Natural Area
CONSULTING MANAGEMENT SERVICES

Shire of Chittering

Bindoon Trails Network

Offset Revegetation Plan

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V2	26/05/2023	Addressing client comments and minor structural changes	KE	LP	Released

Executive Summary

The Shire of Chittering (the Shire) released the Bindoon Trails Network Concept Plan in February 2021. The trail network aims to establish recreational facilities for mountain bikes and walkers which provides safe and established tracks tailoring to a broad range of skills and technical abilities. The project is expected to establish broader community benefits by increasing local tourism and stimulating interactions with the surrounding landscape.

The project requires the removal of a total of 2.3 hectares (ha) of understorey vegetation, primarily from the western side of the project area. The vegetation to be removed is deemed suitable as foraging habitat for the Carnaby's Cockatoo *(Zanda latirostris)*, Baudin's Cockatoo *(Zanda baudinii)*, and Forest Red-tailed Black Cockatoo *(Calyptohynchus banksia naso)* which are listed as endangered and or vulnerable under the *Biodiversity and Conservation Act 2016* (BC Act) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The clearing of this vegetation requires an approved clearing permit issued by the Department of Water and Environmental Regulation (DWER). A clearing permit application was submitted to DWER as application CPS 9796/1. As defined by DWER, as part of this application and to offset this reduction in habitat DWER require the Shire to rehabilitate an offset area of 6.77 ha.

Natural Area Consulting Management Services (Natural Area) has been commissioned by the Shire of Chittering to develop a plan to facilitate the practical delivery of this offset project. Natural Area has drawn upon 20 years of experience planning and implementing revegetation across Western Australia, using this on-ground collective experience to deliver revegetation plans that:

- Are practical to implement based on best and current industry practice.
- Are scientifically accurate and ecologically appropriate, while capturing horticultural and agricultural knowledge to effectively establish functioning ecosystems.
- Provide the most significant environmental impact while understanding the value of investment.

The outlined prescription in this document addresses the primary goals of the offset program which are:

1. Revegetate degraded and completely degraded vegetation to good condition as defined by the *Keighery Vegetation Condition Scale (Keighery, 1994).*
2. Establishment of 6.77 ha of vegetation which provides short, medium and long-term benefit to Black Cockatoo species with a primary focus on establishing foraging habitat.
3. Support natural gregarious Black Cockatoo foraging behaviour by establishing nodes of dense foraging sites within the offset area.
4. Increase connectivity of habitat by establishing vegetation within degraded and completely degraded areas to link areas of remnant good, very good and excellent condition vegetation.
5. Delivery of a proposal which exceeds DWER's offset specifications.

The offset proposal provided within this document should be read in conjunction with the *Detailed Flora and Basic Fauna Survey* (Natural Area, 2021) which provides detailed context of the site including the site description, species present and vegetation condition mapping.

Contents

1.0 Introduction

Natural Area Consulting Management Services (Natural Area) was contracted by the Shire of Chittering (the Shire) to prepare an offset revegetation plan to satisfy requirements from the Department of Water and Environmental Regulation (DWER) for the required offset works associated with the Shire's clearing application CPS 9796/1 for the construction of the proposed Bindoon Trail Network.

This revegetation plan will:

- describe offset locations that will be utilised for revegetation work
- outline management aims and objectives
- describe revegetation activities and methodology
- outline revegetation objectives, success criteria and monitoring requirements
- outline report requirements
- describe contingency plans if success criteria are not met
- outline weed and pest control activities
- provide indicative implementation schedule.

2.0 Site Description

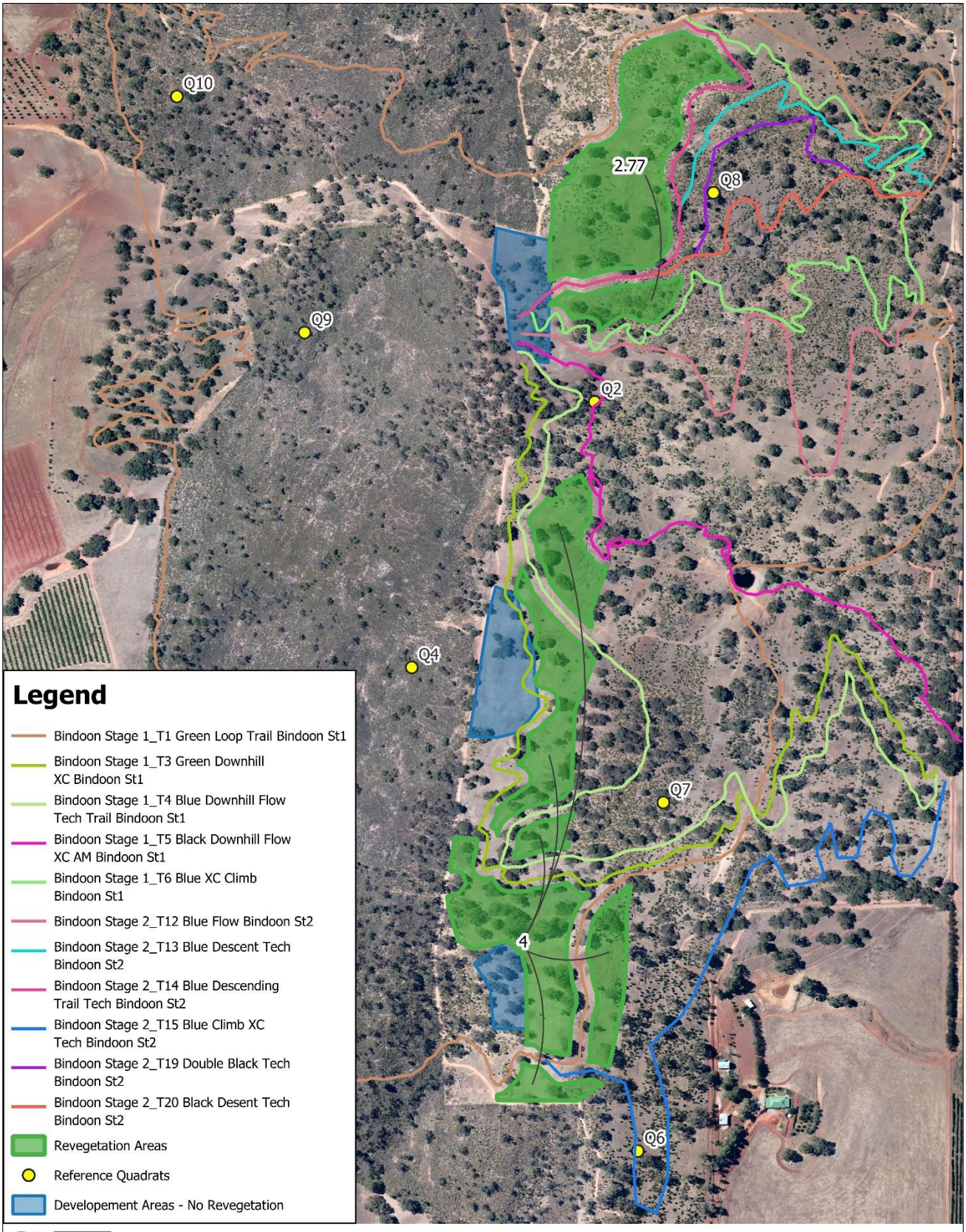
The proposed clearing for the Bindoon Trail Network impacts a total of 2.3 ha of vegetation within a 100.76 ha clearing footprint (Map 1); within Lot 3874 on Deposited Plan 175546, Lot 100 on Deposited Plan 402781 and Lot 88 on Deposited Plan 404798, Bindoon. The overall site context including regional context, climate detailed topography and vegetation complexes have been identified and can be referenced in the *Detailed Flora and Basic Fauna Survey* (Natural Area, 2021). Site information which directly relates to the revegetation scope and methodology has been outlined below.

The total revegetation area required to offset the clearing is 6.77 ha (Map 1). This offset revegetation area has been selected following a scoping survey conducted on May 2, 2023. The area selected for the offset project lies mid-slope and has been chosen due to its gradual slope (<15 %) which allows for the practical installation and maintenance of vegetation (Figure 1).

A buffer zone has been allowed for around each of the proposed offset areas, allowing 4 m either side of the track and 2 m for the track itself. Allowing this buffer zone will reduce the amount of disturbance to the installed vegetation from pedestrians and bikes departing from the tracks. The buffer also allows for a safety mitigation measure to ensure obstacles such as trees do not present a collision hazard in the future. Future development areas have also been considered to ensure no disturbance to offset areas.

Figure 1: Proposed offset site conditions Shire of Chittering May 2023.

Based on the vegetation condition survey map detailed in the *Detailed Flora and Basic Fauna Survey* (Natural Area, 2021), the chosen offset area sits within *Corymbia calophylla and Eucalyptus wandoo subsp. wandoo Open Woodland* vegetation type with the vegetation condition being considered Completely Degraded. It is understood that DWER's requirements are to revegetate an area from Degraded to Good vegetation condition. Due to accessibility constraints and soil type, it is considered more practical and achievable to revegetate the areas selected from Completely Degraded to Good vegetation condition.



Map 1: Revegetation Areas Bindoon, Shire of Chittering

2.1 Soil Type

The main soil type within the offset project site is described as Bindoon 1 x Phase, which is represented by very gentle to moderately sloping (< 15 %) crests and hill slopes. It contains fine to medium textured, and often shallow soils with high coarse fraction. The vegetation complex within this soil type is described as *Corymbia calophylla, Eucalyptus marginata, E. wandoo* and *E*. *accedens* with some *Allocasuarina huegeliana* associated on rocky outcrops (Department of Primary Industries and Regional Development (DPIRD), 2021); Heddle *et al*., 1980).

Areas of naturally exposed rock and shallow soils will influence the final placement and plant density of the final project. The soil contains a mix of red to brown loam with gravel intermixed. Figure 2 depicts the soil structure to a depth of 500 mm which plants will be installed into.

Figure 2: Indictive soil structure sample (500mm) at proposed offset sites.

2.2 Heritage Values

No known European or Aboriginal heritage sites exist within the survey site (Department of Planning, Lands and Heritage (DPLH), 2023 & Government of Western Australia, 2023). The Aboriginal Heritage Inquiry System indicated that two registered sites and three other heritage places exist within 5 km of the survey area. With the closest being the registered site 38659, which is the Needonga (Brockman River) which holds value as a mythological and water source site (DPLH, 2023).

Although no known heritage sites have been documented, it is of extreme importance that heritage values of the site are considered before works commence. All works should be conducted sensitively, ensuring that operators give consideration to ground disturbance. If artifacts, including scatter sites or tree engravings, are present works are to cease immediately, and the Shire notified.

3.0 Reference Site and Species Selection

The required target vegetation condition for the offset revegetation area is Good. The areas determined in the vegetation mapping as Good contained limited diversity. To increase the diversity opportunities, targeted attributes for the offset site have been compiled from the quadrat surveys conducted in the *Detailed Flora and Basic Fauna Survey* (Natural Area, 2021). The quadrat data provided is recent and site specific which provides comprehensive species data which can be used as a relevant reference.

Based on the proposed offset project site layout conditions and target vegetation type, the referenced quadrats with the following attributes were collated to provide targeted attributes for the offset project:

- Situated within *Corymbia calophylla and Eucalyptus wandoo subsp. wandoo Open Woodland*
- Positioned on a mid-slope topography level.

The vegetation condition of the selected quadrats ranged from Completely Degraded to Excellent condition. Two quadrats were situated in areas of Excellent vegetation condition and provided a great representation of diversity.

Relevant quadrat attributes were averaged with the average vegetation condition considered as Good. A species list was collated from the relevant quadrats; with species considered to be alien to the site removed from the list. The collated site attributes are outlined in Table 1 below. The collated native species present within the quadrats are outlined in Table 2 below.

Table 1: Reference site species and attributes based on quadrat samples

Location	Q2	Q4	Q6	Q7	Q8	Q9	Q10	Target Attributes
Veg Condition*	0	3	0	2	1	4	4	2
Species Richness	5	43	7	7	10	34	11	17
Gravel	5%	1%	0%	2%	1%	0%	0%	1.3%
Rock	2%	5%	1%	2%	5%	1%	0%	2.3%
Leaf Litter	1%	10%	0%	5%	10%	2%	2%	4.2%
Bare Ground	1%	2%	0%	1%	5%	1%	0%	1.4%

Vegetation Condition Key*

Rating	Vegetation Condition
0	Completely Degraded
1	Degraded
2	Good
3	Very Good
4	Excellent
5	Pristine

Table 2: Collated species list from reference quadrat samples

Species	Species
Acacia pulchella var. goadbyi	*Grevillea bipinnatifida*
Allocasuarina humilis	*Grevillea pilulifera*
Anigozanthos bicolor	*Haemodorum laxum*
Austrostipa flavescens	*Hakea incrassata*
Banksia bipinnatifida subsp. multifida	*Hakea lissocarpha*
Banksia dallanneyi	*Hakea trifurcata*
Banksia fraseri	*Hakea undulata*
*Billardiera heterophyll**a***	*Hibbertia commutate*
Burchardia congesta	*Hibbertia hibbertioides var. hibbertioides*
Burchardia multiflora	*Hibbertia hypericoides*
Caesia micrantha	*Hyalosperma cotula*
Caladenia flava	*Hypocalymma angustifolium*
Calothamnus sanguineus	*Lagenophora huegelii*
Chamaescilla corymbosa var. corymbosa	*Laxmannia grandiflora*
Cheilanthes austrotenuifolia	*Lepidobolus preissianus*
Conostylis setigera	*Lepidosperma apricola*
Conostylis setosa	*Lepidosperma scabrum*
Corymbia calophylla	*Melaleuca radula*
Crassula exserta	*Morelotia octandra*
Cyanicula sericea	*Neurachne alopecuroidea*
Dampiera alata	*Opercularia vaginata*
Dampiera lavandulacea	*Orthrosanthus laxus*
Darwinia thymoides	*Lysiandra calycina*
Daviesia horrida	*Ptilotus manglesii*
Desmocladus flexuosus	*Ptilotus polystachyus*
Dichopogon capillipes	*Rhodanthe manglesii*
Dioscorea hastifolia	*Sowerbaea laxiflora*
Diuris brumalis	*Stylidium affine*
Diuris porrifolia	*Stypandra glauca*
Drosera erythrorhiza	*Synaphea acutiloba*
Drosera glanduligera	*Thelymitra crinite*

Species	Species
Drosera menziesii	*Thysanotus manglesianus*
Drosera pallida	*Trachymene Pilosa*
Elythranthera brunonis	*Tribonanthes longipetala*
Eucalyptus wandoo subsp. wandoo	*Trymalium ledifolium*
Gastrolobium calycinum	*Verticordia acerosa*
Goodenia berardiana	*Xanthorrhoea acanthostachya*
Grevillea bipinnatifida	*Xanthosia huegelii*

3.1 Revegetation Species Selection

The collated quadrat species list (Table 2) were assessed for suitability of use in revegetation works. Many of the species listed are not suited for installation during the first years of revegetation due to their sensitivity to exposed conditions or potential grazing. Additionally, species which are considered difficult to produce or 'recalcitrant' have also been excluded to allow for a stronger focus on establishing framework species which provide suitable habitat for Black Cockatoos, while still maintaining suitable diversity and ecological function. Through linking areas of Good and Excellent vegetation condition, it is expected that over time a natural migration of some species will occur to build biodiversity within the site.

3.2 Initial Installation Density

The proposed offset revegetation works will require 17,625 nursery grown tubestock stems; 16,925 tubestock will be installed across the offset site to allow for the targeted installation of 0.25 stems per m^2; 700 tubestock will be planted in nodes for cockatoo foraging see Section 3.5. An additional density of 1 stem per m^2 will be targeted using direct seeding, with a total of 27 kg of seed being applied to the site at 4 kg/ha. The seed quantities per species will be determined using seeding calculations of expected presenting species found on site. It is recommended that seeding calculations are adjusted based on the seed presenting, prior to collection activities commencing, to guide collection quantities to target the desired stem count.

Table 3 below outlines the initial stem per m^2 density targets for the first year of installation. Seeding is to only occur in the first year of establishment. As natural deaths of plants are expected, it is anticipated that subsequent infill planting of 50 % of the original installation number of tubestock may be required in the second year to ensure a final completion density of 0.5 stems per m^2 is achieved. Infill numbers will be determined based on monitoring of the site and adjusted accordingly. Further infill may be required in subsequent years if the target density is not achieved.

Vegetation installation rates (Table 3) have been calculated to achieve the required density by the first season of installation. The timeframe may extend if the completion criteria have not been met and upon discussions with DWER and the Shire. General revegetation across the site will target a natural composition of *Corymbia calophylla and Eucalyptus wandoo subsp. wandoo Open Woodland* ensuring that strata layers meet the following ratios:

- 10% Upper storey
- 80% Middle storey

- 10% Lower storey

Table 3: Target initial installation density

Species	Target Stems/m^2	Proposed Quantities	
		Tubestock (each)	Seed (kg)
Tubestock installation	0.25	16,925	-
Direct Seeding	1.00	-	27.0
Cockatoo Foraging Nodes (200 m^2 nodes)	0.01	700	-
Herbaceous Annuals	0.25	-	2.0
Total	**1.51**	**17,625**	**29.0**

3.3 Target Species

Final species selection will be determined by species available from seed collection activities over the 2023-2024 seed collection period. It is recommended that seeding calculations are adjusted based on seed presenting prior to collection activities commencing to guide collection quantities, while ensuring that the minimum diversity count of 13 species from Table 2 is met. Table 4 outlines the suggested quantities of plants and seed to be installed during the initial revegetation works. Infill plant numbers will be determined following monitoring events.

Table 4: Target species for tubestock supply and direct seeding

Species	Nursery	Seed	Strata (Upper, Middle or Lower)	Max Height (m)	Cockatoo Value F (Foraging), N (Nesting), R (Roosting), U (Unknown)
Corymbia calophylla	x	x	Upper	60	F, N, R
Eucalyptus wandoo subsp. wandoo	x	x	Upper	15	F, N, R
Acacia pulchella var. goadbyi		x	Mid	1.5	F
Allocasuarina humilis	x	x	Mid	2	F
Banksia fraseri	x		Mid	6	F
Calothamnus sanguineus		x	Mid	2	F
Daviesia horrida	x	x	Mid	2	F
Gastrolobium calycinum		x	Mid	1.5	F
Grevillea bipinnatifida	x		Mid	1	F
Grevillea pilulifera	x		Mid	1	F
Hakea incrassata	x		Mid	1.5	F
Hakea lissocarpha	x		Mid	1.5	F

Species	Nursery	Seed	Strata (Upper, Middle or Lower)	Max Height (m)	Cockatoo Value F (Foraging), N (Nesting), R (Roosting), U (Unknown)
Hakea trifurcata	x		Mid	3	F
Hakea undulata	x		Mid	2	F
Hypocalymma angustifolium	x		Mid	1.5	U
Melaleuca radula	x	x	Mid	2.4	F
Lysiandra calycina	x		Mid	1.2	U
Synaphea acutiloba	x		Mid	1	U
Trymalium ledifolium	x		Mid	2.5	U
Verticordia acerosa	x	x	Low	0.5	U
Banksia bipinnatifida subsp. multifida	x		Low	0.3	F
Haemodorum laxum		x	Low	1	U
Banksia dallanneyi	x		Low	0.5	F
Darwinia thymoides	x		Low	0.3	F
Stypandra glauca	x		Low	0.3	U

3.4 Herbaceous Annual Species

Seed collection programs will target the species identified in Table 4. During seed collection works, seed collectors should opportunistically target any presenting herbaceous and annual species (Table 5). These species will be incorporated into the general revegetation direct seeding mix to be distributed across the offset site.

Annual herbaceous species have the potential to rapidly establish within disturbed areas and provide the following benefits:

- providing a cover crop for slower emerging species
- assisting to build soil biology and structure
- competing against undesirable plants
- increase connectivity of habitat and abundance of pollinators to assist with seed set and fruit development, particularly within the cockatoo foraging nodes
- rapidly establishing natural food sources including nectar, pollen, associated insects, and seed
- increase the overall biodiversity of the site

While many annual species will remain persistent, many require a disturbance such as fire or soil disturbance to stimulate germination, therefore some species may not persist following the first year of establishment and may not be captured by subsequent monitoring events.

Approximately 2 kg of herbaceous annual seed should be targeted to be broadcast over the entire project site, however this will be subject to availability. Seeding should target 0.25 herbaceous annuals per m^2. Table 5 outlines target species for collection.

The success of the introduction of herbaceous and annual species will be determined by the set of flowers and seed within the first year of installation, with the assumption that seed has been returned to soil stored seed banks. Due to their potential absence in subsequent monitoring events, herbaceous annuals should not be included in the final diversity count; however, should be recorded when presenting to assess the persistence and subsequent recruitment of these species.

Table 5: Indicative herbaceous annual species

Species	Species
Austrostipa flavescens	*Ptilotus manglesii*
Burchardia congesta	*Ptilotus polystachyus*
Burchardia multiflora	*Rhodanthe manglesii*
Dichopogon capillipes	*Trachymene pilosa*
Hyalosperma cotula	*Xanthosia huegelii*
Lagenophora huegelii	

3.5 Cockatoo Foraging Nodes

To enhance the Black Cockatoo foraging value of the offset revegetation seven nodes will be established to promote natural gregarious feeding behaviour. Foraging nodes will also provide high value habitat for nectivores and insectivores of other species within the site. The nodes will be spread evenly throughout the site in areas which can be maintained as necessary. The nodes will be established as per the specification below with each node:

- to consist of a single Proteaceae species (*Banksia* or *Hakea* species, as identified in Table 6).
- planted with a species that are expected to have an established height of 1 m or more (Table 6).
- be a maximum of 200 m^2 (~14.14 m x 14.14 m) in size.
- be initially planted at a rate of 0.5 plant per m^2 (total of 100 plants)
- having each plant installed with a corflute tree guard to protect the plant. Each corflute guard to be installed with two wooden stakes to prevent the guard spinning in the wind and to adequately secure it in the rocky ground.
- to be isolated from other tubestock installation (seeded areas are acceptable to use)
- to be maintained, inclusive of infill planting and watering over summer, to ensure a minimum of 50 plants are established within the nodes after year 3.
- a minimum of five nodes (allowance for if a particular species is not suited) to be present within the offset site after the third year of establishment.

Table 6: Species suitable for Cockatoo Foraging Nodes

Species	Strata	Max Height (m)
Banksia fraseri	Mid	6

Hakea incrassata	Mid	1.5
Hakea lissocarpha	Mid	1.5
Hakea trifurcata	Mid	3
Hakea undulata	Mid	2

4.0 Completion Criteria and Timeframe

The timeframe outlined in Table 7 below describes the specific expected timeframes which the project will be guided by. The prescribed methodology within this plan is designed to achieve final completion criteria by the end of the 2027/2028 financial year. A commitment to an additional three years of general maintenance and weed control will be undertaken following the completion of the offset project.

Completion criteria have been specified to guide the project to achieve the outlined goals within the specified timeframe and ensuring the following DWER's requirements are met:

- Vegetation condition from Degraded and Completely Degraded to Good condition.
- Cockatoo foraging habitat is established with consideration of natural feeding behaviour.
- Land manager legislative obligations are considered.

Table 7: Project time frame and completion criteria

Financial Year	Project Stage	Goals	Completion Criteria
2023 - 2024	Project inception, planning, site preparation and procurement of consumables (plants) and seed collection		
2024 - 2027	Initial Implementation Establishment, maintenance, and adaptive management		
2027 - 2028	Maintenance & completion of establishment period Final monitoring event to determine completion criteria has been reached	Revegetate Degraded and Completely Degraded vegetation to Good condition increasing connectivity between remnant vegetation pockets. Establish 6.77 ha of vegetation which provides short, medium, and long-term benefit to Black Cockatoo species with a primary focus on establishing foraging habitat.	1. Weed coverage is less than 20 %. 2. Native stem density achieves an average of 0.5 stems per m^2 or at least 70 % coverage. 3. Species richness consists of a diversity count of ≥ 13 species, excluding herbaceous annuals (76 % of the target attributes).

Financial Year	Project Stage	Goals	Completion Criteria
		Land manager legislative obligations are considered.	4. No Weeds of National Significance (WoNS) or Declared Pest plant species present within the offset area.
		Support natural gregarious Black Cockatoo foraging behaviour by establishing nodes of dense foraging sites within the offset project area.	5. Five 200 m^2 foraging nodes represented within the 6.77 ha. 6. Each foraging node contain a minimum of 50 established plants of known foraging species of the same taxon.
2028 - 2031	General maintenance, and weed control		

4.1 Site Limitations

There are several limitations which may affect the final outcome of the offset project. The following limitations have been identified and have been considered during the planning stage of this project (Table 8). It is not an exhaustive list, and the progression of the project should be driven by adaptive management throughout the project.

Table 8: Project limitations and considerations

Potential Limitations	Considerations
Increased risk to personnel working on site due to steep site conditions and rocky terrain. Limited site access and manoeuvrability.	Offset project site has been selected due to its moderate gradient.
	Any machinery used on site (seeding) to be of a scale which suits the terrain and tight handling.
Predicted winter conditions may cause slippery conditions which restrict access during very wet periods.	The Shire is upgrading access to the site and any access issues to be reported to the Shire.
Signs of rabbits and kangaroos onsite which may cause damage to vegetation through herbivory.	Fencing of the immediate offset area is unsuitable due to the uneven terrain and existing vegetation (see Section 5.3 for more details on fencing).
	Tree guards are unsuitable in large numbers due to limited access, high input and rocky ground which does not suit stable installation. Tree guards will only be used for Proteaceae species in cockatoo foraging nodes

Potential Limitations	Considerations
	Tubestock species are to be hardened off before dispatch to provide less palatable foraging.
	Installation and seeding density expected to produce enough stems to offset herbivory.
	Integrated pest management to be implemented.
Damage from trampling by foot and cycle traffic.	Fencing is unsuitable (see point above).
	Fencing is of the immediate project site is unsuitable due to the potential collision risk of a cyclist unintentionally leaving the track. A buffer either side of all tracks will be left unvegetated to reduce the risk to the damage while still maintaining the 6.77 ha of offset vegetation.

4.2 Contingency and Adaptive Management

While the methodology in Section 5.0 has been prescribed to ensure the completion criteria stated are achieved, unforeseen site conditions may impede the desired outcomes. It is important that informal and formal monitoring guide progression of the revegetation. Those accountable for the final outcome of the project must be able to identify and understand undesirable impacts, some of which may be associated with the broader landscape, which may affect the projects final outcome and how these may be overcome. The contingency actions and adaptive management recommendations below are not exhaustive and critical analysis of site conditions should be made prior to undertaking contingency actions.

If completion criteria are not met by the end of the defined establishment period, further works should be carried out to ensure that the best possible outcomes for the project are achieved. Available funds should be considered if contingency measures are required, and the project time frame needs to be extended.

Although Dieback (*Phytophthora cinnamomi* or other *Phytophthora* species) were not detected in the area, the offset site it is situated in a vulnerable zone. In the event Dieback is suspected as being the cause of species decline, discussions with the Shire and DWER are recommended to review and refine the revegetation plan and completion criteria as appropriate.

Table 9: Completion criteria and contingency actions

1. Herbacaous annuals are present and set flower/seed within the first year of establishment

Overgrazing of herbivores - Implement more intensive integrated pest management. - Consider tree guarding species prone to predation. - Replant minor tubestock of flowering species.	Weeds outcompete native species - Implement further weed control.

2. Weed Coverage less than 20 %

Adverse weather does not allow for weed control to occur in time - Implement weed control as weather permits.	Unseasonal weather patters promote weed germination events increasing weed burden - Implement additional weed control events.

3. Native stem density achieves 0.5 stems per m^2 or 70 % coverage

Plants suffer from harsh summer period and show sighs of heat and water stress - Consider watering tubestock species to assist survival. - Increase infill numbers in subsequent years.	Over grazing of herbivores - Implement more intensive integrated pest management. - Consider tree guarding species prone to predation. - Infill plant with less palatable species.

4. Species richness consists of a diversity count of 13 species (76 % of target attributes)

Taxon does not suit site conditions - Assess and exclude from infill planting lists.	Overgrazing of herbivores - Implement more intensive integrated pest management. - Consider tree guarding species prone to predation. - Infill plant with less palatable species.

5. No Weeds of National Significance (WoNS) or Declared Pest species present within the offset project area

WoNs and/or Declared Pest plant species found on site
- Conduct targeted weed control to remove species .

6. Five 100 m^2 foraging nodes represented within the 6.77 ha containing ≥50 established foraging species

Plants suffer harsh summer period. Plants show signs of heat and water stress - Increase infill numbers in subsequent years. - Consider watering of tubestock species to assist survival rates.	Overgrazing of herbivores - Implement more intensive integrated pest management. - Consider tree guarding species prone to predation. - Infill plant with less palatable species.

All Criteria Met

✓

4.3 Monitoring

Monitoring of revegetation activities within the rehabilitation site will occur annually in summer. Summer monitoring events will allow assessment of plants which are likely to persist through the drier months and will allow enough time to place plant orders to meet any infill requirements. Summer monitoring should only be implemented if the timeline of the offset plan is adhered to, as it will not allow for adaptive management to address winter or spring weeds. General project management assessment will be utilised to ensure detrimental factors affecting the revegetation is managed.

Monitoring will continue until the completion criteria have been met and maintained for a minimum of two years. Monitoring will consider the mix of other native species and use this information to guide species choice for infill planting activities. Monitoring will also include an assessment of weeds present and signs of pest animal species.

Monitoring will include:

- six fixed photo monitoring points to be set up to enable comparison of the area over time
- five fixed 10 m x 10 m quadrats will be set up across the offset site, with plant survival, vegetation health, community structure and any other relevant observations being noted
- foraging nodes will be assessed individually, assessing for numbers of surviving plants,
- assessment of the presence of herbaceous annuals
- assessment of vegetation structure
- assessment of weed coverage
- assessment of offset area for presence of WoNs or Declared Pests.

4.4 Reporting

A post implementation report will be supplied to the Shire following initial implementation works. The report will provide the following details:

- final species selection and installation numbers.
- photos or works being conducted.
- GPS track logs of seeding activities.
- additional seed installed from salvaging activities.
- limitations and observations noted during implementation activities.

An annual report will be provided to the Shire describing:

- ongoing weed control
- ongoing pest animal control
- revegetation activities carried out
- survival rates, including progress towards completion criteria
- recommendations on infill planting and suggested species
- recommendations on the need for pest animal control.

This document will contribute to reporting requirements associated with approval conditions in the clearing permit issued to the Shire.

5.0 Site Preparation & Revegetation Methodology

5.1 Weed Control

Weed control defined in the context of this plan should aim to provide a reduction in competition to establishing plants and enable natural recruitment to occur where possible. It is not feasible to eradicate weeds or expect them not to encroach back into the site following the completion of works.

A total of 27 weed species were recorded on site. Not all weed species pose a threat to revegetation and are mostly benign. Weed control activities should focus on weeds which are expected to limit germination and compete directly with establishing plants. Recorded weeds which may impact revegetation are outlined in Table 10 below along with suggested control timings.

Table 10: High impact weed species recorded on site (2021)

Species	Common Name	Treatment Timing
Avena barbata*	Bearded Oat	Winter
Briza maxima*	Blowfly Grass	Winter
Centranthus macrosiphon*		Winter/Spring
Cynodon dactylon*	Couch	Summer
Ehrharta longiflora*	Annual Veldt Grass	Winter
Erodium botrys*	Long Storksbill	Winter/Spring
Hordeum leporinum*	Barley Grass	Winter/Spring
Hypochaeris radicata*	Flat Weed	Winter/Spring
Lotus subbiflorus*		Winter/Spring
Parentucellia latifolia*	Common Bartsia	Winter/Spring
Sonchus asper*		Winter/Spring
Sonchus oleraceus*	Common Sowthistle	Winter/Spring
Stachys arvensis*	Staggerweed	Winter/Spring
Trifolium campestre*	Hop Clover	Winter/Spring
Trifolium dubium*	Suckling Clover	Winter/Spring
Ursinia anthemoides*	Ursinia	Winter/Spring

To meet the completion criterion of '*No Weeds of National Significance (WoNS) or Declared Pest plant species present within the offset area after year 3'* WoNS and Declared Pests will be targeted during weed control events. Two species were identified:

1. Bridal Creeper (*Asparagus asparagoides*) - Declared Pest
2. Narrowleaf Cottonbush (*Gomphocarpus fruticosus*) - Declared Pest

Weed control is to be conducted prior to installation of vegetation to reduce immediate competition. Once the plants and seed has been installed, extreme care should be taken to avoid damage to emerging seedlings and installed tubestock.

It is important that weeds be managed prior to seed set. Critically, it is important that weeds are not allowed to get to a size and density which may impact revegetation A licensed Pest Management Technician is to conduct all weed treatment and will be able to recommend best treatment methods based on relevant herbicide label and registered off labels permits. No preemergent or residual herbicides shall be applied to seeding areas. It is important to engage a contractor who is able to hand spot spray amongst revegetation and although this can be time consuming allows for accurate and effective weed management.

Manual weed control should be conducted where required to ensure zero off target damage and no risk of seed being dispersed.

5.2 Revegetation

Revegetation activities will primarily involve direct seeding and planting at the site to restore the vegetation structure. Revegetation methodology is discussed in the following sections.

5.2.1 Seed Collection and Salvage

An experienced revegetation seed collection consultant will be engaged to conduct seed collection throughout the remnant bushland to provide provenance specific seed which will produce a similar vegetation representation from the immediate area. Seed collectors will be licenced, and Revegetation Industry Association of Western Australia (RIAWA) accredited. All seed will be handled under RIAWA standards.

Clearing areas should be marked out prior to clearing being undertaken as part of the construction contractors Construction Environmental Management Plan (CEMP). Seed collectors will move ahead of clearing works and all available seed from plants which are to be removed will be salvage for use during the offset project. Depending on the timing of clearing it is expected that species from the Myrtaceae and Proteaceae family will be available. Salvaged quantities of seed should be reported as additional seed to main seed collection for revegetation and quantities and species provided in the implementation report.

Seed will need to be collected as soon as practical (no later than July 2023) to begin propagation for tubestock to be installed in 2024. This collection event will need to obtain enough seed to produce the required 16,925 stems for general install and 700 stems for Black Cockatoo foraging nodes install in 2024. Due to the timing of this collection, species availability will mostly be limited to Myrtaceous and Proteaceous species. This is in-line with the species to be installed as tubestock and therefore the diversity of tubestock should still be high.

Seed collection for direct seeding will commence in September 2023 and continue to approximately April 2024 to ensure the broadest range of diversity is captured. Seed collectors should ideally be the same contractor implementing the works and/or propagating plants to ensured continuity of quality and accountability of supplied stock. Seed will be collected in quantities to target an initial stem count target of 1 per m^2. Final weights will be determined by the species collected and availability.

5.2.2 Direct Seeding

Direct seeding is most commonly conducted when autumn and early winter rainfall presents adequate soil moisture and rain to settle seed. Seeding is only to be carried out by a competent revegetation consultant. Seed is to be treated to alleviated dormancy and stimulate germination prior to distribution. Incorrect treatment and handling of seed can be detrimental to final stem counts. Seed treatments will include:

- heat treatment
- scarification
- smoke Treatment
- removal of physical dormancy inhibitors.

Following review and adjustments of seeding calculations based on seed collected over the 2023-2024 collection period, seed will be broadcast over the site. The areas to be seeded will need to be scarified to allow an appropriate settlement of seed within the soil and appropriate seed to soil contact is made. It is preferential that equipment that can direct drill seeds to an appropriate depth and cover the seed with minimal seed disturbance. Seed which requires light for germination does not need drilling or covering. Deep ripping is not suitable and will cause excessive disturbance throughout the site. Seed is not to be distributed over rock outcrops and all equipment should avoid these areas. Seeding activities are to be tracked via GPS to document the 6.77 ha of seeded area.

5.2.3 Tubestock Installation

Tubestock is to be installed after first major rains following direct seeding as to not disturb emerging seedlings. Tubestock will need to be installed using mechanical augers with the top of the root ball being buried no less than 5 mm below the soil surface.

5.3 Integrated Pest Management

It is recommended that an integrated pest management approach to pest animals on site is taken. Providing as many control techniques as possible will allow the most effective management of detrimental effects from herbivory. Integrated pest management strategies should be ongoing and adaptively managed throughout the establishment period.

Table 11 below outlines suggested management and rationalisation for each action. Pest management may not totally exclude herbivory on site; however, is expected to increase survival rates of vegetation. Integrated pest management should be implemented by a registered Vertebrate Pest Ecologist who specialises in working in natural areas and sensitive sites. Management works are to be undertaken during the establishment period when tubestock is most palatable. Further management may be required following this and is to be determined during monitoring events.

Table 11: Integrated Pest Management Actions and Rationalisation

Target	Management Action	Rationalisation
Rabbits, Kangaroos, Sheep	Upgrade perimeter fencing	The perimeter fence is currently constructed with 70/90/30 ring lock mesh and barbed wire. This has historically been used to contain sheep; however, is not suitable to manage rabbits or Kangaroos.

		As the alignment of this fence is already clear of vegetation, it is recommended that the fence be upgraded to the minimum standard of: ▪ Minimum of 1.5 m finished height ▪ Top white sighter wire ▪ Mesh apron to deter rabbits Fencing will also provide benefit to the surrounding landscape by deterring illegal tracks being made in surrounding bushland and manage unrestricted access.
Rabbits	Implement biological control	The use of baits such as Pindone should not be used, due to the likely presence of Quenda *(Isoodon fusciventer)* and other native species which are susceptible to this poison. Additionally, 1080 baiting is not appropriate due to the proximity of rural residences. Biological control is an effective and targeted management tool for rabbits. A release of Rabbit Haemorrhagic Disease (RHDV1- K5) is expected to reduce rabbit numbers and should be released in spring and autumn or as recommended by an experienced Vertebrate Pest Ecologist.
Rabbits and Foxes	Conduct night shooting	Due to the rural setting and adequate back stop provided by the terrain, night shooting is deemed a safe and targeted management tool to manage pests. Night shooting should be implemented to target rabbits which may build resistance to RHDV1-K5 following each release event. This will reduce further likelihood of resistance within the local population. Although foxes do not pose a threat to vegetation, as local rabbit populations decline, foxes may increase predation on native species. Foxes should be targeted during the night shoot programs. Night shoots are highly targeted and efficient management practice and should be conducted by a registered Vertebrate Pest Ecologist following a thorough risk assessment.

5.4 Implementation Plan

Table 12 outlines a summary of the implementation schedule as outlined in the methodology above.

Table 12: Implementation of Revegetation,

Financial Year/s	Timing	Task	Comments
2022/23	ASAP	Engage suitable seed consultant to collect seed for propagation of 2024 and subsequent infill tubestock	▪ Seed will be sourced from a Revegetation Industry Association WA (RIAWA) accredited and licenced contractor and collected, processed and handled under RIAWA standards.
2022/23	ASAP	Conduct weed control to the offset project site	▪ Carry out weed control to the offset area to reduce weed burden for 2024. ▪ To be conducted with a boom spray and hand lines where boom is unable to access. ▪ To use Glyphosate and marker dye with no preemergent herbicides to be applied. ▪ A Licenced Pest Management Technician (LPMT) with experience working in bushland and revegetation sites is to be used for all weed control.
2023/24	July	Appoint a revegetation consultant to oversee and implement offset project	▪ A reputable revegetation consultant should be appointed to guide and implement the offset program. ▪ The consultant will have experience in both planning and implementation of revegetation and have knowledge off legislative requirements involved with offset programs. ▪ Preferably RIAWA accredited.
2022/23	Prior to clearing	Conduct salvage of seed in proposed clearing areas	▪ Suitable seed/revegetation consultant to salvage seed which can be sourced from proposed clearing areas.

Financial Year/s	Timing	Task	Comments
2023/24	Prior to September	Place order with nursery for 2024 installation	▪ Plants to be sourced from a Nursery Industry Accreditation Scheme Australia (NIASA) facility which undertake dieback testing and can propagate the majority of stock from seed. ▪ All plant stock and seed to be free from pest and diseases. ▪ Only healthy, true to form nursery stock from provenance specific seed is to be supplied. ▪ Plant stock to have a healthy root system with no evidence of having been restricted or damaged (e.g. root bound) and the root ball of the plant shall remain intact with only minor amount of loose soil present.
2023-2028	Spring and Autumn	Conduct rabbit management (RHDV) & Follow up night shoot program	▪ Engage suitable pest management contractor with experience working in sensitive bushland to release RHDV1-K5 virus. ▪ Follow up night shoot to target rabbits and foxes approximately 3 weeks after RHDV release.
2023/24	September to April	Revegetation consultant to commence seed collection for direct seeding	▪ Seed will be sourced from a Revegetation Industry Association WA (RIAWA) accredited contractor and collected, processed and handled under RIAWA standards. ▪ Seed to be stored in 15 % relative humidity and 10 °C minimum to maximise longevity. ▪ Seed collection contractor should ideally be the same contractor implementing the revegetation plan to allow for flexibility to adapt the species mix and densities required against the completion criteria, depending on what is presenting on site over that seed collection period.

Financial Year/s	Timing	Task	Comments
2023/24	May - June	Conduct pre-revegetation weed control to the offset project site	▪ Conducted at least 2 weeks prior to revegetation works occurring. ▪ Conducted with a boom spray and hand lines where boom is unable to access. ▪ No preemergent herbicides to be applied. ▪ A Licenced Pest Management Technician (LPMT) with experience working in bushland and revegetation sites is to be used for all weed control.
2023/24	June	Direct seeding	▪ It is crucial for the success of direct seeding that seed is handled and treated with the correct methodology to alleviate dormancy prior to broadcasting. ▪ It is preferential that the contractor who is implementing the revegetation treats and broadcasts the seed to allow adaptability in methodology. ▪ Site to be scarified prior to distribution and then rolled following distribution to settle seed and any ground disturbance. ▪ It is preferential that seed equipment is able to direct drill seed as appropriate to a depth of 25-30 mm. ▪ No deep ripping to occur. Deep ripping is unsuitable for terrain and will cause damage to underlying rock formations.

Financial Year/s	Timing	Task	Comments
2023/24	June	Plant Installation (tubestock)	▪ Plant installation to occur immediately following seeding as to not disturb emerging seedlings. ▪ Plants to be installed using a suitable handheld earth auger. ▪ Hard digging conditions should be considered prior to installation and the appropriate time and equipment allowed for to complete the planting. ▪ Plants to be installed with the root ball no less than 5 mm below the surface of the soil.
2023/24	June	Install Cockatoo foraging Nodes	▪ Install 7 cockatoo foraging nodes across offset areas. ▪ 200 m^2 maximum with initial installation of 100 plants (0.5 plants per m^2) ▪ Corflute tree guards to be installed with 2 hardwood stakes to prevent spinning.
2024/25	August	Provide post implementation report to the Shire of Chittering	▪ Final species selection and install numbers of tubestock and seed. ▪ GPS track logs of seeding activities. ▪ Additional seed installed from salvaging activities. ▪ Limitations and observations noted during implementation activities.
2024-2027	June, September & March	Conduct maintenance weed control during establishment period.	▪ 3 weed control events per year to ensure seasonal weeds are treated. ▪ Spot spraying and manual removal as required.
2024-2027	November, December, January, February & March	Conduct maintenance on Cockatoo Foraging Nodes	▪ Maintenance and removal to tree guards as required. ▪ Watering of 3 L per plant.
2024-2027	January	Undertake establishment monitoring during establishment period	▪ Monitor revegetation to assess if success criteria have been met.

Financial Year/s	Timing	Task	Comments
2024- 2027	February	Monitoring report submission	▪ Monitoring report to be submitted to the Shire no more than one month following monitoring event. ▪ Apply adaptive management to ensure success criteria are met. ▪ Ensure plants are ordered if stem density is not being achieved.
2027/28	January	Final monitoring	▪ Final monitoring and report submitted.
2027/28	February	Practical Completion	▪ Maintain the revegetation on an as needed basis with a minimum of 1 event during winter periods. Continue pest management as needed.
2028-2031	June & September	Undertake weed control	▪ Maintenance weed control to occur for a period of three years following completion criteria being met.

6.0 Health & Safety, Environmental and Quality Considerations

While working on site it is important that all people including contractors, volunteers and Shire staff engaged in works are aware of the items outlined in Table 13 below to identify and address Health & Safety, Environmental and Quality Considerations.

Table 13: Health & Safety, Environmental and Quality Considerations

Category	Issue	Considerations
Health & Safety	▪ Steep terrain, rocky and slippery terrain. ▪ Snakes, insects, spiders and ticks	▪ Ensure all personnel attending site are aware of site conditions and have completed an appropriate risk management review. ▪ All vehicles traversing the site are to be suitable for the terrain, have 4WD capability, and access and work on the site only as per the gradient limit recommended by the equipment manufacturers. ▪ Appropriate first aid and qualified staff to be on site at all times.
Health & Safety	▪ Damage to services	▪ 'Before you Dig' search is conducted prior to commencement of excavation work. ▪ Avoid traversing aboveground water pipes.
Health & Safety **Environmental**	▪ Increased fuel load ▪ Establishing vegetation may not tolerate fires resulting in loss of vegetation cover ▪ Access conditions do not allow for effective fire management	▪ Shire to maintain compliant fire breaks within the site. ▪ Revegetation is to provide a 20 m buffer from any proposed development footprints as per the Department of Fire & Emergency Services (DFES) Bush Fire Risk Treatment Standards (DFES, 2020) ▪ Buffers around trails are expected to be up to 10 m wide. This will provide low fuel zones which will break up the site. Buffers should be managed for weeds to maintain lowest possible fuel while allowing natural recruitment to occur. ▪ Develop a fire management and public safety strategy for the overall site. ▪ Consider prescribed burning of surrounding areas to lower fuel zones. Grass trees within the site contain large amounts of fine fuels; however, consideration should be made to habitat value of grass tree foliage.
Environmental	▪ Introduction of *Phytophthora* species and other pathogens	▪ All personnel attending site to follow dieback/pathogen protocol. ▪ No soil to be transported to site on equipment or clothing. ▪ Equipment is cleaned and sterilised appropriately to manage transfer of pathogens.

		▪ Contractors to provide *Phytophthora* management procedure to the Shire prior to attending site.
Environmental	▪ Damage to rock formations and granite outcrop ecosystems	▪ No vehicles to traverse rocky outcrops. ▪ Limit disturbance while conducting seeding and planting works by ensuring equipment is suitable for the terrain (no deep ripping, minimal groundbreaking)
Quality	▪ Damage to newly constructed bike trails	▪ Vehicles with a weight of ≥ 1,000 kg are not permitted to cross the constructed trails. ▪ Bog mats must be used when equipment < 1,000 kg are crossing trails. ▪ Trails are not to be used as site access unless specified by the Shire.
Quality	▪ Work and supplies are not delivered to Australian Standards	▪ Only reputable and specialised contractors to implement works. ▪ All suppliers and contractors to hold appropriate industry accreditations (eg RIAWA & NIASA). ▪ It is strongly suggested that suppliers and contractors are able to provide evidence of an external auditing process and certification to demonstrate compliance to: – Environmental Management ISO 14001:2015 – Occupation Health and Safety ISO 45001:2018 – Quality Management ISO 9001:2015

7.0 References

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