanism by 1,313,404 tCO₂-e which represents an 8.7% increase in Scope 1 emissions when compared to the emissions of the Approved Proposal (15,076,411 tCO₂-e)
- the Combined Proposal is estimated to generate a total of 16,389,815 tCO₂-e Scope 1 emissions covered by the Safeguard Mechanism.
- the Proposal and Combined Proposal Scope 1 emissions not covered by the Safeguard Mechanism are not likely to be above 100,000 tCO₂-e in any year.

Using the electricity demand Scope 2 emissions forecasting data presented in Section 12.4.4.3, the total Scope 2 electricity demand emissions for the Approved Proposal is 4,183,472 tCO₂-e. The Proposal is estimated to generate a total of 392,045 tCO₂-e of Scope 2 electricity demand emissions which represents a 9.4% increase when compared to the emissions of the Approved Proposal (4,183,472 tCO₂-e) the Combined Proposal is estimated to generate a total of 4,575,517 tCO₂-e of Scope 2 electricity demand emissions. Table 12-13 shows the Scope 1 and Scope 2 emissions for the Proposal, Approved Proposal and Combined Proposal for the life of the Project.

Table 12-13: Greenhouse Gas Emissions - Scope and Scope 2 Greenhouse Gas Emissions Summary

Scope	Estimated emissions (tCO ₂ -e)		
	Proposal	Approved Proposal	Combined Proposal
Scope 1 emissions	1,313,404	15,076,411	16,389,815
Scope 2 emissions	392,045	4,183,472	4,575,517

Using the forecasting data presented in Section 12.4.4.4, the Combined Proposal is estimated to generate a total of 4,548,133,199 tCO₂-e Scope 3 emissions, including rail transport emissions. 221,640,847 tCO₂-e Scope 3 emissions are estimated to be generated as a result of the Proposal and 4,326,492,352 tCO₂-e for the Approved Proposal.

12.6.2 Comparison of GHG emissions (residual) against State and National GHG emissions

Based on the 2022 Western Australian emissions and 2022 National emissions inventory reported by DCCEEW and the Combined Proposal estimated average Scope 1 emissions (431,311 tCO₂-e), the estimated percentage contribution of the Combined Proposal average Scope 1 emissions to State and National GHG emissions is 0.523% and 0.093% respectively.

The average emissions of the Combined Proposal including Scope 1 and Scope 2 emission sources (551,719 tCO₂-e) is estimated to represent 0.668% of the 2022 Western Australian emissions inventory, and 0.119% of the National emissions inventory.

12.6.3 GHG emissions following application of the mitigation hierarchy

For the purposes of this assessment, the indicative Safeguard Mechanism decline rate expected to be applied to the Mining Area C NGER facility has been used to calculate the residual Scope 1 GHG emissions which are shown in Table 12-14 and described as follows:

- With mitigation, the Combined Proposal would result in estimated net Scope 1 GHG emissions up to:
 - 6,930,641 tCO₂-e from Mining Area C
- With mitigation, the lifetime Scope 1 GHG emissions for the Combined Proposal will reduce by:
 - 9,459,174 tCO₂-e from Mining Area C (approximately 57.7% reduction of emissions over the life of the Combined Proposal).

Table 12-14: Greenhouse Gas Emissions - Residual Scope 1 Greenhouse Gas Emissions using application of Safeguard Mechanism decline rate

Scope 1 emission sources	Estimated Combined Proposal Scope 1 emissions (tCO ₂ -e)		Percentage (%) reduction in emissions over the life of the Combined Proposal
	With mitigation - estimated net Scope 1 GHG emissions	With mitigation - lifetime Scope 1 GHG Emissions reduction	
MAC CPHSW Stage 1	6,930,641	9,459,174	57.7

12.6.4 Significant residual impacts

Following the application of the mitigation hierarchy (Section 12.5), and utilising the indicative emissions reduction trajectory for Scope 1 emissions aligned to the Safeguard Mechanism, the potential significant residual impacts are:

- Contribution of 6,930,641 tCO₂-e of Scope 1 emissions (residual using the indicative Safeguard Mechanism decline rate from Mining Area C over the life of the Combined Proposal)
- Contribution of 4,575,517 tCO₂-e of Scope 2 emissions (residual) over the life of the Combined Proposal
- Contribution of 4,548,133,199 tCO₂-e of Scope 3 emissions (residual) over the life of the Combined Proposal.

The detailed assessment of offsets is discussed in Section 12.5.3, including how the proposed offset/s may counterbalance the significant residual impact of GHG emissions.

12.7 Environmental outcomes

Table 12-15 summarises the environmental outcomes, proposed assurance (regulation) and proposed monitoring (if required) for each residual impact for GHG emissions. Detail of the proposed monitoring is set out in the Part IV environmental management plans and other relevant statutory decision-making documents discussed in Section 12.5 (Mitigation). Table 12-15 demonstrates how the proposed environmental outcomes for the Combined Proposal, together with the proposed regulation and monitoring, are consistent with the EPA's objective for Greenhouse Gas Emissions (Section 12.1).

As required by the EPA's ERD Instructions, for Significant Amendments, BHP has included information about the existing implementation conditions for the Approved Proposal (Appendix 2). BHP considers that the EPA should inquire into the Approved Proposal implementation conditions (relating to GHG emissions), as provided for under s40AA(3), as part of the assessment of the Proposal under s40 and in the EPA's assessment report required under s44, for the following reasons:

- Given BHP will manage GHG emissions in accordance with the NGER Act and Safeguard Mechanism, BHP has not proposed a condition for GHG emissions.

Table 12-15: Greenhouse Gas Emissions – Proposal environmental outcomes, proposed regulation and monitoring

Residual impact from the Proposal	Environmental outcome	Proposed regulation (Condition or other statutory decision-making process)	Proposed Monitoring	Consistency with EPA objective
1. Generation of GHG emissions	Contribution of 6,930,641 tCO₂-e of Scope 1 emissions (residual using the indicative Safeguard Mechanism decline rate from the Mining Area C mine) over the life of the Combined Proposal Contribution of 4,575,517 tCO₂-e of Scope 2 emissions (residual) over the life of the Combined Proposal Contribution of 4,541,882,612 tCO₂-e of Scope 3 emissions (residual) over the life of the Combined Proposal	NGER Act - reporting of emissions from the Mining Area C mine (Combined Proposal) NGER Facility - reporting of emissions from the Yarmima Power Station NGER Facility - reporting of emissions from the Rail NGER Facility - emissions decline in accordance with the indicative Safeguard Mechanism Decline Rates Renewable Energy Target - defined emissions targets for purchase and surrender of renewable energy certificates CC Act - requirements for facilities to be on a broad trajectory to net zero emissions by 2050	Annual monitoring will be conducted in accordance with the NGER measurement determination, with a summary of Scope 1 emissions and any surrendered offsets published as part of the Safeguard Mechanism by the Clean Energy Regulator. On a 5-yearly interval, BHP will also report on: - total and net Scope 1 GHG emissions from the Combined Proposal - carbon offsets surrendered against the Combined Proposal for the reporting period - the Combined Proposal performance against the emissions reduction trajectory outlined in this document. - the emissions intensity of the Combined Proposal, benchmarking emissions intensity against comparable facilities - a summary of GHG emission reduction and abatement measures implemented and delivered to avoid or reduce GHG emissions - technology and initiatives under development relevant to the Combined Proposal	The significant residual impact of contribution of GHG emissions from the Combined Proposal will be counterbalanced by appropriate abatement measures. GHG emissions will also be avoided and reduced over the life of the project, in accordance with the NGER Act and the Safeguard Mechanism.

13 Other environmental factors

Table 13-1 presents BHP's evaluation of 'other factors'. This includes justification as to why BHP considers that they are not preliminary key environmental factors. To support BHP's position that an environmental factor is not a preliminary key environmental factor for the Proposal, BHP has included supporting information as appendices, where relevant.

Table 13-1: Other environmental factors

Relevant activities for the Proposal	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
LAND		
Landforms EPA objective: <i>To maintain the variety and integrity of significant physical landforms so that environmental values are protected</i>		
Ground disturbance and installation of infrastructure Drainage and stormwater management	Modification of natural landforms from the construction and operation of mines and associated infrastructure Erosion of natural landforms as a result of altered surface water regimes	Significance considerations BHP has reviewed the potential impacts of the Proposal on Landforms, considering the <i>Environmental factor guideline – Landforms</i> (EPA 2018b), with the findings summarised below: - No significant landforms (consistent with the description in Environmental factor guideline – Landforms (EPA 2018b) are located within the Development Envelope. Proposed mitigation - BHP has developed the MCP (BHP 2024f) The MCP has been updated to include the Proposal and will address the potential impacts on natural landforms, including provision of flood bunds, spillways, abandonment bunds and rehabilitation of mine landforms. - BHP proposes that mine closure and rehabilitation is regulated under Part IV of the EP Act. Environmental outcome - The implementation of the Proposal will maintain the variety and integrity of significant physical landforms.
Terrestrial Environmental Quality EPA objective: <i>To maintain the quality of land and soils so that environmental values are protected</i>		
Ground disturbance Drainage and stormwater management Rehabilitation and decommissioning activities	Increased erosion	Significance considerations BHP has reviewed the potential impacts of the Proposal on Terrestrial Environmental Quality, considering the <i>Environmental factor guideline – Terrestrial Environmental Quality</i> (EPA 2016c), with the findings summarised below: - Risk of sedimentation and erosion of the GCOSA is considered unlikely use of the pre-development flow velocities was used to inform the final design outcome. Proposed mitigation - Best management practices in stormwater management to control erosion and scour

Relevant activities for the Proposal	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
		- BHP has updated the MCP to incorporate the Proposal (BHP 2024f) - Ongoing management and monitoring of the diversion is proposed as part of closure and post-closure. - BHP proposes that mine closure and rehabilitation is regulated under Part IV of the EP Act. Environmental outcome The implementation of the Proposal will maintain the quality of land and soils so that environmental values are protected.
AIR		
Air Quality EPA objective: <i>To maintain air quality and minimise emissions so that environmental values are protected</i>		
Construction and of infrastructure (pipelines and diversion)	Particulate emissions (dust) reducing ambient air quality at sensitive receptors	Significance considerations BHP has reviewed the potential impacts of the Proposal on Air Quality, considering the <i>Environmental factor guideline – Air quality</i> (EPA 2020a), with the findings summarised below: - Existing high levels of dust are present within the Pilbara region and windblown dust is expected to be a significant contributor to the ambient dust levels in the area. - No sensitive receptors will be affected by the Proposal. Pastoral leases near the prescribed premise include Juna Downs (N050471) and Marillana (N050368) pastoral stations, located 28km and 44km from the Proposal boundary respectively. The town of Newman is located approximately 120km from the proposal boundary. - Workers accommodation villages Packsaddle Village and Mulla Mulla Village are located within the Development Envelope and impacts to air quality are managed under other legislation. - The current Part V Operating Licence L7851/2002/6 Category 5 – Processing or beneficiation of metallic or non-metallic ore authorises the processing of 151,000,000 t of ore per year and this will not increase as a result of the Proposal. Proposed mitigation - Examples of existing dust management measures at the Approved Proposal that will be applied to the Proposal include the following: - maintain dust controls (e.g. water sprays/cannons)

Relevant activities for the Proposal	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
		– water sites with water tankers within operational areas, including unsealed roads, haul roads and construction areas – seal major traffic thoroughfares and install kerbing or bunding discourage off-road passage where practicable – enforce speed limits – minimise areas of exposed soil (land disturbance) and rehabilitate disturbed areas as they become available. • Air quality (dust) was assessed under Part IV of the EP Act as part of the Mining Area C Southern Flank Public Environmental Review (BHP 2017b) and not considered a key environmental factor for the Approved Proposal. The use of fixed plan engineered controls and proactive operational controls could minimise residual impacts. No additional regulatory controls were required to mitigate the risk of dust impacts on sensitive receptors. • BHP notes that Air Quality (dust) can be regulated under Part V (Section 49) of the EP Act, if required. Environmental outcome The proposal will maintain air quality and minimise dust emissions so that environmental values are protected.
PEOPLE		
Social Surroundings		
EPA objective: <i>To protect social surroundings from significant harm</i>		
Amenity (Noise and Visual Amenity)		
Ground disturbance and earthworks for mine infrastructure (including surplus water/ drainage management) Ongoing implementation of rehabilitation and	Noise emissions and visual changes to the landscape	Significance considerations BHP has reviewed the potential impacts of Social Surroundings (Amenity), considering the <i>Environmental factor guideline – Social surroundings</i> (EPA 2023b), with the findings summarised below: • No sensitive receptors will be affected by the Proposal. Pastoral leases near the prescribed premise include Juna Downs (N050471) and Marillana (N050368) pastoral stations, located 28km and 44km from the Proposal boundary respectively. The town of Newman is located approximately 120km from the proposal boundary. • The visual impact of the Proposal along the Great Northern Highway will be considered to be low. In some locations, the North-West Scheme Pipeline will be visible alongside the road.

Relevant activities for the Proposal	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
decommissioning activities		- BHP have undertaken monitoring since 2020 of visibility levels alongside Great Northern Highway due to a potential for dust derived from mining and associated activities to reduce visibility along sections of Great Northern Highway. - There are unlikely to be long term potential noise impacts related to the Proposal. - The Proposal has been designed to utilise existing tracks and cleared areas for the construction of the pipelines and will not significantly impact the viewshed of locations with high amenity values (panoramic viewpoints, lookouts, gorges and rockpools). Proposed mitigation - BHP proposes that mine closure and rehabilitation is regulated under Part IV of the EP Act. - The provisions of the <i>Environmental Protection (Noise) Regulations 1997 (WA)</i> (Noise Regulations) are applicable, and BHP notes that Noise can be regulated under the Noise Regulations, if required. Environmental outcome The implementation of the Proposal will protect Social Surroundings (Noise and Visual Amenity) from significant impact.

14 Offsets

14.1 Biodiversity factors

14.1.1 Identification of and quantification of significant residual impacts for the Proposal

Table 14-1 identifies the significant residual impacts for the Proposal according to the residual impact significance model in the *WA Environmental Offsets Guidelines* (Government of Western Australia 2014).

Following the assessment of the significance of residual impacts (Sections 7.6, 8.6, 9, 10.6, 11.6 and 12.6) and as summarised in Table 14-1 and Table 14-2, BHP concluded that offsets are required for the following significant residual impacts for the Proposal:

- Clearing of up to 1,043 ha of native vegetation in Good to Excellent condition (in the Pilbara IBRA region)
- Clearing of up to 60 ha of riparian vegetation (locally significant vegetation)
- Potential decline or death of Eucalypt trees within 162 ha of vegetation impacted by groundwater mounding for the Northern RAV MAR scheme clearing of up to 809 ha of critical foraging habitat²⁰ for significant fauna, including Ghost Bat, Northern Quoll, Pilbara Olive Python, Pilbara Leaf Nosed Bat, and Grey Falcon
- clearing of up to 1,045 ha of supporting habitat for Northern Quoll, Pilbara Olive Python, Pilbara Leaf Nosed Bat, and Grey Falcon

Figure 8-15 shows the areas of Good to Excellent condition vegetation within the Pilbara IBRA bioregion and subregions and the likely areas of significant residual impact (i.e. the proposed clearing within the Indicative Footprint).

Critical habitat for the Ghost Bat Pilbara Olive Python, Northern Quoll and Grey Falcon within the Development Envelope has been identified as Stony Plain, Minor Drainage Line, Medium Drainage Line, Breakaway/Cliff, Wetland, Sandy/Stony Plain, Gorge/Gully, Major Drainage Line, Drainage Area/Floodplain and Mulga Woodland. Figure 9-7 and Figure 9-8 in Section 9 shows these habitats within the Development Envelope and the likely areas of impact (i.e. the proposed clearing within the Indicative Footprint). A completed *Offsets Template* is provided in Table 14-2, which identifies and quantifies the significant residual impacts and proposed offsets.

As detailed in condition 10-10 of MS1072, the clearing of 5,564 hectares that was previously approved under Statement 491 is exempt from the requirement to offset. Total clearing as of 30 June 2023 is 10,688 ha.

²⁰ Critical fauna habitats for the different species partially overlap and therefore, to avoid duplication of offsets, where values overlap, they are accounted for once, not multiple times.

Table 14-1: Residual Impact Significance Model

Part IV Environmental Factors	Vegetation and Flora						
		Terrestrial Fauna					
		Subterranean Fauna					
Part V Clearing Principals	Rare flora	Threatened ecological communities	Remnant vegetation	Wetlands & waterways	Conservation areas	High biological diversity	Habitat for fauna
Residual impact that is environmentally unacceptable or cannot be offset	None	None	None	None	None	None	None
Significant residual impacts that will require an offset All significant residual impacts to species and ecosystems protected by statute or where the cumulative impact is already at a critical level	None	None	Clearing of up to 1,043 ha of native vegetation in Good to Excellent condition in the Pilbara IBRA region Clearing of up to 60 ha of riparian vegetation Potential decline or death of Eucalypt trees within 162 ha of vegetation impacted by groundwater mounding for the	None	None	None	Clearing of up to 809 ha of critical foraging habitat ²¹ for significant fauna, including Ghost Bat, Northern Quoll, Pilbara Olive Python, Pilbara Leaf Nosed Bat, and Grey Falcon. Clearing of up to 1045 ha of supporting habitat for Northern Quoll, Pilbara Olive Python, Pilbara Leaf Nosed Bat, and Grey Falcon

²¹ Critical fauna habitats for the different species partially overlap and therefore, to avoid duplication of offsets, where values overlap, they are accounted for once, not multiple times.

Part IV Environmental Factors	Vegetation and Flora						
				Terrestrial Fauna			
						Subterranean Fauna	
Part V Clearing Principals	Rare flora	Threatened ecological communities	Remnant vegetation	Wetlands & waterways	Conservation areas	High biological diversity	Habitat for fauna
			Northern RAV MAR scheme				Potential decline or death of 162 ha of Eucalypt trees from groundwater mounding associated with the Northern RAV MAR scheme
Significant residual impacts that may require an offset Any significant residual impact to potentially threatened species and ecosystems, areas of high environmental value or where the cumulative impact may reach critical levels if not managed	None	None	None	None	None	Groundwater drawdown associated with the Proposal will directly impact two species of stygofauna with uncertain distributions:	Groundwater drawdown associated with the Proposal will result in the loss or changes to stygofauna habitat
Residual impacts that are not significant	None No plant taxon gazetted as Threatened Flora under the BC Act or	None	Each Beard vegetation association will have more than 99% of their pre-European extent remaining	No significant wetlands (e.g. Ramsar) occur within the proposed	None The nearest conservation area is Karijini National	Clearing of no more than 15% of known populations and no more than 32% of records of Priority flora species in the	Clearing of 44 ha of fauna habitat that does not represent critical or supporting

Part IV Environmental Factors	Vegetation and Flora						
		Terrestrial Fauna					
		Subterranean Fauna					
Part V Clearing Principals	Rare flora	Threatened ecological communities	Remnant vegetation	Wetlands & waterways	Conservation areas	High biological diversity	Habitat for fauna
	EPBC Act have been recorded from within the proposed Development Envelope		and are not considered regionally significant. The associations are well represented within Western Australia occurring broadly within, or extending beyond, the Pilbara bioregion	Development Envelope	Park, 20 km to the south-west	Pilbara region species	habitat for significant fauna. No direct impact to known records of Threatened fauna species

Table 14-2: Offsets Template

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
Flora and Vegetation									
Clearing of up to 1,043 ha of native vegetation in Good to Excellent condition in the Pilbara IBRA region	The Proposal Indicative Footprint has attempted to reduce the amount of clearing by keeping pipeline routes to existing tracks and disturbed areas where possible.	BHP undertakes a site-specific rehabilitation approach with disturbed areas progressively rehabilitated in accordance with the Mining Area C – South Flank MCP	<u>Can the environmental values be rehabilitated/evidence?</u> Yes, native vegetation can be rehabilitated. The Mining Area C-Southern Flank is an operating mine and BHP has progressively rehabilitated available areas. BHP provides evidence on rehabilitation in its Annual Environmental Reports. <u>Operator experience in undertaking rehabilitation?</u> BHP started rehabilitation at its WA Iron Ore operations in the Pilbara in the 1990s. From the early 2000s onwards, BHP made landform improvements, including integrating OSAs into the landscape, altering slopes to minimise erosion and use of covers to prevent acid and gas hazards. From 2015 onwards, BHP made revegetation improvements including understanding of seed biology and improvements in collection, dormancy breaking, and seeding methods. <u>What is the type of vegetation being rehabilitated?</u>	<u>Extent</u> Clearing of up to 1,043 ha is in Good to Excellent condition <u>Quality</u> Good to Excellent condition <u>Significance</u> Nil <u>Land Tenure</u> Unallocated crown land or pastoral <u>Time Scale</u> 15-20 years post closure, for areas able to be rehabilitated Applying the Residual Impact Significance Model in the WA Offsets Guidelines, significant residual impacts require an offset where the	Monetary contribution to the PEOF	Low The WA Government will make decisions on specific offsets projects proposed through the PEOF, focusing on on-ground projects. The operation of the fund will use relevant environmental information and knowledge from the WA and Commonwealth governments, natural resource management groups, Traditional Owners, conservation groups,	BHP will contribute funding to the PEOF. The PEOF allows for multiple offset payments to be combined to deliver larger conservation projects or expand successful initiatives in the region to maximise the value of financial offsets. This approach enables strategic landscape scale projects with much greater environmental benefits to be implemented, rather than	N/A	Base rate of \$945 AUD (excluding GST) per ha within the Hamersley IBRA subregion

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
			Detailed vegetation association mapping was completed for the proposed Development Envelope, with 79 vegetation associations mapped within the Development Envelope, 42 occur within the Indicative Footprint and will be directly impacted by clearing. The dominant vegetation associations of the proposed Development Envelope are <i>Triodia Hummock Grassland (HS TsTwTp EllCh AhiAaa)</i>, which makes up approximately 29% of the current extent of vegetation in the Development Envelope <u>Time lag</u> BHP's review of rehabilitation indicates that it will usually take 15-20 years after an area is rehabilitated before it can be assessed against completion criteria. This will depend on climatic conditions when rehabilitation commenced and during the rehabilitation period. <u>Credibility of the rehabilitation proposed (evidence of demonstrated success)</u> As discussed above, BHP has experience in rehabilitation and makes continual improvements in rehabilitation practices. BHP considers that the rehabilitation	cumulative impact is already at a critical level; therefore, an offset is required for the cumulative clearing of native vegetation in the Pilbara (IBRA) region		industry and the research sector.	multiple smaller activities.		

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
			proposed in the Mining Area C-South Flank Hub MCP is credible and the current Annual Environmental Reports provide evidence of rehabilitation success.						
Clearing of up to 60 ha riparian vegetation	Minimise impact through using existing tracks and cleared areas. Mitigate impacts through supplementation and reduction of dewatering. Implementation of the CPHWRMP to monitor and manage impacts to tree health.	BHP undertakes a site-specific rehabilitation approach with disturbed areas progressively rehabilitated in accordance with the Mining Area C South Flank Hub MCP	<u>Can the environmental values be rehabilitated/evidence?</u> Yes, native vegetation can be rehabilitated. The Mining Area C-Southern Flank is an operating mine and BHP has progressively rehabilitated available areas. BHP provides evidence on rehabilitation in its Annual Environmental Reports. <u>Operator experience in undertaking rehabilitation?</u> BHP started rehabilitation at its WA Iron Ore operations in the Pilbara in the 1990s. From the early 2000s onwards, BHP made landform improvements, including integrating OSAs into the landscape, altering slopes to minimise erosion and use of covers to prevent acid and gas hazards. From 2015 onwards, BHP made revegetation improvements including understanding of seed biology and improvements in collection, dormancy breaking, and seeding methods.	<u>Extent</u> <u>Clearing of up to 60 ha of riparian vegetation</u> <u>Quality</u> <u>Good to Excellent condition</u> <u>Significance</u> <u>Nil</u> <u>Land Tenure</u> <u>Unallocated crown land or pastoral</u> <u>Time Scale</u> <u>15-20 years post closure, for areas able to be rehabilitated.</u> <u>Applying the Residual Impact Significance Model in the WA Offsets Guidelines, significant residual impacts require an offset where the</u>	Monetary contribution to the PEOF	Low The WA Government will make decisions on specific offsets projects proposed through the PEOF, focusing on on-ground projects. The operation of the fund will use relevant environmental information and knowledge from the WA and Commonwealth governments, natural resource management groups, Traditional Owners, conservation	BHP will contribute funding to the PEOF. The PEOF allows for multiple offset payments to be combined to deliver larger conservation projects or expand successful initiatives in the region to maximise the value of financial offsets. This approach enables strategic landscape scale projects with much greater environmental benefits to be	N/A	Higher rate of \$1,891 AUD (excluding GST) per ha within the Hamersley IBRA subregion

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
			<u>What is the type of vegetation being rehabilitated?</u> The Proposal will clear up to 60 ha comprising 16 riparian vegetation associations. <u>Time lag?</u> BHP's review of rehabilitation indicates that it will usually take 15-20 years after an area is rehabilitated before it can be assessed against completion criteria. This will depend on climatic conditions when rehabilitation commenced and during the rehabilitation period. <u>Credibility of the rehabilitation proposed (evidence of demonstrated success)</u> As discussed above, BHP has experience in rehabilitation and makes continual improvements in rehabilitation practices. BHP considers that the rehabilitation proposed in the Mining Area C-South Flank Hub MCP is credible and the current Annual Environmental Reports provide evidence of rehabilitation success.	<u>cumulative impact is already at a critical level; therefore, an offset is required for the cumulative clearing of native vegetation in the Pilbara (IBRA) region.</u>		groups, industry and the research sector.	implemented, rather than multiple smaller activities		
Potentially contributes to the clearing of vegetation associated	Limit groundwater level increase to 10 mbgl for	BHP undertakes a site-specific rehabilitation approach with	<u>Can the environmental values be rehabilitated/evidence?</u>	<u>Extent</u> 162 ha of vegetation containing	Monetary contribution to the PEOF	Low The WA Government will make	BHP will contribute funding to the PEOF. The PEOF allows	N/A	Base rate of \$945 AUD (excluding GST) per ha within the

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
with the Proposal if vegetation decline or death occurs of <i>Eucalyptus</i> trees within 177 ha of vegetation impacted by groundwater mounding for the Northern RAV MAR scheme	Northern RAV MAR Use of water consistent with water use hierarchy in order of priority: environmental water requirements, operational use, MAR, and creek discharge BHP will monitor the tree health of <i>Eucalyptus xerothermica</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus victrix</i> trees within the 0-20 mbgl mounding zone, commencing at the cessation of injection of surplus water into the Northern RAV MAR to assess potential decline in health of the trees while the	disturbed areas progressively rehabilitated in accordance with the Mining Area C South Flank Hub MCP	Yes, native vegetation can be rehabilitated. The Mining Area C-Southern Flank is an operating mine and BHP has progressively rehabilitated available areas. BHP provides evidence on rehabilitation in its Annual Environmental Reports. <u>Operator experience in undertaking rehabilitation?</u> BHP started rehabilitation at its WA Iron Ore operations in the Pilbara in the 1990s. From the early 2000s onwards, BHP made landform improvements, including integrating OSAs into the landscape, altering slopes to minimise erosion and use of covers to prevent acid and gas hazards. From 2015 onwards, BHP made revegetation improvements including understanding of seed biology and improvements in collection, dormancy breaking, and seeding methods. <u>What is the type of vegetation being rehabilitated?</u> <i>Eucalyptus xerothermica</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus victrix</i> trees. <u>Time lag?</u> BHP's review of rehabilitation indicates that it will usually take 15-	<i>Eucalyptus xerothermica</i>, <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus victrix</i> trees <u>Quality</u> <u>Good to Excellent condition</u> <u>Significance</u> <u>Nil</u> <u>Land Tenure</u> <u>Unallocated crown land or pastoral</u> <u>Time Scale</u> <u>15-20 years post closure, for areas able to be rehabilitated.</u> <u>Applying the Residual Impact Significance Model in the WA Offsets Guidelines, significant residual impacts require an offset where the cumulative impact is already at a critical level;</u>		decisions on specific offsets projects proposed through the PEOF, focusing on on-ground projects. The operation of the fund will use relevant environmental information and knowledge from the WA and Commonwealth governments, natural resource management groups, Traditional Owners, conservation groups, industry and the research sector.	for multiple offset payments to be combined to deliver larger conservation projects or expand successful initiatives in the region to maximise the value of financial offsets. This approach enables strategic landscape scale projects with much greater environmental benefits to be implemented, rather than multiple smaller activities.		Hamersley IBRA subregion

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
	mounded groundwater gradually recedes.		20 years after an area is rehabilitated before it can be assessed against completion criteria. This will depend on climatic conditions when rehabilitation commenced and during the rehabilitation period. <u>Credibility of the rehabilitation proposed (evidence of demonstrated success)</u> As discussed above, BHP has experience in rehabilitation and makes continual improvements in rehabilitation practices. BHP considers that the rehabilitation proposed in the Mining Area C-South Flank Hub MCP is credible and the current Annual Environmental Reports provide evidence of rehabilitation success.	<u>therefore, an offset is required for the cumulative clearing of native vegetation in the Pilbara (IBRA) region.</u>					
Terrestrial Fauna									
Clearing of 810 ha of critical Ghost Bat, Pilbara Olive Python Northern Quoll and Grey Falcon foraging habitat	Refinement of proposal footprint minimising the amount of clearing required to support the Proposal. Minimise impact through using existing tracks	BHP undertakes site specific rehabilitation approach with disturbed areas progressively rehabilitated and fauna habitats incorporated	<u>Can the environmental values be rehabilitated/evidence?</u> Yes, critical foraging habitat can be rehabilitated via the rehabilitation of native vegetation. BHP has progressively rehabilitated available areas at the Mining Area C - South Flank mine site. BHP provides evidence on rehabilitation	<u>Extent</u> Clearing of 801 ha of critical habitat <u>Quality</u> Poor to Excellent condition <u>Significance</u> Threatened species (Pilbara	Monetary contribution to the PEOF	Low The WA Government will make decisions on specific offsets projects proposed through the PEOF, focusing on on-ground	BHP will contribute funding to the PEOF. The PEOF allows for multiple offset payments to be combined to deliver larger conservation	N/A	Higher rate of \$1,891 AUD (excluding GST) per ha within the Hamersley IBRA subregion

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
	and cleared areas. Implementation of the Fauna Management Plan.	into the rehabilitation process in accordance with the MCP	in its Annual Environmental Reports. <u>Operator experience in undertaking rehabilitation?</u> BHP started rehabilitation at its WA Iron Ore operations in the Pilbara in the 1990s. BHP has continued to make revegetation improvements including the incorporation of fauna habitats into rehabilitated areas. <u>What is the type of vegetation being rehabilitated?</u> Critical foraging habitat within the proposed Development Envelope comprises Drainage Area/ Floodplain, Minor Drainage Line, Medium Drainage Line, Major Drainage Line, Breakaway/Climf, Gorge/Gully, Major Drainage Line, Mulga Woodland and Stony Plain and Wetland. <u>Time lag?</u> BHP's review of rehabilitation indicates that it will usually take 15-20 years after an area is rehabilitated before it can be assessed against completion criteria. This will depend on climatic conditions when rehabilitation commenced and during the rehabilitation period.	Olive Python, Ghost Bat, Northern Quoll and Grey Falcon) habitat <u>Land Tenure</u> Unallocated crown land or pastoral <u>Time Scale</u> 15-20 years post closure, for areas able to be rehabilitated As per the significant framework, the residual impact is considered to be significant because it is habitat for a Threatened species		projects. The operation of the fund will use relevant environmental information and knowledge from the WA and Commonwealth governments, natural resource management groups, Traditional Owners, conservation groups, industry and the research sector.	projects or expand successful initiatives in the region to maximise the value of financial offsets. This approach enables strategic landscape scale projects with much greater environmental benefits to be implemented, rather than multiple smaller activities.		

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
			<u>Credibility of the rehabilitation proposed (evidence of demonstrated success)</u> As discussed above, BHP has experience in rehabilitation and has made improvements in rehabilitation practices. BHP considers that the rehabilitation proposed in the Mining Area C-South Flank Hub MCP is credible and the current Annual Environmental Reports provide evidence of rehabilitation success.						
Clearing of 1,045ha of supporting habitat for Pilbara Leaf-nosed Bat, Pilbara Olive Python, Grey Falcon and Northern Quoll	Refinement of proposal footprint minimising the amount of clearing required to support the Proposal. Minimise impact through using existing tracks and cleared areas. Implementation of the Fauna Management Plan.	BHP undertakes site specific rehabilitation approach with disturbed areas progressively rehabilitated and fauna habitats incorporated into the rehabilitation process in accordance with the MCP	<u>Can the environmental values be rehabilitated/evidence?</u> Yes, supporting habitat can be rehabilitated via the rehabilitation of native vegetation. BHP has progressively rehabilitated available areas at the mine site. BHP provides evidence on rehabilitation in its Annual Environmental Reports. <u>Operator experience in undertaking rehabilitation?</u> BHP started rehabilitation at its WA Iron Ore operations in the Pilbara in the 1990s. BHP has continued to make revegetation improvements including the incorporation of fauna habitats into rehabilitated areas.	<u>Extent</u> <u>Clearing of 1,045ha of supporting habitat</u> <u>Quality</u> Poor to Excellent condition <u>Significance</u> Threatened species (Pilbara Leaf-nosed Bat, Pilbara Olive Python, Grey Falcon, Northern Quoll) habitat <u>Land Tenure</u>	Monetary contribution to the PEOF	Low The WA Government will make decisions on specific offsets projects proposed through the PEOF, focusing on on-ground projects. The operation of the fund will use relevant environmental information and knowledge from the WA and	BHP will contribute funding to the PEOF. The PEOF allows for multiple offset payments to be combined to deliver larger conservation projects or expand successful initiatives in the region to maximise the value of financial offsets. This approach	N/A	Base rate of \$945 AUD (excluding GST) per ha within the Hamersley IBRA subregion

Mining Area C-Southern Flank Significant Amendment (the Proposal)									
Existing environment/ impact	Mitigation			Significant residual impact	Offsets calculation methodology				
	Avoid and minimise	Rehabilitation type	Likely rehabilitation success		Type	Risk	Likely offset success	Time lag	Offset quantification
			<u>What is the type of vegetation being rehabilitated?</u> Supporting habitat within the proposed Development Envelope comprises Stony Plain, Minor Drainage Line, Medium Drainage Line, Breakaway/ Cliff, Wetland, Gorge/ Gully, Major Drainage Line, Hillcrest/ Hillslope, Drainage Area/ Floodplain and Mulga Woodland <u>Time lag?</u> BHP's review of rehabilitation indicates that it will usually take 15-20 years after an area is rehabilitated before it can be assessed against completion criteria. This will depend on climatic conditions when rehabilitation commenced and during the rehabilitation period.	Unallocated crown land or pastoral <u>Time Scale</u> 15-20 years post closure, for areas able to be rehabilitated As per the significant framework, the residual impact is considered to be significant because it is habitat for a Threatened species		Commonwealth governments, natural resource management groups, Traditional Owners, conservation groups, industry and the research sector.	enables strategic landscape scale projects with much greater environmental benefits to be implemented, rather than multiple smaller activities.		

BHP has considered the six principles in the *WA Environmental Offsets Policy* (Government of Western Australia 2011), to determine the proposed offset and to demonstrate that the proposed offset through the PEOF is appropriate to counterbalance the significant residual impact (Table 14-3).

Table 14-3: Consideration of PEOF offset against offset policy principles

Offset principle	Consideration
1. Environmental offsets will only be considered after avoidance and mitigation options have been pursued	BHP has discussed avoidance and mitigation options in Sections 7.5, 8.5, 9.5 and 10.5 for potential significant impacts to the preliminary key environmental factors. These options include consolidation of mining operations aiding in minimising the amount of clearing required to support the Proposal. The significant residual impact that remains is the unavoidable impact of the clearing of native vegetation.
2. Environmental offsets are not appropriate for all projects	Consistent with other projects in the Pilbara, BHP considers that offsets (for the cumulative impact of clearing of vegetation in Good to Excellent condition, riparian vegetation, critical Ghost Bat, Northern Quoll, Pilbara Olive Python and Grey Falcon foraging habitat, and supporting habitat for Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Grey Falcon) are appropriate for this Proposal.
3. Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted	Consistent with offsets applied to recent Pilbara mining projects, BHP's proposed offset is to contribute funds to the PEOF. BHP considers that the base contribution rates are appropriate and proportionate to counterbalance the significant residual impact of the cumulative clearing of native vegetation in Good to Excellent condition in the Pilbara bioregion, and supporting habitat for Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Grey Falcon. The higher contribution rates are proposed for the clearing of critical Ghost Bat, Pilbara Olive Python, Northern Quoll and Grey Falcon foraging habitat and riparian vegetation.
4. Environmental offsets will be based on sound environmental information and knowledge	The WA Government will make decisions on specific offsets projects proposed through the PEOF, focusing on on-ground projects. The operation of the fund will use relevant environmental information and knowledge from the WA and Commonwealth governments, Tradition Owners, natural resource management organisations, conservation groups, industry and the research sector. As outlined in the <i>Pilbara Environmental Offsets Implementation Plan</i> (DWER 2019b), a monitoring and evaluation process will involve annual reviews to ensure the latest science and lessons learnt from on-ground projects inform management priorities and appropriate implementation actions.
5. Environmental offsets will be applied within a framework of adaptive management	An adaptive management framework is outlined in the <i>Pilbara Environmental Offsets Implementation Plan</i> . BHP understands that this will ensure that offsets projects delivered through the PEOF improve native vegetation condition and habitat for threatened species, and deliver enhanced species and ecosystem resilience, consistent with the adaptive management principle in the <i>Pilbara Conservation Strategy</i> (Government of Western Australia 2017).
6. Environmental offsets will be focused on longer term strategic outcomes	BHP will contribute funding to the PEOF. As outlined in the <i>Pilbara Environmental Offsets Implementation Plan</i> , the PEOF allows for the combining of money from multiple offsets to deliver larger and more strategic landscape-scale projects, leading to better biodiversity conservation outcomes. Projects will be designed so that outcomes endure in the longer term (DWER 2019b).

BHP proposes to contribute funds to the PEOF at the rates detailed in Table 14-4, calculated on the 2022-2023 financial year.

- \$945 AUD (excluding GST) per hectare (ha) of the following environmental values cleared as a result of the Proposal within the Hamersley IBRA subregion:
 - (a) 'Good to 'Excellent' condition native vegetation cleared within Development Envelope within the Hamersley IBRA subregion
 - (b) supporting habitat for Pilbara Olive Python (*Liasis olivaceus barroni*)
 - (c) supporting habitat for Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)
 - (d) supporting habitat for Grey Falcon (*Falco hypoleucos*)
 - (e) supporting habitat for Northern Quoll (*Dasyurus hallucatus*)
- \$1,891 AUD (excluding GST) per hectare of the following environmental values cleared as a result of the proposal within the Hamersley IBRA subregion:
 - (a) riparian vegetation (including groundwater dependent vegetation)
 - (b) critical habitat for Pilbara Olive Python (*Liasis olivaceus barroni*)
 - (c) critical habitat for Ghost Bat (*Macroderma gigas*)
 - (d) critical habitat for Grey Falcon (*Falco hypoleucos*)
 - (e) critical habitat for Northern Quoll (*Dasyurus hallucatus*)

BHP has proposed a condition relating to Offsets for this Proposal, which is included in the draft set of proposed implementation conditions for the Combined Proposal in Appendix 3. A draft Impact Reconciliation Procedure is provided in Appendix 21.

As part of the Commonwealth strategic validation process, if required, BHP will also prepare an Offsets Proposal to address residual adverse impacts on relevant Program Matters (MNES).

Table 14-4: Environmental values relevant to the Proposal that require offset

Environmental value/s	IBRA Subregion	Proposed offset rate (\$/ha) for 2022-2023 financial year
Native vegetation in Good to Excellent condition within the proposed Development Envelope	Hamersley	Base rate of \$945 AUD (excluding GST) per ha, or the contribution rate for the relevant financial year as published for the Pilbara Environmental Offsets Fund
Riparian vegetation (including groundwater dependent vegetation)	Hamersley	Higher rate of \$1,891 AUD (excluding GST) per ha, or the contribution rate for the relevant financial year as published for the Pilbara Environmental Offsets Fund
Critical foraging habitat for the Ghost Bat, Pilbara Olive Python, Northern Quoll and Grey Falcon within the proposed Development Envelope	Hamersley	Higher rate of \$1,891 AUD (excluding GST) per ha, or the contribution rate for the relevant financial year as published for the Pilbara Environmental Offsets Fund
Supporting habitat for Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Grey Falcon	Hamersley	Base rate of \$945 AUD (excluding GST) per ha, or the contribution rate for the relevant financial year as published for the Pilbara Environmental Offsets Fund

14.1.2 Significant residual impacts for the Approved Proposal

The following significant residual impacts were identified and quantified for the Approved Proposal:

- the clearing of up to 6,635 ha of native vegetation in 'Good' to 'Excellent' condition, in the Pilbara IBRA region (Hamersley IBRA subregion) including habitat for Pilbara Olive Python, Pilbara Leaf-nosed Bat and Northern Quoll (EPA Report 1610, EPA 2017)
- the loss of five high value caves; 12 low value caves and the clearing of up to 9,307 ha of foraging habitat for the Ghost Bat (EPA Report 1610, EPA 2017).

14.1.3 Significant residual impacts for the Combined Proposal

Table 14-5 presents the extent of the significant residual impacts from the Approved Proposal, the Proposal and the Combined Proposal, and the proposed extent to be offset for the Combined Proposal. The significant residual impacts have been grouped into the table based on the associated offset rate.

Different offset payment rates apply depending on the value impacted, with higher payment rates required for critical habitat for listed threatened species. In order to avoid duplication of offsets, the extent of residual impact to be offset for clearing of native vegetation in Good to Excellent condition will be excluded where there is an overlap in extent to be offset for critical foraging habitat (where the habitats align to vegetation that is in Good to Excellent condition).

Table 14-5: Combined Proposal significant residual impacts

Significant residual impact	Values	Approved Proposal significant residual impact (ha)	Proposal significant residual impact (ha)	Combined Proposal significant residual impact (ha)	Combined extent to be offset (ha)
Clearing of native vegetation in Good to Excellent condition	Vegetation in Good to Excellent condition in Indicative Footprint	6,635	247	6,882	6,882 ¹
Clearing of supporting habitat for Pilbara Olive Python, Northern Quoll, Pilbara Leaf-nosed Bat and Grey Falcon	Stony Plain, Minor Drainage Line, Breakaway /Cliff, Wetland, Gorge/Gully, Major Drainage Line, Hillcrest/Hillslope, Drainage Area/Floodplain.				
Potential clearing of additional 'Good to Excellent' vegetation associated with the Proposal if vegetation decline or death occurs of Eucalyptus trees within 177 ha of vegetation impacted by groundwater mounding for the Northern RAV MAR scheme Degradation or loss of critical and/or supporting habitat for significant fauna from groundwater mounding for the Northern RAV MAR scheme	<i>Eucalyptus xerothermica</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and <i>Eucalyptus victrix</i> trees occurring within 'Good to Excellent' vegetation.	n/a	162	162	162
Clearing of critical foraging habitat for Ghost Bat, Pilbara olive python, Pilbara leaf-nosed bat and Grey Falcon Clearing of riparian vegetation (including groundwater dependent vegetation)	Stony Plain, Minor Drainage Line, Breakaway/ Cliff, Wetland, Gorge/ Gully, Major Drainage Line, Drainage Area/ Floodplain Riparian vegetation (including groundwater dependent vegetation)	9,307	827	10,134	10,134
Total extent to be offset					17,178

1. The extent to be offset has removed areas where vegetation and/or habitat overlap.

BHP has prepared a *Mining Area C- Southern Flank Impact Reconciliation Procedure* (BHP 2025c), provided in Appendix 21.

As part of the Commonwealth strategic validation process, if required, BHP will also prepare an Offsets Proposal to address residual adverse impacts on relevant Program Matters (MNES) and implement the Offsets Proposal in accordance with the approved *Pilbara Strategic Assessment Assurance Plan and Offsets Plan* (BHP 2023g).

15 Holistic impact assessment

BHP has assessed the potential impacts of the Proposal for the relevant environmental factors and environmental values individually (Sections 7 to 13). However, given the link between Inland Waters, Flora and Vegetation, Terrestrial Fauna, Subterranean Fauna, Social Surroundings and Greenhouse Gas Emissions, consistent with the EPA's *How to prepare an Environmental Review Document Instructions* (EPA 2024b), BHP has also considered connections and interactions between the relevant environmental factors to inform a holistic view of impacts to the whole environment.

Figure 15-1 below illustrates the connections and interaction between key activities of the Combined Proposal and environmental values to inform the holistic assessment.

Increased abstraction for the Proposal (compared to the abstraction assessed for the Approved Proposal) has the potential to change groundwater levels and quality, which can affect the ecosystems, beneficial uses and cultural and heritage values that are dependent on these aquifers. Likewise, an increase in surplus discharge has the potential to increase water in ecosystems which affect the landscape, uses, cultural and heritage values of creek systems. BHP considers that the proposed mitigation and regulation (proposed conditions, environmental management plans and other statutory decision-making processes for Inland Waters will maintain the inter-related key environmental values of Coondewanna Flats, Weeli Wolli Spring and Ben's Oasis.

There are inherent links between the factors of Flora and Vegetation and Terrestrial Fauna. Vegetation provides habitat for terrestrial fauna, including significant fauna (listed under the BC Act and EPBC Act), and SRE invertebrate fauna species. Flora, vegetation and terrestrial fauna rely on water to sustain and maintain growth. BHP considers that the proposed mitigation and regulation (limits on clearing, environmental management plans) will limit damage to the inter-related key environmental values of flora and vegetation and terrestrial fauna.

There is an established link between GHG emissions and the risk of climate change. Climate change has the potential impact on the environmental values of WA. Regulation in accordance with the NGER Act and Safeguard mechanism will also mean that the other environmental factor values will be protected.

Implementation of the Proposal will avoid, where possible, and minimise direct disturbance to Aboriginal cultural heritage sites within the Development Envelope. However, it is acknowledged that there are other potential impacts to social, cultural and heritage values (traditional bush tucker and medicine plant species, water values, changes to landscape and access). BHP is committed to ongoing engagement with the Banjima People (the Traditional Owners) and BNTAC in relation to surplus water management, access, rehabilitation, and closure of the Combined Proposal and other matters relevant to Social Surroundings via implementation of the SCHEMP and the management plans associated with the Combined Proposal. The Combined Proposal will be decommissioned and rehabilitated so that the impacts to Social Surroundings, Inland Waters, Terrestrial Fauna, Flora and Vegetation and Subterranean Fauna are mitigated and minimised.

Therefore, BHP considers that when the relevant environmental factors are considered together, for the holistic validation, that the Proposal still meets the EPA's objectives.

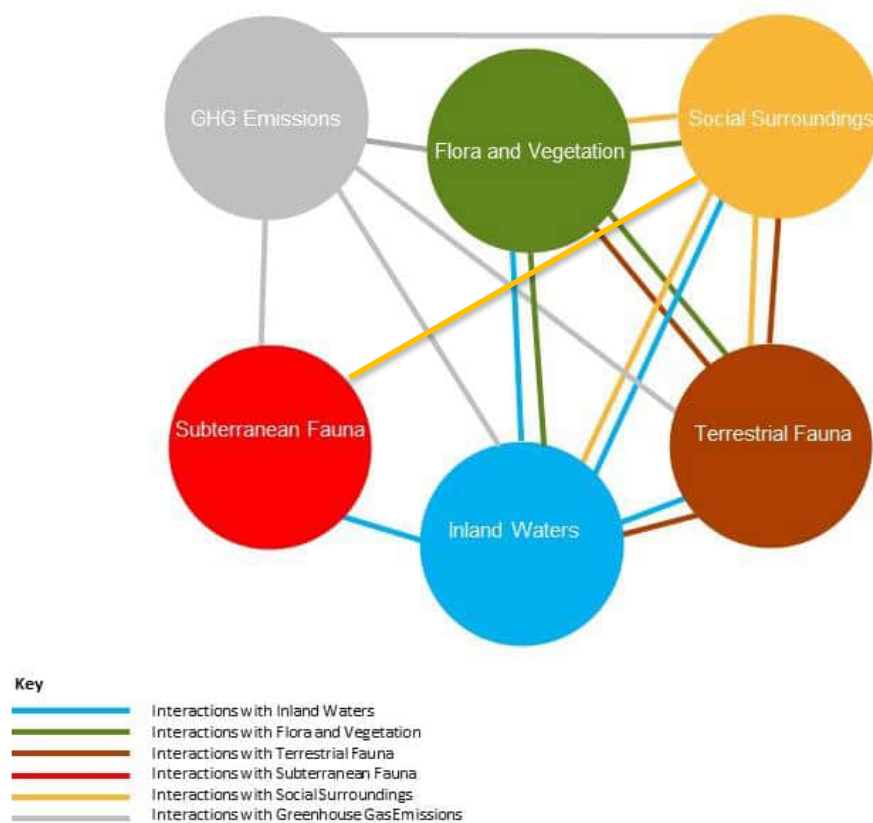


Figure 15-1: Interactions between environmental factors

16 Cumulative impact assessment

BHP undertook a cumulative environmental impact assessment as part of the Pilbara Public Environmental Review Strategic Proposal which considered both BHP and non-BHP mining operations (BHP 2016b). BHP considered the successive, incremental and interactive impacts on the environment of the Strategic Proposal (which includes the Proposal which is in the boundary of the Strategic Assessment) with past, present and reasonably foreseeable future activities. The future activities that BHP considered for the Strategic Proposal were consistent with the definition of reasonably foreseeable future activities in the EPA's *Instruction on how to prepare an environmental review document* (EPA 2024b). The assessment included third party activities for proposals that were referred to the EPA or approved but had not yet commenced including: RTIO's (including joint ventures with Hamersley Iron, Hamersley HMS and Robe River Mining Co.) Brockman Syncline 4, Hope Downs 1, Hope Downs 4, Koodaideri, Marandoo, West Angelas, Western Turner Syncline, Western Turner Syncline Stage 2, Yandicoogina (Junction SE, Junction SW and Oxbow, Pocket and Billiard South); Fortescue Metal Group's Cloudbreak, Christmas Creek, Mindy Mindy and Nyidinghu; Atlas Iron's Davidson's Creek; Australian Premium Iron Management's Hardey; Iron Ore Holdings' Iron Valley; Brockman Resources' Marillana; and Hancock Prospecting's Roy Hill Stage 1 and Roy Hill Stage 2.

In EPA report 1619, the EPA noted that the assessment provided in the Strategic Proposal strengthened the environmental impact assessment process through early consideration for environmental issues at the project planning stage and formal consideration of the cumulative impacts of future proposal (EPA 2018c). Although this Proposal is not seeking validation under the Strategic Proposal, it has considered the assessment undertaken to inform key environmental features of this Proposal.

BHP has undertaken the cumulative impact assessment (of successive, incremental and interactive impacts on the environment) of this Proposal with past, present and reasonably foreseeable future activities within 40 km of the Proposal and/or within the WAIO central catchment area which includes BHP, RTIO and Iron Valley operations (where data is available; Figure 16-1). It should be noted that this may differ for each environmental factor according to the availability of data.

The historical and present status of the existing environment is described for each factor in the Sections above (Section 7 to Section 13), whilst the below is an examination of the reasonably foreseeable cumulative impacts from activities and pressures in the WAIO central catchment area shown on Figure 16-1.

16.1 Inland Water

The cumulative impact assessment for Inland Waters has considered cumulative impacts associated with the Approved Proposal, this Proposal and nearby existing BHP and third-party operations, that influence surface water and groundwater within the Development Envelope.

16.1.1 Cumulative impacts to groundwater regimes

The cumulative impact assessment for Inland Waters has been provided as part of the Combined Proposal in Section 7 as the predicted groundwater drawdown and modelling results for the Combined Proposal alone were unable to be generated due to the proximity and influence of third-party dewatering on existing and proposed operations.

As described in Section 7.5.2, a numerical groundwater model was developed to quantify impacts to groundwater levels from dewatering for below water table mining (BHP 2025a). The groundwater modelling is included in Appendix 7.

The base case model was run with no BHP dewatering or MAR. RTIOs Hope Downs dewatering and creek discharge and MAR (mitigation) was included, however. When compared with the results from the base case models, the results

of this run can be used to determine the relative proportion of impacts from each operator. The results show that maximum cumulative drawdown of:

- between 23 and 64 m is expected beneath Coondewanna Flats. 100% of this drawdown is due to BHP dewatering.
- between 13 and 21 m at HDD0004M, just east of the dyke separating Ben's Oasis from the Hope Downs groundwater compartment. The best estimate of maximum drawdown is 16.3 m, and of this, 13.2 m (81%) is associated with RTIO and 3.1 m (19%) with BHP activities. Cumulative drawdown at Ben's Oasis itself is expected to be negligible.
- between 2.4 to 5.6 m is predicted at Weeli Wolli Spring up to 2045. Beyond 2045, drawdown is predicted to increase significantly to a maximum of between 11.4 and 13.4 m. The best estimate of maximum drawdown is 12.7 m and of this, 9.2 m (72%) is associated with RTIO and 3.5 m (28%) with BHP activities.

Cooperation between BHP and RTIO will be essential during the closure period of Hope Downs 1 to maintain vegetation of the spring while RTIO works to backfill pits and re-establish the aquifer when Hope Downs 1 is being closed. Developing accurate triggers and thresholds based around RTIO closure planning is to be presented in the CPWRMP to minimise any impact the Combined Proposal may have on the PEC.

16.1.2 Cumulative impacts to surface water catchments

As discussed, installation of infrastructure has the potential to change surface water regimes by altering natural surface water flows and reducing the availability of surface water runoff downstream. Mining creates internally draining mine pits and can reduce the volume of rainfall runoff downstream.

For the three key environmental receptors in the catchment area there is considered to be negligible risk from cumulative impacts associated with the Proposal and RTIO Hope Downs 2:

- Coondewanna Flats will have a small reduction in catchment area but surface runoff into the catchment is expected to be maintained in historic ranges. There are no other existing or foreseeable future mines operating within the Coondewanna subcatchment and so cumulative impacts are negligible.
- Weeli Wolli Creek and spring system will have a small cumulative reduction in catchment area (i.e. 48.5 km²; 1.2%) but surface runoff into the catchment is expected to be maintained within historic ranges. A reduction in catchment area of less than 5% is within the natural variation of seasonal rainfall runoff and so cumulative impacts are not expected to be significant.
- The surface water catchment supporting Ben's Oasis is outside the Development Envelope and is unlikely to be impacted by the Proposal. Cumulative impacts are therefore not considered further.

16.1.3 Cumulative impacts to water quality

There are several key cumulative impacts on water quality from mining activities in the Pilbara region. These include:

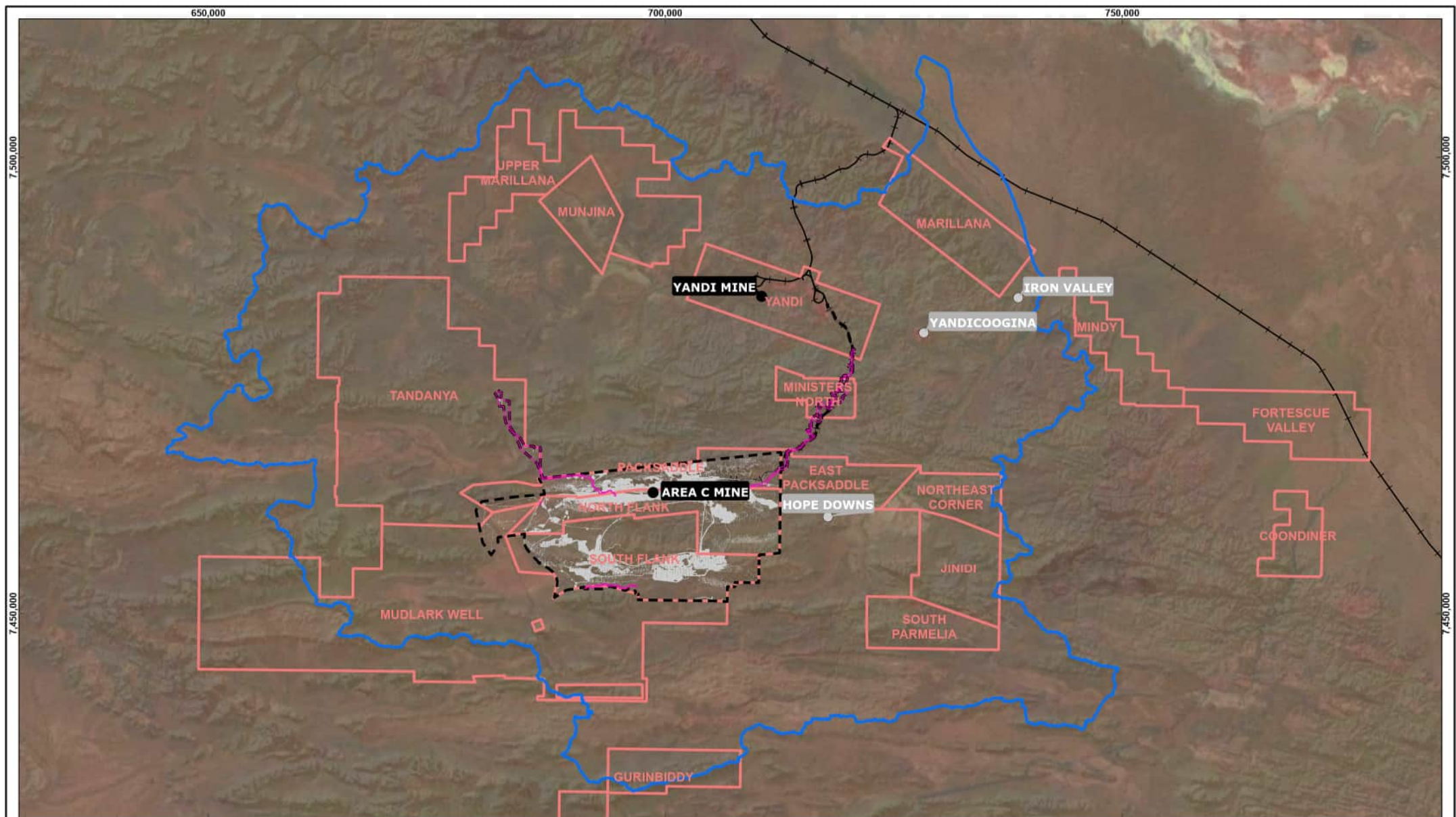
- Contamination from runoff: Mining operations can lead to runoff containing heavy metals, hydrocarbons, and other pollutants entering nearby water bodies. This runoff can degrade water quality, affecting aquatic ecosystems and potentially entering drinking water sources.
- Increased sedimentation: The disturbance of land during mining can increase the amount of sediment in rivers and streams. This sedimentation can smother aquatic habitats, reduce water clarity, and disrupt the natural flow of watercourses.
- Chemical spills and leaks: The use of chemicals in mining processes poses a risk of accidental spills or leaks. Such incidents can introduce harmful substances into the water, posing risks to both the environment and human health.

- Groundwater impacts: Mining activities can alter groundwater flow patterns and introduce contaminants into aquifers. This can affect the availability and quality of groundwater, which is a crucial resource for both ecosystems and local communities.

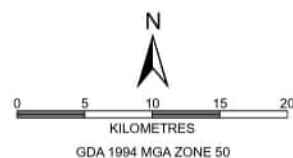
To mitigate these impacts, the implementation of comprehensive water management strategies by individual proponent should be undertaken. These include:

- Proper waste disposal: Ensuring that waste materials are disposed of in a manner that prevents contamination of water sources. Regulated under Part V of the EP Act.
- Water quality monitoring: Regular monitoring of water quality to detect and address any changes promptly. Regulated under Part V of the EP Act for surplus water schemes and under the RiWI Act in relation to groundwater licences.
- Containment measures: Using barriers and containment systems to prevent pollutants from reaching water bodies as specified. Regulated as under Part V of the EP Act and CS Act.
- Rehabilitation efforts: Restoring disturbed land to its natural state to reduce ongoing sedimentation and runoff issue consistent with the MCP.

These measures aim to protect both surface water and groundwater resources, ensuring they remain safe and sustainable for the environment and local communities.



- BHP Operations
- Other Mining Operations
- BHP Rail
- Indicative Footprint
- Development Envelope
- Existing Disturbance
- WAIO Central Catchment
- BHP Tenements



BHP

PUBLIC

**MINING AREA C-SOUTH FLANK
SIGNIFICANT AMENDMENT
CENTRAL PILBARA HUB AND
NEARBY PROJECTS**

WAIO PLANNING, TECHNICAL AND ENVIRONMENT

SCALE @ A4: 1:560,000
DATE: 9/12/2024

PREPARED: GEOMATICS
REQUESTOR: ENV APPROVALS

FIGURE: **16-1**

A1285-077-RevA

16.2 Flora and Vegetation

In line with the approach described at the beginning of this chapter, the cumulative impact assessment for Flora and Vegetation has considered cumulative impacts associated with existing, known and potential future projects in the CPH, where data is available. This includes RTIO's Yandicoogina Revised Proposal and Hope Downs 1 and BHP's Yandi mine, and future proposals including this Proposal and Hope Downs 2 (currently under assessment [2316]) (Figure 16-1).

16.2.1 Cumulative impacts of clearing

As discussed in Section 8.4.1.2, the Proposal has the potential to impact seven priority flora species:

- *Acacia bromilowiana* (P4).
- *Aristida jerichoensis* var. *subspinulifera* (P3)
- *Aristida Lazaridis* (P3)
- *Lepidium catapycnon* (P4)
- *Rhagodia* sp. *Hamersley* (M. Trudgen 17794) (P3)
- *Rostellularia adscendens* var. *latifolia* (P3)
- *Sida* sp. *Barlee Range* (S. van Leeuwen 1642) (P4)

Data for the impacts to significant flora was not available for older projects including Hope Downs 1 and BHP's Yandi mine. Data was available for RTIO's Yandicoogina Revised Proposal, Hope Downs 2 (proposed), Iron Valley BWT Proposal and the Combined Proposal. Neither RTIO's Yandicoogina Revised Proposal or the Iron Valley BWT Proposal will impact any of the species proposed to be impacted by the Combined Proposal. The proposed Hope Downs 2 project will impact individuals of *Acacia bromilowiana* (P4) (202), *Aristida Lazaridis* (P3) (395) and *Rhagodia* sp. *Hamersley* (M. Trudgen 17794) (P3) (56). However, it is not possible to cumulatively assess these impacts with the Combined Proposal because the data presented in the Hope Downs 2 ERD equates to the number of individual plants of each species. Whereas BHP have used the number of records of each species in this document because the number of individuals comprising a single record is not always documented in the data.

Two regional vegetation associations from the Pilbara bioregion are located within the Development Envelope (Associations 18 and 82). Based on the cumulative impacts of the Combined Proposal and nearby existing and reasonably foreseeable future projects, 97.2% of the pre-European extent of Association 18, and 99.2% of Association 82 will remain (Table 16-1).

The Proposal is estimated to contribute 1,043 ha to the cumulative impact of clearing of vegetation in Good to Excellent condition within the Pilbara region, in addition to the 19,696 ha from the Approved Proposal. The contribution from nearby existing or reasonably foreseeable projects includes Hope Downs (4,205 ha), Yandicoogina Revised Proposal (3,008 ha), Iron Valley Revised Proposal (988 ha) and Yandi mine (508 ha), which when considered with the Combined Proposal totals 29,448 ha of clearing of vegetation in Good to Excellent condition within the Pilbara region.

Table 16-1: Cumulative impacts to Beard vegetation units

Beard vegetation unit	Pre-European Extent (ha) ¹	Current extent in bioregion ¹	Proposed extent of loss within the Indicative Footprint	Extent of loss from Approved Proposal (ha)	Extent of loss from existing and reasonably foreseeable future projects ² (ha)				Cumulative loss of current extent (ha)	% of association remaining after cumulative impacts
					Hope Downs 2 (RTIO)	Yandicoogina Revised Proposal (RTIO)	Yandi mine (BHP)	Iron Valley (Polaris)		
18	676,557	671,843	595	8,977	3,067	-	693	0	13,332	97.3%
82	2,563,583	2,550,888	481	12,750	1,790	1,909	3,987	149	20,768	99.2%

¹ Pre-European Extent and Current Extent based on current DBCA data for the Pilbara bioregion (DBCA 2019)² Existing and reasonably foreseeable future projects within 40 km of the Proposal including those in the BHP Strategic Proposal

16.2.2 Cumulative impacts of changes to groundwater regimes

The cumulative impact assessment for changes to vegetation from altered groundwater regimes has been provided as part of the Combined Proposal in Section 8.6.1.1 as the predicted groundwater drawdown and modelling results for the Combined Proposal alone were unable to be generated due to the proximity and influence of third-party dewatering on existing and proposed operations.

As described in Section 16.1.1, the results of the numerical groundwater model (which includes nearby third-party dewatering) indicated impacts to groundwater levels from dewatering for below water table mining are unlikely to significantly impact flora and vegetation at the key regional receptors. The vegetation and flora of Coondewanna Flats is unlikely to be impacted by groundwater drawdown in general as it is considered to be a surface water supported ecosystem. It is further unlikely any cumulative impacts would affect the system as other operations in the area are unlikely to be influencing groundwater levels in Coondewanna Flats.

Post 2045 and the closure of Hope Downs, GDV/potential GDV species *Melaleuca argentea*, *Eucalyptus camaldulensis* and *Eucalyptus victrix* could be subject to impacts from the groundwater drawdown. BHP proposes to fully mitigate these impacts at Weel Wolli Spring by injecting water into several deposits at the MAC-SF Operation (explained in Section 7.6.4.1) from 2041-2051. Cooperation between BHP and RTIO will be essential during the closure period of Hope Downs 1 to maintain vegetation of the spring while RTIO works to backfill pits and re-establish the aquifer when Hope Downs 1 is being closed, and accurate triggers and thresholds based around RTIO closure planning is to be presented in the CPWRMP to minimise any impact the Combined Proposal may have on the vegetation of the PEC.

There is currently no mounding being observed at the location of the Northern RAV MAR from third parties, and any future contribution from third parties is unlikely. Therefore, there are no cumulative impacts expected to flora and vegetation from groundwater mounding in addition to that proposed for the Northern RAV MAR scheme.

16.2.3 Cumulative impacts of changes to surface water regimes

Cumulative impacts from surplus water discharge along Marillana Creek are not expected as there is currently no surplus water discharge occurring in Upper Marillana Creek, nor is there proposed to be from any third parties. In terms of Lower Marillana Creek, it is not anticipated that flows will increase past the existing 9 km wetting front from the Yandi mine, and no changes to the licence allocation (41 ML/day) are required for the Proposal as a maximum of 30 ML/day will be discharged from the Proposal and up to 11 ML/day from the existing Yandi mine. Therefore, cumulative impacts from surplus discharge to flora and vegetation along Lower Marillana Creek will not be significant.

16.3 Terrestrial Fauna

The cumulative impact assessment for Terrestrial Fauna has considered cumulative impacts associated with the Approved Proposal, approved projects in operations (RTIO Hope Downs and Yandicoogina; Polaris Iron Valley; and BHP Yandi), and future proposals including this Proposal, Hope Downs 2 (currently under assessment [2316]) and potential future BHP mines (i.e. Ministers North; Figure 16-1), depending on availability of data.

16.3.1 Cumulative impacts of clearing

The cumulative loss of fauna habitats is difficult to quantify at a regional scale due to the lack of consistent, Pilbara wide fauna habitat mapping, the non-standardised approach to mapping used between consultants and proponents and the lack of publicly available information. As such, BHP has used landform mapping to predict cumulative impacts at a regional scale from existing, known and potential future projects within 40km of the Proposal (Figure 16-1).

This assessment indicates the predicted cumulative impacts to each landform will be less than 3%, with the majority being less than 1% (Table 16-2). Cumulative land clearing associated with implementation of the Proposal alone and the Combined Proposal is negligible at a landform scale (i.e. less than 3% for each land system); however, cumulative loss of fauna habitat as a result of mining in the Hamersley sub-region is recognised as a potentially significant residual impact as it includes clearing of critical and supporting fauna habitats within these land systems. Potentially significant impacts to critical and supporting habitat are proposed to be offset via the PEOF (refer to Section 14).

16.3.2 Cumulative impacts to significant fauna

All of the significant fauna species that occur within the Development Envelope may be affected by cumulative impacts from existing and foreseeable projects. Table 16-3 identifies the occurrence of conservation species within other project areas within 40 km of the Proposal.

All the significant fauna species recorded or considered likely to occur within the Development Envelope may be affected by cumulative impacts from existing or foreseeable future projects (Table 16-3). However, the majority of these species occur widely in the Hamersley sub-region and can move throughout the local landscapes. The retention of high value habitat will help maintain the significant fauna species within the sub-region.

The cumulative loss of critical and/or supporting habitat for significant fauna is likely to represent a significant residual impact but is difficult to quantify based on inconsistent habitat mapping and different methods used by different consultants or Proponents, and lack of publicly available data. However, any project impacting critical and/or supporting habitat for significant fauna will be subject to pay offsets through the PEOF. Projects under the PEOF will be designed to provide conservation benefits for these species in the Hamersley sub-region.

Table 16-2: Cumulative impacts to land systems within the Hamersley subregion

Land system	Current extent in bioregion ¹	Extent of loss from this Proposal (ha)	Extent of loss from existing and reasonably foreseeable future projects ¹ (ha)						Cumulative loss	
			BHP MAC-SF	RTIO Hope Downs 2	RTIO Yandicoogina – Revised proposal	BHP Yandi mine	BHP Yandi mine E8	Polaris – Iron Valley BWT proposal	ha	%
Boolgeeda	961,636.91	468	6185	707	1,491	30	36	99	9,016	0.68
Newman	1,993,744.83	381	13304	1,485	1,161	0	0	215	16,546	0.46
Platform	236,335.59	29	798	1,983	0	0	0	0	2,810	0.98
Wannamunna	63,013.39	147	455	6	0	0	0	0	609	0.56
McKay	426,144.91	3	0	0	499	2,360	16	0	2,878	0.68
River	482,178.97	6	0	0	1,336	129	26	0	1,497	0.31
Robe	128,619.88	28	0	0	0	1,968	47	0	2,043	1.61
Rocklea	2,881,896.86	12	0	4	0	0	0	0	16	0.00
Pindering	38,757.00	0	986	647	0	0	0	0	1,633	2.67
Total	7,212,328.34	1,076	21,727	4,832	4,487	4,487	125	314	37,048	0.5

¹ Existing and reasonably foreseeable future projects within 40 km of the Proposal include Yandicoogina Revised Proposal (Rio Tinto 2015)), MAC-SF (BHP 2017b), Hope Downs 2 (Hamersley HMS 2023; currently under assessment), BHP Yandi mine (existing) and Yandi mine E8 Proposal (potential foreseeable future proposal) and Iron Below Water Table Proposal (AECOM 2016). Data for original mining areas such as RTIO Yandicoogina and Hope Downs is not publicly available.

Table 16-3: Significant fauna occurrence¹ at existing or potential future project areas

Species	This Proposal	Approved Proposal	RTIO Hope Downs 2	RTIO Yandicoogina	BHP Yandi	BHP Jinidi	BHP Ministers North	Polaris Iron Valley
Threatened fauna								
Ghost Bat	✓	✓	✓	✓	✓	✓	✓	x
Northern Quoll	✓	✓	✓	✓	✓	✓	✓	✓
Pilbara Olive python	✓	✓	✓	✓	✓	✓	✓	✓
Pilbara Leaf-nosed Bat	✓	✓	✓	✓	✓	✓	✓	x
Grey Falcon	✓	✓	x	x	✓	✓	✓	x
Priority fauna								
Pilbara Barking Gecko	x	✓	✓	✓	✓	x	✓	x
Ganes Blind Snake	x	✓	✓	✓	x	✓	✓	x
Western Pebble-mound Mouse	✓	✓	✓	✓	✓	✓	✓	✓
Other specially protected fauna								
Peregrine Falcon	x	✓	x	✓	✓	x	✓	x

¹ based on records or considered likely to occur

16.4 Subterranean Fauna

16.4.1 Stygofauna

Cumulative impacts to stygofauna have been assessed as part of the Combined Proposal in as the groundwater drawdown modelling includes cumulative impacts associated with the Approved Proposal, this Proposal and nearby existing third-party operations at Hope Downs. These are the only mining operations currently operating within the Lower Weeli Wolli subcatchment. Cumulative impacts to stygofauna species and habitats in the western portion of the groundwater impact area are negligible given that there are no other mining operations in the Coondewanna subcatchment.

Stygofauna data for Iron Valley was reviewed to inform the cumulative impact assessment. Iron Valley BWT mine occurs approximately 22 km north of the Proposal groundwater drawdown area, and impacts Weeli Wolli Creek; however, impacts associated with drawdown are localised to the mine area and mitigated through discharge. The Iron Valley mine occurs downstream of Weeli Wolli Springs where groundwater flows in a south to north direction and so Iron Valley is unlikely to be contributing toward cumulative impacts to stygofauna values at Weeli Wolli Spring. The stygofauna assemblage collected from the Iron Valley mine project area comprised 22 stygofauna species, which included two potentially restricted species (the syncarid *Bathynella* sp. B24 and the ostracod *Meridiescandona* sp. BOS171) and 20 species with distributions which were either known or considered likely to extend beyond the areas of impact (Bennelongia 2016a). At least 14 of these species are shared with Weeli Wolli Springs; however, the majority of these are widespread species.

None of the potentially restricted stygofauna species identified within the groundwater impact area have been identified within the Rio Tinto's adjacent Hope Downs project area, although there is almost certainly a continuation of the communities in South Flank into this area, as is demonstrated by a number of shared species between South Flank, Weeli Wolli Creek and Hope Downs. The extent of suitable, connected habitats through the alluvial aquifers (and to a lesser extent the calcrete deposits) of the Tertiary detrital valley-fill successions in the Weeli Wolli Creek and Marillana subcatchments are likely to provide for easy dispersal of stygofauna species between areas of groundwater drawdown and surrounding regional aquifers (Bennelongia 2016b).

Currently, BHP is having relatively minimal impact on Weeli Wolli Spring and Weeli Wolli Creek, in the context of RTIOs current impacts from Hope Downs 1. According to publicly available information, at closure of Hope Downs 1, RTIO will undertake mitigation with 20 ML/day injected into the aquifer adjacent to the Hope Downs 1 orebody and 20 ML/day discharged to Weeli Wolli Creek, both continued for 20 years post closure. The range of maximum predicted drawdown during this period is between 2.4 m and 5.6 m. Post-closure of Hope Downs 1 (i.e. expected around 2045), the unmitigated impacts from BHP's dewatering operations (and the partially mitigated RTIO impacts) on groundwater levels at Weeli Wolli Spring will be between 11 m and 14 m. Drawdown of this magnitude could result in significant impacts to stygofauna. However, BHP proposes to fully mitigate these impacts at Weeli Wolli Spring by injecting water into several deposits at the MAC-SF Operation prior to closure of Hope Downs 1 (explained in Section 7.6.3). Cooperation between BHP and RTIO will be essential during the closure period of Hope Downs 1 to maintain vegetation of the spring while RTIO works to backfill pits and re-establish the aquifer when Hope Downs 1 is being closed, and accurate triggers and thresholds based around RTIO closure planning is to be presented in the CPWRMP to minimise any impact the Combined Proposal may have on stygofauna values within Weeli Wolli Springs.

As described in Section 10.5, the CPWRMP outlines a number of management measures and mitigation options that may be used as part of BHP's adaptive management to ensure that potential impacts to groundwater (and subsequently) stygofauna resulting from drawdown are minimised as far as practical. Mitigation measures proposed for implementation once RTIO Hope Downs 1 mining ceases, include managed aquifer recharge within the Development Envelope to keep water levels up throughout the Weeli Wolli PEC.

Overall, impacts to stygofauna values associated with cumulative groundwater drawdown are not expected to result in a significant residual impact based on the proposed mitigation (Section 10.5) and the extent and connectivity suitable stygofauna habitat downstream of Weeli Wolli Springs (see Section 10.6.2.1).

16.4.2 Troglofauna

Cumulative impacts to troglofauna associated with the Approved Proposal and RTIO's Hope Downs operations were previously assessed and approved under MS1072. Whilst the Proposal does have the potential to impact on troglofauna habitat and assemblages from localised mounding associated with the Northern RAV MAR schemes, the habitat values and assemblages within this area are currently unknown and subject to additional survey work (see Section 10.3.2.2). The impacts to troglofauna associated with this Proposal are limited to mounding associated with the Northern RAV MAR which will have an operating life of five-years, with no mounding expected to occur above 10 mbgl. Given that no additional mine pit excavation is proposed as part of this Proposal, potentially suitable troglofauna habitat will be reduced temporarily rather than lost completely. The cumulative impacts to troglofauna are therefore unlikely to be significantly greater than previously assessed; however, this will be further informed once additional survey work has been completed with results expected 2027.

16.5 Social Surroundings

BHP has completed numerous research projects focusing on cumulative impact within BHP operations and the wider Pilbara region. These projects have focused on increasing the understanding of cumulative impact in the Pilbara region and include projects focused on rare site types. All projects have been undertaken in collaboration and partnership with traditional owners, contractors and academic institutions. BHP has undertaken surveys across ~15% of the full Banjima claim area. BHP currently manages over 4,000 known potential heritage sites with the Banjima Claim. Approximately 40% of these places are located within the Mining Area C Development Envelope.

The cumulative impact assessment for Social Surroundings has focussed on the Banjima Native Title determination area (WCD2014/001; Figure 12-1 in Section 12.3) and includes consideration of existing BHP operations (this Proposal, the Approved Proposal, Marillana Creek (Yandi) Life of Mine Proposal) and existing and potential future third-party operations (Yandicoogina, Koodaideri, Hope Downs and Hope Downs 2).

BHP recognises that the implementation of the Combined Proposal, in association with other existing BHP projects and nearby operational and future third-party proposals has the potential to cumulatively affect social, cultural and heritage values. These impacts include the cumulative loss of cultural heritage sites and values, loss of access to sacred sites and other places of cultural significance, loss of cultural integrity of cultural places, degradation of cultural heritage values through indirect effects such as increased dust, vibration, noise, and a loss of amenity.

BHP notes that Banjima representatives through BNTAC have expressed concerns regarding the reliability of cumulative impact assessments to Country and Culture. Cumulative impacts to Country and Culture are often further compounded by the confidentiality of data and lack of publicly available data.

Overall, the above-mentioned existing and potential future operations have taken impacts to Social Surroundings into consideration, with extensive survey effort and Traditional Owner consultation having been undertaken. Many of these operators have management plans in place to enable works to be carried out in a manner that is sensitive to the heritage and cultural values of the Traditional Owners, with ongoing engagement and consultation factored into the management strategies.

BHP has designed this Proposal to minimise impacts to native vegetation, heritage sites and water values in consultation with the Traditional Owners (refer to Section 12.6.1). BHP has refined the design of the Proposal footprint to avoid impacts to Aboriginal heritage sites where possible and minimise additional vegetation clearing to a total disturbance of 1076 ha, taking total clearing associated with the Combined Proposal to 22,900 ha of native vegetation within an expanded Development Envelope of 40,059 ha. Based on a review of existing and potential future proposals

currently being assessed (including the Combined Proposal), a total cumulative clearing of approximately 42,748 ha of native vegetation will have occurred within the Banjima Native Title determination area within the foreseeable future. This represents approximately 5% of the Banjima Native Title determination area which covers an area of approximately 826,300 ha. The Combined Proposal's contribution toward this cumulative clearing is approximately 2.77% of the Banjima Native Title determination area, whereas this Proposal's contribution to the cumulative clearing is approximately 0.13% of the Banjima Native Title determination area. BHP considers that the refinement of the Proposal has minimised the cumulative impacts to native vegetation as far as possible.

The Combined Proposal will result in an increase in existing groundwater abstraction limits and dewater discharge, that will contribute to cumulative impacts when considered in relation existing nearby projects.

Through the implementation of the SCHEMP and CHMP and the other related environmental management plans (EMPs), it is expected that impacts from the Combined Proposal will be appropriately managed so that cumulative impacts to social, cultural and heritage values will be minimised. A key component to the SCHEMP is a commitment to ongoing consultation and sharing of information in relation to cultural and environmental values.

Banjima representatives through BNTAC have expressed concerns regarding ongoing impacts to the culturally significant water values in the vicinity of the proposal, including Flat Rocks, where drawdown impacts are occurring and Marillana Creek, where controlled seasonal discharge is proposed. BHP has been consulting with the Banjima Traditional Owners, through BNTAC and with DWER, on proposed surplus water management measures and considers after the implementation mitigation measures, including groundwater monitoring, tree health monitoring and controlled seasonal surplus water discharge to creeks that the Combined Proposal will not significantly contribute to existing impacts to culturally significant water values. (refer to Section 7).

Impacts to water related values are discussed in Section 7 and Section 16.1 with reference to Marillana Creek and pools (including Flat Rocks) and Yandicoogina Gorge.

The subject of mine closure has featured heavily during Social Surroundings engagements and is of concern to the Banjima Traditional Owners. BHP also notes that the Banjima Traditional Owners have expressed a clear preference for the avoidance of pit lakes at closure. It is unknown how many pit lakes currently occur within the Banjima Native Title determination area; however, there are estimated to be 97 pit lakes in the Pilbara (EPA 2014). Based on the current mine plan, pit lakes at South Flank are in consideration, although all Mining Area C pits and Highway Deposit will be backfilled to 5 m above pre-mining groundwater levels. BHP's progressive closure philosophy for the Combined Proposal includes a priority focus on progressive backfilling into mined-out pits as much as possible; however, based on the current mine plan, and due to availability of resource for backfill, pit lakes would be expected to form in several pits at Combined Proposal.

BHP considers that the cumulative impact to Social Surroundings from implementation of the Combined Proposal when considered in conjunction with past, present and/or reasonably foreseeable future activities has the potential to be significant. The impacts associated with the Combined Proposal will be minimised and managed through the implementation of the SCHEMP (which is yet to be endorsed), the CHMP, EMPs, the MCP and the implementation of the mitigation strategies outlined within these documents. The outcomes of the mitigation measures that are being implemented to manage impacts to water values will be incorporated into the closure strategy for the Mining Area C and South Flank mines.

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Appendices

Appendix 1 Proposal content document

The *Mining Area C- Southern Flank Proposal Significant Amendment Proposal Content Document* (Version 1.0) is provided separately.

Appendix 2 Analysis of Approved Proposal and existing implementation conditions

As required by the Referral Instructions EPA (2024d) and ERD Instructions (2024b), BHP has undertaken analysis of the existing implementation conditions relating to the Approved Proposal.

Table A2-1: Mining Area C- Revised Proposal. MS1072 (Schedule 1)

Element	Authorised Extent	Combined Proposal
Native vegetation clearing	Clearing of no more than 21,824 ha within the Development Envelope of 38,909 ha	Included in total in Condition A1 Limitations and Extent of Proposal
Dewatering	Up to 37.3 gigalitres per annum	Included in total in Condition A1 Limitations and Extent of Proposal
Surplus water management	Up to 34.84 GL per annum via managed aquifer recharge, infiltration ponds, discharge from sedimentation basin and discharge to a drainage line that leads to Pebble Mouse Creek. Discharge along drainage line and Pebble Mouse Creek: - will not extend further than 14 km from the discharge point or extend beyond the boundary of the Mining Area C development envelope. - shall be intermittent under natural no flow conditions for maximum of 120 days in any 12-month period Mounding as a result of managed aquifer recharge at South Flank will be maintained at or below 30 m form ground level within an area of 400 m around the SF0095R bore.	Included in total in Condition A1 Limitations and Extent of Proposal

Review of implementation conditions

BHP has analysed the existing implementation conditions. Where changes are proposed, BHP has evaluated the proposed changes to ensure that the Combined Proposal can be implemented consistently with the EPA's objectives (Tables A2-4, A2-5 and A2-6). Where BHP proposes to retain an existing condition for an Approved Proposal for the Combined Proposal, see the proposed conditions for the Combined Proposal (Appendix 3).

Table A2-4: Mining Area C - Revised Proposal (MS1072)

Condition	Combined Proposal condition (or justification if not required)
1 Proposal Implementation	Condition A1 Limitations and Extent of Proposal Revised to include relevant Proposal extents, consistent with the contemporary condition setting approach recommended by the EPA
2 Contact Details	Condition D3 Contact Details The requirements of this condition are still relevant and are proposed to be retained, as the requirements are consistent with the contemporary condition setting approach recommended by the EPA
3 Compliance Reporting	Condition D1 Non-compliance Reporting, Condition D2 Compliance Reporting The requirements of this condition are still relevant and are proposed to be retained, as the requirements are consistent with the contemporary condition setting approach recommended by the EPA
4 Public Availability of Data	Condition D4 Public Availability of Data The requirements of this condition are still relevant and are proposed to be retained, as the requirements are consistent with the contemporary condition setting approach recommended by the EPA
5 Cultural Heritage Management Plan	Condition B4 Social Surroundings The requirements of this condition are still relevant and are proposed to be retained, as the requirements are consistent with the contemporary condition setting approach recommended by the EPA, BHP proposes an outcome-based condition.
6 Water Management Environmental Management Plan	Condition B1 Inland Waters The requirements of this condition are still relevant and are proposed to be retained, as the requirements are consistent with the contemporary condition setting approach recommended by the EPA, BHP proposes an outcome-based condition to manage potential impacts from the proposal
7 Ghost Bat Environmental Management Plan	B2 Terrestrial Fauna The requirements of this condition are still relevant and are proposed to be retained, as the requirements are consistent with the contemporary condition setting approach recommended by the EPA, BHP proposes an outcome-based condition to manage potential impacts to Ghost Bats from the proposal
8 Greenhouse Gas Reporting	No longer required Given BHP will manage GHG emissions in accordance with the NGER Act and Safeguard Mechanism, BHP has not proposed a condition for GHG emissions.
9 Rehabilitation and Decommissioning	Condition B5 Rehabilitation and Decommissioning BHP proposes to continue to manage rehabilitation, decommissioning and closure according to the measures in the approved <i>Mining Area C Mine Closure Plan</i> (Appendix 5).
10 Offsets	Condition B6 Offsets

Condition	Combined Proposal condition (or justification if not required)
	BHP proposes to continue to manage the requirements of offsets according to the measures in the approved <i>Impact Reconciliation Procedure</i> , which BHP has updated for the Combined Proposal (Rev 2.0, BHP 2025c – Appendix 21).

Appendix 3 Compliance with Approved Proposal

Table A3-1: Current status and history of compliance

Year	AER	Summary of compliance
MS1072: Mining Area C		
Current 2023- 2024	AER 2023-2024 (BHP 2024b)	In the FY2024 reporting period, there were three potential non-compliances with the Approved Proposal. Condition 7-7 of the Approved Proposal states that <i>"In the event of exceedance of threshold criteria, the proponent shall meet the requirements in condition 3 (Compliance Reporting) and shall implement the measures outlined in the Plan, including, but not limited to, actions and investigations to be undertaken, and reporting to the CEO."</i> A continuation of the non-compliance reported in January 2023 in relation to Ghost Bat monitoring. The monitoring program continued to not detect evidence of Ghost Bat presence at one or more High Value Ghost Bat Caves during FY2024. The cave relates to SF18 which has not detected presence since 2016. BHP reported to DWER verbally on 30 January 2023 and submitted letter to DWER on 10 February 2023. BHP has implemented the following actions: • Maintaining through FY2025 the increased monitoring to low value caves or alternative locations that the Ghost Bats may use; • Compare changes to results from the other BHP Ghost Bat Monitoring programs; • Investigate the potential change in presence at the high value caves to be retained and determine if additional threshold actions are required. Monthly groundwater bore levels were not monitored as required under the Central Pilbara Water Resource Management Plan (Version 4.1) monitoring program. Condition 6-7 of the Approved Proposal states that <i>"The proponent shall implement the most recent version of the Plan approved by the CEO."</i> The groundwater bore data was not collected for Weeli Wolli Spring at the following bore locations and times as required by the CPWRMP: • GWB0016DM- February 2024 • GWB0016SM- February 2024 • GWB0017DM- July and August 2023 • GWB0018DM- October 2023, April and May 2024 • GWB0032DM- February 2024 BHP reported in writing on 16/7/2024 Although there are gaps in the monitoring requirements, BHP considers that operations have not affected the receptors as no dewatering activities have commenced in R Deposit. The cause of this non-compliance is administrative error. Condition 10-8 and 10-9 of the Approved Proposal states that <i>"The proponent shall submit an Impact Reconciliation Report in accordance with the Impact Reconciliation Procedure approved in condition 10-7"</i> and;

Year	AER	Summary of compliance
		<i>“The Impact Reconciliation Report required pursuant to condition 10-8 shall provide the location and spatial extent of the clearing undertaken with Areas A and B during each biennial reporting period”</i> The Impact Reconciliation Reporting (IRR) was not submitted on time (30 Sept 2023) BHP requested an extension for the IRR on 8 September 2023 which was subsequently not granted. Verbal reporting during a routine meeting with EPA Services was undertaken in September 2024. BHP attempted to combine State and Federal offset requirements into a single process several years ago. To this date an agreed Federal offset rate remains outstanding and there is no Regulator-endorsed Impact Reconciliation Procedure (IRP) of MS1072 that combines the offset requirements. This had delayed the ability to submit the IRR. Additionally, drafting of the IRR has been delayed due to an administrative error identified in MS1072 and the definition of 'Area A' habitat.
Current 2022- 2023	AER 2022-2023 (BHP 2023a)	In the FY2023 reporting period, there were two potential non-compliances with Ministerial Statement 1072. Condition 7-7 of MS1072 states that <i>“In the event of exceedance of threshold criteria, the proponent shall meet the requirements in condition 3 (Compliance Reporting) and shall implement the measures outlined in the Plan, including, but not limited to, actions and investigations to be undertaken, and reporting to the CEO.”</i> The BHP Ghost Bat monitoring in January 2023 did not detect evidence of bats at one or more High Value Ghost Bat Caves at Mining Area C. It is now 24 months since evidence of bats at one or more High Value Ghost Bat caves has been detected at Mining Area C, therefore meeting the threshold criteria of “Zero Ghost Bat records from scats at one or more High Value Ghost Bat Caves in a 24-month period.” Zero Ghost Bat records from scats at one or more High Value Ghost Bat Caves in a 24-month period. Potentially attributed to increased mining activities, however, there has been no geographical correlation identified between the caves which reached the threshold. BHP reported to DWER verbally on 30 January 2023 and submitted letter to DWER on 10 February 2023. BHP implemented the following actions: Increased the extent of the monitoring to low value caves or alternative locations that the Ghost Bats may use; - Compared changes to results from other BHP Ghost Bat Monitoring programs; and - Investigated the potential change in presence at the high value caves to be retained and determine if additional threshold actions are required. After the Trigger was reached, the monitoring program was increased to include more Ghost Bat caves and population trends were investigated (e.g., ACW01, ACW06, ACW08, ACW10, ACW31, M1 and M2). Condition 6-7 of MS 1072 states that <i>“The proponent shall implement the most recent version of the Plan approved by the CEO.”</i>

Year	AER	Summary of compliance
		Monthly groundwater bore levels were not monitored as required under the Central Pilbara Water Resource Management Plan (Version 4.1) monitoring program. The ground water bore levels were missed at the following locations: - Weeli Wolli Springs: Seven monthly level readings for Rio Tinto Iron Ore owned bores: GWB0017DM (March, April and June 2023), GWB0017SM (October 2022, December 2022 – February 2023), GWM0032SM (January – February 2023). - Ben's Oasis: Nine monthly level readings for BHP WAIO owned bores: HD00004M (July – August 2022), HDD0003M (January 2023), HDD0001M (July – August 2022, October 2022 – January 2023). This potential non-compliance was identified during data QA/QC associated with the preparation of 2023 AER. BHP considered that gap in the monitoring have not affected the water levels at these receptors, with consistent water level trends being visible in the available data and in adjacent bores with complete data sets, this was detailed in tables 3-59 and Table 3-60 of the AER. BHP commenced an investigation into the non-compliance and will provide an update in the FY2024 AER.
History		
2021-2022	AER 2021-2022 BHP (2022a)	A potential non-compliance relating to monthly ground water data collection at monitoring location HCF0042M occurred in December 2021. This was identified during data QA/QC associated with the preparation of the 2021-2022 AER. The data recorded against this monitoring location was considered unreliable for the purposes of reporting and was excluded. Sampling recommenced correctly in January 2022 and every month thereafter. No environmental impact suspected or recorded as a result. The bore was tagged, a work order was put in place to ensure compliance to management plan.
2020-2021	AER 2020-2021 (BHP 2021a)	A non-compliance with condition 2-1 was identified during the FY2021 reporting period. Condition 2-1 of MS1072 states: <i>"The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State."</i> BHP Billiton Iron Ore Pty Ltd formally changed name to BHP Iron Ore Pty Ltd through the Australian Securities and Investments Commission on 19 February 2021. All other details including address and Australian Company Number remained the same. BHP submitted a PAF3 – <i>Notification of Change of Proponent Address and/or Company Name form</i>, for a list of relevant Ministerial Statements to DWER on 23 April 2021. This notification was not provided within the required timeframe.

Year	AER	Summary of compliance
2019-2020	AER 2019-2020 (BHP 2020)	In the FY2020 reporting period there was one non-compliance reported against MS1072 regarding the Tree Health threshold criteria detailed in the Central Pilbara Water Resource Management Plan (CPWRMP). BHP reported an exceedance of the Threshold Criteria required by condition 6-2 regarding statistically significant canopy decline (defined as Crown Condition Score (CCS)), compared to baseline condition of reference trees over eight consecutive monitoring periods; or death of any tree (attributable to water stress caused by dewatering or reinjection), within monitoring sites 12, 15 or 20. Tree health decline was detected at the northern monitoring site (C15 at Coondewanna flats) and a small amount of suspected tree deaths (two to three young trees and multiple saplings/seedlings) adjacent to the C15 monitoring site. BHP determined that lower than average rainfall, lowering of the groundwater levels and changes in surface water flows may have contributed to the decline. In response BHP increased target monitoring at the C15 site (and adjacent area) in the following monitoring period and observed a recovery to within baseline data.
2018-2019	AER 2018-2019 (BHP 2019a)	There were no non-compliances or potential non-compliances with Ministerial Statement 1072 identified within the FY2019 reporting period.
2017-2018	AER 2017-2018 (BHP 2018a)	Following the approval of Ministerial Statement 1072 on 20 February 2018, which superseded Ministerial Statement 491, BHP identified on 21 February 2018, that approximately 13 hectares was cleared within 'Area A' prior to submission of an Impact Reconciliation Procedure to the DWER or agreement of the CEO in accordance with Condition 10-5 and approval of an Impact Reconciliation Procedure or agreement of the CEO in accordance with Condition 10-7. Internal communications to halt clearing activities was issued on 21 February 2018. The area had been previously assessed and approved to impact under Ministerial Statement 491, Environmental Management Plan Revision 6, and agreement of the CEO for impact in accordance with Condition 10-5 was given on 22 February 2018, therefore it is considered that there was no known actual or suspected environmental impact as a result of the non-compliance.

Appendix 4 Environmental Performance Report

Table A4-1: Environmental performance

Environmental factor and objective relevant to the Significant Amendment	Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
Social Surroundings <i>to protect social surroundings from significant harm.</i>	MS1072 Condition 5 Cultural Heritage Management Plan - The proponent shall continue to implement the BHP Iron Ore Cultural Heritage Management Plan (November 2017). - The proponent shall implement the most recent version of the plan approved by the CEO. - Any changes to the plan referred to in condition 5-1 must be approved by the CEO in writing.	The Cultural Heritage Management Plan was implemented for the duration of FY2023 and is the primary mechanism for management of cultural heritage matters at Vista Oriental, Grand Central, Highway, Packsaddle 1-4 and North Flank A-F deposits at South Flank and Mining Area C. BHP and the representatives of the Banjima People participate in ongoing consultation through the Banjima Heritage Advisory Council, and the heritage sub-committee, in relation to BHP's mining operations at Mining Area C and South Flank. In FY2023, there were no reportable incidents identified against the requirements of the Plan. The BHP Heritage Department reports the current status of heritage sites which BHP has legal consent to disturb.
Inland Waters <i>To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected</i>	MS1072 Condition 6 Water Environmental Management Plan: no reduction in the extent of each of the following components of the Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats:	Endorsement of the CPWRMP Version 4.1 was endorsed by DWER on 6 October 2021. The plan details: - Triggers and thresholds for Coondewanna Flats - Management actions and targets for Weeli Wolli Spring and Ben's Oasis - Reporting to address the requirements of Condition 6-8. <i>Water Quantity – Groundwater level mounding</i> Reinjection at the Juna Downs MAR, located to the north of Coondewanna Flats was commissioned on 8 February 2019 and commenced operation on 30 May 2019. During the FY2023 reporting period, groundwater levels at prescribed bores did not exceed trigger or threshold criteria. <i>Water Quantity - Groundwater level drawdown</i>

Environmental factor and objective relevant to the Significant Amendment	Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
	(a) Coolibah woodlands over lignum over swamp wandiree, or (b) Coolibah and mulga woodland over lignum and tussock grasses on clay plains, attributable to the Revised Proposal. • no reduction in the extent of Weeli Wolli Spring occurrence of the Weeli Wolli Spring Priority Ecological Community; and • no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal.	There were no exceedances of groundwater drawdown trigger values for the FY2023 reporting period.
Flora and Vegetation to protect flora and vegetation so that biological diversity and ecological integrity are maintained.	MS1072 Condition 6 Water Environmental Management Plan: • no reduction in the extent of each of the following components of the Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats:	As detailed above for Inland Waters, the CPWRMP Version 4.1 was endorsed by DWER on 6 October 2021. The plan details: • Triggers and thresholds for Coondewanna Flats • Management actions and targets for Weeli Wolli Spring and Ben's Oasis • Reporting to address the requirements of Condition 6-8. <i>Tree health of indicator species – Groundwater level drawdown monitoring of tree health</i> FY2023 Coondewanna Flats bi-annual tree health monitoring (both on-ground and via remote sensing) was undertaken for the post-dry season in November 2022 and June 2023. Post-wet on-ground monitoring component was delayed to July 2022, owing to access limitations arising from wet weather. A summary of the findings are presented below:

Environmental factor and objective relevant to the Significant Amendment	Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
	(a) Coolibah woodlands over lignum over swamp wandiree, or (b) Coolibah and mulga woodland over lignum and tussock grasses on clay plains, attributable to the Revised Proposal. - no reduction in the extent of Weeli Wolli Spring occurrence of the Weeli Wolli Spring Priority Ecological Community; and - no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal.	- Overall, in May 2023, the mean change in Crown Condition Score for <i>Eucalyptus victrix</i> and <i>Acacia aptaneura</i> was minimal across all sites compared to previous monitoring rounds in July and November 2022. - Mean pre-dawn Leaf Water Potential (LWP) and mean midday leaf water potential values were within the historic range for all sites except CF15. There was a decrease in mean pre-dawn Leaf Water Potential (LWP) for <i>Eucalyptus victrix</i> between November 2022 (end of dry season) and May 2023 (end of wet season) at site CF15 (Figure 3-7). Overall, LWP values reflected seasonal conditions and rainfall levels and were within the historical range of values. <i>Changes to Surface Water Flow Regime – water in Lake Robinson outside of natural flow events</i> Surplus water from Mining Area C Operations is discharged into two natural drainage lines located in the north-west of the Development Envelope, the West Packsaddle Tributary North and West Packsaddle Tributary South. To prevent impact to the natural surface water regime at Lake Robinson, surface water attributed to Mining Area C discharge is managed to prevent it from reaching the Trigger and Thresholds criteria as outlined in Central Pilbara Water Resource Management Plan. The Early Warning Point 'Trigger' and Wetting Front Limit 'Threshold' is located 4 kilometres and 7.5 kilometres upstream from Coondewanna Flats Priority Ecological Community (PEC). Surplus discharge water is regulated via the Packsaddle Infiltration Ponds (Western, Central and Eastern). In the FY2023 reporting period there was one stream flow event at sites SCPH0009 and SCPH0010. All occurrences are attributed to natural stream flow events with corresponding rainfall events from the same period with similar timing and water level increases observed in the previous reporting period. BHP engaged a third-party consultant to conduct a two-season detailed flora and vegetation survey to map the extent of the Coondewanna Flats PEC; and a two-phase detailed flora and vegetation assessment Weeli Wolli Spring PEC confirmed the extent of Weeli Wolli Spring PEC. BHP considers it has met its commitments regarding Condition 6 of MS1072 – for the Coolibah Woodlands and Weeli Wolli Spring. <i>Weeli Wolli Spring</i> As dewatering at R deposit and South Flank (Vista Oriental) had not commenced at the time of reporting, BHP considers it has met the outcome, 'no reduction in the extent of the Weeli Wolli Spring occurrence of the Weeli Wolli

Environmental factor and objective relevant to the Significant Amendment	Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
		Spring Priority Ecological Community attributable to the Revised Proposal' has been achieved for the FY2023 reporting period. <i>Ben's Oasis</i> South Flank (Vista Oriental) dewatering has the potential to Ben's Oasis via the Pebble Mouse Creek Valley. At the time of the FY2023 reporting, dewatering in Vista Oriental was yet to commence, BHP considers that the outcome 'no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal' has been achieved for the FY2023 reporting period.
Terrestrial Fauna <i>to protect terrestrial fauna so that biological diversity and ecological integrity are maintained</i>	Fauna Management Plan (Ghost Bat) The proponent shall prepare and submit an Environmental Management Plan (the Plan), on the advice of the Department of Biodiversity, Conservation and Attractions, that demonstrates how the proponent will achieve the following environmental outcomes: (1) maintain the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope as defined in Figure 1 of Schedule 1. (2) no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1	Mining Area C Fauna Management Plan (FMP) was developed for Mining Area C and South Flank Operations. Mining Area C Fauna Management Plan revision 1.1 was endorsed by DWER on 28 January 2021. Revision 2.1 of the Mining Area C Fauna Management Plan was submitted to DWER in March 2023 and Revision 2.2 submitted in November 2024 (BHP 2024d) which is currently under review. <i>Trigger and Threshold Criteria for Population Outcome - Ghost Bat Population Outcome</i> Ghost Bat presence at High Value retained caves has not decreased overall in the MS1072 Development Envelope. A decrease was observed in FY2021, however, it is likely that this result is the function of the relatively low number of sampling events that took place that year. In FY2023, no land disturbance occurred within the Early Response Indicator (ERI) zones at High Value retained AC17, SF14 and SF18. Project and Mining activities in these areas are ongoing. There were no exceedances of land disturbance trigger or threshold criteria as outlined in the endorsed FMP. Based on the outcomes of monitoring conducted during the FY2023 reporting period, BHP considers that the outcomes 'maintain the long-term viability of the Ghost Bat population in the Mining Area C Development Envelope as defined in Figure 1 of Schedule 1.' and 'no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1.' have been achieved for the FY2023 reporting period.

Environmental factor and objective relevant to the Significant Amendment	Ministerial Statement conditions and environmental outcomes/objective	Summary of current environmental performance
Greenhouse Gas <i>to reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change</i>		BHP reports greenhouse gas emissions from Mining Area C annually in accordance with requirements of the National Greenhouse and Energy Reporting Act 2007, as agreed with DWER (Ref 2018-1527146782323). The Clean Energy Regulator requires energy and emissions data for Mining Area C, for the period 1 July 2023 to 30 June 2024 to be finalised by 31 October 2024. Therefore, the emissions data reported in Table 3-65 will reflect FY2023 as FY2024 energy and emissions for Mining Area C have not yet been finalised and submitted to the Clean Energy Regulator.

Appendix 5 Mine Closure Plan

Attached separately

Appendix 6 Proposed implementation conditions

As provided for in the EPA's *Instructions: How to prepare an Environmental Review Document* (EPA 2024b), BHP has provided a draft set of proposed implementation conditions for the Combined Proposal for the EPA's consideration, which contain the following:

- short description of proposal
- proposed limitations and maximum extents of relevant proposal elements (Condition 1)
- the proposed environmental conditions for each of the relevant key environmental factors in the Environmental outcomes Sections 7.1.7, 8.1.7, 9.1.7, 10.1.7, 11.1.7, 12.1.7 etc (Conditions B1-B6)
- proposed general/administrative conditions.

BHP has provided a draft set of proposed implementation conditions for the Proposal below, in the form of a draft Ministerial Statement. BHP's strategic approach is to manage the environment at the subregional or hub level. As future expansions to the Central Pilbara Hub are identified in the Pilbara Expansion Strategic Proposal, BHP has proposed relevant conditions from the Strategic Proposal MS1105, amended only to allow for the Existing Project. This will allow for consistency of conditions (and management) at MAC South Flank, for the Proposal and any future proposals that may be declared as Derived Proposals. Table A2-1 below summarises BHP's selection of the relevant conditions from MS1105 and any proposed changes to these conditions. For clarity, proposed changes or additions to the MS1105 conditions are highlighted.

DRAFT PROPOSED CONDITIONS

STATEMENT THAT SIGNIFICANT AMENDMENTS TO APPROVED PROPOSAL MAY BE IMPLEMENTED

(Environmental Protection Act 1986)

MINING AREA C AND SOUTHERN FLANK MINING OPERATIONS (SIGNIFICANT AMENDMENT)

Proposal: The proposal is to amend the existing Mining Area C and Southern Flank project to include various surplus water management schemes, including an increase in dewatering and surplus water disposal capacity and the construction of permanent surface water diversion structures.

Proponent: BHP Iron Ore Pty Ltd
Australian Company Number: 008 700 981

Proponent Address: 125 St Georges Terrace, PERTH WA 6000

Assessment Number: XXXX

Report of the Environmental Protection Authority: XXXX

Previous Assessment Numbers: 1108, 2085

Previous Reports of the Environmental Protection Authority: 913

Previous Statement Numbers: 491, 1072

Introduction: The Proposal is a significant amendment to the existing Mining Area C Proposal which was agreed to be implemented under Ministerial Statements 1072. The EPA's Report for the existing Mining Area C Proposal is Report 1610, EPA Assessment Number 2085.

1. pursuant to section 45 of the Environmental Protection Act 1986, it has been agreed that the proposal described and documented in Part A of the proponent's referral document dated DD MMM YYYY may be implemented;
2. this Statement supersedes Statement 1072 and from the date of this Statement each of the implementation conditions in Statement 1072 no longer apply in relation to the Amended Proposal; and
3. the implementation of the Amended Proposal, being the Proposal to mine the Mining Area C Northern Flank and Southern Flank orebodies, located in the Hamersley Range as amended by this Proposal, is subject to the following amended implementation conditions:

Conditions and procedures**Part A: Proposal extent****Part B: Environmental outcomes, prescriptions, and objectives****Part C: Environmental management plans and monitoring****Part D: Compliance and other conditions**

PART A: PROPOSAL EXTENT**A1 Limitations and extent of proposal**

A1-1 The proponent must ensure that the proposal is implemented in such a manner that the following limitation or maximum extents / capacities / ranges are not exceeded:

Proposal Element	Location	Maximum extent
Physical elements		
Development Envelope	Figure 1	No more than 40,059 ha
Indicative Disturbance Footprint	Within the Development Envelope shown in Figure 1	Indicative Footprint of 1,482 ha
Direct disturbance of native vegetation	Within the Development Envelope shown in Figure 1	Clearing of no more than 22,900 ha of native vegetation within a 40,059 ha Development Envelope
Operational elements		
Dewatering	Figure 1	Groundwater abstraction for mine dewatering of up to 65.7 GL/a
Surplus Water Management	Figure 1	Up to 56.21 GL per annum via managed aquifer recharge, infiltration ponds, discharge from sedimentation basin, discharge to Lower Marillana Creek, discharge to Upper Marillana Creek discharge to a drainage line that leads to Pebble Mouse Creek. Discharge along Upper Marillana Creek: - will not extend further than 27 km from the discharge point, will include a 90-day no flow period in dry season during every 12-month period, will have an operational duration of 5 years from commissioning. Discharge along Lower Marillana Creek: - to not exceed 30 ML/day, will include a 90-day no flow period in dry season every 12-month period, will have an operational duration of 5 years from commissioning. Discharge along drainage line and Pebble Mouse Creek: - will not extend further than 14 km from the discharge point or extend beyond the boundary of the Mining Area C development envelope. - shall be intermittent under natural no flow conditions for maximum of 120 days in any 12 month period Mounding as a result of managed aquifer recharge at South Flank will be maintained at or below 30 m from

Proposal Element	Location	Maximum extent
		ground level within an area of 400 m around the SF0095R bore
Timing elements		
Project life	N/A	Up to 2073

PART B – ENVIRONMENTAL OUTCOMES, PRESCRIPTIONS AND OBJECTIVES**B1 Water Management Environmental Management Plan**

- B1-1 The proponent shall prepare and submit an Environmental Management Plan, that demonstrates how the proponent will achieve the following environmental outcomes:
- (1) no reduction in the extent of each of the following components of the Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats:
 - (a) Coolibah-Lignum Flats Priority Ecological Community occurrence on the Coondewanna Flats:
 - (b) Coolibah and mulga woodland over lignum and tussock grasses on clay plains
 - (2) no reduction in the extent of the Weeli Wolli Spring occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal
 - (3) no reduction in the extent of the Ben's Oasis occurrence of the Weeli Wolli Spring Priority Ecological Community attributable to the Revised Proposal
 - (4) no increase to groundwater levels in Yandicoogina Gorge beyond historical recorded water levels.
 - (5) maximum wetting front extent at Upper Marillana of 27 km and no adverse impact to riparian vegetation as a result of surplus water discharge at Upper Marillana Creek.

B2 Ghost Bat Environmental Management Plan

- B2-1 The proponent shall prepare and submit an Environmental Management Plan that demonstrates the following environmental outcomes:
- (1) maintain the long-term viability of the Ghost Bat population in the Development Envelope as defined in Figure 1 of Schedule 1.
 - (2) no disturbance of the eleven (11) Retained High Value Ghost Bat Caves as shown in Figure 2 of Schedule 1

B3 Subterranean Fauna

- B3-1 The proponent must not undertake any operation of the Northern RAV managed aquifer recharge scheme until:
- (1) the subterranean fauna survey results confirm troglofauna habitat connectivity exists between the Northern Runaway Valley impact area and troglofauna habitat outside that area, and/or
 - (2) the subterranean fauna survey results confirm that the distribution of any potentially restricted troglofauna species is likely to occur outside of the Northern Runaway Valley impact area.
- B3-2 The proponent must not exceed groundwater drawdown beyond the Approved Proposal limits at the Coondewanna Flats area until either:
- (1) the extent and connectivity of stygofauna habitat between the stygofauna impact area with habitat outside that area is confirmed, and/or:
 - (2) the distributions of potentially restricted stygofauna species including *Paramelitidae* sp. S04 (BR South), nr *Billibathynella* sp. S1, and nr *Notobathynella* sp. S01 are either confirmed, or inferred to,

extend outside the impact area based on additional species records or confirmation of habitat extent and connectivity.

- B3-3 The proponent shall submit the results of the subterranean survey required by condition B3-1 to the CEO and shall not commence managed aquifer recharge of surplus water at Northern Runaway Valley until the CEO has confirmed by notice in writing.
- B3-4 The proponent shall submit the results of the subterranean fauna surveys required by condition B3-2 to the CEO and shall not exceed previously approved dewatering drawdown thresholds until the CEO has confirmed by notice in writing.

B4 Social Surroundings

- B4-1 The proponent must implement the proposal to achieve the following environmental objectives:
- (1) no disturbance to Aboriginal cultural heritage sites in the development envelope, unless consent is granted to disturb that site under WA legislation which specifically relates to Aboriginal heritage and has required informed consultation with relevant Traditional Owners; and
 - (2) subject to reasonable health and safety requirements, no interruption of ongoing access to land utilised for traditional use or custom by relevant traditional owners.
 - (3) avoid, where practicable, and otherwise minimise adverse impacts to Aboriginal cultural heritage within and surrounding the development envelope.
- B4-2 The proponent must undertake ongoing consultation and engagement with relevant Traditional Owners about the achievement of the outcomes and objectives in condition B1-1 and condition B4-1 for the life of the proposal.

B5 Decommissioning and Rehabilitation

- B5-1 The proponent must implement the proposal to ensure the following environmental outcomes are achieved:
- (1) ensure that the Proposal is rehabilitated and decommissioned in an ecologically sustainable manner.
- B5-2 The proponent shall continue to implement the Mine Closure Plan (2018) until the CEO has confirmed by notice in writing that the Mine Closure Plan (2025) satisfies the requirements on advice from the Department of Mines, Industry Regulation and Safety, and the Department of Water and Environmental Regulation.
- B5-3 The plan shall include, but not limited to, the following:
- (1) backfilling of the Highway Deposit Pits, to a level that avoids the creation of a permanent mine pit lake;
 - (2) management of waste rock including waste rock capable of generating Acid and Metalliferous Drainage; and;
 - (3) management of pit lakes.
- B5-4 The proponent shall review and revise the Mine Closure Plan at intervals not exceeding three years, or as otherwise agreed by the CEO, and submit the plan to the CEO at the agreed interval.

B6 Offsets

- B6-1 The proponent must contribute funds to the Pilbara Environmental Offsets Fund calculated pursuant to condition B6-2, to achieve the objective of counterbalancing the significant residual impacts by the proposal to:
- (1) 'Good' to 'Excellent' condition native vegetation;
 - (2) riparian vegetation (including groundwater dependent vegetation) within the Hamersley IBRA subregion;
 - (3) Pilbara Olive Python (*Liasis olivaceus barroni*) critical habitat, Ghost Bat (*Macroderma gigas*) critical habitat, Northern Quoll (*Dasyurus hallucatus*) critical habitat and Grey Falcon (*Falco hypoleucos*) critical habitat, subject to any reduction approved by the **CEO** under condition B6-8; and
 - (4) Northern Quoll (*Dasyurus hallucatus*) supporting habitat, Pilbara Leaf-nosed Bat (*Rhinonictis aurantia*) supporting habitat, Pilbara Olive Python (*Liasis olivaceus barroni*) supporting habitat and Grey Falcon (*Falco hypoleucos*) supporting habitat, subject to any reduction approved by the **CEO** under condition B6-8.
- B6-2 The proponent's contribution to the Pilbara Environmental Offsets Fund must be paid biennially, with the amount to be contributed calculated based on the clearing of native vegetation undertaken in each year of the biennial reporting period in accordance with the rates in condition B6-3. The first biennial reporting period must commence from ground disturbing activities of the environmental value(s) identified in condition B6-3.
- B6-3 Calculated on the 2023-2024 financial year, the contribution rates are:
- (1) \$945 AUD (excluding GST) per ha of the following environmental values cleared as a result of the proposal within the Hamersley IBRA subregion:
 - (a) Good to Excellent condition native vegetation.
 - (2) \$1,891 AUD (excluding GST) per ha of the following environmental values cleared as a result of the proposal within the Hamersley IBRA subregion:
 - (a) Riparian vegetation (including groundwater dependent vegetation)
 - (b) critical habitat for Pilbara Olive Python (*Liasis olivaceus barroni*)
 - (c) critical habitat for Ghost Bat (*Macroderma gigas*)
 - (d) critical habitat for Northern Quoll (*Dasyurus hallucatus*)
 - (e) critical habitat for Grey Falcon (*Falco hypoleucos*)
 - (3) \$945 AUD (excluding GST) per ha of the following environmental values cleared as a result of the proposal within the Hamersley IBRA subregion:
 - (a) Northern Quoll (*Dasyurus hallucatus*) supporting habitat;
 - (b) Pilbara Leaf-nosed Bat (*Rhinonictis aurantia*) supporting habitat;
 - (c) Pilbara Olive Python (*Liasis olivaceus barroni*) supporting habitat; and
 - (d) Grey Falcon (*Falco hypoleucos*) supporting habitat.

- B6-4 The rates in condition B8-3 change annually each subsequent financial year in accordance with the percentage change in CPI applicable to that financial year.
- B6-5 To achieve the objective in condition B8-1 the proponent must prepare an Impact Reconciliation Procedure and submit to the **CEO**. This procedure must:
- (1) spatially define the environmental value(s) identified in condition B6-1;
 - (2) spatially define the areas where offsets required by condition B6-1 are to be exempt;
 - (3) include a methodology to calculate the amount of clearing undertaken during each year of the biennial reporting period for each of the environmental values identified in condition B6-3;
 - (4) state that clearing calculation for the first biennial reporting period will commence from ground disturbing activities in accordance with condition B6-2 and end on the second 30 June following commencement of ground disturbing activities;
 - (5) state that clearing calculations for each subsequent biennial reporting period will commence on 1 July of the required reporting period, unless otherwise agreed by the **CEO**;
 - (6) indicate the timing and content of the Impact Reconciliation Reports; and
 - (7) be prepared in accordance with Instructions on how to prepare *Environmental Protection Act 1986* Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports (or any subsequent revisions).
- B6-6 The proponent must submit an Impact Reconciliation Report in accordance with the confirmed Impact Reconciliation Procedure in condition B6-5.
- B6-7 The Impact Reconciliation Report required pursuant to condition B6-6 must provide the location and spatial extent of the ground disturbing activities undertaken as a result of the proposal during each year of each biennial reporting period.
- B6-8 The proponent may apply in writing and seek the written approval of the **CEO** to reduce all or part of the contribution payable under condition B6-2 where:
- (1) a payment has been made to satisfy a condition of an approval under the *Environment Protection and Biodiversity Conservation Act 1999* in relation to the proposal; and
 - (2) the payment is made for the purpose of counterbalancing impacts of the proposal on matters of national environmental significance.
- B6-9 The **CEO** may grant approval to discount the amount payable under condition B6-1(4) if the **CEO** is satisfied that the payment will offset the significant residual impacts of the proposal.
- B6-10 Condition C1 applies to the confirmed Impact Reconciliation Procedure required by condition B6-5 as if it were an environmental management plan.
- B6-11 Failure to implement a confirmed Impact Reconciliation Procedure or submit an Impact Reconciliation Report as required by condition B6-6 represents a non-compliance with these conditions.
- B6-12 The clearing of 5,564 hectares of native vegetation previously authorised under Ministerial Statement 491 is exempt from the requirement to offset under condition B6-1.

PART C – ENVIRONMENTAL MANAGEMENT PLANS AND MONITORING

C1 Environmental Management Plans: Conditions Relating to Approval, Implementation, Review and Publication

- C1-1 Upon being required to implement an environmental management plan under Part B, or after receiving notice in writing from the **CEO** that the environmental management plan required in Part B satisfies the relevant requirements, the proponent must:
- (1) implement the most recent version of the confirmed environmental management plan; and
 - (2) continue to implement the confirmed environmental management plan referred to in condition C1-1(1), other than for any period which the **CEO** confirms by notice in writing that it has been demonstrated that the relevant requirements for the environmental management plan have been met, or are able to be met under another statutory decision-making process, in which case the implementation of the environmental management plan is no longer required for that period.
- C1-2 The proponent:
- (1) may review and revise a confirmed environmental management plan provided it meets the relevant requirements of that environmental management plan, including any consultation that may be required when preparing the environmental management plan; and
 - (2) must review and revise a confirmed environmental management plan and ensure it meets the relevant requirements of that environmental management plan, including any consultation that may be required when preparing the environmental management plan, as and when directed by the **CEO**.
- C1-3 Despite condition C1-1, but subject to condition C1-4, the proponent may implement minor revisions to an environmental management plan if the revisions will not result in new or increased adverse impacts to the environment or result in a risk to the achievement of the limits, outcomes or objectives which the environmental management plan is required to achieve.
- C1-4 If the proponent is to implement minor revisions to the environmental management plan under condition C1-3, the proponent must provide the **CEO** with the following at least twenty (20) business days before it implements the revisions:
- (1) the revised environmental management plan clearly showing the minor revisions;
 - (2) an explanation of and justification for the minor revisions; and
 - (3) an explanation of why the minor revisions will not result in new or increased adverse impacts to the environment or result in a risk to the achievement of the limits, outcomes or objectives which the environmental management plan is required to achieve.
- C1-5 The proponent must cease to implement any revisions which the **CEO** notifies the proponent (at any time) in writing may not be implemented.
- C1-6 The confirmed environmental management plan, and any revised environmental management plan under conditions C1-2 and C1-4, must be published on the proponent's website and provided to the **CEO** in electronic form suitable for online publication by the Department of Water and Environmental Regulation within twenty (20) business days of being implemented, or being required to be implemented (whichever is earlier).

C2 Conditions Related to Monitoring

- C2-1 The proponent must undertake monitoring capable of:

(1) substantiating whether the proposal limitations and extents in Part A are exceeded.

C2-2 The proponent must submit as part of the Compliance Assessment Report required by condition D2 and to the other decision-making authority, a compliance monitoring report that:

- (1) outlines the monitoring that was undertaken during the implementation of the proposal;
- (2) identifies why the monitoring was capable of substantiating whether the proposal limitation and extents in Part A are exceeded;
- (3) outlines the results of the monitoring;
- (4) reports whether the proposal limitations and extents in Part A were exceeded, based on analysis of the results of the monitoring; and
- (5) reports any actions taken by the proponent to remediate any potential noncompliance.

C3 Environmental Management Plans: Conditions Related to Management Actions and Targets for Objective Based Conditions

C3-1 The environmental management plans required under conditions B1-1 and B2-1 must contain provisions which enable the achievement of the relevant objectives of those conditions and substantiation of whether the objectives are reasonably likely to be met, and must include:

- (1) management actions;
- (2) management targets;
- (3) contingency measures if management targets are not met; and
- (4) reporting requirements.

C3-2 Without limiting condition C1-1, the failure to achieve an environmental objective, or implement a management action, regardless of whether contingency measures have been or are being implemented, represents a noncompliance with these conditions.

PART D – COMPLIANCE, TIME LIMITS, AUDITS AND OTHER CONDITIONS

D1 Non-compliance Reporting

D1-1 If the proponent becomes aware of a potential non-compliance, the proponent must:

- (1) report this to the **CEO** within seven (7) days of being aware of the potential non-compliance;
- (2) implement contingency measures;
- (3) investigate the cause;
- (4) investigate environmental impacts;
- (5) advise rectification measures to be implemented;
- (6) advise any other measures to be implemented to ensure no further impact; and
- (7) provide a report to the **CEO** within twenty-one (21) days of being aware of the potential non-compliance, detailing the measures required in conditions D1-1(1) to D1-1(6) above.

D1-2 Failure to comply with the requirements of a condition, or with the content of an environmental management plan required under a condition, constitutes a non-compliance with these conditions,

regardless of whether the contingency measures, rectification or other measures in condition D1-1 above have been or are being implemented.

D2 Compliance Reporting

- D2-1 The proponent must provide an annual Compliance Assessment Report to the **CEO** for the purpose of determining whether the implementation conditions are being complied with.
- D2-2 Unless a different date or frequency is approved by the **CEO**, the first annual Compliance Assessment Report must be submitted on 1 October, and subsequent reports must be submitted annually from that date.
- D2-3 Each annual Compliance Assessment Report must be endorsed by the proponent's Chief Executive Officer, or a person approved by proponent's Chief Executive Officer to be delegated to sign on the Chief Executive Officer's behalf.
- D2-4 Each annual Compliance Assessment Report must:
- (1) state whether each condition of this Statement has been complied with, including:
 - (a) exceedance of any proposal limits and extents;
 - (b) achievement of environmental outcomes;
 - (c) achievement of environmental objectives;
 - (d) requirements to implement the content of environmental management plans;
 - (e) monitoring requirements;
 - (f) implement contingency measures;
 - (g) requirements to implement adaptive management; and
 - (h) reporting requirements;
 - (2) include the results of any monitoring (inclusive of any raw data) that has been required under Part C in order to demonstrate that the limits in Part A, and any outcomes or any objectives are being met;
 - (3) provide evidence to substantiate statements of compliance, or details of where there has been a non-compliance;
 - (4) include the corrective, remedial and preventative actions taken in response to any potential non-compliance;
 - (5) be provided in a form suitable for publication on the proponent's website and online by the Department of Water and Environmental Regulation;
 - (6) be prepared and published consistent with the latest version of the Compliance Assessment Plan required by condition D2-5 which the **CEO** has confirmed by notice in writing satisfies the relevant requirements of Part C and Part D.
- D2-5 The proponent must prepare a Compliance Assessment Plan which is submitted to the **CEO** at least six (6) months prior to the first Compliance Assessment Report required by condition D2-2, or prior to implementation of the proposal, whichever is sooner.
- D2-6 The Compliance Assessment Plan must include:

- (1) what, when and how information will be collected and recorded to assess compliance;
- (2) the methods which will be used to assess compliance;
- (3) the methods which will be used to validate the adequacy of the compliance assessment to determine whether the implementation conditions are being complied with;
- (4) the retention of compliance assessments;
- (5) the table of contents of Compliance Assessment Reports, including audit tables; and
- (6) how and when Compliance Assessment Reports will be made publicly available, including usually being published on the proponent's website within sixty (60) days of being provided to the **CEO**.

D3 Contact Details

- D3-1 The proponent must notify the **CEO** of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty-eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

D4 Public Availability of Data

- D4-1 Subject to condition D4-2, within a reasonable time period approved by the **CEO** upon the issue of this Statement and for the remainder of the life of the proposal, the proponent must make publicly available, in a manner approved by the **CEO**, all validated environmental data collected before and after the date of this Statement relevant to the proposal (including sampling design, sampling methodologies, monitoring and other empirical data and derived information products [e.g. maps]), environmental management plans and reports relevant to the assessment of this proposal and implementation of this Statement.

- D4-2 If:

- (1) any data referred to in condition D4-1 contains trade secrets; or
- (2) any data referred to in condition D4-1 contains particulars of confidential information (other than trade secrets) that has commercial value to a person that would be, or could reasonably be expected to be, destroyed or diminished if the confidential information were published, the proponent may submit a request for approval from the **CEO** to not make this data publicly available and the **CEO** may agree to such a request if the **CEO** is satisfied that the data meets the above criteria.

- D4-3 In making such a request the proponent must provide the **CEO** with an explanation and reasons why the data should not be made publicly available.

D5 Independent Audit

- D5-1 The proponent must arrange for an independent audit of compliance with the conditions of this statement, including achievement of the environmental outcomes and/or the environmental objectives and/ or environmental performance with the conditions of this statement, as and when directed by the **CEO**.
- D5-2 The independent audit must be carried out by a person with appropriate qualifications who is nominated or approved by the **CEO** to undertake the audit under condition D5-1.
- D5-3 The proponent must submit the independent audit report with the Compliance Assessment Report required by condition D2, or at any time as and when directed in writing by the **CEO**. The audit report is to be supported by credible evidence to substantiate its findings.

D5-4 The independent audit report required by condition D5-1 is to be made publicly available in the same timeframe, manner and form as a Compliance Assessment Report, or as otherwise directed by the **CEO**.

Figures (attached)

Figure 1 Development Envelope

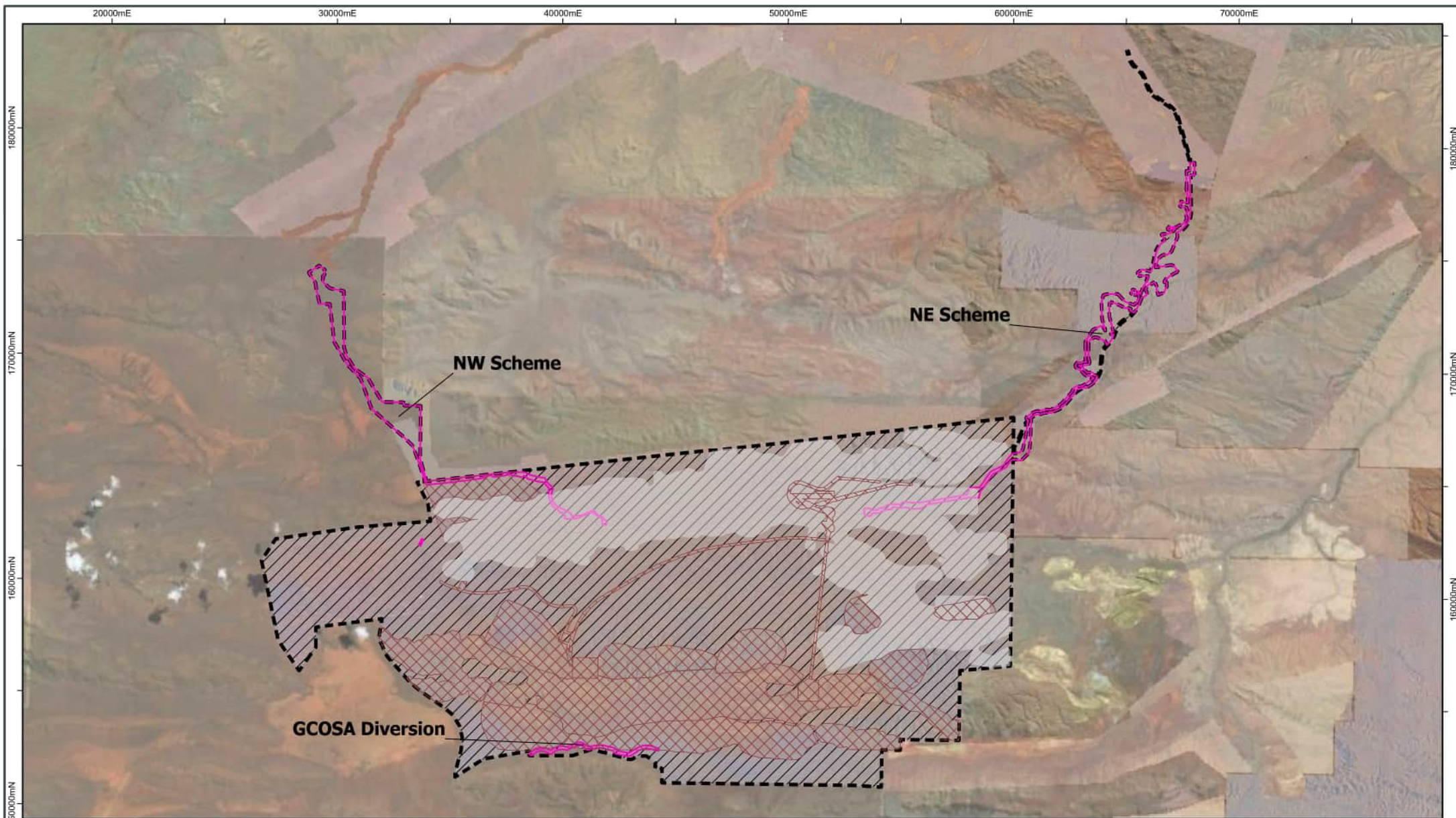
Schedule 1

Coordinates defining the Development Envelope are provided electronically.

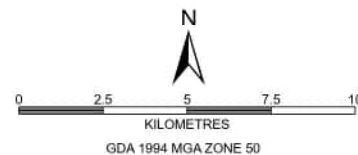
Schedule 1**Figures (attached)**

Figure 1 Development Envelope

Coordinates defining the Development Envelope are provided electronically.



-  Proposed Development Envelope
-  Indicative Footprint
-  Approved Development Envelope
-  EMP Rev6 Area
-  Additional Impact Assessment Area





MINING AREA C-SOUTH FLANK

SIGNIFICANT AMENDMENT

APPROVED DEVELOPMENT ENVELOPE,
PROPOSED DEVELOPMENT ENVELOPE
AND INDICATIVE FOOTPRINT

WAO PLANNING, TECHNICAL AND ENVIRONMENT

PUBLIC

FIGURE: **1**

SCALE @ A3: 1:225,000

DATE: 19/02/2025

REQUESTOR: ENVIRONMENT

PREPARED: GEOMATICS

REVIEWED:

NO: **A1285-049 RevC**

Appendix 7 Inland Waters

The following studies undertaken to support the assessment of Inland Waters for the Proposal:

1. Marillana Creek Infiltration Proposal Geotechnical Mapping and Investigation Report (4DG 2019)
2. Marillana Creek Wetting Front Modelling (AQ2 2019)
3. Yandi E8 Creek Discharge Wetting Front (BHP 2021d)
4. Update of South Flank Grand Central Overburden Storage Area Surface Water Management Plan and Surface Water Impact Assessment (WSP 2024)
5. Central Pilbara Hydrogeological Assessment (BHP 2025a)
6. Runaway Valley North Updated Hydrogeological Assessment of MAR (Advisian 2024)
7. Hydrogeological Investigation Drilling Program, Ministers North (RPS 2021)
8. FY23 Ministers North SUR Phase 1 Hydrogeological Drilling Completion Report (BHP 2023c)
9. Technical Memorandum Ministers North Conceptual Hydrogeological Model (BHP 2019b)
10. Yandicoogina Gorge Numerical groundwater modelling (BHP 2023h)
11. Carbonate Precipitation from Groundwater – Source, Controls and Management (Earth Systems 2023)
12. Preliminary PFAS Assessment Mining Area C (Cardno 2022)
13. Acid and Metalliferous Drainage Risk Assessment – Mining Area C and South Flank (BHP 2021b)
14. Yandicoogina Gorge Mitigation Water Quality Desktop Review (Biologic 2023f)
15. Ministers North Ecohydrology (AQ2 2022)

Appendix 8 Central Pilbara Water Resources Management Plan v5.0

Attached separately

Appendix 9 Summary of Flora and Vegetation studies and surveys

Table A8 presents a summary of Flora and Vegetation information used in the assessment of the Proposal.

Table A8: Flora and Vegetation studies and surveys

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Yandi E8 Targeted Flora Survey (Biologic 2023e)	Targeted	Not applicable	13-20 May 2022	Good	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	Not applicable	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority flora were recorded: <i>Ipomoea racemigera</i> (P2), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), and <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P4).	Twenty-two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Central Pilbara Hub Detailed and Targeted Flora Survey (Biologic 2024a)	Single season detailed and targeted	152 quadrats, 21 releves	March and April-May 2022 June 2022 Nov 2021	Good	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	77 vegetation associations classified into 26 broad floristic formations. None aligned with Federal or State listed TECs. Vegetation condition ranged from Completely Degraded to Excellent.	Twenty Priority flora were recorded: Priority 1: <i>Triodia</i> sp. Karijini (S. van Leeuwen 4111); Priority 2: <i>Aristida lazaridis</i> , <i>Eragrostis</i> sp. Mt Robinson (S. van Leeuwen 4109), <i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068), <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708), <i>Ipomoea racemigera</i> , and <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725); Priority 3: <i>Eremophila naaykensis</i> , <i>Indigofera gilesii</i> , <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> , <i>Pilbara trudgenii</i> , <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Rostellularia adscendens</i> var. <i>latifolia</i> , <i>Solanum kentrocaule</i> , <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431), <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), and <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684); and Priority 4: <i>Eremophila magnifica</i> subsp. <i>magnifica</i> , <i>Lepidium catapycnon</i> , and <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	17 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	10
Targeted Flora Surveys of Pipeline Corridors (GHD 2022)	Targeted	Not applicable	Apr-May 2021	Good	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	Not applicable	Four Priority flora species were recorded: <i>Aristida lazaridis</i> (P2), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3) and <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P4).	Not stated.	10

²² Based on current conservation status of taxa.

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Ministers North and Yandi Vegetation Association and Condition Mapping (Onshore 2020)	Desktop	Not applicable	Not applicable	Not applicable	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	The consolidated vegetation association mapping resulted in the delineation of 40 vegetation associations, classified under 21 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from Completely Degraded to Excellent.	Not applicable	Not applicable	10
Ministers North Miscellaneous Licence Area Amendment Surveys and Yandicoogina Creek Detailed Flora and Vegetation Assessment (Biologic 2020)	Two season detailed survey of Yandicoogina Creek	31 quadrats 2 releves	9-15 September 2019 26-30 March 2020	Poor (First season) Optimal (second season)	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	35 vegetation associations classified into 18 broad floristic formations. None aligned with Federal or State listed TECs. Three associations have affinities with the DBCA listed PEC: <i>Riparian flora and plant communities of springs and river pools with high water permanence of the Pilbara</i> (P2; DBCA 2023) (MA Eco EuaTtSogl AtpGoroCule, MA EcoMa AtpCuleGoro TtEuaSopl and MA MaEco CyvTydFis TtEua). Vegetation condition ranged from Degraded to Excellent.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Four Priority flora were recorded: <i>Aristida lazaridis</i> (P2), <i>Fimbristylis sieberiana</i> (P3), <i>Gymnanthera cunninghamii</i> (P3), and <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P4).	Seventeen introduced species were recorded, none listed as a Declared Pest under the BAM Act.	10
Runaway Valley Baseline Vegetation Monitoring Survey (Astron 2020)	Baseline monitoring	41 permanent monitoring sites installed	March 2019	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	The keystone tree species monitored were <i>Acacia aptaneura</i> , <i>Eucalyptus camaldulensis</i> , <i>Eucalyptus victrix</i> , <i>Corymbia hamersleyana</i> and <i>Corymbia deserticola</i> . One Priority Flora species, <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), was also monitored where present.	One Priority Flora species was recorded, <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794).	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	10
Area C West to Yandi Flora and Vegetation Assessment (Astron 2019)	Single season detailed	67 quadrats 24 releves	13-22 November 2018	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	38 vegetation associations classified into 16 broad floristic formations None aligned with Federal or State listed TECs or State listed PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora was recorded: <i>Eremophila naaykensis</i> (Priority 3).	Three introduced species were recorded, none listed as a Declared Pest under the BAM Act.	10

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
MAC4 Pipeline Routes Reconnaissance Flora and Vegetation Survey (Biologic 2019b)	Reconnaissance	52 releves	November 2018	Good	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	17 vegetation associations classified into 8 broad floristic formations None aligned with Federal or State listed TECs or State listed PECs.	Two priority listed taxa, <i>Eremophila naaykensis</i> (Priority 3) and <i>Aristida lazaridis</i> (P2).	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Yandicoogina Creek GDV Survey (Onshore 2018)	Reconnaissance	34 releves	June 2018	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	10 vegetation associations classified into 8 broad floristic formations None aligned with Federal or State listed TECs or State listed PECs.	Five Priority flora were opportunistically recorded: <i>Aristida lazaridis</i> (P2); <i>Fimbristylis sieberiana</i> (P3); <i>Gymnanthera cunninghamii</i> (P3); <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3); and <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1643) (P4).	10 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Ministers North Detailed Flora and Vegetation Survey (Biota 2017)	Two season detailed	22 quadrats and 15 releves	September 2016 May and July 2017	Optimal	Environmental Factor Guideline Flora and Vegetation (EPA 2016a) Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016g)	10 vegetation associations classified into 6 broad floristic formations None aligned with Federal or State listed TECs or State listed PECs.	Three Priority flora were recorded: <i>Fimbristylis sieberiana</i> (Priority 3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 4), and <i>Acacia bromilowiana</i> (Priority 4).	13 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Marillana Creek Riparian Flora and Vegetation Survey (Onshore 2015)	Single season detailed/ monitoring	40 quadrats 237 releves Monitoring: 5 permanent monitoring points established	8-19 June 2015	Excellent	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000) Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	22 vegetation associations classified into eleven broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Five Priority flora were recorded: <i>Amaranthus centralis</i> (Priority 3), <i>Aristida lazaridis</i> (Priority 2), <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (Priority 3), <i>Ipomoea racemigera</i> (Priority 2) and <i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3).	Twenty-two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Mining Area C Review of Flora and Vegetation Baseline Information (Onshore 2014b)	Desktop	Not applicable	2014	Not applicable	Not applicable	28 vegetation associations classified into eleven broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs.	Eight Priority flora were recorded: <i>Acacia bromilowiana</i> (Priority 2); <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (Priority 3); <i>Aristida lazaridis</i> (Priority 2); <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4); <i>Nicotiana umbratica</i> (Priority 3); <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (Priority 3); <i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3).	10 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Vegetation Mapping Review Coolibah-lignum Flats Priority Ecological Community (Onshore 2013c)	Vegetation mapping review	Not applicable	June 2012	Not stated	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	Nine vegetation associations classified into six broad floristic formations. Vegetation associations were all recorded within the 'Coolibah-lignum flats: Eucalyptus victrix over Muehlenbeckia florulenta community' Priority Ecological Community (PEC) (Sub-types 1 and 3).	Nine Priority flora taxa have been recorded; <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P3), <i>Aristida lazaridis</i> (P2), <i>Rhagodia</i> sp. Hamersley (M.Trudgen 17794) (P3), <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3), <i>Swainsona thompsoniana</i> (P3), <i>Goodenia lyrata</i> (P3).	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Level 2 Flora and Vegetation Survey Mudlark Leases (Onshore 2013a)	Two season detailed	259 quadrats	February, June and July 2011 July 2012	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	38 vegetation associations classified into 16 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs.	22 Priority flora were recorded: <i>Acacia bromilowiana</i> (Priority 2), <i>Acacia effusa</i> (P3), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Aristida lazaridis</i> (P2), <i>Dampiera metallorum</i> (P3), <i>Eragrostis</i> sp. Mt Robinson (P3), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Eremophila</i> sp. West Angelas (P3), <i>Grevillea saxicola</i> (P3), <i>Hibiscus</i> sp. Gurinbiddy Range (P2), <i>Indigofera gilesii</i> (P3), <i>Olearia mucronata</i> (P3), <i>Oxalis</i> sp. Pilbara (P3), <i>Pilbara trudgenii</i> (P3), <i>Ptilotus mollis</i> (P4), <i>Rhagodia</i> sp. Hamersley (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 4), <i>Solanum kentrocaule</i> (P3), <i>Themeda</i> sp. Hamersley Station, (P3), <i>Triodia karijini</i> (P2) and <i>Triodia</i> sp. Mt Ella (P3).	12 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Level 2 Flora and Vegetation Survey Tandanya (Onshore 2013b)	Two season detailed	574 quadrats	August and October 2011 May and June 2012	Good	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	37 vegetation associations classified into 15 broad floristic formations. Presence of the 'Coolibah-lignum flats: Eucalyptus victrix over Muehlenbeckia florulenta community' Priority Ecological Community (PEC) (Sub-types 1 and 3).	16 Priority flora were recorded. <i>Acacia bromilowiana</i> (Priority 2), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Aristida lazaridis</i> (P2), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3), <i>Goodenia lyrata</i> (P3), <i>Indigofera gilesii</i> (P3), <i>Oxalis</i> sp. Pilbara (P3), <i>Rhagodia</i> sp. Hamersley (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3), <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 4), <i>Swainsona thompsoniana</i> (P3), <i>Themeda</i> sp. Hamersley Station, (P3), <i>Triodia karjini</i> (P2) and <i>Triodia</i> sp. Mt Ella (P3) and <i>Vittadinia</i> sp. Coondewanna Flats (P3).	16 introduced species were recorded, none listed as a Declared Pest under the BAM Act	Not attached
Level 2 Flora and Vegetation Survey South Flank (Onshore 2012)	Two season detailed	220 quadrats	March, April, May and September 2010 June 2011	Poor/Very Good	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	34 vegetation associations classified into 16 broad floristic formations. Presence of the 'Coolibah-lignum flats: Eucalyptus victrix over Muehlenbeckia florulenta community' Priority Ecological Community (PEC) (Sub-types 1 and 3).	12 Priority flora were recorded: <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Sida</i> sp. Barlee Range (S van Leeuwen 1642) (P4), <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3), <i>Aristida lazaridis</i> (P2), <i>Pilbara trudgenii</i> (P2), <i>Dampiera metallorum</i> (P3), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3), <i>Triodia</i> sp. Mt. Ella (ME Trudgen 12739) (P3), <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3), <i>Ptilotus mollis</i> (P4) and <i>Acacia bromilowiana</i> (P4).	Eight introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Southern Flank to Jinidi Level 2 Flora and Vegetation Survey (Biota 2012b)	Two season detailed	67 quadrats and 8 releves	March and April 2011 August 2011	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	35 vegetation associations classified into 12 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs.	Seven Priority flora were recorded: <i>Grevillea saxicola</i> (P3); <i>Acacia subtiliformis</i> (Priority 3); <i>Goodenia lyrata</i> (Priority 3); <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (Priority 3); <i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3); <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4); and <i>Ptilotus mollis</i> (Priority 4).	Fifteen introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Flora and Vegetation Review, Yandi ML 270SA (Onshore 2011a)	Targeted/review of vegetation mapping	115 releves	9-16 December 2010	Not stated	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	24 vegetation associations classified into 12 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority flora were recorded; <i>Lepidium catapycnon</i> (P4), <i>Acacia subtiliformis</i> (P3) and <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	14 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C to Yandi Flora and Vegetation Survey (Astron 2010)	Single season detailed	20 quadrats and seven releves	September 2010	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	13 vegetation associations classified into 5 broad floristic formations None aligned with Federal or State listed TECs or State listed PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa was recorded; <i>Acacia bromilowiana</i> (P4).	21 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Flora and Vegetation Survey, Area C and Surrounds (Onshore 2011)	Two season detailed	510 quadrats	November and December 2009 February and June 2010	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	37 vegetation associations classified into 11 broad floristic formations None aligned with Federal or State listed TECs. One State listed PEC occurs: the Weeli Wolli Spring Community (P1).	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. 13 Priority flora taxa were recorded; <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (Priority 3); <i>Aristida lazaridis</i> (Priority 2); <i>Stylidium weeliwolli</i> (Priority 2); <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 3); <i>Acacia subtiliformis</i> (Priority 3); <i>Euphorbia inappendiculata</i> (Priority3); <i>Fimbristylis sieberiana</i> (Priority 3); <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (Priority 3); <i>Nicotiana umbratica</i> (Priority 3); <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (Priority 3); <i>Rostellularia adscendens</i> var. <i>latifolia</i> (Priority 3); <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 4); <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4).	11 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Camp Hill Flora and Vegetation Survey Report and Fauna Assessment (Onshore and Biologic 2011)	Single season detailed	138 quadrats	August 2010	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	28 vegetation associations classified into 13 broad floristic formations None aligned with Federal or State listed TECs or PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Five Priority flora taxa were recorded; <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (Priority 3); <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (Priority 3); <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (Priority 3); <i>Acacia bromilowiana</i> (Priority 4) and <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority4).	Seven introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Jinayri to Area C Access Corridor Flora and Vegetation Assessment (ENV 2010a)	Single season detailed	42 quadrats and 3 releves	May 2009	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	10 vegetation associations were mapped None aligned with Federal or State listed TECs. The majority of vegetation association 3a, the Eucalyptus Open Woodland, represents the Priority 1 Weeli Wolli Spring PEC. The remainder of vegetation association 3a is within the buffer of the community.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority Flora were recorded within the project area; <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3), <i>Acacia subtiliformis</i> (P3) and <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3).	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Coondewanna Flats Flora and Vegetation Assessment (Astron 2011)	Two season detailed	40 quadrats and 3 releves	September 2010 May 2011	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	17 vegetation associations classified into 10 broad floristic formations None aligned with Federal or State listed TECs. Vegetation associations matching the two sub-types of the Priority Ecological Community (PEC): Coolibah-lignum flats: <i>Eucalyptus victrix</i> over <i>Muehlenbeckia florulenta</i> were recorded in the Survey Area.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority Flora were recorded within the project area: <i>Aristida lazardis</i> (P2), <i>Rhagodia</i> sp. Hamersley (M.Trudgen 17794) (P3) and <i>Themeda</i> sp Hamersley Station (M.E. Trudgen 11431) (P3).	Six introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Packsaddle West Flora and Vegetation Survey and Fauna Assessment (Astron 2010)	Single season detailed	120 quadrats and 8 releves	April and May 2010	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	27 vegetation associations classified into 10 broad floristic formations None aligned with Federal or State listed TECs. The buffer zone of one Priority Ecological community: 'Coolibah and mulga (Acacia aneura) woodland over lignum and tussock grasses on clay plains' was noted in the southeastern corner of the Survey Area, totalling 5.5 ha.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority species were recorded during the current survey; <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Rhagodia</i> sp. Hamersley (P3), and <i>Aristida jerichoensis</i> var. <i>subsp inulifera</i> (P3).	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
South Flank NVCP Extension Flora, Vegetation and Fauna Assessment (ENV 2010b)	Single season detailed	41 quadrats and 1 releve	November 2009	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	14 vegetation associations classified into 4 broad floristic formations None aligned with Federal or State listed TECs. The Coolibah lignum Flats (Priority 3) PEC was recorded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority Flora species, <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (Priority 3) was recorded.	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Newman to Yandi Transmission Line Flora and Vegetation Assessment (ENV 2009b)	Single season detailed	150 quadrats 29 releves	5-15 May 2009	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	30 vegetation associations classified into 13 broad floristic formations	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Four Priority flora were recorded; <i>Goodenia</i> sp. East Pilbara (P3), <i>Euphorbia australis</i> var. <i>glabra</i> (P3), <i>Acacia subtiliformis</i> (P3), <i>Rhagodia</i> sp. Hamersley (P3),	14 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Minsters North Exploration lease Flora and Vegetation Assessment (ENV 2009a)	Single season detailed	65 quadrats	September 2007	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Five vegetation associations None aligned with Federal or State listed TECs or PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority Flora species was recorded in the survey area: <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 4).	Three introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C Deposit A, D, P1 and P3 Flora and Vegetation Assessment (Woodman 2009)	Two season detailed	62 quadrats	April, May and June 2008	Not stated	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	15 floristic communities None aligned with Federal or State listed TECs or PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority flora were recorded: <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3), <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3).	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Flora and Vegetation on the Hope Downs 4 Mine Infrastructure Corridor (Mattiske 2008)	Two season detailed	139 quadrats	April, May and September 2008	Optimal	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	25 plant communities None aligned with Federal or State listed TECs . The C4 community is similar to the Department of Environment and Conservation Priority Ecological Community “Weeli Wolli Spring Community” (Priority 1).	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. <i>Rhagodia</i> sp. Hamersley (M.E. Trudgen 17794), Priority 3, <i>Stylidium weeliwolli</i> , Priority 3, <i>Eremophila youngii</i> subsp. <i>lepidota</i> , Priority 4, <i>Eremophila forrestii</i> subsp. <i>viridis</i> , Priority 3	Nine introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Field Survey for Priority and Rare Flora - Area C South Flank (Pilbara Flora 2008)	Targeted	Not applicable	May 2008	Good	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Not applicable	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One priority species was recorded: <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4)	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Summary of important findings from Rapid Growth Project 5 Railway Project - Biological Assessments (ENV 2008b)	Single season detailed	141 quadrats 18 releves	15-23 April 2008	Not stated	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Not defined (preliminary summary report)	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora was recorded; <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3).	Ten introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Two Phase Assessment of the Flora and Vegetation of the Proposed Marillana Creek (Yandi) Mine Extension Areas RGP5-KBR (BHP Billiton 2008)	Two season detailed	119 quadrats	13-19 November 2007 10-17 March 2008	Good	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Ten vegetation associations	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Ten introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C South Flank Deposit Flora and Vegetation Assessment (ENV 2008a)	Single season detailed	109 quadrats	November and December 2007	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	29 vegetation associations in eight landform categories None aligned with Federal or State listed TECs or PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Two Priority species were recorded: <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (Priority 4), <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4).	Three introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Yandi Mine Extension RGP5 - EIA Flora Survey Interim Report Post Phase 1 Survey (Ecologia 2007)	Two season detailed	60 quadrats	13-20 November 2007 March 2008	Not stated	Not stated	Interim report – associations not defined at time of reporting	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C Deposit R Flora and Vegetation Assessment (ENV 2007)	Single season detailed	72 quadrats	October 2006	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002) Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to the Agricultural Area, Position Statement No. 2 (EPA 2000)	Not stated, no TECs or PECs present	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority species were recorded: <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (Priority 4).	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Minsters North Biological Survey (ecologia 2006)	Reconnaissance	Not applicable	May 2006	Excellent	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Three main vegetation types and two sub-types	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Three introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C Packsaddle Wastewater treatment Plant Flora and Vegetation Assessment (ecologia 2005)	Reconnaissance	Not applicable	July 2005	Not stated	Not stated	Two vegetation complexes	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C Deposits D, E and F Biological Survey (ecologia 2004a)	Two season detailed	35 quadrats	May and October 2004	Optimal	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Eight vegetation types	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Area C Packsaddle Range Biological Survey (ecologia 2004b)	Single season detailed	Not stated	April and May 2004	Optimal	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004a)	Seven vegetation associations	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Flora and Vegetation Survey Lease M47/292 and E4 Drill Lines (Maunsell 2004)	Single season detailed	Not stated	15-16 December 2003	Poor	Survey undertaken prior to EPA guidelines being available	Seven vegetation associations	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Not stated	Not attached
Yandi Life of Mine Flora and Fauna (Maunsell 2003)	Targeted	Not applicable	23-28 September 2003	Not stated	Survey undertaken prior to EPA guidelines being available	Not applicable	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
IOWA Conveyor: Amendment to Rare and Priority Flora Survey (ecologia 2003)	Targeted	Not applicable	8 August 2003	Not reported	Survey undertaken prior to EPA guidelines being available	Not applicable	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Not reported	Not attached
Mining Area C Rail Corridor Rare Flora Survey (Biota 2002)	Targeted	Not applicable	12-18 November 2001	Poor	Survey undertaken prior to EPA guidelines being available	Not applicable	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Not reported	Not attached
Mining Area C Rail Corridor Seasonal Rare Flora Survey Phase 2 (Biota 2003)	Targeted	Not applicable	21-31 March 2002	Good	Survey undertaken prior to EPA guidelines being available	Not applicable	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Not reported	Not attached
Mining Area C Packsaddle Village and Access Road Rare and Priority Flora Survey (ecologia 2002)	Targeted	Not applicable	March 2002	Not stated	Survey undertaken prior to EPA guidelines being available	Not applicable	No plant taxa gazetted as Threatened or Priority Flora pursuant to the BC Act or listed under EPBC Act.	Not reported	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora ²²	Introduced Flora	Appendix
Mining Area C to yandi Rail Line Baseline Weed Survey (Ecologia 2001)	Weed survey	Not applicable	16-17 October 2001	Not stated	Survey undertaken prior to EPA guidelines being available	Not applicable	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Marillana Creek Western Access Corridor - Biological Assessment (Halpern Glick Maunsell 1999)	Single season detailed	22 quadrats	23-30 April 1999	Not stated	Survey undertaken prior to EPA guidelines being available	25 vegetation associations	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Yandi Vegetation and Soil Survey (Ecologia 1998b)	Single season detailed	32 detailed sites plus supplementary transects	27 May-1 June 1998	Poor	Survey undertaken prior to EPA guidelines being available	Fourteen vegetation associations	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Seven introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Mining Area C Biological Survey (ecologia 1998a)	Single season detailed	132 detailed flora sites	April and May 1997	Optimal	Survey undertaken prior to EPA guidelines being available	15 units within four major landforms	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora was recorded: <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4).	Six introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Appendix 10 Flora and Vegetation survey reports

The following studies undertaken to support the assessment of Flora and Vegetation for the Proposal are provided:

1. Central Pilbara Hub Detailed and Targeted Flora Survey (Biologic 2024a)
2. Ministers North Targeted Significant Flora and Vegetation Assessment (Spectrum 2023)
3. Targeted Flora Surveys of Pipeline Corridors (GHD 2022)
4. Ministers North and Yandi Vegetation Association and Condition Mapping (Onshore 2020)
5. Ministers North Miscellaneous Licence Area Amendment Surveys and Yandicoogina Creek Detailed Flora and Vegetation Assessment (Biologic 2020a)
6. Runaway Valley Baseline Vegetation Monitoring Survey (Astron 2020)
7. Area C West to Yandi Flora and Vegetation Assessment (Astron 2019)
8. Consolidation of Regional Vegetation Mapping, BHP Billiton Iron Ore Pilbara Tenure (Onshore 2014a)

Appendix 11 Summary of Terrestrial Fauna studies and surveys

Table A10 presents a summary of Terrestrial Fauna information used in the assessment of the Project.

Table A10: Summary of Terrestrial Fauna studies and surveys

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Vertebrate fauna studies						
Mining Area C Biological Survey (Ecologia 1998a)	Detailed (Level 2)	Trapping, active searching, nocturnal searches, bird census, opportunistic sightings and mist site (bats) collections	Apr 1997	Survey undertaken prior to EPA guidelines being available	Six fauna habitats recorded: Mulga Woodland, Gully systems and Gorge and Creekline bases, Detrital Slopes: Ridges and Hill tops, Outwash and Acacia Shrubland	Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)
Marillana Creek Western Access Corridor - Biological Assessment (Maunsell 1999)	Basic (Level 1)	Active searching, nocturnal searches, bird census, opportunistic sightings	Apr 1999	Survey undertaken prior to EPA guidelines being available	Five fauna habitats mapped including: Riverine, Minor Drainage, Outwash Plains, Mulga Woodland and Hills and Ridges	Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)
Area C Deposits D, E and F Biological Survey (ecologia 2004a)	Detailed (Level 2)	Trapping, opportunistic searching and bird censuses	May – Jun 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Five fauna habitats were mapped: Eucalypt woodland, Mallee woodland, Mulga woodland, Gorges, and Gullies/Major Drainage Lines.	Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Marillana Creek (Yandi) Iron Ore Mine Modification Level 2 Fauna Survey (Ecologia 2008)	Detailed (Level 2)	Trapping (funnel, Elliot, cage), bird census, opportunistic searches, bat recordings, nocturnal searches	Mar 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Fauna habitats included Minor Drainage Line, Hillslope, Outwash Plain and Open Plain.	One Priority fauna species was recorded: Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4).
Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Terrestrial Vertebrate Fauna Assessment (Outback Ecology 2008b)	Detailed (Level 2)	Trapping, transect searches, bird census, nocturnal surveys,	Mar 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Broad habitats mapped include: Eucalypt woodland on drainage line or valley plain, open gully, rocky gorge, mixed Acacia woodland and hill crest.	Pilbara Leaf-nosed Bat (<i>Rhinonictis aurantia</i> ; Vu; Vu) Fork-tailed Swift (<i>Apus pacificus</i> ; Mi; Mi) Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits: Bat Survey and Assessment (Specialised Zoological 2008)	Targeted	Bat survey (ANABAT, SD-1), harp traps and cave assessment	Apr 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Not mapped	None recorded
Newman to Yandi Transmission Line Terrestrial Vertebrate Fauna Assessment (ENV 2009c)	Basic (Level 1)	Diurnal fauna searches, nocturnal searches, bird census, bat calls (ANABAT), and opportunistic observations	May 2009	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Seven fauna habitat types were identified including Alluvial Plain, Scree/Low Hills, Riverine, Stony Plain, Gorge/Gully, Minor Drainage Line, and Hill Crest	Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Area C to Jinayri to Mount Newman Railway Terrestrial Vertebrate Fauna Survey (Outback Ecology 2010)	Detailed (Level 2)	Trapping, targeted transect searches, spotlighting, bird census, bat calls (ANABAT), and opportunistic observations	Oct – Nov 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Eight fauna habitat types mapped: Mulga Woodland, Sand Plain, Drainage Line, Alluvial Flood Plain, Stony Plain, Rocky Ridge/Gorge, Hill Crest/Slope and Riverine	Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Gane's Blind Snake (<i>Anilius ganei</i> ; P1) Osprey (<i>Pandion haliaetus</i> ; Mi; Mi) Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)
East Packsaddle Level 1 Vertebrate Fauna Study (Biologic 2010)	Basic (Level 1)	Trapping, opportunistic searches and targeted fauna survey techniques	October 2009 Mar - Apr 2010	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Seven major fauna habitats were identified within the study area: Mulga Association, Major Drainage Line, Drainage Area, Crest/Slope, Gorge/Gully, Valley and Calcrete Plain and Sandplain.	Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> , P4) Peregrine Falcon (<i>Falco peregrines</i> ; OS) Eastern Great Egret (<i>Ardea modesta</i> ; Mi; Mi) Eastern Osprey (<i>Pandion cristatus</i> ; Mi; Mi)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Camp Hill Exploration Leases Level 2 Flora & Vegetation Survey and Level 1 Fauna Assessment (Onshore and Biologic 2011)	Basic (Level 1)	Survey transects, bird census, bat survey (ANABAT), opportunistic observations, burrow excavation (scorpions and spiders)	Aug 2010	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Eight broad habitat types were mapped: Basalt Gilgai Rocky Plain, Basalt Low Hills, Gorge, Hardpan Plain, Hilltop and Hillslope, Medium Drainage Area, Mulga association and Sandy / Stony plain	Northern Quoll (<i>Dasyurus hallucatus</i> ; En; En) Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Pilbara Leaf-nosed Bat (<i>Rhinonictis aurantia</i> ; Vu; Vu) Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4)
Area C and Surrounds Vertebrate Fauna Survey (Biologic 2011a)	Detailed (Level 2)	Trapping, bird census, bat survey (ANABAT), motion cameras, hair funnels, opportunistic observations, nocturnal surveys and targeted transect searches	Oct 2009 Mar 2010	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Mulga Association, Major Drainage Line, Drainage Area, Crest/Slope, Gorge/Gully, Valley, Calcrete Plain and Sandplain	Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4) Fork-tailed Swift (<i>Apus pacificus</i> ; Mi; Mi) Peregrine Falcon (<i>Falco peregrinus</i> ; OS), Gane's blind snake (<i>Anilius ganei</i> ; P1) Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i> ; P2)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Area C to Yandi Fauna Survey (Biologic 2011b)	Basic (Level 1) and Targeted	Motion cameras, bird census, bat surveys (ANABAT), targeted transect searches and opportunistic observations	Sept 2010	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Five major fauna habitat types were mapped: Gorge, Major Drainage Line, Valley (within both Ironstone and Basalt geology), Minor Drainage Line and Hilltop and Slopes	Western Pebble-mound mouse (<i>Pseudomys chapmani</i> ; P4)
Southern Flank Vertebrate Fauna Study (Biologic 2011c)	Detailed (Level 2)	Trapping, opportunistic searches, motion cameras, hair traps, bird census, bat recordings (ANABAT) and nocturnal surveys	Aug-Sept 2011	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Mulga, Major Drainage Line, Hilltop/Slopes, Gorge/Gully, Valley, Sandy Areas, Mixed Shrub, Spinifex on Gravelly Plain and Coolibah-Lignum	Northern Quoll (<i>Dasyurus hallucatus</i> ; En; En) Pilbara Leaf-nosed Bat (<i>Rhinonicteris aurantius</i> ; Vu). Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4) Peregrine Falcon (<i>Falco peregrinus</i> ; OS), Gane's blind snake (<i>Anilius ganei</i> ; P1) Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i> ; P2)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
South Flank to Jinidi Level 2 Vertebrate Fauna Survey (Biota 2012a)	Detailed (Level 2)	Traps, nocturnal searches & road spotting, active foraging, targeted searches, ultrasonic recorders and Harp traps, bird census and opportunistic observations	April 2011 November 2011 February 2012	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Hilly areas, Calcrete plain, Creeks with shrubland and/or hummock grasslands, Mulga plains, Stony plains, Major creeks with eucalypt woodland and Rocky gullies and gorges	Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i> ; P2) Western Pebble-mound mouse (<i>Pseudomys chapmani</i> ; P4)
Area C West Vertebrate Survey (Biologic 2013a)	Detailed (Level 2) and targeted survey	Trapping (funnel, Elliott and cage), nocturnal searches & road spotting, active foraging, targeted searches, ultrasonic recorders, bird census, motion cameras, opportunistic observations.	April/May 2011 September/October 2011 January 2012	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Basalt Gilgi Rocky Plains, Basalt Low Hills, Coolibah-Lignum, Drainage Area, Crest/ Slope, Gorge/ Gully, Major Drainage Line, Sandy/Stony Plains, Hardpan Plains, Mulga Associations; and Valley	Northern Quoll (<i>Dasyurus hallucatus</i> ; En; En) Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Pilbara Olive Python (<i>Liasis olivaceus barroni</i> ; Vu; Vu) Wood Sandpiper (<i>Tringa glareola</i> ; Mi; Mi) Western Pebble-mound mouse (<i>Pseudomys chapmani</i> ; P4) Short-tailed Mouse (<i>Leggadina lakedownensis</i> ; P4) Peregrine Falcon (<i>Falco peregrinus</i> ; OS)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Area C West to Yandi Level 2 Vertebrate Fauna Survey (Biota 2013b)	Detailed (Level 2)	Trapping, bird census, diurnal searches, bat survey (ANABAT, SM2 and Harp traps), nocturnal survey, active foraging and opportunistic observations	May – Jun 2011 Sept 2011 Feb 2012	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Seven fauna habitats were identified including: Rocky free faces and gorges, Stony and loamy plains, Major creeks, Hilly areas, Minor creeks, Calcrete plains and Mulga plains	Pilbara Leaf-nosed Bat (<i>Rhinonicteris aurantius</i> ; Vu). Western Pebble-mound Mouse (<i>Pseudomys chapmani</i> ; P4). Common Greenshank (<i>Tringa nebularia</i>). Peregrine Falcon (<i>Falco peregrinus</i> ; OS).
Mudlark Vertebrate Fauna Survey (Biologic 2013c)	Detailed (Level 2)	Trapping, targeted transect searches, bird census, bat survey (SM2), motion cameras, active foraging, nocturnal surveys and opportunistic observations	May-Jul 2011 Oct 2011 May 2012 Jan 2012	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Five broad fauna habitats were identified: Crest/ Slope, Gorge/ Gully, Major Drainage Line, Stony Plain, and Mulga	Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Pilbara Olive Python (<i>Liasis olivaceus barroni</i> ; Vu; Vu) Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i> ; P2) Western Pebble-mound mouse (<i>Pseudomys chapmani</i> ; P4)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
South Flank Targeted Northern Quoll Survey (Biologic 2013d)	Targeted survey	Trapping (cage and Elliot), motion cameras and targeted searches	Jun – July 2012 July 2012	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	N/A	Northern Quoll (<i>Dasyurus hallucatus</i> ; En; En) Ghost Bat (<i>Macroderma gigas</i> ; Vu; Vu) Pilbara Olive Python (<i>Liasis olivaceus barroni</i> ; Vu; Vu)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Mining Area C – Desktop Review of Baseline Information on Vertebrate Fauna (Biologic 2013b)	Desktop	N/A	Jan 2014	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Eight broad fauna habitats were identified within the Study Area: Drainage Area, Crest/ Slope, Gorge/ Gully, Major Drainage Line, Stony/ Sand Plains, Sand Plains, Mulga Associations and Valley	Northern Quoll (<i>Dasyurus hallucatus</i>; En; En) Ghost Bat (<i>Macroderma gigas</i>; Vu; Vu) Pilbara Leaf-nosed Bat (<i>Rhinioncteris aurantius</i>; Vu). Grey Falcon (<i>Falco hypoleucos</i>; Vu; Vu) Pilbara Olive Python (<i>Liasis olivaceus barroni</i>; Vu; Vu) Gane's blind snake (<i>Anilius ganei</i>; P1) Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i>; P1) Western Pebble-mound mouse (<i>Pseudomys chapmani</i>; P4) Peregrine Falcon (<i>Falco peregrinus</i>; OS)

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Consolidated Fauna Habitat Mapping (Biologic 2014)	Desktop	Not applicable	2014 2018	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	15 fauna habitat types were mapped within the Development Envelope: Breakaway/ Cliff, Drainage Area/ Floodplain, Gilgai Plain, Gorge/ Gully, Hardpan Plain, Hillcrest/ Hillslope, Major Drainage Line, Medium Drainage Line, Minor Drainage Line, Mulga Woodland, Sand Plain, Sandy/Stony Plain, Stony Plain, Wetland	Not applicable
South Flank Targeted Fauna Survey (Biologic 2016b)	Targeted	Targeted searches, nocturnal surveys and motion cameras	Nov 2015 Dec 2015	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	N/A	None recorded

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Ministers North to Yandi Corridor Single Phase Level 2 Fauna and Detailed Flora/Vegetation Survey (Biologic 2017b)	Basic (Level 1)	Motion cameras, bat survey (Five SM2), bird census (SM4) and opportunistic observations	October 2017	Technical Guidance Terrestrial Fauna Surveys (EPA 2016) Technical Guidance Sampling methods for Terrestrial vertebrate fauna (EPA 2016e)	Seven fauna habitats were identified within the Study Area: Basalt Outcrop, Breakaway/Climb, Gorge/ Gully, Hillcrest/ Hillslope, Major Drainage Line, Minor Drainage Line and Drainage Area/ Floodplain	Western Pebble-mound mouse (<i>Pseudomys chapmani</i> ; P4)
Ministers North level 2 vertebrate fauna survey (Biologic 2017a)	Detailed (Level 2)	Targeted and nocturnal searches, trapping, bat survey (SM2), motion cameras and opportunistic sightings	Oct 2016 Apr 2017	Technical Guidance Terrestrial Fauna Surveys (EPA 2016) Technical Guidance Sampling methods for Terrestrial vertebrate fauna (EPA 2016e)	Gorge/Gully, Hillcrests/slopes, Major Drainage Line and Minor Drainage Line	Western Pebble-mound mouse (<i>Pseudomys chapmani</i> ; P4)
SRE invertebrate fauna studies						
Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits Terrestrial Invertebrate Short-range Endemic Assessment (Outback Ecology 2008a)	Detailed (Level 2)	Habitat assessments, dry pit trapping, and hand searching/active foraging	Apr 2008 Jun 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Habit types with highest potential to support SREs include south facing ridges, gorges, rocky outcrops, and gullies	Three potential SRE species: the mygalomorph spiders <i>Synothele</i> sp and <i>Aname</i> sp; and the millipede <i>Antichiropus</i> sp. nov. 'Area C'.

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Area C Mine Short-range Endemic Habitat Assessment (Outback Ecology 2009)	Basic (Level 1)	Habitat assessment, burrow excavation	Apr - May 2009	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004)	Gullies and gorges at the eastern end of Packsaddle Range; south-facing ridges and slopes of the Packsaddle Range; and south-facing and east-facing ridges and slopes on the Jirralpur Range.	None reported
Area C and Surrounds Short Range Endemic Invertebrate Fauna Survey (Biota 2011a)	Detailed (Level 2)	Habitat assessments, wet pit trapping, and hand searching/active foraging	Feb 2010 Jun 2010	Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna (EPA 2009)	Habitat types found to support potential SRE taxa included Mulga woodland, hills and ridges, gullies and gorges, major creeks/drainages, broad valleys and flood plains	Seven potential SREs were recorded: the mygalomorph spiders <i>Aname</i> 'MYG104', <i>Aname</i> 'MYG195', <i>Aname</i> 'MYG197'; the millipedes <i>Antichiropus</i> 'Area C sp. 2' and Gen 'indet.' sp. 'indet.'; the pseudoscorpion <i>Synsphyronus</i> 'long hand 2'; and the scorpion <i>Urodacus</i> 'firetail'.
Short Range Endemic Invertebrate Fauna Survey - South Flank (Biota 2011b)	Detailed (Level 2)	Habitat assessments, wet pit trapping, and hand foraging	Feb 2010 Aug 2010	Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna (EPA 2009)	Habitat types found to support potential SRE taxa included rocky gullies and slopes, Mulga plains and drainage lines	Four potential SREs were recorded: the mygalomorph spider <i>Aname</i> 'MYG195', the millipedes <i>Antichiropus</i> 'Area C sp. 2' and Gen 'indet.' sp. 'indet.' and the scorpion <i>Urodacus</i> 'firetail'

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
A Survey of the Short Range Endemic Invertebrate Fauna of South Flank to Jinidi (Biota 2013a)	Detailed (Level 2)	Habitat assessments, dry pit trapping, and hand searching/active foraging	Apr 2011 Nov 2011 Jan – Feb 2012	Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna (EPA 2009)	Stony hills, Calcrete plains, Creeks with shrubland and/or hummock grasslands, Mulga plains, Stony and loamy plains, Major creeks with eucalypt woodland, Gorges and breakaways	11 Potential SREs: Barychelid sp. 'B1', Ctenizid sp. 'C1', Idiopid sp. 'I1', Idiopid sp. 'I2', Idiopid sp. 'I4', Idiopid sp. 'I6', Nemesiid sp. 'N30', Nemesiid sp. 'N34', Nemesiid sp. 'N36', Nemesiid sp. 'N63', Nemesiid sp. 'N64' One Unknown SRE: Beierolpium sp.
South Flank Targeted Millipede Survey (Biota 2013c)	Targeted	Wet pit trapping	Apr – May 2012	Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna (EPA 2009)	Habitat mapping not undertaken	None recorded
A Survey of the Short Range Endemic Invertebrate Fauna of Area C West to Yandi (Biota 2014)	Detailed (Level 2)	Habitat assessment, Pitfall trapping, Funnel trapping, targeted searches, active foraging, leaf litter and soil sifting	May - June 2011 Sept 2011 Feb 2012	Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna (EPA 2009)	Seven broad SRE invertebrate fauna habitat types were recorded: Rocky Free Faces and Gorges, Stony and Loamy Plains, Major Creeks, Hilly Areas, Minor Creeks, Calcrete Plain, Mulga Plains	10 potential SRE taxa (all mygalomorph spiders) including: Barychelid sp. 'B2', Barychelid sp. 'B20', Ctenizid sp. 'C2', Ctenizid sp. 'C11', Nemesiid sp. 'N36', Nemesiid sp. 'N39', Nemesiid sp. 'N41', Nemesiid sp. 'N47', Nemesiid sp. 'N52', and Nemesiid sp. 'N53'.

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Ministers North Short-range Endemic Invertebrate Survey (Biologic 2016a)	Detailed (Level 2)	Habitat assessment, active foraging, leaf litter and soil sifting, and targeted searches for burrows.	Mar – Apr 2015 Aug – Sept 2015	Guidance Statement No. 20 'Sampling of Short Range Endemic Fauna (EPA 2009)	Gorge/ Deep Gully, Shallow Gully, Ridge/ Breakaway, Boulder Pile/ Tor, Hillslope/Footslope, Drainage Foci, Drainage Line, and Stony Plain	Eight Potential SRE taxa were recorded: Karaops sp. 'indet.' (a selenopid spider); Barychelidae sp. 'indet.' (a mygalomorph spider); Lychas 'hairy tail grp' (a scorpion); Buddelundia '49' and Philosciidae sp. 'indet.' (isopods); Chilenophilidae sp. 'indet.' and Australoschendyla sp. 'indet.' (geophilomorph centipedes); and Cryptops sp. 'indet.' (a scolopendromorph centipede).
Aquatic fauna						
Yandi: Marillana Creek Aquatic Fauna Survey Wet & Dry 2017 Sampling (Wetland Resource Management [WRM] 2018)	Baseline	Habitat characterisation and sampling of water quality, microinvertebrates (zooplankton), hyporheic fauna, macroinvertebrates, fish and opportunistic observations for other aquatic vertebrates (frogs and turtles).	May 2017 (wet season) Sept 2017 (dry season)	Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002) Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004) Guidance Statement No. 20 'Sampling of	Sites were generally dominated by transmissive gravel and sand substrates and characterised by submerged macrophyte and algal habitats. Sites MC1 and MC2 are semi-permanent to permanent water pools.	Five stygal SREs were recorded: amphipods Paramelitidae sp. B, Paramelitidae sp. D and Chydaekata sp.; the isopod <i>Pygolabis weeliwolli</i> , and the ostracod <i>Gomphodella</i> n. sp. (BOS334) Three freshwater fish species were recorded: the Western Rainbowfish (<i>Melanotaenia australis</i>), Spangled Perch (<i>Leiopotherapon unicolor</i>) and Pilbara Tandan (<i>Neosilurus</i> sp.).

Title/ Reference	Survey Level*	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna Recorded
Yandi Aquatic Fauna Survey: Wet & Dry Season Sampling 2014 (WRM 2015)	Baseline	Habitat characterisation and sampling of water quality, microinvertebrates (zooplankton), hyporheic fauna, macroinvertebrates, fish and opportunistic observations for other aquatic vertebrates (frogs and turtles).	April 2014 (wet season) Sept 2014 (dry season)	Short Range Endemic Fauna (EPA 2009) ANZECC & ARMCANZ (2000) - default guidelines used for water quality		Aquatic invertebrates of significance included stygal and potential SREs, and ICUN listed damselflies and dragonflies. Three freshwater fish species were recorded: the Western Rainbowfish (<i>Melanotaenia australis</i>), Spangled Perch (<i>Leiopotherapon unicolor</i>) and Pilbara Tandan (<i>Neosilurus</i> sp.).
Lake Robinson Aquatic Invertebrate Fauna and Water Quality Surveys (WRM 2013b)	Baseline	Three sites were sampled within Lake Robinson. Methods included taking water quality samples, sediment collection and rehydration, and net sweeping for invertebrates.	March 2011 January 2012		Ephemeral waterbody	No significant invertebrate fauna recorded.
WRM (2013) Jinidi Baseline Aquatic Surveys: Wet 2011, Dry 2011 and Wet 2012 (WRM 2013a)	Baseline	Sites were sampled including sites at Weeli Wolli Springs, reference sites and Jinidi sites.	May 2011 (wet season) September 2011 (dry season) May 2012 (wet season)		Permanent and semi-permanent waterbodies Riparian vegetation	Aquatic invertebrates of significance included stygal species and potential SREs and ICUN listed dragonflies and damselflies.

Appendix 12 Terrestrial Fauna survey reports

The following studies undertaken to support the assessment of Terrestrial Fauna for the Proposal are provided:

1. Central Pilbara Hub Stage 2 Targeted MNES Vertebrate Fauna Survey (Biologic 2025a)
2. CPH Targeted Matters of National Environmental Significance Vertebrate Fauna Survey (Biologic 2023a)
3. Targeted Pilbara Olive Python Survey: South Flank and Mining Area C (Biologic 2023d)
4. Yandi 45C Targeted Significant Vertebrate Fauna Survey (Astron 2023)
5. MAC Phase 4 Marillana Creek Targeted MNES Fauna Survey (Biota 2022)
6. Ministers North Level 1 Fauna Survey (GHD 2021)
7. MAC4 Pipeline Level 1 Vertebrate Fauna Assessment (Biologic 2019a)
8. Ministers North SRE Invertebrate Fauna Desktop and Field Survey (Bennelongia 2024a)
9. Yandi Operations Short-Range Endemic Fauna Survey Report (Bennelongia 2024c)
10. Ministers North and Yandicoogina Creek Short-Range Endemic Invertebrate Fauna Survey (Biologic 2021)
11. Ministers North Yandicoogina Creek Aquatic Ecosystem Survey Dry 2022 and Wet 2023 (Biologic 2024c)
12. MAC Phase 4: Aquatic monitoring Dry 2022 and Wet 2023 (Biologic 2024b)
13. Weeli Wolli Spring: Aquatic Monitoring 2021 (Biologic 2023h)
14. Weeli Wolli Spring: Aquatic Monitoring Wet and Dry 2022 (Biologic 2024d).

The following studies undertaken to support the assessment of Terrestrial Fauna for the Proposal are currently in preparation and will be provided when available:

1. Ministers North Targeted Significant Vertebrate Fauna Survey (Astron 2025 *in prep*)
2. Pineapple Hill and Runaway Valley North Detailed SRE Survey (Biota 2025 *in prep*)

Appendix 13 Terrestrial Fauna likelihood of occurrence

Table A13 presents the likelihood of occurrence assessment for conservation significant fauna in the Development Envelope.

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Fauna recorded within the Development Envelope				
Northern Quoll (<i>Dasyurus hallucatus</i>)	En	En	Rocky habitats which provide diversity of microhabitats, retain water, and provide protection from predators. Gorge/Gully and Breakaway habitats that are cave forming are particularly important for Northern Quoll, as they provide denning sites for breeding and shelter, and diverse microhabitats for foraging.	There are eight records of Northern Quoll within the Development Envelope. In addition, there are almost 500 regional records of Northern Quoll within 20 km of the Development Envelope. The Gorge/ Gully, Breakaway/ Cliff and Major Drainage Line habitats are likely to represent critical habitat whereas the Medium and Minor Drainage Lines are likely to represent supporting habitat.
Ghost Bat (<i>Macroderma gigas</i>)	Vu	Vu	Ghost Bats roost in deep, complex caves that provide diurnal and nocturnal roost with stable temperature and humidity, and good foraging opportunities, typically within 2 km of diurnal roosts.	There are at least 289 records of the Ghost bat in the Development Envelope. In addition, there are over 460 regional records of the species within 12 km of the Development Envelope. Stony Plain, Drainage Area/ Floodplain, Mulga Woodland, Minor Drainage Line, Medium Drainage Line, and Major Drainage Line Within the Study Area, provide critical foraging habitat whereas Undulating Low Hills and Gorge/ Gully habitats provide supporting foraging and dispersal habitat.
Pilbara Leaf-nosed Bat (<i>Rhinonicteris aurantius</i>)	Vu	Vu	Roosts in deep, warm, humid caves or rock cracks near water pools and forages in a range of habitats including along watercourses and over <i>Triodia</i> grasslands.	The Pilbara leaf-nosed bat was recorded at four locations during the recent survey and has historically been recorded three times within the Development Envelope. In addition, at least 34 suitable Category 4 caves are present within the Development Envelope. The Gorge/ Gully, Breakaway/ Cliff and Major Drainage Line habitats represent critical habitat whereas the Stony Plain, Hillcrest/ Hillslope, Drainage Area/ Floodplain, Mulga Woodland, Undulating Low Hills, Minor Drainage Line and Medium Drainage Line all provide supporting habitat for the species.

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Pilbara Olive Python (<i>Liasis olivaceus barroni</i>)	Vu	Vu	Prefers rocky outcrops, escarpments, and gorges, often in close proximity to water holes (including man-made) which attract suitable sized prey species. Microhabitat preferences include rock piles, on top of rocks or underneath spinifex.	The Pilbara Olive Python has been recorded eight times within the Development Envelope including five historical records, one recent eDNA record and one recent scat record, and a direct sighting at the discharge point at Yandi mine. Critical habitat for the species occurs within the Gorge/ Gully, Breakaway/ Cliff and Major Drainage Line habitats whereas Medium Drainage Line is likely to provide supporting habitat.
Grey Falcon (<i>Falco hypoleucos</i>)	-	Vu	Nests in the tall trees along watercourses, as well as in telecommunication towers. Frequents timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined water courses.	There are three historical records of the Grey Falcon within the Development Envelope; however, the species has not recorded during recent surveys. Critical habitat is present within the Major and Medium Drainage Line habitat.
Fork-tailed Swift (<i>Apus pacificus</i>)	Mi	Mi	Is a predominantly airborne species that occurs in low to very high airspace and is mainly independent of terrestrial habitats and landforms.	There are five records of this species within the Development Envelope, four of which occur within the Additional Area. However, given that the species is largely aerial, it is unlikely to depend on any of the terrestrial fauna habitats present in either the Development Envelope or Additional Area.
Gane's blind snake (<i>Anilius ganei</i>)	-	P1	Associated with moist gorges and gullies.	There are four historical records of this species within the Development Envelope; however, it has not been recorded during recent surveys. Suitable habitat is present within the Gorge/Gully and Drainage Area/ Floodplain habitats.
Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i>)	-	P2	Confined to the Hamersley Ranges from Tom Price to Newman and occurs in rocky areas with spinifex and low tree cover.	There are six records of the Pilbara Barking Gecko within the Development Envelope, none of which occur within the Additional Area. Suitable habitat for this species occurs within the Gorge/Gully, Hillcrest/ Hillslope and Minor Drainage Line habitats.

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Western Pebble-mouse (<i>Pseudomys chapmani</i>)	-	P4	Stony hillsides with hummock grassland and shelter in complex burrow systems under a mound which they construct on the surface using pebbles collected in the vicinity.	There are over 158 records of this species within the Development Envelope including 17 records within the Indicative Footprint. The Stony Plain, Undulating Low Hills and Hillcrest/Hillslope habitats provide suitable habitat for this species.
Peregrine Falcon (<i>Falco peregrinus</i>)	n/a	OS	Hunts in any habitat and nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines.	There are three records of this species within the Development Envelope, one of which occurs within the Additional Area. Suitable habitat occurs within the Gorge/ Gully and Drainage Area/ Floodplain habitats; however, there is limited breeding habitat available given the lack of large cliff faces.
<i>Other significant fauna considered unlikely to occur</i>				
Common Sandpiper (<i>Actitis hypoleucos</i>)	Mi	Mi	Prefers wetland habitats with steep shorelines, in particular along mangrove-lined creeks, muddy areas with rocky outcrops, steep sided dams, and sewage ponds.	Has not been recorded in the Development Envelope. There is limited suitable habitat present within the proposed Development Envelope and the closest record is approximately 20 km away.
Common Greenshank (<i>Tringa nebularia</i>)	Mi	Mi	A Migratory wader species generally found in a variety of freshwater, marine and artificial wetlands, including swamps, open muddy or rocky shores of lakes and large rivers, sewage farms, saltworks, muddy coastal flats, mangroves, and estuaries.	Has not been recorded in the Development Envelope. There is limited suitable habitat present within the proposed Development Envelope and the closest record is approximately 20 km away.
Glossy Ibis (<i>Plegadis falcinellus</i>)	Mi	Mi	Inhabits wetlands and freshwater marshes at the edges of lakes, rivers, and wet swamp areas.	Has not been recorded in the Development Envelope. There is limited suitable habitat present within the proposed Development Envelope and the closest record is approximately 20 km away.

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Wood sandpiper (<i>Tringa glareola</i>)	Mi	Mi	Species occurs as a non-breeding summer migrant which occurs throughout the region. Occurs mainly in river pools, sewage ponds, flooded claypans, and shallow, freshwater wetlands, lakes, pools and waterholes.	Has not been recorded in the Development Envelope. There is limited suitable habitat present within the proposed Development Envelope and the closest record is approximately 20 km away.
Night parrot (<i>Pezoporus occidentalis</i>)	En	Cr	Arid and semi-arid areas characterised by dense, low vegetation. Based on accepted records, the habitat consists of <i>Triodia</i> grasslands in stony or sandy environments, of samphire and chenopod shrublands, on floodplains and claypans and margins of salt lakes, creeks, and other water sources	Has not been recorded in the Development Envelope despite extensive, targeted survey effort. There are no nearby regional records with the closest confirmed record being approximately 50 km to the north-east. Whilst there is some suitable habitat present within the Stony Plain and Drainage Area/Floodplain habitats, these areas are often small in size and lack connectivity. There is also a lack of neighbouring ephemeral freshwater sources and foraging habitat (i.e. succulent chenopod shrubs).
Curlew Sandpiper (<i>Calidris ferruginea</i>)	Cr Mi	Cr	Inhabits intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. Also recorded inland, though less often, including ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. Occurs in both fresh and brackish waters.	Has not been recorded within the Development Envelope and there are no known nearby regional records. Some suitable habitat does occur within the Major Drainage Line and Medium Drainage habitats; however, the species is more commonly associated with coastal areas.
Australian Painted Snipe (<i>Rostratula australis</i>)	En	En	Inhabits shallow terrestrial freshwater wetlands, lakes, swamps and claypans.	Preferred habitat not present, no nearby regional records and has not been recorded within the Development Envelope despite extensive survey effort.

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Red Goshawk (<i>Erythrorhynchus radiatus</i>)	En	Vu	Occurs in coastal and sub-coastal areas and in wooded and forested lands of tropical and warm-temperate Australia including riverine habitats. The Red Goshawk nests in large trees, usually within 1 km of permanent water.	Is more commonly associated with coastal and sub-coastal areas. There are no nearby regional records and the species has not been recorded despite extensive survey effort.
Greater bilby, dalgtye (<i>Macrotis lagotis</i>)	Vu	Vu	Includes mulga scrub and hummock grasslands on sandplains or along drainage or salt-lake systems. Requires sandy or loamy soils in which to burrow.	Has not been recorded in the Development Envelope despite extensive survey effort. The closest contemporary records are approximately 37 km west of the Development Envelope. Some marginal habitat is present within the Drainage Area/ Floodplain habitats; however, these are limited in extent and connectivity.
Great desert skink (<i>Liopholis kintorei</i>)	Vu	Vu	Red sandplains and sand ridges. Prefers a mosaic landscape of different aged vegetation and inhabits sites that have been burnt (3-15 years). Sparsely distributed across arid sand flats and clay-based or loamy soils vegetated with spinifex.	Has not been recorded in the Development Envelope, there are no nearby regional records and there is a lack of suitable sandy habitats within the Development Envelope.
Princess Parrot (<i>Polytelis alexandrae</i>)	Vu	P4	Inhabits sand dunes and sand flats in the arid zone of western and central Australia. It occurs in open savanna woodlands and shrublands and also frequents <i>Eucalyptus</i> or <i>Allocasuarina</i> trees in riverine or littoral areas.	The Development Envelope occurs on the periphery of the species' range, and the species has not been recorded, despite extensive survey effort over numerous years.

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Southern Whiteface (<i>Aphelocephala leucopsis</i>)	Vu	-	Occupies a wide range of open woodlands and shrublands where there is an understorey of grasses or shrubs, or both. These areas are usually in habitats dominated by acacias or eucalypts on ranges, foothills and lowlands, and plains.	The Development Envelope occurs on the north-western periphery of species known range with the closest records being over 100 km to the south-east. The species has not been recorded despite numerous surveys.
Gull-billed Tern (<i>Gelochelidon (Sterna) nilotica</i>)	Mi	Mi	A migratory seabird that occasionally inhabits swamps, lagoons, river pools, claypans, and dams	Has not been recorded within the Development Envelope and only one (historical) regional record approximately 35 km away. The species is more commonly associated with coastal areas.
Oriental Plover (<i>Charadrius veredus</i>)	Mi	Mi	Inhabits sparsely vegetated plains, beaches and tidal flats, and saltworks and sewage ponds.	Has not been recorded within the Development Envelope and there are no known nearby regional records and no suitable habitat present.
Pectoral Sandpiper (<i>Calidris melanotos</i>)	Mi	Mi	Mainly inhabits swamps, lagoons, river pools, irrigation channels, and sewerage ponds.	Has not been recorded within the Development Envelope, there are no known nearby regional records and there is lack of preferred habitat present.
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	Mi Vu	Mi	Inhabits muddy edges of shallow fresh/brackish wetlands with emergent sedges, saltmarsh, grass, and low vegetation.	Has not been recorded within the Development Envelope, there are no known nearby regional records and a lack of preferred habitat.
Barn swallow (<i>Hirundo rustica</i>)	Mi	Mi	Coastal open country generally, especially near surface water and man-made structures, such as bridges and power wires.	Has not been recorded within the Development Envelope and no nearby regional records. This species generally occurs closer to coastal areas.
Yellow wagtail (<i>Motacilla flava</i>)	Mi	Mi	Damp short-grass flats, edges of swamps, sewerage ponds, grazed, or mowed grass and irrigated areas.	Development Envelope is outside species' range (Kimberely).

Species	Conservation status		Preferred habitat	Likelihood of occurrence
	EPBC Act	BC Act / DBCA		
Grey wagtail (<i>Motacilla cinerea</i>)	Mi	Mi	Mainly banks and rocks in fast flowing fresh water.	Has not been recorded within the Development Envelope and there is also no suitable habitat present.
Brush-tailed Mulgara (<i>Dasycerus blythi</i>)	-	P4	Known to occur in a range of habitats, including tussock/hummock grasslands and low open woodlands.	Has not been recorded from the Development Envelope. There are multiple records to the north-east and south-east of the Development Envelope, with the closest being over 15 km away. However, there is limited suitable sandy habitat present within the Development Envelope. Given the high level of survey effort and lack of records, and limited availability of suitable habitat, the species is considered unlikely to occur.
Short-tailed mouse (<i>Leggadina lakedownensis</i>)	-	P4	Open tussock and hummock grassland, Acacia shrubland and savanna woodland on alluvial clay/sandy soils, and cracking clays.	Has not been recorded from the Development Envelope. Whilst two regional records occur approximately 13.5 km west of the Development Envelope, limited suitable and connected habitat (i.e. cracking clays) is present.
Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>)		P4	Rugged, rocky areas and scree, often with sparse vegetation. Suitable habitat in the Development Envelope is widespread and includes rocky areas of Hilltop and Slopes, Valley and Gorge habitats.	Suitable habitat exists; however, this species has not been recorded despite numerous surveys nearby. There are few records in the Pilbara and none within 50 km of the Development Envelope.

Appendix 14 MS 1072 Ghost Bat Caves

Cave ID.	Value (Biologic 2016)	Categorisation (Bat Call WA 2021a)	Location	Disturbance Commitment	Monitoring Frequency
AC1	High	Category 2	Northern Flank	Impact	Bimonthly
AC2	High	Category 4	Northern Flank	Impact	Bimonthly
AC3	High	Category 3	Northern Flank	Impact	N/A ¹
AC4	High	Category 4	Northern Flank	Impact	N/A ¹
AC5	High	Category 2	Northern Flank	Impact	Bimonthly
AC6	High	Category 3	Northern Flank	Impact	Bimonthly ²
AC7	Low	Category 4	Northern Flank	Impact	Triennially
AC8	High	Category 4	Northern Flank	Impact	Bimonthly
AC9	High	Category 2	Northern Flank	Impact	Bimonthly
AC11	Low	Category 4	Northern Flank	Impact	N/A ³
AC12	Low	Category 4	Southern Flank	Impact	Triennially
AC13	High	Category 3	Northern Flank	Retain	Bimonthly
AC14	High	Category 4	Southern Flank	Retain	Bimonthly
AC15	Low	Category 4	Northern Flank	Retain	Triennially
AC16	Low	Category 4	Northern Flank	Impact	Triennially
AC17	High	Category 2	Southern Flank	Retain	Bimonthly
AC18	High	Category 4	Southern Flank	Retain	Bimonthly ⁴
AC19	Low	Category 4	Northern Flank	Impact	Triennially
AC20	Low	Category 4	Northern Flank	Retain	Triennially
AC25	Low	Category 4	Southern Flank	Impact	Triennially
AC26	Low	Category 4	Southern Flank	Retain	Triennially
AC27	Low	Category 4	Southern Flank	Retain	Triennially
AC28	Low	Category 4	Northern Flank	Impact	Triennially
AC29	Low	Category 4	Northern Flank	Impact	Triennially
AC30	Low	Category 4	Northern Flank	Impact	Triennially
AC31	Low	Category 3	Northern Flank	Impact	Triennially
AC32	High	Category 3	Northern Flank	Retain	N/A ⁵
AC34	Low	Category 4	Northern Flank	Impact	Triennially
AC37	Low	Category 4	Southern Flank	Impact	Triennially
AC38	Low	Category 4	Northern Flank	Impact	Triennially
SF1	High	Category 2	Southern Flank	Impact	N/A ¹
SF2	High	Category 3	Southern Flank	Impact	N/A ¹
SF3	Low	Category 2	Southern Flank	Retain	Bimonthly
SF4	High	Category 4	Southern Flank	Retain	Bimonthly
SF5	High	Category 2	Southern Flank	Retain	Bimonthly
SF6	High	Category 4	Southern Flank	Impact	Bimonthly
SF7	Low	Category 4	Southern Flank	Retain	Triennially
SF8	High	Category 2	Southern Flank	Retain	Bimonthly
SF9	Low	Category 4	Southern Flank	Retain	Triennially
SF10	Low	Category 4	Southern Flank	Retain	Triennially
SF11	Low	Category 4	Southern Flank	Impact	Triennially
SF12	Low	Category 4	Southern Flank	Impact	Triennially
SF13	Low	Category 4	Southern Flank	Impact	Triennially
SF14	High	Category 2	Southern Flank	Retain	Bimonthly
SF15	High	Category 4	Southern Flank	Impact	N/A ¹
SF16	Low	Category 4	Southern Flank	Impact	Triennially
SF17	High	Category 4	Southern Flank	Impact	N/A ¹
SF18	High	Category 4	Southern Flank	Retain	Bimonthly
SF19	Low	Category 4	Southern Flank	Impact	Triennially
SF20	Low	Category 4	Southern Flank	Retain	Triennially
SF21	Low	Category 4	Southern Flank	Retain	Triennially
SF22	Low	Category 4	Southern Flank	Impact	N/A ¹
SF23	Low	Category 4	Southern Flank	Impact	Triennially
SF24	Low	Category 4	Southern Flank	Retain	Triennially
SF25	Low	Category 4	Southern Flank	Impact	Triennially
SF26	High	Category 4	Southern Flank	Retain	Bimonthly

Cave ID.	Value (Biologic 2016)	Categorisation (Bat Call WA 2021a)	Location	Disturbance Commitment	Monitoring Frequency
SF27	High	Category 2	Southern Flank	Retain	Bimonthly
SF28	Low	Category 4	Southern Flank	Retain	Triennially
SF29	Low	Category 4	Southern Flank	Impact	Triennially
SF30	Low	Category 4	Southern Flank	Retain	Triennially
SF31	Low	Category 4	Southern Flank	Retain	Triennially
SF32	Low	Category 4	Southern Flank	Retain	Triennially
SF33	Low	Category 4	Southern Flank	Impact	Triennially
AMAC-01	Artificial Ghost Bat Cave	Category 4	Northern Flank	Retain	Bimonthly

Appendix 15 Historical SRE Invertebrate Fauna Records from the Development Envelope

Taxa	SRE status	Location	
		Development Envelope	Indicative Footprint
<i>Aganippe</i> MYG083	Confirmed SRE	✓	No
<i>Aganippe</i> MYG306-DNA	Confirmed SRE	✓	No
<i>Aganippe</i> <i>sigillate</i>	Confirmed SRE	✓	No
<i>Aname</i> MYG104	Confirmed SRE	✓	No
<i>Aname</i> MYG195	Confirmed SRE	✓	No
<i>Anidiops</i> MYG286-DNA	Confirmed SRE	✓	No
<i>Antichiropus</i> DIP006	Confirmed SRE	✓	No
<i>Antichiropus</i> DIP007	Confirmed SRE	✓	No
<i>Antichiropus</i> sp. `area C 2`	Confirmed SRE	✓	No
<i>Antichiropus</i> sp. indet.	Confirmed SRE	✓	No
<i>Aureocrypta</i> MYG315-DNA	Confirmed SRE	✓	No
<i>Chenistonia</i> 'MYG088'	Confirmed SRE	✓	No
<i>Conothele</i> MYG280	Confirmed SRE	✓	No
<i>Conothele</i> MYG282-DNA	Confirmed SRE	✓	No
<i>Karaops</i> <i>banyjima</i>	Confirmed SRE	✓	No
<i>Karaops</i> sp. `nov. Area C`	Confirmed SRE	✓	No
<i>Kwonkan</i> MYG339-DNA	Confirmed SRE	✓	No
<i>Kwonkan</i> MYG341-DNA	Confirmed SRE	✓	No
<i>Missulena</i> <i>langlandsi</i>	Confirmed SRE	✓	No
<i>Spirobolida</i> indet. sp. indet.	Confirmed SRE	✓	No
<i>Synsphyronus</i> sp. `PSE014 long hand 2`	Confirmed SRE	✓	No
<i>Teyl</i> MYG027	Confirmed SRE	✓	No
<i>Trigoniulidae</i> indet. sp. indet.	Confirmed SRE	✓	No
<i>Urodacus</i> sp. `firetail`	Confirmed SRE	✓	No
<i>Yilgarnia</i> MYG197	Confirmed SRE	✓	No
<i>Aureocrypta</i> sp. `chichester`	Potential SRE	✓	No
<i>Austrostrophus</i> <i>stictopygus</i>	Potential SRE	✓	No
<i>Karaops</i> sp. `indet.`	Potential SRE	✓	Yes
<i>Scolopendra</i> sp. indet	Uncertain SRE	✓	Yes

Appendix 16 Fauna Management Plan

Attached separately

Appendix 17 Summary of Subterranean Fauna studies and surveys

Table A18 presents a summary of Subterranean Fauna information used in the assessment of the Proposal.

Title/ Reference	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Significant Fauna
Mining Area C Stygofauna Assessment: Subterranean Fauna Sampling Compliance Report (Biota 2004a)	A subterranean fauna sampling programme designed in collaboration with the Western Australian Museum. 153 drill holes sampled over three phases using haul nets.	Aug 2002 Nov 2002 Aug 2003	Guidance Statement Number 54 (EPA 2003)	A relatively small number of stygofauna were collected including amphipods, specimens from the genus <i>Chydaekata</i> and <i>Diacyclops humphreysi</i> .
Orebody 18, 23, 25 and Mining Area C Expansion Stygofauna Surveys (Biota 2004b)	14 drill holes sampled across E deposit, Camp Hill and regional sites using net hauls.	Sept 2004	Guidance Statement Number 54 (EPA 2003)	No stygofauna were recorded during this survey.
BHP Billiton Iron Ore Regional Stygofauna Research Program (Biota 2006)	Program design document that outlined the framework and components of a regional stygofauna investigation plan including ongoing monitoring of stygofauna at various BHP operations including Mining Area C.	Twice yearly monitoring	Guidance Statement Number 54 (EPA 2003)	N/A
Boundary Ridge Stygofauna Report (Subterranean Ecology 2008b)	Twenty samples were obtained from 14 holes sampled by net hauling and a further six holes sampled again in June 2008. Stygofauna were detected in 50 % of holes sampled.	March 2008 June 2008	Guidance Statement Number 54 (EPA 2003)	A total of 43 specimens belonging to two morpho-species, an amphipod (<i>Paramelitidae</i> sp. S4) and a syncarid (<i>Parabathynellidae</i> sp. S2) were collected and sent for DNA sequencing.
BHP Billiton Regional Subterranean Fauna Study (Stygofauna) 2005-2007 (Biota 2008)	Monitoring survey effort over four phases involved 36 samples from nine bores using net hauls, across the MAC Study Area.	Phases I-IV: 2005 to 2007	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007).	A total of 1,226 stygofauna specimens representing five higher taxonomic groups. were collected from Marillana Creek during the four phases. Specimens were not identified to species level; however, the results indicate that the superficial alluvial systems of Marillana Creek support a diverse stygofauna community.

Title/ Reference	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Significant Fauna
Area C Packsaddle Range Stygofauna Survey (Subterranean Ecology 2008a)	Detailed survey where 62 samples were collected from 37 sites	Dec 2007 Feb 2008 Apr 2008	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	A single species of oligochaete belonging to the family Enchytraeidae was collected in two bores.
Area C Deposit A, D, P1 and P3 Troglifauna Assessment (Bennelongia 2009)	Detailed survey where 375 samples collected within the pits and a further 193 out-of-pit samples were collected. A further 294 samples from out-of-pit bores were collected from the study areas around Deposits P4, P5 and P6. Targeted nr <i>Draculoides</i> sp. S1 Survey where 71 samples were collected.	Dec 2007 until Oct 2008 Dec 2007	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	A total of 49 troglifauna species were recorded indicating that the Mining Area C has a rich and diverse assemblage of troglifauna present. nr <i>Draculoides</i> sp. S1 was collected from western boundary of Deposit P3, in Brockman Iron Formation, demonstrating that this species has a linear range of at least 12 km.
Area C Packsaddle P4, 5 and 6 Stygofauna Survey (Subterranean Ecology 2009)	Detailed survey where 96 samples were collected from 45 drill holes. Stygofauna were sampled using sampling net hauls.	Mar – Jun 2008 Oct - Dec 2008	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	Ten specimens representing a single species of oligochaete belonging to the family Enchytraeidae were collected in one bore.
Area C Mine and Surrounds Baseline Stygofauna Survey (Bennelongia 2011a)	Detailed survey where a total of 78 samples from 45 bores were sampled	Feb 2010 Mar 2010 May 2010	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	A total of 201 stygofaunal specimens were collected, representing at least 17 species.
Area C Mine and Surrounds Baseline Troglifauna Survey (Bennelongia 2011b)	Detailed survey where a total of 491 samples were collected across five survey areas. Methods included scraping and trapping.	February - July 2010	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	A total of 1,141 troglifauna specimens were collected representing 60 species of troglifauna belonging to 16 orders.

Title/ Reference	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Significant Fauna
Camp Hill Stygofauna Report (Bennelongia 2011c)	A detailed survey where 118 samples were collected from 82 bores over three sampling rounds using haul nets.	Mar 2009 Jun 2009 May 2010	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	1,721 stygofauna specimens representing at least 22 species were collected. Two species with uncertain distributions were recorded: the amphipods <i>Chydaekata</i> sp. B1 and Paramelitidae sp. B4.
South Flank Baseline Troglifauna Survey (Bennelongia 2011e)	A detailed survey where 36 samples were collected from 18 bores during phase 1 and 400 samples were collected from 215 bores during phase 2.	Apr – Jun 2008 Mar – May 2010	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	At least 46 species belonging to 16 Orders were collected at the South Flank Study Site. Twenty-seven of the 46 species (59%) are also known from Mining Area C.
South Flank Baseline Stygofauna Survey (Bennelongia 2011d)	Detailed survey where 151 stygofauna samples were collected from 81 bores using net hauls.	Mar 2011 Jun 2011	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	A total of 121 specimens were collected representing eight species.
South Flank Targeted Troglifauna Survey (Bennelongia 2013a)	Targeted survey where 439 scrapes were collected at South Flank, with trapping also occurring at 146 of these holes. Methods included scraping and setting traps.	March – Aug 2012 (six phases)	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	163 troglifauna specimens representing 30 species from eight classes and 14 Orders The five targeted species were collected during the sampling program: <i>Draculoides</i> sp. B08, B09, B16 and B20, and <i>Allopauropus</i> sp. B11 (previously <i>Pauropodina</i> sp. B11).
Weeli Wolli Creek Catchment: 2011 Stygofauna Sampling Bennelongia (2013b)	Detailed survey where 111 samples were collected across the Study Area using net hauls.	May - Nov 2011 (five phases)	Guidance Statement Number 54 (EPA 2003) Guidance Statement No. 54a (EPA 2007)	985 stygofauna specimens, comprising 26 species belonging to seven higher order groups. When combined with data from previous sampling in the Study Area, a total of 51 species have been recorded from the Study Area (noting this includes Weeli Wolli Spring, Rhodes Ridge and Lower Weeli Wolli Creek subcatchment).

Title/ Reference	Sampling Methods and Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Significant Fauna
Packsaddle 1 and 2 targeted troglofauna survey (Bennelongia 2014)	Detailed and targeted survey where 232 samples were collected from 118 drill holes. Methods included scraping and setting traps. Four troglofauna species of interest were targeted.	November 2013 – May 2014 (two phases)	Consideration of subterranean fauna in environmental impact assessment in WA (EPA 2013) Guidance Statement No. 54a (EPA 2007)	331 troglofauna specimens representing 31 species belonging to 13 orders were collected. The four targeted species with uncertain distributions were recorded: the schizomid <i>Draculoides</i> sp. SCH012, the pseudoscorpion <i>Lagynochthonius</i> sp. S03, the harvestman Opiliones sp. B02, and the symphylan <i>Hanseniella</i> sp. B08.
Packsaddle East Subterranean Fauna: Baseline Report (Bennelongia 2015)	A detailed survey. Methods included troglofauna trapping and scraping with 29 drill holes were sampled and stygofauna net hauls where 12 drill holes were sampled.	Mar – May 2015 (one phase)	Consideration of subterranean fauna in environmental impact assessment in WA (EPA 2013) Guidance Statement No. 54a (EPA 2007)	Twelve species of troglofauna and 27 stygofauna species were recorded. Eight troglofauna species and three stygofauna species were considered potentially restricted. Based on all work to date, 20 troglofauna species and 27 stygofauna species are known to occur in the Survey Area.

Appendix 18 Subterranean Fauna survey reports

The following studies undertaken to support the assessment of Subterranean Fauna for the Proposal are provided:

1. East Packsaddle Subterranean Fauna Assessment (Biologic 2025b)
2. South Flank MAR subterranean fauna desktop assessment (Bennelongia 2018)
3. Mining Area C Southern Flank: Stygofauna Assessment (Bennelongia 2016b)

Appendix 19 IBSA data package

BHP has provided biodiversity data and reports as part of the IBSA data package, prepared consistent with the EPA's *Instruction for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA)* (EPA 2021d).

BHP has provided the following IBSA data packages via the online IBSA Submissions portal:

Survey	IBSA number
Central Pilbara Hub Detailed and Targeted Flora Survey (Biologic 2024a)	IBSA-2024-0443
Ministers North Targeted Significant Flora & Vegetation Assessment (Spectrum 2023)	IBSASUB-20250212-37674A63
Consolidation of Regional Vegetation Mapping, BHP Biliton Iron Ore Pilbara Tenure (Onshore 2014a)	IBSA-2020-0345
Central Pilbara Hub Stage 2 Targeted MNES Vertebrate Fauna Survey (Biologic 2025a)	IBSASUB-20250207-C337431B
CPH Targeted Matters of National Environmental Significance Vertebrate Fauna Survey (Biologic 2023a)	IBSA-2024-0319
Targeted Pilbara Olive Python Survey: South Flank and Mining Area C (Biologic 2023d)	IBSASUB-20250206-4B3B3C15
Yandi 45C Targeted Significant Vertebrate Fauna Survey (Astron 2023)	IBSA-2025-0038
MAC Phase 4 Marillana Creek Targeted MNES Fauna Survey (Biota 2022)	IBSA-2022-0292
Minsters North SRE Invertebrate Fauna Desktop and Field Survey (Bennelongia 2024a)	IBSA-2025-0046
Yandi Operations Short-Range Endemic Fauna Survey Report (Bennelongia 2024c]	IBSA-2025-0040
East Packsaddle Subterranean Fauna Assessment (Biologic 2025b)	IBSA-2025-0047
Mining Area C-Southern Flank: Stygofauna Assessment (Bennelongia 2016b)	IBSA-2025-0043
Weeli Wolli Spring: Aquatic Monitoring 2021 (Biologic 2023h)	IBSA-2025-0062
MAC Phase 4: Marillana Creek Baseline Aquatic Ecosystem Survey Dry 2022 & Wet 2023 (Biologic 2024b)	IBSASUB-20250217-6C3A0E2B

BHP is also in the process of compiling the survey data for the following biodiversity reports into the IBSA data format to allow submission via the online IBSA Submissions portal:

- Targeted Flora Surveys of Pipeline Corridors (GHD 2022)

- Ministers North Miscellaneous Licence Area Amendment Surveys and Yandicoogina Creek Detailed Flora and Vegetation Assessment (Biologic 2020a)
- Runaway Valley Baseline Vegetation Monitoring Survey (Astron 2020)
- Area C West to Yandi Flora and Vegetation Assessment (Astron 2019)
- Ministers North Level 1 Fauna Survey (GHD 2021)
- MAC4 Pipeline Level 1 Vertebrate Fauna Assessment (Biologic 2019a)
- Ministers North and Yandicoogina Creek Short-Range Endemic Invertebrate Fauna Survey (Biologic 2021)
- Ministers North Yandicoogina Creek Aquatic Ecosystem Survey Dry 2022 and Wet 2023 (Biologic 2024c)
- Ministers North Aquatic Ecosystem Survey: Dry 2021 – Wet 2022 (Biologic 2023c)

Appendix 20 Social, Cultural, Heritage and Environmental Management Plan

Attached separately

Appendix 21 Impact Reconciliation Procedure v2.0

Attached separately.