MIWF and OHTL Macrozamia conferta Translocation Management Plan (EPBC 2020/8756, EPBC 2020/8759)

Prepared for:
ACCIONA Energy Australia Global Pty Ltd

4 May 2022

Document Information

DOCUMENT	MIWF and OHTL Macrozamia conferta Translocation Management Plan (EPBC 2020/8756, EPBC 2020/8759)
ATTEXO REF	ACC-007-010
DATE	4-05-2022
PREPARED BY	Selina Carruthers, Sonny Royal, Jeromy Claridge
REVIEWED BY	Darren Maxwell

Quality Information

REVISION	DATE	DETAILS	AUTHORISATION	
			Name/Position	Signature
1	04-05-2022	Issued for use	Darren Maxwell	

Prepared for:
ACCIONA Energy Australia Global Pty Ltd

Prepared by:
Attexo Group Pty Ltd
attexo.com.au
ABN 75 637 138 008

Contents

Figures

Tables

1.0 Introduction

ACCIONA Energy Australia Global Pty Ltd (ACCIONA) proposes to develop and operate the MacIntyre Wind Farm (MIWF) and Overhead Transmission Line (OHTL) (the Project). Development of the Project will involve potential significant residual impacts to *Macrozamia conferta*, which is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Nature Conservation Act 1992* (NC Act). This Translocation Management Plan (this Plan) has been developed to address EPBC Act approval conditions (EPBC 2020/8756 and EPBC 2020/8759) for the Project that outline requirements for the *M. conferta* translocation and management. Relevant EPBC Act approval conditions and where they have been addressed in this Plan are presented in **Table 2.1**.

1.1 Purpose and Scope

This Plan sets out the proposed approach to translocation and management of *Macrozamia conferta*. The Preliminary Documentation submitted prior to approval outlines the significant impact assessment for the species and provides information on the scale of the potential impacts on the species relative to the overall population. This Plan sets out relevant information on *M. conferta* ecology, conservation advice (including listed threats), impact and translocation site assessments, approach to translocation and management, propagation, monitoring, assessment of risks and corrective actions, overall objectives, and performance principles.

The structure of the Plan has been developed to address the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018) and requirements set out in the *National Multi-Species Recovery Plan for Cycads* (Queensland Herbarium 2007).

1.2 Project Description

The Project is anticipated to consist of 162 wind turbines that will generate approximately 923 MW of renewable energy to contribute to the national electrical grid, together with the construction and operation of a 64 km, high-voltage (330 kV) overhead transmission line (OHTL), two switching stations and associated ancillary infrastructure.

The Project is located approximately 40 km south-west of the township of Warwick and 70 km south-west of Toowoomba traversing the Southern Downs Regional Council, Goondiwindi Regional Council, and Toowoomba Regional Council Local Government Areas. The Project infrastructure components are shown in **Figure 1.1**.

1.3 Relevant Conservation Advice

This Plan has been prepared to address relevant recovery plans and documents as set in **Table 1.1**.

Table 1.1 Conservation Advices, Recovery Plans, and Threat Abatement Plans

Document Name	How this Plan Addresses Relevant Requirements
Guidelines for the Translocation of Threatened Plants in Australia (Third Edition)	The Guidelines documents best-practice methods of translocation for threatened plants and has been incorporated into site preparation and maintenance actions in this Plan.
National Recovery Plan for Cycads	The National Recovery Plan for Cycads outlines recovery objectives to: **a.** prevent further loss of individuals, populations, pollinator species and habitat critical to the species' survival.

Document Name	How this Plan Addresses Relevant Requirements
	b. recover existing populations to normal reproductive capacity to ensure viability in the long-term, prevent extinction, maintain genetic viability, and improve conservation status. This Plan addresses the first objective: site preparation and maintenance pre and post translocation will minimise threats and provide ongoing protection to the translocated and recipient *Macrozamia conferta* populations. This Plan addresses the second objective: translocation of *M. conferta* into recipient populations increases genetic diversity for both *M. conferta* and pollinator species.
Approved Conservation Advice for *Macrozamia conferta*	Key threats and threat abatements are identified in the Conservation Advice and incorporated into recipient site preparation and maintenance actions in this Plan.

Attexo

MacIntyre Wind Farm

Project Location

Figure 1.1

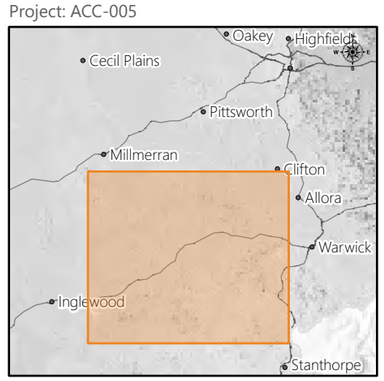
MacIntyre Wind Farm Boundary

Clearing Corridor

MIWF

OHTL

Date: 18/03/2022
Author: MKH
Reviewed: JC
Project: ACC-005



0 5 10 Km

Scale: 1:250,000@A3

Data Source(s):
Digital Cadastral Database - Department of Natural Resources, Mines and Energy (2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Department of Resources, Dept.of Environment and Science, Esri, HERE, Garmin, METI/NASA, USGS, Esri, Geoscience Australia, NASA, NGA, USGS, Esri, USGS

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx

2.0 Translocation Management Plan Approval Conditions

This Plan has been developed to address relevant EPBC Act approval conditions (EPBC 2020/8756 and 2020/8759) that outline requirements for the *Macrozamia conferta* Translocation Management Plan. EPBC Act approval conditions and where they have been addressed in this Plan are presented in **Table 2.1**.

Table 2.1 EPBC Act approval conditions for the *Macrozamia conferta* Translocation Management Plan

Condition Number	Condition Requirement	Translocation Plan Compliance
***Macrozamia conferta* Translocation Management**		
16	For the protection of *M. conferta* individuals, the approval holder must, prior to the action having any impact on *M. conferta*, submit to the department, for the written approval of the Minister, a *Macrozamia conferta* Translocation Management Plan (MTMP). The MTMP must be prepared by a suitably qualified field ecologist. The approval holder must ensure that the action has no impact on any *M. conferta* individual until the MTMP has been approved by the Minister in writing. The approval holder must implement the MTMP approved by the Minister.	This Plan has been developed by a suitably qualified field ecologist, Darren Maxwell, and prepared for approval by the Minister. The proposed translocation and management procedures provided in this Plan will be implemented following the Minister's approval.
Impact site assessment		
17	To determine the extent of the impacts to *M. conferta* within the project footprint prior to clearance of any *M. conferta*, the MTMP must include the findings of pre-clearance surveys for *M. conferta* undertaken across the entire project footprint to identify the number and size of *M. conferta* individuals that cannot be avoided by the action.	Survey effort, methodology and findings published in the *MIWF and OHTL MNES (Preliminary Documentation) Assessment Reports (EPBC 2020/8756, 2020/8759)* (GHD 2021) and addressed in **Section 5.1** of this Plan. Pre-clearance surveys identified a total of 3,664 *Macrozamia conferta* individuals (121 within the OHTL footprint, and 3,543 within the MIWF footprint) that cannot be avoided by the action (see **Figure 5.2**). Approximately 3,517 plants were mature, with the remaining 147 plants juvenile.
Translocation site assessment		
18	The MTMP must include an assessment of a proposed *M. conferta* translocation site that: **a.** includes a description of the translocation site, including location, size, condition, environmental values present and surrounding land uses; **b.** includes baseline data, including results from field validation surveys, and quantifiable ecological data on site habitat quality, and other supporting evidence, that documents the quality of habitat for *M. conferta* within the translocation recipient site; **c.** includes information about the numbers, age classes and density of any *M. conferta* individuals already present in the translocation recipient site;	This Plan address the following: **a.** Criteria developed by Commander et al. (2018) including location, size, condition, environmental values present and surrounding land uses, were used to assess the long-term suitability of the recipient translocation site and are outlined in **Section 5.2.1** and **Table 5.2**. **b.** Targeted surveys for *M. conferta* and BioCondition (Eyre et al. 2015) surveys were undertaken to assess suitability of the translocation site. Survey findings and suitability is demonstrated in **Section 5.2**. **c.** *M. conferta* were identified during field surveys within the translocation site and descriptions of individuals found in **Section 5.2.3**. **d.** Criteria developed by Commander et al. (2018) including landscape connectivity to maintain

Condition Number	Condition Requirement	Translocation Plan Compliance
	d. evidence that the location of the translocation recipient site will enable maintenance of gene flow between *M. conferta* individuals translocated to the recipient site and other established *M. conferta* populations in the surrounding area; and **e.** includes information about the presence and abundance of suitable pollinator species for *M. conferta* both in and around the translocation recipient site.	*M. conferta* population were used to assess the long-term suitability of the recipient translocation site and are outlined in **Section 5.2.4** and **Table 5.2** **e.** Information for known ecological functions (i.e. pollinators) are addressed in **Section 5.2.5** and **Table 5.2**.
Translocation of *Macrozamia conferta*		
19	The MTMP must include a translocation program for *M. conferta* individuals that will be impacted by the action that produces, within 20 years of the commencement of the action, a long-term viable population that is equal to or greater than the original population of *M. conferta* impacted by the action and maintains or improves this outcome for the duration of the approval.	A review of approved and successful translocation programs (Cycas and Macrozamia) was undertaken to develop the translocation program for *M. conferta* in this Plan, see **Section 7.0**. Proposed translocation and management methods are provided in **Section 9.0** including methods for site preparation. Proposed monitoring and evaluation actions to assess and improve the outcome of translocation and management methods are provided in **Section 10.0**.
20	The *M. conferta* translocation program must: **a.** be in accordance with the Guidelines for translocation of threatened plants; **b.** specify the procedure for the translocation of *M. conferta* to areas outside of the impact areas suitable for their survival; **c.** be undertaken by a suitably qualified field ecologist; **d.** record the location of translocated *M. conferta* individuals; **e.** specify ongoing management procedures to enable the re-establishment of translocated *M. conferta* individuals, including adaptive management strategies to ensure potential risks and threats are managed; **f.** specify ongoing management procedures to ensure the success of the *M. conferta* translocation program; **g.** specify the monitoring and record keeping processes of the translocation program to ensure easily replicable and consistent data collection; and **h.** specify translocation completion criteria for achieving no net loss of *M. conferta* impacted by the project over the period of effect of this approval.	This Plan addresses the following points of Condition Number 20), specifically: **a.** The Guidelines[1] have been addressed in this Plan as follows: **i.** Objectives of a translocation program that directly support the conservation of the target species and to establish or maintain a self-sustaining population (**Section 4.0**) **ii.** Pre-translocation assessment of biology and ecology (**Section 3.0**), including propagation methods (**Section 9.3**) **iii.** Selection of source and recipient sites (**Section 5.0**) **iv.** Pre-translocation preparation requirements and procedures involved in implementing a translocation program and adaptive management (**Section 9.0**) **v.** Required actions following translocation, including monitoring, evaluation, documentation and dissemination of results (**Section 10.0**) **b.** Translocation methods are provided in detail in **Section 9.2** **c.** Qualifications and experience of suitably qualified field ecologist, Darren Maxwell, are presented in **Appendix A**.

[1] EPBC Act *Policy Statement - Translocation of EPBC Act listed threatened species - Assessment under Chapter 4 of the EPBC Act* (2013)

Condition Number	Condition Requirement	Translocation Plan Compliance
		d. Location of translocated *M. conferta* individuals will be recorded during translocation, see **Section 10.2** **e.** Monitoring actions to assess outcome of translocated *M. conferta* and potential (see **Table 10.1**) whilst adaptive management strategies to assess and mitigate risk are outlined in **Section 11.0** **f.** Management and monitoring procedures to ensure ongoing success of the translocation program are outlined in **Table 10.1** **g.** Monitoring processes to assess translocation outcomes are addressed by site maintenance actions and *M. conferta* health assessment (see **Section 10.0** and **Table 10.1**) whilst reporting requirements are outlined in **Section 10.5** **h.** **Table 9.2** identifies auditable performance and completion criteria for recipient translocation site maintenance post-translocation of *M. conferta*.
Propagation of *Macrozamia conferta*		
21	The MTMP must commit to a program of propagation of seedlings to replace or exceed the number of *M. conferta* individuals impacted by the action that do not survive for at least twenty years after translocation.	Proposed propagation and cultivation methods for seedlings to replace or exceed the 3,664 *M. conferta* specimens impacted in the Project area are provided in **Section 9.3**
22	The program specified in the MTMP for propagating *M. conferta* individuals within the translocation recipient site must: **a.** specify the minimum number of *M. conferta* that will be propagated or how the number will be determined to achieve the requirement of condition 21; **b.** specify the seed collection procedure for propagation and how this method will not impact adversely on the viability of the existing *M. conferta* population; **c.** specify the propagation procedure; **d.** specify ongoing management procedures for propagated *M. conferta* individuals; **e.** be able to record where *M. conferta* seedlings are planted within the translocation site; **f.** specify the monitoring and record keeping processes of the seedling propagation program to ensure easily replicable and consistent data collection; and **g.** specify the seedling propagation and planting completion criteria for achieving no net loss of *M. conferta* impacted by the action within 20 years of the commencement of the action and then maintained or improve that outcome over the period of effect of this approval.	This Plan addresses the following: **a.** A minimum of 916 *M. conferta* to be propagated and how the number was determined is provided in **Section 9.3.1** **b.** Collection will be undertaken from all plants translocated, and if necessary from wild plants in accordance with the *Code of Practice for the harvest and use of Protected Plants* (DES 2020) with methods provided in **Section 9.3.1** **c.** The proposed propagation procedure is provided in **Section 9.3.2** to produce the 916 *M. conferta* seedlings required to fill the predicted deficit in translocated specimens. **d.** Proposed ongoing management procedures for propagated *M. conferta* individuals are provided in **Section 10.3**, **Table 9.2**, and **Section 11.0** **e.** Location of all propagated *M. conferta* individuals planted within the translocation site will be recorded during monitoring and evaluation efforts post-translocation, see **Section 10.2** **f.** Monitoring processes to assess translocation outcomes are addressed by site maintenance actions and *M. conferta* health assessment (see **Section 10.0** and **Table 10.1**) whilst reporting requirements are outlined in **Section 10.5** **g.** **Table 9.2** identifies auditable performance and completion criteria for recipient translocation site maintenance post-translocation of *M. conferta*.

Condition Number	Condition Requirement	Translocation Plan Compliance
25	To determine the likely effectiveness of the management actions in the approved MTMP to translocate *M. conferta* individuals impacted by the action, the approval holder must engage a suitably qualified field ecologist to undertake, within every twelve months for the first five years following the date on which the Minister first approved the MTMP and subsequently by every fifth anniversary the date on which the Minister first approved the MTMP until the number of *M. conferta* individuals impacted by the action that survive for at least twenty years after translocation exceeds the number of *M. conferta* individuals impacted by the action, an assessment of the effectiveness of the management actions in the approved MTMP.	Following the approval of this Plan, an annual report that includes assessment of translocation actions and results within the previous 12 months will be undertaken and prepared by a suitably qualified ecologist, see **Section 10.5**.
26	The approval holder must ensure that each assessment of the effectiveness of the management actions in the approved MTMP is: **a.** subject to a peer-review completed within 6 months of the completion each such assessment; and **b.** published on its website with the findings of the peer-review within 6 months of the completion of the peer-review and remains published for the remaining duration of this approval.	Ongoing assessment of the effectiveness of management actions will include: **c.** Assessment of the effectiveness of management actions in the annual report (see **Section 10.5**) which will undergo peer-review prior to final publication; and **d.** Annual reports will be published and available for public access on ACCIONA's website.
27	The translocation site for *M. conferta* must be identified and secured prior to the removal or translocation of any *M. conferta* individuals.	The proposed translocation site will be legally secured prior to the removal or translocation program commencement, see **Section 6.0**.

3.0 *Macrozamia conferta* Ecology

3.1 Ecology

Macrozamia conferta is a small cycad (**Plate 3-1**) that occurs in undulating to hilly terrain at altitudes between 600-750 m above sea level. The species is mostly found in open eucalypt forest communities that occur in flat areas or low ridges in ash-grey to white, silty loam or on skeletal, grey-white soils on steep slopes (Jones and Forster 1994; Halford 1997; DEWHA 2008). The species is closely associated with remnant Regional Ecosystem (RE) 13.11.6 described as open forest dominated by Lemon-scented gum (*Corymbia citriodora* subsp. *variegata*), Broad-leaved red ironbark (*Eucalyptus fibrosa*), Yellow Box (*E. melliodora*), Narrow-leaved ironbark (*E. crebra*) and Grey Box (*E. moluccana*) with an understorey comprised of *Acacia lineata*, *A. fimbriata*, *Jacksonia scoparia* and *Melichrus urceolatus* on metamorphics, but also corresponds to REs 13.11.3, 13.11.5 and 13.11.8. Known populations are largely found within a 25 km^2 area that includes Durikai, Bringalily and Devine State Forests, west of Warwick, Queensland (Queensland Herbarium 2008).

Macrozamia conferta has an obligate pollination mutualism with a species of *Tranes* weevil (Forster et al. 1994) to achieve cross-pollination of male and female cones that develop on separate plants (Terry 2001). Mature cones have been recorded in October and November whilst ripe seeds have been observed in February and March. However, seed germination does not occur for another 12 months due to the delayed fertilisation process of Macrozamia (Norstog and Nicholls 1997).

Population-level mast-seeding events can vary with access to water, nutrients and sunlight (Halliday and Pate 1976; Ornduff 1990; 1991). Male cones are cylindrical and 7-18 cm long with 2.5-4 cm in diameter whilst female cones are ovoid and 6-12 cm long with 3.5-6 cm in diameter (DES 2009). Seeds are ovoid and are 2-2.5 cm long with 1.6-2cm in diameter and become red when ripe (DES 2009) (**Plate 3-1**). Cone and seed development may be hindered if the plant is exposed to unfavourable conditions (Halford 1997).

The species is restricted to areas of unique geology and topology in Queensland and is unlikely to colonize outside of these areas due to poor dispersal of large and heavy seeds from the existing populations (Terry et al. 2008). Laidlaw and Forster (2012) found the species is already restricted to refugial areas and that the species' limited dispersal (short distance <100 m or no dispersal), slow generational turnover (20-25 years, 60-80 years for three generations) and obligate pollination mutualisms are the biggest threats impeding expansion into nearby suitable areas. Hall and Walter (2013) studying *Cycas ophiolitica* found of 840 seeds only 24 were dispersed >1 m and recruitment was an average of 2.2 seedling and 0.7 juveniles, suggesting seedlings within this dispersal range perish. Multiple faunal classes have been observed to disperse *Macrozamia* spp. seeds (White 1912; Loaring 1952; Eckenwalder 1980; Jones 2002; Banack and Cox 2003; Chemnick 2007; Hall 2013.) but this is likely to reflect infrequent chance events rather than the typical pattern.

Plate 3-1 Typical *Macrozamia conferta* present in the Project area (Attexo 2021)

3.2 Threats to the Species

Key threats to *Macrozamia conferta* were derived from the Approved Conservation Advice for *Macrozamia conferta* (DEWHA 2008) and the *National Multi-species Recovery Plan for the cycads* (Queensland Herbarium 2007) and are provided in **Table 3.1**.

Table 3.1 Key threats to *Macrozamia conferta*

Threat	Description
Predation of foliage	Threat of predation by grazing animals is unlikely as all species belonging to *Macrozamia* contain cycasin which can cause debilitating symptoms or death if ingested in sufficient quantities by many mammals (Halford 1997). Grazing by livestock or native fauna on *M. conferta* foliage can result in plant death or serious injury (Seawright et al. 1993). The foliage is predated by native insects that are dependent on the cycads for their lifestyle (Forster et al. 1994).
Poisoning	To reduce the likelihood of livestock being poisoned by cycads, chemicals including kerosene, arsenic or herbicides were applied to the growing points of plants to remove them from grazing areas (Kelly 1967; Vitelli 1993).
Illegal harvesting of adult plants	Removal of adult *M. conferta* from the population is thought to have an immediate and long-term deleterious effect on population viability (Raimondo and Donaldson 2003) given the species slow growth and reproduction turnover.
Loss of genetic variation and insect pollinators	*M. conferta* depends on a species of *Tranes* weevil to complete pollination hence reproduction whilst the weevil depends on *M. conferta* to complete its life cycle. Disruption of this obligate mutualistic relationship in combination with *M. conferta* growth period (see **Section 3.0**) will ultimately result in extinction of both species via inbreeding depression and lack of genetic variation and recruitment (Bond 1994). Loss of genetic variation and insect pollinators are caused by all other threats listed in this table.
Frequent high-intensity fire	Adult *M. conferta* are fire-tolerant, generally resprouting after fires where the above ground foliage is entirely burnt. High intensity fires that occur during masting events result in high losses of potential seed and destruction of seed banks on the soil surface. Established seedlings do survive low intensity burns; however, fires of increasing frequency and intensity will result in cumulative seedling loss. Fire kills seeds and any germinating seedlings. Intense fires sterilise the topsoil and only larger subadults and mature cycads are able to survive (P. Forster pers. comm. 2021). Fire impacts on insect-plant pollination interactions is unknown but may be detrimental to plants which are coning and receptive to pollinators.
Timber harvesting	Heavy machinery used for timber harvesting damages individuals and may result in soil compaction. Damage to adult *M. conferta* is minimal as the species has a subterranean trunk; however, soil compaction may impact root development and the positioning of log dumps may impact individuals.

4.0 Proposed Translocation Management Approach

The overarching approach to translocation and management is to:

- Translocate all individual plants potentially impacted by construction directly to a suitable translocation site closely linked to an existing *M. conferta* population;
- Collect seed from plants during translocation, and propagate in a nursery setting until plants are suitable to plant out at the translocation site;
- Manage the translocation site until a self-sustaining population of plants is established that is at least equal to the number of plants impacted by the Project.

5.0 Impact and Translocation Site Assessment

5.1 Impact Site Assessment

The presence of *Macrozamia conferta* within the Project footprint was confirmed during ecological surveys undertaken as part of Preliminary Documentation studies (GHD 2021). Stratified meander grids and targeted meanders were performed to detect plants in four broad areas within the Project area and relative densities in each broad area were estimated. Areas of potential habitat were mapped for the species, and the location of individual records are shown on **Figure 5.1**.

To assess the condition of vegetation and habitat within the Project footprint, BioCondition surveys were undertaken in accordance with Eyre et al. (2015) at 8 locations where *M. conferta* occurred. The vegetation structure and composition at these sites ranged from grassy woodlands to open eucalypt forests with sparse understorey. High density populations of *M. conferta* were most commonly found in open forest communities of RE 13.11.5 and 13.11.6 whilst lower densities were associated with REs 13.11.3 and 13.11.8, with some individuals in non-remnant areas. REs with *M. conferta* present are described as follows:

- RE 13.11.3 - *Eucalyptus crebra, E. dealbata, E. albens* grassy woodland on metamorphics (Of Concern VM Act);
- RE 13.11.5 - *Eucalyptus sideroxylon, E. fibrosa* subsp. *nubilis* open forest on metamorphics (Least Concern VM Act);
- RE 13.11.6 - *Corymbia citriodora* subsp. *variegata*, *Eucalyptus crebra*, *E. dealbata* open forest on metamorphics (Least Concern VM Act);
- RE 13.11.8 - *Eucalyptus melliodora* and/or *E. microcarpa/E. moluccana* woodland +/- *E. albens*, *E. dealbata*, *E. crebra*, *E. melanophloia* on metamorphics (Of Concern VM Act).

Based on studies undertaken as part of the Preliminary Documentation, population densities of *M. conferta* within the impact site ranged from 1 to 592 plants per hectare. Population structure observed was 1:8 female to male with 96% of the population adult plants on average. The location of habitat is shown in **Figure 5.1**. Habitat mapping as defined by GHD (2021) included the following:

- All records of *M. conferta* collected within the Project area;
- All areas of remnant vegetation that meet the conservation advice description (DEWHA 2008) (that is REs 13.11.3, 13.11.5, 13.11.6 or 13.11.8) within 1 km of any *M. conferta* record, except for areas in which absence of the species has been confirmed.

Pre-clearance *M. conferta* surveys were undertaken across areas of mapped habitat, plus a reasonable buffer (described as the survey area) as shown on **Figure 5.1**. The pre-clearance surveys involved structured, systematic searches of the entire clearing footprint within the survey area and were undertaken by two ecologists under the direction of a suitably qualified field ecologist. Systematic searches were undertaken through the application of the following steps:

- Started at one end of a survey block and systematically moved across the block in a series of parallel search lines;
- Search lines were close enough together to identify all potential specimens, and walking pace was slow enough, that any *M. conferta* specimen is recorded;
- Recorded the location of each individual including size of each specimen (mature or juvenile); and
- Continued until the entire survey area was searched.

Pre-clearance surveys counted a total of 3,664 *Macrozamia conferta* individuals within the survey area as shown on **Figure 5.2**. This included 3,543 specimens within the MIWF project footprint and 121 within the OHTL project footprint. In total, 3,517 specimens where mature, with the remaining 147 specimens juvenile.

The following plates show photos of a mature *Macrozamia conferta* identified during pre-clearance surveys.

Plate 5-1 Pre-clearance *Macrozamia conferta* photos

Attexo

MacIntyre Wind Farm

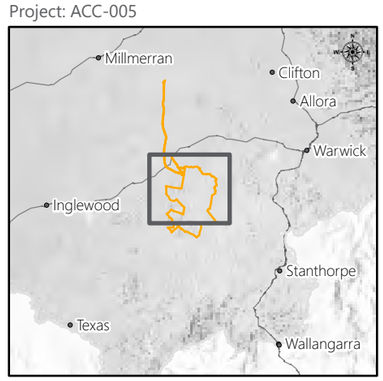
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.1

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- Clearing Corridor - OHTL
- Turbine
- Access Track
- Pre-clearance Survey Extent
- *Macrozamia conferta* Habitat
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 1 2 3 4 5 Km

Scale: 1:100,000@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Earthstar Geographics, Esri, USGS

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx

Attexo

MacIntyre Wind Farm

Macrozamia conferta

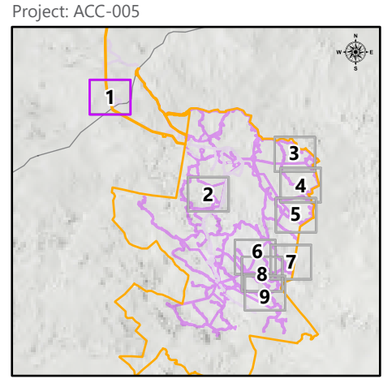
Pre-clearance Survey Extents

Figure 5.2 Sheet 1 of 9

- Clearing Corridor - OHTL
- Macrozamia Survey Extent
- *Macrozamia conferta* Records
- Property Boundary

Cunningham Highway

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

Attexo

MacIntyre Wind Farm

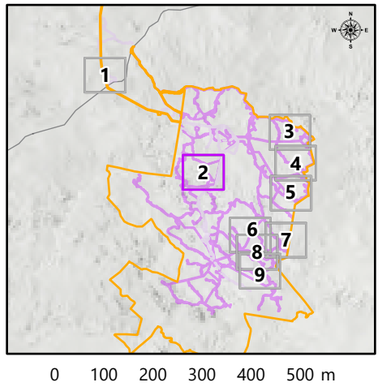
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 2 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- Clearing Corridor - OHTL
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, CGIAR, Maxar

Attexo

MacIntyre Wind Farm

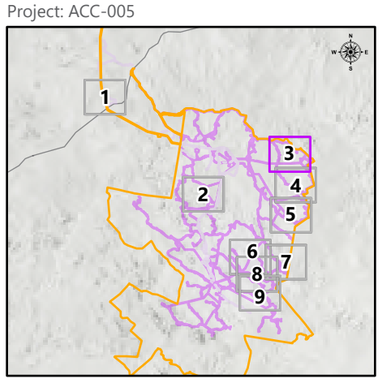
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 3 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- *Macrozamia conferta* Records
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, CGIAR, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5 GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx

Attexo

MacIntyre Wind Farm

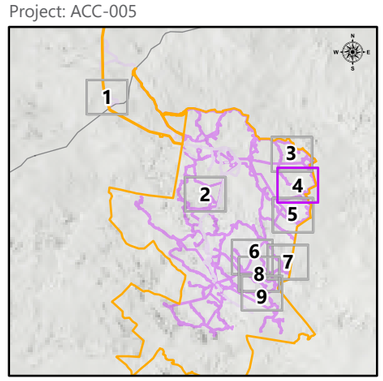
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 4 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- *Macrozamia conferta* Records
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005

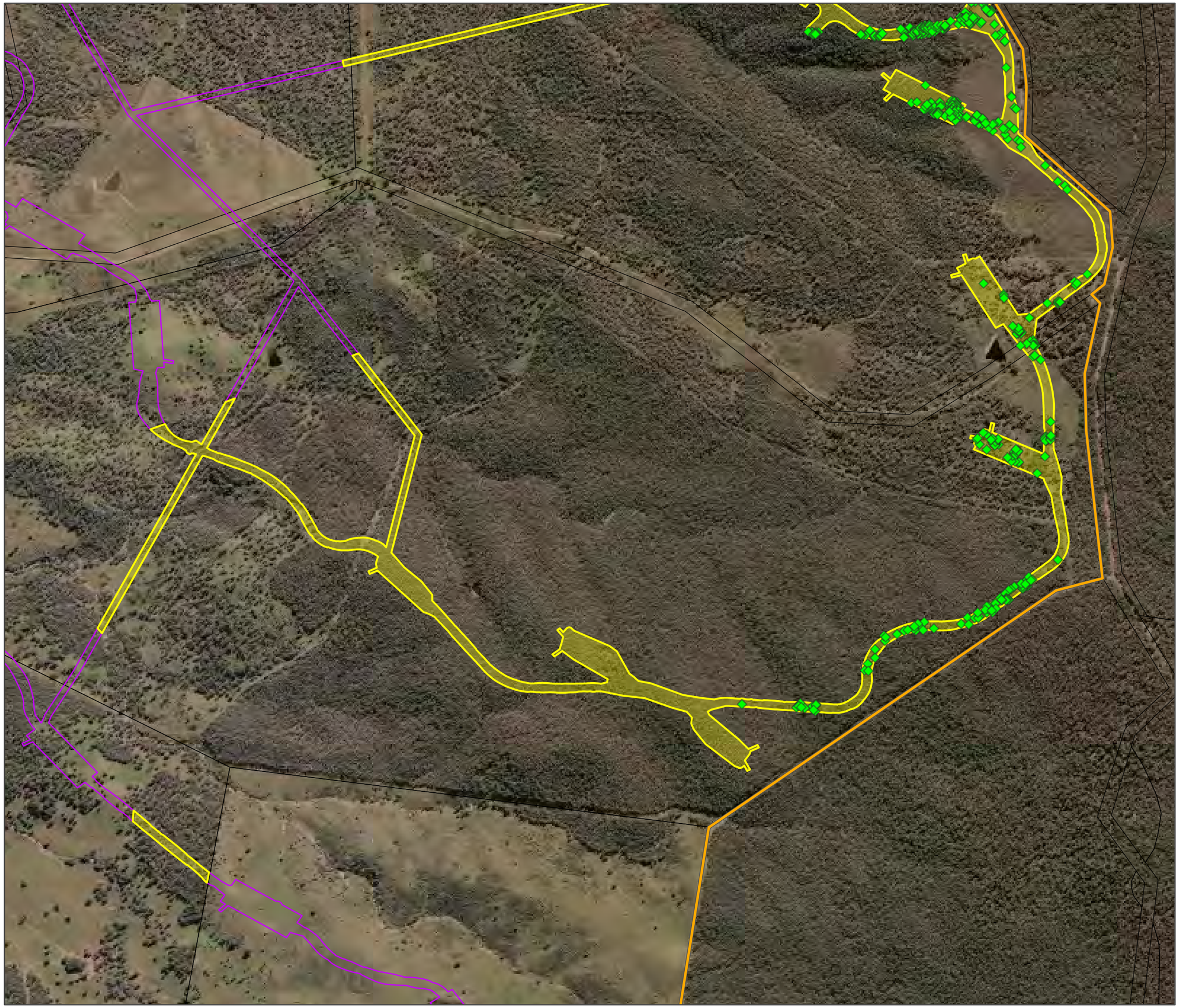


0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx



Attexo

MacIntyre Wind Farm

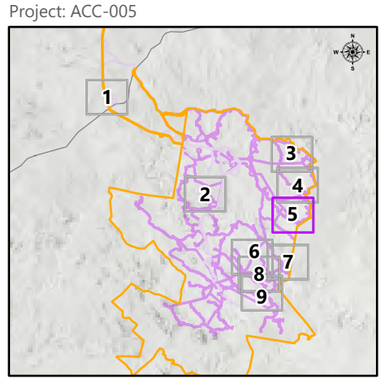
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 5 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- *Macrozamia conferta* Records
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, CGIAR, Maxar

Attexo

MacIntyre Wind Farm

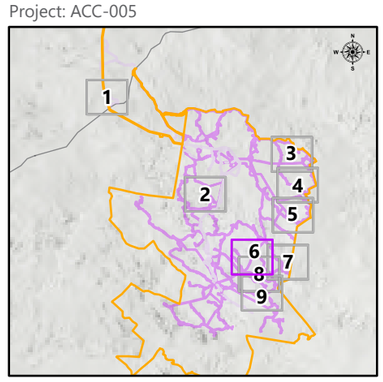
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 6 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- *Macrozamia conferta* Records
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005

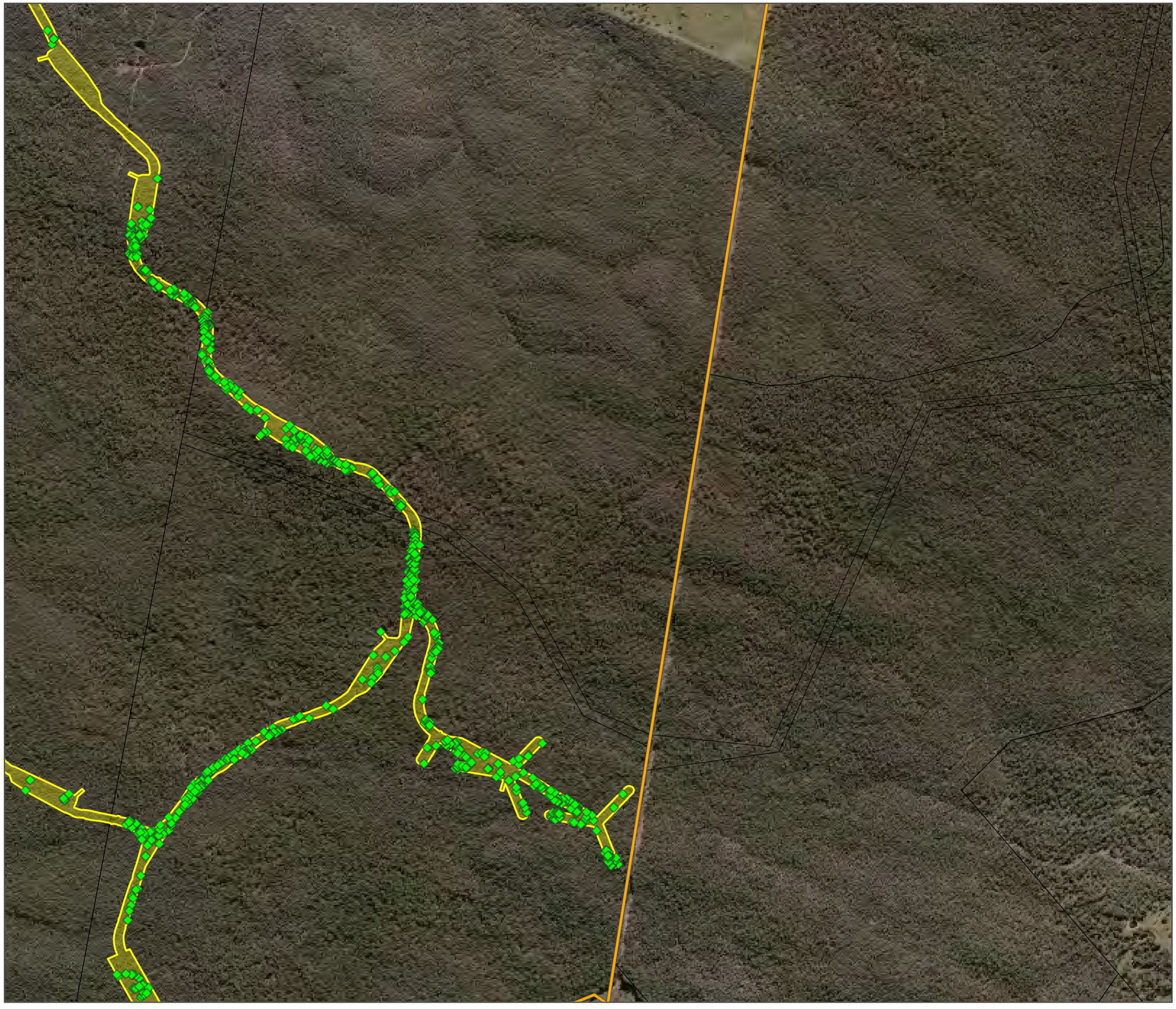


0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx



Attexo

MacIntyre Wind Farm

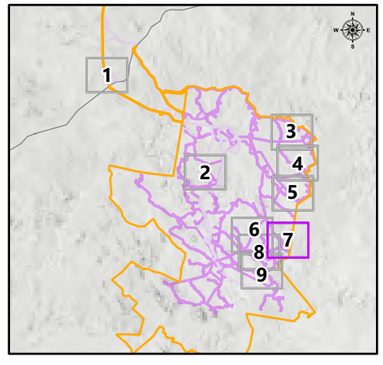
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 7 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005

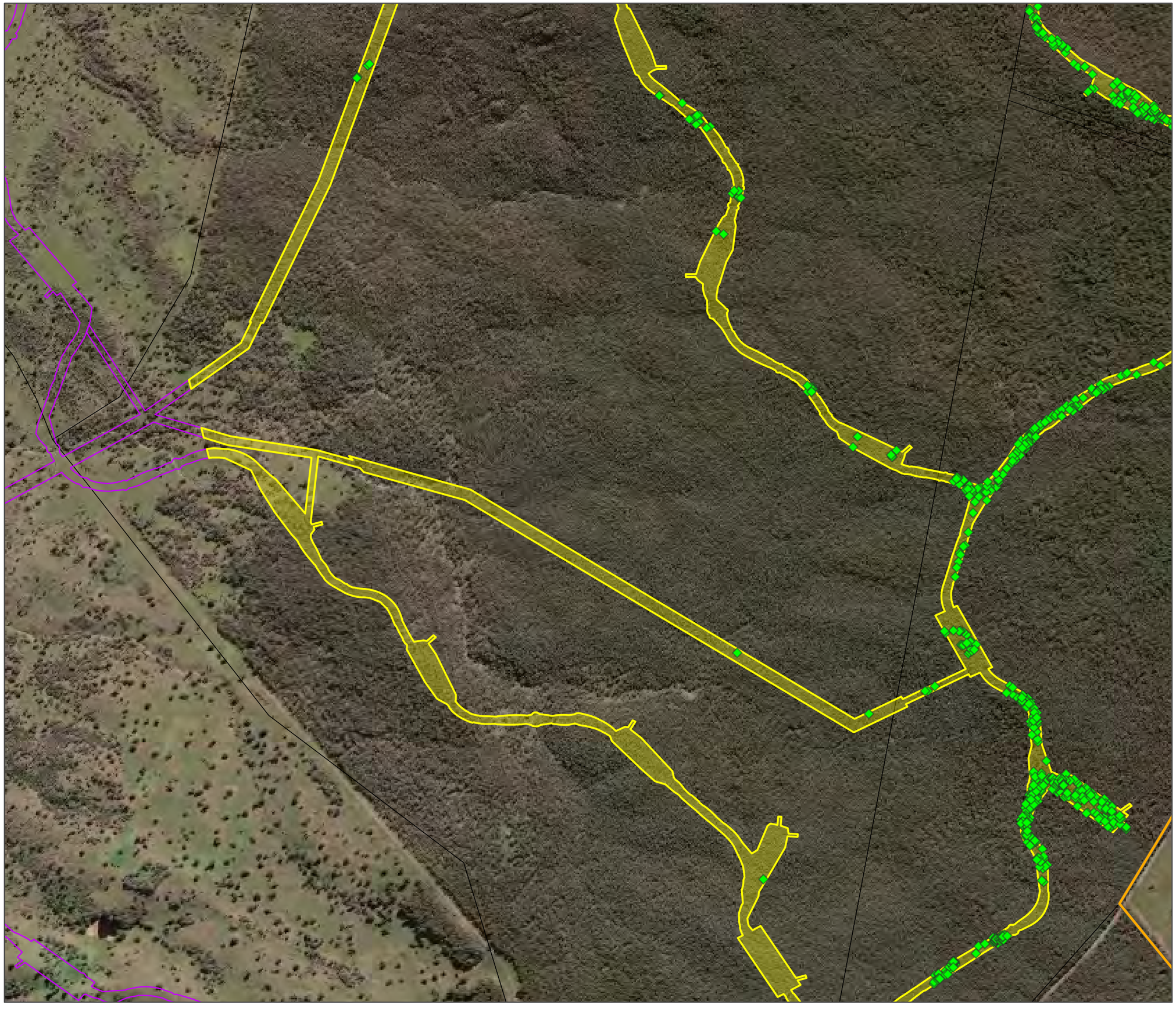


0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx



MacIntyre Wind Farm

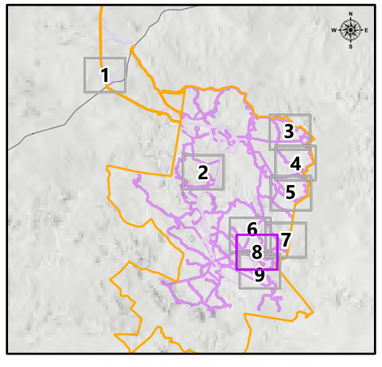
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 8 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- *Macrozamia conferta* Records
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACC\ONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx

Attexo

MacIntyre Wind Farm

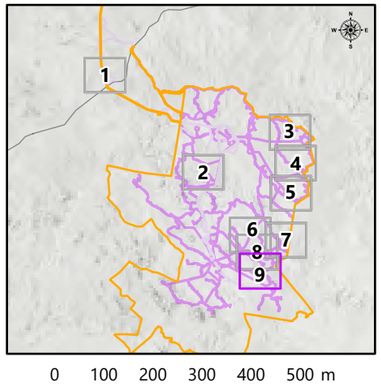
Macrozamia conferta

Pre-clearance Survey Extents

Figure 5.2 Sheet 9 of 9

- MacIntyre Wind Farm Boundary
- Clearing Corridor - MIWF
- Clearing Corridor - OHTL
- *Macrozamia conferta* Records
- Macrozamia Survey Extent
- Property Boundary

Date: 27/04/2022
Author: TOD
Reviewed: JC
Project: ACC-005



0 100 200 300 400 500 m

Scale: 1:12,500@A3

Data Source(s):
Digital Cadastral Database - Department of Resources(2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

5.2 Translocation Site Assessment

5.2.1 Site Description

The translocation site comprises a 12 ha plot of suitable habitat representing remnant vegetation of RE 13.11.5 – *Eucalyptus sideroxylon, E. fibrosa* subsp. *nubilis* open forest on metamorphics, with existing *Macrozamia conferta* present. The translocation site located on the Collin property (Lot Plan 4BNT1111) as shown on **Figure 5.3**. The translocation site occurs within areas mapped in the MIWF MNES Assessment Report (GHD 2021) as *M. conferta* habitat.

The following photos show existing site conditions at the translocation site.

Plate 5-2 Translocation site photo from north-facing aspect

Plate 5-3 Translocation site photo from south-facing aspect

5.2.2 Site Habitat Quality

The presence of *Macrozamia conferta* within and adjacent the translocation site was confirmed during ecological surveys undertaken by 'suitably qualified field ecologist'[2], Darren Maxwell. Systematic transect searches and targeted meanders were undertaken to detect *M. conferta* throughout the translocation site and surrounding areas.

Vegetation and habitat condition within the translocation site were assessed using a BioCondition transect assessment in accordance with Eyre et al. (2015) and a fixed plot was established for ongoing monitoring efforts of the site. See **Appendix B** for the BioCondition assessment field data sheet and **Table 5.1** for the vegetation structure and community of the translocation site.

[2] As per the definition of 'suitably qualified field ecologist' provided in the EPBC Act approval

Table 5.1 Vegetation structure and community of translocation site

Vegetation Structure	Translocation Site within 13.11.5
Canopy species	*Eucalyptus sideroxylon* subsp. *sideroxylon, E. fibrosa* subsp. *nubilis, Callitris endlicheri, C. glaucophylla*
Sub-canopy species	*Eucalyptus fibrosa* subsp. *nubilis, E. woollsiana, E. crebra, Callitris glaucophylla, C. endlicheri*
Shrub layer species	*Daviesia mimosoides* subsp. *mimosoides, Eucalyptus infera, Cassinia laevis, Acacia semilunata, A. ixiophylla, A, conferta, Olearia elliptica, Melaleuca decora, Dodonaea triangularis*
Ground layer species	*Acacia lineata, Entolasia stricta, Schoenus subaphyllus, Paspalidium caespitosum, Gahnia aspera*

In addition to vegetation structure and composition habitat requirements, soils at the translocation site were observed as ash-grey/white silty loam and stony/skeletal grey-white soils. These soils are consistent with soils present at existing high-density populations. *Macrozamia conferta* populations in the Project footprint that occur on flat to low undulating terrain at altitudes ranging from 600-750 m above sea level and the translocation site is located within the same elevation range at 640 m above sea level.

With consideration of the above habitat requirements, and proximity to existing populations, translocation sites are most likely to have similar climate and rainfall conditions as *M. conferta* populations in the Project footprint.

5.2.3 *Macrozamia conferta* Translocation Site Survey Results

Existing *M. conferta* occurring within the translocation site were identified, with information recorded on their location, the relative density, age classes and condition assessments of each specimen. A total of 41 *M. conferta* individuals were identified within the translocation site with an approximate density of 4 individuals per hectare. A total of 2% were seedlings and 98% were mature with 51% healthy and 49% with some leaf damage by insect or fungus. The location of *M. conferta* within and adjacent the translocation site are shown on **Figure 5.3**.

Plate 5-4 A healthy, mature *Macrozamia conferta* specimen within the translocation site

5.2.4 Maintenance of Connectivity for Genetic Flow and Diversity

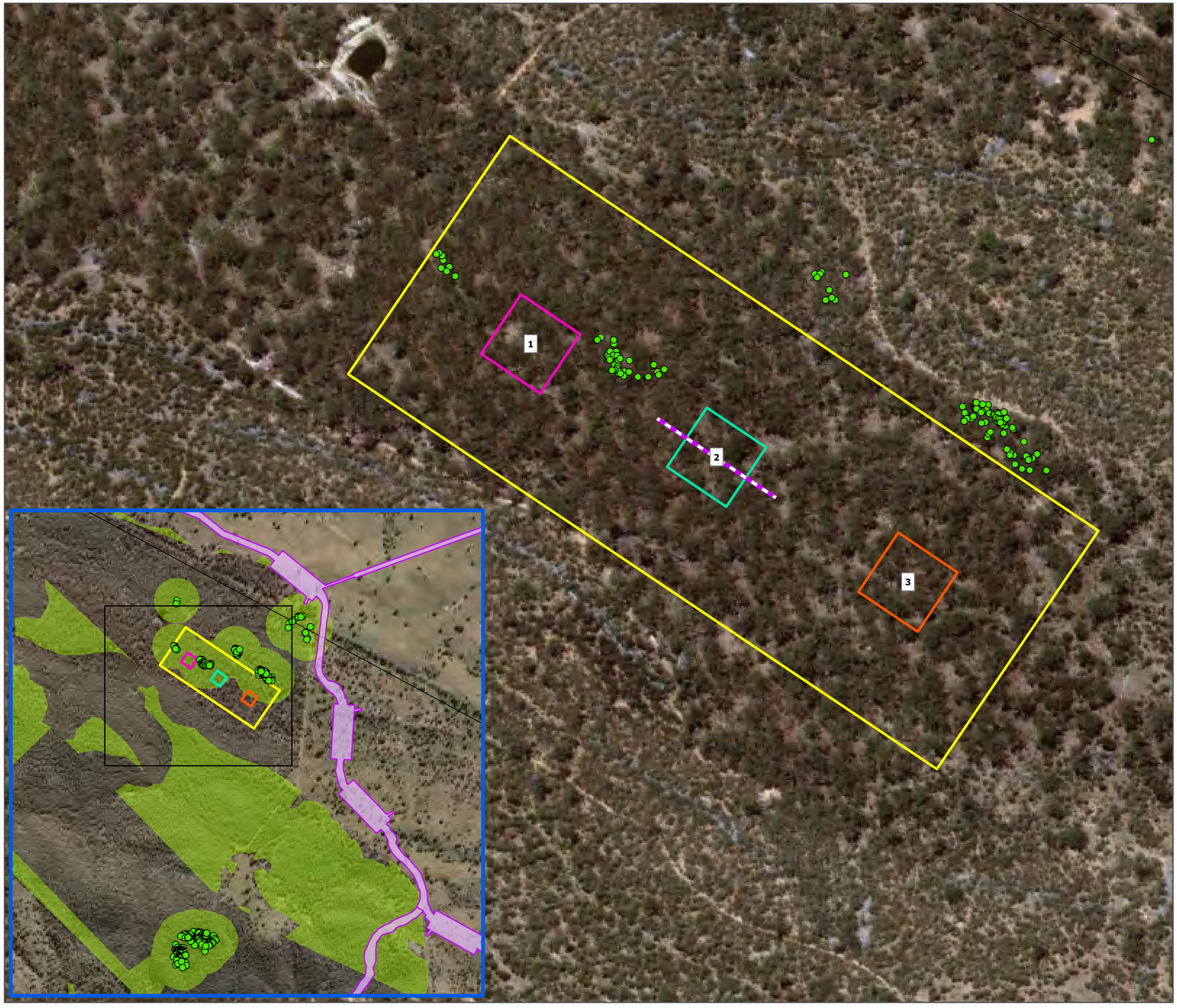
In addition to the 41 *Macrozamia conferta* individuals within the translocation site, 76 *M. conferta* were identified directly north, and approximately 400 to the south (see **Figure 5.3**). Locating the translocation site within and adjacent an existing population is expected to provide connectivity for future genetic flow and diversity, creating a self-sustaining population.

Through the translocation program, individuals from disparate geographic areas will be brought together at the translocation site. It is anticipated that this will further increase the diversity of the gene pool within the recipient population and thus genetic variability will be maintained. High genetic diversity at the population level reduces the risk of *M. conferta* inbreeding depression. The density of the translocated individuals within the translocation site and proximity to established populations will allow for connectivity with existing specimens to maintain suitable adaptation and subsequent population viability. The translocation site occurs within state and regional biodiversity corridors and adjoins existing specimens, therefore also maintains genetic connectivity between populations on a larger scale.

5.2.5 Presence and Abundance of Pollinator Species

Mutualistic species such as *Macrozamia conferta* occur in higher community composition densities (Primack 2012). *Macrozamia conferta* translocated from the Project footprint and any specimens propagated from seed will be replanted at the translocation site. The translocation site was established within the Collin property site in proximity to existing specimens as per the requirements outlined in the *Guidelines for the Translocation of Threatened Plant in Australia* (Commander et al. 2018). Having existing specimens within or adjacent the translocation site will maximise the likelihood that relevant habitat factors are present (e.g. obligate pollination mutualism with insect pollinator *Tranes* sp.). The condition of all translocated *M. conferta* individuals within the translocation site will be continually monitored for the duration of the project.

As expected, based on the time of year, no pollinator species were observed while undertaking baseline surveys of the translocation or reference sites.



Attexo

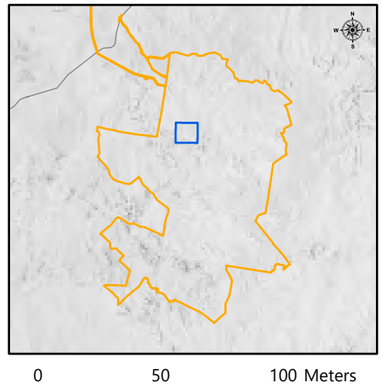
MacIntyre Wind Farm

Macrozamia conferta
translocation site and records

Figure 5.3

- *Macrozamia conferta* Record
- Permanent BioCondition Plot
- Recipient Site Boundary
- Monitoring Plot 1
- Monitoring Plot 2
- Monitoring Plot 3
- *Macrozamia conferta* Habitat
- Property Boundary

Date: 18/03/2022
Author: MKH
Reviewed: JC
Project: ACC-005



0 50 100 Meters

Scale: 1:2,500@A3

Data Source(s):
Digital Cadastral Database - Department of Natural Resources, Mines and Energy (2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Esri, Geoscience Australia, NASA, NGA, USGS, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5 GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx

5.3 Translocation Site Suitability

Commander et al. (2018) developed criteria to assess the long-term suitability of translocation site. These criteria are used to determine the suitability of the *M. conferta* translocation site and are described in **Table 5.2**.

Table 5.2 Criteria for suitable translocation site

Criterion	Description	Compliance
a)	Habitat is matched as close as possible to source location (i.e. same or similar regional ecosystem, topography, altitude),	The translocation site is in the same geographic range of *Macrozamia conferta* natural range. The sites are within the same Bioregion (New England Tableland) and subregion. Proposed sites occur within the same regional ecosystems, topography, attitude, soil type and climatic conditions.
b)	Habitat area is large enough to support a self-sustaining population and whether ecological requirements are met	Translocation site is located in a large patch of remnant vegetation with existing specimens.
c)	Connectivity to other patches of supporting habitat and other *M. conferta* populations is maintained	The translocation site occurs in close proximity to existing populations (see **Section 3.0**). Connectivity for gene flow and pollinator dispersal will be maintained between existing populations and translocated populations by large contiguous patches of remnant critical and potential habitat adjacent the translocation site.
d)	Microclimate is appropriate	The translocation site occurs in remnant vegetation of the same vegetation structure and community as the source location. There is no known existing literature or approved advice regarding *M. conferta* microclimate requirements.
e)	Future climate projections and the sustainability of the species and population at the site	The translocation site occurs in close proximity to impacted plants. The climatic requirements of *M. conferta* are currently unknown but having translocation site in close proximity to existing populations will increase the probability of success.
f)	Known ecological functions are present in the site (i.e. pollinators, mycorrhizal fungi)	Obligate mutualism of *M. conferta* with its pollinator species is a known ecological function. High-densities of *M. conferta* mimicking natural populations are proposed in translocation site, which should maximise the potential success of obligate pollinators.
g)	Land use history and degree of disturbance on the site (i.e. logging or weed infestation)	The translocation site occurs within remnant vegetation with limited evidence of logging. Several weeds were identified within the translocation site, and these will be managed during translocation and management of the site.
h)	Ecosystem functional status/the ability of the ecosystem to regenerate without continual support once pressure is removed	Translocation site occurs in remnant vegetation with limited existing weed populations. Ecosystem function should continue post the translocation maintenance period.

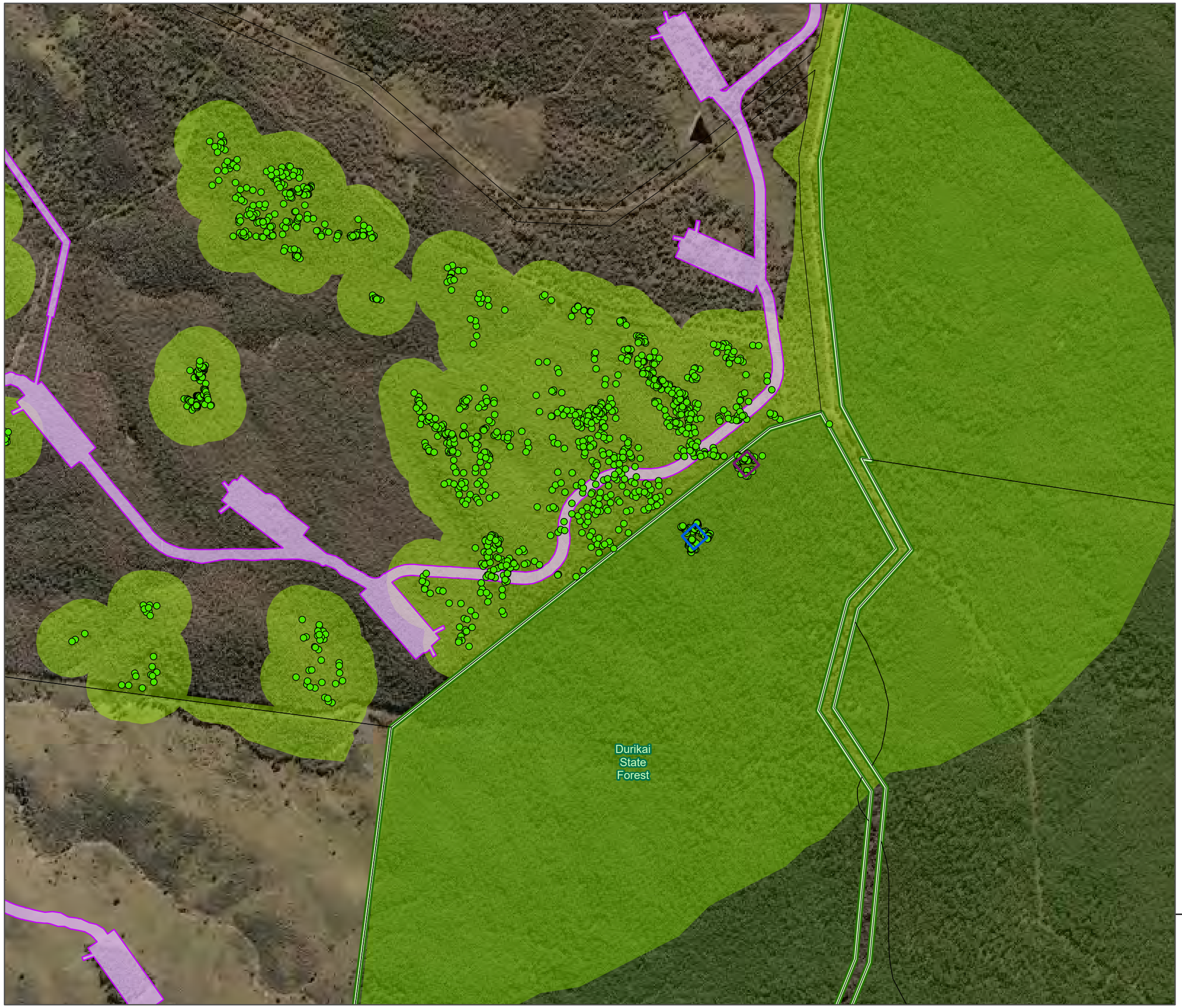
Criterion	Description	Compliance
i)	Processes impacting soil health and stability	Activities during site preparation and translocation will impact soil health and stability (i.e. mechanical/chemical weeding, digging transplant holes, pedestrian, and excavation machinery). Care will be taken to minimise potential impacts during translocation. Soils at translocation site have not been assessed as having high erosive or dispersive potentials and are unlikely to be significantly impacted by translocation activities.
j)	Existing threats and management in place to eliminate or control (i.e. current weed, feral animal or fire control)	Existing threats at the translocation site include potential future logging and/or uncontrolled, high intensity fires. These threats will be controlled and eliminated pre (see **Section 9.0**) and post translocation (see **Section 9.4**). Site maintenance post-translocation will include annual inspection, weed management and fire management.
k)	Long-term security of the site to ensure ongoing protection of translocated population (i.e. private land signed covenants with conservation agreement)	Long-term security of the site for the purposes of an environmental offset will be achieved under Section 19F of the *Vegetation Management Act 1999*.
l)	Compatibility of current and future management of the site with managing a translocated population (i.e. will proposed fire management be compatible with current site conditions)	Proposed management of identified risks to the species are consistent with current and future land management practices that seek to minimise the risk of high-intensity fires and control livestock access.
m)	Adjacent land use impact on translocation site and if a buffer is required, and proximity to existing and future infrastructure (i.e. access tracks) which will dictate accessibility for re-location and ongoing management	Adjacent land uses include Durikai and MacIntyre State Forest, and land within the Project area. Translocation site occurs in proximity to existing *M. conferta* populations; therefore it is apparent that adjacent land uses do not and will not have any impact on the translocation site.

Section 6.7 of the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al. 2018) outlines the importance of removing, ameliorating or controlling threats at the translocation site pre and post translocation. Site preparation prior to translocation will be undertaken (as outlined in **Section 9.1**) and movement between translocation site and areas within Project footprints with be planned to avoid damage to existing *M. conferta* populations.

5.4 Reference Sites

In line with requirements set out in the *EPBC Act Policy Statement - Translocation of EPBC Act listed threatened species*, establishment of reference sites is important for the comparison of existing populations with translocation populations to assess the overall success of translocation activities. Two reference sites were established within existing *M. conferta* populations within Durikai State Forest. These sites occurred within similar landscape position, aspect, soils and regional ecosystems (RE 13.11.5) as the translocation site.

A total of 88 *M. conferta* individuals were identified within the two reference sites with an approximate density of 200 individuals per hectare. A total of 4% were seedlings and 96% were mature with 54% healthy and 46% with some leaf damage by insect or fungus. The locations of *M. conferta* reference sites are shown on **Figure 5.4**.



Attexo

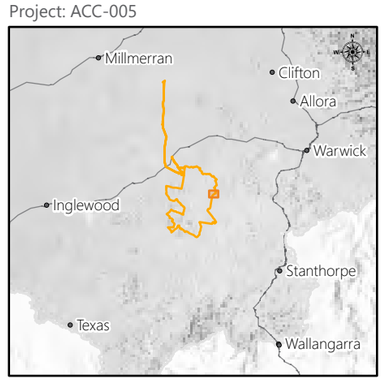
MacIntyre Wind Farm

Macrozamia conferta reference sites

Figure 5.4

Clearing Corridor
MIWF
Macrozamia conferta Record
Reference Site 1
Reference Site 2
Macrozamia conferta Habitat
State forest
Property Boundary

Date: 18/03/2022
Author: MKH
Reviewed: JC
Project: ACC-005



Scale: 1:10,000@A3

Data Source(s):
Digital Cadastral Database - Department of Natural Resources, Mines and Energy (2021)
© State of Queensland (Department of Natural Resources, Mines and Energy) 2020, Esri, CGIAR, Maxar

Path: C:\Users\Tim ODonnell\Attexo Group\Attexo - Documents\Projects\ACCIONA Energy\ACC-005 MIWF Offsets Delivery\5. GIS\4.7 Working\18_MNES_Plan\18_MNES_Plan.aprx

6.0 Translocation Site Legally Secured

The translocation site has been legally secured through a legal agreement with the landholder that ensures the translocation site will be managed for the duration of the management period in accordance with requirements set out in this Plan. Additional evidence of the executed agreement can be provided upon request.

7.0 Review of Relevant Translocation Programs

Both Macrozamia and Cycas genera belong to the order Cycadales, hence share similar biology, growth process and habitat requirements (Jones 2002). A number of translocation programs for these genera have been undertaken in Queensland. Information and learnings from these translocation programs were reviewed. **Table 7.1** lists previous Cycas and Macrozamia translocation programs relevant to this Plan.

Table 7.1 Relevant *Cycas* and *Macrozamia* translocation programs

Document Number/Reference	Title
60162199	AECOM (2011) – Translocation Program for *Macrozamia pauli-guilielmi*
WBYD-1355	Department of Transport and Main Roads (DTMR) (2015) – Bruce Highway Cooroy to Curra (Section D: Woondum to Curra)
EPBC Approval 2017/7892	GHD (2017) – *Macrozamia pauli-guilielmi* Impact Management Plan
EPBC Approval 2012/6279	Vegetation Matters (2013) – Translocation Performance Report for *Macrozamia pauli-guilielmi* and *Acacia attenuata*
3380-GLNG-4-1.3-0013	GLNG Gas Transmission Pipeline (Santos 2013) – *Cycas megacarpa* Translocation and Management Plan
Q-LNG01-15-MP-0118	Australia Pacific LNG Upstream (2014) – *Cycas megacarpa* Management and Translocation Plan
2018.8141 CCWF CTP.V4.3	Clarke Creek Wind Farm (NGH Environmental 2020) – Cycad Translocation and Management Plan
QCLNG-BX00-ENV-PLN-000025	QCLNG Pipeline Project (QGC 2016) – *Cycas Megacarpa* Translocation and Management Plan

The methods and management actions proposed in this Plan were developed with consideration of the above-listed translocation plans. The *Macrozamia pauli-guilielmi* translocation program and performance reviews undertaken by Vegetation Matters (2013), GHD (2017) and DTMR (2015) are particularly relevant to *M. conferta*.

The translocation programs undertaken to date identified that *Macrozamia* species are resilient to translocation and generally recover well, particularly if minimal damage to the underground stem occurs. The stem of adult plants provides a substantial store of water and nutrients and acts as a buffer for plants to withstand the temporary loss of leaves and photosynthetic potential and regrow the fine root system following uprooting during translocation (DTMR 2015). Vegetation Matters (2013) achieved high survivorship (88%) of *M. pauli-guilielmi,* highlighting the use of experienced successful operators is a major strength of translocation projects and is critical to translocation success. These *M. pauli-guilielmi* translocation programs identified the following challenges for successful translocation:

- The sandy nature of the soil: which can lead to difficulty in retaining soil around the root ball during excavation; and
- The size of the underground stem: which must be carefully accessed before excavation to avoid damage; and
- The optimal time for translocation is in the cooler months prior to new leaf flushes and masting in spring.

Macrozamia pauli-guilielmi translocation is highly applicable to *M. conferta* translocation as they belong to the same genus and share similar features as outlined in **Table 7.2**. Challenges for *M. pauli-guilielmi* are relevant to *M. conferta*

and are addressed throughout this Plan. Specifically, through appropriate excavation methods that will be used to retain soil around the larger root ball (see **Section 9.2.1**) and translocation to take place in the cooler months (see **Section 9.2**).

Table 7.2 Morphology of *Macrozamia conferta* and *M. pauli-guilielmi*

Feature	*Macrozamia pauli-guilielmi*	*Macrozamia conferta*
Morphology		
Underground stem	20 cm diameter 25 cm long Subterranean	15-30 cm diameter Up to 1 m long Subterranean
Leaves	1-6 leaves 30-50 cm long	1-5 leaves 35-60 cm long
Rachis	Spirally twisted (>2 times)	Spirally twisted (2-3 times)
Leaflets	140-200 leaflets 15-30 cm long by 2-4 mm wide	50-90 leaflets 6-30cm long by 2-6 mm wide

8.0 Review of Macrozamia Propagation

Numerous Macrozamia species are propagated commercially throughout Australia. As a result, there is a wealth of information on techniques for germination and propagation of Macrozamia, and a large number of nurseries that grow and sell the genus.

Macrozamia propagation is generally from seed which germinates easily without the need for any pre-treatment. Optimum germination occurs at 30°C and as low as 20°C, although the time taken for seeds to germinate will be correspondingly longer. Temperatures lower than 10°C or in excess of 38°C can cause damage (Elliot and Jones 1993).

9.0 Translocation Management Methods

Translocation will be managed by a suitably qualified ecologist with ecological restoration, translocation and plant establishment experience. A Translocation Database (TD) with information and records of all *M. conferta* proposed for relocation and seed collection will be developed for use in monitoring and maintenance of plants post-translocation and will include the following data:

- Site ID, specimen ID, GPS location, time of excavation;
- Age class: seed, seedling, juvenile, sub-adult, adult at reproductive maturity;
- Sex (distinguishable when cones produced, see **Section 3.1**);
- Female to male ratio, to replicate translocated population dynamics (see **Section 5.1**);
- Presence of cones and maturity: undeveloped, ripe, old;
- Proximity of seedlings to the maternal parent and identification number of maternal parent;
- Foliage characteristics: number of fronds, new growth, dead fronds;
- Evidence of disturbance: presence of fire, insect damage, defoliation;
- Severity of disturbance: low, medium, high; and
- Evidence of damage incurred to the plant through the translocation process, especially caudex damage and loss of the coralloid root clusters that are critical for nitrogen uptake.

9.1 Translocation Site Preparation

9.1.1 Weed Management

Two species listed as restricted invasive weeds under the *Biosecurity Act 2014* that occur within the translocation site:

- Velvety Tree Pear (*Opuntia tomentosa*); and
- Common Prickly Pear (*Opuntia stricta*).

Prior to the commencement of translocation, any restricted invasive weed species will be controlled and removed.

9.1.2 Fire Management

Adult *Macrozamia* have an underground stem and can resprout after loss of above-ground foliage from fire, however, seedlings and unburied seeds are immediately destroyed (Queensland Herbarium 2007). Mast-seeding events often follow fire, with a small percentage of individuals coning in the first year following the fire, and a high percentage of individuals coning in the second year. Based on this response to fire, the following measures will be implemented to both stimulate growth post-translocation and reduce the severity of fire hazard within the translocation site:

- Reduce standing and accumulated fuel load (either with initial low-intensity controlled burn or brush cutting);
- Controlled burns based on present fuel load and regional ecosystem, as outlined in the Regional Ecosystem Description Database (Peeters and Butler 2014).

9.2 Translocation Method

Translocation methods follow established guidelines, legislation and codes listed below:

- *Nature Conservation (Plants) Regulation 2020*;
- Code of Practice – For the harvest and use of protected plants (NC Act);
- National Multi-species Recovery Plan for the cycads (Queensland Herbarium 2007);
- Guidelines for the Translocation of Threatened Plants in Australia (Commander et al. 2018).

The optimal time for translocation is immediately before the emergence of new growth in Spring before the onset of the wet season. However, translocation at any time of year is likely to be appropriate, particularly when soil moisture is high. Damage to plants incurred by excavation is reduced when there is soil moisture as opposed to very dry conditions (P. Forster pers. comm.). Seedlings and mature plants of most *Macrozamia* can be readily transplanted and can tolerate minor root damage. In *M. conferta*, care is required for maintaining the taproot as this can be up to 1 m long and the coralloid root masses critical for nitrogen uptake (P. Forster pers. comms. 2021).

Excavation of individual plants will be undertaken through a combination of both machine-driven extraction and careful in-close treatment of each individual plant using a manual methods. The excavation method will be selected based on the size of the plant to be translocated, with smaller plants typically excavated by hand, and larger plants using machinery.

Relocation and replanting of individual plants will occur as soon as practicable from the time the plant is excavated to minimise the amount of time that the plant is out of the ground.

To achieve successful translocation the following conditions of individual plants will be assessed prior to excavation to avoid damage:

- The size of taproot and coralloid root mass;
- The extent of the micro-habitat established around the base of the plant; and
- Presence of pollinator species (*Tranes* spp. of weevil, thrips, beetles).

In review of several published *Cycas* and *Macrozamia* translocation programs that have been successfully undertaken (see **Section 7.0**) and discussed with Dr Paul Forster (pers. comm. 2021) from the Queensland Herbarium, a methodology was developed to specifically address these matters and is described in the following sections.

9.2.1 Plant and Soil Removal

At the area of impact, the following actions will be undertaken for the removal of *M. conferta* prior to translocation and replanting:

1. Use marker paint or fluorescent dye to denote the north side of every plant to ensure relocated plants retain similar north-south orientation.
2. Trim all fronds back to the point of attachment between rachis and stem.
3. Apply an anti-transpirant (e.g., Envy®), if required, to the foliage of each plant to reduce the risk of desiccation.
4. Assess the topography and soil conditions (moist or dry) for each plant and overall safety of the area. If soil is too dry, water root ball prior to excavation.
5. Depending on soil conditions, hand-digging may be required for small individuals, however, excavation of mature plants will ideally be with an excavator (nominally 13t) mounted tree spade with basket attachment.

   Note: care will be taken during excavation to avoid damagingthe subterranean caudex which can be up to 1 m long and in retaining as much of the soil around the root ball as possible should be retained, as the weight of the soil falling off the root ball can damage the roots of the plant.
6. Movement of larger and heavier individuals will likely be done using a tree spade. Where soil conditions make this impractical a soft sling on an excavator bucket and packed using hessian sacking (or similar material) will be employed to avoid bruising and damage of stems and roots.
7. Wrap the root ball and roots in rolls of hessian sacking (or similar) and spray with water to retain moisture of the root ball while the plant is awaiting replanting.
8. If roots become damaged, they will be trimmed with sterilised secateurs and a fungicide applied by spraying the roots with Banrot® to prevent infection. Damaged root ends will either be allowed to form a callus (by leaving plants in the shade within the holding area for two weeks) or be painted with a standard arboricultural stem sealant. A rooting hormone will also be applied to promote root growth.
9. Translocation will be managed to limit the time period that *M. conferta* specimens are out of the ground and to minimise bruising of plant stems.

9.2.2 Replanting of Translocated Plants

At the translocation site, the following actions will be undertaken for the replanting of *M. conferta*:

1. Holes to receive translocated plants will be dug, either by hand or machine depending on the size of individual plants. The soil within the hole will be loosened, and the hole should be not much deeper than the root ball of the plants being transplanted.
2. Plants will be positioned in new holes. Just prior to planting, the hessian will be removed, and any further damaged roots will be trimmed and Banrot® (or similar) reapplied.
3. The root ball of each plant will be re-packed with sandy loam from the site to provide a suitable substrate for new roots to grow and original topsoil removed from the hole will be used to fill the remainder. Plants will be placed in a vertical alignment.

4. If required, the foliage will be sprayed a second time with an anti-transpirant (e.g. Envy®), to reduce the risk of desiccation.
5. Each plant will be watered thoroughly with suitable quality irrigation water.
6. A systemic fungicide will be applied around each root ball.
7. Each plant will be watered about once a month (10-20 litres) depending on rainfall for 6 months after replanting or as deemed appropriate.
8. Where insect damage to translocated specimens is observed during monitoring, a control program will be employed that does not impact on pollinator populations.

Tree guards will be placed around juvenile *M. conferta* to limit impacts from native herbivores until individuals have achieved leaf lengths of 35-60 cm, at which time the specimens have reached maturity and defence mechanisms (cycasin) against browsing have developed.

9.3 Propagation and Cultivation

The translocation will be supplemented with propagation of *M. conferta* seed in a nursery. Seeds will be collected by a suitably qualified person and propagation will be undertaken by a nursery with experience growing Macrozamia species.

Table 9.1 *Macrozamia conferta* Translocation, Seed Collection and Propagation Estimates

Description	Quantification	Justification
Translocation		
Impacted individuals	3,664	Count of total individuals of *M. conferta* impacted by the Project as identified by the pre-clearance survey.
Surviving translocated individuals	2,748	Assuming low-end survival rate of 75% for directly translocated specimens (Santos GLNG Project2013); Australia Pacific LNG, QCLNG 2014).
Deficit of individuals post translocation	916	Impacted individuals less surviving individuals.
Propagation		
Seeds collected	1,077	Assuming 85% germination rate.
Propagated plants	916	Assuming all propagated plants survive planting out

9.3.1 Seed Collection and Storage

Macrozamia have seeds with a delayed germination mechanism (dormancy). Harvested straight out of the disintegrating fruiting cone and where the seeds retain fleshy sarcotesta, they are not ready to germinate and require

storage for 8-12 months for full development of the embryo. Older seeds where the sarcotesta has been removed, may be picked up from the ground and should be ready to germinate (P. Forster pers. comm. 2021).

They will be stored in paper bags in a dry, well ventilated space away from extremes of temperature. Viable seeds can be determined by the float test (i.e. put in a bucket of water, those that sink should be viable, those that float should be thrown away).

Seed will be collection from all seed-bearing individuals impacted by the Project to maximise genetic variation is maintained for overall population viability. Should numbers of seed collected from translocated plants be fewer than the estimate provided in **Table 9.1**, seed collection will be undertaken from wild plants. If this occurs, collection will be undertaken in accordance with the *Code of Practice for the harvest and use of Protected Plants* (DES 2020). For all seed collected the following will occur:

- Upon collection, maternal plant and seed will be labelled with unique ID, date, GPS location and collector's details;
- Only fully ripe fruit to be collected;
- Cuts to be made to fruit will be made with sterilised equipment as close to the base as possible;
- No more than 20% of the total number of fruits will be collected from any one plant in any 12 month period (for wild plants).

Information related to each seed collected will be stored and managed in the translocation database for monitoring the progress and survival rate of propagated individuals and allow the assessment of seed viability and fitness of maternal plants.

Seeds will be collected from any seed-bearing plants being translocated. Some seeds collected will be suitable for germination straight away, with other seeds requiring storage for 8-12 months before germination. Where storage is required, these seeds will be stored in paper bags in dry, well ventilated space away from extremes of temperature (P. Forster pers. comm. 2021).

9.3.2 Propagation

Propagation will take place off-site at a suitably experienced nursery and will follow a method tailored to the germination requirements of *M. conferta*. The nursery will be responsible for the establishment and management of seed propagation processes, will have relevant experience in *Cycas* and *Macrozamia* nursery propagation methods and will operate under the *Australian Standards for maintenance of plant health* and the *Nursery Industry and Garden Australia Standard*.

Seeds are known to germinate best in the warmer months of the year. Germination will occur in communal pots/trays with the seed lightly pressed into the substrate surface and not totally buried (P. Forster pers. comm. 2021). The following methodology outlines the general horticultural techniques of propagation:

- Remove flesh from seed;
- Initial planting of seed in suitable seed raising mix and irrigated regularly throughout growth;
- After the seed takes root and the first leaf appears, seed will be planted into 140 mm pots and transferred into nursery;
- Once root ball formed and filling 140 mm pot (9-12 months), transfer into 300 mm pot with same potting mix;

- Final transfer into translocation site will occur when the plant is large enough – approximately three years after germination.

9.3.3 Tissue Cultivation

Tissue culture is proposed as a back-up measure to seed collection and propagation. Tissue culture will only be applied if there are significant failings in the methods outlined above.

Tissue culture of cycads has been successful as outlined in numerous studies:

- Nadarajan et. al. (2018) reported that cycad conservation could benefit from application of in-vitro micro-propagation. The study cited the production and medium to long term storage of explants initiated from seed tissue and reported that progress has been made relating to the in vitro growth of cycad tissues.
- The International Union for Conservation of Nature – Species Survival Commission (IUCN-SSC) Cycad Action Plan (Donaldson 2003) highlights the potential for using in vitro propagation and tissue culture to improve germination, increase growth rates of seedlings, and develop plants from tissue culture for species with low seed set, all of which contribute to having more plants in cultivation. Litz et al. (2004) reported that biotechnology – specifically tissue culture – is a viable way to conserve the germplasm of this ancient plant group (Cycads).
- The University of Florida – Institute of Food and Agriculture has been successfully undertaking ex situ conservation of Cycads through tissue culture. Studies have been focussed on the use of mature specimen leaf tissue with the work aimed at commercialising in-vitro cycad production for conservation purposes (UF/IFAS, 1996). Forsyth and Giddy (1990) reported that despite Cycads being protected by the Convention in International Trade in Endangered Species of Flora and Fauna (CITES 2014), and legal protection in various countries, there has not been a substantial increase in cycad numbers in the wild mainly due to reproductive failure, as a very few seeds germinate in nature.
- Da Silva et. al. (2015) undertook a study into the various methods in use for in-vitro propagation of Cycadales. The study found that seedling tissue, new leaf tissue from mature specimens, megagametophytes and zygotic embryos have been used successfully. Explants from these methods produced callus, coralloid roots and somatic embryos in-vitro. The study found that the most productive method for mass production and preservation of cycads was organogenesis where plantlets were acclimatized in less than 200 days.
- Charvez and Litz (1999) trialled a range of tissue culture substrates in a randomized block trial and found that in Zamiaceae callus initiation occurred on a wide range of medium, whereas shoot initiation required a specific medium supplemented with 2.26uM 2,4-D. The trial successfully produced explants from a range of tissue sources.
- Chaplot and Jasrai (2000) developed protocols for root shoot differentiation in *Cycas revoluta* and produced shoot primordia within 20 – 25 days of cultivation.
- Teixeira da Silva et. al. (2014) in their review of previous studies into tissue culture of Cycadales found that Cycads were successfully produced by tissue culture as early as 1954 (*Zamia floridana*) and published the growing media protocols from a range of studies for numerous species.

Four commercial tissue culture laboratories in Queensland were contacted regarding the potential to produce *M. conferta* plantlets from tissue culture. They considered that, provided they were able to link up with laboratories who have previously successfully produced Cycadales in-vitro (i.e. UF-IFA) (to short cut experimentation on production protocols), it is highly likely that *M. conferta* could be propagated via tissue culture.

An in-vitro propagation program for *M. conferta is* proposed to support the translocation and traditional propagation by seed programs described in this plan. A commercial tissue culture laboratory would be commissioned to liaise

with international laboratories on previously successful mediums and methods for Cycadales, the collection of propagation material and subsequent tissue culture production of *M. conferta* plantlets.

9.3.4 Planting from Nursery Stock

Nursery stock of *Macrozamia conferta* will be planted out within the translocation site following similar methods to the establishment of translocated plants:

1. Holes at the translocation locality will be dug by hand and the soil within the hole will be loosened, and the hole not much deeper than the root ball of the plants being transplanted.
2. Each plant will be watered thoroughly with potable water.
3. A systemic fungicide will be applied around each root ball.
4. Each plant will be watered about once a month (10-20 litres) depending on rainfall for 6 months after replanting or as appropriate.
5. Where insect damage to translocated specimens is observed during monitoring a control program will be employed that does not impact on pollinator populations.

9.4 Translocation Site Maintenance

Maintenance will occur at the translocation site for the duration of the Plan and will involve the following actions:

- Each individual translocated plant will be tracked through the planting process and information stored in the TD (i.e. total population number, number of deaths and damage, growth stage, presence of cone/seed etc.);
- Plants will likely be watered once a month post translocation, the amount depending on the regional rainfall levels, for the first six months;
- Annual weed management activities will take place post translocation to reduce competition for nutrients and water by aggressive weeds (if present) and lower fire hazard;
- Ongoing application of insecticide if insect herbivory is detected post translocation;
- If root damage or plant rot is evident, ongoing preventative treatment (i.e. sealant, fungicide, removing damaged parts) will be implemented to minimise further damage;
- Controlled burns or other fuel load reduction techniques as required (see **Section 9.1.2**)

Table 9.2 identifies auditable performance and completion criteria for translocation site maintenance post-translocation of *M. conferta*. Site maintenance is necessary to ensure potential threats to *M. conferta* (see **Section 3.2**) do not become established in translocation site. Maintenance and management of specimens will continue until the end of the period of effect of the approval or achievement of all commitments within this Plan. Maintenance actions undertaken throughout the translocation and monitoring period will be recorded in the annual report (see **Section 10.5**) and will aid in the assessment of the overall success of *M. conferta* translocation.

Table 9.2 Post-translocation performance measures for translocation site

Criteria	Frequency	Action if non-compliant
Translocation Site Maintenance and Condition		
Damage by pest insects	Once a year	Pest control plan and action if required
Weeds[3]	Once a year	Weed removal and management if required
Fuel load	Once a year	Weed removal and management if required (i.e. grass < 0.5m high; cover < 50% extending at least 0.5m from plants)
Erosion control established Erosion control maintained	Start Once a year	Erosion control plan and action if required Apply appropriate measures if required
Translocation Success Criteria		
A population of >100% of the initial number impacted is established and self-sustaining	Once a year	Additional propagation and planting *M. conferta* up to target population numbers
Maintenance Criteria		
Records of watering, weed and insect control, fire management, fence maintenance, erosion control measures, etc.	As conducted	Ensure TD is continually updated, data management implemented, and reporting procedures established and followed

[3] Weeds listed as restricted matters under the *Biosecurity Act 2014*

10.0 Monitoring and Evaluation

Monitoring will evaluate the success of the translocation, propagation and maintenance programs implemented. Monitoring results will be used to determine which corrective actions should be implemented and when (i.e. if there is a decline in the health and/or survival of translocated plants relative to reference populations, additional plants will be established from propagated stock).

10.1 Reference Site Establishment

Reference plots within existing populations have been established to allow for an assessment of overall population changes in response to climatic conditions. The reference plots will occur where there is a representative sample of the existing population of similar density, population structure (i.e. adults, sub-adults, seedlings), vegetation community, soil quality, and altitude to the translocated population. The reference site will allow for a statistically robust comparison to be made between translocated plants and an unimpacted baseline population.

10.2 Monitoring of Translocated *Macrozamia conferta*

Three monitoring plots have been established within the translocation site. The parameters described in **Table 10.1** will be monitored post-translocation to measure and assess individual and population growth, identify potential threats or environmental factors within the translocation that may impact *M. conferta*, and provide recommendations to improve methods of translocation. At each monitoring event the following information will be recorded to assess the overall success of the translocation at the completion of the monitoring period:

- Ecologist on site, date, time, translocation site ID (for corresponding reference plot);
- Identify individual with unique ID, GPS location and record:
  - Photo log;
  - New frond growth;
  - Cone development and sex;
  - Seed development;
  - Recruitment;
  - Presence of pollinators[4].

[4] Only likely to be present in October / November

Table 10.1 Monitoring of *Macrozamia conferta* at translocation site

Parameter	Description	Frequency
Growth of *M. conferta* individuals and population		
Survival/mortality	Total number of individuals present and population structure (i.e. % dead, mature and coning, mature, juvenile or seedling)	• 1-3 months: once a month. • 4-24 months: once every quarter • Annually for the remainder
Gender and reproduction	Presence of reproductive organs (i.e. cones and seed) and M:F ratio in population	
New growth	Presence or absence of new growth	
Predation	Presence or absence of insect damage (i.e. leaves or cones)	
Identification of potential and existing threats		
Fire	Reduce fuel loads in the wider area and around base of individuals if necessary (i.e. removal of weeds, litter bed and standing fuel) Inspect firebreaks and monitor density of high-risk weed species (i.e. Lantana camara)	• Once a year
Weeds	Monitor existing density of known weeds during ongoing weed management practices, including areas in the immediate vicinity	
Pests	Inspect signs of access and damage	

10.3 Monitoring of Propagated *Macrozamia conferta* Seedlings

10.3.1 Seedlings in Nursery

The nursery will be responsible for the establishment and management of seed propagation processes, and the monitoring of seedling health and success. At minimum, the following monitoring actions and information will be recorded in the TD:

- Seeds and propagated individuals will be watered following a schedule that will be inspected weekly to prevent overwatering or underwatering. Rescheduling of watering times may take place depending on climatic conditions but changes to schedule must be recorded and all personnel notified.
- Seeds and propagated individuals will be inspected weekly for signs of desiccation or high soil moisture, damage from fungal disease or insects, or established weeds.

- Pests and disease will be treated as necessary using appropriate control methods approved by senior nursery staffer.
- Weed control will be undertaken if necessary, using appropriate removal methods.
- Slow release fertiliser will be applied to all plants on a bi-annual basis.
- The nursery will undergo hygiene inspections and management methods in accordance with the *Biosecurity Manual for the Nursery Production Industry v.1* (Plant Health Australia 2010).

10.3.2 Seedlings in Translocation site

Seedlings that have been planted into the translocation site will be monitored in the same way as the translocated plants outlined in **Section 10.2**

10.4 Corrective Actions

Successful translocation programs for *Cycas* species have been undertaken for a range of projects (Santos GLNG Project, Australia Pacific LNG, QCLNG). These propagation programs identified survival rates of >95% for specimens planted from nursery stock and ~70-90% for directly translocated specimens. Similarly, successful seed collection and propagation programs for *Cycas* species have been undertaken for a range of projects (Santos GLNG Project, Australia Pacific LNG, QCLNG). These propagation programs identified >70% germination and survival rates of cycad seedlings in nursery.

In the event of any of the following corrective triggers, corrective actions will be taken based on the adaptive management strategies outlined in **Section 11:**:

- A 10% decline in the translocated population compared with reference plots – additional planting from nursery stock and a review of management actions will be undertaken;
- Any significant outbreak of weeds observed within the groundcover layer of the translocation site – weeds present will be controlled (see **Table 11.1**) and a review of weed management systems will be undertaken;
- The germination rates of seeds in the nursery is <85% – additional seeds will be collected and germinated and a review of propagation procedures and processes will be undertaken.

10.5 Reporting Requirements

An annual report that includes assessment of translocation actions and results will be prepared. Information to be reported and (submitted on request) will include a summary of the results of the previous 12 months, Translocation Database information, and evaluation of translocation success and monitoring methods implemented.

The report will include details of all actions taken during translocation process and how outcomes demonstrate compliance and achieved a sustainable population of *M. conferta*. These include:

- The final number of *M. conferta* collected from the Project footprint;
- The final number of seeds collected from translocated plants;
- Propagation success in nursery of seeds collected;

- The success rate and health status of translocated *M. conferta*;
- The success rate and health status of propagated seedlings transferred into translocation site;
- Any problems that impeded propagation and translocation methods and overall success;
- All individuals and facilities involved in the translocation process;
- Demonstrated compliance with management actions outlined in this Plan.

10.6 Confidence of Translocation, Propagation and Monitoring Methods

At 20 years from the completion of translocation activities, the total number of plants within the translocation site will be equal to or greater than the total number of plants impacted by the Project.

The health of translocated and propagated individuals will be equal to or greater than those within the disturbed site prior to disturbance occurring from the Project (according to age class) based on the following:

- Crown health;
- Reproductive capacity (i.e. recruitment).

There is a high degree of confidence (>90%) in the methods and outcomes outlined in this Plan as it has been developed and reviewed in correspondence with suitably qualified ecologists, cycad experts and approved *Cycas* and *Macrozamia* translocation plans. Improved methods and advice include:

- Competent and experienced operators on site doing the translocation;
- Improved methods of excavation (tree spades);
- *M. conferta* is morphologically easier to move (P. Forster pers. comm. 2021) (smaller plant and no emergent trunk will be easier to move with machinery and less damage to plant);
- Methods, management and monitoring based on approved methods of cycad translocation;
- Translocation site selected to meet all habitat and ecological requirements of *M. conferta*.

Further, this plan has applied a risk-based approach, where the results of monitoring activities inform corrective actions to be applied. In addition, this plan has been reviewed by Dr Paul Forster from the Queensland Herbarium.

11.0 Risk Assessment and Management Strategies

Salvage and translocation are proven methods for mitigating the impacts of land clearing and has been undertaken successfully in previous *Cycas* and *Macrozamia* translocation programs (Queensland Herbarium 2007). Experienced personnel and careful excavation techniques have been the key drivers of success in *Macrozamia* translocation (P. Forster pers. comm. 2021). In addition, *Macrozamia* translocation is logistically much simpler to do than *Cycas* translocation and may have higher success rates (P. Forster pers. comm. 2021) given:

- *Macrozamia conferta* is a much smaller plant than *Cycas*: plants can fit easily in a digger bucket;
- *M. conferta* do not have trunks like *Cycas*: increased damage of snapped trunks during translocation;
- *M. conferta* has a much more compact growth form with minimal area for damage (i.e. a ball) whereas *Cycas* have the caudex plus aerial trunk(s);
- To ensure the survival of translocated *M. conferta* and propagated seedlings at the translocation site is successful, adaptive management strategies will be implemented throughout the translocation process. To mitigate threats that impact the survival of *M. conferta* (see **Section 3.2**) and minimise the risk of loss and damage to individuals during and post translocation, the following actions in **Table 11.1** will be performed.

Table 11.1 Risks / Threats and Management Actions

Risk/Threat	Description	Management Action	Timeframe
Desiccation	Planting during poor climatic conditions in addition to insufficient watering can cause wilting, insufficient nutrient uptake and eventually death	• Controlled watering in the case of dry events • Local water supply and water cartage tanks will be available on site so watering can be done where/when necessary	• Watering will begin when seedlings and individuals are first introduced into sites and monthly post-introduction
Germination failure	Not enough seed germinated in the nursery to replant on site	• Review germination methods and seed storage techniques	• Germination rates will be known within the first 12 months
Waterlogging	Too much watering can cause root rot and eventually death	• Controlled and monitored watering events, scheduled according to monthly rainfall received • Inspect 10 cm of surrounding surface soil to check if too wet, rescheduling of future watering (i.e. no watering necessary during wet season)	• Watering of seedlings and individuals monitored and scheduled in accordance with rainfall patterns from first introduction into sites and monthly post-introduction
Weed infestation	Limited weeds occur in the Project area and are unlikely to pose a threat to *M. conferta*. Nevertheless, there is a risk of woody weeds suppressing *M. conferta* growth and increasing fire	• Targeted manual and chemical weed control, in accordance with the manufacturing label or an off-label permit issued by the Australian Pesticides and Veterinary Medicines Authority,	• Until complete establishment of translocated and propagated seedlings

Risk/Threat	Description	Management Action	Timeframe
	fuel if they become established.	will be conducted by trained personnel pre-translocation (see **Section 9.1.1**) and following translocation of *M. conferta* and seedlings. This will minimise the risk of establishment of introduced weeds and accumulation of fire fuel. • Strict weed control hygiene will be followed during movement between Project footprint and translocation site (see **Section 9.1.1**) to reduce spreading of weeds	
Habitat destruction and loss of individuals	Due to livestock and native animal grazing and trampling, illegal harvesting, timber harvesting, fire, poisoning	• Weed control will reduce accumulation of standing fuel and accumulation of debris that may increase extreme fire events. • Current fire regimes will be monitored (i.e. conducting cool burns to reduce fuel loads) following RE-specific burns and fire breaks implemented and maintained	• Until complete establishment of translocated and propagated seedlings

12.0 Outcomes

The long-term success of translocation programs can depend on a number of factors including, propagation techniques and personnel, suitability of the translocation site, genetic variation of the translocated individuals and the survival rate of the translocated plants. Given the translocated plants will be sourced from the immediate area and propagated seedlings will be replanted into an existing population of *M. conferta*, the risk from the majority of the aforementioned factors inhibiting success are minimised.

The implementation of this Plan will be considered a success where the translocation site maintains a stable population of *M. conferta* equal or greater in size to the number of plants impacted by the development of the Project.

13.0 References

AECOM. (2011). Translocation Program for *Macrozamia pauli-guilielmi*. Wide Bay Training Area DEOS MIRF. AECOM Australia Pty Ltd.

Anon, BLOGS.IFA2 (1996). University of Florida – Institute of Food and Agriculture. http://blogs.ifas.ufl.edu/news/1996/02/16/ufifas-cycad-research-helps-save-living-fossils/, accessed 2/07/2021.

Australia Pacific LNG. (2014). *Cycas megacarpa* Management and Translocation Plan. Revision 8.

Banack, S. & Cox, P. (2003). Biomagnification of cycad neurotoxins in flying foxes: Implications for ALS-PDC in Guam. Neurology 61:387-389.

Bond, W.J. (1994). Do mutualisms matter? Assessing the impact of pollinator and disperser disruption on plant extinction. Philosophical Transactions of the Royal Society, London, Series B. 344, 83-90.

Chaplot, B. B. and Jasrai, Y.T. (2000). Differentiation of shoot buds in bulb-scale cultures of Cycas revoluta Thunb. Phytomorphology 50: 37-40.

Charvez, V. M., Litz, R.E. (1999). Organogenesis from megagametophyte and zygotic embryo explants of the gymnosperm Dioon edule Lindley (Zamiaceae, Cycadales). Plant Cell, Tissue and Organic Culture 58, 219-222.

Chemnick, J. (2007). Seed dispersal agents of two Mexican cycads. In A. P. Vovides, D. Stevenson, and R. Osborne [eds.], Proceedings of Cycad 2005 the 7th International Conference on Cycad Biology. New York Botanical Gardens Press, New York, New York, USA.

Commander, L. E., Coates, D. J., Broadhurst, L., Offord, C. A., Makinson, R. O. & Matthes, M. (2018). Guidelines for the translocation of threatened plants in Australia. Australian Network for Plant Conservation Incorporated.

Department of Environment and Science (DES). (2009). Species Profile – *Macrozamia conferta*. Accessed 24/06/2021.

Department of Environment and Science (DES). (2020). Code of Practice: For the harvest and use of protected plants under and authority. *Nature Conservation Act 1992* (Qld). Accessed 20/04/2022.

Department of the Environment, Water, Heritage and the Arts (DEWHA). (2008). *Macrozamia conferta* in Species Profile and Threats Database, Department of the Environment, Water, Heritage and the Arts, Canberra. Accessed 24/06/2021.

Donaldson, J. S., Dehgan, B., Vovides, A. P. & Tang, W. (2003). Cycads in trade and sustainable use of Cycad populations. In: Cycads Status Survey and Conservation Action Plan (ed J. S. Donaldson). IUCN, Gland, Switzerland.

Donaldson, J. S. (2003). Cycads: Status Survey and Conservation Action Plan. IUCN/SSC Cycad Specialist Group, IUCN, Gland, Switzerland and Cambridge, UK.

Eckenwalder, J. E. (1980). Dispersal of the West Indian cycad *Zamia pumilia* L. Biotropica 12: 79-80.

Elliot, W.R. and Jones, D.L. (1993). Encyclopaedia of Australian plants, suitable for cultivation. Volume 6. Lothian Publishing Co., Melbourne.

Eyre, TJ, Kelly, AL, Neldner, VJ, Wilson, BA, Ferguson, DJ, Laidlaw, MJ and Franks, AJ. (2015). BioCondition: A Condition Assessment Framework for Terrestrial Biodiversity in Queensland. Assessment Manual Version 2.2, Queensland Herbarium, Department of Science, Information Technology, Innovation and Arts, Brisbane.

Forster, P. I., Machin, P., Mound, L. & Wilson, G. (1994). Insects associated with the reproductive structures of cycads in Queensland and north-east New South Wales, Australia. Biotropica 26: 217-222.

GHD. (2017). Department of Transport and Main Roads Coondoo Creek Bridge Replacement Macrozamia pauli-guilielmi Impact Management Plan

GHD. (2021). Listed threatened ecological communities, species and migratory species. Overhead Transmission Line Project – Appendix C. ACCIONA Energy Australia Global Pty. Ltd. 92-94.

Halford, D. (1997). *Macrozamia conferta*, in Species Management Manual. Department of Natural Resources, Brisbane.

Hall, J. A. & Walter, G. H. (2013). Seed dispersal of the Australian cycad *Macrozamia miquelii* (Zamiaceae): are cycads megafauna-dispersed "grove forming" plants? Am. J. Bot. 100, 1127–36.

Halliday, J. & Pate, J. S. (1976). Symbiotic nitrogen fixation by coralloid roots of the cycad *Macrozamia riedlei*: physiological characteristics and ecological significance. Australian Journal of Plant Physiology 3, 349-358.

Handreck, K.A. and Black, N.D. (1986). Growing Media for Ornamental Plants and Turf. New South Wales University Press, Kennsington, Australia.

Jones, D. L. & Forster, P. I. (1994). Seven new species of *Macrozamia* section *Parazamia* (Miq.) Miq. (Zamiaceae section *Parazamia*) from Queensland. Austrobaileya 4(2): 271.

Jones, D. L. (2002). Cycads of the world, 2 ed. Reed New Holland Books, Sydney, Australia.

Kelly, T.K. (1967). Killing zamias with power kerosene. Queensland Agricultural Journal 93, 184-185.

Laidlaw, M. J. & Forster, P. I. (2012). Climate Predictions Accelerate Decline for Threatened *Macrozamia* Cycads from Queensland, Australia. Biology 1, 880-894.

Loaring, W. A. (1952). Birds eating the fleshy outer coat of zamia seeds. Western Australian Naturalist. 3, 94.

Nadarajan, J., Benson, E. E., Xaba P., Harding K., Lindstrom A., Donaldson J., Seal C. E., Kamoga D., Agoo E. M. G, Li N., King E. & Pritchard H. W. (2018). Comparative Biology of Cycad Pollen, Seed and Tissue - A Plant Conservation Perspective. The Botanical Review 84: 295 – 314.

NGH Environmental. (2020). Cycad Translocation and Management Plan – Clarke Creek Wind Farm. NGH Environmental Pty Ltd.

Norstog, K. J. & Nicholls, T. J. (1997). The Biology of the Cycads. Cornell University Press, Ithaca and London.

Ornduff, R. (1990). Geographic variation in reproductive behavior and size structure of the Australian cycad Macrozamia communis (Zamiaceae). Am. J. Bot. 77, 92–99.

Ornduff, R. (1991). Coning phenology of the cycad Macrozamia riedlei (Zamiaceae) over a five-year interval. Bull. Torrey Botanical Club 118, 6–11.

Peeters, P.J. & Butler, D.W. (2014). Eucalypt open-forests: regrowth benefits management guideline. Department of Science, Information Technology, Innovation and the Arts, Brisbane.

Plant Health Australia (2010). Biosecurity Manual for the Nursery Production Industry v.1

Primack, R. B. (2012). A primer of Conservation Biology, Fifth Edition. Sinauer Associates, Inc. Publishers, USA.

QGC. (2016). *Cycas megacarpa* Translocation and Management Plan. QCLNG Pipeline Project.

Queensland Herbarium. (2007). National Multi-species Recovery Plan for the cycads, *Cycas megacarpa, Cycas ophiolitica, Macrozamia cranei, Macrozamia lomandroides, Macrozamia pauli-guilielmi* and *Macrozamia platyrhachis*. Queensland Parks and Wildlife Service, Brisbane.

Queensland Herbarium. HERBRECS. (2008). *Macrozamia conferta*, in BriMapper version 2.12. Queensland Herbarium. Accessed 24/06/2021.

Raimondo, D.C. and Donaldson, J.S. (2003). Responses of cycads with different life histories to the impact of plant collecting: simulation models to determine important life history stages and population recovery times. Biological Conservation 111, 345-358.

Rowe, T. and Rowe, C. (1995). Transplanting *Cycas ophiolitica*. Palms and Cycads 47, 15-17.

Santos GLNG. (2013). *Cycas megacarpa* Management and Translocation Plan. GLNG Gas Transmission Pipeline.

Seawright, A.A., Brown, A.W., Nolan, C.C. and Cavanagh, J.B. (1993). Cycad toxicity in domestic animals – what agent is responsible? In D.W. Stevenson and K.J. Norstog (eds.), The Biology, Structure, and Systematics of the Cycadales. Proceedings of CYCAD 90, the Second International Conference on Cycad Biology, pp. 61–70. Palm and Cycad Societies of Australia Ltd., Milton, Australia.

Teixeira da Silva, J.A., W.R. Woodenberg, & SA. Zeng. (2014). Cycads in vitro. Plant Tissue Culture & Biotechnology 24: 287–301.

Terry, I., Forster P., Moore C. J., Roemer R. B. & Machin P. J. (2008). Demographics, pollination syndrome and conservation status of *Macrozamia platyrhachis* (Zamiaceae), a geographically restricted Queensland cycad. Austral. J. Bot. 56, 321–32.

Terry, I. (2001). Thrips and weevils as dual, specialist pollinators of the Australian cycad *Macrozamia communis* (Zamiaceae). International Journal of Plant Sciences 162, 1293-1305.

Vitelli, J.S. (1993). Zamia and its control. Northern Muster [Newsletter for Beef Producers, Department of Primary Industries, Ayr] 42, 25.

White, L. M. (1912). Notes on the cassowary (*Casuarius australis*, Wall). Emu 12: 172-181.

Appendix A

Suitably Qualified Field Ecologist

In accordance with the EPBC Act Approval Condition 16, this Plan has been prepared by a suitably qualified field ecologist. Qualifications and experience are presented in **Table 13.1**.

Table 13.1 Suitably qualified field ecologist definition and justification

Assessment Component	Justification
Suitably qualified field ecologist means a person who has professional qualifications and at least three (3) years of work experience designing and implementing surveys for and conservation management of cycad species belonging to either the Cycadaceae and/or Zamiaceae families, and can give an authoritative assessment and advice on the presence of *Macrozamia conferta* using relevant protocols, standards, methods and/or literature. If the person does not have appropriate professional qualifications, the person must have at least five (5) years of work experience designing and implementing surveys for and conservation management of Macrozamia conferta.	Darren's technical expertise is based on extensive ecological survey and management experience in New South Wales, Queensland, the Northern Territory and South-east Asia. Darren's core expertise relates to the ecosystems, vegetation communities and terrestrial flora of Queensland, particularly biodiversity values and protected plants. He has managed several flora research programs as a consultant, including several successful threatened flora translocation programs. Darren has worked with plants from the Cycadaceae family for the last 10 years through his involvement in several projects including APLNG *Cycas megacarpa* Translocation, and *Macrozamia conferta* identification for the MacIntyre Wind Farm Project.

Appendix B

Site Data

Date:	10.3.2022	**Any general notes can go here**
BioCondition Site Number:	BC01	
Observers:	SR & Dm	
Habitat Description:	Remnant	
RE:	13.11.5	Remnant/regrowth/predom cleared
General Tree Health:		

	Zone	Easting	Northing
Plot Origin			
Plot Centre			

Plot Centre direction (degrees)	140	
Coarse woody debris (metres/ha):		
Recruitment (%):	100	
Non native plant cover (%):	15	
EDL height (metres):		
Eucalypt large tree DBH (cm):		(from benchmark)
No. Of large eucalypt trees (trees/ha):		
Non euc large tree DBH (cm): (0 is not applicable)		(from benchmark)
No. Of large non-eucalypt trees (trees/ha):		(please use '0' not 'n/a' throughout)
Sub-canopy height (m):		

Five 1 x 1m plots

Ground Cover	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Mean
Native perennial grass cover						0
Native other grass						0
Native forbs and other species						0
Native shrubs						0
Non-native grass						0
Non-native forbs and shrubs						0
Litter						0
Rock						0
Bare ground						0
Cryptogams						
Total	0	0	0	0	0	

Native plant species richness - trees	10
Native plant species richness - shrubs	9
Native plant species richness - grasses	14
Native plant species richness - forbs and other	24

E Cover	0
T1 Cover	87.9
T2 Cover	6.9
T3 Cover	0
Shrub Cover	0.6

100 x 50m Total native tree species richness

Species	Recruitment
E. moluccana	Yes
E. sideroxylon	Yes
E. fibrosa	Yes
Psydrax odorata	Yes
Pittosporum angustifolium	Yes
Notelaea microcarpa	Yes
Acacia fimbriata	Yes
Acacia pustula	Yes
Acacia sp. (neriifolia)	Yes
Corymbia citriodora	Yes

Macrozamia conferta density (total number in plot (0.5ha))	per ha
	0

Myrtaceous trees >30cm DBH with hollows >6mm dia (total number in plot (0.5ha))	per ha
	0

Total hollows 6-20mm dia (in plot (0.5ha))	per ha
	0

100m transect

Species	Start	Finish	Cover	Species category		50 x 10m Native plant species richness	
E. moluccana	0	15.5	15.5	T1		**Species**	**Species Category**
E. fibrosa (sp)	15.8		15.8	T1		*Olearia elliptica*	Shrub
E. sideroxylon	24	30	6	T1		*Acacia fimbriata*	Shrub
E. fibrosa	36	41.3	5.3	T1		*Acacia ixiophylla*	Shrub
E. moluccana	42.1	44.9	2.8	T2		*Leptochloa sp.*	Grass
E. sideroxylon	43	60.8	17.8	T1		*Eriachne mucronata*	Grass
E. sideroxylon	62.7	73.5	10.8	T1		*Lomandra multiflora*	Other
E. sideroxylon	74.4	79.5	5.1	T1		*Brunoniella australis*	Forb
Olearia elliptica	75.5	76.1	0.6	S		*Einadia trigonos*	Forb
E. sideroxylon	80.2	84.3	4.1	T2		*Cleistochloa subjuncea*	Grass
E. sideroxylon	82.4	91	8.6	T1		*Aristida queenslandica*	Grass
E. fibrosa (sp)	97	100	3	T1		*Pimelea neoanglica*	Shrub
			0			*Oxalis corniculata*	Exotic
			0			*Sigesbeckia orientalis*	Exotic
			0			*Desmodium brachypodium*	Forb
			0			*Goodenia glabra*	Forb
			0			*Phyllanthus virgatus*	Forb
			0			*Lomandra filiformis*	Other
			0			*Euphorbia drummondii*	Forb
			0			*Conyza sp*	Exotic
			0			*Eragrostis parviflora*	Grass
			0			*Juncus sp.*	Other
			0			*Fimbristylis dichotoma*	Other
			0			*Cyperus sp.*	Other
			0			*Lobelia purpurascens*	Forb
			0			*Digitaria sp.*	Grass
			0			*Entolasia stricta*	Grass
			0			*Haloragis heterophylla*	Forb
			0			*Euchiton sphaericus*	Forb
			0			*Euchiton japonicus*	Forb
			0			*Enneapogon sp.*	Grass
			0			*Arundinella nepalensis*	Grass
			0			*Psydrax odorata*	Shrub
			0			*Rumex brownii*	Forb
			0			*Austrostipa sp.*	Grass
			0			*Aristida vagans*	Grass
			0			*Aristida gracilipes*	Grass
			0			*Cyperus sp*	Other
			0			*Phytolacca octandra*	Exotic
			0			*Lomandra longifolia*	Other
			0			*Opuntia tomentosa*	Exotic
			0			*Eragrostis sp.*	Grass
			0			*Notelaea microcarpa*	Shrub
			0			Acacia penninervis	Shrub
			0			Solanum nigrum	Exotic
			0			Sida cunninghamiana	Forb
			0			Sida rhombifolia	Exotic
			0			Anagallis arvensis	Exotic
			0			Centella asiatica	Forb
			0			Austrostipa sp.	Grass
			0			Bromus sp.	Exotic
			0			Lomandra confertifolia	Other
			0			Solanum nemophila	Forb
			0			Cheilanthes sieberi	Other
						Acacia sp. (neriifolia)	Shrub
						Pittosporum angustifolia	Shrub
						Glycine tabacina	Forb

Site data

Origin: Image down stransect

Centre North

35m Quadrat

Centre East

45m Quadrat

Centre South

55m Quadrat

Centre West

65m Quadrat