

**Vasse Diversion Drain Upgrade
Revegetation Plan
Water Corporation
P875B-01-Rev5
September 2020**

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1 EXECUTIVE SUMMARY

The Vasse Diversion Drain is a 100-year-old strategic infrastructure corridor, constructed in the 1920s to create more arable land in the catchment, its primary function now, is to prevent flooding of the Busselton Township. Water Corporation plan to upgrade the drain and associated infrastructure to better accommodate future flood events.

The upgrade works require the clearing of 2.16 ha of existing vegetation, much of which is in a degraded state, although some of which is locally and nationally significant habitat.

Tranen Revegetation Southwest (Tranen) were commissioned by Water Corporation to prepare a Revegetation Plan for environmental offset works related to the planned Vasse Diversion Drain (VDD) Upgrade Project CPS8191/1.

The Revegetation works have the following objectives:

1. Mitigate the effects of vegetation clearing within the local area and maximise local environmental benefits;
2. Build on existing and previous successful environmental enhancement projects undertaken locally;
3. Enhance habitat for the WRP and provide connectivity between areas of local distribution; and
4. Facilitate better connection and engagement between the local environment and community.

The overarching strategy for the revegetation works is to re-create naturally occurring and connected vegetation communities that are appropriate for their geographic location, support long-term ecological function and provide suitable habitat for critical species.

The Revegetation Plan is also designed to consider key management requirements for native vegetation in an urban context. Due to a number of factors requiring consideration within the plan, additional layers of complexity are inherent in the development of an appropriate revegetation strategy.

This Plan seeks to progressively establish focal areas of high biodiversity, with native vegetation forming a discontinuous mosaic-like corridor of variable structural composition and biological complexity, to reflect natural vegetation community structure.

A summary of the proposed revegetation works is provided in the following table.

Table 1 VDD Upgrade Summary of Revegetation Activities

Item	Zone	Total Area (m2)	Site Preparation			Planting density (plants / m2)	Revegetation				Zone Specific Management Tasks	
			Mulching (m2)	Ripping (m2)	Matting (m2)		Total Plants	Total Tree guards	Mature trees	Vegetation Composition Classification(s)		Fencing (lm)
1.0	Zone 1 - Quindalup Dune	7,908	6,000	3,000	0	1.6	11,023	0	0	Low Fuel; Open; Restoration	850	Possum nesting boxes
2.0	Zone 2 - VDD Embankments	6,848	0	0	3,500	4	16,436	0	0	Restoration (Functional)	150	Embankment re-grading; Toe protection (brushwalling); pathway construction
3.0	Zone 3 - QE Ave Swale	4,572	0	0	2,500	3	13,716	0	0	Restoration	960	
4.0	Zone 4 - PEC Upland											
4.1	Zone 4.1 - Possum Corridor PEC	24,747	0	0	0	1	7,425	7,425	0	Open	0	Possum bridges and nesting boxes
4.2	Zone 4.2 - Western PEC	9,267	6,000	6,000	0	2	11,121	5,000	0	Open; Restoration;	500	
4.3	Zone 4.3 - Central PEC	9,128	5,000	5,000	0	2	14,605	10,000	214	Restoration	0	Matural trees installed along path edge at 5m centres
4.4	Zone 4.4 - Eastern PEC	42,829	20,000	30,000	0	2	42,829	20,000	0	Low Fuel; Open; Restoration; Biodiverse Nodes	1,500	
4.5	Zone 4.5 - Southern PEC	36,643	0	0	0	1	3,665	0	0	Restoration; Biodiverse Nodes	2,210	C. procera habitat enhancement
5.0	Zone 5 - Drainage PEC											
5.1	Zone 5.1 - Western Basin PEC	1,490	0	0	0	2	1,490	0	0	Drainage	0	
5.2	Zone 5.2 - Southern Swale PEC	3,559	0	0	0	3	10,677	3,000	0	Drainage	0	
	TOTAL / Avg	146,991	37,000	44,000	6,000	0.90	132,987	45,425	214		6,170	

2 INTRODUCTION AND BACKGROUND

In April 2020, Tranen Revegetation Southwest (Tranen) were commissioned by Water Corporation to prepare a Revegetation Plan for environmental offset works related to the planned Vasse Diversion Drain (VDD) Upgrade Project CPS8191/1. The revegetation works are required to mitigate the impacts of vegetation clearing associated with the upgrade project, with the intention to maximise the retention and enhancement of ecological values in the local area and in the immediate vicinity of the disturbance.

2.1 Background

The Vasse Diversion Drain is a 100-year-old strategic infrastructure corridor, originally constructed in the 1920s to create more arable land in the catchment, its primary function now, is to prevent flooding of the Busselton Township (Water Corporation 2020). Water Corporation plan to upgrade the drain and associated infrastructure to better accommodate future flood events.

2.2 Project Specific Conditions of Approval

This project has been assessed Bilaterally by the DWER Native Vegetation branch under Part V of the EP Act [WA] and by AWE under the EPBC Act 1999 [cth].

2.2.1 Environmental Protection and Biodiversity Conservation Act 1999 (Cth)

The project was referred under the EPBC Act (Cth). The project is a ‘Controlled Action,’ all activities must be undertaken in compliance with conditions set in the EPBC 2017/7932 Approval Conditions.

Table 2: EPBC 2017/7932 environmental approval conditions

Ref	Requirement	Comments
1	To minimise impacts to EPBC Act listed species, the approval holder must: a) clear no more than 2.16 hectares (ha) of Western Ringtail Possum habitat within the project area (hatched yellow in Attachment A and Attachment B); b) comply with and implement the conditions of the clearing permit CPS 8191/1 or as varied from time to time; and c) notify the Department in writing of any variations of the conditions of clearing permit CPS 8191/1 within 10 business days of such a change being approved by the State Government.	Refer to <i>CD00116 – Vasse Diversion Drain Upgrade, Construction Environmental Management Framework</i> (Water Corporation 2020).
2, 3, 4	To avoid and mitigate impacts to the Western Ringtail Possum	Refer to Bamford Consulting Ecologists (2020).
5, 6	Minimise impacts to the Carburnup King Spider Orchid	Refer to project CEMF (Water Corporation 2020)

Ref	Requirement	Comments
7	Implement the weed management and soil hygiene management measures	Refer to project CEMF (Water Corporation 2020)
8	provide a fauna management plan for approval	Refer to Bamford Consulting Ecologists (2020).
9	implement a flora management plan as required by condition 10	Refer to project CEMF (Water Corporation 2020)
10	To compensate for the residual significant impacts on the Western Ringtail Possum, the approval holder must implement condition 17 of the clearing permit CPS 8191/1.	This document
12	The approval holder must maintain accurate and complete compliance records.	Management and process for compliance reporting for the Revegetation and Offsets ONLY are relevant to this document.
14	14. The approval holder must: a) submit plans electronically to the Department for approval by the Minister; b) publish each plan on the website within 20 business days of the date the plan is approved by the Minister or of the date a revised action management plan is submitted to the Minister or the Department, unless otherwise agreed to in writing by the Minister; c) exclude or redact sensitive ecology d) keep plans published on the website until the end date of this approval.	The Corporation will ensure all plans are published as required on the Project website. Including this document.
16	Annual Compliance reporting	Management and process for compliance reporting for the Revegetation and Offsets ONLY are relevant to this document.

2.2.2 Part V, Environmental Protection Act 1986 (WA)

The Water Corporation has been granted a Purpose Permit under Part V of the EP Act (WA) for project activities. All activities must be undertaken in compliance with conditions set in the DWER Purpose Permit CPS 8191/1.

Table 3: Environmental conditions specific to DWER Purpose Permit CPS8191/1

Ref	Requirement	Responsibility
11	Fauna Management – Other approvals	Refer to Bamford (2020) and IndoPacific (2020)
12	Fauna management – Carter’s freshwater mussel	Refer to (IndoPacific 2020)
13	Fauna management – western ringtail possum	Refer to Bamford (2020)
14	Fauna management – western ringtail possum rope bridges	The Corporation has engaged BCE to identify suitable locations. Tranen Revegetation Southwest will facilitate the installation of the rope bridges. This will be reported in a separate Memorandum.
15	Fauna management – western ringtail possum nest boxes	The Corporation has engaged BCE to identify suitable locations. Tranen Revegetation Southwest will facilitate the installation of the rope bridges. This will be reported in a separate Memorandum.
16	Within 12 months of the commencement of clearing, the Permit Holder must undertake revegetation within 0.55 hectares of the area hatched red on attached Plan 8191/1d in accordance with condition 17 of this permit.	This document

Ref	Requirement	Responsibility
17	<p>Offset – revegetation and rehabilitation</p> <p>a) Within 3 months of clearing commencing, the Permit Holder must submit a Project Revegetation Plan to the CEO for approval for the revegetation of 10.34 hectares of land within the areas cross-hatched red on Plan 8191/1e, which shall be developed in accordance with A Guide to Preparing Revegetation Plans for Clearing Permits (Department of Water and Environmental Regulation (DWER) 2018).</p> <p>b) The Project Revegetation Plan must be prepared by an environmental specialist.</p> <p>c) The Project Revegetation Plan must include the following:</p> <ul style="list-style-type: none"> (i) site preparation; (ii) deliberate planting of native vegetation that will provide suitable habitat(b) for western ringtail possum; (iii) deliberate planting of species associated with the <i>Eucalyptus rudis</i> (flooded gum), <i>Corymbia calophylla</i>, <i>Agonis flexuosa</i> Closed Low Forest (near Busselton)' priority ecological community (PEC) in areas as outlined in the Project Revegetation Plan; (iv) deliberate planting of up to 300 seedlings of <i>Conospermum caeruleum</i> var. Busselton; (v) planting of local provenance native understorey species at an optimal time so as to achieve the completion criteria specified in condition 17(a)(xii) below; (vi) a biannual weed control program within the area hatched red on Plan 8191/1e to achieve the completion criteria outline under condition 17(a)(xii), criterion 2; (vii) establishment of a total of 34, 5 x 5 metre monitoring quadrats within the area hatched red on Plan 8191/1e; (viii) maintenance of sufficient fencing to protect revegetation areas adjacent to areas most impacted by public access as outlined in the Project Revegetation Plan; (ix) implementation of hygiene protocols by cleaning earth-moving machinery of soil and vegetation prior to entering and leaving the site; (x) installation of signage to educate reserve users of the revegetation activities being undertaken; (xi) (xi) achieve the below completion criteria within the ten year monitoring period for the area hatched red on Plan 8191/1e; (xii) remedial actions to be undertaken if completion criteria are not met; and (xiii) management commitments that will be achieved. <p>d) The Permit Holder shall implement the Project Revegetation Plan as approved by the CEO.</p>	This document

Ref	Requirement	Responsibility
18 (b)	<p>Record keeping The Permit Holder must maintain the following records:</p> <p>a) In relation to revegetation activities undertaken pursuant to conditions 16 and 17 of this Permit:</p> <p>(i) the date(s) each area was revegetated;</p> <p>(ii) the location of each area revegetated recorded using a GPS unit set to GDA94, expressing the geographical coordinates in Eastings and Northings or decimal degrees;</p> <p>(iii) at least two photographs of each area revegetated taken on an annual basis at the same location each year;</p> <p>(iv) a description of the revegetation activities undertaken each year for each area revegetated; and</p> <p>(v) a description of the tree density and native understorey vegetation cover for each area revegetated recorded on an annual basis.</p>	<p>Management and Processed relating to recording keeping and reporting of the Revegetation and Offset ONLY are provided in this document.</p>

2.2.3 Completion Criteria

The development of this plan has been guided by the approved clearing permit issued by the Department of Water and Environmental Regulation (DWER). The permit includes the provision of the Completion Criteria required to be achieved at the end of the project period. The following is an excerpt from Section 17 of the permit:

Table 4 Completion Criteria - DWER Clearing Permit CPS 8191/1

Criterion	Aspect	Scale	Completion criteria description	Monitoring frequency
1	Per cent <i>weed</i> cover	Average of <i>quadrat</i> data and site traverse	<15 per cent weed cover across all sites	Bi-annually in the first 2 years, and annually for the next 8 years
2	Declared <i>weeds</i>	Site traverse	Absence of declared weeds	Bi-annually in the first 2 years, and annually for the next 8 years
3	Per cent bare ground	Average of <i>quadrat</i> data and site traverse	Per cent of bare ground to be no greater than that recorded in the <i>pre clearing surveys</i> .	Bi-annually in the first 2 years, and annually for the next 8 years
4	Vegetation condition	Site traverse	The condition of the vegetation to be in a good to very good condition on average across the revegetation area (Keighery 1994).	Bi-annually in the first 2 years, and annually for the next 8 years
5	Native vegetation cover/density	Average of <i>quadrat</i> data	>70 per cent native cover	Bi-annually in the first 2 years, and

				annually for the next 8 years
6	Species richness	Average of <i>quadrat</i> data	>70 per cent of species planted represented across all sites respectively (PEC, GCWS & QD) as outlined in the species list provided in the Project Revegetation Plan	Bi-annually in the first 2 years, and annually for the next 8 years
7	<i>Conospermum caeruleum</i> var. Busselton	Site traverse / direct survival observation	>50 per cent survival rate to be achieved	Bi-annually in the first 2 years, and annually for the next 8 years

2.3 Documentation

This report is based on the following information provided by the Client:

- Water Corporation 2020. CD00116, 2017/7932, CPS 8191/1 Vasse Diversion Drain Upgrade Var 2. Mitigation Package Summary. March 2020; and
- Various email correspondence with Water Corporation personnel inc. various attachments;
- Clearing Permit issued by DWER: CPS 8191/1.

2.4 Objectives

The Revegetation works have the following objectives:

1. Mitigate the effects of vegetation clearing within the local area and maximise local environmental benefits;
2. Build on existing and previous successful environmental enhancement projects undertaken locally;
3. Enhance habitat for the WRP and provide connectivity between areas of local distribution; and
4. Facilitate better connection and engagement between the local environment and community.

3 SITE DESCRIPTION

3.1 Site Location

The VDD revegetation project area is located within the City of Busselton, approximately 2 km south west of the Busselton CBD. A general location map showing the extent of site is provided in Appendix 1.

3.2 Existing Vegetation and Fauna

The upgrade works will require approximately 2.16 hectares of vegetation clearing as part of construction works. The condition of this vegetation is variable, approximately 75% of which is degraded or completely degraded (Water Corporation 2020). Despite this, the vegetation is considered locally and nationally significant, with the area considered habitat for the Critically Endangered Western Ringtail Possum (WRP). A section of vegetation to be cleared is also a WA state government Priority Ecological Community (PEC) - *Eucalyptus rudis*, *Corymbia calophylla*, *Agonis flexuosa* Closed Low Forest (near Busselton), which forms critical habitat for the State and Federally Protection Declared rare flora *Caladenia procera* (Cabunup Spider Orchid)

The existing condition of native vegetation within the revegetation zones is highly variable. However, in general, the majority is considered completely degraded due to the high level of disturbance from close urban proximity and previous land-use, minimal native vegetation strata representation and high weed abundance. Much of the revegetation area is considered “parkland cleared” with sparse trees and exotic grass understorey.

4 REVEGETATION STRATEGY

The overarching strategy for the revegetation works is to re-create naturally occurring and connected vegetation communities that:

- Are appropriate for their geographic location,
- Support long-term ecological function, and
- Provide suitable habitat for critical species.

The Revegetation Plan is also designed to consider key management requirements for native vegetation in an urban context.

Due to the numerous factors requiring consideration within the plan, additional layers of complexity are inherent in the development of an appropriate revegetation strategy. This Plan seeks to progressively establish focal areas of high biodiversity, with native vegetation forming a discontinuous mosaic-like corridor of variable structural composition and biological complexity, to reflect natural vegetation community structure.

4.1 Revegetation Zones

The project area (the “site”) is separated into 5 key management zones based on existing and targeted vegetation communities. These are broken down into targeted management strategies and actions for specified sub-zones.

Initial revegetation quantities and planting densities for these zones have been produced based on the current existing native vegetation cover and the percentage of each zone available for intensive revegetation works. These are summarised as follows:

- Zone 1 – Quindalup Dune;
- Zone 2 – VDD Embankments;
- Zone 3 – Queen Elizabeth Avenue Swale (QE Ave Swale);
- Zone 4 – PEC Upland:
 - Zone 4.1 – Possum Corridor PEC;
 - Zone 4.2 – Western PEC;
 - Zone 4.3 – Central PEC;
 - Zone 4.4 – Eastern PEC;
 - Zone 4.5 – Southern PEC.
- Zone 5 – Drainage PEC:
 - Zone 5.1 – Western Basin PEC;
 - Zone 5.2 – Southern Swale PEC.

Detailed descriptions of each zone are provided in Section 5.

4.2 Vegetation Composition Classification

Vegetation composition has been classified within each revegetation zone to account for factors such as fire risk management, drainage asset management and the scale of species richness to be implemented. This is an additional consideration utilised to determine planting requirements and the composition of vegetation in each zone. The following classes have been utilised to define the types of vegetation to be established:

- **Low Fuel (3.6% of site):** Buffer of low-growing native vegetation adjacent to residential / commercial properties to reduce fire risk;
- **Open (34.3%):** Revegetation with minimal use of mid-storey species to maintain canopy separation and reduced fire risk / fuel loads, while minimising potential higher fuel loads where possible;
- **Restoration (58.9%):** Full strata representation and high biodiversity values;
- **High Diversity Nodes (Progressive):** Focal points of increased diversity within Restoration areas, extending outwards across the Restoration areas progressively. The extent of which will be determined by the site's trajectory towards meeting the Completion Criteria and availability of resources;
- **Drainage (3.2%):** Full strata representation and high biodiversity values where practical. Consideration is also provided for maintenance of management access and hydrological function.

4.3 Revegetation Species Prioritisation and Listing

The species utilised for the revegetation will focus on replicating suitable vegetation communities relevant to the local area. The original comprehensive species list was provided by DBCA to guide the revegetation species list. The species have been categorised and prioritised based on the following factors:

- **Propagation capacity:** The feasibility of propagating sufficient material for use in revegetation in the allocated project period;
- **Local availability:** Relative abundance of material that can be locally acquired, assuming that access to suitable collection areas is provided and seasonal / annual productivity variation is accounted for;
- **Provenance requirement:** Species with a proven distinct genetic provenance that is deemed important to preserve or, in some cases, a perceived provenance requirement;
- **Management requirement:** Likelihood of successful and eventual self-sufficient establishment considering the likely on-going pressures experienced at the project site.

Utilising the above factors, three species lists have been developed and are summarised as follows:

1. **Priority Species List:** Composed of mostly locally abundant and/or common species that can be propagated with relative ease. Plants will be sourced through a combination of nursery stock and locally collected provenance material. The quantities provided in this list are for planting in the first two years of project commencement. Species in this list are to be measured against the species richness Completion Criteria as outlined in the Clearing Permit;
2. **Progressive Target Species List:** Includes more difficult to source and/or propagate species. These are feasible for inclusion in the initial stages, and progressively expanded-on depending on project success trajectory, available resources and if sufficient material can be sourced and successfully propagated. There is potential to consider some targeted direct seeding. Due to the anticipated risks in sourcing and propagating material, this list is not to be considered as part of project Completion Criteria.

3. **Opportunistic Species List:** This list covers the remaining species provided in the initial list and is comprised of species that are uncommon, difficult to propagate and/or highly vulnerable. These species will be considered if sufficient material is sourced and resources are available. Any species used from this list will be focussed in the High Diversity Nodes and will likely only be attempted later in the project timeline where resources are available and surrounding, potentially buffering vegetation, is sufficiently established. These species will not be considered as part of project Completion Criteria.

4.3.1 Revegetation Species Mixes

A combination of revegetation zone and vegetation composition has been used to develop the following table, which categorises the site into specific species mixes relevant to each distinct area of site.

Table 4 Revegetation Composition

Reveg Zone	Revegetation Species Mix	Area (m ²)	Species List	Vegetation Structure
1	Quindalup Dune Low Fuel	1,254	1,2	Lower storey only
1	Quindalup Dune Open	3,299	1,2	Minimal mid-storey
1	Quindalup Dune Restoration	3,355	1,2	All strata
2	VDD Embankment Restoration	6,848	1,2	Lower and mid-storey
3	QE Ave Swale Restoration	4,572	1,2	All strata
4.1	Possum Corridor Open	24,747	1,2	Minimal mid-storey
4.2	Western PEC Open	3,670	1,2	Minimal mid-storey
4.2	Western PEC Restoration	5,597	1,2,3	All strata + high diversity node
4.3	Central PEC Restoration	9,128	1,2	All strata
4.4	Eastern PEC Low Fuel	4,317	1,2	Lower storey only
4.4	Eastern PEC Open	20,347	1,2	Minimal mid-storey
4.4	Eastern PEC Restoration	18,165	1,2,3	All strata + high diversity node
4.5	Southern PEC Restoration	36,643	1,2,3	All strata + high diversity node
5.1	Western Basin PEC Drainage	1,490	1,2	All strata
5.2	Southern Swale PEC Drainage	3,559	1,2	All strata
		146,991		

The full species lists are provided in Appendix 3 of this document. Quantities are provided for *List 1: Priority Species* only and are intended for installation in the first two years of project commencement. Further infill planting utilising species from all lists will occur progressively to increase diversity and/or ensure the key Completion Criteria are met within the project timeframe and subject to available resources.

5 REVEGETATION APPROACH

Maps of the revegetation zones are provided in Appendix 2. The following provides a description of each revegetation zone, specific revegetation strategies required to achieve the overall aim of the revegetation works and a summary of key tasks in sequential order.

Further detailed methodology of each management action is provided in Section 6 of this document.

5.1 Zone 1 – Quindalup Dune

This zone encompasses a section of land at the north of the site directly adjacent to the previously completed first stage of the Vasse Diversion Drain Enhancement Project on the western bank of the VDD. The Quindalup Dune covers the upland areas, extending approximately 400 m along the western side of the VDD. A large proportion of the land was previously a Water Corporation depot site, which is now currently a gravel area used for informal parking and material lay-down. The remaining upland area is cleared parkland type vegetation, with weed / grass dominant understorey and peppermint tree overstorey.

The overall management within this zone is focussed on extending the works undertaken in the previous stage of enhancement works, which includes improvements to public access and revegetation.

Revegetation within the upland sections is to be undertaken through a combination of ground preparation and revegetation works to increase the diversity and ecological value of the area. The weeds will be treated via herbicide, followed by slashing and removal of biomass where weed cover is dense. The ground surface will then be mulched, followed by deep ripping across the revegetation area. Planting of tubestock will be undertaken following mulch application. Tree guards have not been allocated to this area due to the lower level of rabbit activity that was observed. Several possum nesting boxes will also be installed in amongst the existing peppermint trees.

Carpark / Gravel Area: The gravel carpark / laydown area of approx. 2,500 m² is to have the top 200mm removed and replaced with topsoil / clean-fill. The base of the excavation will also be deep ripped to reduce compaction.

Pathway Extension: As part of the extension of the previous enhancement project, a 2 m wide crushed limestone pathway will be constructed to join the existing pathway on the western side to the pedestrian bridge to the south of the site, a length of approximately 300 m. This will provide connection between the previous project and the wider enhancement / revegetation works. The path will likely need to meander through existing trees in some sections of site.



Figure 1 Zone 1 – Quindalup Dune

Zone 1 – Summary of Approach and Key Tasks

- Vegetation composition will be a combination of Restoration, Low Fuel and Open revegetation classes;
- 3m wide Low Fuel vegetation will be established adjacent to the residential property boundary;
- Soil remediation through removal of surface gravel, decompaction and replacement with topsoil in existing carpark / laydown area;
- Installation of crushed limestone pedestrian path through the western side of site adjacent to the VDD Embankment;
- Installation of WRP nest boxes;
- Soil surface preparation including ripping and mulching;
- Vegetation to reflect Quindalup Dune reference vegetation community;
- Low-impact fencing to manage access and protect establishing vegetation.

5.2 Zone 2 - VDD Embankments

The VDD embankments at the north of the site are highly degraded, with high weed cover and significant erosion occurring in many areas. The works in this area are intended to continue the enhancement and stabilisation works previously undertaken and contribute to the complete implementation of the wider vision for the area (Calibre 2018a).

Both the western and eastern embankments are to be revegetated to reflect the work previously undertaken on the adjacent embankments. This will include the removal of weeds, re-profiling of the embankment, erosion control matting and dense revegetation. Additional stabilisation is to be performed in selected sections of the lower embankment using bioengineering techniques, specifically brushwalling, due to the success of similar works in the area. Additional access management will be installed in the form of vegetated palisades in a number of locations along the embankment. More mature plants are to be installed along the lower embankment to provide more immediate erosion mitigation and improved survival. As with the original design of the Geocatch project, the works are intended to create a stable drain embankment with high ecological and aesthetic values.



Figure 2 Zone 2 – VDD Embankments

Zone 2 – Summary of Approach and Key Tasks

- Vegetation composition will be Restoration class revegetation, with a focus on functional species for embankment stabilisation;
- Embankment regrading, bioengineering (matting and brushwalling) and vegetated palisade areas to better control access;
- Use of advance stock on lower embankment to facilitate establishment of toe protection;
- Continuation of fencing along the top of the embankment.

5.3 Zone 3 - Queen Elizabeth Avenue (QE Ave) Swale

The swale runs along the western side of Queen Elizabeth Avenue, totalling a length of approximately 350 m. The swale contains some significant existing remnant wetland vegetation, which is to be completely cleared and modified as part of the upgrade works. It is intended to be revegetated across the entire area, with the embankments and base of the swale reinstated. The newly re-constructed embankments of the swale are to be covered with biodegradable coir mesh matting to prevent erosion during vegetation establishment in the first 2-3 years. The revegetation will focus on a wetland vegetation community to reflect the surrounding landscape and the likely hydrological conditions of the swale.

Weed control will be conducted prior to matting installation, although weed cover should be low due to the removal of surface soils, which should not be reintroduced. No other ground preparation will be required due to the reconstructed surface and the works will focus on stabilising the embankments and the rapid establishment of vegetation while maintaining swale function.



Figure 3 Zone 3 - QE Ave Swale

Zone 3 – Summary of Approach and Key Tasks

- Vegetation composition will be Restoration class revegetation;
- Protecting swale batters with matting to reduce erosion;
- Species planted to reflect a modified assemblage based on the Geographe Coastal Wetland System while maintaining function of asset;
- Fencing perimeter of swale with low-impact public management fencing.

5.4 Zone 4 – PEC Upland

The PEC Upland is comprised of several discrete revegetation areas with variable management strategies. Zone 4 covers all revegetation zones within the PEC suitable geographic range, including the north and south side of the VDD.

5.4.1 Zone 4.1 – Possum Corridor PEC

The Possum Corridor PEC zone covers a large area of existing vegetation in variable condition across the northern side of the VDD. The key focus of this zone is to enhance the WRP habitat and provide additional connectivity between the other revegetation zones. The primary tasks will be the installation of numerous rope bridges connecting pockets of vegetation and canopy continuity, with strategic infill planting across the entire area to improve habitat and ecological value. Additional opportunities for community engagement are also presented in this zone due to the proximity of a school and prior revegetation works that they have been undertaken in the area.

Rope bridges will be installed at each road cross-over running west-to-east and additional bridges installed across more major roads to provide connectivity to the greater area. Planting and tree guard installation will be conducted opportunistically around the zone, focussing on more degraded areas and where previous planting has had limited success. No ground preparation, mulching or other surface preparation is to be performed due to the sporadic nature of the infill planting. Comprehensive weed control will be undertaken as per other revegetation zones and will contribute to the ecological enhancement of this area.



Figure 4 Zone 4.1 - Possum Corridor PEC

Zone 4.1 – Summary of Approach and Key Tasks

- Vegetation composition will be Open revegetation, with a focus on increasing diversity of existing vegetation and possum habitat;
- Installation of rope bridges across gaps in canopy / roads and nest boxes for WRP;
- Management actions will focus on long-term weed management as a priority;
- Tree guards will be used in this area to reduce damage from rabbits;
- Vegetation to reflect PEC reference vegetation community.

5.4.2 Zone 4.2 – Western PEC

These pockets of revegetation will focus on the enhancement of existing vegetation, which is currently in a degraded state and has minimal native understorey representation. The primary site preparation for this sub-zone will involve significant ground preparation due to heavy compaction, particularly along informal vehicle tracks. These sites will be deep ripped following weed control and slashing. Mulching will also be undertaken in the revegetation areas to assist water retention and suppress the weeds.

Herbivore protection fencing will be installed around the larger revegetation area, with the composition of revegetation being Restoration class and include a High Diversity Node in the centre.

The area to the south will focus on Open class revegetation and additional fuel load management through weed control and slashing. The small pocket to the west of QE Ave and the above southern area will have tree guards installed, with no mulching occurring in either of these areas.



Figure 5 Zone 4.2 – Western PEC

Zone 4.2 – Summary of Approach and Key Tasks

- Vegetation composition will be a combination of Open, Restoration and High Diversity Node revegetation;
- Deep ripping will be required in some areas of high soil compaction;
- Mulching will be undertaken in selected areas of this zone;
- A High Diversity Node will be established within the fenced section of the Zone;
- Herbivore exclusion fencing installed in selected areas;
- Vegetation to reflect PEC reference vegetation community.

5.4.3 Zone 4.3 – Central PEC

The Central PEC zone extends along a narrow area directly adjacent to and between the Possum Corridor PEC zone and the dual-use path (DUP) for approximately 1 km along the north side of the VDD. The current vegetation condition is mostly degraded or completely cleared, with minimal vegetation and highly modified and weedy understorey. The revegetation will be undertaken primarily to re-instate cleared vegetation and enhance ecological connectivity between the northern areas and the large areas of remnant vegetation further south. A shallow drainage swale has been constructed through this section to manage stormwater runoff from the new DUP and College Avenue.

Revegetation will exclude the base of the drainage swale (approx. 3 m width) to maintain asset management access and avoid existing underground services. This area will be left weed and vegetation free as part of on-going maintenance.

Additional mature tree stock (*Agonis flexuosa*) will be installed approx. 1.5 m offset from the north side of the DUP, with spacing at approx. 5m with the aim to provide a continuous canopy corridor for the WRP. Additional tubestock of low-lying species will be installed along this strip to enhance the ecological and aesthetic value adjacent to the path. The trees will also provide a “tree avenue” along the newly constructed DUP, which will have both ecological and aesthetic benefits. Tree guards will be used on all tubestock due to the high abundance of rabbits in this area.

A low-impact fence will be installed along the edge of the DUP to protect revegetation from pedestrian encroachment.



Figure 6 Zone 4.3 – Central PEC

Zone 4.3 – Summary of Approach and Key Tasks

- Vegetation composition will be Restoration revegetation;
- Revegetation works will be excluded from a 3m strip through the base of the drainage swale to maintain access and function and avoid underground services;
- Some ripping will be required in selected areas of high soil compaction;
- Mulching will be undertaken in selected areas;
- A single row of mature *Agonis flexuosa* will be installed along the path side of the zone to create a tree “avenue” at 5 m spacing, with some additional low-lying vegetation established underneath;
- Low-impact fencing to be installed along the DUP for protection of establishing vegetation;
- Vegetation to reflect PEC reference vegetation community.

5.4.4 Zone 4.4 – Eastern PEC

The Eastern PEC covers land adjacent to a section of industrial area at the eastern end of the site on the northern side of the VDD. It is characterised by open cleared parkland with large mature trees and minimal native understorey, dominated by introduced grasses. This zone is to be enhanced through the introduction of more representative native vegetation strata to increase WRP habitat and local ecological values. This section will also provide ecological connection to another previously completed restoration project by Geocatch: College Avenue Living Wetland Project.

Following weed control and slashing activities, this zone will be selectively ripped in open areas, followed by mulching, prior to planting. A combination of tree guards and herbivore protection fencing will also be installed to protect from herbivory.



Figure 7 **Zone 4.4 – Eastern PEC**

Zone 4.4 – Summary of Approach and Key Tasks

- Vegetation composition will be a combination of Low Fuel, Open, Restoration and High Diversity Node revegetation;
- A 10m wide Low Fuel zone including a 3m wide mineral earth firebreak / access track and turn-around will be established adjacent to the existing commercial property boundary;
- Some ripping will be required in open areas of high soil compaction;
- Mulching will be undertaken in selected areas;
- Multiple High Diversity Nodes will be established within the Restoration areas;
- The base of existing drainage channels will be excluded from revegetation works to maintain access and function;
- Existing vegetation within drainage areas will be managed through weed control and vegetation management;
- Herbivore exclusion fencing will be installed where practical across this zone, tree guards used in other areas;
- Vegetation to reflect PEC reference vegetation community.

5.4.5 Zone 4.5 – Southern PEC

The Southern PEC zone currently has significant native vegetation cover, although some sections have high weed cover and multiple signs of disturbance such as informal access tracks and high volumes of litter. The area has known populations of *C. procera* and other notable native species; therefore, is a high value area for local ecology.

Works in this zone will focus on ecological enhancement and improvements to known orchid habitat utilising a Restoration class revegetation approach and include a number of High Diversity Nodes. Works will also focus on reducing the fire fuel load through weed control and removal of weed biomass. Ground disturbance will be avoided to ensure that existing orchids are not disturbed. Revegetation planting will be limited to selected areas to increase diversity, targeted in the High Diversity Nodes. Fencing is proposed for as much of the zone as practical to reduce uncontrolled access and protect orchid populations from people and herbivores.



Figure 8 Zone 4.5 – Southern PEC

Zone 4.5 – Summary of Approach and Key Tasks

- Vegetation composition will be Restoration and High Diversity Node revegetation;
- No significant soil disturbance or other preparation will occur due to the potential for orchids to be present;
- Multiple High Diversity Nodes will be established within the Restoration areas;
- Revegetation will be minor and focus only on High Diversity Nodes;
- Key focus on careful weed management across this zone;
- Herbivore exclusion fencing will be installed where practical across this zone;
- Vegetation to reflect PEC reference vegetation community.

5.5 Zone 5 – Drainage PEC

Drainage PEC zones are differentiated from other PEC zones due to their unique species assemblages and the differing management requirements. The two sub-zones within this zone are also separated due to the requirements for differing approaches.

5.5.1 Zone 5.1 – Western Basin PEC

This sub-zone is primarily focussed on the revegetation of a compensating basin with minimal native vegetation cover. Species will comprise mostly native rushes and sedges and be concentrated around the edges of the basin as to ensure function of the drainage asset. No additional ground preparation works will be required within the basin. Due to the predominance of hardy rushes / sedges to be used in the revegetation, no tree guards are required for this sub-zone.



Figure 9 Zone 5.1 – Western Basin PEC

Zone 5.1 – Summary of Approach and Key Tasks

- Vegetation composition will be Drainage PEC revegetation class,
- Revegetation works will focus on the outer edges of the basin to maintain drainage access and function;
- Vegetation to reflect relevant PEC reference vegetation community.

5.5.2 Zone 5.2 – Southern Swale PEC

The Southern Swale PEC zone is a narrow section of vegetation to be cleared along the southern side of the VDD, located within the PEC. This area has a varied vegetation community structure and ecological condition, with evidence of several disturbances and past rehabilitation efforts. The upgrade works will require the clearing of the vegetation of this zone and reinstatement of ground conditions post-construction.

Revegetation works will focus on the establishment of species specific to the PEC and is intended to cover the entire zone due to the current vegetation cover and the proximity to other nearby dense vegetation. No specific ground preparation works are proposed for this area, although tree guards will be installed to protect all the tubestock planted.



Figure 10 Zone 5.2 - Southern Swale PEC

Zone 5.2 – Summary of Approach and Key Tasks

- Vegetation composition will be Restoration PEC revegetation class;
- Vegetation to reflect relevant PEC reference vegetation community.

6 IMPLEMENTATION METHODOLOGY

The following section outlines the specific methodology for each management action to be implemented as part of the project. The methodology for the key tasks is to be consistent across all of the zones in the project area, with some slight variations depending on site specific conditions. Further refinement of these will be required as part of implementation management, ensuring the need to remain flexible to provide the most effective outcomes.

6.1 Site Hygiene and Dieback Management

Site hygiene management is of the highest priority when working on this site. Several hygiene management measures are required to minimise the spread of weeds and diseases.

All vehicles and plant are to be cleaned down with all dirt and vegetative material removed offsite before being mobilised to site. Inspections will be undertaken by the superintendent or equivalent before the machine can be unloaded from the float. Ongoing inspections will be conducted periodically for the duration of the works.

6.2 Site Preparation

Several key site preparation tasks are critical to successful vegetation establishment. These tasks are itemised in order of implementation for the majority of the revegetation zones, although some variation in sequence may be required at the time of implementation.

6.2.1 Site Set-out

- Each revegetation zone and composition class area is to be visually delineated along the boundaries.
- Marking pegs / stakes or similar is to be used as a guide for revegetation areas where practical.
- It is expected that a high degree of accuracy is not required for these works and that the mark-out will not be required to be undertaken by a licenced surveyor.

6.2.2 Preliminary Weed Control

- Herbicide (predominantly Glyphosate Biactive or Fluazifop) is to be applied to control weeds within the revegetation areas via either boom spray or spot spray application. The exact application method will be determined by distribution of existing native vegetation.
- A minimum of 2x herbicide applications are to be undertaken prior to any revegetation works. These are to be at least 3 weeks apart.
- Additional weed control events may be required prior to planting in areas of high weed abundance.
- Manual and mechanical weed control will be conducted where possible within areas of existing native vegetation during follow-up events.
- Woody weeds are to be treated via cut-stump herbicide application using high concentration Glyphosate or Triclopyr. These are predominantly located in the Geocatch Extension Zone.

- Slashing is to be undertaken in areas of dense weed cover following initial herbicide treatment to reduce weed biomass / seed bank and facilitate installation of mulch and plants.
- All greenwaste generated from weed control activities is to be removed and disposed of offsite.

6.2.3 Soil Surface Preparation

- Deep ripping is to be undertaken to a minimum depth of 300 mm using a single tine.
- Riplines are to be approximately 1 m spacing and cross ripped where possible to ensure a more natural distribution of planting.
- Ripping is to occur after any mulching to avoid compacting the riplines;
- Riplines will require some rainfall post-installation and prior to planting to allow for settlement of the soil.

6.2.4 Mulching

- Mulch material is to be weed and disease free and be a coarse nature mulch or similar equivalent product.
- Mulch is to be installed to a nominal depth of 75 mm in all specified areas via a combination of machinery and manual methods. Compaction from repeated tracking over areas is to be avoided when using machinery.
- All mulching is to be undertaken prior to planting.

6.3 Possum Infrastructure

6.3.1 Possum Bridges

- Simple rope bridges are to be installed across roadways and other large gaps in the tree canopy.
- Installation is to be undertaken by a qualified arborist to ensure connections to trees are appropriate and installation is undertaken safely.
- Oversight of exact locations and specifications of rope bridges is to be provided by the appropriate specialist consultants.

6.3.2 Fauna Shelters (Nesting Boxes)

- Specification for fauna shelters are to be determined in consultation with Geocatch and specialist consultants.
- The fauna shelters are to be fabricated by the Busselton Men's Shed, who have experience in building these structures.
- The fauna shelters are to be installed strategically under direction from specialist consultants and secured minimising damage to trees.

6.4 Embankment Stabilisation

6.4.1 Embankment Re-grading

- Following initial weed treatment, the embankments are to be re-profiled through a combination of manual and mechanical techniques to create more bank stability and improved conditions for revegetation.
- Works are to focus on large areas of exposed banks and where there is minimal native vegetation.

6.4.2 Erosion Control Matting

- 700 gsm coir mesh matting and/or 800gsm jute matting is to be installed across exposed and re-profiled areas of embankment. The lower-most section of the embankment will not be matted due to fluctuating water levels potentially damaging the matting.
- The matting should be secured using 280mm biodegradable starch pins.
- The top edges of the matting is to be trenched-in and sheets laid perpendicular to the flow of the drain.
- Focus of matting is to be on large open areas, and work around existing vegetation where possible.

6.4.3 Foreshore Toe Stabilisation

- Toe stabilisation is to utilise a similar approach to the Calibre design (Calibre 2018b), as amended by Tranen, implemented for the first stage of the Geocatch VDD enhancement project.
- Brushwalls are to be installed along exposed areas of the lower embankment, particularly in areas with minimal existing native vegetation.
- Sufficient space is to be allowed for behind brushwalls to provide an area for planting
- All plants installed at the toe of the embankment should be larger, more advanced stock (minimum 130 mm pots) and ideally salt-hardened prior to installation.
- The key design parameter for the brushwall is to ensure to top of the structure is above the typical high-water mark of the drain. More than one brushwall may be required in some areas to provide adequate toe protection across multiple water horizons.

6.5 Revegetation

6.5.1 Species Selection and Plant Propagation

- Plant stock is to be species native to the local area and local provenance where possible. Limitations exist for provenance in this area due to the restricted extent of remnant vegetation this should not restrict the ability to source a diverse selection of species;
- Local provenance material is to be sourced from the Swan Coastal Plain - Perth (SWA02) Interim Biogeographical Region of Australia (IBRA) sub-region, within 100km of the site where possible.
- Species have been selected based on balancing likely availability, function, local ecology and specific regulatory requirements specific to Endangered and Priority species.

- Stock is to be sourced from accredited nurseries, with a proportion to be sourced from local nurseries where possible.
- Tubestock is to be provided in deep cells and / or forestry tubes or similar. Advanced *Juncus kraussii* is to be minimum 130 mm pots and mature trees in min. 11 litre pots.

6.5.2 Tubestock Installation

- Tubestock is to be planted via planting tubes / augers for efficiency and safety purposes.
- Watering of all stock is to occur on the day of planting prior to installation.
- 10 g fertiliser tablets or 5 g of TerraCottem™ is to be installed with each tubestock, except for wetter areas. Terracottem is to be installed on the embankments and tablets will be used in upland areas.
- Corflute tree guards are to be installed around each tubestock as specified. The guards are to be secured with a single hardwood stake.

6.5.3 Mature Trees

- Stock is to be min. 11 L in size and at least 1 m in height.
- Holes for the mature trees are to be over-excavated by an additional 50% for the size of the pot and back-filled with a soil conditioner medium.
- Each tree is to be secured with 2 x 50 mm x 50 mm x 1800 mm hardwood stakes and attached with rubber tree-tie.
- 1 m wide mulch rings at a depth of 75 mm to be installed around each tree when not located in mulched areas.
- Watering is to be conducted immediately post-install and additional follow-up watering depending on weather conditions at time of install.

6.6 Fencing

6.6.1 Post and Rail Barrier Fencing

This fence type is to be installed along the top of the VDD Embankment in Zone 2. This will be a continuation of the existing fencing located in the adjacent section. The fence is to be Treated pine post and rail, using 125mm diameter timber and constructed to 1.2 m in height. A single sighter wire to be included as per existing fence design.

6.6.2 Public Management Fencing

This fencing is aimed to be visibly low-impact, with treated pine posts and three white sighter wires with a height of 1.2 m. It is designed to discourage public access to revegetation areas without creating a significant physical barrier or visually disrupting the visual amenity of the revegetation areas.

6.6.3 Herbivore Protection Fencing

This fencing will be utilised to protect larger areas of revegetation from herbivory as a more effective alternative to tree guards and limit public access. It is to be constructed from ring-lock material to a min. height of 1.2 m and include a 600 mm high rabbit skirt, which also extends 300mm over the ground to prevent digging underneath.

6.6.4 Temporary Orchid Protection

Orchid protection fencing is to be installed for the duration of construction works around areas of known and potential *C. procera* habitat. This is to be a hard barrier at least 1.8 m in height and shade cloth installed on the construction side to reduce impacts of dust.

7 POST-INSTALLATION MONITORING AND MAINTENANCE

Following completion of the installation phase, the site will enter a ten-year maintenance period. Regular monitoring will be undertaken to track progress against the established completion criteria. Where the success targets are not being met, remedial action will be determined and undertaken to ensure the project goals are met by the end of the maintenance period.

7.1 Vegetation Monitoring

7.1.1 Monitoring Events

- A ten-year comprehensive monitoring program is to be established to monitor the success of the revegetation efforts against the established criteria, provide recommendations to improve success and document the progress of the works more generally.
- Monitoring will be undertaken each spring and autumn for the first two years with annual monitoring conducted in spring for the remaining eight years.
- Monitoring quadrats are to be established across all revegetation areas, with a total of 34 monitoring quadrats established across all revegetation zones.
- Quadrats are to be 5 m x 5 m in size and randomly established, ensuring representation of all vegetation types and revegetation zones.
- Photo monitoring points are also to be established across the site to provide qualitative data and a direct visual capture of progress.
- Visual assessment of the entire site through site traverses is to be undertaken as part of each monitoring event to provide a broader picture of success, and identify the progress of areas that are not captured by the quadrat data;
- Additional informal monitoring of site progress is to be undertaken regularly in addition to formal monitoring events where possible.

7.1.2 Monitoring Reporting

- A report is to be provided for each monitoring event to document the findings and provide recommendations for any additional actions required to achieve the project targets.

7.2 Site Maintenance

7.2.1 Weed Management

- Weed management will be undertaken over the maintenance period to ensure <15% weed cover, as per Criteria 1 and 2 of Condition 17.(c)(xi) of the Clearing Permit.
- Herbicide spraying and manual removal of weeds is to be undertaken quarterly across the revegetation areas to align with seasonal changes: spring, summer, autumn, winter.
- Spot spraying will be the maintenance method of herbicide application to minimise off-target damage to revegetation plantings.

7.2.2 Infill Planting

- Infill planting is to occur as required over the monitoring and maintenance period to ensure Completion Criteria are met for vegetation cover and richness targets, as per Condition 17.(c)(xi).
- The requirements for infill planting will be determined based on the outcomes of the monitoring and will utilise all species from the proposed species lists where appropriate.
- Increasing species richness, particularly in High Diversity Nodes and Restoration areas will be a focus of the infill planting. However, key indicators of revegetation success will need to show a positive trajectory towards meeting the Completion Criteria before significant efforts are made to increase diversity further.

7.2.3 Tree Guard Maintenance and Removal

- All tree guards are to be monitored and maintained, including adjustment, replacement and removal once no longer required. Guards will remain in place until the plant has matured and is resilient enough to survive without it or has died. All guards will be removed by the end of the maintenance period.

7.2.4 Watering

- Watering of tubestock is to be undertaken fortnightly (if required) for the first summer post-installation to assist establishment.
- This is to focus on larger revegetation areas where planting is dense, and mature trees. More sporadic planting is to be watered only if practical to do so.

8 REFERENCES

Calibre 2018b. Vasse Diversion Drain Enhancement Project Stage 1 – Detailed Design. Calibre Consulting, March 2018.

Calibre 2018a. Vasse Diversion Drain Restoration and Landscape Concept Plan. Calibre Consulting, January 2018.

Water Corporation 2020. CD00116, 2017/7932, CPS 8191/1 Vasse Diversion Drain Upgrade Var 2. Mitigation Package Summary. March 2020

Appendix 1 Site Location

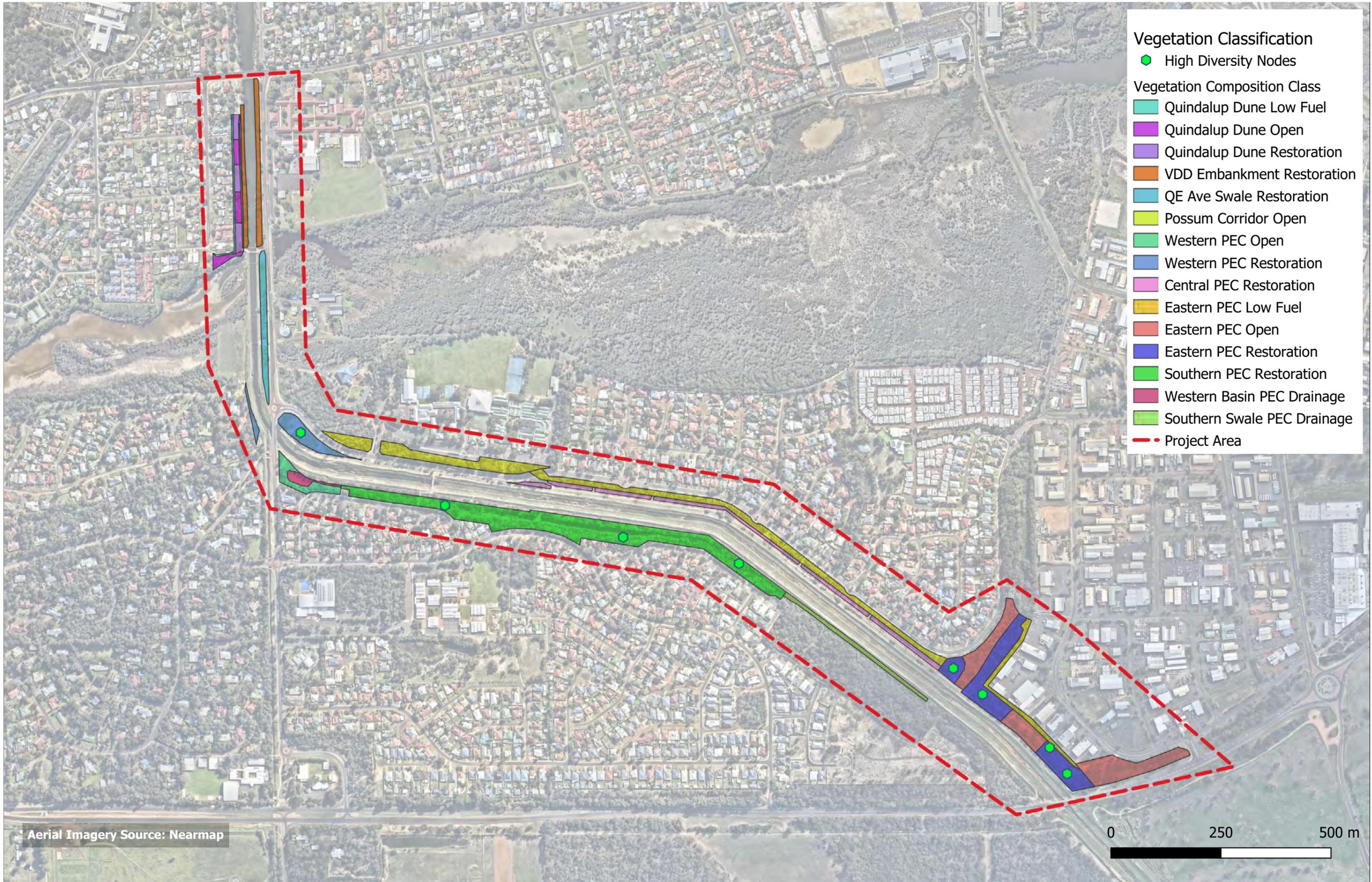


Appendix 2 Revegetation Zones



Aerial Imagery Source: Nearmap





Aerial Imagery Source: Nearmap



Project: VDD Upgrade Revegetation Plan
 Project Number: P875B
 Client: Water Corporation

Drawing: Overview of Vegetation Composition
 Drawing Number: P875B-02
 Revision: 1

Date: 21/08/20
 Drawn By: AJ



Appendix 3 Indicative Species Lists

Revegetation Zones	Area (m2)	Seedling Density (plants / m2)	Total Seedlings
Quindalup Dune Low Fuel	1,254	1.3	1,599
Quindalup Dune Open	3,299	1.0	3,332
Quindalup Dune Restoration	3,355	1.8	6,092
VDD Embankment Restoration	6,848	2.4	16,637
QE Ave Swale Restoration	4,572	3.0	13,716
Possum Corridor Open	24,747	0.3	7,742
Western PEC Open	3,670	1.0	3,778
Western PEC Restoration	5,597	1.4	7,868
Central PEC Restoration	9,128	1.4	13,016
Eastern PEC Low Fuel	4,317	1.0	4,252
Eastern PEC Open	20,347	0.9	17,463
Eastern PEC Restoration	18,165	1.0	18,132
Southern PEC Restoration	36,643	0.1	3,772
Western Basin PEC Drainage	1,490	1.0	1,548
Southern Swale PEC Drainage	3,559	2.6	9,093
TOTAL	146,991	0.87	128,040

Species	Quindalup Dune				Geographic Coastal Wetland	Priority Ecological Community											Total
	Quindalup Dune Low Fuel	Quindalup Dune Open	Quindalup Dune Restoration	VDD Embankment Restoration	QE Ave Swale Restoration	Possum Corridor Open	Western PEC Open	Western PEC Restoration	Central PEC Restoration	Eastern PEC Low Fuel	Eastern PEC Open	Eastern PEC Restoration	Southern PEC Restoration	Western Basin PEC Drainage	Southern Swale PEC Drainage		
Tree Species																	
Agonis flexuosa	0	300	800	0	250	0	50	150	500	0	500	500	50	0	50	3,150	
Banksia grandis	0	0	0	0	0	0	50	100	300	0	500	500	50	0	50	1,550	
Banksia littoralis	0	0	0	0	150	0	0	0	250	0	300	300	50	50	150	1,250	
Corymbia calophylla	0	0	0	0	0	0	50	100	200	0	500	500	50	0	50	1,450	
Eucalyptus decipiens	0	0	0	0	0	0	0	100	100	0	300	300	50	0	50	900	
Eucalyptus rudis	0	0	0	0	150	0	25	0	100	0	300	300	50	50	100	1,075	
Melaleuca preissiana	0	0	0	0	0	0	0	0	0	0	100	100	50	50	200	500	
Melaleuca raphiophylla	0	0	0	0	500	0	0	0	0	0	100	100	50	50	200	1,000	
Sub-Total	0	300	800	0	1,050	0	175	450	1,450	0	2,600	2,600	400	200	850	10,875	
Shrub Species																	
Acacia cochlearis	0	0	500	800	0	0	0	0	0	0	0	0	0	0	0	1,300	
Acacia littorea	0	0	500	800	300	0	0	0	0	0	0	0	0	0	0	1,600	
Acacia pulchella	0	0	0	0	0	200	100	250	500	0	150	500	25	0	100	1,825	
Acacia saligna	0	0	0	0	50	100	0	50	200	0	50	200	25	0	50	725	
Acacia stenoptera	0	0	0	0	0	200	100	250	200	0	100	400	25	0	100	1,375	
Adenanthos meisneri	0	0	0	0	0	250	100	300	400	0	500	500	100	0	250	2,400	
Alyxia buxifolia	0	100	200	250	0	0	0	0	0	0	0	0	0	0	0	550	
Daviesia physodes	0	0	0	0	0	150	0	200	250	0	200	300	50	0	100	1,250	
Diplolaena dampieri	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	100	
Gompholobium capitatum	0	0	0	0	0	100	50	150	300	0	300	500	50	0	150	1,600	
Gompholobium tomentosum	0	0	0	0	0	150	100	250	400	0	350	500	50	0	150	1,950	
Hakea prostrata	0	0	0	0	0	150	0	200	400	0	100	500	50	0	100	1,500	
Hakea varia	0	0	0	0	300	0	0	200	300	0	100	500	50	25	100	1,575	
Hibbertia cuneiformis	0	150	500	800	0	300	50	250	350	0	300	400	50	0	150	3,300	
Hibbertia racemosa	0	0	0	0	0	200	100	200	350	0	350	400	50	0	150	1,800	
Hovea trisperma	0	0	0	0	0	150	200	200	350	0	300	300	50	0	100	1,650	
Jacksonia furcellata	0	0	0	0	0	150	0	250	400	0	50	300	50	0	150	1,350	
Kunzea glabrescens	0	0	0	0	0	150	0	150	250	0	50	400	50	25	150	1,225	
Melaleuca cuticularis	0	0	0	600	300	0	0	0	0	0	0	0	0	0	0	900	
Melaleuca incana	0	0	0	0	250	0	0	0	0	0	0	0	0	0	0	250	
Melaleuca viminea	0	0	0	0	250	0	0	0	0	0	0	0	0	0	0	250	
Olearia axillaris	0	100	100	600	0	0	0	0	0	0	0	0	0	0	0	800	
Phyllanthus calycinus	0	100	150	250	0	250	0	150	300	0	350	300	50	0	150	2,050	
Rhagodia baccata	500	200	300	600	200	0	0	0	0	0	0	0	0	0	0	1,800	
Spyridium globulosum	0	0	500	500	0	250	0	250	500	0	150	500	50	0	200	2,900	
Xanthorrhoea brunonis	0	0	0	0	0	250	50	150	300	0	100	300	50	0	150	1,350	
Xanthorrhoea preissii	0	0	0	0	0	250	50	150	300	0	100	300	50	0	150	1,350	
Sub-Total	500	650	2,850	5,200	1,650	3,250	900	3,600	6,050	0	3,600	7,100	875	50	2,450	38,725	
Herbs and Groundcover Species																	
Anigozanthos manglii	0	0	0	0	0	350	300	500	600	0	1000	800	50	0	150	3,750	
Austrostipa compressa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Seed only	
Austrostipa flavescens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Seed only	
Chamaesclila corymbosa	0	0	0	0	0	150	200	200	300	350	500	300	50	0	150	2,200	
Conospermum caeruleum var. Busselton	0	0	0	0	0	300	150	100	200	250	300	350	50	25	150	1,875	
Conostylis aculeata	0	0	0	0	0	500	200	400	500	500	1200	700	50	0	150	4,200	
Dampiera alata	0	0	0	0	0	250	100	200	250	200	500	400	50	0	150	2,100	
Dampiera linearis	0	0	0	0	0	250	200	200	300	300	500	400	100	0	150	2,400	
Hardenbergia comptoniana	0	50	50	0	0	150	100	100	150	150	300	200	50	0	150	1,450	
Kennedia prostrata	0	0	0	0	0	500	200	400	500	500	900	500	50	0	150	3,700	
Lomandra micrantha	0	0	0	0	0	500	200	250	400	0	800	450	50	0	150	2,800	
Muehlenbeckia adpressa	0	0	0	0	150	150	100	100	150	200	300	300	50	0	150	1,650	
Patersonia occidentalis	0	0	0	0	0	500	200	400	500	600	1200	700	50	0	150	4,300	
Rytidosperma caespitosum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Seed only	
Rytidosperma occidentale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Seed only	
Samolus junceus	0	0	0	0	500	0	0	0	0	0	0	0	0	0	0	500	
Samolus repens	0	0	0	0	500	0	0	0	0	0	0	0	0	0	0	500	
Scaevola calliptera	0	0	0	0	0	292	100	250	300	500	500	400	50	0	150	2,542	
Scaevola crassifolia	0	150	100	600	0	0	0	0	0	0	0	0	0	0	0	850	
Stackhousia monogyna	0	0	0	0	0	200	100	150	250	200	500	300	50	0	150	1,900	
Stylidium brunonianum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Seed only	
Trachymene coerulea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Seed only	
Sub-Total	0	200	150	600	1,150	4,092	2,150	3,250	4,400	3,750	8,500	5,800	700	25	1,950	36,717	
Rushes and Sedges																	
Baumea juncea	0	0	0	0	2066	400	553	568	516	502	1163	1032	597	273	1243	8,913	
Carex preissii	0	0	0	0	0	0	0	0	300	0	500	500	300	200	800	2,600	
Ficinia nodosa	1099	500	500	5037	0	0	0	0	0	0	0	0	0	0	0	7,136	
Gahnia trifida	0	0	0	0	2500	0	0	0	300	0	500	500	300	200	800	5,100	
Juncus kraussii	0	0	0	1300	1800	0	0	0	0	0	0	0	0	0	0	3,100	
Juncus kraussii - advanced	0	0	0	2000	0	0	0	0	0	0	0	0	0	0	0	2,000	
Lepidosperma gladiatum	0	1682	1792	2500	0	0	0	0	0	0	0	0	0	0	0	5,974	
Lepidosperma longitudinale	0	0	0	0	3500	0	0	0	0	0	300	300	300	300	500	5,200	
Lepidosperma squamatum	0	0	0	0	0	0	0	0	0	0	300	300	300	300	500	1,700	
Sub-Total	1,099	2,182	2,292	10,837	9,866	400	553	568	1,116	502	2,763	2,632	1,797	1,273	3,843	41,723	
TOTAL	1,599	3,332	6,092	16,637	13,716	7,742	3,778	7,868	13,016	4,252	17,463	18,132	3,772	1,548	9,093	128,040	

Progressive Target Species List

SPECIES NAME	PEC	GCWS	QD
Adriana quadripartita		*	
Agrostocrinum scabrum	*		
Austrostipa campylachne	*		
Burchardia congesta	*		
Chorizema diversifolium	*		
Cryptandra arbutiflora	*		
Dianella brevicaulis	*		
Dichondra repens			*
Dichopogon capillipes	*		
Hibbertia hypericoides	*		
Hyalosperma cotula	*		
Hypolaena pubescens	*		
Leucopogon parviflorus			*
Leucopogon propinquus	*		
Lobelia tenuior	*		
Logania serpyllifolia	*		
Logania vaginalis	*		
Lomandra caespitosa	*		
Lomandra nigricans	*		
Lomandra preissii	*		
Lomandra sericea	*		
Lomandra suaveolens	*		
Microlaena stipoides	*		
Microtis media	*		
Myoporum caprarioides		*	
Opercularia apiciflora	*		
Opercularia hispidula	*		
Opercularia vaginata	*		
Philothea spicata	*		
Pimelea angustifolia	*		
Pimelea argentea			*
Pimelea rosea	*		
Pimelea sylvestris	*		
Platytheca galioides	*		
Sowerbaea laxiflora	*		
Tetraria capillaris	*		
Tetraria octandra	*		
Thysanotus multiflorus	*		
Thysanotus patersonii/manglesianus	*		

Opportunistic Species List

SPECIES NAME	PEC
Astroloma ciliatum	*
Astroloma pallidum	*
Caesia micrantha	*
Caladenia attingens	*
Caladenia flava	*
Caladenia paludosa	*
Caladenia reptans	*
Caladenia speciosa	*
Cassytha glabella	*
Cassytha racemosa	*
Centrolepis aristata	*
Centrolepis drummondiana	*
Comesperma confertum	*
Craspedia variabilis	*
Cyrtostylis huegelii	*
Daucus glochidiatus	*
Desmocladus fasciculatus	*
Drosera erythrorhiza	*
Drosera glanduligera	*
Drosera menziesii	*
Drosera pallida	*
Eriochilus dilatatus	*
Geranium solanderi	*
Hibbertia cunninghamii	*
Hibbertia diamesogenos	*
Homalosciadium homalocarpum	*
Hydrocotyle callicarpa	*
Hypoxis occidentalis	*
Lagenophora huegelii	*
Leptoceras menziesii	*
Levenhookia pusilla	*
Lomandra hermaphrodita	*
Lomandra pauciflora	*
Lyginia barbata	*
Lyperanthus nigricans	*
Millotia tenuifolia	*
Olax benthamiana	*
Oxalis exilis	*
Poranthera microphylla	*
Pterostylis nana	*
Pterostylis vittata	*
Pyrorchis nigricans	*
Rhodanthe citrina	*
Stylidium calcaratum	*
Stylidium crassifolium	*
Stypandra glauca	*
Thysanotus arenarius	*
Thysanotus sparteus	*
Thysanotus thyrsoideus	*
Trachymene pilosa	*
Tricoryne elatior	*
Tripterococcus brunonis	*
Xanthosia candida	*
Xanthosia huegelii	*