Clarke Creek WIND FARM

Cycad Translocation and Management Plan

CLARKE CREEK WIND FARM

NOVEMBER 2021

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ACRONYMS AND ABBREVIATIONS

CTD	Cycad Translocation Database
CTMP	Cycad Translocation and Management Plan
Cwth	Commonwealth
DAWE	(Cwlth) Department of Agriculture, Water and the Environment – formerly DoEE
DEHP	(Qld) Department of Environment and Heritage Protection (now DES)
DES	(Qld) Department of Environment and Science
DoEE	(Cwlth) Department of the Environment and Energy
EPBC	(Cwth) *Environment Protection and Biodiversity Conservation Act 1999*
EMP	Environmental Management Plan
GBO	General biosecurity obligation under the *Biosecurity Act 2014* (Qld)
ha	hectares
m	metres
MNES	Matters of national environmental significance under the EPBC Act
OMP	Offset management plan
sp.	Species (singular)
spp.	Species (plural)
TEC	threatened ecological community (EPBC Act)
VM Act	(Qld) *Vegetation Management Act 1999*
WoNS	Weeds of national significance

1 INTRODUCTION

1.1 PURPOSE

This Cycad Translocation and Management Plan (CTMP) (the 'Plan') has been prepared for the Clarke Creek Wind Farm (the 'Project') to satisfy the requirements of Condition 8 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) approval for the Project (EPBC 2018/8141).

The CTMP specifies the activities required to minimise the impact of the Project on populations of listed *Cycas megacarpa and Cycas ophiolitica* within the Project Area, including assessment, management, monitoring and reporting objectives and actions to be implemented prior to, during and following translocation of cycad individuals from the Project development footprint.

The CTMP has been developed in accordance with the *National Multi-Species Recovery Plan for Cycads* (Queensland Herbarium, 2007), the *Guidelines for the Translocation of Threatened Plants in Australia* (Commander et al., 2018) and the conditions stipulated under the EPBC Act approval.

The CTMP (version 4.3) was approved by the Department of Agriculture, Water and the Environment (DAWE) in accordance with Condition 4 of the approval for EPBC 2018/8141 on12th June 2020. Since that time additional cycad surveys have been completed and information obtained which require the CTMP to be updated.

The project comprises of three stages. The first two stages will be developed first comprising up to 111 wind turbines. Targeted cycad surveys were conducted in the Stage 1 and Stage 2 development corridor (i.e. Southern and Central portions of the Project) from 28 February to 7 March 2021. These surveys identified about 2,850 Cycads occurring within the broader approved disturbance corridor for Stage 1 and Stage 2 of the project, however a reduced number of approximately 650 Cycads are expected to require translocation. The final numbers will be confirmed during the detailed design phase.

The Queensland Herbarium was consulted in relation to the survey and it was concluded that the populations within the study area are considered to be exclusively *Cycas terryana* (as confirmed by the Queensland Herbarium on 23rd June 2021 – refer to Appendix C). Cycas terryana is listed as Vulnerable under the QLD *Nature Conservation Act 1992*, however it is not listed under the EPBC Act. The EPBC-listed *C. megacarpa* and *C. ophiolitica* may also be present within the Project Area and were previously confirmed by the Queensland Herbarium from samples, but were later re-determined to be *C. terryana* (refer to Appendix C). Cycas terryana that cannot be avoided will be managed in accordance with the Queensland Protected Plants Clearing Permit requirements, which includes translocation.

This CTMP remains relevant for any project works which interact with *C. megacarpa* or *C. ophiolitica* individuals. The CTMP will be implemented and will remain in effect until such time as the performance measures within this Plan are achieved.

Appendix A describes the ecology of the two EPBC-listed cycad species in addition to a comparison table with the state-listed *C. terryana*.

1.2 OBJECTIVES

The objectives of this management plan are to:

- meet the EPBC condition of approval related to the protection and translocation of *C. megacarpa* and *C. ophiolitica* individuals within the Project Area, including:

  - To establish salvaged and propagated healthy *Cycas* spp. individuals within the translocation recipient area. Establishment of *Cycas* spp. includes replacing salvaged and translocated plants which do not survive at a 4:1 ratio with seedlings or juvenile cycads of the same species.
  - To protect, maintain and monitor translocated cycads in line with the performance measures of this Plan.
- provide information in relation to the Project impact area, temporary storage area and translocation site, describing suitability of these areas;
- outline a translocation program and protocol for the salvage, propagation and planting of *C. megacarpa* and *C. ophiolitica;*
- describe the proposed management measures to ensure the success of the translocation program; and
- identify parameters and performance criteria to monitor and assess the success of the translocation program.

1.3 CONDITIONS OF EPBC APPROVAL

This plan has been prepared to address Condition 8 of the EPBC Act Approval (EPBC 2018/8141). Table 1-1 states the relevant approval conditions and where each requirement of Condition 8 is addressed within the Plan, with additional reference to how the cycad translocation program will meet the Guidelines for the translocation of threatened plants (Commander et al., 2018)

Table 1-1 Relevant approval requirements under EPBC Act Approval

Specific requirements of EPBC Act Approval – Condition 8	**Relevant Section of the CTMP where requirement is addressed**
For the protection of listed Cycad(s) species, the approval holder must include within the Environmental Management Plan, a Cycad(s) translocation program that:	
• is in accordance with the *National multi-species recovery plan* and the *Guidelines for the translocation of threatened plants* (the Guideline)	This plan (whole document), and specifically the sections of the guideline described below.
• Section 4.2 of the Guideline: Selection of recipient sites	Figures 2.1, 2.2 and Section 3 – Pre-Translocation Assessment
• Section 4.3 of the Guideline: Site selection beyond the known range	Not applicable as cycads will be translocated within the known range for each species / population within the Clarke Creek Project Area – See Figures 2.1 and 2.2.
• Section 6.1 of the Guideline: Logistical assessment 1. Personnel 2. Resource requirements	 Suitably Qualified Personnel Definition: Persons with demonstrated ecological knowledge and experience in the management and translocation of cycads. Section 6 – Resource Requirements

Specific requirements of EPBC Act Approval – Condition 8	Relevant Section of the CTMP where requirement is addressed
• Section 6.2 of the Guideline – Scheduling for translocation activities - 6.2.1 Timeline for translocation planting - 6.2.2 Single verses staggered planting	Section 6.2 of this plan.
• Section 6.3 of the Guideline – Collection of source material - 6.3.1 How much material can be collected from each source plant? - 6.3.2 Collection of material and preparation for whole plant transplantation. - 6.3.3 Collection licence requirements - 6.3.4 Record keeping requirements during propagation	Section 6.3 of this plan.
• Section 6.4 – Establishment and maintenance of an ex-situ collection - 6.4.1 – Storage and propagation of seeds - 6.4.2 – Vegetative propagation - 6.4.3 – Phytosanitary considerations during propagation - 6.4.4 – Propagation monitoring and recording	Section 6.4 of this plan.
• Section 6.5 – Learning from the translocation – experimental design - 6.5.1 Pilot studies - 6.5.2 Translocation as a scientific experiment - 6.5.3 Designing an experiment	Section 6.5 of this plan.
• Section 6.6 – Identification of post translocation management, monitoring and evaluation methods - 6.6.1 – Ongoing management - 6.6.2 – Monitoring and evaluation	Section 6.6, Section 8 - Monitoring and evaluation) and Appendix B of this plan.
• Section 6.7: Pre-translocation site preparation	Section 6.7 and Section 2.3 – Translocation Recipient Site.
• Section 7.1 – 7.4: Implementing translocation and ongoing maintenance	Section 4 – Translocation Plan and Section 7 – Management and Maintenance.
• Section 8.2 – 8.5: Translocation monitoring and evaluation	Section 8 – Monitoring and Evaluation.
• specifies the number of Cycad(s) that cannot be avoided by the action;	Section 2.1 – Impact Site and Section 7 – Pre-translocation Assessment.
• specifies the procedure for the relocation of Cycad(s) to areas outside of the impact areas suitable for their survival;	Section 4 – Translocation Plan.
• identifies where Cycad(s) will be translocated to;	Figure 2-1 and Section 2.3.

Specific requirements of EPBC Act Approval – Condition 8	Relevant Section of the CTMP where requirement is addressed
• specifies ongoing management to enable the successful re-establishment of translocated cycads;	Section 7 – Management and Maintenance
• specifies the process for monitoring and reporting the progress and ultimate success (health) of translocated individuals; and	Section 8 - Monitoring and Evaluation
• specifies the program for propagating Cycad(s) to replace any relocated individuals that have not survived the translocation process.	Section 5 – Seed Collection and Propagation

2 BACKGROUND INFORMATION

2.1 IMPACT SITE

Cycas megacarpa and *C. ophiolitica* had been identified within the Project footprint during seasonal ecological surveys undertaken in 2017 (NGH Environmental and Green Tape Solutions, 2018), however these have since been redetermined by the QLD Herbarium to be *C. terryana*, which is not an EPBC-listed cycad species (refer to Appendix C). Nonetheless, potential remains for the EPBC-listed Cycads to occur within the Project Area, particularly within the Stage 3 area (northern portion of site), therefore this CTMP remains relevant. Cycads have predominantly been recorded in good quality remnant patches of woodland and open forest within the northern, eastern and southern sections of the Project Area (Figure 2-1 and Figure 2.2)

The March 2021 survey did not identify any EPBC-listed cycads within the Stage 1 and Stage 2 development corridor.

Without appropriate mitigation, the Project has the potential to impact EPBC-listed cycads due to clearing for the construction of infrastructure.

Wherever feasible, the project design will seek to avoid or minimise impacts to EPBC-listed cycads through the detailed design of the Project layout It is not expected that the number of EPBC-listed cycad plants impacted would be greater than 500 plants; however, if this number of plants is exceeded, the CTMP will be updated and submitted to DAWE for approval.

Avoiding clearance of some cycads will not be possible due to constraints associated with Project construction (e.g., topography, geology and location of cycads). Where impacts are unavoidable, cycads will be salvaged and translocated. The Project is considered unlikely to result in a significant impact EPBC-listed cycads populations within the Project area when the management measures recommended in this Plan are implemented.

Cycad salvage and translocation is a proven method of mitigating the impacts of land clearing on cycad populations. Translocation of cycads from clearing impact areas to establish ex situ populations has been undertaken successfully for both species (Queensland Herbarium, 2007).

2.2 TEMPORARY STORAGE SITE

Past cycad translocation experience indicates that temporary storage and horticultural management of salvaged cycads can improve the survival rate of translocated individuals, especially if they have incurred damage during the salvage process (Australian Pacific LNG, 2014). Salvaged cycads that are not immediately translocated to a permanent recipient site will be stored and maintained at a temporary storage facility prior to being planted at their permanent recipient site. The exact location of the temporary storage site will be determined once the detailed design of the wind farm are completed. Figures 2.1 and 2.2 illustrates suitable areas that could be used for the temporary storage site.

The temporary storage site will meet the following criteria:

- Large enough to adequately store the salvaged cycads, collected seedlings and propagated cycads before planting into the recipient site(s
- Appropriate security measures will be implemented and discussed with the contractor (e.g., padlocked gates and security measures, if required).

- The current land use does not negatively impact on the health of cycads in storage e.g., aerial spraying will not be undertaken within proximity of the site. Fencing installed around the compound will ensure no disturbance by livestock and feral pests (cattle, feral pigs and browsing herbivores).
- There will be no significant infestations of listed restricted weeds or environmental weed species within the proposed compound and compound surrounds. Where weed infestations exist within the temporary storage site, they will be managed to avoid any negative impacts upon stored cycads for the duration of the holding.
- The site will provide an acceptable level of shade. This is particularly important during the hotter months of the year.
- The site will be in an area where there is minimal risk of flooding events.
- The soils within the storage site will not be sodic or prone to significant erosion in a way that could impact stored cycads.
- Water will be available at the site.
- A firebreak can be established around the storage compound to reduce the risk of wildfire impacting cycads whilst in storage, if deemed necessary.
- Cycads are naturally occurring at the site or nearby thereby increasing the likelihood that local pollinators are present.

2.3 TRANSLOCATION RECIPIENT SITE

Cycad individuals salvaged from the Project footprint and any specimens propagated from seed will be translocated back into suitable sites within the Project Area (see Figures 2.1 and 2.2), which may include project biodiversity offset areas. The final recipient site/s will be defined following the completion of the detailed design and further consultation with the respective landowners.

The suitability of a translocation site is informed by a range of factors including:

- the final number of cycads to be salvaged from the Project footprint;
- site constraints such as topography and proximity to existing and future infrastructure (in particular, access tracks) which will dictate accessibility for translocation and ongoing management
- suitable environmental conditions, including suitable habitat and microclimate i.e. similar vegetation community type as the impact site which is to be in good condition and have good connectivity to other patches of supporting habitat and connectivity of cycad individuals within the wider area. Other conditions include the size, structure, condition and status of supporting habitat;
- the presence of required ecological function e.g., necessary pollinators; and
- any potential threats to translocated individuals (e.g., proximity to bushfire-prone vegetation, cattle grazing/damage pressures, current level of weed infestation and pest animal activity, soil stability) and the management effort to control these potential threats.

Suitable translocation recipient sites located within the Project area are shown on Figure 2-1, although there are many other suitable locations across the project area which could be chosen once final investigations are completed.

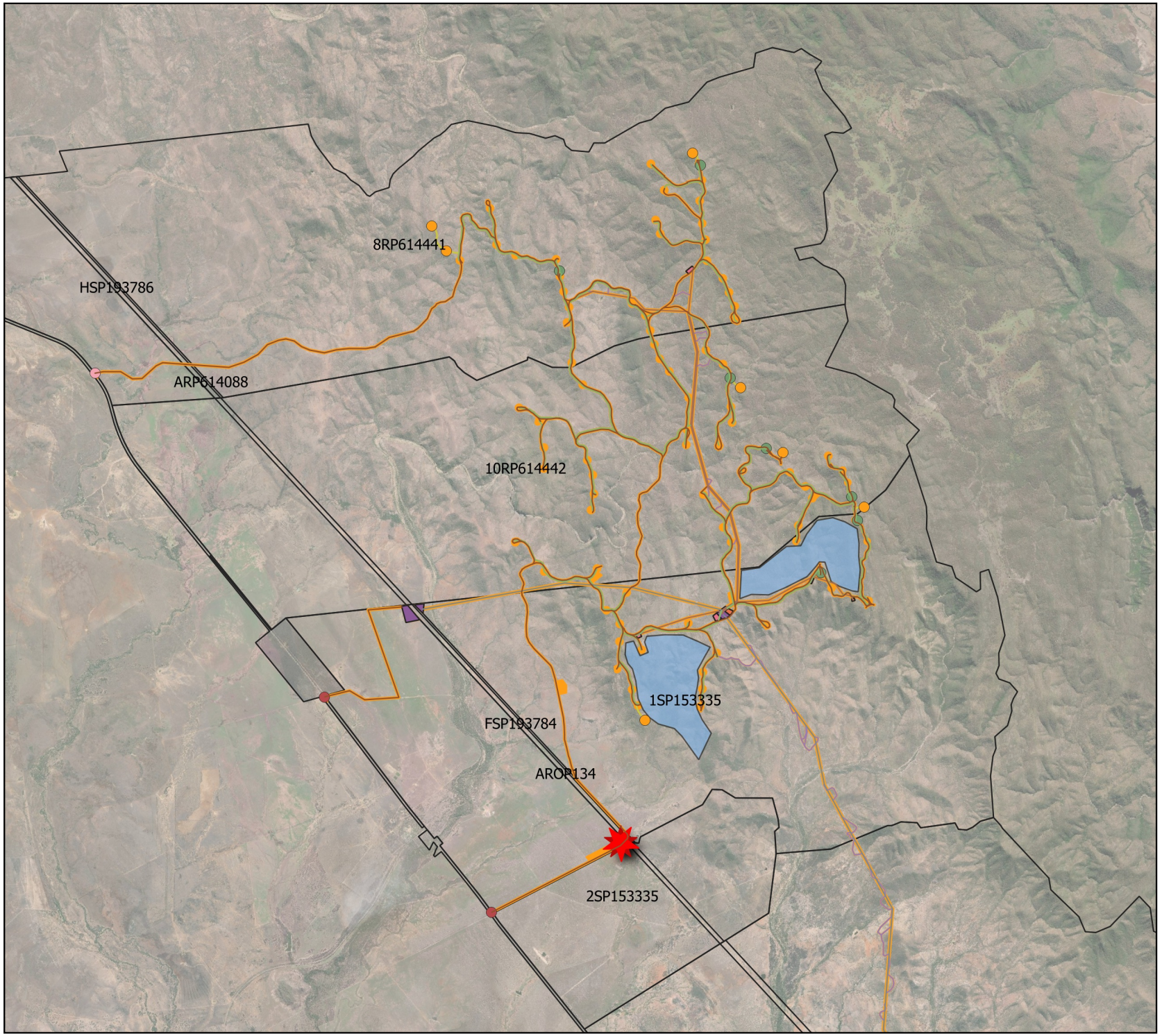
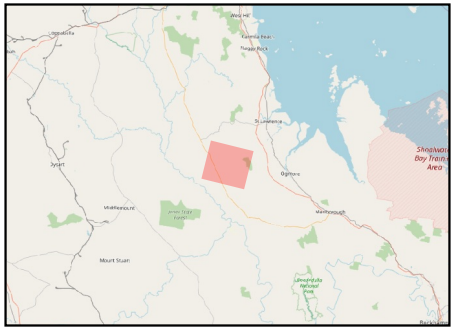


Figure 2-1 Indicative location of recipient sites and temporary storage location within the Stage 3 (Northern) area.

Project: PR17116 - Clarke Creek Wind Farm

- Temporary Storage Location
- CTMP Translocation Sites
- MCR3_Disturbance_Stage3
- Cadastre



0 1 2 3 4 5 km

Notes:
-Flora Survey by Green Tape Solutions and NGH Environmental 2021
-Site Infrastructure and Impact Areas from Client
-Base map Copyright (c) Esri and its data suppliers. Copyright (c) State of Queensland (DNRME)

Created By: JA
Date: 8/11/2021
Version: 2

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Figure 2-2: Indicative location of recipient sites and temporary storage location within the Stage 1 & 2 (Central and Southern) areas.

Project: PR17116 - Clarke Creek Wind Farm

- Temporary Storage Location
- CTMP Translocation Sites
- MCR3_Disturbance_Stage1 & 2
- MCR3_Disturbance_Stage 3
- Cadastre

0 1 2 3 4 5 km

Notes:
-Flora Survey by Green Tape Solutions and NGH Environmental 2021
-Site Infrastructure and Impact Areas from Client
-Base map Copyright (c) Esri and its data suppliers. Copyright (c) State of Queensland (DNRME)

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3 PRE-TRANSLOCATION ASSESSMENT

Pre-translocation surveys will be undertaken prior to the commencement of vegetation clearing, including during the infrastructure micro-siting process. These surveys will be done by qualified ecologists and may be combined with pre-clearance fauna surveys. Areas will be surveyed approximately four weeks prior to clearing (or earlier where possible). The purpose of these surveys is to:

- Confirm the total number of cycad individuals for each species that are impacted by the Project.
- Map and tag the extent and individual locations of cycads within the Project footprint.
- Record baseline data for each cycad within the impact area, which will be used to monitor individuals following translocation, to inform management actions for translocated specimens and to evaluate the ongoing and overall success of the translocation program.
- Confirm suitable location for a temporary storage site (refer to Section 2.2); and
- Confirm suitability of habitat for translocation recipient site/s within the Project area (refer to Section 2.3).

The pre-translocation surveys of cycads within the Project impact area will consist of a systematic walk-through of the development footprint. The location of all EPBC-listed cycad individuals within the Project footprint will be recorded with a hand-held GPS receiver. Each individual cycad will be assigned a unique identification number that is to be recorded on fire-proof tags (e.g., aluminium plant tags) that are attached in a secure manner to the plant (e.g., with fine-gauge wire at the base of a mature but not senescent leaf). The Queensland Herbarium (or other approved organisation) will be consulted to confirm the cycad species type where this cannot be confirmed by the on-site qualified ecologist.

The following data will also be recorded:

- Age class/maturity – seedling, juvenile, adult at reproductive maturity (refer to Table 3-1);
- Height class, with classes based on 25 cm intervals (i.e. seedling, 0 - 25 cm, 26 - 75 cm, 76 – 100 cm etc.);
- Sex (if identifiable);
- Evidence of current disturbance factors e.g., recent fire event, insect damage and defoliation;
- Severity of any damage arising from current disturbance factors; and
- Georeferenced photographs of each plant

This data will be collated into a database in an appropriate format (e.g., GIS Esri Shapefile, MS Excel spreadsheet or MS Access database). The Stage 1 and Stage 2 areas were surveyed in March 2021 with no EPBC-listed cycads identified.

Table 3-1 Definitions of cycad maturity (Australian Pacific LNG, 2014).

Age class	Definition
Seedling	• A newly formed plant that is not attached to an older individual (i.e., is not a 'pup'[1]) • The sub-surface stem and subterranean trunk is less than 5 cm in length; • Does not have an above-ground stem or a formed crown; and

[1] A 'pup' is the growth of a new cycad, they are genetic clones of their parent plant, and typically develop around and attached to the parent plant near or just below the soil level. Both male and female plants can produce pups.

Age class	Definition
	• Has less than five (5) active fronds which are usually less than 50 cm in length (total rachis length).
Juvenile	• Is a singular plant that is not attached to an older individual (i.e., is not a 'pup'); • The crown has started to gain shape; • The plant has a surface height up to 5 cm (from ground to crown base); • The sub-surface stem and subterranean trunk is usually 5 – 25 cm in length but may be up to 40 cm; and • The plant has 5 or more active fronds.
Sub-adult	• Is a singular plant not attached to an older specimen/individual (not a pup); • The crown has fully developed; and • The plant has a surface height between 5 and 55 cm (from ground to crown base). Or: • Is a pup or multitude of pups attached to an older specimen/individual (usually at or near the base); and • The tallest stem has a surface height of 0 – 55 cm (from ground to crown base).
Adult (of reproductive capacity)	• Is a singular plant not attached to an older specimen/individual (not a pup); • The crown has fully developed; and • The plant has a surface height greater than 55 cm (from ground to crown base). Or: • Is a pup or multitude of pups attached to an older specimen/individual (usually at or near the base); and • The tallest stem has a surface height greater than 55 cm (from ground to crown base).

4 TRANSLOCATION PLAN

In general, cycads are straightforward to translocate and are widely used as landscape plants in the nursery industry. There have been at least four *C. megacarpa* and *C. ophiolitica* translocation programs in Central Queensland with varying degrees of success. The data collected and work methods utilised in these programs have been adapted for this Project and will be used in conjunction with the general policies and guidelines proposed by Commander et al. (*Guidelines for the Translocation of Threatened Plants in Australia;* 2018) and the *National Multi-Species Recovery Plan for Cycads* (Queensland Herbarium, 2013).

Commander et al., 2018 detail actions that should be undertaken prior to the translocation of the cycads into the recipient site(s), with the key action being the removal of any threats from the translocation recipient site(s).

All cycads located within the Project disturbance area that cannot be avoided will be salvaged and translocated as part of this Plan. However, some cycads may be inaccessible and unable to be salvaged for translocation due to OH&S requirements, and the location of plants that cannot be salvaged will be recorded along with the justification.

4.1 SALVAGE FROM IMPACT SITE

Cycads may be successfully translocated at any time of the year; however, the optimal time is immediately prior to the start of new growth, generally in the cooler months (i.e., winter and spring) and before the onset of the wet season. Cycads are generally tolerant of some root damage, however as with most species, better results are achieved with the retention of a solid root ball. Following a review of the available information for cycad species, including the three documented translocation projects for *C. megacarpa* (Australian Pacific LNG, 2014, Santos GLNG, 2013, QGC, 2016), a multi-step plan has been developed for the salvage and translocation of cycad individuals, as follows:

1. Establish and maintain a "Cycad Translocation Database[2]" (CTD) to record actions required for delivery of this CTMP. The CTD will record the following:
    i. the chain of custody for cycads salvaged and seeds collected;
    ii. details of management actions;
    iii. details of seed collection and propagation;
    iv. details of translocation to recipient site and final location of translocated or propagated cycad.

    Appendix B details the records which will be collected and retained.
2. Site preparation will be undertaken prior to salvage e.g., preparation to ensure unimpeded access, weed treatment (where relevant) to minimise the risk of transporting weed propagules, collection of data records etc.
3. Marker paint or fluorescent dye will be used to mark the north side of each mature plant. This will ensure that the plants are replanted with a similar north-south orientation.
4. Clear the area surrounding the individual plants by hand.
5. Trim fronds back to where the rachis is attached to the stems.
6. Spray trunks and around the crown area (not the crown itself) with an anti-transpirant (e.g., Envy®) to prevent the plants drying out.

[2] The database acts as a chain of custody identifying each plant and seed used during the project and prevents unlawful transactions in plants and plant parts of an endangered species.

7. Removal will entail hand-digging where required, for example on steep slopes or when individuals are located against trees or boulders. Otherwise, mechanical removal will be undertaken where topography and soil characteristics allow for it e.g., on gentle slopes and soft soils.
8. To avoid bruising the trunks/stems of the cycads, care will be taken whilst transporting the plants. Any large or heavy plants will be loaded using a soft sling (or equivalent) on a backhoe or excavator bucket and packed using rolls of hessian sacking or similar.
9. Where applicable, damaged roots will be trimmed with clean/sterile secateurs and fungicide powder (e.g., Banrot®, Formula 20®) applied to prevent infection. Vitamin B or seaweed emulsion will also be applied to encourage root growth.
10. The plants will be positioned in the temporary storage site or directly in the recipient site (refer to Section 4.3) with the north marked side facing north.
11. The cycads at the temporary storage site will be potted up into pots or woven grow bags depending on the size of the individual.
12. The rootball of each plant will be re-packed with sandy loam to provide a suitable free draining soil medium for new roots to grow. This soil will be free of weed seeds. Backfill around the plant will use topsoil removed from the hole.

Any significant damage incurred to an individual plant as part of the salvage process will be recorded in the translocation database. This will assist in identifying any immediate or future horticultural requirements and will inform the analysis of monitoring results when tracking the progress of individual plants (particularly in the event of plant death during storage or following translocation). Where appropriate, damage to cycads will be treated with an appropriate disinfection and/or protection product (e.g., wound sealant or dressing) to minimise the risk of pathology.

4.2 STORAGE AT TEMPORARY STORAGE SITE

A suitably qualified horticulturist (see Table 6-1) with relevant experience in the management of native cycad species will be engaged to manage the temporary storage site.

All specimens stored at the temporary site will be potted up into either plastic pots or appropriately sized woven grow bags, depending on the size of the individual. Plastic posts will be of 1:2 diameter to depth ratio (i.e., deep pots) and along with grow bags, will be elevated off the surface of the storage facility to facilitate drainage of excess water in pots / bags. Care will be taken to ensure that cycads are not over watered to prevent roots rotting.

4.3 TRANSLOCATION TO PERMANENT RECIPIENT SITE

Actions undertaken prior to the translocation of Cycad individuals will include, at a minimum:

- The removal of significant weed species from within the immediate vicinity and surrounds of the recipient site, for example, through an initial controlled burn to weed and fuel loads with follow up mechanical removal or targeted weed treatment with herbicides (note: pre-emergent herbicides are not to be used).
- Where present in material numbers, the management of pest animal species from within the immediate vicinity and surrounds of the recipient site through trapping, baiting or exclusion fencing. Note pest animals to cycads include include feral pigs, cattle, horses and deer which may dig up or trample cycad plants and seedlings. Firebreaks will be constructed, where deemed beneficial and not already established.

- Suitable watering arrangements, for example, the installation of a water tank and watering infrastructure or suitable access for a water cart.

Translocating cycads to the permanent recipient site will include the following steps:

1. To avoid bruising the trunks/stems of the cycads, care will be taken whilst transporting the plants to the recipient site(s). Any large or heavy plants will be loaded using a soft sling on a backhoe or excavator bucket and packed using rolls of hessian sacking or similar.
2. Establish the transplant holes at the recipient site(s). The holes will not be too much deeper than the rootball of the plants being transplanted. The soil within the new holes will also be loosened.
3. Carefully remove each plant from its pot whilst preserving the rootball(s) of soil to retain as much soil around the rootball(s) as possible to avoid damaging the root system.
4. If there is any hessian sacking around the plant(s) it will be removed as they are placed into their new location.
5. Where applicable, trim any damaged roots with clean/sterile secateurs and apply fungicide powder (e.g., Banrot®, Formula 20®) to prevent infection. Vitamin B or seaweed will also be applied to encourage root growth.
6. The plants will be positioned with the marked side facing north.
7. The rootball of each plant will be re-packed with sandy loam to provide a suitable medium for new roots to grow. This soil will be free of weed seeds. Backfill around the plant using the topsoil removed from the hole.
8. Where necessary, the plants will be staked with multiple stakes for stability or rocks used.
9. If deemed necessary, spray the trunks of the plants again with an anti-transpirant (e.g., Envy®) to minimise moisture loss.
10. The crown and any remaining foliage on each plant may be sprayed with an insecticide (Confidor® at an application rate of 10ml/9L water or Crown® at an application rate of 5ml/9L water).
11. Using ordinary water, thoroughly water around each translocated plant

Planting patterns and ratio of *C. megacarpa / C. ophiolitica* relative to composition of species collected from impact sites will be considered to ensure that *C. ophiolitica / C. megacarpa* are not introduced into incompatible populations and are planted into populations of similar composition to where they were salvaged from.

5 SEED COLLECTION AND PROPAGATION

In accordance with Condition 8(g) of the EPBC Act approval, the CTMP must specify a program for propagating cycads to replace any relocated individuals that have not survived the translocation process. To address this requirement, seeds will be collected, propagated and maintained within the temporary storage facility or suitable alternative location (e.g. offsite nursery) until the replacement plants are planted out within recipient sites. Seed collection will be undertaken by the Project ecologist or other suitably experienced personnel while propagation will be undertaken by a propagation contractor (see Table 6-1).

Previous translocation programs undertaken in Central Queensland determined that the mortality rate for translocated cycads was highest within the first 12 months following translocation (Wain, 2018), with 19% of deaths occurring within the first 12 months and approximately 32% after 4 years. Adult plants were noted to take at least 6 months to die, however numbers within the adult age class stabilised after approximately 18 months. Based on this observed mortality rate, sufficient seed will be collected to replace a minimum of 50% of the total number of individuals translocated, with additional seed collected to account for other factors such as non-viable seed, seedling mortality and survival rate of propagated stock following planting. Seed will be collected from cycad individuals across the Project area to ensure that the genetic variability of the source population is maximised.

5.1 COLLECTION METHODOLOGY

Collection will be conducted in accordance with the conditions of the licence, any additional DES requirements, collection guidelines and all relevant requirements outlined in the Code of Practice for the harvest and use of Protected Plants (DES, 2017). The collection methodology is as follows:

- Landholder protocols and communication will be followed in line with the project requirements.
- Personnel involved in seed collection will take care to minimise damage to any understorey plants through trampling or by vehicles.
- Personnel involved in seed collection will take precautions to prevent the spread of weed seeds, propagules and pathogens into and out of seed collection areas, whether by vehicle or on a person's clothing, footwear etc. This will include measures such as the disinfection of tools and equipment, removal and appropriate disposal of weed seeds and propagules from clothing, cleaning of boots and vehicle wash-downs as per the project requirements.
- Personnel involved in seed collection will take precautions to minimise damage to soils, roads and tracks, especially in wet conditions.
- To ensure sufficient genetic variation within the translocated population, seed collection will not be restricted to those individuals being directly impacted by the Project. Seed will be taken from five or more maternal parent plants at least 100 metres apart.
- Only fully ripe fruit is to be collected – seed must have been shed or on the point of being shed.
- Cuts to remove fruits will be made with clean, disinfected 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.
- Seeds from multiple plants will not be mixed into the one collection bag or container.
- Seeds from adult plants will not be mixed with seeds found on the ground if the origin of seeds on the ground is uncertain.

- At collection, all seed collection bags/containers will be clearly labelled with the species, date, place of collection (GPS coordinates or waypoint), total number of seeds collected from that point, collector's name and the relevant licence number.
- Seed collection records will be kept at the propagation premises and be made available upon request to a conservation officer appointed under S 127 of the NC Act (i.e., maintain the CTD).

Seed collection information will identify the origin of each seed. All seed collection data will be collated into an appropriate data management tool or equivalent system for record keeping, to track the progress and survival rate of propagated individuals through the entire process, from the point of collection. This tool also supports inputs that allow seed viability and fitness for each maternal plant to be tracked over time.

5.2 PROPAGATION METHODOLOGY

Propagation of collected cycad seed must be undertaken in accordance with a valid Protected Plants Growing Licence and the *Code of Practice for the harvest and use of Protected Plants* (DES, 2017).

Seed collection and propagation will be undertaken by suitably qualified and experienced seed collectors and a propagation contractor with experience in propagating native cycad species (see Table 6-1). Propagation will be undertaken off site at a propagation nursery.

The specific methodology for seed collection and propagation will be developed in consultation with the propagation contractor in accordance with the best practice management. This would include watering, monitoring and management of pest infestation or disease, fertiliser application (as relevant), and appropriate cleanliness and hygiene of nursery.

6 PRE-TRANSLOCATION PREPARATION

6.1 LOGISTICAL ASSESSMENT

Key roles in delivery of this Plan include:

- Cycad translocation team to oversee the delivery and implementation of the CTMP. A qualified ecologist and project manager with the skills and experience will oversee the delivery of the program.
- Horticulturists/ecologists who will undertake seed propagation and maintenance of the ex-situ cycads salvaged from the construction footprint.
- Translocation specialists experienced in salvage of cycads from the construction footprint and translocating into the recipient site/s.
- The Queensland Herbarium takes an active interest in the management of these cycad species. The aim is to reinstate the plants into the province from which they originate, where this is not possible the Queensland Herbarium will be consulted to ensure there are no genetic suppression or regression impacts to affected cycad population(s) from the proposed translocation arrangements.

Note: the same person may fulfill one or more of the above roles provided they meet the relevant requirements of each role.

6.1.1 Personnel

Arrangements for engaging personnel to implement this Cycad Translocation and Management Plan are in progress. The proponent is assessing potential contractors to undertake the works and will ensure that all elements of the CTMP implementation are satisfied. Table 6-1 defines suitably qualified personnel to implement the CTMP.

Table 6-1 Definitions of suitably qualified personnel

Terms for the purpose of the CTMP	Definitions
Ecologist	Qualified ecologist must have professional ecological qualifications, training, skills and experience related to cycad translocation activities. The ecologist will give authoritative independent assessment, advice and analysis on performance relative to the cycad translocation using the relevant protocols, standards, methods and/or literature.
Seed collectors	Persons trained, or have skills, in seed collection of threatened plants, particularly cycads.
Horticulturist/Propagation contractor	Professional with qualifications, training, skills and experience related to the propagation of cycads with knowledge, skills and experience in cycad translocation activities. (horticulture or other training considered relevant).

6.1.2 Resource requirements

The preparation and implementation of this CTMP is a condition of EPBC Approval 2018/8141. Accordingly, the proponent will implement this plan to meet the approval conditions for the project. This section specifically addresses Chapter 6 of the Guidelines for the Translocation of Threatened Plants in Australia (the Guidelines). The Clarke Creek Wind Farm is a long-term project and as such, will continue to fund and support the implementation of the CTMP.

While the implementation arrangements for the CTMP are not finalised, there is sufficient detail to inform the resource requirements to deliver the plan. Personnel engaged on the project have considerable experience in cycad translocation and conservation and a wide range of experience in threatened species conservation projects and delivery. Details of personnel who are suitably qualified botanists and cycad specialists (as per Table 6-1) engaged to date in the project are as follow:

- Joseph Adair (Green Tape Solutions), 30 years' experience. Joseph has managed an on-ground sub-contractor and supervised two successful cycad translocation projects in Queensland. His role was project oversight and preparation / finalisation of the report CTP approvals from State and Commonwealth agencies, selection of the nursery to undertake cycad care and maintenance, development of the protocols for custody control and the production of seedlings for the project, audit of the activities undertaken and quality control. He led the selection of the offset site for the Santos project on Red Shirt and development of the Offset Management Plan for the project including planting of cycads. Before this while with QPWS, his team developed protocols for managing and working with protected plants, including cycads for several projects undertaken by council and Main Roads, one of which was on the Calliope Range Road upgrade project which involved removal and reinstating cycads on the range.
- Carla Perkins (Green Tape Solutions), 13 years' botanical experience. Carla has strong experience in protected plant translocation works including field collection, storage and propagation of reproductive material (cuttings and seed) for threatened plants in Central Queensland with SANTOS and APLNG. Species included *Acacia pedelyii, Apatophyllum teretifolium, Cadellia pentastylis, Desmodium macrocarpum, Macropteranthes leiocaulis, Solanum johnsonianum* and *Wahlenbergia islensis*.

Financial assessment of the following elements is shown in Table 6-2, noting that costs are indicative only and will be subject to a tendering process. These components will be refined as the project progresses.

Table 6-2 High level estimated resource requirements to implement the CTMP on the basis of 500 individuals

Item	Status / comment	Cost (approximate)	Annual cost 1st year	Ongoing annual costs	Total Cost
Pre-translocation research into biology and ecology	Complete – refer to past Cycad translocation projects	Minimal – desktop assessment	$6,000	$0	$6,000
Genetic and taxonomic studies, where necessary	Complete – refer to past Cycad translocation projects	Minimal – desktop assessment	$600	$0	$600
Surveys for source and recipient translocation sites	Complete – initial surveys complete, and identification of potential translocation sites are provided in this plan	$15,000	$18,000	$0	$18,000
Collection and where necessary storage of seeds	Seeds to be collected from the Project Area (4 to 1 ratio). Plants that do not survive translocation replaced at a ratio of 4:1, applying the Qld offset ratio. Note that dead mature/seeding plants are replaced by seedlings/juveniles	$20,000	$24,000	$0	$24,000
Propagation and management of plants	Nursery site to be confirmed, horticulturist to be confirmed.	$80,000	$48,000	$0	$96,000
Translocation recipient site preparation	Control of threats such as grazing, fencing, restoration work and feral animal control.				
		$180,000 establishment	$180,000	$0	$180,000
Fire management	Install fire breaks, initial prescribed burn to reduce fuel loads if necessary.	$6,000 annually (10 years)	$24,000	$6,000	$84,000
Personnel training	As required to maintain currency for the duration of the project.	$12,000	$1,200	$1,200	$12,000
Planting equipment	Shade house, pots and grow bags.	$12,000	$12,000	$0	$12,000
Machinery and transport for whole plant transplantation	Rubber tyre mini-excavator and operator. Light truck / trailer to salvage plants and transport them to temporary storage site or recipient site.	$150,000	$180,000	$0	$180,000

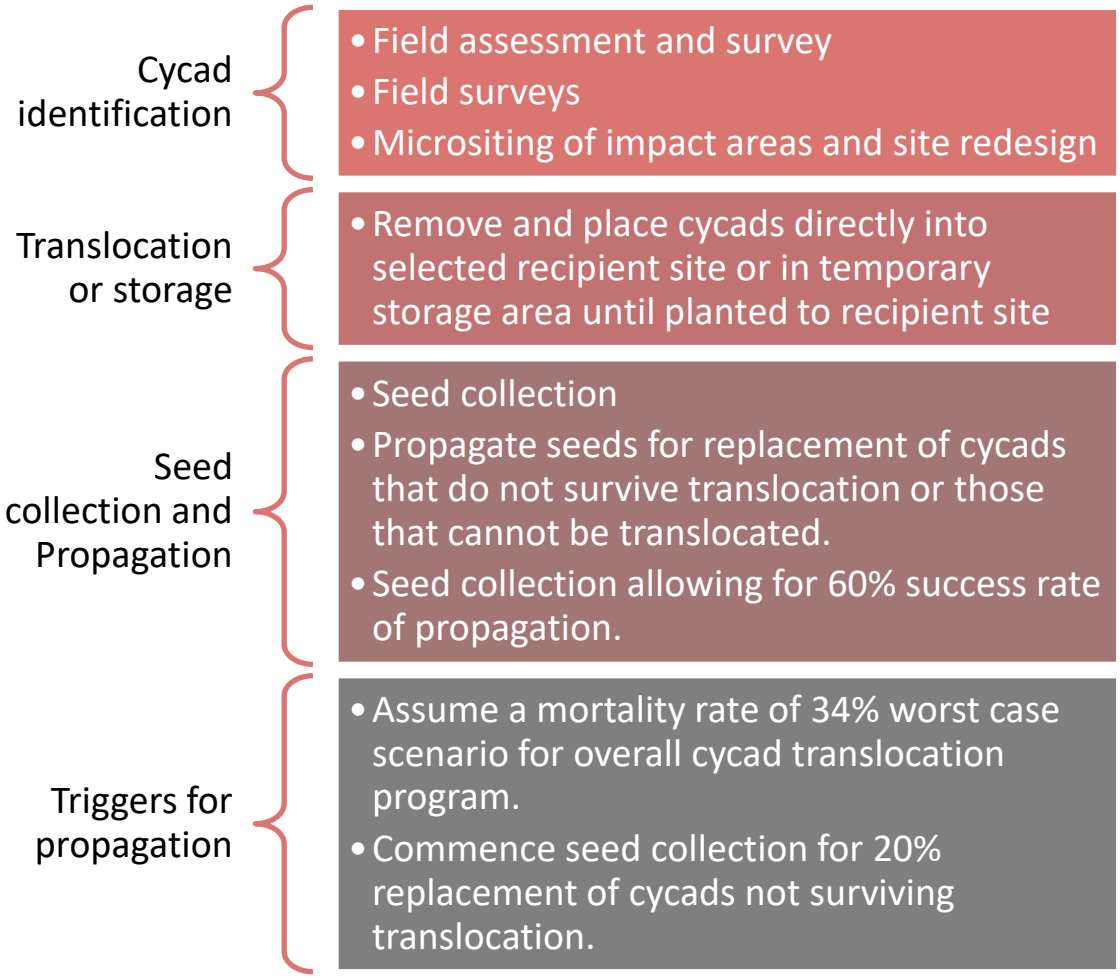
Item	Status / comment	Cost (approximate)	Annual cost 1st year	Ongoing annual costs	Total Cost
After-planting management requirements including watering	Translocation site management and maintenance.	$18,000 yearly first 5 years / reducing to $4,000 for next 5 years	$18,000	$18,000	$114,000
Long-term monitoring and evaluation programs; and	Establish and develop and maintain CTMP data base, monitoring and evaluation.	Monthly – year 1	$6,000	$0	$6,000
Long-term monitoring and evaluation programs; and	Establish and develop and maintain CTMP data base, monitoring and evaluation.	Quarterly for years 2 -5	$2,400	$0	$9,600
Long-term monitoring and evaluation programs; and	Establish and develop and maintain CTMP data base, monitoring and evaluation.	Annually for years 6 - 10	$1,200	$0	$6,000
Intervention	Allow for three (3) incidents during the program.	$1,000 - $15,000 per incident.	$0	$18,000	$54,000
			$521,400	**$68,400**	**$802,200**
Allowance for inflation in the defined management period	~ 2.5% inflation annually (10 years).			*$19,159*	*$224,696*

6.2 SCHEDULING TRANSLOCATION ACTIVITIES

The timeline for translocation activities is dependent upon finalising the construction timeframes for the Project. The translocation program will be developed to adapt to the construction program and will involve staggered planting if the project is staged or staggered. Construction of the first two stages of the project is expected to commence approximately early-2022 and is anticipated to progress over a two (2) year period. Cycad pre-translocation assessment and translocation activities are expected to commence from early-2022, with translocation from impact areas expected within the first year. The Stage 3 (Northern) area will be developed at a later time.

The cycad translocation process is summarised in the Figure 6-1 below.

Figure 6-1: Cycad Translocation Process



The schedule to implement the CTMP is summarised below (dependent on construction commencement):

- Assessment and identification of cycads for removal from site: Early 2022 or earlier. Site access to cycads will be concurrent with pre-clearance surveys.
- Select and secure direct cycad translocation sites within the project area (early 2022 or earlier).
- Secure the temporary cycad storage site: Early 2022 once construction site compounds established.
- Prepare translocation program: Early 2022
    - Personnel
    - Equipment
    - Vehicles
    - Chain of custody
- Prepare recipient sites (early 2022)
- Collect cycads: Commencing Q2, 2022 and continuing throughout vegetation clearing.
- Translocate suitable cycads to recipient site/s or store at temporary storage facility
- Care and maintenance of translocated cycads mid 2022 onwards.
- Seed collection: Assessment as for cycad inspections (collection from source plants to be translocated and from plants adjacent to the construction footprint) – Commencing mid-2022.
    - Seed collection – 2022, year 1,
    - Propagation of seed 2022-23, year 2 (seeds need to dormant for up to 12 months before germination and propagation).
- Planting propagated cycads .
    - Initial – replanting of translocated cycads into recipient site/s – late 2022 onwards.
    - Ensure suitable water and maintenance supply for translocated cycads.
    - Planting out of seedlings and juvenile cycads as available once suitable cortex is achieved and climatic conditions are suitable.
    -

6.2.1 Timelines for translocation planning

Table 6-3 below shows the likely times and duration for these actions. The schedule may be amended to address construction schedules which are being developed, weather and environmental conditions required to collect suitable seed and planting into the recipient site/s.

Table 6-3 Indicative timeline for implementation of the Cycad Translocation Management Plan

Year 1: 2022	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Planning	Planning for CTMP implementation			Prepare recipient site(s) and temporary storage location (if needed)								
Cycad salvage and translocation. Seed collection				Salvage and translocate cycads. Collect seed								
Cycad monitoring, care and recipient site mgt.				Care and maintenance of translocated cycads								
Year 2: 2023	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Propagation	Additional collection of seed and seed propagation – number dependant on cycad survival rates.											
Cycad salvage and translocation.	Continue cycad salvage and translocation as construction front progresses											
Cycad monitoring, care and offset site mgt.	Maintenance of translocated cycads in recipient site(s) and recipient site maintenance.											
Seedling care	Care of seedlings in the nursery											
Cycad care	Care of salvaged cycads in the ex-situ storage facility – monitor progress, additional seed collection if necessary											
Year 3: 2024	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Seedling care	Care of seedlings in the nursery – further collection of seed if required. Potential planting of propagated cycads into recipient site											
Cycad monitoring, care and recipient site mgt.	Maintenance of translocated cycads in recipient site(s) and recipient site maintenance.											
Cycad care and planting	Care of salvaged cycads in the ex-situ storage facility*				Planting of salvaged cycads from storage site into recipient site.				Maintenance of cycads in recipient site and recipient site maintenance.			
Year 4: 2025	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Seedling care and planting	Care of seedlings in the nursery – monitor progress, additional seed collection if necessary. Planting of propagated seedlings into recipient site											
Cycad monitoring, care and offset site mgt.	Maintenance of translocated cycads in recipient site(s).											
Year 5: 2026	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Recipient site	Care and maintenance of cycads in recipient site(s)											
Seedling care and planting	Care of seedlings in the nursery – monitor progress. Planting of propagated seedlings into recipient site											
Year 6: 2027	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Seedling planting into recipient site	Planting of propagated seedlings into recipient site											
Cycad monitoring, care and recipient site mgt.	Maintenance of translocated cycads in recipient site(s) and recipient site maintenance.											
Year 7-10: 2028 - 2031	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cycad monitoring, care and recipient site mgt..	Maintenance of translocated cycads in recipient site and recipient site maintenance.											

6.2.2 Single verses staggered plantings

Seed propagation and planting is reliant on the ripeness of the seed on the cycads and seed availability in the vicinity of the project area. Seed germination and propagation is likely to take up to 12 months as the seed will need time to pass through a period of dormancy. This is typical of cycad propagation processes. Given the unknown status of seed propagation success, planting out of the seedlings into the recipient site will be staged. Seedlings will be planted out once the cortex of the seedling is appropriately sized (typically 4 cm or greater). Planting out is contingent on suitable weather and climatic conditions, being cooler weather and suitable moisture conditions, generally in late Autumn to early Spring. This allows time for the seedlings to establish before the hot summer months. A local water supply will be required in the event of dry weather to water the seedlings during establishment in the first two to three years. Planting additional seedlings into the recipient site/s will aid in ensuring that the necessary number of plants are successfully propagated.

6.3 COLLECTION OF SOURCE MATERIAL

The seed collection methodology is described in Section 5.1. Seed collection will be from the properties where the impact to cycads occurs (Table 6-4):

Table 6-4 Properties from which cycads and cycad seed will be salvaged as relevant to each project stage.

Lot	Plan	Shire
8	RP614441	Isaac
10	RP614442	Isaac
1	SP153335	Isaac
8	ROP41	Isaac
23	CP896088	Isaac
18	RP848821	Isaac/Livingstone
1	RP801235	Isaac/Livingstone
1	SP303299	Livingstone
3	RP801346	Livingstone
3	ROP178	Livingstone
4	ROP192	Livingstone

6.3.1 How much material will be collected from each source plant?

Collection will be in accordance with the Queensland "Code of practice for the harvest and use of protected plants" and Department of Environment and Science Protected Plant growing licence held by the propagator or other responsible person. Typically, collection of seed is limited to no more than 20% of the seed, or other propagative material, from any one plant in any 12-month period. Seed will preferentially be collected from cycads to be translocated from the construction footprint. Any required additional seed will be collected from cycads within the local province.

6.3.2 Collection licence requirements

Plant and seed collection and translocation must only be carried out under a valid Protected Plants Harvesting Licence issued by the Department of Environment and Science (DES) (Table 4-1). Some authorities are still to be obtained for the CTMP. Details will be provided as these are available.

Table 6-5 QLD DES Authorities for salvage, seed collection and growing protected plants for this CTMP

Responsible person	Authority details (licence / permit)
WA0037101	Salvage of protected plant – Clearing permit
Tba	Licence to grow protected plants

6.3.3 Note: Only one licence (a protected plant harvesting licence (DOC, 290KB)) is required to harvest protected plants. If a licensed harvester intends to grow protected plants from harvested plant parts then only a protected plant growing licence (DOC, 273KB) is required. Record keeping for the CTMP

Records to be kept for the CTMP are required by Australian and State government agencies (DAWE and DES). DES requires that a protected plant harvest record (XLS, 113KB) must be created and kept by the person or entity when harvesting whole restricted plants or restricted plant parts harvested under a licence or exemption. The harvest record must include the information required in the Code of practice for the harvest and use of protected plants (PDF, 260KB) and be kept in a written or electronic record system. This is to ensure a person or entity undertaking a harvest can maintain specific details of the harvest for compliance purposes, while also demonstrating the plant or plant part was lawfully harvested from the wild.

DES further requires that details of the flora survey trigger map used to identify high-risk areas for endangered, vulnerable or near threatened plants is retained by the proponent. Information collected from the flora survey must be reported to the QLD using the DES WildNet data entry form (XLS, 543KB).

Further records to be kept for the CTMP are described in Appendix B which describe records for each plant and seed interacted with during the program. The intent of these records is to ensure relevant data on the implementation of the project is retained for salvage, seed collection and nursery management and translocation into the selected recipient site. This data will ensure the establishment and maintenance of a chain of custody and record the management actions to implement the plan. The data will aid in decision making should adaptive management actions be required during the project.

6.4 ESTABLISHING AND MAINTAINING AN EX-SITU POPULATION

The selected nursery will be responsible for the establishment and management of the ex-situ population and seed propagation. The selected nursery will have relevant experience in nursery *C. megacarpa* and *C. ophiolitica* propagation methods and operate under the Australian Standards for maintenance of plant health and the Nursery Industry and Garden Australian Standard. Seed will be stored in cool, dry and dark environment until ready for use.

6.5 LEARNING FROM THE TRANSLOCATION – EXPERIMENTAL DESIGN

Since 2012 there have been several projects whereby *C. megacarpa* and *C. ophiolitica* have been propagated and translocated. Some of these are:

- Santos GLNG Gas Transmission Pipeline project;
- QGC Gas Transmission Pipeline project;
- APLNG Gas Transmission Pipeline project;
- Calliope to Biloela Highway upgrade – Department of Transport and Main Roads (DTMR);
- Panorama Drive road construction – Yeppoon;
- Mt Archer road repair and picnic area upgrade – Rockhampton; and
- Bajool Quarry expansion – Bajool.

The persons engaged in the preparation of this CTMP for this Project have hands-on experience in translocating cycads. In each case the learning from the past project is incorporated into the next program. As described in section 6.3, the data kept for these works allows for learning and adaptive management in the delivery of the project.

This project will apply this collective knowledge in delivering the project using known techniques to salvage, propagate and translocate cycads. Where there are learnings from the project these will be recorded and provided to DAWE and DES during project reporting.

Data from the CTMP will be made available through the project annual compliance reporting (Condition 25 of EPBC 2018-8141). Additional details regarding the CTMP can be requested from the proponent to assist any relevant third-party research.

The CTMP has been developed for the purpose of the CCWF and additional research or experimental design is not proposed.

6.6 IDENTIFICATION OF POST-TRANSLOCATION MANAGEMENT, MONITORING AND EVALUATION METHODS

6.6.1 Ongoing management

As part of the post translocation management requirements, the nursery seedlings will be monitored by a qualified ecologist(s) for a period of up to 5 years following planting. The monitoring and reporting requirements for these seedlings are provided below. Management and mitigation measures are also outlined in Section 7.

Monitoring of nursery grown Cycad seedlings and salvaged cycads

As a minimum, each survey will involve the following tasks:

- Visually inspect translocated and propagated Cycads.
- Visually inspect a sample of seedlings within the control site, which is separate from the translocation site. The control site is a reference site to aid in determining performance of the plants in the translocation site.
- Observation data will be recorded against the respective unique identification code on a spreadsheet pro-forma.

- If a plant appears to have died, a photograph of the individual will be taken during the field inspection.
- Monthly rainfall data from the onsite rain gauge.
- Input of collected survey data into the data management tool for analysis.

If a fire (prescribed or wildfire) occurs in the translocation site, the following information will be collected from each individual noticeably impacted:

- Level of impact to plants (e.g. has the plant died; only partially burnt, etc.).
- Rate of recovery (new growth).

6.6.2 Reference Site Suitability Assessment

Establishment of a reference site will allow for comparison between the recipient and reference site cycads, translocation outcomes and performance of site management to improve land condition. The reference site will be a representative sample of the naturally occurring population(s) of similar height classes and similar topography and aspect to those translocated as part of the project works.

This site will be in a nearby area that can be accessed during the life of the monitoring program and will be located in an area not subject to future development.

6.6.3 Correction and Prevention

General maintenance

The primary management goal of the translocation site is to establish and secure a population of threatened cycads.

Advice will be given to regulators on the following events:

- Severe stress/death of a significant number of plants.
- Severe pest attack resulting in death.

In each case corrective actions will be targeted to the specific threat to the plant/s if deemed necessary. Where pesticides are to be used, this will be at the direction of the supervising horticulturist and ecologist. Use of any herbicides, insecticides, fungicides and other chemicals will be carefully assessed to ensure suitability of application and does not cause environmental damage or off-target impacts.

Plants will be watered during extremely dry and prolonged weather periods if deemed necessary to prevent the death of the plants.

6.6.4 Monitoring and evaluation

Monitoring and evaluation methods are described in Section 8 and the items to be monitored are described in Appendix B. Monitoring will be in accordance with the schedule below.

0-12 months- Monthly basis the first inspection will take place following the completion of the Cycads being placed in their permanent recipient site)).

12-60 months **-** Quarterly basis .

60 – 120 months - Annual until final inspection

7 MANAGEMENT AND MITIGATION

Table 7-1 illustrates the threats and related management actions identified for the translocated and propagated cycads.

Table 7-1 Risk and management actions

Risks	Detail	Management Actions	Timeframe
Desiccation	Insufficient water can lead to the plants failing to thrive at the storage and recipient sites.	• Controlled watering during exceptionally dry periods will aid in ensuring the cycads survive. • Have water available on site ensuring that translocated plants and seedlings receive necessary water while they are being established during dry seasons, and to provide a fire management capacity.	Duration of watering will be determined by the contractor to ensure the survival of the plants and establishment of translocated/propagated Cycads.
Water logging	Over watering of cycads can lead to root rot and loss of plants in storage.	• Monitor water delivery to ensure that plants are not over watered. Soil in pots / bags will be damp and not wet. • Monitor root health periodically to ensure there is no rot occurring. Treat rot with suitable fungicide such as Banrot® Formula 20® or similar.	Duration of watering will be determined by the contractor to ensure the survival of the plants and establishment of translocated/propagated Cycads.
Invasive or declared weeds	Dense stands of Lantana (*Lantana camara*) increase the fuel loads which may fuel uncontrolled hot fires at translocation recipient site.	<u>Weed control</u> • Manual control and targeted control in accordance with manufacturer's label or an off-label permit issued by the Australian Pesticides and Veterinary Medicines Authority. Splatter gun treatment may be required in heavily infested areas of Lantana. Also, introduced grasses or other competitive weeds will be controlled using selective recommended herbicides. • Herbicides will only be used by trained personnel, in accordance to manufactures instructions and with appropriate Personal Protective Equipment (PPE).	Until establishment of translocated/propagated Cycads. Likely most relevant during recipient site establishment
	Invasive or declared weeds (e.g. Lantana) have the potential to limit the successful recruitment of	<u>Weed prevention/hygiene</u> • The potential for the introduction or spread of weeds will be minimised by restricting vehicle and livestock access to the recipient site and implementation of weed control measures.	

Risks	Detail	Management Actions	Timeframe
	Cycas sp. at the recipient site.	• Prior to translocations being undertaken, declared weeds will be identified and managed at the recipient location/s.	
Grazing	Livestock damage to young plants	<u>Fencing</u> • Livestock will be excluded from the recipient site if impacts are considered to be a significant risk at each recipient site. <u>Livestock access / grazing</u> • Pulse grazing for fuel control may be permitted at appropriate times once *Cycas sp.* plantings are sufficiently established, as determined by a suitably qualified Ecologist. • At intervals during and at the conclusion of the pulse grazing period a suitably qualified Ecologist will monitor for potential impacts of livestock on the translocated plants and condition of the recipient site.	Until establishment of translocated/propagated Cycads
Feral animal control	Feral animals including pigs, horses, cattle and to a lesser extent wild deer can impact on the translocated or propagated new plants.	<u>Pest animal management</u> • Record incidental observations of pest animal impacts on the translocated and naturally regenerating populations. If impacts are considered to be a significant risk specific control measures will be implemented. • Controls may include shooting, trapping and/or baiting. Notice of access and proposed pest control methods and/or chemical usage (including material safety data sheets) must be provided to the landholder two weeks prior to any events occurring. <u>Secure fencing</u> • Establishing a fence suitable to restrict access of feral animals where deemed necessary.	Until establishment of translocated/propagated Cycads
Fire	Wild fires have the potential to burn the recipient site and destroy the planting.	• The recipient area will preferentially be located within the offset site, in which case there will be a maintained fire break. Alternatively, the recipient area will be chosen for reduced adjacent fuel load. • Fuel loads will be monitored by field personnel to determine if fuel load and climatic conditions have the potential to cause a fire that could be detrimental to the planted population. Where the potential for detrimental fires exists, further actions will be implemented to reduce fuel loads to an acceptable level at appropriate times.	Until establishment of translocated/propagated Cycads

Risks	Detail	Management Actions	Timeframe
		• Biomass/fuel loads will primarily be managed through a combination of grazing across the recipient site and where necessary, slashing (hand held equipment) around the *Cycas sp*. • Grazing will only be undertaken once *Cycas sp*. are sufficiently established as determined by a suitably qualified Ecologist based on the results of regular monitoring. • Where applicable and feasible, cool (trickle burns) fuel reduction burns in a rotational mosaic pattern will be conducted to reduce the hazard of uncontrolled fires.	
Insect attack and fungal infections	A range of boring insects have potential to attack cycads and can cause significant damage to the plants.	• Periodic inspections will be conducted as per the monitoring program outlined in this Plan to identify if significant insects are present and check for other issues. • Where fungal infections and damage (likely to cause death) is evident treatment with a fungicide powder (e.g. Banrot®, Formula 20®). • Where insect damage occurs apply an insecticide if the insect damage is considered likely to cause death to the cycad individual, (e.g. Crown, Bugmaster, Rogor, Supracide, Dipel but not a pyrethrum based one), and add a wetting agent (e.g. a few drops of dish washing liquid).. • Insect and fungicide treatment may require removal of leaves and trunk material to remove rotten wood. Where trunk wood is removed it must be covered with a suitable tar solution (e.g. Steri-prune paint) to prevent further damage and drying out.	Until establishment of translocated/propagated Cycads
Unauthorised access	Damage caused by unauthorised entry or use of the recipient site	<u>Restricted access</u> • Access to the recipient site will be restricted to approved personnel; approved contractors and guests (e.g. DES and DAWE) and the landholder; • Access to the recipient site will be within the project area which will have controlled access points. All access points will be secure and padlocked to restrict entry to authorised personnel.	Until establishment of translocated/propagated Cycads
Land degradation	Erosion and sediment related impacts caused by construction activities	• The recipient site will be located outside the project disturbance area. Therefore, it is unlikely to be impacted from erosion or sediment resulting from the construction activities. Construction related erosion and sediment will be controlled through the CEMP and EMP.	Until establishment of translocated/propagated Cycads
	Erosion and sediment impacts from poor agricultural land management practice	• Erosion and sediment management measures will be implemented if this is considered to be an issue.	On establishment of recipient site.

Risks	Detail	Management Actions	Timeframe
Intervention triggers	Triggers for intervention	• The following criteria are triggers for corrective actions to ensure this plan achieves its objectives: ○ If monitoring shows less than ▪ 80% success of salvaged plants surviving in storage, ▪ 50% seed propagation success, ▪ 60% of translocated plants surviving at the translocation site.	Until establishment of translocated/propagated Cycads
	Corrective actions	• Corrective actions described in this table above and will be applied as necessary.	Until establishment of translocated/propagated Cycads

8 MONITORING AND EVALUATION

8.1 REPORTING REQUIREMENT

The implementation of this Plan will be reported as part of the annual EMP performance report. The reporting mechanisms will align with approved EMP reporting and review to demonstrate compliance. All monitoring and translocation actions will be recorded in the CTD.

Reports will detail the actions of this translocation program and results of works to achieve a sustaining population of *C. megacarpa* and *C. ophiolitica.* The report will include but not be limited to the following:

- Collection of cycads from the project footprint.
- Establishment of temporary holding facility and maintenance of collected cycads.
- Collection of seed for propagation.
- The progress and success (health) of translocated individuals.
- The permanent recipient site/s for the translocated plants and final planting of seedlings.
- Translocation of plants from project footprint into the recipient site.
- Planting of seedlings into recipient site.
- Any issues and actions to address these and the success or otherwise of these measures.
- Persons engaged in the program, including suitably quality horticulturalists and ecologists (see Table 6-1).
- Management of the storage and recipient sites in accordance with this plan.

Reporting will occur on an annual basis in accordance with the compliance reporting requirements (Condition 25 of EPBC Approval).

8.2 MONITORING OF TEMPORARY STORAGE AND RECIPIENT SITE

To monitor the health of the salvaged cycads whilst in temporary storage, the potted cycads will be inspected by a suitably qualified ecologist / horticulturist (as per Table 6-1) on a monthly basis with inputs from the transplant contractor. The first inspection will take place one month following commencement of salvage activities and will continue until all cycads are transplanted from the temporary storage to their permanent recipient site.

Once translocated, cycad individuals will be monitored by a qualified ecologist for a period of 10 years following their translocation into the permanent recipient site(s). Monthly inspections will be undertaken for the first 12 months following translocation (Year 1), quarterly for Years 2 – 5 and annually until Year 10. The findings at the end of the monitoring period will determine the success of the program.

8.3 PERFORMANCE CRITERIA

Table 8-1 specifies the criteria for measuring the success of management activities within the recipient site, and establishment of translocated/propagated Cycads. Once the translocation completion criteria have been achieved (see table below), further cycad propagation, plantings and site management will not be conducted.

Table 8-1 Performance criteria for cycad translocation

Objectives	Measurable criteria for success
Successful translocation of impacted *C. megacarpa*. and *C ophiolitica* individuals	Impacted cycads are salvaged from the impact site prior to clearing where possible.
	All salvaged cycads are translocated to a project recipient site. If a cycad does not survive translocation four propagated cycads are planted in its place at the recipient site.
	At the completion of translocation activities, there is no net loss in the number of cycads as a result of project construction activities.

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APPENDIX A CYCAD SPECIES DESCRIPTIONS AND GENERAL ECOLOGY

CYCAD ECOLOGY

Most cycads rely on fire for successful reproduction. Whilst adult plants are generally resistant to most fires, growth may be impacted through the destruction of foliage and the trunks may be scarred. Seed and seedling are fire-sensitive and fire may result in significant impacts to a population through the mortality of seeds and seedlings (Queensland Herbarium, 2007). Both species occur in habitats within the Project area that are susceptible to periodic fire events of potentially varying intensities. Appropriate fire management is essential to the long-term success of both retained and translocated individuals within the Project area.

Both species are thought to be pollinated by small beetles. Fruiting cones (megasporophylls) are usually produced from late autumn to late summer (May to February), with seed dropping from the plant from autumn onwards (March). Due to a delayed fertilisation system that is unique to cycads, the seeds are not ready to germinate for at least nine months after they drop from the plant (Queensland Herbarium, 2007).

While there is little information on *C. megacarpa* and *C. ophiolitica* seed dispersal and recruitment, it is known that within cycad species there is generally limited dispersal of ripe seed via mammals. Plant distribution is usually strongly clustered as a result of a limited dispersal distance, with the bulk of seed dispersal localised to around the parent plants (Queensland Herbarium, 2007).

Cycad species have a number of insect predators which damage the foliage of specimens, including the leaf beetle *Lilioceris nigripes* and the lycaenid butterfly *Theclinesthes onycha* (Queensland Herbarium 2007).

Figure A- 1: Comparison of character states for C. media, C. ophiolitica and C. terryana (from Forster, 2011)

Character State	*C. media*	*C. ophiolitica*	*C. terryana*
Mature leaf indumentum	glabrous	tomentose below and on rhachis	tomentose below and on rhachis
Leaflet insertion	± flat to weakly keeled	strongly keeled	keeled
Leaflet number	160–300	170–220	184–320
Leaflet colour mature leaves	glossy green	glaucous grey-blue	glossy green to glaucous green-grey
Leaflet texture	flexible to weakly brittle	flexible	strongly brittle
New growth indumentum colour	pale orange-brown	mixture of grey-white and pale orange-brown	pale grey-fawn
Cataphyll indumentum colour	orange-brown	orange-brown	pale grey-fawn
Megasporophyll indumentum	ferruginous or grey	brown	fawn-tan
Megasporophyll width (mm)	17–30	12–30	30–38
Seed sarcotesta colour	green becoming orange-yellow, not pruinose	green becoming yellowish, pruinose	green becoming orange, not or only weakly pruinose
Seed size: length × wide (mm)	31–38 × 26–32	29–33 × 28–32	37–40 × 30–35

DESCRIPTION OF *CYCAS OPHIOLITICA*

Cycas ophiolitica (listed as endangered under the EPBC and NC Act, and vulnerable under the IUCN Red List) is endemic to central Queensland where the known populations are concentrated in two areas, around Marlborough and Rockhampton. *C. ophiolitica* occurs in open woodland, woodland or open forest dominated by eucalypts, often on serpentinite substrates. This species is closely related to *C. megacarpa*.

C. ophiolitica is a small to medium sized cycad with an erect trunk and rounded crown. It grows to 2 m tall, though it can reach 4 m, with a trunk diameter of 4 – 20 cm (Department of Environment and Science [DES], 2018). The glossy blue-green / dark green fronds are 95–140 cm long, with 170–220 pinnae (DoEE, 2017). New growth is bluish-green, densely hairy with grey-white or pale orange-brown hairs that persist as the leaves age.

Male plants produce brown, hairy cylindrical cones that are 14-17 cm long and 6-8 cm in diameter. The female plants produce loose, open cone-like structures at the top of the plant. Two to six seeds are borne on female sporophylls that are up to 30 cm long, have a broad flat spear-shaped tip (apical lobe) with an apical spine to 2 cm long. As the seeds mature, the stalks lengthen and spread away from the top of the plant.

The seeds are ovoid to spherical in shape, green becoming light-brown or yellowish-white, 29–33 mm long and 28–32 mm in diameter and often with a thin powdery coating. It is distinguished from *Cycas megacarpa* by its blue-green new growth, the orange wool within the crown, hairy petioles, narrower and more crowded leaflets and much smaller seeds (DoEE, 2017 and DES, 2018).

C. ophiolitica is distinguished from *C. media* by the orange wool in the crown, the hairy petioles and the narrower, more crowded leaflets. It is distinguished from *C. megacarpa* by the narrower, more crowded leaflets and much smaller seeds.

Forster and Holland (Queensland Herbarium, 2007) note that the degree of relationship between C*. megacarpa* and *C. ophiolitica is* not yet known, especially at the northern end of the range of forms and that systematic and genetic studies would be required to accurately determine species boundaries.

Figure A- 2: Male *Cycas ophiolitica*

DESCRIPTION OF *CYCAS MEGACARPA*

Cycas megacarpa is a small to medium sized cycad that is listed as endangered under the EPBC Act and the Queensland *Nature Conservation Act 1992* (NC Act), and vulnerable under the IUCN Red List of Threatened Species. *C. megacarpa* occurs in woodland or open woodland dominated by eucalypts, often on rocky substrates, in coastal areas ranging from Woolooga, north of Gympie to Rockhampton. Approximately 46 populations have been recorded across this distribution range, yet only eight of these known populations are considered to be viable in the long-term (i.e. have a population size of >3,500 individuals) (Queensland Herbarium, 2007).

At maturity, *C. megacarpa* has an erect trunk and grows to 3 m in height (sometimes to 8 m) with a trunk diameter of 8-15 cm. It has fronds measuring 70 – 110 cm in length, with 120 – 170 pinnae (leaflets). New growth is blue- green and densely hairy with orange-brown hairs that later fall off (Queensland Herbarium, 2007), while mature leaves are mid- to dark- green, semi- to highly glossy. All cycads are unisexual (i.e. male and female reproductive structures develop on separate plants). Female *C. megacarpa* plants produce loose open cone-like structures (megasporophylls) at the top of the plant (within the crown) that measure 14 – 25 cm long. Within this cone, two to four seeds are borne on individual sporophylls (seed bearing structures) that 15- 25cm long with a broad flattened spear shape tip (apical lobe) and an apical spine to 2 cm long. As the seeds mature, the stalks lengthen and spread away from the top of the plant. Male cones are ovoid (egg-shaped), 18 cm long, 7 cm in diameter and are coloured yellow to orange-brown. The seeds are ovoid in shape, 38–50 mm long and 35–45 mm in diameter and are green in colour turning yellow, pinkish or purplish as they mature (DoEE, 2019).

C. megacarpa is visually similar to *Cycas media* (listed as Least Concern under the NC Act and the IUCN Red List) which is also expected to occur within the area. These two species can be distinguished by *C. megacarpa* having larger seeds, shorter and more strongly keeled leaves with fewer leaflets and a slender trunk. *C. megacarpa* is distinguished from *C. ophiolitica* by the green new growth and larger seeds. A recently described species, *C. terryana* also potentially occurs within the Project area (Forster, 2011).

Figure A- 3 Female *Cycas megacarpa*

APPENDIX B DATABASE DESCRIPTION AND FIELDS

Cycads salvaged	Description
Plant ID	Sequential ID for each plant salvaged
Latitude (x)	Decimal Degrees
Longitude (y)	Decimal Degrees
Species	*Cycas megacarpa* or *Cycas ophiolitica*
Health	Health (Good, Fair, Poor, Dead)
Height class	Seedling, Juvenile, Sub-adult, Adult (reproductive capacity)
Action taken	Salvaged or Retained
Date salvaged	Date
Damage	Damage to plant during salvage
Seedling	Is the salvaged plant a Seedling (Yes) Only otherwise leave blank
Comment	Notes about the plant / salvage. Additional information about plant - (pups, subterranean trunk, crown numbers, pests evident, etc…)
Height	In metres
Gender	Male / Female (if known)
Fruit present	Yes / No
Cone size	No Cone if none, in millimetres if present (mm)
Insects present	Yes / No
Insect attack	Yes / No
New growth	Yes / No

Temporary Storage	Details
Plant ID	Number / code
Plant location within Temporary Storage	Row / location
Watering	Date watered
Insecticide	Date applied
Fungicide	Date applied
Other	Any other management actions
Comments	Other notes of management / resources used / repotting etc…

Seed collection	DESCRIPTION
Collection date	Date
Collector	Name of collector
Species	*Cycas megacarpa* or *Cycas ophiolitica*
Area number/name	Locality Name / Place descriptor
Latitude (x)	Decimal degrees
Longitude (y)	Decimal degrees
Parent plant id number	Plant ID - Parent if known for seedlings collected.

Bag number	Sequential bag number if from plants salvaged record (S 1, S2, …) If from wild stock (W1, W1, …)
Number of seeds in bag	Number of seeds taken from plant / or ground in bag
Comments	Any notes

Cycads translocated	**Description**
Plant ID (Salvage ID)	Plant ID from salvage site / if propagated - next sequential number
Latitude (x)	Decimal Degrees
Longitude (y)	Decimal Degrees
Species	*Cycas megacarpa*, *Cycas ophiolitica or Cycas terryana*
Date translocated	Date Cycad placed in recipient site
Damage	Damage to plant during translocation
Comment	Notes about the plant / translocation
Description	Additional information about plant - (pups, subterranean trunk, crown numbers, pests evident, etc…)

APPENDIX C QUEENSLAND HERBARIUM SPECIES CONFIRMATION ADVICE