



**NEOEN**

**PRELIMINARY CYCAS MEGACARPA  
SPECIES MANAGEMENT PLAN**

Mount Hopeful Wind Farm

**FINAL**

November 2023



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Mount Hopeful Wind Farm

### FINAL

Prepared by  
Umwelt (Australia) Pty Limited  
on behalf of  
Neoen Australia Pty Ltd

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# Abbreviations

Abbreviations	Description
AEMO	Australian Energy Market Operator
AHD	Australian Height Datum
BESS	battery energy storage systems
CEMP	Construction Environmental Management Plan
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of Environment and Science
DoR	Department of Resources
DSDILGP	Department of State Development, Infrastructure, Local Government and Planning
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth)
EPMs	Exploration Permits for Minerals
ha	hectare
IDW	Inverse Distance Weighted method
km	kilometres
LGA	Local Government Areas
MNES	Matters of National Environmental Significance
MW	megawatts
NC Act	<i>Nature Conservation Act 1992</i> (QLD)
Neoen	Neoen Australia Pty Ltd
PO	Performance Outcome
PVMP	Preliminary Vegetation Management Plan
QREZ	Queensland Renewable Energy Zones
RE	Regional Ecosystem
SIS	State Infrastructure Strategy
SMP	Species Management Plan
TEC	Threatened Ecological Communities
the Project	Mount Hopeful Wind Farm
Umwelt	Umwelt (Australia) Pty Ltd
VM Act	<i>Vegetation Management Act 1999</i> (QLD)
WoNS	Weeds of National Significance

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# 1.0 Introduction

Umwelt is supporting Neoen Australia Pty Ltd (Neoen) in seeking project approvals for the Mount Hopeful Wind Farm (the Project). The Project is located approximately 45 kilometres (km) south of Rockhampton and 65 km west of Gladstone, within the Central Queensland Region.

The Project involves the development of a wind farm that contains 63 wind turbine generators (WTGs), ancillary infrastructure including up to ten temporary and ten permanent wind monitoring masts, six substations, battery energy storage systems (BESS), temporary construction compound/laydown areas, a concrete batching plant, high voltage (275 kilovolt (kV)) overhead powerlines, as well as underground power and communication cables. The Project includes an access road corridor which would involve upgrades to approximately 30 km of existing road between the Burnett Highway at Dixalea and Glengowan Road to ensure the safe transportation of Project infrastructure. The Project is expected to have a maximum generation capacity of approximately 400 megawatts (MW).

This preliminary *Cycas megacarpa* Species Management Plan (SMP) will support State and Federal approvals pertaining to the management of *Cycas megacarpa* for the Project.

Information contained within the following documents has been used to inform and develop this plan, including:

- *Terrestrial Flora Assessment Report* (Umwelt 2022).
- The Preliminary *Cycas megacarpa* Translocation and Management Plan prepared by Ecologica Consulting (Attachment J of the Preliminary Documentation).
- The Preliminary Vegetation Management Plan (Attachment E of the Preliminary Documentation).
- The Offset Management Strategy (Attachment K of the Preliminary Documentation).
- Field survey data collected between July 2019 and July 2023.

## 1.1 Ecology Study Boundaries

Three distinct Project boundaries are presented that are relevant to this plan, including:

- Study Area: refer to **Section 1.1.1**.
- Development Corridor: refer to **Section 1.1.2**.
- Disturbance Footprint refer to **Section 1.1.3**.

**Figure 1.1** contains the ecological boundaries for the Project.



### 1.1.1 Study Area

The Study Area refers to the boundaries of the 17 freehold land parcels which encompass the infrastructure that has been designed for the proposed wind farm, as well as the boundary of the access road corridor (inclusive of the local road reserve for Glengowan Road, Playfields Rd and McDonalds Rd and small area of one additional adjacent land parcel) and a connection to the switching station in the road reserve at South Ulam Road. The area covers approximately 16,976 hectares (ha) and extends approximately 25 km north-south at the longest point and 42 km east-west at the widest point (this includes approximately 30 km of access road). The Study Area represents the limit of the vegetation and habitat mapped for the Project. It should be noted however, that this boundary does not represent the spatial bounds in which all Project field surveys have been conducted (this area being larger and including areas outside of the Study Area).

Lot and plans relevant to the Study Area include:

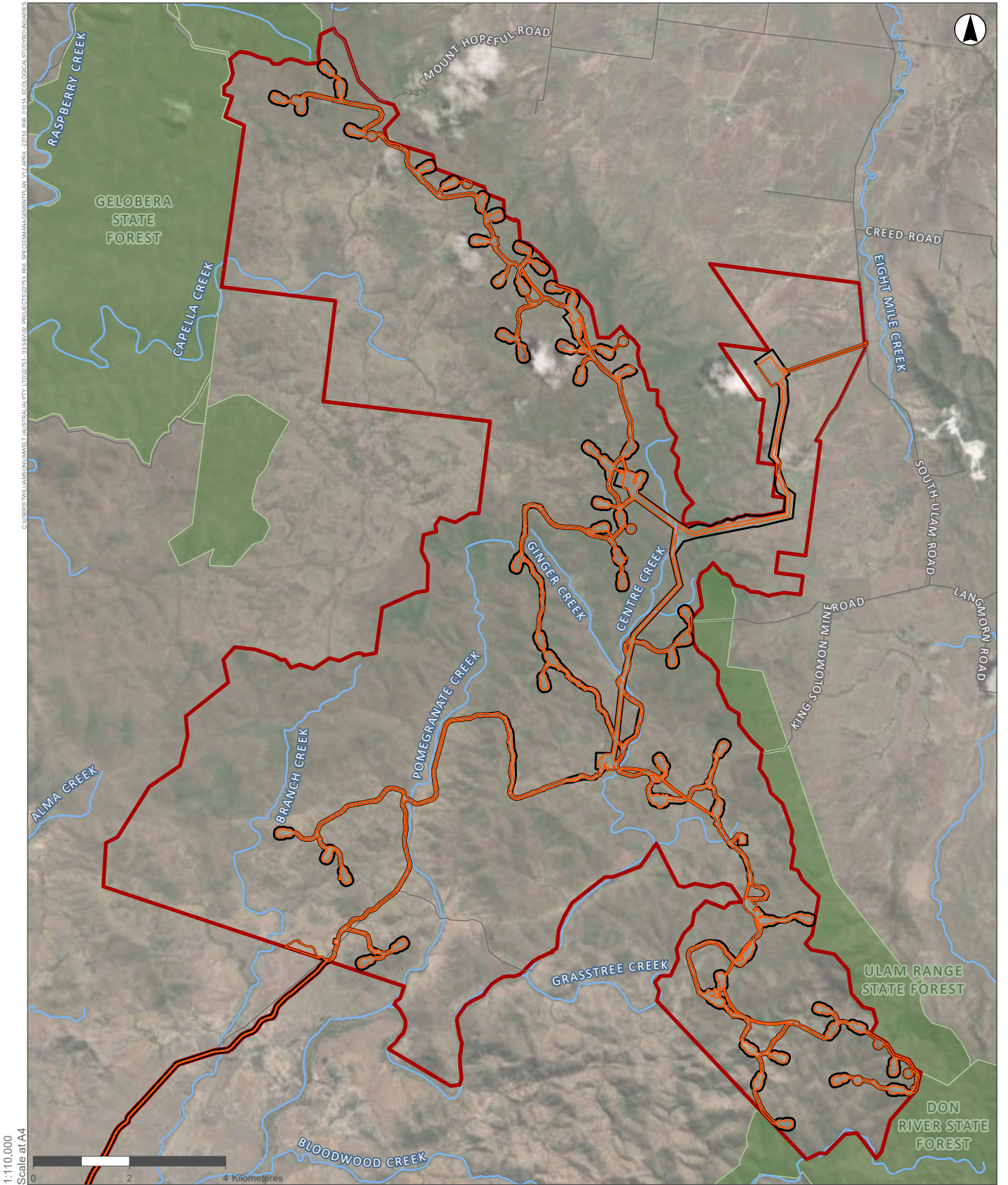
- Those relevant to the proposed wind farm:
  - 148/DS151, 2420/DT4077, 21/RN46, 30/RN72, 50/DT40144, 1933/RAG4058, 21/RN1345, 100/SP289441, 33/DT40123, 2039/RAG4056, 23/RN25, 38/DT40131, 2057/RAG4059, 24/RN34, 25/RN25, 15/RN1089 and 2345/DT4077.
- That relevant to the access road corridor:
  - 17/RAG4094.

### 1.1.2 Development Corridor

The Development Corridor is a 'buffered' version of the indicative Project layout, covering approximately 1,564.6ha. This area represents the maximum spatial extent where disturbance may occur within the Study Area and includes areas required for temporary and permanent Project infrastructure, equipment and materials laydown, installation and access.

### 1.1.3 Disturbance Footprint

The Disturbance Footprint covers approximately 883.6 ha and represents the maximum extent of clearing works and the indicative locations of Project infrastructure. It is a 'worst-case' scenario in terms of the extent of clearing works. The Disturbance Footprint will be used when discussing impacts, avoidance and mitigation measures pertaining to *Cycas megacarpa*.

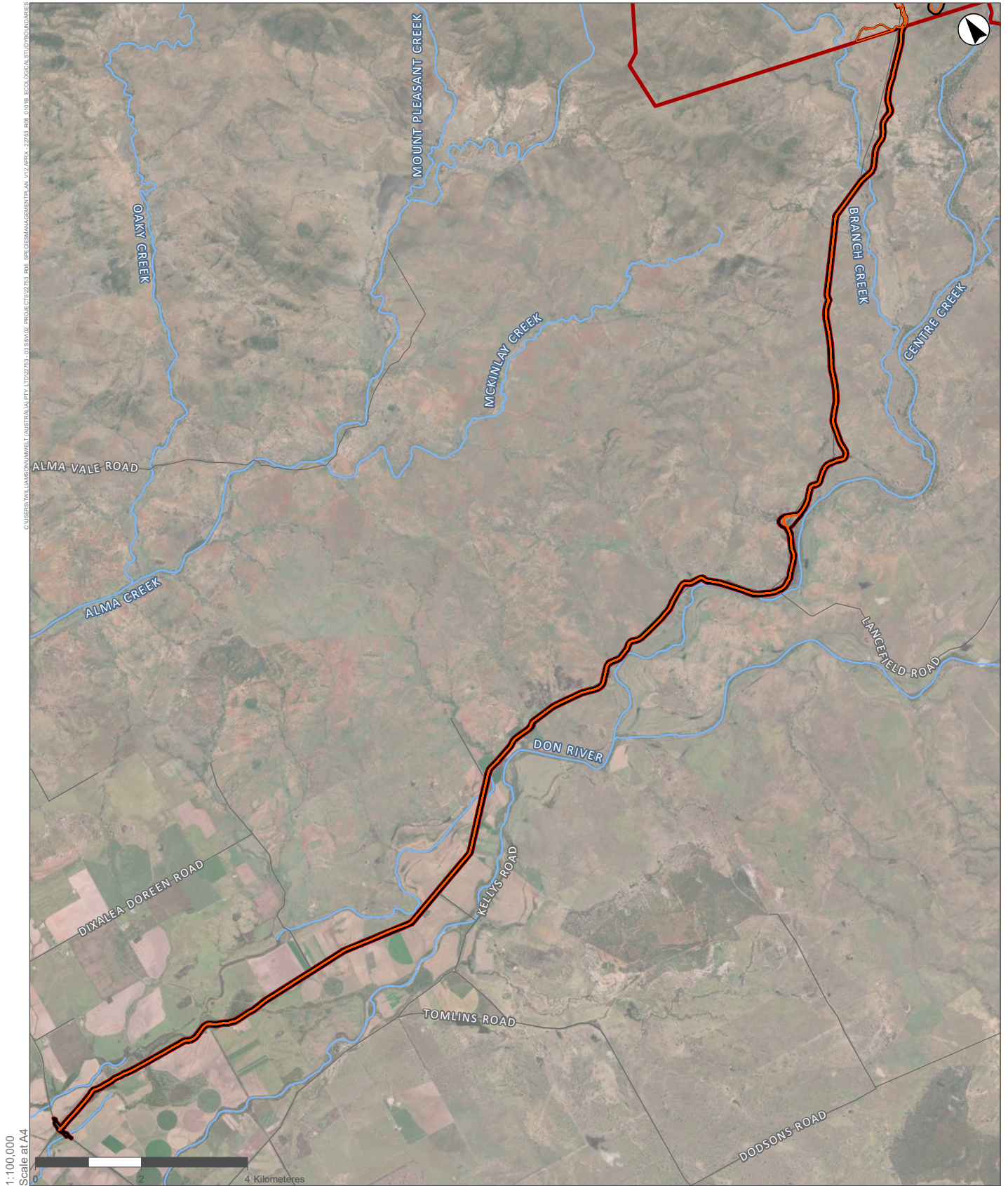


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Scale at A4

GDA 1994 MGA Zone 56

- Legend**
- Roads
  - Watercourse
  - Disturbance Footprint
  - Development Corridor
  - Study Area
  - State Forest

**FIGURE 1.1A**  
**ECOLOGICAL BOUNDARIES**



GDA 1994 MGA Zone 56

- Legend**
- Roads
  - Watercourse
  - Disturbance Footprint
  - Development Corridor
  - Study Area
  - State Forest

**FIGURE 1.1B**  
**ECOLOGICAL BOUNDARIES**

## 1.2 Project Description

### 1.2.1 Project Infrastructure

The Project will utilise existing infrastructure as well as construct new Project infrastructure, refer **Section 1.2.1.1** and **Section 1.2.1.2** below.

#### 1.2.1.1 Existing Infrastructure:

Powerlink electricity towers and associated overhead electricity transmission lines intersect the Study Area in a north-west to south-east direction. An existing telecommunication tower is located approximately 2 km north of the Study Area. A 120 m guyed lattice meteorological mast was erected over the Study Area in August 2020, as well as a 140 m and 110 m guyed lattice meteorological mast in November 2022.

Other rights and encumbrances of note include:

- An easement (A/RP612717) for high voltage electricity transmission line intersecting the eastern portion of the Study Area on Lot 100 SP289441.
- A strata for a Profit à Prendre (030/RN72) over Lot 30/RN72 for a Forest Consent Area to the State of Queensland (represented by the Department of Agriculture and Fisheries).
- Three Exploration Permits for Minerals (EPMs) overlap the Study Area, comprising EPM 15810 held by Mount Morgan Exploration Pty Ltd, EPM 27098 held by GBM Resources Limited, and EMP Application area 27105 held by Prophet Resources Pty Ltd.
- An existing road reserve (Playfields, McDonalds and Glengowan Roads) exists within the western extent of the Study Area (the access road corridor).
- An existing road reserve (South Ulam Road) exists within the eastern extent of the Study Area (switching station access point).

#### 1.2.1.2 Proposed Infrastructure

The Project will construct 63 WTGs with the turbine specifications used for the assessment shown in **Table 1.1**. These specifications are considered to be an upper limit and are intended to provide flexibility for any innovation in turbine design between now and the time of detailed design and construction.

**Table 1.1 Turbine Specifications**

Feature	Maximum Specifications
Project generation capacity	Approximately 400 MW
Turbine electrical output	Approximately 6.5 MW
Maximum number of turbines	63
Tip height	Up to 260 m
Blade length	Up to 90 m

Additionally, the Project will also require the provision of ancillary infrastructure, including the following:

- Up to 10 temporary wind monitoring towers.
- Up to 10 permanent wind monitoring towers.
- Up to six substations, a BESS and ancillary electrical infrastructure.
- Up to 13 km of high voltage (275 kV) overhead powerlines.
- Site operational, maintenance and storage areas containing permanent site offices, workshops, warehouses, mobile offices, lunch room, amenities and ablutions.
- Overhead and/or underground power and communication cables.
- Up to 175 km of gravel capped roads.
- Two permanent site access points.
- An access road corridor including approximate 30 km of road upgrades along McDonalds, Playfields and Glengowan Roads.
- An access point to the switching station in the road reserve at South Ulam Road.
- A range of temporary infrastructure to facilitate the construction of the Project, including:
  - One construction compound.
  - A temporary worker’s accommodation camp to provide for a peak construction workforce of up to approximately 450 people and including a water treatment plant, sewage treatment plant and sprayfield.
  - Three concrete batching plants.
  - Two laydown areas.

## 1.2.2 Anticipated Project Timeline

A summary of the anticipated construction works associated with the Project are provided in **Table 1.2**.

**Table 1.2 Anticipated Construction Works**

Project Stage/Component	Description
Construction Commencement, Completion and Commissioning of Project	<ul style="list-style-type: none"> <li>• Commencement of construction works: Quarter 4, 2023.</li> <li>• Completion of construction works: Quarter 3, 2025.</li> <li>• Commissioning of the Project: Scheduled in Quarter 4, 2025.</li> </ul>
Duration of Construction Works	Between 22 and 28 months.
Planned Construction Activities	<ul style="list-style-type: none"> <li>• Site establishment (temporary site facilities, lay down areas, equipment and materials).</li> <li>• Earthworks for access roads and wind turbine hardstands.</li> <li>• Excavations for the foundations.</li> </ul>

Project Stage/Component	Description
	<ul style="list-style-type: none"> <li>• Construction of wind turbine foundations.</li> <li>• Installation of electrical and communications cabling and equipment.</li> <li>• Installation of wind turbine transformers, in parallel with electrical reticulation works.</li> <li>• Arrival of wind turbine components to the Project Site.</li> <li>• Installation of wind turbines.</li> <li>• Commissioning of wind turbines.</li> <li>• Reliability testing.</li> </ul>

### 1.3 Aim and Objectives

The aim of this SMP is to reduce the potential impact on *Cycas megacarpa* within the Study Area, by outlining mitigation and management measures to be implemented throughout the duration of the Project. It should be noted that the mitigation and management measures discussed in **Section 5.0** are based on the Development Corridor and Disturbance Footprint only. The specific objectives of the SMP are to:

- Provide a description of the nature and location of Project activities including approximate timing where possible.
- Provide relevant background information pertaining to *Cycas megacarpa* including:
  - A description of the species, species distribution, biology and reproduction, preferred habitat and microhabitat including associations with soil, landscape features, geology and with ecological communities and flora where relevant.
  - Information on *Cycas megacarpa* within the broader region and known local populations.
- Provide a description of *Cycas megacarpa* habitat.
- Outline the number of *Cycas megacarpa* individuals contained within the Study Area, Development Corridor and Disturbance Footprint. The number of individuals in each development class will also be provided within the Study Area.
- Detail the requirements of pre-clearance surveys to confirm the location, extent, numbers, and age class of the population of *Cycas megacarpa* within the Disturbance Footprint (plus a 5 m buffer).
- Include information on the vegetation clearing requirements to reduce impacts to surrounding individuals and *Cycas megacarpa* habitat.
- Detail specific weed management measures to reduce impacts on the long-term integrity of the remaining *Cycas megacarpa* habitat and population including high-biomass weeds.
- Detail the erosion, sedimentation, and dust management requirements specific to the mitigation and management of *Cycas megacarpa*.
- Detail the monitoring and reporting requirements for pre-construction, construction, operation and maintenance, and decommissioning and rehabilitation phases of the Project.
- Detail the number, location and proportion of individuals that will be avoided including avoidance measures.

## 2.0 Legislative Context

The legislation relevant to the SMP is summarised in **Table 2.1**.

**Table 2.1** Legislation Relevant to the Project

Relevant Legislation	Governing Agency	Summary	Project Relevance
<b>Commonwealth Legislation</b>			
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (EPBC Act)	Department of Climate Change, Energy, the Environment and Water (DCCEEW)	The EPBC Act is Australia's key piece of environmental legislation. It outlines nine Matters of National Environmental Significance (MNES). Actions that adversely affect MNES may be deemed to be a controlled action under the EPBC Act.	The following MNES are relevant to the Project: <ul style="list-style-type: none"> <li>• Threatened Species.</li> <li>• Migratory Species.</li> </ul>
EPBC Act Environmental Offsets Policy	DCCEEW	The EPBC Act Environmental Offsets Policy outlines the use of environmental offsets under the EPBC Act and are considered during the assessment phase of an environmental impact assessment. Specifically, this policy applies to project assessments and approvals under Parts 8 and 9 of the EPBC Act, in addition to strategic assessments under Part 10.	Pending the outcomes of the EPBC Act assessment decision, offsets may be required, including for <i>Cycas megacarpa</i> habitat.
<b>State Legislation</b>			
<i>Nature Conservation Act 1992</i> (NC Act)	Department of Environment and Science (DES)	The purpose of the NC Act is to conserve biodiversity by creating and managing protected areas, managing and protecting native wildlife, and managing the spread of non-native wildlife.  The flora survey trigger map identifies high-risk areas where Endangered, Vulnerable or Near Threatened native plants are present or are likely to be present. The map is used to determine requirements to be considered before clearing native plants.	Where a proposed development will result in impacts to flora protected under the NC Act, authorisation from the Director General of the DES is required.  The following values under the NC Act are relevant to the Project: <ul style="list-style-type: none"> <li>• Threatened flora species, and</li> <li>• High-risk areas for protected plants are mapped within the Study Area, therefore a protected plants flora survey in accordance with the <i>NC Act Flora Survey Guidelines – Protected Plants</i> is required prior to clearing native plants.</li> </ul>

Relevant Legislation	Governing Agency	Summary	Project Relevance
<i>Biosecurity Act 2014</i>	Department of Agriculture and Fisheries	The <i>Biosecurity Act 2014</i> lists flora pest species as either a Prohibited or Restricted biosecurity matter.	<p>The <i>Biosecurity Act 2014</i> defines specific requirements for notification and management actions for all listed biosecurity matters, including specific requirements for the disposal of Restricted Matters.</p> <p>Under the <i>Biosecurity Act</i> all persons in Queensland are responsible for managing biosecurity risks and ensuring a pest, disease or a contaminant is not spread, known as a General Biosecurity Obligation.</p>
<i>Environmental Offsets Act 2014</i> (EO Act)	DES	An environmental offset condition may be imposed under certain Queensland legislation that applies to development assessment where the activity is a prescribed activity under the EO Act. Activities which have an impact on a Matter of State Environmental Significance may require offsetting under the Act.	Consideration of offsetting requirements for the Project will need to be determined once a fixed design for the Project is completed. Requirements for offsets are therefore not discussed as part of this report.



## 3.0 *Cycas megacarpa*

### 3.1 Description and Listing Status

*Cycas megacarpa* is a small to medium sized cycad with an erect trunk standing around 3 m–5 m tall and approximately 15 centimetres (cm) wide. The leaves are 70–110 cm long, with 120–170 leaflets. New growth is green, densely hairy with orange-brown hairs that later fall off (DCCEEW, 2022); Department of Environment and Science (DES) 2022).

The male and female reproductive structures occur on separate plants. Male plants produce brown cylindrical cones, and the female plants produce loose open cone-like structures at the top of the plant. The seeds are ovoid, green becoming yellowish, pinkish or purplish as they mature, 38–50 millimetres (mm) long, 35–45 mm diameter (DCCEEW 2022; DES 2022). Refer to **Photo 3.1** for an example of *Cycas megacarpa* within the Study Area.

*Cycas megacarpa* is listed as Endangered under the EPBC Act and the NC Act.



**Photo 3.1** *Cycas megacarpa* located within the Study Area

## 3.2 Distribution and Habitat Requirements

*Cycas megacarpa* is endemic to south-east Queensland, found from as far south as Woolooga to Bouldercombe in the north. It is found in woodland, open woodland and open forests dominated by narrow-leaved ironbark (*Eucalyptus crebra*) and lemon-scented gum (*Corymbia citriodora*) as well as red bloodwood (*C. erythrophloia*), silver-leaved ironbark (*E. melanophloia*) and brush box (*Lophostemon confertus*), often in conjunction with a grassy understory. It occurs at altitudes of 40–500 m, typically on undulating, hilly terrain either on gentle to steep slopes or hill crests. The soils are generally well drained, shallow, often stony, sandy loam to clay loam in texture and derived from sandstones, fine grained sediments and acid and basic volcanic rocks (Queensland Herbarium 2007).

This species has been recorded in a number of Regional Ecosystems (REs) that are considered suitable habitat for *Cycas megacarpa*. According to the Queensland Herbarium (2007), the REs that *Cycas megacarpa* has been recorded in are:

- Brigalow Belt Bioregion: REs 11.3.25, 11.3.26, 11.11.3, 11.11.15, 11.12.1, 11.12.6.
- South East Queensland Bioregion: REs 12.1.3, 12.5.5, 12.11.2, 12.11.6, 12.11.7, 12.12.3, 12.12.4, 12.12.5, 12.12.7, 12.12.9, 12.12.11, 12.12.12, 12.12.16, 12.12.23, 12.12.27.

### 3.2.1 Habitat Critical to the Survival

As per the National Recovery Plan, habitat where remaining viable populations occur is considered to be critical to the survival of *Cycas megacarpa* (Queensland Herbarium 2007). The population within the Study Area is considered viable (>3,500 individuals), making all known habitat within the Study Area critical to the survival of the species. The projected population size within the Study Area is 141,392 individuals.

### 3.2.2 Occurrence and Populations within the Broader Region

Based on records held at the Queensland Herbarium, 46 known populations of *Cycas megacarpa* were documented, with an estimated minimum area of occupancy of 2,527 ha and a projected total number of individuals greater than 372,964 across the species range (Queensland Herbarium 2007). Of the 46 known populations, 20 populations are known to occur in reserve tenures, consisting of:

- National Parks (4 populations).
- State Forests (12 populations).
- Roadside Reserves (3 populations).
- Forest Reserve (1 population).

The remaining 26 populations occur in freehold, vacant crown land, grazing homestead or unknown tenure types. Population sizes ranged from <10 – >1,000. Seven of these populations were identified as being important populations considered to be viable in the long term outlined in **Table 3.1** (Queensland Herbarium 2007). Based on two surveyed populations of *Cycas megacarpa*, between 3,500–4,500 plants are a minimum viable population for the species (Queensland Herbarium 2007).

There are several known populations that occur within proximity to the Study Area including:

- Population 5 (Dee Range) with an estimated population of 5,600 individuals. This population adjoins and potentially overlaps the northern extent of the Study Area.
- Population 6 (Mount McCamley) with an estimated population of 28 individuals. This population is located 2.7 km east of the Study Area.
- Population 7, 8 and 9 (Don River State Forest) with an estimated population of 115,200 individuals. These populations are located in the southern section of the Don River State Forest, between 10 and 15 km south of the Study Area.

A study by James et al. (2018), which looked at the distribution and genetic structure of *C. megacarpa*, identified evidence of considerable historic gene flow among populations across its entire range, and showed little differentiation across the entire species. Genetic clustering was shown to occur within a 36 km radius, consistent with the hypothesis that *C. megacarpa* existed as a set of three linked metapopulations, historically linked by gene flow. However, due to ongoing increasing population isolation, this may continue to reduce the species' viability. Based on this evidence it can be concluded that *C. megacarpa* can be considered one population, with the most genetic similarity within a 36 km radius.

Genetic analysis for other projects noted that the Boulder Creek population appears to link the populations to the north, south and east of it genetically. Further to this it was noted that in the northern region, where the Mount Hopeful population in part lies (Dee Range), individuals were genetically similar to each other when within a 16.8 km radius.

Decreasing genetic diversity was not found to occur even within smaller populations, potentially due to the persistence of adult cycads through multiple generations, allowing rare alleles to remain within the population over a longer period of time and potentially passed on to successive generations. This, and dispersal and cross pollination between adjacent populations, may maintain the genetic diversity of small populations (James et al., 2018).

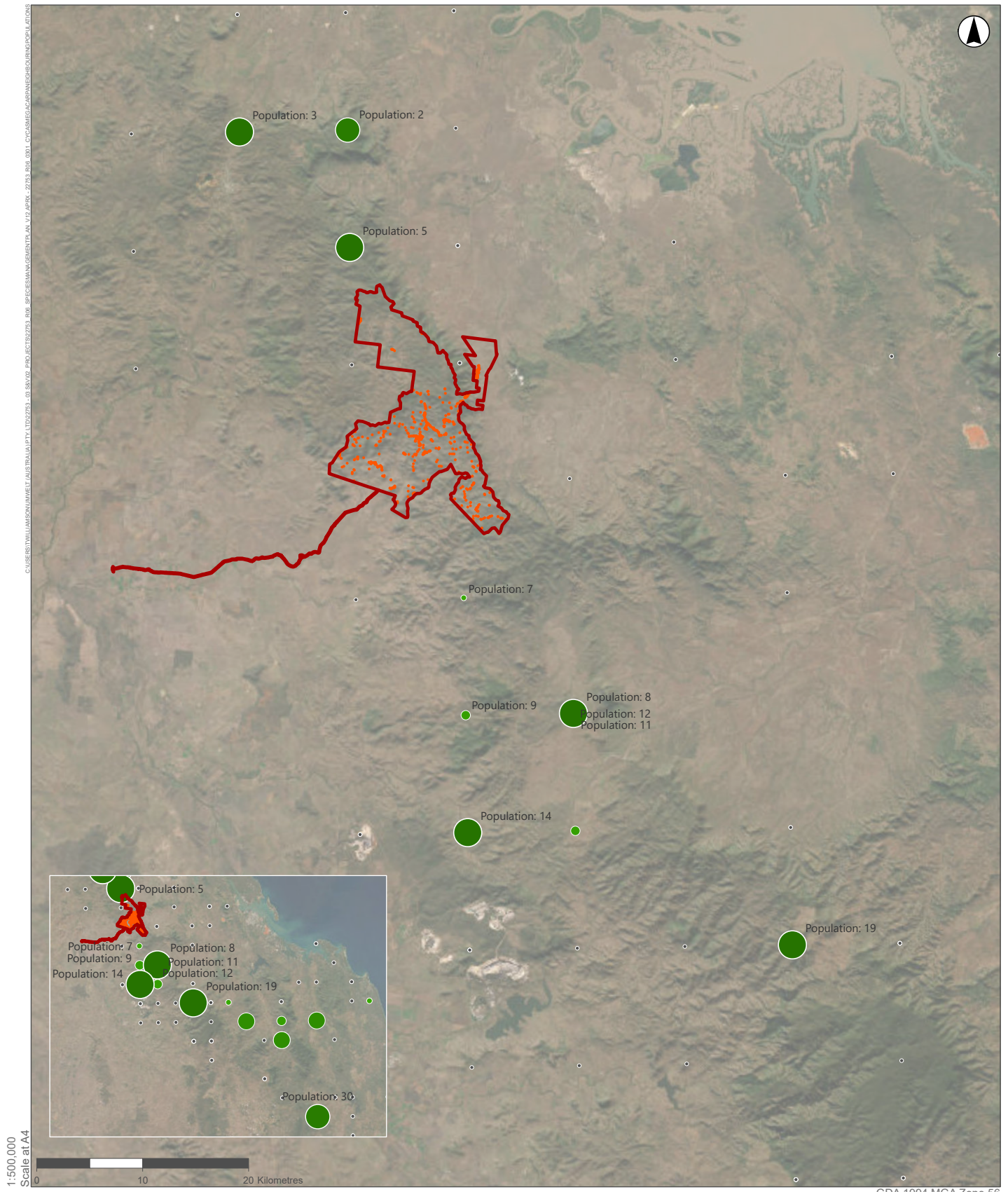
The Mount Hopeful population intersects Population 5 in the northern section and is likely to be a part of the locally known populations (Populations 7 to 9). As such there is the potential for the local population to be in excess of 160,000 individuals. Noting that the study by James et al. 2018 identified three distinct metapopulations with Mount Hopeful located between the northern and Callide/Calliope metapopulations.

To determine the location of existing populations within the region Queensland Herbarium records within the Atlas of Living Australia database (Atlas of Living Australia 2022) were consulted. For each record the Catalogue Number was correlated to *Appendix 1. Population Statistics (Table 1)* within the *National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia platyrhachis* (Queensland Herbarium 2007) to determine the population the record belongs to. This information was used to understand how the populations within the region apply at a Project level.

**Table 3.1** *Cycas megacarpa* Known Important Populations

Population	Tenure Type	Projected Occupancy of Population (ha)	Projected Number of Plants in Population	Approximate Number Plants per ha	Approximate Distance from Study Area Population <sup>1</sup>
Population Eight (Biloela)	State Forest Reserve	800	115,200	144	20 km south-east
Population Nineteen (Kroombit)	State Forest Reserve	c.250	76,750	307	49 km south-east
Population Thirty (Wonbah)	State Forest Reserve	c. 20	Thousands (not defined within the SPRAT profile for the species)	N/A	146 km south-east
Population Two (Bouldercombe)	Not available	c. 100	Thousands (not defined within the SPRAT profile for the species)	N/A	16 km north
Population Three (Mt Morgan)	Freehold Title	>850	159,800	188	19 km north-west
Population Five (Dee Range)	Freehold Title & Road Reserve	c. 100	5,600	56	5 km north
Population Fourteen (Biloela)	Freehold Title & Road Reserve	>200	14,400	72	58 km south

<sup>1</sup> Approximate location obtained from ALA records.



**Legend**

- Study Area
- *Cycas megacarpa* within Study Area (Umwelt)
- *Cycas megacarpa* Record (ALA) (+/- 2km)
- Unknown
- ≤10
- >10≤50
- >10≤150
- >50≤150
- >150≤300
- >500≤3500
- >3500

**FIGURE 3.1**  
**CYCAS MEGACARPA**  
**NEIGHBOURING POPULATIONS**

A population's viability in the long term is based on evidence of replacement by age structure and population size (Queensland Herbarium 2007). A population with a progression of size classes, with fewer, large (old) individuals down to many juveniles can be considered as adequately replacing itself (Queensland Herbarium 2007). Healthy populations of *Cycas megacarpa* are known to have a range of individuals from large adults (5–8 m in height) through to seedlings. Reference surveys completed in large and small populations of *Cycas megacarpa* (Queensland Herbarium 2007) determined that between 40% (small population) and 80% (large population) were juveniles and between 11% (small population) and 14% (large population) were of reproductive age (>1 m tall).

### 3.3 Occurrence and Potential Habitat for the Project

#### 3.3.1 Species Occurrence

Targeted *Cycas megacarpa* surveys were undertaken across the Study Area targeting suitable habitat for the species with a focused survey effort within the Development Corridor (**Figure 3.2**). Field surveys extended over four years from 2019 to 2022. Across the field survey program, a total of seven flora field surveys were completed over 35 field days, which included targeted surveys for *Cycas megacarpa* undertaken by suitably qualified ecologists. Approximately 4,138.6 ha within the Study Area was surveyed opportunistically or as part of the targeted surveys. Within the Development Corridor, approximately 1,069.6 ha was surveyed equating to 68.3% of the total area.

Survey methods involved traversing the Study Area and Development Corridor and where individuals were encountered, recording individuals (point record), providing visual density estimates or conducting plot-based counts (the latter both within a 0.25 ha area). Where no individuals were encountered, points records were logged to identify areas absent of *Cycas megacarpa* (nil recorded).

Using the data captured, the known and potential habitat extent for *Cycas megacarpa* was mapped (**Section 3.3.2**) and density projections were made to determine total projected counts for the Project (**Section 3.3.3**).

#### 3.3.2 Known and Potential Habitat

Habitat mapping for *Cycas megacarpa* was completed via field validation of boundaries, the interpretation of point records, plot-based density estimates, aerial imagery and field notes. Habitat has been defined for the Project as follows:

- Known habitat (confirmed): includes all land within 80 m of a confirmed record. No refinement based on habitat suitability was required.
- Known habitat (suspected): includes areas of the Development Corridor for which known habitat (confirmed) does not overlap, however based on field validated data points, adjacent records and connective habitat (i.e., no clear break in vegetation, or evidence of land clearing), *Cycas megacarpa* presence is presumed or reasonably suspected, and was mapped accordingly.
- Nil recorded: includes areas of the Development Corridor which have been confirmed (via field survey) to not support *Cycas megacarpa*. Nil recorded habitat also includes areas where reasonable extrapolation to edges of the Development Corridor has been applied, based on nearby 'absence' records, absence of connective habitat (i.e. aerial imagery evidence of land clearance) and field derived opinions of ecologists.

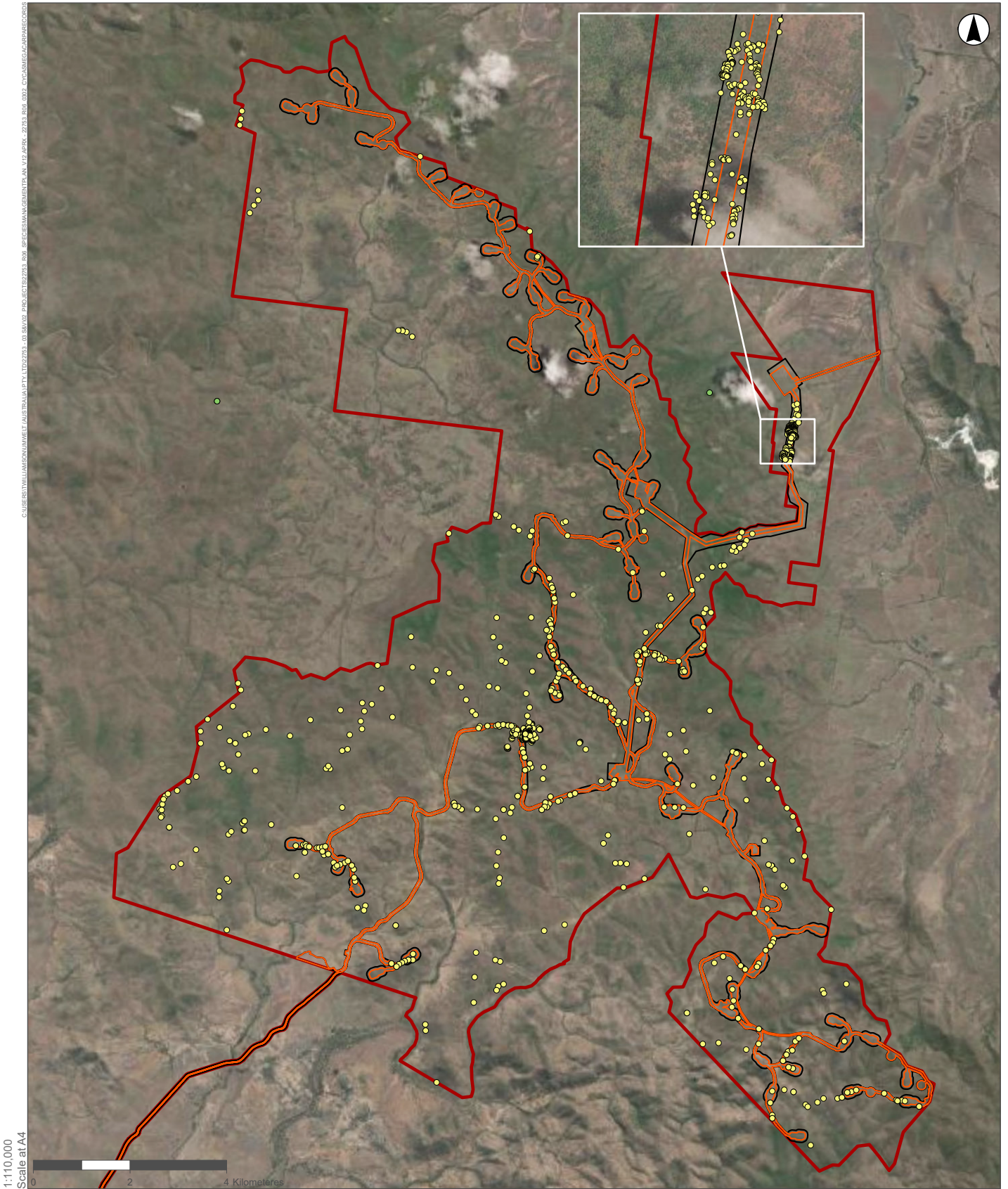
*Cycas megacarpa* habitat within the Study Area includes remnant, regrowth and cleared vegetation units. Habitat within the Study Area and the Development Corridor which is known to support the species include:

- Eucalypt woodland to open woodland on steep slopes or undulating terrain, dominated by *Corymbia citriodora*, *Eucalyptus crebra*, white mahogany (*E. acmenoides*) and gum-topped box (*E. moluccana*).
- Woodlands on alluvium, dominated by weeping tea-tree (*Melaleuca fluviatilis*), Moreton Bay ash (*Corymbia tessellaris*) and Queensland blue gum (*Eucalyptus tereticornis*).
- Semi-evergreen vine thicket and microphyll vine forest.
- Non remnant or cleared pasture.
- The primary habitat for this species (i.e., where the species was most consistently recorded and abundant) was woodland to open forest on upper slopes and crests consisting of *Corymbia citriodora*, *Eucalyptus crebra*, *E. melanophloia*, pink bloodwood (*C. intermedia*) and *E. tereticornis* on metamorphosed sediments and volcanic geologies at altitudes of between 200 and 500 m.

The extent that habitat is mapped throughout Development Corridor and Disturbance Footprint is provided in **Table 3.2** and shown on **Figure 3.3**. Given the data resolution required to complete habitat extent mapping, the comparative habitat extent areas are unavailable for the Study Area.

**Table 3.2 Habitat Extent and Justification for *Cycas megacarpa***

Habitat Criteria	Mapping Justification	Extent within Development Corridor (ha)	Extent within the Disturbance Footprint (ha)
Known habitat (confirmed)	An 80 m buffer on confirmed <i>Cycas megacarpa</i> records, to reflect the latest population research which indicates most individuals disperse within 80 m of mature female plants (Etherington <i>et al.</i> 2018; James 2016).	209.5	145.1
Known habitat (suspected)	Reasonable extrapolation of known habitat (confirmed) mapping.	131.8	79.3
<b>Known habitat (total)</b>	<b>Combined areas of confirmed and suspected habitat</b>	<b>341.3</b>	<b>224.4</b>
Nil detected	Field validated locations with no detectable individuals, including reasonable extrapolation of mapping.	1,223.3	659.3



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Scale at A4

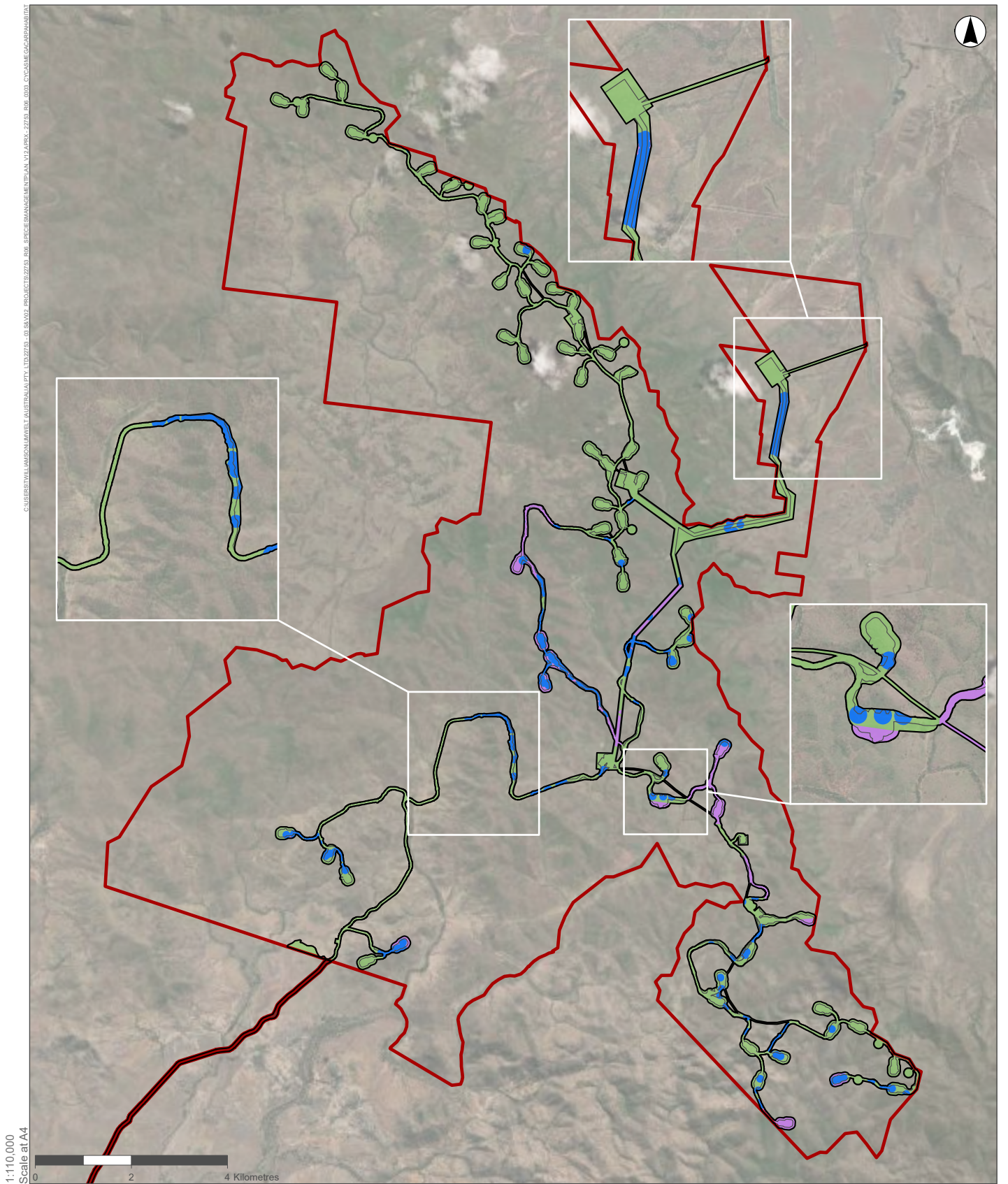
GDA 1994 MGA Zone 56

**Legend**

- Disturbance Footprint
- Development Corridor
- Study Area
- Cycas megacarpa* Record (ALA)
- Cycas megacarpa* Records (Umwelt)

**FIGURE 3.2**  
**CYCAS MEGACARPA RECORDS**





GDA 1994 MGA Zone 56

**Legend**

- Disturbance Footprint
- Development Corridor
- Study Area
- Cycas megacarpa Habitat**
- Known (confirmed)
- Known (suspected)
- Nil Recorded

**FIGURE 3.3**  
**CYCAS MEGACARPA HABITAT**

### 3.3.3 Population Characterisation and Cycad Density Projection

For density projections and population demographic characterisation, a plot-based sampling approach was used, with 0.25 ha plots established for actual counts or used to categorise populations as part visual density estimates. At each of the plot-based sites the age class structure (e.g. development class) was recorded for each individual using the following classification:

- Juvenile (<50 cm)
- Sub-adult (0.5–1 m)
- Adult (>1–5 m)
- Large adult (>5 m).

Using this approach, an actual count of individuals was obtained for each point record. The resulting dataset, including zero record data points were able to be analysed by a spatial interpolation model. Interpolation models can be used to predict values for cells in a raster from a limited number of sample data points. The underlying assumption that makes interpolation a viable option is that spatially distributed objects are spatially correlated, thereby assuming that things that are close together tend to have similar characteristics.

The interpolation selected for this analysis was the Inverse Distance Weighted method (IDW). IDW is a method of interpolation that estimates cell values by averaging the values of sample data points in the vicinity of each processing cell. The closer a data point is to the centre of the cell being estimated, the more influence, or weight, it has in the averaging process. This method assumes that the variable being mapped decreases in influence with distance from its sampled location.

The interpolation was conducted using ESRI GIS mapping software ArcGIS Pro. To provide a visual aid, the resultant output was categorised and styled into density categories, comprising High (25–50 plants per 0.25 ha), Moderate (10–25 plants per 0.25 ha), Low (0.5–10 plants per 0.25 ha), Absent (0–0.5 plants per 0.25 ha). The output was analysed against locations of actual counts and habitat extent mapping. To enhance the accuracy of the model, and where available, the IDW outputs were clipped to known habitat (confirmed and suspected) areas.

A breakdown of *Cycas megacarpa* density is provided in **Table 3.3**. These areas are displayed on **Figure 3.4**. Areas of high density *Cycas megacarpa* were prioritised for avoidance by the Project.

**Table 3.3** *Cycas megacarpa* Density Summary

Density Categories	Study Area <sup>1</sup>	Development Corridor <sup>2</sup>	Disturbance Footprint
High (25–50 plants per 0.25 ha)	74.9 ha	0.9 ha	0.7 ha
Moderate (10–25 plants per 0.25 ha)	711.2 ha	21.7 ha	12.4 ha
Low (1–10 plants per 0.25 ha)	5,389.0 ha	294.5 ha	191.3 ha

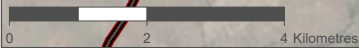
<sup>1</sup> Study Area values have been corrected to provide contextual comparison with development corridor, for which IDW outputs have been clipped to the known (confirmed) and known (suspected) habitat area.

<sup>2</sup> IDW outputs clipped to areas of mapped known (confirmed) and known (suspected) habitat area.



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GDA 1994 MGA Zone 56

**Legend**

- |                                |  |
|--------------------------------|--|
| Disturbance Footprint          | Predicted Distribution Density of <i>Cycas megacarpa</i> |
| Development Corridor           |  |
| Study Area                     |  |
| Surveyed Locations             |  |
| <i>Cycas megacarpa</i> Absent  | Absent (0 - 1)   |
| <i>Cycas megacarpa</i> Present | Low (1 - 10)   |
|                                | Moderate (10 - 25)                                       |
|                                | High (25-50)   |

**FIGURE 3.4**  
**MODELLED CYCAS MEGACARPA DENSITY**

### 3.3.4 Project Count – Population Size

To inform impact assessment and the potential requirement for secondary approvals or biodiversity offsets, it was necessary to project an upper limit of individuals within the various Project boundaries. This was completed using the outputs of the IDW density map, and where available, aligned with known habitat areas (as mapped by Umwelt) for the species.

To achieve a projected count per hectare, density count plot data (collected over 0.25 ha plots) was projected out by a factor of four. For visual estimate records, a mid-point was assumed for actual count prior to projecting (i.e., count of 6.5 individuals was assumed in areas visually estimated to support 1–10 plants per 0.25 ha). IDW polygon sizes were determined and then multiplied by the project count.

Following completion of the projections, and to provide a contextual basis of comparison, a correction factor was applied to Study Area estimates, in line with observations made in the Development Corridor. This correction factor accounts for the overestimation of ‘low’ density points, which are mapped across large areas and not appropriately weighted due to the absence of data record points.

The results of this assessment are summarised below in **Table 3.4** for the Study Area, Development Corridor and Disturbance Footprint. Desktop and field survey *Cycas megacarpa* records are shown on **Figure 3.2**.

**Table 3.4** *Cycas megacarpa* Individuals

	Study Area	Development Corridor	Disturbance Footprint
Individual records of <i>Cycas megacarpa</i>	141,392	6,021	3,727

The number of individuals of *Cycas megacarpa* that are estimated to occur within the Study Area based on data interpolation (refer above in **Section 3.3.4**) is 141,392 individuals across an area of 16,975.8 ha. The development class distribution of the population within the Study Area generally mirrors the overall proportions of a regional study of *Cycas megacarpa* across all surveyed populations identified in *Conservation Genetics and Demographic Analysis of the Endangered Cycad Species Cycas megacarpa and the Impacts of Past Habitat Fragmentation* (James *et al.* 2018). **Table 3.5** below displays the number of *Cycas megacarpa* individuals in each development class taken from James *et al.* (2018) with respect to the Study Area. To provide an accurate comparison to James *et al.* (2018) development classes have been aligned where possible in **Table 3.5**. This shows a range of individuals from large adults through to seedlings, with a large number of reproductive age adults (> 1 m), required to maintain a viable population.

**Table 3.5** Number of *Cycas megacarpa* individuals in each development class from James *et al.* (2018) and across the Study Area

Development Class	James <i>et al.</i> (2018) Individual Numbers	James <i>et al.</i> (2018) Percentage in Population	Study Area Individual Numbers	Study Area Percentage in Population
Seedlings ( $\leq 0.49$ m, non trunked)	Approximately 450	16%	262	21%
Juveniles ( $\geq 0.5$ m, not trunked; $\leq 0.49$ m, trunked)	Approximately 900	33%	368	30%
Sub adults (<1 m, trunked)	Approximately 550	20%	- <sup>1</sup>	- <sup>1</sup>
Adults ( $\geq 1$ m, trunked)	Approximately 500	18%	572 <sup>2</sup>	47%
<b>Total</b>	<b>2,668</b>	<b>-</b>	<b>1,202</b>	<b>-</b>

<sup>1</sup> Juvenile and sub adults have been different classifications for the Umwelt surveys, as a result these have been captured as 'Juveniles' to compare to James *et al.*, (2018).

<sup>2</sup> Adults have been separated into adult and large adults for the Umwelt surveys. Adults and large adults have been captured as 'Adults' to compare to James *et al.*, (2018). The data collected during the Umwelt surveys shows that a larger proportion of 'Adults' were identified within the Study Area. Further work will need to be done to characterise population in line with James *et al.*, (2018).

### 3.4 Threats

The National Multi-species Recovery Plan for the cycads, *Cycas megacarpa*, *Cycas ophiolitica*, *Macrozamia cranei*, *Macrozamia lomandroides*, *Macrozamia pauli-guilielmi* and *Macrozamia platyrhachis* (Queensland Herbarium 2007) lists several threats pertaining to *Cycas megacarpa* as outlined in **Table 3.6**.

**Table 3.6** General Threats to *Cycas megacarpa*

Threat	Description of Threat
Destruction due to land clearing	<i>Cycas megacarpa</i> populations most at risk from land clearing are those present in land that has already been cleared, or is considered to be non-remnant. Populations in areas of remnant vegetation may still be at risk from permitted small-scale clearing or exceptional circumstance such as for a dam or highway construction, however individuals may be salvaged.  Destruction of individuals and habitat from land clearing activities is still considered as the greatest risk to these species.
Legal harvesting and commercial salvage	The selective destruction of <i>Cycas megacarpa</i> was carried out by the application of power kerosene, arsenic or herbicides to the growing points as recently as the early 1990's. Consumption of the foliage by domestic stock can result in death or serious injury, which resulted in the broad scale clearing of the species.
Illegal harvesting, whole plants and seed	Cycads continue to be a desirable and collectable commodity worldwide, for use in horticultural landscaping, botanic gardens and private collections. Removal of small numbers of adult plants from a cycad population is thought to have an immediate and long-term deleterious effect on population viability.
Loss of genetic variation and insect pollinators, particularly relevant for small populations	<i>Cycas megacarpa</i> covers a wide distribution with small disjunct populations. The potential for gene flow between populations is small which can result in limited dispersal of seeds, and genetic information between populations  Small or fragmented population of less than 500 individuals, are at risk from the loss of genetic diversity.

Threat	Description of Threat
Land management practices including fire and timber harvesting	<p><b>Fire</b></p> <p>The seed bank and juvenile <i>Cycas megacarpa</i> plants are at risk due to fire management practices. Cycad seeds do not live a long time in the soil and most fires, especially high intensity fires, will destroy the seeds present in the soil. Saplings are also known to be destroyed by fire even at low intensities.</p> <p><b>Timber Harvesting</b></p> <p>Populations are at risk from inappropriate timber harvesting due to the compaction or destruction of individuals caused by heavy machinery. Timber harvesting may also influence insect populations known to pollinate <i>Cycas megacarpa</i>, however the associated threat and impact to <i>Cycas megacarpa</i> is not known.</p>

Two additional threats that are not directly included within the ‘Threats Section’ within the National Multi-species Recovery Plan for the cycads, *Cycas megacarpa*, *Cycas ophiolitica*, *Macrozamia cranei*, *Macrozamia lomandroides*, *Macrozamia pauli-guilielmi* and *Macrozamia platyrhachis* (Queensland Herbarium 2007) are noted for *Cycas megacarpa*.

The beetle, *Lilioceris nigripes*, and the lycaenid butterfly, *Theclinesthes onycha*, are known to predate on cycads. Little is known about their roles, although evidence suggests that impacts to new foliage from these species can be devastating. Feral pigs (*Sus scrofa*) can also cause damage to *Cycas megacarpa* individuals and habitat. There is evidence of feral pigs foraging on rhizomes, bulbs and tubers from *Macrozamia* spp. and as such other members of the Cycadaceae family may provide a foraging resource for feral pigs (Choquenot, Mcllroy & Korn 1996). These threats have been included when discussing the mitigation and management (**Section 5.0**) and compliance management (**Section 6.0**).

Threats to *Cycas megacarpa* specific to the Project and Project activities are outlined in **Table 3.7**. Mitigation and management measures to minimise and control these specific threats are outlined in **Section 5.0**.

**Table 3.7 Project Specific Threats to *Cycas megacarpa***

Threat	Description of Threat
Vegetation clearing, habitat loss, fragmentation and degradation	Based on the Disturbance Footprint, the Project will result in the disturbance of up to 224.4 ha of known habitat (confirmed or suspected) for <i>Cycas megacarpa</i> . Refer to the Preliminary Vegetation Management Plan (Attachment F of the Preliminary Documentation) for details pertaining to the mitigation and management of vegetation clearing, habitat loss, fragmentation and degradation. Vegetation clearing will only occur within approved areas in line with the approved clearing limits outlined in approval documents.
Soil erosion	Removal of vegetation and disturbance to the soil profile through clearing and construction activities can lead to soil erosion, which in turn can lead to habitat decline.
Dust generation	Soil exposed through vegetation clearance can lead to dust generation, which in turn settles on adjacent vegetation. Dust impacts to vegetation are understudied, but are dependent on the type of vegetation, type of dust (chemical properties, grain size) and total dust load settling on vegetation or plants.

Threat	Description of Threat
Introduction and exacerbation of introduced flora species	<p>Introduction and/or spread of weeds is a major threat that can impact the long-term survival of threatened species like <i>Cycas megacarpa</i>. Weed species are common within the cleared and regrowth areas of the site as well as sporadically throughout the remnant vegetation within the Study Area.</p> <p>The weed species that pose the biggest threat are Category 3 'restricted' species listed under the Biosecurity Act, Weeds of National Significance (WoNS), as well as high-biomass grass species, referred to as 'weed' species throughout this report.</p> <p>High-biomass grass species can out-compete native vegetation as well as reduce the germination of native species. The high biomass of these species also increases the intensity and/or frequency of fires, which is a general and Project specific threat to <i>Cycas megacarpa</i>. Refer to the <i>Terrestrial Flora Assessment Report</i> (Umwelt 2022) for the weed species that pose the biggest threat within the Study Area.</p>
Increased frequency and intensity of fires	<p>Bush fire risk is elevated leading to increased frequency and/or intensity of fires due to Project activities that may cause a fire to start. Such as electrical fire and /or higher density of high biomass grass species due to vegetation clearance and edge effects. It should be noted that generally speaking wind farms are not expected to adversely affect fire behaviour, nor create major ignitions risks (Australasian Fire and Emergency Service Authorities Council Limited 2018) as:</p> <ul style="list-style-type: none"> <li>• Automatic shutdown and isolation procedures are usually installed within the turbine system.</li> </ul> <p>Wind turbine towers are not expected to start fires if they are struck by lightning, as the turbine towers have built-in protection mechanisms. Placing wind turbine towers on ridgelines also reduces the risk of fire via lightning strike.</p>

### 3.5 Recovery Actions

The Queensland Herbarium (2007) has identified current actions that are being undertaken and future actions to be considered to reduce the threats to *Cycas megacarpa*. **Table 3.8** contains the identified threats from **Table 3.6** as well as current and future actions to reduce threats to *Cycas megacarpa*.

**Table 3.8 Current and Future Actions to Reduce Threats to *Cycas megacarpa***

Threat	Current Actions to Reduce Threats	Future Actions to Reduce Threats
Destruction due to land clearing	<ul style="list-style-type: none"> <li>• Clearing prohibited in areas with <i>Cycas megacarpa</i>.</li> <li>• A permit to clear remnant vegetation must be obtained.</li> <li>• Many populations discovered, surveyed, and documented.</li> </ul>	<ul style="list-style-type: none"> <li>• Undertake detailed surveys of populations currently considered threatened, and update maps to reflect known extent.</li> <li>• Relevant legislation and permitting to be revised to prevent clearing of habitat.</li> <li>• Negotiate conservation agreements to secure conservation of significant known populations of <i>Cycas megacarpa</i> on freehold and leasehold property.</li> </ul>
Legal harvesting and commercial salvage	<ul style="list-style-type: none"> <li>• Permitted commercial harvesting of whole plants ceased in December 2005.</li> </ul>	<ul style="list-style-type: none"> <li>• Relevant legislation and permitting to be revised to prevent clearing of habitat.</li> <li>• Harvesting of plant parts and seed to cease except for the purposes listed within <i>The National Multi-species Recovery Plan for the cycads, Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi and Macrozamia platyrhachis</i> (Queensland Herbarium 2007).</li> </ul>
Illegal harvesting, whole plants and seed	<ul style="list-style-type: none"> <li>• Information provided to the public and specifically to horticultural societies through talks, displays and publications about the illegal harvesting of <i>Cycas megacarpa</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• Major landholders and custodians to be contacted and made aware of regulations pertaining to the destruction and harvesting of <i>Cycas megacarpa</i>.</li> <li>• Provide assistance with fencing of small, isolated populations.</li> <li>• Further education to the public, horticultural societies and nursery industry around the conservation of <i>Cycas megacarpa</i>.</li> </ul>
Loss of genetic variation and insect pollinators, particularly relevant for small populations	<ul style="list-style-type: none"> <li>• Preliminary work on the identification of pollinators has been undertaken for <i>Macrozamia lomandroides</i> and <i>Macrozamia platyrhachis</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• Undertake research to determine the genetic variation, robustness of population mosaics and to determine key pollinators for <i>Cycas megacarpa</i>.</li> <li>• Establish long-term monitoring plots including population statistics and pollinator populations.</li> <li>• Translocation of individual plants under immediate threat to suitable nearby habitat.</li> </ul>
Land management practices including fire and timber harvesting	<ul style="list-style-type: none"> <li>• Observations on cone, seed and seedling loss due to fire have been made for <i>Cycas megacarpa</i>.</li> <li>• Timber harvesting guidelines have been written for the species.</li> </ul>	<ul style="list-style-type: none"> <li>• Provision of interim management guidelines to be provided to landholders.</li> <li>• Establish long-term monitoring plots for populations affected by timber harvesting and response to fire.</li> </ul>



## 4.0 Potential Impacts

### 4.1 Overview

The Project has the potential to impact on *Cycas megacarpa* individuals and habitat within the Study Area during the construction, operation and maintenance and decommissioning phases of the Project. The key potential impacts associated with the different Project phases have been summarised below in **Table 4.1**.

The greatest potential impact on *Cycas megacarpa* will be from direct impacts associated with the clearing of habitat and individuals during the construction phase of the Project. Within the Disturbance Footprint, a maximum area of 224.4 ha of *Cycas megacarpa* habitat of will be directly impacted (**Section 3.3.1**).

The Project may also result in the removal of 3,727 *Cycas megacarpa* individuals within the Disturbance Footprint (**Section 3.3.1**).

Mitigation and management measures to reduce Project impacts are discussed in **Section 5.0**.

**Table 4.1 Project Activities, Risks and Potential Impacts**

Project Phase	Project Activity	Risk/ Threat	Potential Impacts
Construction	Site establishment and vegetation clearing	Habitat loss, fragmentation, and degradation	<ul style="list-style-type: none"> <li>Reduce the extent and condition of suitable habitat (known and potential).</li> <li>Reduction in population size and number of <i>Cycas megacarpa</i> individuals within a community.</li> </ul>
		Introduction and exacerbation of weed species	
	Construction activities including vehicular movement	Dust generation	
		Soil erosion and sedimentation	
Operation and Maintenance	Project activities	Introduction and exacerbation of weed species	
Decommissioning	Project conclusion and rehabilitation works	Dust generation	

## 5.0 Avoidance, Mitigation and Management

### 5.1 Avoidance

Revisions to both the Study Area and Development Corridor have occurred throughout the life of the Project as a result of community and landholder consultation, wind resource data, grid connectivity options and an understanding of on-ground constraints.

The Development Corridor size and configuration in particular has undergone at least three significant revisions (all of which have resulted in a reduced number of turbines) to account for impacts to *Cycas megacarpa*. Known high-density areas of *Cycas megacarpa* were prioritised for avoidance; the current Disturbance Footprint avoids almost all of these areas (>99% avoided). As part of ongoing avoidance measures micro-siting around Project infrastructure will further prioritise the following, where possible:

- Large reproductive-age individuals (>1 m).
- Mature female plants.

Further avoidance opportunities exist for *Cycas megacarpa* with the installation of overhead powerlines, with individuals less than 4 m potentially be retained in these areas. The final number of *Cycas megacarpa* individuals to be avoided will be based on the final detailed design and subject to micro-siting requirements of transmission line infrastructure. Approximately 629 individuals within the Disturbance Footprint are mapped under 33 kilovolt (kV) and 275 kV reticulation.

### 5.2 Mitigation and Management Objectives

The overarching management objective is to ensure there is no loss or decline of *Cycas megacarpa* individuals (including those identified in future pre-clearance surveys), by:

- Ensuring there is no disturbance to identified populations or suitable habitat for *Cycas megacarpa* outside of the approved Disturbance Footprint and 5 m either side of this. This will include clear communication and delineation of ‘no-go’ areas where impacts will be avoided during construction. It should be noted that some areas outside of the Disturbance Footprint will need to be accessed to undertake other monitoring activities such as removing carrion as part of the carrion removal program. Refer to the Preliminary Bird and Bat Adaptive Management Plan (Attachment G of the Preliminary Documentation).
- Minimising the loss of individuals or populations and habitat by reducing the area of the Disturbance Footprint where possible. Micro-siting of infrastructure will be implemented to avoid known populations and associated habitat.
- Increasing the awareness of *Cycas megacarpa* among Project personnel, landholders, and the general community.
- Undertaking pre-clearance surveys to confirm the location, extent, numbers, and age class of the *Cycas megacarpa* population within the Disturbance Footprint (plus 5 m buffer), with all efforts made to avoid impacts to high-density locations and large reproductive-age individuals (>1 m).

- Stipulating vegetation clearing requirements and methods to reduce impacts to surrounding individuals and their habitat.
- Specific weed/ pest and pathogen management measures to reduce impacts on the long-term integrity of the remaining *Cycas megacarpa* habitat.
- Erosion, sedimentation, dust and fire management requirements specific to *Cycas megacarpa*.
- Translocation and propagation requirements for the *Cycas megacarpa* individuals that would otherwise be removed through clearing for the Project. The plan specifies pre and post monitoring requirements, translocation and propagation methods and protocols and reporting requirements and performance criteria. Refer to the Preliminary *Cycas megacarpa* Translocation and Management Plan (Attachment J of the Preliminary Documentation) (Attachment J of the Preliminary Documentation) for specific information pertaining to the management and translocation of *Cycas megacarpa* individuals.
- Reporting requirements and performance measures.

It should be noted that the management and mitigation measures outlined in **Table 5.2** will be based on areas and buffers specific to each point along the Development Corridor and within the Disturbance Footprint. Once the pre-clearance surveys have been completed and the Disturbance Footprint has been defined, then specific parameters will be applied to the Disturbance Footprint with appropriate buffer distances. These details will be included in the final approved SMP.

As mentioned above, large reproductive-age individuals (>1 m) will be avoided, where practical. Project infrastructure will be micro-sited within the Development Corridor, where conditions and wind resource allow for areas of lower ecological significance to be prioritised. Areas of lower ecological significance include areas with no or low *Cycad megacarpa* density.

The specific management and mitigation measures to reduce threats and minimise impacts on *Cycas megacarpa* are outlined in **Table 5.2**. Management and mitigation measures have been based on current best practices and information provided in the following documents, research papers and guidelines:

- Species Profile and Threats Database for *Cycas megacarpa* (DCCEEW 2022).
- National Multi-species Recovery Plan for the cycads, *Cycas megacarpa*, *Cycas ophiolitica*, *Macrozamia cranei*, *Macrozamia lomandroides*, *Macrozamia pauli-guilielmi* and *Macrozamia platyrhachis* (Queensland Herbarium 2007).
- Investigating the demographics and intrapopulation spatial patterns of the endangered *Cycas megacarpa* (Etherington et al. 2018).
- Conservation genetics and demographic analysis of the endangered cycad species *Cycas megacarpa* and the impacts of past habitat fragmentation (James et al. 2018).
- *Queensland's Threatened Plants Spotlight on Cycads* (Hyslop & Haskard 2005).
- *Survey of Threatened Plant Species in South East Queensland Biogeographical Region* (Queensland CRA/RFA Steering Committee 1998).

A review of publicly available ecological and translocation reports was also completed to understand *Cycas megacarpa* populations including translocated populations:

- *MNES Assessment Report: Specimen Hill Wind Farm* (EMM 2020).
- *Cycas megacarpa Translocation and Management Plan: QCLNG Pipeline Project* (QGC 2016).
- *Cycas megacarpa Management and Translocation Plan* (Origin 2014).
- *GLNG Gas Transmission Pipeline: Cycas megacarpa Translocation and Management Plan* (Santos 2013).

## 5.3 Roles and Responsibilities

The roles and responsibilities for Project staff are outlined in **Table 5.1** below.

**Table 5.1 Roles and Responsibilities**

Role	Responsibility	Duties
Project Manager	Oversees the construction and operation and maintenance phases of the Project.	<ul style="list-style-type: none"> <li>• Ensure contractors and all on site personnel are given adequate training in the requirements of this SMP.</li> <li>• Ensure processes and procedures are in place prior to site mobilisation to ensure the successful implementation of this SMP.</li> <li>• Implement the monitoring program, outlined in <b>Section 6.2</b>.</li> <li>• Undertake and record corrective actions and non-compliance.</li> <li>• Report to administrating authorities where required.</li> </ul>
Construction Manager	Oversees site construction and reports to the Project Manager.	<ul style="list-style-type: none"> <li>• Ensure the implementation of this SMP throughout the construction phase.</li> </ul>
Environment Officer	Ensures the implementation this SMP through the construction and operation and maintenance phases. Reports to the Project Manager.	<ul style="list-style-type: none"> <li>• Notify the Project Manager of any environmental incidents/non compliances that occur on site.</li> <li>• Audit site works in accordance with this SMP. Notify the Project Manager on project progression.</li> <li>• Undertake environmental monitoring and reporting, where applicable.</li> </ul>
Suitably Qualified Ecologist	Provides independent ecological expertise. Reports to the Environment Officer.	<ul style="list-style-type: none"> <li>• Undertake pre-clearance surveys, baseline monitoring, and ongoing management and monitoring as per the requirements of this SMP.</li> </ul>
All Project personnel	Construction, operation and maintenance. Reporting requirements will differ depending on Project roles.	<ul style="list-style-type: none"> <li>• Reports environmental incidents and non-compliance to the Environment Officer.</li> <li>• Undertake site and role specific training.</li> <li>• Follow the requirements outlined in this SMP.</li> </ul>

## 5.4 Measures

**Table 5.2 Summary of Proposed Management and Mitigation Measures for *Cycas megacarpa***

Risk/ threat	Associated Performance Criteria	Mitigation Measures and Management Action (s)	Timing
Loss of individuals or populations	No loss or decline of known populations of <i>Cycas megacarpa</i>	<p><b>Pre-construction</b></p> <ul style="list-style-type: none"> <li>• A maximum of 3,727 <i>Cycas megacarpa</i> individuals will be impacted by clearance works being undertaken in the Disturbance Footprint. Of these:               <ul style="list-style-type: none"> <li>○ Approximately 3,727 <i>Cycas megacarpa</i> individuals will be translocated based on the health of the individuals (trunk and crown) and occupational health and safety. The exact numbers to be translocated will be determined after pre-clearance surveys. Refer to Translocation and Management Plan for <i>Cycas megacarpa</i> (Attachment J of the Preliminary Documentation) for specific information pertaining to the management and translocation of <i>Cycas megacarpa</i> individuals.</li> </ul> </li> </ul> <p>It should be noted that approximately 629 <i>Cycas megacarpa</i> individuals occur in areas where overhead powerlines are predicted to be placed. All cycads under overhead powerlines are subject to further avoidance. Individuals predicted to be retained are subject to the final detailed design and micro-siting of towers, access tracks etc., and to the extent of vegetation clearing prescribed in the Bushfire Management Plan. It is anticipated that trees under 4 m will be retained pending outcomes of the Bushfire Management Plan. Any <i>Cycas megacarpa</i> individuals that meet this criteria will be clearly demarcated and avoided during construction.</p> <p>Prior to any vegetation clearing pre-clearance surveys will be undertaken within the Disturbance Footprint to inform the micro-siting process. All <i>Cycas megacarpa</i> individuals within the Disturbance Footprint and within 5 m of the Disturbance Footprint will be recorded. A total number of <i>Cycas megacarpa</i> individuals within this area (Disturbance Footprint with a 5 m buffer) will be confirmed, including total numbers in each age class. Refer to <b>Section 5.5</b> for the details pertaining to pre-clearance survey methods.</p> <p><b>Pre-construction, Construction and Operation and Maintenance</b></p> <ul style="list-style-type: none"> <li>• Micro-siting and the optimisation of infrastructure placement within the Development Corridor will be undertaken to further minimise disturbance to known <i>Cycas megacarpa</i> individuals. Where practical, areas that contain no or low densities of <i>Cycas megacarpa</i> will be prioritised.</li> </ul>	<p><b>Pre-construction:</b> Prior to commencement of site disturbance and any construction activities.</p> <p><b>Construction and Operation:</b> At all times throughout the life of the Project.</p>

Risk/ threat	Associated Performance Criteria	Mitigation Measures and Management Action (s)	Timing
		<ul style="list-style-type: none"> <li><i>Cycas megacarpa</i> individuals will be clearly marked, so that accidental damage is avoided in populations not directly impacted by construction activities.</li> <li>'No-go' areas, including clearing limits will be clearly demarcated including the implementation of signage and fencing. Information fact sheets will also be given to applicable land holders. 'No go' areas will include areas adjacent to the Disturbance Footprint which contain habitat (known or potential) or <i>Cycas megacarpa</i> individuals.</li> <li>Ongoing monitoring will occur within Disturbance Footprint and 5 m either side of the Disturbance Footprint to monitor individual numbers and the health and condition of retained individuals, which will include the presence of insects that predate on cycads and feral pig presence (<i>Sus scrofa</i>). Refer to <b>Section 6.2</b> for more details.</li> </ul> <p><b>Operation and Maintenance</b></p> <ul style="list-style-type: none"> <li>Rehabilitation will be undertaken of disturbed areas no longer required for active use or construction to ensure <i>Cycas megacarpa</i> habitat is restored and does not lead to further degradation. Refer to <b>Section 5.6</b> for the details pertaining to restoration and rehabilitation within <i>Cycas megacarpa</i> habitat.</li> </ul>	
Loss of individuals or populations	No loss or decline of Known populations of <i>Cycas megacarpa</i>	Personnel will be informed of the known <i>Cycas megacarpa</i> populations within the Development Corridor and Disturbance Footprint, as well as the procedures for minimising Project impacts through site inductions, training, and toolbox talks in line with this SMP. Project vehicles and personnel are to stay on approved tracks to reduce the risk of impacting areas of retained habitat and individuals.	Prior to personnel entering and working on the Project site.
Habitat degradation or deterioration leading to loss of individuals or populations	Management of weed species to ensure there are no new species or infestations identified within the Disturbance Footprint.	<p><b>Pre-construction</b></p> <ul style="list-style-type: none"> <li>Pre-clearance surveys will be undertaken within the Disturbance Footprint (plus 5 m buffer) to record the presence and abundance of weed species. Baseline conditions will need to be established prior to construction such that impacts from the Project can be monitored throughout the Project lifecycle. Areas containing infestations will be treated prior to the commencement of site disturbance and any construction activities. Refer to the Preliminary Vegetation Management Plan (Attachment F of the Preliminary Documentation) for details pertaining to pre-clearance surveys for weed species.</li> </ul>	<p><b>Pre-construction:</b></p> <p>Prior to commencement of site disturbance and any construction activities.</p>

Risk/ threat	Associated Performance Criteria	Mitigation Measures and Management Action (s)	Timing
		<p><b>Construction and Operation and Maintenance</b></p> <ul style="list-style-type: none"> <li>• Ongoing weed inspections and management will be completed within the Disturbance Footprint (plus 5 m buffer), especially in proximity to <i>Cycas megacarpa</i> individuals during construction and operation and maintenance (i.e. construction and <i>Cycas megacarpa</i> translocation). The weed management area shall be increased where operational maintenance activities are required to be undertaken from unformed areas of the Project site until such time when weed presence in this area (if existing) can no longer be directly attributed to the Project. Refer to the Preliminary Vegetation Management Plan (Attachment F of the Preliminary Documentation) for details pertaining to pre-clearance surveys for weed species.</li> <li>• Management of weed species within areas disturbed as part of Project construction (including rehab areas) will continue up to two years post construction, or until weed presence in these areas can no longer be directly attributed to Project activities. Refer to the Preliminary Vegetation Management Plan (Attachment F of the Preliminary Documentation) for details pertaining to management of identified Project weeds.</li> <li>• Use of chemical treatment in infestation areas, to be prioritised for use in the early wet season to limit seed formation. Personnel using herbicides are to receive appropriate training prior to commencing work and hold any necessary licences required under Queensland law. Only herbicides registered for use over water will be used within 10 m of watercourses.</li> <li>• Site vehicles (mobile plant including light vehicles) and equipment are to arrive on site ‘clean’ of weed seeds and other organic matter. Site vehicles are to be inspected and recorded with documented evidence, via a washdown register and weed and seed certificate, prior to site mobilisation.</li> <li>• Site vehicles (mobile plant including light vehicles) must drive to conditions and remain on approved access tracks to avoid mud, organic matter and weed seeds becoming stuck or caught on the vehicle. Offroad driving will be minimised to avoid contamination when driving between properties within the Project site.</li> <li>• Site vehicles to be washed down after working in areas where infestations are noted within the project site (where identified), and where weed control measures have not been implemented.</li> </ul>	<p><b>Construction and Operation and Maintenance:</b></p> <p>At all times throughout the life of the Project.</p>

Risk/ threat	Associated Performance Criteria	Mitigation Measures and Management Action (s)	Timing
		<ul style="list-style-type: none"> <li>• During the annual wet season light vehicles shall be maintained, washed down periodically, and kept in a clean condition.</li> <li>• Light vehicles and worker transport vehicles to remain on established roads when offsite, for example between work shifts. Further inspections will not be required when this action is implemented.</li> <li>• Personnel boots must be cleaned regularly, as well as between properties by removing excess mud / organic material. Clothing to be checked for weed seeds prior to moving between properties and offsite.</li> <li>• Equipment or material being brought into port facilities for direct transfer to the Study Area is required to pass the quarantine inspections and protocols, as per by the Australian Quarantine and Inspection Service.</li> <li>• Material imported into the Study Area (i.e., for use as road base etc.) must be obtained from an appropriately licensed source where the source location is deemed 'weed clean'. Evidence must be obtained from the provider prior to importation of material to the Project site. Imported fill (rocks/screenings) shall be free of contamination from mud clumps and weed seeds.</li> <li>• Use only native or certified weed free seeds in all rehabilitation works, including hydro mulch. No viable weed species (declared or otherwise) are to be mulched or chipped in rehabilitation works.</li> <li>• All personnel are to be trained in the identification of key weed species during general induction and toolbox talks. Known weed species on the site are to be displayed on posters on the HSE board and any other suitable locations around the Project site.</li> </ul>	
Habitat degradation or deterioration leading to loss of individuals or populations	Approved clearing limits will not be exceeded, as outlined in the Project's Development Approval	<p><b>Pre-construction</b></p> <ul style="list-style-type: none"> <li>• Micro-siting does not result in additional disturbance to <i>Cycas megacarpa</i> known habitat above the approved limits. Micro-siting of infrastructure will be implemented to avoid known populations and habitat where possible. Where individuals cannot be avoided, translocation and/or propagation of individuals will be undertaken accordance to the Preliminary <i>Cycas megacarpa</i> Translocation and Management Plan (Attachment J of the Preliminary Documentation).</li> </ul>	<p><b>Pre-construction</b></p> <p>Prior to commencement of site disturbance and any construction activities.</p>



Risk/ threat	Associated Performance Criteria	Mitigation Measures and Management Action (s)	Timing
		<ul style="list-style-type: none"> <li>Pre-clearance surveys will be undertaken within known and potential habitat for <i>Cycas megacarpa</i> prior to construction activities occurring within the Disturbance footprint and 5 m either side of the Disturbance Footprint, to inform the micro-siting process. Refer to <b>Section 5.5</b> for the details pertaining to pre-clearance survey methods.</li> </ul> <p><b>Construction</b></p> <ul style="list-style-type: none"> <li>Known <i>Cycas megacarpa</i> habitat and clearing extents will be clearly demarcated with fencing or flagging.</li> <li>Site personnel will undergo site induction and training to understand the locations, key characteristics, and habitat associated with <i>Cycas megacarpa</i>, as the procedures for minimising Project impacts through site inductions, training, and toolbox talks in line with this SMP.</li> </ul>	<p><b>Construction</b></p> <p>Prior to commencement of site disturbance and any construction activities.</p>
	<p>Implementation of erosion control and dust suppression measures during the construction phase.</p>	<p><b>Construction and Operation and Maintenance</b></p> <ul style="list-style-type: none"> <li>The potential impacts of erosion and sedimentation will be mitigated and managed through the development and implementation of the final Erosion and Sediment Control Plan (a Conceptual Erosion and Sediment Control Plan (ESCP) is provided as Attachment H of the Preliminary Documentation).</li> <li>Progressive rehabilitation of bare/ disturbed areas will be completed as soon as the area is no longer needed for construction.</li> <li>Areas of bare earth will be limited to essential areas needed for the construction of Project infrastructure. Vegetation cover, mulch, and other suitable methods to prevent dust generation will be adopted, where practicable.</li> <li>Stockpiles (topsoil and subsoil) will be maintained to prevent windblown dust generation, especially during dry and/or windy conditions. This will include watering or covering of material as per the Preliminary ESCP (Attachment H of the Preliminary Documentation).</li> <li>Maximum speed limits will be in place as applicable within the Study Area to avoid excessive dust generation. Speeds on public roads are to be observed as per road signage.</li> <li>Restrict vehicles to approved access tracks (where constructed, or where approval for use exists with the landowner) and only vehicles required for the safe and essential construction activities will be allowed in work areas.</li> </ul>	<p>At all times throughout construction and operation and maintenance.</p>

Risk/ threat	Associated Performance Criteria	Mitigation Measures and Management Action (s)	Timing
		<ul style="list-style-type: none"> <li>A construction water cart will be used to suppress dust during earthworks. Where watering is used, ensure that there is no surface ponding/pooling of water as per the Preliminary ESCP (Attachment H of the Preliminary Documentation).</li> <li>Promptly clean up spilled materials on traffic areas where the disturbance of the spilled material will generate harm/excessive dust.</li> </ul>	
Legal harvesting and commercial salvage	Not applicable to the Project. Commercial salvaging not proposed for Project, all <i>Cycas megacarpa</i> individuals will be translocated.		
Loss of genetic variation and insect pollinators, particularly relevant for small populations	Not applicable to the Project. There are approximately 141,392 <i>Cycas megacarpa</i> individuals within the Study Area <i>Cycas megacarpa</i> population.		
Land management practices including fire and timber harvesting	No loss or decline of known populations of threatened species.	<p><b>Construction and Operation and Maintenance</b></p> <ul style="list-style-type: none"> <li>Implement bushfire management measures in accordance with an approved Bush Fire Management Plan. The Bush Fire Management Plan will include and cater for the natural habitat and needs for <i>Cycas megacarpa</i>.</li> <li>Machinery will be located in areas outside the known vicinity of individuals, and areas which contain <i>Cycas megacarpa</i> individuals or habitat will be clearly demarked as ‘no go’ zones outside of the Disturbance Footprint, and after the translocation of <i>Cycas megacarpa</i> individuals has occurred.</li> </ul> <p><b>Operation and Maintenance</b></p> <ul style="list-style-type: none"> <li>Following agreement with the landholder any additional access tracks within the Development Corridor and Study Area that are required for construction and will not be used during operation, should be decommissioned or made inaccessible (subject to agreement with landholder) so that there are no direct or indirect impacts to <i>Cycas megacarpa</i>.</li> </ul>	<p><b>Construction</b></p> <p>Prior to commencement of site disturbance and any construction activities.</p> <p><b>Operation and Maintenance</b></p> <p>After construction activities have ceased</p>

## 5.5 Pre-Clearance Survey Methodology

Pre-clearance surveys are ecological surveys that will be undertaken prior to clearing works and the permanent removal of vegetation. Field surveys will be completed by suitably qualified ecologists<sup>3</sup> and will include targeted surveys specific to *Cycas megacarpa*. The field team undertaking the in-situ pre-clearance surveys will be led by a suitably qualified and experienced person(s) to ensure that the data collection is consistent, adequately captured and is able to be utilised for comparative analysis during future monitoring activities. The pre-clearance surveys are limited to the Disturbance Footprint and 5 m either side of the Disturbance Footprint.

All data collected will be inputted into an appropriate, project specific database that will allow for the monitoring team to track the health of retained *Cycas megacarpa* individuals. A report will be prepared based on the findings of the pre-clearance survey, which will inform the number of individuals to be translocated and offset, as well as the micro-siting process.

Where a *Cycas megacarpa* individual has been identified then the following information will be recorded:

- Unique identification code. Note, the unique identification code ideally will be comprised of the entity name/project; the year they were first tagged and assessed; and their number in sequence (e.g. BC 22 0001, BC 22 0002, etc.).
- Co-ordinates.
- Height (where applicable) or noting an individual is a seedling.
- Trunk condition (where applicable).
- No. of active and dead pups.
- Foliage development stage and any deformities.
- The presence of invertebrates including potential pollinators.
- The presence and degree of insect attack, along with the predator species present.
- The presence and developmental stage of fruiting material including number of seeds and degree of ripeness. Seeds may also be collected from female plants during this process for propagation in a nursery or the bush-house.
- Presence of seedlings and how far and what direction from the parent plant the seedlings are located.
- Overall condition and other relevant observations.
- Current height and crown condition recorded and photo logged (reference position north).

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<sup>3</sup> A suitably qualified ecologist is a person who possessed a degree in environmental planning, environmental science, environmental management or similar from a recognised tertiary institution, and has at least five years of relevant experience in environmental assessment.

- The age class structure (e.g., development class) for each individual using the classification in James *et al.*, (2018):
  - Seedlings ( $\leq 0.49$  m, non-trunked).
  - Juveniles ( $\geq 0.50$  m, non-trunked;  $\leq 0.49$  m trunked).
  - Sub adults ( $< 1$  m, trunked).
  - Adults ( $\geq 1$  m, trunked).

Where practical, seeds will be collected during pre-clearance surveys to be used in translocation. It is important to note that specific licenses under the NC Act will need to be obtained to complete this task. For example, the Protected Plant Harvesting Licence.

To account for any potential margin of error in satellite accuracy (when recording the position of *Cycas megacarpa* individuals) and any additional alignment adjustments, all *Cycas megacarpa* individuals within 5 m either side of the Disturbance Footprint will be accounted for and will have the following information recorded:

- Co-ordinates.
- Height.
- The presence and developmental stage of fruiting material including number of seeds and degree of ripeness. Seeds may also be collected from female plants during this process for propagation in the nursery or bush-house.
- Overall condition and other relevant observations.
- Current height and crown condition recorded and photo logged (reference position north).

A pre-clearance survey report will be populated after the field surveys as detailed in **Section 6.2.1.1**.

## 5.6 Restoration and Rehabilitation

Rehabilitation of Project areas no longer used for construction activities will further reduce potential impacts on *Cycas megacarpa*. The following measures will be undertaken after the *Cycas megacarpa* translocation within known and potential *Cycas megacarpa* habitat:

- The period between construction activities and restoration of disturbed areas will be kept to a minimum to prevent the establishment of exotic species and loss of soil.
- Reinstatement of the disturbed area. Topsoil and subsoil to be re-instated in the same order as extracted to minimise inversion of sub and topsoils. Topsoil to be replaced to match surrounding ground levels. Note soil (topsoil and subsoil) stockpile locations will be identified prior to construction for use in areas to be rehabilitated.
- Re-profiling of natural contours to the original profile and drainage lines/ patterns reinstated correctly, where relevant. No areas are to be left in an unstable condition. Refer to the Erosion and Sediment Control Plan for erosion and sediment mitigation measures.

- Spreading of felled vegetation and woody debris across cleared areas to protect the topsoil and to provide additional seed stock. When re-spreading on slopes, tree trunks should be placed along the line of the contour.
- No weed species to be introduced and a biosecurity management plan or protocols specific to cycad removal works to be implemented.
- No areas left in an unstable condition.
- Seed mix to contain relevant species, aligned with prior land use. The species that will be used in rehabilitation works will be identified in consultation with the landowners. Where practicable vegetation best aligned with the historic vegetation at the rehabilitation site will be selected. All rehabilitation activities adjacent to remnant areas to consist only of native species.
- Where possible, and in areas where the Disturbance Footprint is adjacent to *Cycas megacarpa* known habitat, revegetation is to occur through natural regeneration and through assisted planting to create a vegetated buffer between the Disturbance Footprint and *Cycas megacarpa* habitat. The vegetation within these areas will consist of native species analogous to adjacent vegetation community.
- Where rock was naturally occurring on the ground surface, the rock can be reinstated as part of rehabilitation works.
- All waste materials and equipment to be removed from the Disturbance Footprint area once Cycad removal works are completed. This excludes mulched vegetation (no weed seed) which will be used in rehabilitation works.
- Any temporary access roads not required for operation and maintenance, or that are not going to be retained by the landowner are to be closed and reinstated to a condition comparable with the surrounding land use.
- All work areas, temporary access tracks and other areas that have been compacted by construction activities are to be ripped to relieve compaction and to trap water and seed, where practical. This work should be undertaken outside of the wet season.

## 6.0 Compliance Management

### 6.1 Training Requirements

Training will be undertaken to ensure site personnel are familiar with the content and requirements of this SMP. The site manager will be responsible for ensuring individuals are aware of their responsibilities and reporting requirements. Site inductions and toolbox talks will be used as implementation methods before commencing work on site.

### 6.2 Monitoring and Reporting

The mitigation and management measures outlined in **Section 5.0** will be monitored throughout the duration of the Project. Regularly monitoring the effectiveness of the mitigation and management measures allows the SMP to be reviewed and updated where required.

As part of Annual Compliance Reporting, all reports discussed in **Section 6.2.1** to **Section 6.2.4**, will be provided to DCCEEW in accordance with Project approval conditions. It is anticipated that all actions relating to the management of *Cycas megacarpa* will be included, including any non-compliance items. Non-compliance items will also require notification to DCCEEW within 5 business days.

The following sections detail the monitoring activities and reporting requirements for each Project phase, including pre-construction, construction, operation and maintenance and post phase.

#### 6.2.1 Pre-Construction

A pre-clearance survey will be undertaken during the pre-construction phase. **Table 6.1** outlines the monitoring requirements associated with the pre-construction phase, which includes a pre-clearance survey. Refer to **Section 5.5** for details pertaining to the pre-clearance survey methodology.

**Table 6.1 Pre-Construction Monitoring Requirements**

Activity	Frequency	Timing	Purpose and Requirements	Deliverable	Responsibility
Pre-clearance survey	Once off activity	Prior to commencement of site disturbance and any construction activities.	Identify and quantify <i>Cycas megacarpa</i> individuals within the Disturbance Footprint (with a 5 m buffer) to be translocated or avoided.	Pre-clearance Report and register	Suitably qualified ecologist

##### 6.2.1.1 Pre-Clearance Report

Following completion of the pre-clearance survey, a report will be developed that includes the following details:

- Details of the survey effort undertaken.
- The location and extent of *Cycas megacarpa* individuals and habitat and comparison to the estimation of population size and density.

- The exact count of *Cycas megacarpa* individuals each with their own unique identifier.
- *Cycas megacarpa* population and structural information as per **Section 5.5**.

### **6.2.2 Construction**

Regular site inspections will be undertaken to ensure there is no further loss or decline of known populations of *Cycas megacarpa* and associated habitat. **Table 6.2** contains the monitoring requirements associated with the construction phase.

**Table 6.2 Construction Monitoring Requirements**

Activity	Frequency	Timing	Purpose and Requirements	Deliverable	Responsibility
Construction audits	Monthly	Throughout construction	<p>Determine if there is any increase in weed presence and abundance within the Disturbance Footprint (plus 5 m buffer)</p> <p>Items to be monitored include:</p> <ul style="list-style-type: none"> <li>Introduced flora species population density, abundance and distribution within applicable areas.</li> </ul>	Site Inspection Checklist and Environmental Incidents Register	Site Construction Manager
Post-clearing audit	Once off activity	Directly after clearing has been completed	<p>Provide an update on the location and number of <i>Cycas megacarpa</i> individuals, the extent of habitat removed and the total area of disturbance within the Disturbance Footprint and 5 m either side.</p> <p>Items to be monitored will include:</p> <ul style="list-style-type: none"> <li>Numbers of <i>Cycas megacarpa</i> individuals including a note on any population size reduction or recruitment of individuals.</li> <li>Any <i>Cycas megacarpa</i> individuals that were damaged during the construction phase but left <i>in situ</i> (numbers, location, condition).</li> <li>Significant erosion from construction vehicle access or tree clearing required for the Disturbance Footprint.</li> <li>Any adverse effects to individuals remaining within the Disturbance Footprint and 5 m either side of the Disturbance Footprint that were avoided during construction. This includes fire, and incidental damage from vehicles or site machinery.</li> <li>Introduced flora species population density, abundance and distribution within the vicinity of <i>Cycas megacarpa</i> individuals.</li> <li>Evidence of predation by insects, specifically the butterfly <i>Theclinesstes onycha</i> and the beetle <i>Lilioceris nigripes</i>.</li> <li>Evidence of feral pig (<i>Sus scrofa</i>) presence.</li> </ul>	Post-clearing Monitoring Report	Environment Officer



Activity	Frequency	Timing	Purpose and Requirements	Deliverable	Responsibility
Rehabilitation monitoring	Timing will be based on progression towards completion criteria.	During Project construction and continuing until meets completion objectives.	<p>The intent of rehabilitation monitoring is to re-establish a native ground cover after disturbance to prevent the establishment of exotic flora species and to assist with erosion mitigation measures.</p> <p>Rehabilitation monitoring must include monitoring of <i>Cycas megacarpa</i> that were damaged during construction but left <i>in situ</i>.</p>	Progressive Rehabilitation Monitoring Report	Suitably qualified ecologist

### 6.2.3 Progressive Rehabilitation Monitoring

Rehabilitation management measures will be progressively implemented during construction across cleared areas that are no longer required for construction activities in accordance with the Rehabilitation Monitoring Plan and/or the Preliminary Vegetation Management Plan (Attachment F of the Preliminary Documentation). Replanting of native species will be consistent with the vegetation communities that surround rehabilitation areas. Successful rehabilitation would include rehabilitation objectives based around the following completion criteria:

- Safe to humans and wildlife.
- Stable.
- Self-sustaining.
- Consistent with the vegetation communities that surround rehabilitation areas.

The Rehabilitation Monitoring Plan (to be developed in response to the State approval) will include detailed monitoring methodology, rehabilitation completion criteria, monitoring sites and monitoring implementation schedule.

### 6.2.4 Post-Construction and Operation

The key monitoring and reporting requirements during the post-construction and operation phase ensure there is no further loss or decline of known populations of *Cycas megacarpa* and associated habitat.

Site inspections will be undertaken after construction activities and during operation to ensure compliance with this SMP and to ensure there is no further loss or decline of known populations of *Cycas megacarpa* and associated habitat (**Table 6.3**). Non-compliance must be reported to the relevant authorities within 5 business days.

The Preliminary *Cycas megacarpa* Translocation and Management Plan (Attachment J of the Preliminary Documentation) provide details on the monitoring requirements of the reference sites.

**Table 6.3 Post-Construction and Operation Monitoring Requirements**

Activity	Frequency	Purpose and Requirements	Deliverable	Responsibility
Operation audits	Once a year	Site inspections will be completed to monitor the environmental controls as per this SMP and to ensure corrective actions are being implemented, where required.	Operation audits	Suitably qualified ecologist
	Once every 5 years	The audit will include surveys of adjacent <i>Cycas megacarpa</i> , situated within 5 m of the final Development Footprint, to monitor for the potential further loss or decline in the known populations.	Operation audits	Suitably qualified ecologist

Activity	Frequency	Purpose and Requirements	Deliverable	Responsibility
		<ul style="list-style-type: none"> <li>• Numbers of <i>Cycas megacarpa</i> individuals including a note on any population size reduction or recruitment of individuals.</li> <li>• Any <i>Cycas megacarpa</i> that were damaged during the construction phase but left in situ (numbers, location, condition).</li> <li>• Significant erosion.</li> <li>• Any adverse effects to individuals remaining within 5 m either side of the Disturbance Footprint that were avoided during construction. This includes fire, and incidental damage from vehicles or site machinery.</li> <li>• Introduced flora species population density, abundance and distribution within the vicinity of <i>Cycas megacarpa</i> individuals.</li> <li>• Evidence of predation by insects, specifically the butterfly <i>Theclinesthes onycha</i> and the beetle <i>Lilioceris nigripes</i>.</li> <li>• Evidence of feral pig (<i>Sus scrofa</i>) presence.</li> </ul>		
Rehabilitation monitoring	Timing will be based on progression towards completion criteria	The intent of rehabilitation monitoring is to re-establish a native ground cover after disturbance to prevent the establishment of exotic flora species and to assist with erosion mitigation measures.	Progressive Rehabilitation Monitoring Report	Suitably qualified ecologist

### 6.3 Corrective Actions

The SMP is a dynamic document that requires review and amendment throughout the life of the Project to ensure the measures within remain effective. It is recommended that this plan be updated:

- When additional ecological data relevant to the protection of *Cycas megacarpa* and vegetation and is collected for the Project.
- Where there is significant change to the Project schedule, Development Corridor, Disturbance Footprint or a change in the construction methods.
- Where a change in legislation or best practice methodology has been identified.

The Project Manager and the Construction Manager will be notified within one week of each monitoring event (outlined in **Section 6.2**) if any of the following triggers in **Table 6.4** occur, resulting in non-compliance. In the event of non-compliance, DCCEEW must be notified within 5 business days, and revised management measures must be referred to DCCEEW for approval within 30 business days of notification.

**Table 6.4 Corrective Actions**

Risk / Threat	Trigger	Corrective Action
Loss of individuals or populations outside of the Disturbance Footprint	Loss, damage or severe stress of individuals or populations noted	<ul style="list-style-type: none"> <li>• Undertake toolbox talks and re-educate site personnel on site practices and <i>Cycas megacarpa</i> management obligations.</li> <li>• Review and update this SMP.</li> </ul>
Introduction or infestation of weeds and/or pests	Evidence of infestations by exotic flora species encroaching on <i>Cycas megacarpa</i> individuals and habitat  OR evidence of exacerbation of pests which may have deleterious impacts to the species (i.e. feral pig)	<ul style="list-style-type: none"> <li>• Treat new infestations within the Disturbance Footprint (plus 5 m buffer).</li> <li>• Undertake additional monitoring to review the success of treatment on infestations.</li> <li>• Implement a species-specific control program for pest fauna in consultation with landowner(s).</li> <li>• Undertake toolbox talks and re-educate site personnel on site practices and <i>Cycas megacarpa</i> management obligations.</li> <li>• Review weed management procedures within the Preliminary Vegetation Management Plan (Attachment F of the Preliminary Documentation).</li> </ul>
Vegetation Clearing: approved clearing limits are exceeded	Clearing outside of the Disturbance Footprint or approved clearing limits exceeded	<ul style="list-style-type: none"> <li>• Review clearing procedures.</li> <li>• Install additional fencing or flagging to highlight non go areas.</li> <li>• Undertake toolbox talks and re-educate site personnel on site practices and <i>Cycas megacarpa</i> management obligations.</li> </ul>
Reduced vegetation condition or species health from dust generation	Evidence of dust deposition on adjacent individuals or vegetation.	<ul style="list-style-type: none"> <li>• Review mitigation and management procedures within the Erosion and Sediment Control Plan.</li> <li>• Increase frequency of dust suppression measures.</li> <li>• Undertake toolbox talks and re-educate site personnel on site practices and <i>Cycas megacarpa</i> management obligations.</li> </ul>
Loss of individuals or populations	Reduction in individuals or population due to land management practices (fire and timber harvesting)	<ul style="list-style-type: none"> <li>• Rehabilitate and restore any impacted areas.</li> <li>• Review incident to identify causes of timber harvesting or accidental fires.</li> <li>• Review the mitigation measures within the Bush Fire Management Plan.</li> <li>• Undertake toolbox talks and re-educate site personnel on site practices and <i>Cycas megacarpa</i> management obligations.</li> </ul>

Risk / Threat	Trigger	Corrective Action
Loss of individuals or populations	Reduction in individuals or population due to the presence of a significant numbers of insects, specifically the beetle ( <i>Lilioceris nigripes</i> ) and the lycaenid butterfly ( <i>Theclinesthes onycha</i> )	<ul style="list-style-type: none"> <li>• Undertake treatment options as where known (<b>Appendix A</b>).</li> </ul>
Loss of individuals or populations	Reduction in individuals or population due to increased pest presence, including the presence of feral pigs ( <i>Sus scrofa</i> ) around <i>Cycas megacarpa</i> individuals	<ul style="list-style-type: none"> <li>• Implement pest eradication program in conjunction with surrounding landholders. <b>Appendix A</b> contains appropriate eradication measures.</li> <li>• Install fencing around impacted <i>Cycas megacarpa</i> individuals.</li> <li>• Undertake toolbox talks and re-educate site personnel on site practices and <i>Cycas megacarpa</i> management obligations.</li> </ul>

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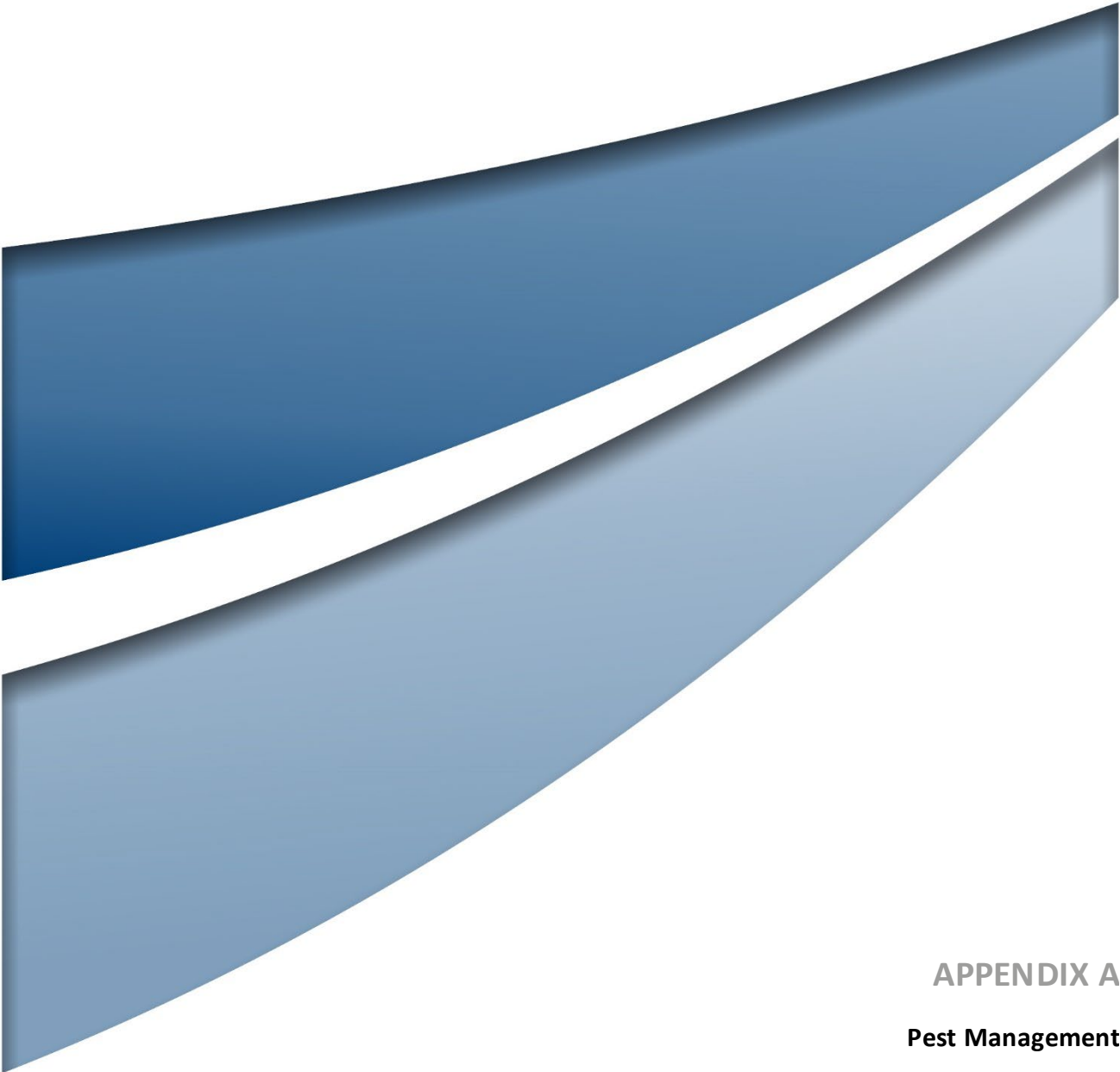
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**APPENDIX A**  
**Pest Management**



Species	Management Actions	Image
<p><i>Theclinessthes onycha</i></p>	<p>The following steps should be undertaken to control <i>Theclinessthes onycha</i> as per cycad blue butterfly on the Palm and Cycad Societies of Australia web page (Palm and Cycad Societies of Australia 2016)</p> <ol style="list-style-type: none"> <li>1. Remove the wool created from the <i>Theclinessthes onycha</i> in the crown before new leaves emerge.</li> <li>2. Locate an insecticide (Crown, Bugmaster, Rogor, Supracide are suggested) and combine wetting agent so the insecticide sticks to the leaves.</li> <li>3. Spray the emerging leaves (both sides) and the crown weekly just before the new leaves emerge and also after rain.</li> <li>4. Treatment should continue until new growth appears to when the leaves harden off.</li> </ol>	
<p>Feral pig (<i>Sus scrofa</i>)</p>	<p>The following management actions are references from the feral pig (<i>Sus scrofa</i>) factsheet (Department of Agriculture and Fisheries 2020).</p> <ul style="list-style-type: none"> <li>• Install pig-proof fences made of fabricated sheep mesh held together with plain or barbed wire.</li> <li>• Shooting pigs by helicopters where there are a large number of individuals present.</li> <li>• Poison individuals with 1080. Pre-feeding with non-poisoned baits is suggested several days prior to installing poisoned baits.</li> </ul>	