Environmental Offsets Strategy

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Horse Pit Extension Project – Caval Ridge Mine

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Definitions

Term	Definition
Areas of Interest	A shapefile provided by BMA indicating the area permitted to survey. The Area of Interest was surveyed for its suitability to acquit Project impacts on target protected matters.
Broad Vegetation Group	High-level groupings of vegetation communities and Regional Ecosystems in Queensland by Neldner et al. (2020).
Croydon Offset Area	The approximately ~~263.68~~512.26 ha Offset Area within the Croydon Station ~~OIA sized~~. The Offset Area is a subset of the Area of Interest. The size of the Offset Area reflects the area (ha) and habitat values required to acquit HPE Project impacts on ornamental snake~~.~~, squatter pigeon (southern) and MSES Connectivity Areas.
Habitat Quality Score	A method of evaluating habitat quality within a particular community based on key indicators including site condition, site context and species habitat index (if necessary). The method produces a score out of 10, where the maximum score of 10 represents a fully intact system. Scores of 4, 5 and 6 may indicate good quality regrowth or medium value habitat.
Inderi Offset Area	The approximately 66.61 ha area within the Inderi property (Lot 55 DSN318) to offset the HPE Project's offset obligations concerning king bluegrass and regulated vegetation.
Matters of National Environmental Significance	Environmental values protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. Significant impacts to these values may require offsets under the legislation.
Matters of State Environmental Significance	State interests defined under Schedule F of the Queensland State Planning Policy and include ecological features such as Regulated Vegetation, wetlands, fish habitat areas and threatened species habitat.
~~Offset Investigation~~Study Area	The area within the Area of Interest as supplied by Inderi property and Croydon Station surveyed as part of the initial field assessments conducted by E2M.
Regional Ecosystem	A vegetation community in a bioregion that is consistently associated with a combination of geology, landform, and soil. Regional Ecosystems are described in the Regional Ecosystem Description Database, produced by the Queensland Herbarium.
Regulated Vegetation	Vegetation that is mapped within the regulated vegetation management map produced by Department of Natural Resources, Mines and Energy. The Queensland *Vegetation Management Act 1999* is applicable to regulated vegetation.
Remnant vegetation	Vegetation which forms the predominant canopy of the community that: a) covers more than 50% of the undisturbed predominant canopy; and b) averages more than 70% of the vegetation's undisturbed height; and c) is composed of species characteristic of the vegetation's undisturbed predominant canopy.

Term	Definition
Threatened species	Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) or Conservation Dependent (CD) under the *Environmental Protection and Biodiversity Conservation Act 1999* or extinct in the wild (PE), critically endangered (CE), endangered (E), vulnerable (V) or near threatened (NT) under the *Nature Conservation Act 1992*.
Vegetation community	An identified vegetation community (i.e. structure, composition, condition and/or underlying geology) verified from a field survey. Communities may include Regional Ecosystems, remnant vegetation and/or disturbed/novel ecosystems (e.g. parkland, disturbed roadsides etc.).

Abbreviations

Abbreviation	Description
AU	Assessment Unit
API	Aerial Photographic Interpretation
BOM	Bureau of Meteorology
BMA	BM Alliance Coal Operations Pty Ltd
BVG	Broad Vegetation Group
CVM	Caval Ridge Mine
DAWE	Commonwealth Government Department of Agriculture, Water and the Environment
DBH	Diameter at breast height
DCCEEW	Commonwealth Government Department of Climate Change, Energy, the Environment and Water
DEE	Commonwealth Government Department of the Environment and Energy
DES	Queensland Government Department of Environment and Science
DoR	Queensland Government Department of Resources
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (superseded in 2013)
E2M	E2M Pty Ltd
EA	Environmental Authority
EO Act	Queensland *Environmental Offset Act 2014*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographic Information Systems
GPS	Global Positioning System

Abbreviation	Description
GTRE	Ground-truthed Regional Ecosystem
ha	Hectares
HPE	Horse Pit Extension Project
HVR	High-value Regrowth
MNES	Matters of National Environmental Significance
MSES	Matters of State Environmental Significance
NC Act	*Nature Conservation Act 1992*
~~OIA~~	~~Offset Investigation Area~~
PMST	Commonwealth Protected Matters Search Tool database
RE	Regional Ecosystem
SAT	Spot Assessment Technique (method used to detect indirect koala evidence)
SIA	Significant Impact Assessment
SLR	SLR Consulting Pty Ltd
SO	Stream order
sp.	Singular species. For example, *Eucalyptus* sp. refers to a single species of *Eucalyptus*
spp.	Multiple species. For example, *Eucalyptus* spp. refers to multiple species of *Eucalyptus*
TEC	Threatened Ecological Community
the Project	Horse Pit Extension Project
VM Act	Queensland *Vegetation Management Act 1999*
WoNS	Weed of National Significance

1 Introduction

1.1 Background

The development of the BM Alliance Coal Operations Pty Ltd (BMA) Horse Pit Extension (HPE) Project at Caval Ridge Mine (CVM) is expected to have a significant ~~and~~, residual impact on ~~four~~five Matters of National Environmental Significance (MNES) and/or Matters of State Environmental Significance (MSES) (referred to collectively as 'target protected matters'):

- 167.84 ha of ornamental snake (*Denisonia maculata*) habitat;
- 83.53 ha of squatter pigeon (southern) (*Geophaps scripta scripta*) habitat;
- 23.40 ha of king bluegrass (*Dichanthium queenslandicum*) habitat;
- 23.40 ha of MSES Regulated Vegetation[1]; and
- 84.19 ha of connectivity area.

The impacts are expected to trigger offset requirements under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) Environmental Offsets Policy (DSEWPaC 2012) (Commonwealth Offsets Policy) and the Queensland *Environmental Offsets Act 2014* (EO Act).

Two ~~Offset Investigation~~ potentially suitable Areas ~~(OIAs)~~of Interest were proposed ~~to identify suitable Offset Areas to acquit impacts using~~by BMA as a proponent driven, land~~-~~ based approach~~. The OIAs~~ to offset the impact to the target protected matters. The Areas of Interest are located on the following properties:

- Lot 55 on Plan DSN318 (known as Inderi); and
- Lot 4 on Plan KL210 (known as Croydon Station).

To determine the suitability of the ~~OIAs as an offset~~two Areas of Interest, E2M Pty Ltd (E2M) was engaged by SLR Consulting Pty Ltd (SLR) on behalf of BMA to conduct a terrestrial ecology assessment and prepare an Offset Strategy.

1.2 Purpose of this offset strategy

The purpose of this Offset Strategy is to:

- Present the results of the E2M terrestrial ecology assessment conducted within the Inderi property and Croydon Station ~~OIAs~~;
- Discuss the overall suitability of the proposed ~~Offset Areas, within each OIA,~~offset areas to acquit the HPE Project's offset requirements by:
  - assessing each offset area against the offset requirements of the HPE Project in accordance with the EPBC Act Offsets Assessment Guide

[1] a native grassland community designated as Regional Ecosystem (RE) 11.8.11 within the Broad Vegetation Group (BVG) 30b[1]. RE 11.8.11 is listed as 'of concern' under the *Vegetation Management Act 1999*

- demonstrating the HPE Project's compliance with the Commonwealth and State environmental and offset legislation framework
- evaluating the anticipated environmental outcome; and
- outlining how the offset will be implemented.

1.3 Offset requirements and delivery mechanism

The HPE Project offset requirements and delivery mechanisms are summarised in Table 1.

Table 1. Offset requirements summary

Target protected matter	Status		Significant Residual Impact (ha)	Notional Offset Area required (ha)		Offset delivery mechanism
	EPBC Act	State		EPBC Act[2]	EO Act[1]	
ornamental snake (*Denisonia maculata*)	V	V	167.84	259.00	NA[4]	Land-based offset
squatter pigeon (southern) *Geophaps scripta scripta*	V	V	83.53	228.00	NA[4]	Land-based offset
king bluegrass (*Dichanthium queenslandicum*)	E	V	23.40	33.00	NA[4]	Land-based offset
MSES Regulated Vegetation	NA	of concern	23.40	NA	34.00[3]	Land-based offset
connectivity area	NA	NA	84.19	NA	84.19	Land-based offset

[1] Queensland *Environmental Offsets Act 2014*

[2] Based on the EPBC offset calculator using site-based attributes (BioCondition scores)

[3] Based on the EO Act land-based offsets multiplier calculator

[4] See section 1.4 Duplication of offsets

1.4 Duplication of offsets

~~Two~~Three of the target protected matters~~,~~ (ornamental snake ~~and~~, king bluegrass~~,~~ and squatter pigeon (southern)), are listed under both Commonwealth and State legislation. The Queensland EO Act specifies that the State ~~or Local~~ Government cannot impose an offset condition for the same, or substantially the same, impact if the Commonwealth has completed its assessment for a controlled action. As per Section 15 of the Queensland EO Act, an administering agency may impose an offset only if:

- The same impact, or substantially the same impact, has not been assessed under a Commonwealth Act; and
- The same prescribed matter, or substantially the same prescribed matter, has not been assessed under a relevant Commonwealth Act.

Ornamental snake ~~and~~, king bluegrass and squatter pigeon (southern) impact assessment and offset considerations (including the notional offset area required) are determined in accordance with the Commonwealth EPBC Act and offset framework. Consequently, additional offsets are unlikely to also be imposed under the State for those matters.

2 Offset Area Survey Methods

The ecological values of the two ~~Offset~~ Areas ~~(i.e. Inderi property and Croydon Station)~~of Interest were ~~generated~~identified through a desktop assessment and a field survey conducted ~~at each property~~ in accordance with the recommended guidelines prescribed by the relevant Commonwealth and/or State governments. The following section details the methods employed to conduct both the desktop and the field assessments.

Following completion of ~~the ecological assessments of the Inderi and Croydon Station OIAs~~field studies, a suitable ~~Offset Area (Inderi Offset Area and Croydon Offset Area)~~subset area within each ~~OIA~~Area of Interest was identified to acquit MNES and MSES values impacted by the HPE Project. These subset areas are referred to as the Inderi Offset Area and the Croydon Offset Area.

2.1 Desktop assessment

The desktop assessment consolidated information from relevant databases, mapping, aerial imagery and published literature to produce an initial characterisation of the ecological values of the ~~OIAs~~Area of Interest and surrounding landscape. In part, this initial characterisation guides the assessment strategy required in the field by providing information such as previously recorded threatened species, potential habitat features and mapped vegetation communities.

The desktop assessment sourced information from the:

- Commonwealth Department of ~~Agriculture, Water and~~ Climate Change, Energy, the Environment ~~(DAWE~~and Water (DCCEEW) EPBC Act Protected Matters Search Tool (PMST) Database (2022);
- Regulated Vegetation Management mapping and associated RE mapping (i.e. Vegetation Management Supporting Map) (Version 11), including Essential Habitat Mapping (Department of Resources (DoR) 2021);
- Queensland MSES mapping (Department of Environment and Science (DES) 2019a);
- DES WildNet databases for species listed under the *Nature Conservation Act 1992* (NC Act) (DES 2020b; DES 2018)
- Atlas of Living Australia (2021);
- GeoScience Australia 1:100,000 drainage network of Queensland (Geoscience Australia 2020);
- DoR Detailed Surface Geology (2020) descriptions to confirm DES Land zone definitions; and
- historical and latest available aerial photography (Queensland Government Q-Imagery) (NearMap 2020).

Where necessary, a search radius of 20 km from the approximate centre point of the ~~OIAs~~Area of Interest; Inderi (-24.3238; 148.4711) and Croydon (-22.3888; 148.9440); was applied to the desktop search databases.

Preliminary vegetation mapping was also undertaken by way of Aerial Photographic Interpretation (API). API allows for accurate vegetation community mapping at a property scale as well as the accurate delineation of heterogenous polygons mapped by DoR into homogenous polygons of REs. Based on the preliminary mapping, suitable representative sites were identified for each vegetation community to inform the field survey. This process also identified key areas to target during the field survey to verify the correct RE classification as well as undertake Habitat Quality Assessments.

2.2 Field assessment

~~The field~~Field surveys were conducted to identify and characterise the presence, extent and condition of the target protected matters within the ~~OIAs.~~two Areas of Interest at the Inderi property and Croydon Station. The methods employed adhere to the guidelines and methodologies prescribed or supported by the Commonwealth and State Governments.

2.2.1 Ground-truthed Regional Ecosystems

Ground-truthed ~~REs~~Regional Ecosystems (GTREs) are vegetation communities that have been field verified in accordance with the Queensland *Methodology for Surveying and Mapping of Regional Ecosystems and Vegetation Communities in Queensland* (Neldner et al. ~~2020~~2022). Neldner et al. ~~.~~

~~The vegetation type (remnant, regrowth, etc) was determined based on the undisturbed canopy cover, height and form of the dominant vegetation (i.e. Specht vegetation classification system (Specht 1970)). Woody~~(2022) also prescribes the method for determining remnant status of woody and non-woody vegetation communities ~~(those dominated by trees/shrubs) were categorised as either remnant, regrowth or non-remnant based on~~using a series of metrics collected in the field (e.g. canopy cover, height ~~and~~, species composition ~~as per~~, cultivation status, ~~Neldner et al. (2020). Remnant classification of~~ non-~~woody vegetation communities (e.g. grasslands) are as defined under Neldner et al. (2020) as an area that:~~

- ~~has not been cultivated for 15 years;~~

~~contains~~ native species ~~normally found in the RE; and~~).

- ~~is not dominated by non-native perennial species.~~

~~2.2.1.1 Suitable vegetation offsets for MSES Regulated Vegetation~~

~~Under the *Queensland Environmental Offset Policy* (DES, 2021), a suitable offset for MSES Regulated Vegetation must be:~~

~~of the same broad~~The structural form of vegetation was determined using the Specht vegetation classification system (Specht 1970) which defines structural forms of vegetation in terms of the dominant plant form and the percentage of foliage cover of the tallest plant layer.

~~2.2.1.2~~2.2.1.1 Broad vegetation group ~~(BVG) as the impacted regional ecosystem;~~

- ~~of the same RE status; and~~
- ~~within the same bioregion;~~

BVGs are higher-level groupings of vegetation communities ~~and REs identified within Queensland in accordance with~~assessed at the 1:1,000,000 mapping scale[2] and based on Neldner et al. (2021) and the Regional Ecosystem Description Database (REDD) (Queensland Herbarium, 2021). ~~Under the Queensland *Environmental Offsets Policy* (DES), 2021), BVGs are assessed at the 1:1,000,000 mapping scale. The associated RE status (i.e. 'endangered' or 'of concern') is based on the Queensland *Vegetation Management Act 1999* class. The HPE Project and OIAs are all located within the Brigalow Belt Bioregion (Bioregion 11) within Queensland.~~

[2] Under the Queensland *Environmental Offsets Policy* (DES), 2021

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The *Queensland Environmental Offset Policy* (DES, 2021) permits a suitable offset for MSES Regulated Vegetation to be of the same BVG (rather than the same RE) as the impacted RE. In addition, a suitable offset for MSES Regulated Vegetation must be:

- of the same RE status based on the Queensland *Vegetation Management Act 1999* class (e.g. 'endangered' or 'of concern'); and
- within the same bioregion (Bioregion 11);

2.2.2 Habitat quality assessments

Habitat quality assessments were conducted in accordance with the *Guide to Determining Terrestrial Habitat Quality Version 1.3* (referred to as the Habitat Quality Guide) (DES 2020). The Habitat Quality Guide incorporates landscape scale data, site-based vegetation attribute data (using the BioCondition assessment framework (Queensland Herbarium 2015) and fauna species-specific habitat data.

2.2.2.1 Landscape-scale Attributes

An assessment of landscape-scale attributes is required to determine if the proposed ~~OIA~~Area of Interest is situated in a landscape that can achieve a conservation outcome (i.e. suitably connected and contains large tracts of vegetation). In accordance with the Habitat Quality Guide, the ~~OIAs~~Areas of Interest were assessed against the criteria summarised in Table 2.

Table 2. Landscape-scale attributes assessment criteria within a fragmented subregion

Attribute	Description	Assessment extent	Maximum score
Size of patch	The size of the patch assessed and associated directly with connecting remnant vegetation	-	10
Connectedness	The proportion of the site's boundary that is connected to remnant vegetation	-	5
Context	The percentage of remnant and regrowth vegetation within a 1 km buffer of the site	1 km buffer	5

2.2.2.2 Site-based Attributes

Site-based attribute data were collected within 100 x 50 m areas (including various sub-plots) at sampling sites within each assessment unit and compared to BioCondition benchmark values (Queensland Herbarium, 2019). A summary of the site-based attributes assessed, plot area and associated maximum score is summarised in Table 3. The number of BioCondition survey sites within each assessment unit adhered to the Habitat Quality Guide recommendations summarised in Table 4.

A Trimble TDC600 Global Positioning System (GPS) device was used to record the mid-point location (50 m mark) of each BioCondition survey site.

Table 3. Site-based attributes assessment criteria

Attribute	Description	Assessment plot	Maximum score
Large trees	Number of large trees per hectare, as determined by exiting BioCondition benchmarks for the associated RE	100 m x 50 m	15†
Tree canopy height	Median canopy height in metres of the ecologically dominant layer.	100 m x 50 m	5†
Recruitment (%)	The proportion of overstorey species present at a site that are regenerating (<5 cm diameter at breast height (DBH))	100 m x 50 m	5†
Tree canopy cover (%)	Vertical projection of the tree canopy crown cover along a transect	100 m transect	5†
Shrub layer cover (%)	Vertical projection of the shrub layer cover of native shrubs	100 m transect	5†
Coarse woody debris	The length of fallen woody logs and other coarse woody debris (>10 cm diameter and >0.5 m in length) per hectare	50 m x 20 m	5†
Native plant species richness	Native plant species richness, comprising all life forms (i.e. trees, shrubs, grasses and forbs/other)	100 m x 50 m (trees) 50 m x 10 m (shrubs, grasses, forbs/other)	5 each (20 total)
Non-native plant cover	Percentage cover of non-native/weed plant species	50 m x 10 m	10
Native perennial grass cover (%)	Average percentage cover of native perennial grass species	Five 1 m x 1 m	5
Organic litter cover	The average percentage cover of organic material such as fallen leaves, twigs, and branches <10 cm diameter	Five 1 m x 1 m	5

† do not apply to grasslands RE's

Table 4. BioCondition survey effort guidelines[1]

Assessment unit size (ha)	Suggested number of sampling sites
0-50	2
50-100	3
100-500	4
500-1000	5
>1000	6

[1] Guide to determining terrestrial habitat quality (DES 2020)

2.2.2.3 Fauna species-based attributes

In accordance with the Habitat Quality guide, targeted fauna species habitat assessments were conducted to provide further information regarding the habitat suitability independent of site-based attribute assessments. The fauna species-based attributes consider threatening processes and survey microhabitat features (aka indicators) essential to the target fauna species: ornamental snake~~.~~ and squatter pigeon (southern). These features include:

- abundance of gilgai;
- RE and condition (e.g. remnant, regrowth, non-remnant);
- vegetative ground cover;
- gilgai depth;
- soil crack abundance;
- soil crack depth;
- permanent and ephemeral water sources;
- presence and proximity to water;
- abundance of coarse woody debris;
- leaf litter abundance;
- litter depth; and
- threat abundance.

Each indicator was scored on a scale from 0 (absent) to 25 (very high) and used to calculate a weighted score. A total species habitat score (out of 10) was calculated for the ornamental snake (Appendix B).

2.2.3 Flora and fauna habitat values

2.2.3.1 King bluegrass (*Dichanthium queenslandicum*)

Random meander surveys for king bluegrass (*Dichanthium queenslandicum*) were conducted in suitable habitat within the Inderi property ~~OIA~~Area of Interest (i.e. RE 11.8.1 and RE 11.8.5) based on methods described by Cropper (1993) and Goff et al. (1982). The random meander technique involves traversing potential habitat within an area and searching for flora species that may not have been located using more structured search methods (e.g. BioCondition assessment). This technique is particularly suitable for locating species that typically occur at very low densities or that may be distributed in isolated clumps.

King bluegrass is a perennial species and has been observed seeding throughout the year (DES, 2022). Although conditions at the time of the survey were dry, the species was recorded within suitable habitat within the ~~OIA.~~Area of Interest. King bluegrass locations were recorded, and samples of the specimens were collected and sent to the Queensland Herbarium for formal identification.

2.2.3.2 Ornamental snake (*Denisonia maculata*)

In accordance with the Commonwealth *Draft Referral Guidelines for the Nationally Listed Brigalow Belt Reptiles* (DSEWPaC 2011a) and the *Survey Guidelines for Australia's Threatened Reptiles* (DSEWPaC 2011b), the most effective ornamental snake detection method is nocturnal spotlighting. The species is most active during the wet season when warm weather and inundated gilgai attract the ornamental snake's main prey, frogs. During the dry season however, ornamental snake activity above ground is

limited and the species can remain inactive in shelter sites and soil cracks for long periods (e.g. months) (DSEWPaC 2011b).

As the Croydon Station ~~OIA~~ field ~~survey~~surveys occurred ~~at the beginning of~~during the dry season (May 2021 and April 2022) (i.e. outside the survey window for species detection~~,~~) ornamental snake habitat ~~assessments~~was (refer to Section 2.2.2.3) ~~to delineate areas~~delineated based on the presence of suitable habitat features.

2.2.3.3 Squatter pigeon (southern) (*Geophaps scripta scripta*)

In accordance with the *Survey Guidelines for* ~~the~~ *Australia's Threatened Birds* (DEWHA, 2010) and *Terrestrial Vertebrate Fauna Survey Guidelines for Queensland* (Eyre et al., 2018), targeted surveys within Croydon Station Area of Interest comprised:

- species ~~were undertaken.~~ habitat assessments;
- water source watches;
- diurnal active searches; and
- opportunistic surveys.

The two field surveys (May 2021 and April 2022) coincided with optimal detection periods when squatter pigeon are most actively foraging for grass seed (Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2022).

2.2.4 Additional ecological values

In addition to assessments for target protected matters requiring offsets for the HPE Project, the survey also ~~included~~considered the ~~assessment of~~ potential for other MNES and MSES ~~values present~~ within the ~~OIAs and Offset~~ Areas ~~that may be of conservation benefit.~~of Interest. A summary of these additional assessments for MNES and MSES values is provided ~~below.~~in Section 2.2.4.1.

2.2.4.1 Threatened Ecological ~~Communities~~Community assessments

TEC assessments were conducted within relevant vegetation communities using the key diagnostic characteristics and condition thresholds published within the respective Commonwealth approved listing advice.

2.2.4.1.1 Natural Grasslands TEC

The Commonwealth approved listing advice for the Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin TEC (Natural Grasslands TEC) lists seven REs, including RE 11.8.11, with the potential to support the TEC. To qualify as a Natural Grassland TEC, the Commonwealth listing advice (TSSC 2009) identifies the following diagnostic characteristics:

- a sparse or absent tree canopy (<10% projective crown cover);
- a sparse shrub layer (<50% projected crown cover); and
- the dominance of perennial native grasses and the presence of at least three (of 13) indicator species.

Condition thresholds further categorise Natural Grassland TECs into 'best' and 'good quality' as there are very few patches of undisturbed native grasslands remaining and most patches have some degree of disturbance and degradation (Table 5).

Table 5. Condition thresholds for the Natural Grasslands TEC

Criteria*	Best quality	Good quality
Patch size	At least 1 ha	At least 5 ha
Grasses	At least 4 native perennial grass species from the list of perennial native grass indicator species	At least 3 native perennial grass species from the list of perennial native grass indicator species
Tussock cover	At least 200 native grass tussocks	At least 200 native grass tussocks
Woody shrub cover**	Total projected canopy cover of shrubs is less than 30%	Total projected canopy cover of shrubs is less than 50%
Introduced species	Perennial non-woody introduced species are less than 5% of the total projected perennial plant cover.	Perennial non-woody introduced species are less than 30% of the total projected perennial plant cover.

* All five criteria must be met

** The shrub layer is typically absent. However, where shrubs are present, they are defined as woody plants, more than 0.5 m tall that occupy the mid vegetation layer. The upper, or tree canopy layer, also is typically absent but may comprise scattered trees to less than 10% projective crown cover.

Sampling would be based upon a quadrat size of 0.1 ha (e.g. 50 m x 20 m) selected in an area with the most apparent native perennial grass species. Unless exceptional circumstances apply, to maximise the assessment of condition, sites must be assessed during a good season, two months after cessation of disturbance (fire/grazing/mowing/slashing) and within two months of effective rain.

2.2.4.1.2 Brigalow TEC

The Commonwealth Approved Conservation Advice for the Brigalow TEC (*Acacia harpophylla* dominant and co-dominant) (Department of the Environment (DotE) 2013) provides the key diagnostic criteria a vegetation community must meet to be considered a TEC. These criteria comprise:

- *Acacia harpophylla* is either dominant or co-dominant;
- is located in one of 16 REs (which includes 11.4.8 and 11.4.9);
- patch size of ≥0.5 ha; and
- weeds comprise <50% total vegetation cover.

A brigalow vegetation community may also be considered a TEC if the vegetation class is regrowth pending species composition and structural elements are broadly consistent with an RE and the vegetation meets the condition criteria. Regrowth vegetation in poor condition however, should be excluded from the TEC (Butler 2007). Poor condition patches have one or more of the following attributes:

- has been comprehensively cleared (not just thinned) within the last 15 years;
- weed cover ≥ 50%; and
- patch size ≤ 0.5 ha.

2.2.4.2 Opportunistic observations

Opportunistic surveys were also undertaken during the field assessments. Opportunistic observations included recording pest species, namely restricted biosecurity species identified under the Queensland *Biosecurity Act 2014* (Biosecurity Act) and Weeds of National Significance (WoNS), as these can be a threatening process for the target MNES and MSES. Estimated weed densities were categorised based on the following densities:

- scattered - 1-2 individuals/10 m^2;
- low - 3-4 individuals/10 m^2;
- moderate - 5-6 individuals/10m^2; and
- high - >7 individuals/10m^2.

Additional opportunistic surveys were undertaken to identify threatened species (including MNES and MSES) or indirect signs (i.e. bones, hair traces, tracks, scats, diggings, burrows, nests, skins) that could indicate presence throughout the ~~OIAs.~~Areas of Interest. These observations were made whilst traversing through the ~~OIAs~~Areas of Interest both on foot and through slow vehicle drives.

2.2.5 Survey limitations and assumptions

Ecological surveys have a range of inherent limitations associated with seasonal timing of the survey, variable climate conditions and species behaviour. The survey conducted represents a "snapshot" in time and may not provide a true indication of presence or absence of flora and fauna species within the survey areas. In particular, grassland flora variability due to natural factors such as climate, can cause large and seasonal fluctuations in species dominance and cover in grassland communities (Wilson et al. 2002).

The values of the 'Notional Offset Area Required' presented in this report are based on the output of the EPBC Act Offset Assessment Guide (Department of Environment and Energy, 2012) and the EO Act land-based offset multiplier calculator (Department of Environment and Heritage Protection, 2014).

3 Inderi Offset Area Description

3.1 Property details

The Inderi property (formally Lot 55 on Plan DSN318) supports 1,800 to 2,000 head of cattle across 3,033.52 ha of natural grasslands, open woodlands and stands of leucaena (*Leucaena leucocephala*) on gently undulating rises. The property is located approximately 20 km northwest of the township of Rolleston and 242 km south of the Caval Ridge Mine (Figure 1).

The Inderi property is proposed as a proponent-driven, land-based offset and investigated specifically for its potential to acquit the HPE Project impacts to:

- *Dichanthium queenslandicum* habitat (MNES); and
- Regulated Vegetation containing 'of concern' RE 11.8.11 (BVG 30b) (MSES).

The Inderi property already supports three other offset areas (two in progress and one established) including a 137.2 ha BMA offset (secured in 2014) for values associated with the Natural Grasslands of the Queensland Central Highlands and northern Fitzroy Basin Threatened Ecological Community (MNES).

3.1.1 Inderi ~~OIA and~~ Offset Area

Offset suitability assessments were completed by E2M across the Inderi ~~OIA.~~Area of Interest. Following the completion of the field surveys and identification of target ~~offset~~protected matters, a subset of the ~~OIA~~Area of Interest (i.e. Inderi Offset Area) was then determined based on the availability of suitable habitat and vegetation to acquit associated offset requirements for *Dichanthium queenslandicum* (MNES) and Regulated Vegetation containing 'of concern' RE 11.8.11 (BVG 30b) (MSES). The Inderi Offset Area spans 67 ha and is strategically located amongst the other three for a cumulative environmental benefit (Figure 1).

Table 6. Inderi Offset Area details

Property name	Inderi
Lot on Plan	Lot 55 DSN318
Tenure	Freehold
Primary LGA	Central Highlands Regional Council
Planning Scheme Zone	Rural
Property area	3,033.52 ha
Offset area	The Inderi Offset Area spans 66.61 ha and will acquit: • The area required to offset regulated vegetation (BVG30b) under the Queensland EO Act using the Land-based Offsets Multiplier Calculator is 34 ha of non-remnant RE 11.8.11; and • The area required to offset EPBC Act obligations is 33 ha (king bluegrass habitat)
Legally binding mechanism	Voluntary Declaration (*Vegetation Management Act 1999*)

Figure 1. Inderi Offset Investigation Area and associated Offset Area

3.2 Desktop results

The desktop assessment identified the following environmental matters potentially occurring within or in proximity (20 km) of the Inderi Offset Area:

- MNES identified under the EPBC Act, including:
  - Six TECs, including:
    - Natural Grassland TEC;
    - Brigalow TEC;
    - Coolibah - Black Box Woodlands of the Darling Riverine Plains and the Brigalow Belt South Bioregions;
    - Poplar Box Grassy Woodland on Alluvial Plains;
    - Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions; and
    - Weeping myall woodlands
  - 23 threatened flora and fauna species, including the targeted king bluegrass (*Dichanthium queenslandicum*) and ornamental snake (*Denisonia maculata*); and
  - Listed migratory species
- MSES identified under the EO Act; including:
  - Regulated Vegetation, comprising:
    - Of Concern prescribed REs (BVG 30b and 17a);
    - prescribed REs intersecting a watercourse; and
  - Essential habitat for ornamental snake (*Denisonia maculata*) and king bluegrass (*Dichanthium queenslandicum*).

3.3 Existing environment

3.3.1 Survey conditions

The Inderi ~~OIA and~~ Offset Area was surveyed by two ecologists on the 10th and 11th May 2021. Survey conditions during the field survey were dry, with temperatures ranging from 11.4˚C to 31.5˚C[2]. Below average rainfall was recorded during the three-month period (i.e. February, March and April) preceding the field survey, recording a total of 67.6 mm (Bureau of Meteorology[3] (BOM) 2021). As such, conditions for identification of annual groundcover species, including grass and forb species, were not considered optimal.

[3] Rolleston Airport weather station 035129

3.3.2 Vegetation communities

3.3.2.1 Inderi ~~OIA~~Offset Area

A total of three REs were identified within the Inderi ~~OIA~~Offset Area, comprising remnant, regrowth and non-remnant vegetation. A summary of REs, vegetation type, associated BVG, field survey description and extent are provided in Table 7 and depicted in Figure 2. The majority of the ~~OIA~~Offset Area was found to contain remnant and non-remnant grasslands consistent with RE 11.8.11 (172.71 ha) and eucalypt sparse open woodlands, characteristic of RE 11.8.5 (183.43 ha).

3.3.2.2 Inderi Offset Area

Within the Inderi Offset Area, a total of three REs were identified, comprising remnant and non-remnant vegetation. The non-remnant grasslands, consistent with RE 11.8.11, were dominated by introduced species, including buffel grass (*Cenchrus ciliaris**), red natal grass (*Melinis repens**) and parthenium (*Parthenium hysterophorus**). Associated native species included *Dichanthium* spp., *Aristida* spp., *Iseilema vaginiflorum*, *Eriochloa crebra* and *Panicum decompositum*.

Remnant RE 11.8.5 areas were observed on undulating rises and upper slopes. These areas were dominated by mountain coolabah (*Eucalyptus orgadophila*) with associated red bloodwood (*Corymbia erythrophloia*) with a sparse shrub layer comprising *Bursaria incana* and *Grewia* spp. The ground layer comprised a combination of the introduced and native grass species.

A small area of non-remnant RE 11.3.3a was also observed within the Inderi Offset Area in association within ephemeral drainage lines. This community was dominated by black tea tree (*Melaleuca bracteata)* occurring on heavy clays/loams. The ground layer was dominated by introduced and native grasses similar to species observed within non-remnant RE 11.8.11.

Table 7. Ground-truthed REs within the Inderi property ~~Offset Investigation Area and~~ Offset Area

RE	BVG	VM Act[1] class	Field description	Vegetation type	Total area (ha) within Inderi Offset Area
11.3.3a	21b	OC	• Regrowth *Melaleuca bracteata* woodland (8 m) with *Acacia salicina* and *Eremophila mitchellii* along an unnamed drainage (SO1) within the southern part of the Area of Interest • The sparse shrub layer consisted of juvenile canopy species with *Carissa ovata, Grewia latifolia,* and *Capparis canescens.* • Native grass species present in the ground layer were similar to that of the adjacent natural grasslands and included multiple species in the genus *Aristida, Sporobolus* and as *Bothriochloa ewartiana* and *Enteropogon acicularis.*	Regrowth	0
				Non-remnant	0.32
11.8.5	11a	LC	• *Eucalyptus orgadophila* and *Corymbia erythrophloia* with *Bursaria incana* open woodland (14 m) on basalt derived plains (Photo 1). • Sparse shrub layer consisting of juvenile canopy species and *Grewia latifolia* • The ground layer comprised a combination of native and exotic grass species including Dichanthium species, *Heteropogon contortus*, *Aristida leptopoda, Eriochloa crebra and Melinis repens*, Cenchrus ciliaris* and Parthenium hysterophorus*.*	Remnant	26.78
11.8.11	30b	OC	• Natural grassland composed of native grass species across gently undulating rises (Photo 2). Emergent trees and shrubs were absent from the grassland. Ground cover was sparse to very sparse at the time of survey (due to dry survey conditions). • Native grass species include: *Dichanthium species, Aristida leptopoda, Aristida latifolia, Panicum decompositum, Heteropogon contortus, Eriochloa* spp., *Enneapogon* spp., *Bothriochloa* spp., *Digitaria* spp., *Tragus australianus* and *Iseilema vaginiflorum.*	Remnant	0
				Non-remnant	39.83

RE	BVG	VM Act[1] class	Field description	Vegetation type	Total area (ha) within Inderi Offset Area
			• The vegetation classification was non-remnant due to the non-native species cover. Non-native species include: *Parthenium hysterophorus** was present at low densities (likely underestimated due to dry condition), *Cenchrus ciliaris** (low to dense ground cover), *Melinis repens** and *Setaria parviflora**.		

[1] Vegetation Management Act class: E – Endangered; OC – Of Concern; and LC – least concern

Photo 1. Mountain coolabah (*Eucalyptus orgadophila*) and red bloodwood (*C. erythrophloia*) woodland within the Inderi ~~OIA~~Offset Area (RE 11.8.5)

Photo 2. Natural grasslands characteristic of RE 11.8.11 within the Inderi Offset Area

Figure 2. Ground-truthed Regional Ecosystems

3.3.3 Flora habitat values

3.3.3.1 Inderi ~~OIA~~Offset Area

One target threatened flora species, king bluegrass (*Dichanthium queenslandicum*), was identified during the May 2021 field survey. King bluegrass is a perennial grass species endemic to central and southern Queensland, occurring on heavy fertile black soils within the Fitzroy Basin and regions near the northern Darling Downs district (DSEWPaC 2013; Stanley and Ross, 1989). Within its distribution, king bluegrass inhabits native grasslands and open woodlands with a grassy understorey and a *Eucalyptus orgadophila, Corymbia erythrophloia*, *E. coolabah* tree layer (DSEWPaC 2013; Stanley and Ross 1989). The species occurs in association with other bluegrasses (*Dichanthium spp*. and *Bothriochloa spp*.) and other native grasses associated with heavy, black soil types (Simon 1982).

Despite the dry conditions, king bluegrass was recorded at two locations in a remnant grassland and open woodland communities (REs 11.8.11 and 11.8.5) within the Inderi ~~OIA~~Area of Interest (Photo 3 and Figure 3). A specimen was collected and submitted to the Queensland Herbarium where the identification was confirmed. The species has also been previously recorded within the adjacent BMA offset area (refer to Figure *3*). ~~The Inderi OIA supports approximately 356 ha of *Dichanthium queenslandicum* habitat in association with remnant and non-remnant REs 11.8.11 and 11.8.5.~~

~~3.3.3.2 Inderi Offset Area~~

~~Although no king bluegrass individuals were observed within the Inderi Offset Area during the May 2021 field survey, approximately 67 ha of suitable habitat was present, comprising remnant RE 11.8.5 and non-remnant RE 11.8.11.~~ The Inderi Offset Area is located between the confirmed records of king bluegrass (i.e. the ~~species identified~~record within the existing BMA offset area (700 m to the south-east) and ~~habitat~~the E2M field record to the north-west (approximately 2.6 km~~).~~)). While the species was not detected within the Inderi Offset Area, the proximity to confirmed records of the species, coupled with active management, suitable habitat is considered likely to support populations of the species over the duration of the offset.

In total, the Inderi Area of Interest supports approximately 356 ha of *Dichanthium queenslandicum* habitat in association with remnant and non-remnant REs 11.8.11 and 11.8.5. However, only 33 ha is notionally required to acquit Project impacts. The Inderi Offset Area is 66.95 ha.

The Inderi Offset Area also contains areas of DoR-mapped essential habitat for king bluegrass (*Dichanthium queenslandicum*), associated with DoR mapped Remnant vegetation containing RE 11.8.5. These areas are associated with the record detected within the existing BMA offset area established in 2014 (Figure *3*).

Photo 3. *Dichanthium queenslandicum* recorded within the ~~Inderi OIA~~broader study area during field survey (left) and seed head (right)

Figure 3. Inderi Offset Area Dichanthium queenslandicum ~~Habitat~~habitat

3.3.4 Fauna habitat values

No threatened fauna species were recorded during the field surveys within the Inderi ~~OIA~~Area of Interest or Offset Area. Suitable habitat for target threatened fauna species relevant to the HPE Project (i.e. ornamental snake) was not observed within the Inderi ~~OIA.~~Area of Interest.

3.3.5 Ecological function

3.3.5.1 Waterways and wetland features

No watercourses are mapped within the Inderi Offset Area.

The Inderi ~~OIA~~Area of Interest contains DoR mapped stream order (SO) 1 and 2 watercourses. All watercourses and drainage lines within the ~~OIA~~Area of Interest were ephemeral and dry at the time of the field surveys. Riparian corridors varied in composition and structure with some areas fringed by regrowth/degraded black tea tree (*Melaleuca bracteata*) with introduced and native grass. The watercourses were characterised by narrow, meandering channels with black, loam beds.

No wetland management areas or MSES wetlands are mapped within the Inderi ~~OIA~~Area of Interest or Offset Area.

3.3.5.2 Connectivity Areas

The Inderi ~~OIA~~Area of Interest and Offset Area, situated within the Basalt Downs subregion of the Brigalow Belt Bioregion, contains 156.77 ha of non-remnant/regrowth vegetation able to support connectivity area offsets, including 150 ha of non-remnant RE 11.8.11 (native grassland).

3.4 Additional ecological values within the Offset Area

3.4.1 MNES

3.4.1.1 Threatened Ecological Communities

No Natural Grasslands TEC is located within the Inderi Offset Area. While areas associated with remnant and non-remnant RE 11.8.11 did not qualify for the Natural Grasslands TEC, these areas have potential to qualify in the future pending grassland restoration and/or management efforts to reduce weed encroachment and promote native tussock cover. The prevalence of weed species (mostly parthenium and buffel grass) and the scarcity of grass tussocks precluded this community from qualifying as a 'best' or 'good' condition grassland.

3.4.1.2 Threatened species

One additional threatened species, namely *Dichanthium setosum,* listed as Vulnerable under the EPBC Act is also considered likely to occur within the Inderi Offset Area.

Dichanthium setosum is a perennial grass up to 70 cm tall, with unbranched culms and bearded nodes (Stanley and Ross 1989b). Leaf sheaths are glabrous and linear, reaching up to 18 cm in length and 0.15 to 0.4 cm wide (Stanley and Ross 1989b). Spikelets are arranged on one to two racemes, rarely three, 3.5 to 8 cm long (Stanley and Ross 1989b). The sessile spikelet is 5 to 6 mm long with long hairs on the lower of the glume. Pedicellate spikelets are 5 to 5.5 mm long (Stanley and Ross 1989b). Lemma and awn on upper florets are approximately 2.5 cm long (Stanley and Ross 1989b).

The species occurs in natural grasslands and eucalypt woodlands on heavy, basalt-derived, black soils and red-brown, hard-setting, loam with clay subsoils (Stanley and Ross 1989b). The species is relatively tolerant to disturbance and has been recorded within disturbed areas such as cleared woodlands, grassy roadside remnants, grazed land and pastures (Stanley and Ross 1989b).

The species has been recorded on the Meteor Downs Station, located 10 km west of the Inderi Property within *Eucalyptus orgadophila, Eucalyptus melanophloia* and *Corymbia erythrophloia* open woodlands (RE 11.8.5) (Atlas of Living Australia 2021; BRI AQ0971077; BRI AQ0971078; BRI AQ0732237).

Approximately 67 ha of suitable *D. setosum* habitat is present within the Inderi Offset Area, in association with vegetation communities containing RE 11.8.11 and RE 11.8.5.

3.4.2 MSES

3.4.2.1 Protected wildlife habitat

The DoR-mapped essential habitat for the ornamental snake was inspected during the field surveys and found to lack the attributes required to support the species. The closest record for the species is approximately 20 km southeast of the Inderi Offset Area, near the township of Rolleston (DES 2018).

Three additional threatened flora species listed under the NC Act are also considered likely to occur within the Inderi Offset Area. Specifically, these species include:

- *Cyperus clarus* (Vulnerable);
- *Digitaria porrecta* (Near Threatened); and
- *Trioncinia retroflexa* (Vulnerable).

3.4.2.1.1 Cyperus clarus

Cyperus clarus, listed as Vulnerable under the NC Act, is a slender tufted perennial up to 90 cm tall, which is found near Emerald in central Queensland to Delungra on the New South Wales north-west slopes (Wilson 1991). *Cyperus clarus* stems are erect and rigid, smooth to scabrous at the tip and 1-2.5 mm thick (Wilson 1991). The leaves are flat or folded (2-6 mm wide) and shorter than the flowering stem (DES 2019b). The flower head has 3 to 6 branches to 10 cm long, with each branch consisting of dense clusters of 8 to 20 short spikelets (Wilson 1991). The spikelets are flattened (7 to 18 mm long and 3 to 4.5 mm wide), with glumes golden brown to brown, 3 to 4 nerved, 2.5 to 4 mm long with the sides having and an excurved tip (Wilson 1991). The egg-shaped nuts are dusky brown to black in colour, 1.6 to 1.9 mm long and 0.6 to 0.8 mm in diameter (Cunningham et al. 1981).

Within its distribution, *Cyperus clarus* occurs on black soil (basalt derived) within grasslands or open woodland (Wilson 1991). The species is associated with grasslands on deep alluvial black clay where *Aristida leptopoda* and *Panicum queenslandicum* occur; and in *Eucalyptus melanophloia* woodland with mid-dense ground stratum of *Chrysopogon fallax* (DES 2019b). The species has been previously recorded within 20 km of the Inderi Offset Area in association with Albinia National Park. Suitable habitat within the Inderi Offset Area include non-remnant grasslands (RE 11.8.11) and remnant open eucalypt woodlands (RE 11.8.5).

3.4.2.1.2 Digitaria porrecta

Digitaria porrecta, listed as Near Threatened under the NC Act, is a loosely tufted, erect, or ascending grass up to 60 cm tall. The species has been recorded from Nebo, south-west of Mackay, the Central Highlands between Springsure and Rolleston and from Jandowae south to Warwick (DES 2019b).

The culms of the species are branched and the nodes are pubescent (Webster 1987). The leaf sheaths are typically glabrous, or have a few hairs towards the base, with membranous ligules 2 to 3 mm long. The leaf blades are linear (5-15 cm long and 0.3-0.4 cm wide), pubescent or glabrous with an attenuate apex (Webster 1987). Inflorescence are on panicles with several racemes up to 25 cm long, with lower racemes whorled and branched (3 to 10 cm long) with upper racemes solitary (Webster 1987). The spikelets are arranged in pairs, 5 to 7 mm long, with the lower glume 1-1.5 mm long and upper glume shorter than spikelet (Stanley and Ross 1989c).

Within its distribution, *Digitaria porrecta* occurs in native tussock grasslands, open woodlands containing poplar box (*Eucalyptus populnea*) or forest red gum (*E. tereticornis*) on heavy, cracking clays (DES 2019b). The species has been previously recorded within proximity (10 km) of the Inderi Offset Area, at the Rolleston Coal Mine (Atlas of Living Australia 2021). Suitable habitat within the Inderi Offset Area include non-remnant grasslands (RE 11.8.11) and remnant open eucalypt woodlands (RE 11.8.5).

3.4.2.1.3 Trioncinia retroflexa

Trioncinia retroflexa, listed as Endangered under the NC Act, is considered likely to occur within the Inderi ~~OIA.~~Area of Interest. The species is an erect, perennial herb, to 50 cm tall, endemic to Clermont and Springsure in central Queensland, occurring on basaltic plains (Queensland Herbarium 2017). Leaves are usually basal alternate, deeply divided (once or twice), trowel-shaped and up to 3.7 cm long by 2.5 cm wide. The flower heads are up to 7mm in diameter and radiate on stems from the centre of the plant (Veldkamp 1992). The ring of involucral bracts surrounding the flower head are straight with at least five irregular florets around the outer edge of the flower head. The ray florets are 2-lobed and approximately 3.25 mm long (Veldkamp 1992). There are 10 or more disc florets in the centre of the flower head, each with 4 short, yellow petals (Veldkamp 1992). The fruit are 8-11 mm long, dark-brown to black in colour, slightly curved inward, ribbed and with a number of warty ridges (Veldkamp 1992). There are three, sometimes four, strongly reflexed awns at the apex (Veldkamp 1992).

Within its distribution, *Trioncinia retroflexa* habitat includes grasslands on basalt soils and dark brown or black cracking clay soils (Veldkamp 1992). Several records of the species have been previously documented in grasslands within 16 km of the Inderi Offset Area . Suitable habitat within the Inderi Offset Area include non-remnant grasslands (RE 11.8.11).

4 Croydon Station Offset Area Description

4.1 Property details

Croydon Station (~~formally~~ Lot 4 on Plan KL210) is a large 58,669 ha cattle station located 100 km north of Marlborough and approximately 100 km east southeast of the HPE Project ~~area.~~(i.e. the impact site). Croydon Station occurs in both the Isaac-Comet Downs and Nebo-Connors Ranges biogeographic subregions and is bordered by the Connors Ranges to the east.

~~Brigalow~~The vegetation within the property is predominately shrubby brigalow (*Acacia harpophylla*) (RE 11.4.9) with mixed eucalypt woodland (RE 11.3.2/11.3.4/11.3.7) on alluvial plains along numerous drainage systems including Lotus Creek and Connors River.

Brigalow was first cleared ~~within~~on the ~~Croydon OIA~~Station in the early 1970s and ~~has~~have been periodically re-cleared to manage regrowth ~~(DoR, 2022).~~(DoR, 2022). Pasture improvement with species such as buffel grass (*Cenchrus ciliaris*) has also been undertaken~~.~~ to support cattle grazing.

BHP Mitsui Coal Pty Ltd (BMC) currently ~~have~~own and manage an existing 360.54 ha Offset Area (Category A) secured within Croydon Station immediately adjacent to the ~~OIA~~northern extent of the Area of Interest (Figure 4).

~~4.1.1~~ The Croydon ~~OIA and Offset~~Station Area

~~Offset suitability assessments were completed by E2M across the Croydon OIA, spanning on a 1,204.5 ha (Figure 4). The OIA is mapped as non-remnant, brigalow (*Acacia harpophylla*) shrublands (RE 11.4.8/11.4.9). The Connors River (stream order 7) and two unnamed stream order 3 anabranches traverse the OIA and serve as permanent water sources. Following the completion~~ of ~~the field surveys and identification of target offset matters, a subset of the OIA (i.e.~~ Interest~~Croydon Offset Area)~~ was ~~then determined based on the availability of suitable habitat and vegetation to acquit associated offsets~~surveyed for it's suitability to offset Project impacts to ornamental snake ~~(*Denisonia maculata*) (MNES). The Croydon~~habitat, squatter pigeon habitat and connectivity area.

Table 8. Property and Offset Area details

Property name	Croydon Station
Lot on Plan	Lot 4 on Plan KL210
Tenure	Leasehold
Primary LGA	Isaac Regional Council
Planning Scheme Zone	Rural
Property area	58,669 ha
Offset area	The Croydon Offset Area is 502.48 ha and can acquit the required 259 ha offset for ornamental snake and 228 ha for squatter pigeon (southern).
Legally binding mechanism	Voluntary Declaration (*Vegetation Management Act 1999*)

4.1.1 Croydon Offset Area

The Croydon Offset Area is a subset of the broader Area of Interest delineated to capture the requisite amount of ornamental snake habitat and squatter pigeon habitat necessary to fulfil the notional offset areas (259 ha and 228 ha, respectively).

The 512.26 ha Offset Area consists of remnant eucalypt woodland and regrowth brigalow. Much of the area demarcated as an offset for squatter pigeon habitat consists of riparian habitat along Lotus Creek located south of Lotus Creek Road whereas all of the ornamental snake habitat is located within regrowth shrubby brigalow north of Lotus Creek Road. As the two target matters have different habitat types, the requisite offset areas cannot be collocated.

The Croydon Offset Area is partially located adjacent to the existing BMC offset area (Figure 4).

Securing the Croydon Offset Area will facilitate connectivity between the two offset areas and enhance the conservation benefit for the species and vegetation communities the offsets are currently managed for (i.e. ornamental snake, squatter pigeon, yakka skink, Brigalow Threatened Ecological Community as well as other 'least concern' species inhabiting the area).

Figure 4. Croydon Station ~~Offset Investigation Area and~~ Offset Area

4.2 Desktop results

The desktop assessment identified the following environmental matters potentially occurring within or in proximity (20 km) of the Croydon ~~OIA~~Area of Interest:

- MNES identified under the EPBC Act, including:
  - Four TECs, including:
    - Brigalow TEC;
    - Natural Grassland TEC;
    - Poplar box grassy woodlands on alluvial plains; and
    - Semi-evergreen vine thickets of the Brigalow Belt (North and South) and Nandewar Bioregions
  - 28 threatened flora and fauna species, including the targeted king bluegrass (*Dichanthium queenslandicum*), squatter pigeon (southern) (*Geophaps scripta scripta*) and ornamental snake (*Denisonia maculata*); and
  - Listed migratory species.
- MSES identified under the EO Act; including:
  - Regulated Vegetation, comprising:
    - Endangered and Of Concern prescribed REs (BVG 25a, 17a and 16c);
    - prescribed REs intersecting a watercourse; and
  - Protected wildlife habitat comprising essential habitat for ornamental snake (*Denisonia maculata*), koala (*Phascolarctos cinereus*) and king bluegrass (*Dichanthium queenslandicum*).

4.3 Existing environment

4.3.1 Survey conditions

The Croydon ~~OIA and Offset~~ Area of Interest was surveyed by two ecologists ~~from the~~ during two separate field trips:

- 12th to 15th May 2021~~.~~; and
- 6th to 10th April 2022.

Survey conditions during the May 2021 field survey were dry, with temperatures ranging from 11˚C to 31˚C. Recent rainfall data is limited for the area. Carfax weather station (034016) (approx. 35 km west of ~~OIA~~Area of Interest) recorded 24 mm of rainfall in February 2021 and 49 mm in March 2021 (no data for April 2021). Iffley weather station (34100) (approx. 60 km west of ~~OIA~~Area of Interest) recorded 41 mm of rainfall in February 2021 and 25 mm in April 2021 (no data for March 2021). Based on available data and anecdotal evidence, Croydon Station has likely received limited rainfall (~100 mm) over the three months preceding the field survey. Conditions during the field survey were dry and ground cover was limited.

Survey conditions during the April 2022 field survey were also dry, with temperatures ranging from 19˚C to 32˚C. Iffley weather station (approx. 60 km west of Area of Interest) recorded 88 mm of rainfall in three month period preceding the field survey.

4.3.2 Vegetation communities

~~4.3.2.1 Croydon OIA~~

~~A total of two REs were identified within Croydon OIA. A summary of REs, vegetation type, associated BVG, field survey description and extent is provided in Table 9 and depicted in Figure 5.~~

~~4.3.2.2 Croydon Offset Area~~

The majority of the Croydon Offset Area was found to contain regrowth brigalow (*Acacia harpophylla*) as the ecologically dominant layer, consistent with RE 11.4.9~~.~~ in the north and RE 11.3.1 in the southern extent. Other associated shrub species observed included Queensland ebony (*Lysiphyllum carronii*), yellowwood (*Terminalia oblongata*), *Capparis* spp. and scrub boonaree (*Alectryon diversifolius*) (Photo 4). Ground layer cover was limited and composed of mixed native and introduced grasses and forbs, including and buffel grass (*Cenchrus ciliaris**), fairy grass (*Sporobolus caroli)*, parthenium (*Parthenium hysterophorus**), sabi grass (*Urochloa mosambicensis**), harissia cactus (*Harrisia martinii**) and *Bothriochloa* spp.

Remnant riparian corridors, comprising RE 11.3.25, were characterised by Queensland blue gum (*Eucalyptus tereticornis)* and river red gum (*E. camaldulensis)* dominated woodlands to 21 m tall. Associated subcanopy species included *Acacia salicina*, *Lysiphyllum hookeri*, *Melaleuca* spp., sandpaper fig (*Ficus coronata*) and Moreton Bay ash (*Corymbia tessellaris*). The ground layer was heavily disturbed from cattle, particularly around areas containing water, dominated by exotic species including Parthenium (*Parthenium hysterophorus**), snakeweed (*Stachytarpheta jamaicensis**) and harissia cactus (*Harrisia martinii**).

Photo 4. Typical regrowth brigalow (RE 11.4.9) present throughout the Croydon Station ~~OIA and~~Area of Interest and northern parts of the Croydon Offset Area

Table 9. ~~GTREs~~Vegetation communities within the Croydon Offset ~~Investigation Area and Offset~~ Area

RE	BVG	VM Act class[1]	Field description	Vegetation type	Total area (ha) within Croydon Offset Area
11.3.1	25a	E	• *Acacia harpophylla* dominated woodlands and shrublands with *Lysiphyllum carronii, Terminalia oblongata, Capparis spp. Alectryon diversifolius, Atriplex muelleri* and *Sclerolaena birchii* (Photo 4). • gilgai present, but varying levels of soil cracks across these areas. • Low to moderate density parthenium*, *Harrisia martinii**, *Urochloa mosambicensis* Parkinsonia aculeata** and *Cenchrus ciliaris**.	Remnant	0.11
11.3.2	17a	OC	• *Eucalyptus populnea* woodland on alluvial plains	Remnant	2.03
11.3.3	16c	OC	• *E. coolabah* dominated woodlands with associated *A. harpophylla* and *E. tereticornis*. • Native ground layer species include *Eleocharis* spp., *Cyperus* spp., *Paspalidium* spp., *Juncus* sp. and *Leptochloa digitata* • Low to moderate density *Harrisia martinii**, *Xanthium spinosa* Parkinsonia aculeata** and *Cenchrus ciliaris**.	Remnant	41.38
11.3.4	16c	OC	• Mixed eucalypt woodlands comprising *E. tereticornis, Corymbia tessellaris, C. dallachiana, E. coolabah* and *Acacia salicina.* • Native ground layer species include *Eragrostis* spp., *Chrysopogon fallax*, *Panicum* sp., *Bothriochloa* sp. and *Dichanthium sericeum* • Low density *Harrisia martinii**, *Cenchrus ciliaris* Parkinsonia aculeata**, *Vachellia farnesiana** and *Stylosanthes scabra**.	Remnant	38.83
11.3.7	9e	LC	• Mixed eucalypt woodlands comprising *Corymbia tessellaris, C. dallachiana* and *Acacia salicina.* • Native ground layer species include *Eragrostis* spp., *Chrysopogon fallax* and *Dichanthium sericeum*	Remnant	9.42

RE	BVG	VM Act class[1]	Field description	Vegetation type	Total area (ha) within Croydon Offset Area
			• Low density *Harrisia martinii**, *Cenchrus ciliaris**, *Vachellia farnesiana** and *Stylosanthes scabra**.		
11.3.25	16a	LC	• thin *E. tereticornis*/*E. camaldulensis* with fringing creek lines, 21 m tall canopy). • accompanying canopy species include *Acacia salicina*, *Lysiphyllum hookeri*, *Melaleuca spp.*, sandpaper fig (*Ficus coronata*) and *Corymbia tessellaris.* • highly disturbed understorey in some areas, impacted by cattle. Other areas included juvenile canopy species as well as sedges such as *Gahnia aspera.* • weeds included low densities of mimosa bush (*Vachellia farnesiana*).	Remnant	~~120.49~~156.65
11.4.9	25a	E	• ~~*Acacia harpophylla* dominated woodlands and shrublands with *Lysiphyllum carronii*, *Terminalia oblongata*, *Capparis spp.* *Alectryon diversifolius*, *Atriplex muelleri* and *Sclerolaena birchii* (Photo 4).~~ • A thin band of remnant brigalow (*Acacia harpophylla*) (15 m tall) with a highly disturbed understory located adjacent to a riparian area/creek line. • *Acacia harpophylla* shrubland (2-4 m) with minor areas containing emergent *Eucalyptus cambageana* (4-6 m) with gilgai. • gilgai present. • Low density parthenium*, *Harrisia martinii*~~*),~~*, *Urochloa mosambicensis** and *Cenchrus ciliaris**.	Regrowth~~Remnant~~	~~2~~263.69

[1] Vegetation Management Act class: E – Endangered; OC – Of Concern; and LC – least concern
[2] Biodiversity Status: E – Endangered; OC – Of Concern; and NC – No Concern at Present

Figure 5. Croydon ~~Ground~~ground-truthed and State mapped Regional Ecosystems

4.3.3 Target flora species

No target threatened flora species were recorded during the field surveys within the Croydon ~~OIA or~~ Offset Area.

4.3.4 Target fauna species

~~4.3.4.1 Croydon OIA~~

Suitable habitat for ~~one threatened fauna species~~two target protected matters, ornamental snake~~,~~ and squatter pigeon (southern), was ~~observed~~recorded during ~~the~~ field surveys within the Croydon Station Area of Interest.

4.3.4.1 Ornamental Snake~~survey.~~

Approximately 723.5 ha of suitable ornamental snake habitat was ground-truthed within the Croydon ~~OIA.~~ Area of Interest; however only 259 ha are notionally required to fully acquit the requisite offset.

Gilgai were observed throughout remnant, regrowth and non-remnant RE 11.4.8/11.4.9 and differed in size and depth, with varying soil crack depths (shallow to deep) (Photo 5). Coarse woody debris ~~was~~is limited within these areas; ~~however,~~but the shrub cover (~19%) ~~was~~is relatively low to the ground (1.5 m tall) ~~providing~~and likely to provide adequate refuge for the species.

~~The terrestrial ecological survey was~~The May 2021 and April 2022 field surveys were conducted outside of the recommended ornamental snake survey window (i.e. summer/wet season) and while daytime temperatures were warm (~30°C), night time temperatures dropped to ~11°C (BOM 2021). The cooler temperatures and dry conditions likely affected the availability of prey (i.e. frogs) and reduced nocturnal activity (and likelihood of detection) of the species.

~~4.3.4.2 Croydon Offset Area~~

~~A total of 264~~Approximately 263.68 ha of ~~suitable habitat for the~~ ornamental snake habitat was demarcated from the total available habitat identified within the ~~Croydon Offset Area.~~broader area (i.e. approximately 723.5 ha of ornamental snake is available). While ~~no individuals were~~the species was not observed during the 2021/2022 field ~~survey, the species has been previously~~surveys, ornamental snake was recorded ~~during ecological surveys conducted~~in 2016 by Eco Logical Australia ~~(2016), in association~~during ecological studies associated with the ~~existing~~adjacent BMC offset. These records were located within in brigalow regrowth habitat, located on the eastern boundary of the Offset Area and areas to the east of Connors River (Figure *6*).

Photo 5. Gilgai within brigalow regrowth supports suitable ornamental snake habitat

Figure 6. Croydon Offset Area ornamental snake habitat

4.3.4.1.1 Squatter pigeon

A total of 246.50 ha of squatter pigeon (southern) habitat has been allocated within the Offset Area to satisfy the notionally required offset area (i.e. 228 ha) (Table 10).

Seven squatter pigeon were recorded at three locations within the broader study area during the May 2021 field surveys (Figure 7). The observations were made approximately 2.2 km from the Offset Area in association with remnant riparian vegetation fringing the eastern anabranch of Connors River.

Photo 6. Squatter pigeon observed within the Croydon Study Area during May 2021 field surveys

Preferred habitat was recorded in association with remnant and non-remnant riparian vegetation along Lotus Creek, anabranches of Connors River that traverse the broader study area and associated floodplain. The Lotus Creek and Connors River anabranches are considered permanent water sources. Suitable habitat was also mapped in association with areas of remnant and regrowth vegetation. Squatter pigeon habitat was mapped in accordance with the criteria detailed within the draft Central Queensland Threatened Species Habitat Descriptions (Kerswell et al., 2020), consistent with the method adopted for the Project.

Table 10. Squatter pigeon habitat within the Offset Area

GTRE	Vegetation Type	Offset area (ha)
11.3.25	Remnant	156.62
11.3.3	Remnant	41.55
11.3.4	Remnant	38.91
11.3.7	Remnant	9.42
	TOTAL squatter pigeon habitat within the Offset Area	246.50

Figure 7. Croydon Offset Area squatter pigeon (southern) habitat

4.3.5 Ecological function

4.3.5.1 Waterways and wetland features

~~No~~A number of watercourses are ~~mapped~~located within the Croydon Offset Area, ~~however it is located between two branches of the Connors River.~~

~~The Croydon OIA is traversed by multiple DoR mapped stream orders,~~ including ~~SO 1, 2, 5, 6 and 7 (Figure 5).~~ Lotus Creek and ~~the lower branches~~anabranches of Connors River ~~contained water at the time of the field survey, with upper branches and ephemeral drainages largely dry or containing scattered pools.~~. Higher stream order watercourses within the ~~OIA~~Offset Area were characterised by wide, sandy channels with defined bed and banks. At the time of the field surveys the upper branches of Connors River and ephemeral drainages were largely dry or containing scattered pools, with Lotus Creek containing flowing water.

No wetland vegetation management areas or MSES wetlands are mapped within the Croydon ~~OIA~~Area of Interest or Offset Area.

4.3.5.2 Connectivity

~~The~~ Croydon ~~OIA~~Station, located within the Isaac-Comet Downs subregion of the Brigalow Belt Bioregion, contains ~~655.91~~1,329 ha of regrowth vegetation that may provide potential Connectivity Area offsets, including 263.68 ha within the Croydon Offset Area (Figure 8).

Figure 8 ~~Suitable offsets for~~. MSES connectivity areas within the Croydon ~~OIA and~~ Offset Area

4.4 Additional ecological values within the Offset Area

4.4.1 MNES

4.4.1.1 Threatened Ecological Communities

No TECs listed under the EPBC Act were identified within the Croydon Offset Area during the field survey. The brigalow (*Acacia harpophylla*) regrowth communities (~~RE~~REs 11.4.9 and 11.3.1) observed within the Offset Area has the potential to develop into the Brigalow TEC over time, with appropriate management. While these shrubland communities are dominated by brigalow (*Acacia harpophylla*) and conform to the RE type, area requirements and weed cover thresholds, they have been comprehensively cleared in the last 15 years and are therefore, at the time of survey, excluded from the Brigalow ecological community.

4.4.2 MSES

4.4.2.1 Regulated Vegetation

Areas containing ~~regrowth~~endangered remnant REs 11.3.1 and 11.4.9 and of concern REs 11.3.3 and 11.3.4 may be suitable offsets for MSES regulated vegetation. Regrowth vegetation of RE 11.4.9 and RE 11.3.1 (BVG 25a), totalling ~~265.88~~692.26 ha, may also be utilised as a potential offset ~~within the Offset Investigation Area~~in conjunction with appropriate management measures for MSES Regulated Vegetation containing an Endangered RE.

5 Habitat Quality Analysis

Habitat quality assessments were conducted in accordance with the *Guide to Determining Terrestrial Habitat Quality Version 1.3* (referred to as the Habitat Quality Guide) (DES 2020). The Habitat Quality Guide measures the overall viability of a potential offset area and its capacity to support the target protected matters.

The Habitat Quality Guide incorporates landscape scale data, site-based vegetation attributes (using the BioCondition assessment framework (Eyre et al. 2015)) and fauna species habitat attributes. The following sections summarise the attribute data for the Inderi Offset Area and Croydon Offset Area. The detailed Habitat Quality score data and associated calculations are in Appendix B.

5.1 Inderi Offset Area scores

5.1.1 Landscape-scale attribute score

Landscape-scale attributes describe the broader landscape surrounding a potential offset area and the relative influence that these areas have on the vegetation quality present. The Inderi Offset Area is located within a fragmented landscape, as identified under the BioCondition Assessment Manual (Eyre et al. 2015). A summary of landscape-scale attribute scores for the Inderi Offset Area are summarised in Table 11. The Inderi Offset Area has a total landscape-scale attribute score of 13 out of 20. The Inderi Offset Area is not located within a mapped State-wide Biodiversity Corridor.

Table 11. Inderi landscape-scale attribute scores for fragmented subregions

Landscape attribute	Comment	Score
Patch size	≥25 – 100 ha remnant OR ≥25 – 200 ha remnant and regrowth	5
Connectivity	connected with adjacent remnant vegetation along 50% to 75% of its perimeter	4
Context	69% remnant	4
Ecological Corridors	The Offset Area is not located within a State Biodiversity Corridor	NA
	Total	13

5.1.2 Site-based attribute scores

A total of 15 BioCondition surveys were conducted across two assessment units within the Inderi ~~OIA~~Area of interest for the two target protected matters (i.e. *Dichanthium queenslandicum* habitat and MSES Regulated Vegetation). The scores were then averaged based on the assessment units present within the Inderi Offset Area. The BioCondition data was analysed to generate the site-based attribute scores summarised in Table 12.

Site-based attribute scores and associated BioCondition data are provided in Appendix C.

Table 12. Inderi Offset Site site-based attribute scores for each target protected matter

Target protected matter	Assessment Unit	Broad Condition Class	RE	Area (ha)	Number of survey sites	Average site-based attribute score (/10)
MNES known to occur						
Dichanthium queenslandicum	1	non-remnant	11.8.11	39.83	8	4.81
	2	remnant	11.8.5	26.78	7	
MSES known to occur						
Regulated Vegetation Of Concern RE (BVG 30b)	1	non-remnant	11.8.11	39.83	8	3.96

5.2 Croydon Offset Area scores

5.2.1 Landscape-scale attribute score

Landscape-scale attributes describe the broader landscape surrounding Croydon Station and reflect the influence the landscape has on vegetation quality within the Croydon Offset Area. The Croydon Offset Area is located within a fragmented landscape, as identified under the BioCondition Assessment Manual (Eyre et al., 2015). A summary of landscape-scale attribute scores for the Croydon Offset Area are summarised in Table 13. The Croydon Offset Area has a total landscape-scale attribute score of 9 out of 20~~. The Croydon OIA is also located within a mapped State-wide Biodiversity Corridor~~.

Table 13. Croydon landscape-scale attribute scores

Landscape attribute	Comment	Score (/20)
Patch size	<5 ha remnant AND/OR regrowth (DoR mapped)	0
Connectivity	Connected with adjacent remnant vegetation along >75% of its perimeter	5
Context	(≥10% to 30% remnant vegetation AND ≥30% regrowth) 28% remnant and 27% regrowth	4
Ecological Corridors	The Offset Area is located within and adjacent to State Biodiversity Corridor (Regional) in association with Lotus Creek	N/A
	Total	9

5.2.2 Site-based attribute score

~~A total of nine BioCondition surveys were conducted within the one assessment unit within the Croydon OIA for the one target protected matter (i.e. ornamental snake habitat). The scores were then averaged~~

based on the assessment units present within the Croydon Offset Area. The BioCondition data was analysed to generate the site-based attribute Habitat Quality scores summarised in Table 14.

Site-based Habitat Quality calculations and BioCondition data are provided in Appendix B.

Table 14. Croydon site-based attribute scores for each target protected matter

Target protected matter	Assessment Unit	Broad Condition Class	RE	Area (ha)	Number of survey sites	Average site-based attribute score (/10)
MNES likely to occur						
ornamental snake (*Denisonia maculata*)	1	regrowth	11.4.9	265.88263.68	9	3.41
squatter pigeon (southern) (*Geophaps scripta scripta*)	3	remnant	11.3.25	156.62	5	5.66
	5	remnant	11.3.3	41.55	1	
	4	remnant	11.3.4	38.91	1	
	6	remnant	11.3.7	9.42	1	
MSES known to occur						
Connectivity area	1	regrowth and non-remnant	11.4.9	263.68265.88	9	3.41

5.2.3 Species habitat attribute score

Species habitat attribute scores assess the suitability of habitat within the Offset Area to support fauna based on species-specific habitat requirements, not just vegetation-based metrics used for site-based attribute scores. Fourteen ornamental snake habitat assessments were conducted throughout regrowth RE 11.4.9.

The 'indicators' (habitat characteristics of species-specific lifecycle requirements) within the Croydon Offset Area that influence the suitability of ornamental snake and squatter pigeon habitat are detailed in Table 15. and Table 16 respectively.

Table 15. Ornamental snake habitat attribute score

Habitat attributes	Indicators	Score	Weighting	Weighted score	Justification
Quality and availability of food and habitat required for foraging (25%)	Abundance of native amphibians (low (0) to high (5)) x5	12.5	1.00	12.5	At the time of survey (late May 2021) the availability of food (i.e. frogs) within the Offset Area was low correlating with the reduced activity period for ornamental snakes. The potential quality and availability of foraging habitat within the Offset Area is high based on the abundance of gilgai, observed soil cracks and proximity to permanent water. This weighted score (12.5) based on dry season data is likely lower than the actual quality and availability of food/foraging habitat.
	Sub-total			12.5	
Quality and availability of habitat required for shelter and breeding (25%)	Gilgai abundance (absent (0) to high (5)) x 5	20	0.25	5	Gilgai are abundant throughout RE 11.4.9 within the Offset Area
	Gilgai depth (shallow (1) to deep (5)) x 5	10	0.25	2.5	Gilgai within RE 11.4.9 are relatively shallow
	Soil crack abundance (absent (0) to abundant (5)) x 5	15	0.20	3	Soil cracks are common within gilgai
	Soil crack depth (shallow (1) to deep (5)) x 5	10	0.20	2	Soil cracks within gilgai vary in depth from shallow to deep
	Woody debris (absent (0) to abundant (5)) x 5	5	0.10	0.5	Woody debris is scarce within RE 11.4.9

Habitat attributes	Indicators	Score	Weighting	Weighted score	Justification
	Sub-total			13	
Quality and availability of habitat required for mobility (25%)	Average patch size (<1ha (0), 1-5ha (8.3), 5-10ha (16.6), >10ha (25))	25	1	25	There are approximately 266 ha of regrowth RE 11.4.9 within the Offset Area, largely contiguous
	Sub-total			25	
Absence of threats (25%)	Cane toad abundance (high (0) to absent (5)) x 5	20	0.25	5	At the time of survey (late May 2021) cane toads were not observed within the RE 11.4.9. Cane toads were opportunistically observed (in low abundance) near permanent water. This weighted score (5), based on dry season data, is likely higher than the actual score (i.e. the threat to ornamental snake from cane toads is realistically higher)
	Habitat degradation via cattle (high (0) to absent (5)) x 5	20	0.25	5	The impact on vegetation, soil and gilgai from cattle at the time of survey appeared low
	Predation by feral species (high (0) to absent (5)) x 5	10	0.25	2.5	Feral pigs were detected regularly during survey and pose a predator risk to ornamental snake
	Invasive weeds (abundant (0) to absent (5)) x 5	20	0.25	5	Weeds and introduced pasture grass were limited within RE 11.4.9 (buffel was localised) but may reflect the dry survey conditions This weighted score (5), based on dry season data, is potentially higher than the actual score (i.e. weeds may be comparatively more abundant in the wet season)
	Sub-total			17.5	
	Total			6.8 / 10	

Table 16. Squatter pigeon (southern) habitat attribute score

Habitat attributes	Indicators	Score	Weighting	Weighted score	Justification
Quality and availability of food and habitat required for foraging (25%)	Average ground cover less than 33% (dense ground cover (>70%) (0) to less than 33% (5)) x 5	10.00	0.5	5.00	Ground cover within the southern extent of squatter pigeon habitat includes improved pasture grass such as buffel, and decreases the habitat quality
	Average distance to water (>3km (0), 1-3km (12.5), <1km (25))	25.00	0.4	10.00	Permanent water sources are within 1 km of squatter pigeon habitat within the Area of Interest
	Abundance of seeds (absent (0) to abundant (5)) x 5	15.00	0.1	1.50	Seed diversity was moderate during the field survey
	Sub-total			16.50	
Quality and availability of habitat required for shelter and breeding (25%)	Average ground cover less than 33% (dense ground cover (>70%) (0) to less than 33% (5)) x 5	10.00	0.5	5.00	Ground cover within the southern extent of squatter pigeon habitat includes improved pasture grass such as buffel, and decreases the habitat quality
	Average distance to water (>1km (0), <1km (25))	25.00	0.4	10.00	Permanent water sources are within 1 km of squatter pigeon habitat within the Area of Interest
	Well-draining soil for nesting (absent (0) to majorly (5)) x 5	5.00	0.1	0.50	Most of the squatter pigeon habitat within the Area of Interest is located on Land Zone 3 which includes a diverse range of soils but typically is poorly drained
	Sub-total			15.50	
Quality and availability of habitat required for mobility (25%)	Dispersal habitat (no barrier to movement) present connecting fragmented patches of breeding and foraging habitat (ground cover (>70%) (0) to less than 33% (5)) x 5	15.00	1	15.00	There are no barriers to movement within or between squatter pigeon habitat identified within the Area of Interest

Habitat attributes	Indicators	Score	Weighting	Weighted score	Justification
	Sub-total			15.00	
Absence of threats (25%)	Abundance of feral predators (abundant (0) to absent (5)) x5	10.00	0.2	2.00	Feral pigs were regularly recorded within the Area of Interest during the field surveys thereby reducing habitat quality for a ground nesting bird such as squatter pigeon
	Encroachment of non-native pasture grass (e.g. buffel grass) (increases ground cover) (abundant (0) to absent (5)	10.00	0.2	2.00	With a history of pasture improvement, buffel grass was abundant throughout the Area of Interest
	Habitat loss (e.g. clearing for agriculture) (total loss of habitat (0) to no clearing (5))	15.00	0.2	3.00	The Area of Interest has been subject to habitat loss from agricultural activities
	Overstocking (abundant (0) to absent (5))	20.00	0.2	4.00	Evidence of over stocking was not observed during the field surveys
	Bushfire (high risk (0) to low risk (0)) x 5	25.00	0.2	5.00	Bush fire risk is low
	Sub-total			16.00	
	Total			6.3 / 10	

6 Offset Suitability

6.1 Inderi offset calculators

A summary of the target MNES and MSES values for the HPE Project and corresponding offset values within the Inderi Offset Area is provided in Table 17.

Table 17. Summary of ~~target protected matters, offset obligations and~~ Inderi Offset Area suitability

Target Protected Matter	Impact Site			Inderi Offset	
	Significant Residual Impact (ha)	Offset Area required (ha)	BioCondition site-attribute score (/10)[1]	Area within Offset Area (ha)	BioCondition site-attribute score (/10)[1]
MNES					
Dichanthium queenslandicum habitat	23.40	33.00[2]	3	66.61	5
MSES					
Regulated Vegetation (of concern RE (BVG 30b)	23.40	34.00[3]	3	39.83	4

[1] Rounded to nearest whole number as per Commonwealth Offset Assessment Guide calculator format

[2] Based on the EPBC Act offset calculator (Table 18)

[3] Based on the EO Act land-based offsets multiplier calculator

6.1.1 EPBC Act Offset Assessment Guide

The EPBC Act Environmental Offsets Policy is accompanied by the Offsets Assessment Guide which is a practical tool using a balance sheet approach to compare impacts to offsets for threatened species and ecological communities.

The *Dichanthium queenslandicum* habitat data collected from the HPE Project disturbance footprint (impact site) and the Inderi Offset Area was analysed in accordance with the Offset Assessment Guide impact and offset calculator to return a summary (Table 18 and Appendix D).

Associated risk of loss without the offset have estimated based on historical land management within the offset area and surrounds and those detailed for the Central Highlands Regional Council within *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* (Maseyk et al., 2017).

Table 18. *Dichanthium queenslandicum* offset calculator inputs

Attribute	Score	Rationale
Time over which loss is averted	20 years	Maximum of 20 years
Start area	33 ha	Area of suitable ling bluegrass habitat within the Inderi Offset Area comprising non-remnant RE 11.8.11 and remnant RE 11.8.5.

Risk of loss without offset	5%	The risk of loss without offset was derived in accordance with 'Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act (Maseyk et al., 2017). *Dichanthium queenslandicum* (king bluegrass) and Natural Grasslands TEC were confirmed to occur within the Inderi Offset Investigation Area but are situated immediately adjacent the delineated Offset Area. However, the habitat within the Offset Area is suitable for restoration/improvement activities and there is "credible, site-specific evidence to indicate development will occur within the foreseeable future" based on past land management and contemporary/future land use. Portions of the Inderi Offset Investigation Area are classified as Category X Regulated Vegetation (non-remnant) under State Legislation (i.e. Vegetation Management Act 999), and do not require approval to cultivate under State legislation. As such, cultivation within the delineated Offset Area has occurred over a number of years. While it is uncertain whether past cultivation events indicate future cultivation, the previous impact to the community paired with the current and ongoing land use, namely cattle grazing, is anticipated to gradually deteriorate the grassland habitat via the threatening processes described in the Offset Strategy without the protection and management afforded by an offset. Under Pathway D, the ROL (without offset), in accordance with Maseyk et al. (2017), must be greater than the product of the average annual background rate of loss and the time horizon of the proposed offset. The average annual background rate of loss for the Central Highlands Regional Council LGA over the life of the offset (20 years) is 1.81%. Based on the historical land management involving cultivation and current land use of cattle grazing, which is expected to exacerbate the documented threatening processes impacting native grasslands at Inderi), the ROL (without offset) is slightly higher than the average annual background rate of loss (i.e. 1.81%). As such, the ROL (without the offset) for the Inderi Offset Area is calculated to be 5%. Furthermore, it is also worth noting that non-woody communities (e.g. grasslands) are not captured within the method employed to calculate ROL (Maseyk et al., 2017). As such, the estimated ROL for the Central Highlands

Attribute	Score	Rationale
		Regional Council may not be entirely accurate for grasslands within the Inderi Offset Area.
Risk of loss with offset	0%	The Offset Area will be legally secured and clearing activities will be restricted. The risk of losing all habitat value for *D. queenslandicum* with the offset secured is negligible.
Confidence in result	85%	The level of certainty about the strength and effectiveness of the proposed risk-mitigation measures (i.e. legally binding mechanism) is high.
Time until ecological benefit	20 years	Depending on the effective application of the methods described in the Offset Area Management Plan paired with favourable environmental conditions (e.g. sufficient rainfall), improvements in habitat quality may be realised (or quantifiable/discernible) in shorter timeframe; however, twenty years allows for adaptive management (if required) and latitude for poor weather.
Start quality (/10) (offset area)	5	The BioCondition Assessment data analysis resulted in a site-attribute score of 5/10 within *D. queenslandicum* habitat in the Inderi Offset Area.
Future quality without offset (/10)	4	Native perennial grass cover and species richness were uniformly low relative to ecosystem benchmarks throughout the grassland community within the Inderi Offset Area. The dry conditions (i.e. below average rainfall) combined with grazing has likely diminished the habitat quality and occurrence of *D. queenslandicum* within the offset Without the security and management of an offset, the future quality may remain static (status quo) or, more likely, decrease due to grazing and/or weed encroachment (particularly where parthenium and buffel grass are already localised).
Future quality with offset (/10)	7	The application of grassland restoration techniques (e.g. regrowth/restricted grazing, controlled burn, etc) with the clearing protection of a legally binding mechanism is expected to increase native grass species richness/cover and improve *D. queenslandicum* habitat quality
Confidence in result	85%	The level of certainty in the change of habitat quality through grassland restoration is quite high as the threats and mitigation measures specific to natural grasslands are well studied and defined. The methods proposed to enhance the habitat quality are consistent with the approved conservation advice.
Overall calculator rating (% of impact offset)	100%	To achieve 100% offset acquittal (using the above metrics), the requisite offset area is 33 ha.
Minimum direct offset requirement met (90%)?	Yes	To achieve the minimum (90%) direct offset requirement (using the above metrics), the requisite offset area is 30 ha.

6.1.2 EPBC Act Environmental Offsets Policy Compliance

The EPBC Act Environmental Offsets Policy (EOP) requires that offsets must deliver an overall conservation gain that compensates for the significant residual impacts associated with the HPE Project. A suitable offset must meet the offset requirements of the EOP. Compliance of the Inderi Offset Area as proposed in this strategy with the EOP is demonstrated in Table 19.

Table 19. Inderi offset area compliance with EPBC Act EOP offset requirements

EPBC EOP offset requirements	Rationale
Deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The Inderi Offset Area supports confirmed *D. queenslandicum* habitat. With formal protection and land management, the viability of *D. queenslandicum* will be improved by promoting the recovery of the species thereby delivering an overall conservation outcome
Be built around direct offsets but may include other compensatory measures	The full offset requirement will be delivered via a direct, land-based offset within the Inderi Offset Area
Be in proportion to the level of statutory protection that applies to the protected matter AND Be of a size and scale proportionate to the residual impacts on the protected matter	The proposed offset will provide a direct offset and measurable conservation gain. The proposed offsets have been developed using the OAG (Section 6.1.1) which uses the area of impact and the quality of habitat to assess the total quantum of impact to protected matters that needs to be offset
Effectively account for and manage the risks of the offset not succeeding	Potential risks to the success of the offsets have been identified at an overall level and are reflected in the OAG inputs (Section 6.1.1). A detailed risk assessment has been developed as part of the Offset Area Management Plan (OAMP). The OAMP also includes measures (such as regular monitoring), triggers and remedial actions to manage risk
Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The Inderi Offset Area does not have any existing formal conservation arrangement in place or existing requirements from other approvals that require the landowner or licensees to undertake conservations works. Current permitted land use across the offset area includes cattle grazing
Be efficient, effective, timely, transparent, scientifically robust and reasonable	Direct, land-based offsets have been selected as the preferred offset method for this project as it is a robust and widely accepted approach, with a high degree of confidence in outcome
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	The offset will be secured using a Voluntary Declaration under the provisions of the VM Act and supported by an OAMP. The OAMP will detail the monitoring and reporting program

6.1.3 EO Act Land-based Offsets Multiplier Calculator

In accordance with the Queensland Environmental Offsets Policy (DES, 2021) an offset must be of a size and scale proportionate to the significant residual impact on a prescribed environmental matter necessary to achieve a conservation outcome (Table 20). The offset requirement for a significant residual impact on a 'Of Concern' Regional Ecosystem is set at a maximum multiplier of 4 (i.e. a maximum of four times the residual impact). A land-based offset can achieve a conservation outcome using a multiplier of less than 4 pending approval by the administering agency. The Land-based Offsets Multiplier Calculator (DEHP), assists in refining the multiplier using scientific data as well as impact and offset site field data.

Based on the area impacted and habitat quality of the remnant grassland ('Of Concern' RE 11.8.11) within the HPE Project disturbance footprint relative to the area of grassland available and its habitat quality within the Inderi Offset Area, the Land-based Offsets Multiplier Calculator returned a multiplier of:

- 2.86 for remnant RE 11.8.11; and
- 1.45 for non-remnant RE 11.8.11.

Using the Combined Offset Delivery Calculator, 34 ha of non-remnant grassland (RE 11.8.11) will 100% directly offset the HPE's Project impact on 23.4 ha of remnant grassland (RE 11.8.11) (Appendix E).

Table 20. Justification of conservation outcome for MSES within the Inderi Offset Area

Offset Plan requirements	Rationale
Describe the prescribed environmental matter to which the offset condition relates	The Inderi Offset Area will acquit Project impacts to MSES Regulated Vegetation containing of concern RE 11.8.11 (BVG 30b).
State whether the offset condition will be delivered, wholly or partly, on the land on which the environmental offset will be undertaken	The Inderi Offset Area will acquit the entirety (100%) of the required impacts to MSES Regulated Vegetation containing of concern RE 11.8.11 (BVG 30b) associated with the Project. Incorporating the revised offset multipliers (refer to DEHP land-based offset multiplier tool (2014)) for land-based offsets, 34 ha of non-remnant grassland characteristic of RE 11.8.11 will directly acquit 100% of HPE Project impacts to 23.4 ha of remnant RE 11.8.11
Include particulars of, or a description sufficient to identify, the land on which the environmental offset will be undertaken	The Inderi Offset Area comprises parts of the cadastral parcel formally referred to as Lot 55 on Plan DSN318.
Identify, and contain details of, any person with an interest in the land on which the environmental offset will be undertaken	Landowner and manager.

Offset Plan requirements	Rationale
Describe the existing land use of the land on which the environmental offset will be undertaken and any impact that land use may have on the delivery of the offset	The Inderi property currently supports cattle grazing with selected areas previously tilled for pasture/fodder. The Offset Area within the property comprises a 67 ha area largely characterised by natural grasslands and coolabah (*Eucalyptus orgadophila*) open woodlands on gently undulating rises (Figure *2*). An existing BMA offset area (established in 2014) is secured within the Inderi property located immediately adjacent to the Offset Area (Figure 2) and is undergoing active management. The proposed Offset Area will be fenced to exclude any livestock grazing and managed in accordance with an Offset Area Management Plan.
State— (i) the measures the authority holder will take to secure the land on which the environmental offset will be undertaken as a legally secured offset area	The Inderi offset Area will be legally secured into perpetuity in accordance with the Queensland Environmental Offset Policy via: • an environmental offset protection area under section 30 of the *Environmental Offsets Act 2014*; or • an area declared as an area of high nature conservation value under section 19F of the *Vegetation Management Act 1999*, where it is secured for the purposes of an offset
Why the authority holder considers the stated measures are reasonable and practicable	The securement of the offset under through either instrument identified above will protect the vegetation from future clearing activities. Risk assessment and identification of management action within the OAMP will further assist in mitigating potential risks, including force majeure, and improving condition (i.e. weed management, livestock management, revegetation etc.). As such, the effective application of these methods are considered reasonable and practicable to secure the Offset Area and associated ecological values.
The period during which the authority holder will take the measures	In accordance with Section 2.3.1.5 of the Queensland Environmental Offset Policy (DES, 2021), the Inderi Offset Area will be actively managed until: • the administering agency is satisfied the actions and obligations of the offset delivery plan have been completed in full; and • the offset has been secured for at least the same duration as the impact on the prescribed environmental matters arising from the prescribed activity.

Offset Plan requirements	Rationale
Why the authority holder considers the stated period is reasonable for the purpose of securing the land.	Provided the effective application of the methods described in the OAMP (e.g. livestock management, revegetation and weed management) are implemented, paired with favourable environmental conditions (e.g. sufficient rainfall), improvements in habitat quality may be realised (or quantifiable/discernible) within twenty years. However, as per the Queensland Environmental Offset Policy, securement of the offset will be required as detailed above.

6.2 Croydon Station offset calculators

A summary of the target MNES values for the HPE Project impact site and corresponding offset values within the Croydon Offset Area is provided in Table 21.

Table 21. Summary of ~~target protected matters, offset obligations and~~ Croydon Offset Area suitability

Target Protected Matter	Project Site				Croydon Offset		
	Significant Residual Impact (ha)	Offset Area required (ha)	Site-attribute score (/10) [1]	Species-habitat attribute score (/10)	~~Area~~Habitat within Offset Area (ha)	Site-attribute score (/10) [1]	Species-habitat attribute score (/10)
MNES							
ornamental snake	167.84	259.00[2]	4	6	263.68	3	7
squatter pigeon (southern)	88.53	228.00[2]	5	5	248.64	6	6
MSES							
Connectivity area	84.19	84.19[3]	NA	NA	263.68	3	NA

[1] rounded to nearest whole number as per Commonwealth Offset Assessment Guide calculator format

[2] based on the EPBC Act Offset calculator using the site-attribute scores for both the project and offset areas (Table 21 and)

[3] Based on the EO Act land-based offsets multiplier calculator

6.2.1 EPBC Act Offset Assessment Guide

The EPBC Act Environmental Offsets Policy is accompanied by the Offsets Assessment Guide which is a practical tool using a balance sheet approach to compare impacts to offsets for threatened species and ecological communities.

6.2.1.1 Ornamental snake

The ornamental snake habitat data collected from the HPE Project disturbance footprint (impact site) and the Croydon Offset Area was analysed by the Offset assessment guide impact and offset calculator to return a summary (Table 22 and Appendix D).

Associated risk of loss without the offset have estimated based on historical land management within the offset area and surrounds and those detailed for the Isaac Regional Council within *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* (Maseyk et al., 2017).

Table 22. Ornamental snake offset calculator inputs

Attribute	Score	Rationale
Time over which loss is averted	20 years	Maximum of 20 years

Attribute	Score	Rationale
Start area	259 ha	Ornamental snake habitat ground truthed within regrowth and non-remnant RE 11.4.9 within the Croydon Offset Area.
Risk of loss without offset	9%	The risk of loss without offset was derived in accordance with 'Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act (Maseyk et al., 2017). Ornamental snake habitat (i.e. brigalow) within the Croydon Offset Area is situated in an area classified as Category X Regulated Vegetation which is not protected under State legislation (i.e. Vegetation Management Act 1999). Brigalow was first pulled and burnt on Croydon Station in the early 1970s and seeded to buffel grass for cattle grazing. The area was pulled again in 1988 and subjected to controlled burning in 1989. This cycle of clearing and burning regrowth brigalow was repeated every 5-7 years, guided by seasonal conditions and market commodity prices. Evidence of brigalow pulling and burning was observed within ornamental snake habitat during survey of the Croydon Offset Investigation Area. Without the securement and protection of an offset, recurrent disturbance of regrowth brigalow is permissible without approval under State vegetation clearing legislation; consequently degrading ornamental snake habitat incrementally over time. As habitat within Category X Aligning with Pathway B, Maseyk et al. (2017) stipulates the ROL (without offset) must be greater than the product of the average annual background rate of loss and the time horizon of the proposed offset. The average annual background rate of loss for the Isaac Regional Council LGA over the life of the offset (20 years) is 8.42% (Maseyk et al., 2017). Based on the historical land management of Croydon Station, the ROL (without offset) is slightly higher than the average annual background rate of loss (i.e. 8.42%). As such, the ROL (without the offset) is estimated at 9%.
Risk of loss with offset	0%	The Offset Area will be legally secured and clearing activities will be restricted. The risk of losing all habitat value for ornamental snake with the offset secured is negligible.

Attribute	Score	Rationale
Confidence in result	85%	The level of certainty about the strength and effectiveness of the proposed risk-mitigation measures (i.e. legally binding mechanism) is high.
Time until ecological benefit	20 years	The brigalow (*Acacia harpophylla*) (ecologically dominant layer) within the regrowth woodland is 0.5m-4m tall within the Croydon Offset Area. In the absence of clearing, the stand will continue to naturally regenerate increasing ground cover, species richness and coarse woody debris; thereby enhancing foraging habitat for ornamental snake. Managing feral pigs and maintaining low intensity livestock grazing will reduce soil compaction and degradation in gilgai thereby also improving foraging and refuge habitat for ornamental snake in gilgai. With effective management, these ecological benefits are measurable within 20 years.
Start quality (/10) of offset area	3	The BioCondition Assessment data analysis resulted in a site-attribute score of 3/10 for ornamental snake habitat.
Future quality without offset (/10)	2	Without the protection and management provided by an offset, the future quality of ornamental snake habitat within the offset area is likely to degrade (3) in response to ongoing pasture conversion.
Future quality with offset (/10)	5	Managing the threats affecting ornamental snake habitat quality (e.g. clearing, fire, cattle and feral pigs) while facilitating natural brigalow regeneration will improve the habitat quality score (both site-based attributes and species-habitat attributes).
Confidence in result	85%	The level of certainty in the change of habitat quality is high as the management actions recommended to improve ornamental snake habitat within the Croydon Offset Area are based on published methods focusing on species priority recovery and threat abatement actions as well as brigalow regrowth management guidelines.
% of impact offset	100%	To achieve 100% offset acquittal (using the above metrics), the requisite offset area is 259 ha.
Minimum direct offset requirement met (90%)?	Yes	To achieve the minimum (90%) direct offset requirement (using the above metrics), the requisite offset area is 235 ha.

6.2.1.2 Squatter pigeon

The Commonwealth Offset Assessment guide analysed data collected from the HPE Project impact site and the Croydon Offset Investigation Area to determine the suitability of Croydon Station as an offset (Table 22 and Appendix D).

Associated risk of loss without the offset have estimated based on historical land management within the offset area and surrounds; protection under State legislation (i.e. VM Act); and those detailed for the

Isaac Regional Council within *Guidance for deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act* (Maseyk et al., 2017).

Table 23. Squatter pigeon offset calculator inputs

Attribute	Score	Rationale
Time over which loss is averted	20 years	Maximum of 20 years
Start area	246.50 ha	Approximately 246.50 ha of squatter pigeon habitat is present within the Croydon Area of Interest.
Risk of loss without offset	5%	According to the Guidance to deriving 'Risk of Loss' estimates when evaluating biodiversity offset proposals under the EPBC Act (Maseyk et al., 2017), the estimated risk of loss for the Isaac Regional Council is 8.42%. However, as the Area of Interest contains remnant vegetation (MSES) protected under the State legislation (VM Act), the risk of loss without the offset is likely to be lower than by Maseyk et al.'s (2017) estimate.
Risk of loss with offset	0%	The Offset Area will be legally secured and clearing activities will be restricted. The risk of losing all habitat value for squatter pigeon with the offset secured is negligible.
Confidence in result	85%	The level of certainty about the strength and effectiveness of the proposed risk-mitigation measures (i.e. legally binding mechanism) is high.
Time until ecological benefit	20 years	The suitable habitat comprises remnant, woodlands within the Croydon Area of Interest. Management of vegetation and habitat, including weeds and pest fauna over the duration of the offset will improve habitat for the species with effective management, these ecological benefits are measurable within 20 years. Managing feral pests (e.g. wild dogs, feral cats) will assist in minimising threats to the species within the Offset Area.
Start quality (/10) of offset area	6	The habitat quality estimated the site-based attribute and species habitat attribute score as six out of 10 (rounded to the nearest whole number) for squatter pigeon habitat.
Future quality without offset (/10)	5	Without the protection and management provided by an offset, the future quality of squatter pigeon habitat within the offset area is likely to degrade (one point) in response to ongoing land management and lack of weed and pest management.
Future quality with offset (/10)	7	Managing the existing threats to the species (e.g. grazing management and feral cats) while improving vegetation condition will improve the habitat quality score by at least one point (both site-based attributes and species-habitat attributes).

Attribute	Score	Rationale
Confidence in result	85%	The level of certainty in the change of habitat quality is high as the management actions recommended to improve squatter pigeon habitat within the Croydon Area of Interest and manage existing threats.
% of impact offset	100%	To achieve 100% offset acquittal (using the above metrics), the requisite offset area is 228 ha.
Minimum direct offset requirement met (90%)?	Yes	To achieve the minimum (90%) direct offset requirement (using the above metrics), the requisite offset area is 205 ha.

6.2.2 EPBC Act Environmental Offsets Policy Compliance

The EPBC Act Environmental Offsets Policy (EOP) requires that offsets must deliver an overall conservation gain that compensates for the significant residual impacts associated with the HPE Project. A suitable offset must meet the offset requirements of the EOP. Compliance of the Croydon Offset Area as proposed in this strategy with the EOP is demonstrated in Table 24.

Table 24. Croydon Station offset area compliance with EPBC Act EOP offset requirements

EPBC EOP offset requirements	Rationale
Deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The Croydon Offset Area supports confirmed ornamental snake and squatter pigeon habitat. With formal protection and land management, the viability of ~~ornamental snake~~habitat for target species will be improved by promoting the recovery of the species thereby delivering an overall conservation outcome~~.~~.
Be built around direct offsets but may include other compensatory measures	The full offset requirement will be delivered via a direct, land-based offset within the Croydon Offset Area.
Be in proportion to the level of statutory protection that applies to the protected matter AND Be of a size and scale proportionate to the residual impacts on the protected matter	The proposed offset will provide a direct offset and measurable conservation gain. The proposed offsets have been developed using the OAG (Section 6.2.1) which uses the area of impact and the quality of habitat to assess the total quantum of impact to protected matters that needs to be offset.
Effectively account for and manage the risks of the offset not succeeding	Potential risks to the success of the offsets have been identified at an overall level and are reflected in the OAG inputs (Section 6.2.1). A detailed risk assessment has been developed as part of the OAMP. The OAMP also includes measures (such as regular monitoring), triggers and remedial actions to manage risk.

EPBC EOP offset requirements	Rationale
Be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The proposed Croydon Offset Area does not have any existing formal conservation arrangement in place or existing requirements from other approvals that require the landowner or licensees to undertake conservations works. Current permitted land use across the offset area includes cattle grazing.
Be efficient, effective, timely, transparent, scientifically robust and reasonable	Direct, land-based offsets have been selected as the preferred offset method for this project as it is a robust and widely accepted approach, with a high degree of confidence in outcome.
Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	The offset will be secured using a Voluntary Declaration under the provisions of the VM Act and supported by an OAMP. The OAMP will detail the monitoring and reporting program.

6.2.3 EO Act Land-based Offsets Multiplier Calculator

In accordance with the *Queensland Environmental Offsets Policy* (DES, 2021), the offset requirement for a significant residual impact on a MSES connectivity area is set at a maximum multiplier of 1 (i.e. 1:1 ratio).

Based on the DES Impact Assessment Tool Environmental Offset Calculator, the Croydon Offset Area contains suitable habitat to acquit more than 100% of the significant residual impacts on MSES connectivity area, containing ~~263.68~~321.77 ha of regrowth vegetation for the required 84.19 ha impacted by the Project.

Table 25. Justification of conservation outcome for MSES within the Croydon Offset Area

Offset Plan requirements	Rationale
Describe the prescribed environmental matter to which the offset condition relates	The Croydon Offset Area will acquit Project impacts to MSES connectivity area, containing suitable areas of regrowth vegetation (non-remnant).
State whether the offset condition will be delivered, wholly or partly, on the land on which the environmental offset will be undertaken	The Croydon Offset Area will acquit the entirety (100%) of the required impacts (84.19 ha) to MSES Connectivity area associated with the Project. In accordance with the *Queensland Environmental Offsets Policy*, MSES connectivity area is to be offset at a multiplier of 1. A total of 84.19 ha of non-remnant vegetation, characteristic of RE 11.4.9 will directly acquit 100% of HPE Project impacts to MSES connectivity area.
Include particulars of, or a description sufficient to identify, the land on which the environmental offset will be undertaken	The Croydon Offset Area comprises parts of the cadastral parcel formally referred to as Lot 4 on Plan KL210.
Identify, and contain details of, any person with an interest in the land on which the environmental offset will be undertaken	Landowner and manager.

Offset Plan requirements	Rationale
Describe the existing land use of the land on which the environmental offset will be undertaken and any impact that land use may have on the delivery of the offset	The Croydon property currently supports cattle grazing with selected areas previously tilled for pasture/fodder. The Offset Area within the property comprises a ~~263.68~~321.77 ha area largely characterised by regrowth brigalow (*Acacia harpophylla*) shrublands on undulating clay plains. An existing BMC offset area, approximately 361 ha is secured within Croydon Station adjacent to the Croydon Offset Area and is undergoing active management. The proposed Offset Area will be fenced to exclude any livestock grazing and managed in accordance with an Offset Area Management Plan.
State— (i) the measures the authority holder will take to secure the land on which the environmental offset will be undertaken as a legally secured offset area	The Croydon Offset Area will be legally secured into perpetuity in accordance with the Queensland Environmental Offset Policy via: • an environmental offset protection area under section 30 of the *Environmental Offsets Act 2014*; or • an area declared as an area of high nature conservation value under section 19F of the *Vegetation Management Act 1999*, where it is secured for the purposes of an offset
Why the authority holder considers the stated measures are reasonable and practicable	The securement of the offset under through either instrument identified above will protect the vegetation from future clearing activities. Risk assessment and identification of management action within the OAMP will further assist in mitigating potential risks, including force majeure, and improving condition (i.e. weed management, livestock management, revegetation etc.). As such, the effective application of these methods are considered reasonable and practicable to secure the Offset Area and associated ecological values.
The period during which the authority holder will take the measures	In accordance with Section 2.3.1.5 of the Queensland Environmental Offset Policy (DES, 2021), the Croydon Offset Area will be actively managed until: • the administering agency is satisfied the actions and obligations of the offset delivery plan have been completed in full; and • the offset has been secured for at least the same duration as the impact on the prescribed environmental matters arising from the prescribed activity.

Offset Plan requirements	Rationale
Why the authority holder considers the stated period is reasonable for the purpose of securing the land.	Provided the effective application of the methods described in the OAMP (e.g. livestock management, revegetation and weed/pest management) are implemented, paired with favourable environmental conditions (e.g. sufficient rainfall), improvements in habitat quality may be realised (or quantifiable/discernible) within twenty years. However, as per the Queensland Environmental Offset Policy, securement of the offset will be required as detailed above.

7 Offset Delivery

7.1 Timeframes for offset delivery

The final offsets package will be included as part of the assessment process for the HPE Project. An Offset Area Management Plan (OAMP) has also been developed for each property as a component of this strategy. It is the intent that the Offset Areas will be secured prior to or within 12 months of disturbance associated with the HPE Project. It is anticipated the Offset Areas will be in place until the completion criteria are met for a minimum of 20 years (whichever is longer).

Both this strategy and associated OAMPs will be implemented as required, post approval of the Project.

7.2 Offset legal security

The Offset Areas will be legally secured in accordance with the Queensland Environmental Offset Policy via:

- an environmental offset protection area under section 30 of the *Environmental Offsets Act 2014*; or
- an area declared as high nature conservation value under section 19F of the *Vegetation Management Act 1999*, where it is secured for the purposed of an offset (i.e. Voluntary Declaration).

7.3 Offset area management plan

The OAMPs for each Offset Area will guide the ongoing management and monitoring and will be implemented for the life of the offset. OAMPs produced for the Inderi and Croydon Offset Areas include:

- *Horse Pit Extension Project Offset Area Management Plan: Croydon Offset Area* (E2M, 2023~~2~~); and
- *Horse Pit Extension Project Offset Area Management Plan: Inderi Offset Area* (E2M, 2022b).

7.3.1 OAMP structure and inclusions

The OAMPs include the following:

- a description of the offset area/s, including location, size, condition, environmental values present and surrounding land uses;
- details of how the offset area/s will provide connectivity with other habitats and biodiversity corridors and/or will contribute to a larger strategic offset;
- maps and shapefiles to clearly define the location and boundaries of the offset areas, accompanied by the offset attributes (e.g. physical address of the offset areas, the listed threatened species and communities that the environmental offsets compensate for and the size of the environmental offsets in hectares);
- specific offset completion criteria derived from the site habitat quality to demonstrate the improvement in the quality of habitat in the offset area/s over a 20 year period;
- details of the management actions, and timeframes for implementation, to be carried out to meet the offset completion criteria;
- details of the nature, timing and frequency of monitoring to inform progress;

- proposed timing for the submission of monitoring reports which provide evidence demonstrating whether the interim milestones have been achieved;
- timing for the implementation of corrective actions if monitoring activities indicate the interim milestones have not been achieved;
- risk analysis and a risk management and mitigation strategy for all risks to the successful implementation of the OAMP and timely achievement of the offset completion criteria, including a rating of all initial and post-mitigation residual risks in accordance with a risk assessment matrix;
- evidence of how the management actions and corrective actions consider relevant approved conservation advice and are consistent with relevant recovery plans and threat abatement plans;
- details of the legal mechanism for legally securing the proposed offset area/s, such that legal security remains in force over the offset area/s for at least 20 years to provide enduring protection for the offset area/s against development incompatible with conservation.

7.3.2 Overview of proposed management and monitoring activities

The overall management objective of the proposed offset area on the Inderi property and Croydon Station is to reduce threatening processes and increase the habitat quality of the area to a level at which it provides greater conservation value than its current form and that of the current impact site.

Management measures that will be undertaken are set out in detail in the OAMPs and include:

- reduced livestock grazing intensity during the dry season as necessary to reduce fuel loads and manage potential bushfire risk while maintaining a minimum groundcover of at least 50% throughout the Offset Area;
- prohibition of cultivation and general vegetation clearing impacts; and
- weed and pest animal identification, prevention and control.

There are also a number of specific restrictions that will apply to the offset area in order to support the delivery of conservation benefits for target protected matters. These restrictions are:

- vegetation clearing is prohibited;
- grazing is restricted during the wet season to allow D. queenslandicum within the Inderi Offset Area, to flower, seed and disperse promote natural regeneration and replenish the soil seed bank;
- planned fires are prohibited other than for ecological purposes; and
- introduction of feral animals and weeds will be minimised and existing populations suppressed.

Monitoring of the Offset Areas will occur in accordance with the regime specified in the OAMPs and across designated locations. Habitat Quality monitoring sites within the Croydon and Inderi Offset Areas will be based on the sites assessed as part of the initial offset investigations (i.e. BioCondition) and used to determine baseline habitat quality.

Weed and groundcover monitoring will be undertaken at each of the Habitat Quality monitoring sites as well as opportunistic locations during regular monitoring events. These opportunistic locations will be in areas where regeneration, or weed occurrences are notably different from other areas representative of the offset area generally. Additional monitoring activities will include:

- feral animal and weed monitoring conducted concurrently with BioCondition;
- manager monitoring of grazing, pest plants, pest animals fencing, access and fire breaks.

All monitoring results (including leaseholder / property manager observations) are to be recorded in documented or electronic form suitable for external audit. Reports will be provided to the relevant authorities for review as required.

8 Conclusion

The development of the Horse Pit Extension Project is likely to have a significant residual impact on ~~four~~five prescribed environmental matters: ornamental snake habitat (MNES/MSES), squatter pigeon (southern) habitat (MNES/MSES), king bluegrass habitat (MNES/MSES), Regulated Vegetation containing an Of Concern RE (MSES) and Connectivity Areas (MSES).

The offset investigation concluded that the Inderi Property and Croydon Station OIAs are suitable to deliver proponent-driven, land-based offsets to acquit 100% of the Project impacts to:

- ornamental snake habitat (on Croydon);
- squatter pigeon (southern) habitat (on Croydon);
- king bluegrass habitat (on Inderi);
- Regulated Vegetation (on Inderi); and
- Connectivity area (on Croydon)

A summary of Offset Suitability is summarised in Table 26.

Table 26. Summary of offset suitability

Target Protected Matter	Impact Site			Inderi Offset			Croydon Offset			
	Significant Residual Impact (ha)	Site-attribute score (/10)	Species-habitat attribute score (/10)	Area available within Offset Area (ha)	Site-attribute score (/10)	Area required to acquit 100% impact (ha)	Area available within Offset Area (ha)	Site-attribute score (/10)	Species-habitat attribute score (/10)	Area required to acquit 100% impact (ha)
MNES										
Dichanthium queenslandicum habitat	23.40	3	N/A	66.61	5	33.00	0	N/A	N/A	N/A
ornamental snake habitat	167.84	4	6	0	N/A	N/A	263.68	3	7	259[1]
squatter pigeon habitat	88.53	5	5	0	N/A	N/A	246.50	6	6	228[1]
MSES										
Regulated Vegetation (of concern RE (BVG 30b)	23.40	3	N/A	39.83	4	34.00	N/A	N/A	N/A	N/A
Connectivity Areas	84.19	5	N/A	Not required for offset			263.68	3	~~NA~~N/A	84.19

[1] based on the results of the EPBC Act Offset Assessment Guide using site-based attribute data (BioCondition assessment)

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Appendix A Database search results

Appendix B Habitat Quality Site Data

Appendix C BioCondition Survey Sites

Appendix D EPBC Offset Calculator

Appendix E MSES Land-based Multiplier and Combined Offset Calculators