



Bremer Bay Cross Runway Construction

Environmental Surveys 2024

28 May 2024



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Prepared for:

Shire of Jerramungup
8 Vasey Street
JERRAMUNGUP, 6337

Project reference: GSBL566-Bremer Airfield TEC and Pc-V2

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Record of Distribution

No. of copies	Report File Name	Report Status	Date	Prepared for:	Initials
1	GSBL566-Bremer Airfield TEC and Pc	V2	28 May 2024	Shire of Jerramungup	JS
1	GSBL566-Bremer Airfield TEC and Pc	V2	28 May 2024	GSBL	JS

EXECUTIVE SUMMARY

The Shire of Jerramungup is planning the development and construction of a second runway for its airfield located on Don Ende Drive in the Town of Bremer Bay.

As the construction of the cross runway will require clearing of remnant native vegetation, the Shire of Jerramungup submitted a referral to the Australian Government, Department of Climate Change, Energy, Environment and Water (DCCEEW) under the Environmental Protection and Biodiversity Conservation Act, 1999 (EPBC Act). The submission was supported by various site assessments defining environmental factors including the occurrence of the *Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia*, Threatened Ecological Community (Kwongkan TEC) (DoE 2014a, 2014b) and the occurrence of Phytophthora Dieback. The original assessments were undertaken in 2019 and 2020, respectively, and due to the time elapsed since these original assessments the original data requires review and re-survey.

The survey of vegetation and flora of the proposed runway extension and surrounding context area was reviewed and used as a basis for the design of the field survey. The review considered the methods used and results regarding the extent and condition of the Banksia Shrubland (Kwongkan TEC 100%) and Mallee Heath (Kwongkan TEC 50%) and other vegetation types recorded in the survey area.

Representative sites in the vegetation types mapped during the original survey were selected from which to obtain evidence of vegetation and floristics such as vegetation type, composition, structure and condition, in line with the EPA (2016) Guidance and the scope of works.

The survey considered and reviewed the characteristics and condition threshold definitions for the Kwongkan TEC provided by the Approved Conservation Advice for the Kwongkan TEC, which also informed 2019 study.

The Kwongkan TEC was confirmed to be present as vegetation units defined as S1 Banksia Shrubland (100% Kwongkan TEC) and the M1 Mallee Heath (50% Kwongkan TEC). These vegetation units were consistent with the Kwongkan TEC characteristics and occupied the majority of the survey area and proposed clearing footprint. They were also noted to occur extensively in surrounded areas of remnant vegetation.

The Kwongkan TEC 100% and TEC 50% vegetation of the cross-runway Survey Area was found to be in generally *Pristine Condition*, save for some sites alongside and adjacent to tracks, fences and the existing runway including drains, where the conditions was found to be in *Excellent* and *Very Good Condition*. The presence of Phytophthora Dieback in one location also caused the vegetation condition in that area to be classified as *Very Good Condition*.

A significant vegetation conservation and management challenge is presented by the presence of Phytophthora Dieback confirmed to be present by this survey, particularly due to the range of susceptible plants in the S1 Banksia Shrubland (100% Kwongkan TEC) and M1 Mallee Heath (50% Kwongkan TEC) vegetation types.

Phytophthora Dieback was identified in vegetation to the north of the existing runway. The infested area is associated with a drain that carries stormwater from the runway into adjoining

vegetation and was confirmed from 3 positive soil and tissue sample results. Where *Phytophthora Dieback* was identified, it was observed to be having a significant impact on vegetation. Because the pathogen spreads rapidly in drainage lines and the Bremer Airfield is situated high in the topographical profile, there is an inherent risk of the disease spreading offsite through infested drainage. To limit the extent of offsite drainage and associated disease spread, it is important that the disease is not spread further by human vectoring of the disease around the proposed new runway during construction works. A site specific operational hygiene plan will be required to be developed and implemented.

Both the Kwongkan 100% and Kwongkan 50% vegetation types of Reserve 24521 are locally significant and of conservation value. While the impact upon these values is locally significant and unavoidable in the circumstances, it can be partially mitigated through the implementation of relevant whole or sections of Priority Conservation Actions of the *Approved Conservation Advice*.

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1 INTRODUCTION

1.1 Background

The Shire of Jerramungup is planning the development and construction of a second runway for its airfield located on Don Ende Drive in the Town of Bremer Bay.

As the construction of the cross runway will require clearing of remnant native vegetation, the Shire of Jerramungup submitted a referral to the Australian Government, Department of Climate Change, Energy, The Environment and Water (DCCEEW) under the Environmental Protection and Biodiversity Conservation Act, 1999 (EPBC Act). The submission was supported by various site assessments defining environmental factors including the occurrence of the *Proteaceae Dominated Kwongkan Shrublands of the Southeast Coastal Floristic Province of Western Australia*, Threatened Ecological Community (Kwongkan TEC) (DoE 2014a, 2014b) and the occurrence of Phytophthora Dieback. The original assessments were undertaken in 2019 and 2020, respectively, and due to the time elapsed since these original assessments the original data requires review and re-survey.

The associated surveys required to update these datasets were undertaken in an area referred to as the Survey Area, as shown on Figure 1. The Survey Area lies within the Esperance Plains Interim Biogeographic Regionalisation of Australia (IBRA) Region (DoE 2014c). State-wide pre-European vegetation mapping (Shepherd *et al.* 2002) shows that the Survey Area's native vegetation includes Mallee-heath: mixed heath with scattered mallees e.g., *Eucalyptus tetragona* (*E. pleurocarpa* *vegetation association 47).

The Kwongkan TEC is formally known as *The Proteaceae Dominated Kwongkan Shrublands ecological community of the southeast coastal province of Western Australia*. It is a type of shrubland and heathland found on the coastal and subcoastal plains of southern Western Australia, from Mt Manypeaks and the Stirling Range in the west to Mt Ragged and Pt Culver in the east. The community is dominated by plants of the Proteaceae family in genera including Adenanthos, Banksia, Conospermum, Grevillea, Hakea, Isopogon, Lambertia and Petrophile, which finds it included in the Mallee-heath association of Shepherd *et al.* (2002).

The Kwongkan TEC is listed as Endangered under the national EPBC Act, being impacted by multiple threatening processes including Phytophthora Dieback, to which it is particularly susceptible. The TEC is considered to be under severe level of threat and in need of special protection. The Threatened Species and Scientific Committee's Conservation Advice (DoE 2014b) provides guidance on management and research for Kwongkan TEC conservation and restoration. Further, listing of the community under the EPBC Act requires that any activity that is likely to impact the ecological community will need formal referral for an environmental impact assessment and approval (DoE 2014a).

Phytophthora Dieback is an introduced soil borne plant pathogen that affects up to 40% of native plant species within Western Australia. Most commonly the disease is caused by the species *Phytophthora cinnamomi*, however, other species such as *P. multivora* can also have significant impact under specific environmental conditions. Phytophthora Dieback is commonly introduced to an area through infested soils carried as basic raw materials or as dirt on vehicles, plant and machinery. In favourable conditions the pathogen can result in the collapse of entire vegetation communities. Once introduced to an area, Phytophthora Dieback will spread through further human vectoring and also via water movement and

root to root contact, resulting in extensive infestations which may cause significant impact to native vegetation communities. There is currently no practical method of eradication of the pathogen.

Invasive weeds pertinent to the Survey Area have been listed by DCCEEW (EPBC ref 2019/8434) as including Victorian tea-tree (*Leptospermum laevigatum*), Sydney golden wattle (*Acacia longifolia*), Taylorina (*Psoralea pinnata*) Blackberry (*Rubus fruticosus aggregate*), Boxthorn (*Lycium ferocissimum*) and Bridle Creeper (*Asparagus asparagoides*).

1.2 Scope of Works

In order to review and update the original environmental survey information, the Shire of Jerramungup engaged Great Southern Bio Logic to undertake vegetation, Phytophthora Dieback and weed occurrence surveys across the proposed Survey Area as shown in Figure 1. The original survey area was consistent with the previous 2020 Dieback survey area, limited to the extent of the proposed clearing. As requested by DCCEE, the survey area has subsequently been extended to include the proposed clearing area and the extent of the Shire Reserve 24521, north of the proposed clearing area only. The scope of works undertaken is presented below:

- A field re-check of existing Kwongkan TEC occurrence data and classifications
- an operational scale Phytophthora Dieback assessment of the Bremer Airfield Survey Area
- an occurrence assessment for Declared Plants, Weeds of National Significance (WoNS) and specified weed species listed in the request for additional information letter from the DCCEE. The weed assessment included the Survey Area and associated access routes.
- Review of the Operational Hygiene Management Plan (OHMP) for implementation during proposed works on the site.

1.3 Site Characteristics

The Bremer Bay Airfield is situated approximately 4 km to the north east of the Bremer Bay townsite on the south coast of Western Australia. The airfield is situated within Shire of Jerramungup Reserve 24521 and accessed from the south along Don Ende Drive. The proposed cross runway is to be aligned from the south east to the north west, crossing the existing runway. The total project area, shown in Figure 1 and identified as the Survey Area, is approximately 184 ha and is currently predominantly vegetated, with the exception of the intersection with the existing runway.

The existing site facilities are fenced to exclude uncontrolled access, however, the proposed cross runway alignment is currently unfenced. On site facilities include an aircraft hanger, water storage and refuelling pad for aerial water bomber support, runway lighting and minor site buildings. To the south and west of Reserve 24521 there is privately owned, cleared agricultural land and to the north and east is the Fitzgerald River National Park (FRNP), managed by the Department of Biodiversity Conservation and Attractions (DBCA).

The Survey Area is gently undulating and situated on an elevated ridgeline that drains to all sides. Notably, drainage from the northern section of the proposed cross runway drains north and west into a major creek system that flows into the Wellstead Estuary. This creek system forms the southern boundary of the FRNP and adjoining Reserve 24521.

1.3.1 Topography

The Bremer Bay Airfield is approximately 4 km west of the Bremer Bay townsite and adjoins the southern boundary of the FRNP. It is situated on elevated ground that is described as gently undulating. The proposed new runway alignment covers a local high point to the north west.

There is a major tributary of the Wellstead Estuary to the north of the airfield, situated within the FRNP, and a minor tributary to the Wellstead Estuary to the south of the airfield. This results in all drainage from the airfield eventually entering the estuary. The topography to the north of the airfield and proposed new runway becomes moderately steep due to the influence of the major tributary.

2 REGULATION AND MANAGEMENT

2.1 Legislative Framework

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) lists the *Proteaceae Dominated Kwongkan Shrublands ecological community of the southeast coastal province of Western Australia* (Kwongkan TEC) as an Endangered vegetation community (DoE 2014a, 2014b). The same Act identifies *Phytophthora Dieback* as a key threatening process that poses a significant threat to biodiversity values within Australia.

The Western Australian *Biodiversity Conservation Act* (2016) and the associated DBCA Species and Communities Program list the Kwongkan Ecological Community as a Priority Ecological Community (PEC) Priority 3 (iii). These categories reflect a possible TEC that does not meet State survey or definition criteria and they are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities (DBCA 2023).

The Commonwealth Approved Conservation Advice for *Proteaceae Dominated Kwongkan Shrublands of the southeast coastal floristic province of Western Australia* (Approved Conservation Advice) (DoE 2014b) and existing relevant management and recovery plans (CALM 1991; DEC 2012) provide direction to avoid and mitigate against key threats.

Phytophthora Dieback policy prepared under the EPBC Act includes the national Threat Abatement Plan (TAP) for disease in natural ecosystems caused by *Phytophthora cinnamomi* (TAP) (Commonwealth of Australia (CoA) 2018), and recovery plans for threatened flora species and threatened ecological communities that include Dieback management considerations.

The TAP (CoA 2018) establishes a national framework to guide and coordinate Australia's response to *Phytophthora Dieback*. This identifies research, management and other actions to mitigate impact of the pathogen to natural values.

Legislation, policies and strategies that underpin weed management in Western Australia includes the Australian Weeds Strategy, the Biosecurity and Agriculture Management Act, 2007, WA Organism list and DBCA Corporate Policy Statement 14: Weeds Management.

2.2 Current Western Australian Management

Current management of the Kwongkan TEC is predominantly undertaken by the DBCA's Parks and Wildlife Service, through implementation of the *Biodiversity Conservation Act* (2016) and the *Conservation and Land Management Act* (1984). DBCA also implements the conservation advices from the Commonwealth including the Approved Conservation Advice (DoE 2014b); recovery plans including the recovery Plan for Fitzgerald Biosphere (DEC 2012); State protected area management plans such as the Fitzgerald River National Park Management Plan (CALM 1991); and periodical research and management initiatives such as *Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management Region* (Barrett *et al.* 2009).

In Western Australia, *Phytophthora Dieback* management is regulated by the DBCA through implementation of the *Biodiversity Conservation Act* (2016) and the *Conservation and Land Management Act* (1984). The DBCA also has certain statutory obligations under the *Biosecurity and Agriculture Management Act* (2007) concerning biosecurity matters generally, including *Phytophthora*.

In Western Australia, management of *Phytophthora Dieback* is overseen by the DBCA. The DBCA's primary tool for the management of *Phytophthora Dieback* in WA is the *Phytophthora Dieback Management Manual* (PDMM (DBCA 2020)). This document identifies methods and requirements for minimising disease spread and mitigating impacts of the disease on vegetation on lands managed by the DBCA. It is assumed that the objectives of the PDMM are aligned with the National Threat Abatement Plan.

2.2.1 TEC Assessment

The WA Environmental Protection Authority (EPA) terrestrial biodiversity survey standards *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016) provides detailed guidance on the type and design of surveys for environmental impact assessment, such as the survey reported herein.

2.2.2 *Phytophthora Dieback* Assessment

In Western Australia, assessment and management of *Phytophthora Dieback* is overseen by the DBCA who regulate standards, implementation of hygiene and maintain a registration system for appropriately qualified *Phytophthora Dieback* Interpreters. The DBCA's primary tools for the management of *Phytophthora Dieback* in WA include the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA 2015) and the *Phytophthora Dieback Management Manual* (DBCA 2020).

The Dieback Working Group also contribute to *Phytophthora Dieback* management in Western Australia through the development and distribution of management guidelines for community and industry groups. *Standard Dieback Signage - protocols for use* (Project Dieback, 2008) guides standardised signage across tenures to raise awareness and mitigate disease spread.

The *Phytophthora Dieback Interpreters Manual for Lands managed by the Department* (DBCA 2015) presents defined *Phytophthora Dieback* assessment methodologies. It identifies several assessment methods that provide for either linear or non-linear assessment. Assessment methods may vary depending on the project type, disturbance activity and objectives of the assessment.

While this document refers to lands managed by the DBCA, it is recognised in Western Australia as Industry best practice and is routinely applied to both State agency and private estate.

DBCA (2015) guidelines identify six potential disease hygiene categories based on presence/absence of the disease, or the unknown disease status of an area. An area can have an unknown disease status if the vegetation at the site is not susceptible to the disease or it cannot be assessed because of disturbance, e.g., fire. As a result, even if the pathogen is present, there may be no interpretable signs.

Only areas with suitable remnant native vegetation can be assessed. Areas that have been cleared or significantly altered are excluded from survey. In some cases, small, excluded areas may be afforded a hygiene category if they are small enough to be influenced by adjacent surveyed vegetation or situated such that topographical influences can be used to determine disease presence or absence.

The six possible disease categories are listed and described below:



1. **Infested** – Areas a registered interpreter determines to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi*
2. **Uninfested** – Areas determined by a registered interpreter to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*
3. **Uninterpretable** – Natural, undisturbed areas where susceptible plants are absent, or are too few to make a determination of the presence or absence of *P. cinnamomi*
4. **Temporarily uninterpretable** – Areas where disease presence or absence cannot be determined due to a level and type of site disturbance that will recover within the short to medium term, e.g., fire, rehabilitation
5. **Not yet resolved** – *Phytophthora* occurrence diagnosis cannot be made because of inconsistent or incomplete evidence (including sample results). The category is only to be used in low interpretability zones (400 mm to 600 mm rainfall range) and
6. **Disease risk roads (DRR)** – Interpreters will use the DRR category to show the disease status is unknown because of suspected or apparent recent use under unknown hygiene conditions.

Following the determination of disease categories, protectable areas are identified to determine areas that are likely to remain free from the disease with the application of appropriate disease hygiene as required.

Protectable areas are defined in the *Phytophthora Dieback Interpreters Manual for Lands managed by the Department* (2015) as areas that:

- have greater than 600 mm of annual rainfall or are water gaining sites in the 400 mm - 600 mm rainfall zone
- are determined to be free from *Phytophthora cinnamomi* by a DBCA registered disease interpreter. Uninterpretable areas may be classified as protectable
- comprehensive transect assessment areas that are positioned in the landscape and are of sufficient size that they will not be engulfed by *Phytophthora* via autonomous spread. Such an area is defined as being greater than 4 ha with a minimum axis greater than 100 m, and not down slope of an infested area
- linear assessment areas longer than 100 m after the application of appropriate disease category buffers
- have controllable human vectors and/or
- include high conservation and/or socio-economic values.

3 METHODS

3.1 Kwongkan TEC Survey

3.1.1 Desktop Review

The Southern Ecology (2019) report including mapping of the vegetation and flora of the proposed runway extension and surrounding context area was reviewed and used as a basis for the design of the field survey reported herein. The review considered the methods used and results on the extent and condition of the Banksia Shrubland (Kwongkan TEC 100 %) and Mallee Heath (Kwongkan TEC 50%) and other vegetation types recorded, as well as the locations and number of the floristic data collection used to support the findings. The vegetation types identified follow Shepherd et al. (2002).

The Kwongkan TEC Approved Conservation Advice DoE (2014b) that informed the 2019 study, and which applies to this Kwongkan TEC Survey was also reviewed, particularly Section 1.5. *Key Diagnostic Characteristics and Condition Thresholds*.

Maps of the airfield showing the cross-runway assessment area within Reserve 24521 were provided by Great Southern Biologic. The map showing the vegetation type including the Banksia Shrubland (100% Kwongkan TEC) and Mallee Heath (50% Kwongkan TEC) distribution and extent, and floristic data collection locations from the Southern Ecology (2019) report was copied and used to guide the field survey.

3.1.2 Field Survey

The field survey was undertaken by an experienced landscape and vegetation ecologist, Nathan McQuoid, during 11, 12 and 13 December 2023. Flora Taking (Biological Assessment) Licence Number FB62000466, current until 29 August 2025 is held. A key to allow access to the airfield was made available by the Shire of Jerramungup.

No previous spatial data related to mapping of the vegetation communities at the Survey Area was available, however, the Southern Ecology (2019) map showing the vegetation types including the Banksia Shrubland (100% Kwongkan TEC) and Mallee Heath (50% Kwongkan TEC) distribution and extent, and floristic data collection locations was used to guide the field survey.

Spatial data of the existing and proposed runway Survey Areas and Reserve 24521 boundaries was provided by Great Southern Bio Logic. These were loaded onto a Garmin 76 hand-held GPS for field survey use.

The field survey included an overview of the area to match on-ground Kwongkan TEC occurrences with the vegetation mapping and data collection locations from the 2019 assessment. The overview comprised assessment of internal and broader area access tracks and short walking traverses to cross-check vegetation present with 2019 vegetation mapping within the context and location of the cross-runway development area.

Representative sites in the vegetation types mapped in 2019 were selected from which to obtain evidence of vegetation and floristics as vegetation type, composition, structure and condition, using the Perth Bushlands (Keighery 1994) data collection by relevé method. Field data at selected relevé sites was recorded using a field survey sheet and GPS locations were recorded by Garmin 76 hand-held GPS unit.

Data collected included location, landform and substrate, vegetation type, composition (as dominant plant taxa), structure and condition by relevé using the Perth Bushlands (Keighery 1994) methodology. This method supports a comprehensive assessment of site attributes and vegetation composition, structure and condition.

The Perth Bushlands (Keighery 1994) vegetation and floristics survey data sheet includes condition categories (Appendix A), which match the condition criteria of the EPA (2016) Vegetation Condition Scale as used in the original survey.

As described in Section 4, the results of the TEC review concurred with the original survey outcomes. However, as the original survey spatial data was not available, the data presented in Figure 2 was created using relevé data and observations from the current survey in combination with a hard copy map and aerial imagery to re-create the original TEC occurrence maps. This results in minor variations between original and review mapping.

This method is consistent with the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* ‘targeted survey’ (EPA 2016), considered suitable for a field survey designed to meet the survey scope; a review and on-ground assessment of the extent and condition of the Banksia Shrubland (100% Kwongkan TEC) and Mallee heath (50% Kwongkan TEC) recorded by the Southern Ecology (2019) study.

3.2 Phytophthora Dieback Occurrence Survey

Due to the mobility of the disease through autonomous spread and human vectoring, all operational scale disease occurrence data has a limited life of 12 months which may be extended to three years with annual recheck surveys. As the original survey was performed in October 2020, a full Comprehensive Transect survey was performed. This method is consistent with the DBCA guideline, *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). The information produced using this method of survey provides operational level disease hygiene information for application across all assessable vegetation within the Survey Area.

A summary of key survey activities is provided below.

3.2.1 Desktop Interpretation

The Survey Area was subject to an initial desktop assessment involving a review of available previous assessment reports and spatial data (ELA 2016, 2014), the Vegetation Health Service (VHS) *Phytophthora* sample database and examination of available aerial imagery to assess:

- the extent of assessable remnant native vegetation occurring within the Survey Area
- the known occurrence of *Phytophthora Dieback* within or influential to the Survey Area
- the occurrence of site specific or influential high risk disease vectors including but not limited to roads, creek lines and gravel pits and
- evidence of existing disease signatures such as areas of obvious vegetation decline.

3.2.2 Field Survey

The operational scale comprehensive transect survey was undertaken by a DBCA registered disease interpreter (Reg. No. DPW-PDI-018), during December 2023 and January 2024. It included diagnosis of the disease within assessable remnant vegetation across the Bremer Bay Airfield Survey Area. The

Comprehensive Transect Survey method involves walking transects, spaced at 50 m, through non-linear areas of vegetation.

Visual diagnosis involves identification of susceptible species deaths occurring in patterns consistent with disease spread, such as radiating from an identified vector. Plant deaths associated with *Phytophthora* are rapid and complete rather than partial. Further, the disease presents a chronologic pattern of deaths, with the oldest deaths closest to the disease vector and most recent deaths further from the vector, forming a disease front.

Visual diagnosis can be confirmed through the collection and analysis of representative soil and tissue samples collected from a sub-set of indicator species deaths. Positive sample recoveries used to determine disease presence may include historic positive *Phytophthora* recoveries, recorded on the VHS positive sample data base, with direct influence over a site. The extent of disease occurrence is mapped using topography and visual evidence consistent with expression associated with positive sample recoveries.

Field data including disease presence and vegetation interpretability information was collected using a hand-held GPS unit and converted to ArcGIS™ shapefiles. Collected field data includes point files recording uninfested vegetation, unsusceptible vegetation and identified individual plant deaths attributed to *Phytophthora*. Field data also includes track files showing disease hygiene boundaries demarcated during survey.

3.2.3 Sampling Program

Visual diagnosis was supported by laboratory assessment of soil and tissue samples. As defined in *Phytophthora Dieback Interpreters Manual for Lands managed by the Department* (DBCA 2015), soil and tissue samples were collected from representative individual disease indicator species deaths located across the site. Sample results were then used to inform the likely cause of death of other disease indicator species exhibiting similar symptoms in similar vegetation units across the Survey Area.

Sampling for *Phytophthora* Dieback involves the collection of soil and tissue samples from fresh deaths of plants considered to be reliable indicator species of *Phytophthora* expression. Where suspicious deaths are identified, soil and root tissue material is collected into heavy duty plastic bags and forwarded to the Vegetation Health Service (VHS) laboratory for analysis.

3.2.4 Demarcation

Demarcation of disease hygiene boundaries was performed in accordance with the requirements defined in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). Flagging tape used for demarcation of hygiene boundaries is defined below:

- Infested vegetation – Dayglo Pink tape
- Uninterpretable – Pink and Black striped tape
- Protectable Uninterpretable – Double banded pink and black striped tape
- Uninfested – No demarcation

Demarcation tapes are tied on trees and other suitable bushes or shrubs, along the category boundary. Knots on the demarcation tapes face the category being demarcated. When demarcating infested or uninterpretable vegetation adjoining uninfested vegetation, the tapes are placed 10 – 15 m into the uninfested vegetation to allow a buffer between the hygiene categories.

3.3 Targeted Weed Survey

As defined in the DCCEE request for additional information (EPBC ref 2019/8434), weeds are defined as including Victorian Tea-tree (*Leptospermum laevigatum*), Sydney Golden Wattle (*Acacia longifolia*), Taylorina (*Psoralea pinnata*) Blackberry (*Rubus fruticosus aggregate*), Boxthorn (*Lycium ferocissimum*) and Bridle Creeper (*Asparagus asparagoides*). Plants classified as either Declared Plants (DP) or Weeds of National Significance (WoNS) were also considered during the assessment.

3.3.1 Weed Desktop Assessment

Prior to undertaking the field-based weed survey a detailed desktop assessment was undertaken. The detailed desktop assessment included a review of on-line databases to search for known occurrences of target weeds occurring within the vicinity of the alignment

Information gathered during the desktop assessment was used to compile a list of potential target weeds that were anticipated to potentially occur along the alignment. Prior to the field surveys, weed species that had the potential to occur within the airfield were researched and a field guide of potential species developed to aid identification.

3.3.2 Weed Field Survey

The weed survey was undertaken on 12 December 2023. The weed survey was performed with reference to the methods for a targeted survey defined in the *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA 2016). It is, however, noted that the methods in this guideline are primarily intended for surveys of native flora and vegetation that may occur widely across all areas rather than introduced species that are likely to occur in disturbed areas where a human vector that can introduce the weeds to an area is present.

Survey effort included walking traverses spaced approximately 50 m apart, across the Survey Area. Due to the likelihood of weeds establishing in disturbed areas, a higher survey intensity was applied to areas associated with cleared agricultural land, high use access tracks and the existing runway.

4 RESULTS AND DISCUSSION – KWONGKAN TEC SURVEY

4.1 Desktop Review

The Southern Ecology (2019) study review examined the extent distribution and condition of four vegetation types: S1 Banksia Shrubland (Kwongkan TEC 100%); S2 *Phymatocarpus* shrubland; M1 Mallee Heath (50% Kwongkan TEC); and Other *Eucalyptus* spp. Woodland.

The 2019 study considered the characteristics and condition threshold definitions for the Kwongkan TEC provided by DoE (2014b). These definitions and the recommended Buffer Zone (Appendix B) also inform this Kwongkan TEC Survey.

The 2019 study also recorded floristic and condition data at nine sites within the area of the cross-runway assessment area in three of the four vegetation types. The floristic data provided supporting evidence of the vegetation types present in the broader airfield reserve as the context area and the areas for the cross-runway extension and associated infrastructure. This mapping and data provided the basis for the design and implementation of this survey. A search and review of legislation and management guidelines relating to the Kwongkan TEC at the Bremer Bay airfield site, identified the following guidance, management and recovery plans, and conservation recommendations (Appendix C):

- Guide to Proteaceae - Dominated Shrubland: A Nationally-protected Ecological community, and the Kwongkan TEC Conservation Advice (DOE 2014b);
- WA Priority Ecological Community List (DBCA 2023);
- Recovery Plan for Fitzgerald Biosphere (DEC 2012);
- Fitzgerald River National Park Management Plan (CALM 1991); and,
- Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management region (Barrett et al. 2009).

The conservation management recommendations of these publications (Appendix C) can be distilled as:

- Conserve, restore and connect Kwongkan TEC.
- Protect the Kwongkan TEC and vegetation types from *Phytophthora Dieback* and altered hydrology.
- Ensure appropriate fire regimes are understood and maintained (long fire intervals have been found to be required (Barrett et al 2009; Hopper 2009; Hopper et al 2021).
- Monitor Kwongkan TEC for changes in extent and condition.
- Increase the profile and value perception of the Kwongkan TEC in the community.

4.2 Field Survey

Kwongkan TEC Vegetation

The field survey was undertaken by an experienced vegetation ecologist over three days, December 11 to 13, 2023.

The field survey established thirty-two floristic relevé sites across the site, including the Survey Area and with additional survey effort undertaken within the surrounds to review vegetation types reported in the original survey. Four vegetation types were recorded (Figure 2).

The relevé site data and the traverse of the s Survey Area and surrounds confirmed the presence, extent and distribution of the four vegetation types recorded and interpreted in the original 2019 study, as S1 Banksia Shrubland (100% Kwongkan TEC), S2 *Phymatocarpus* dominated shrubland; M1 Mallee heath (50% Kwongkan TEC); and Other *Eucalyptus* spp. woodland (Figure 2).

The Kwongkan TEC was confirmed to be present as S1 Banksia Shrubland (100% Kwongkan as 4.62 ha of the Survey Area (Figure 2).

The M1 Mallee Heath (50% Kwongkan TEC) was confirmed to be present as 48.54 ha of the Survey Area, (Figure 2).

Vegetation types S2 *Phymatocarpus* shrubland and Other *Eucalyptus* spp. Woodland, were confirmed to comprise 3.63 ha of the Survey Area (Figure 2).

Discerning the four vegetation types across the Survey Area and surrounds (Figure 2) was able to be carried out with confidence due to their distinctive structure and composition, and the support of the relevé data (Appendix D).

The thirty-two relevé sites covered the occurrences of the two Kwongkan vegetation types present across the Survey Area and surrounds as a traverse survey, and to review and compare the floristic structure and composition and vegetation condition recorded by the Southern Ecology (2019) study of the Survey Area.

The variability of the M1 Mallee Heath (50% Kwongkan TEC) as described and discussed in the original study was confirmed by the relevé data and the survey traverse, including the variability of this Kwongkan matching the DoE (2014b) definition. This interpretation and site circumstance shows that both Kwongkan vegetation types either fully comprise or partially comprise the Kwongkan TEC (DoE 2014b) depending on sand depth (Southern Ecology 2019) and should be treated and managed as equal despite their technical variability. As such, they have been considered and mapped together with a 30 m buffer applied as shown in Figure 3 (DoE 2014b), for the evaluation of cross-runway development impact and the most practical conservation of the remainder.

The technical variability of the Kwongkan TEC within the broad M1 Mallee Heath (50% Kwongkan TEC) is an artifact of the listing description and interpretation process, which at the time considered that a 30% or greater cover rating would be sufficient to describe the common occurrence of Proteaceae family plants within the broad M1 Mallee Heath vegetation type common across the region. However, this and other studies have shown that a figure of 25% would have been a more accurate rating to ensure the substantive variability of Proteaceae occurrence was effectively interpreted. This situation provides for both 100% and 50% Kwongkan TEC's to be considered as one (Figure 3) for this survey and impact assessment.

The area to the north of the airfield within Reserve 24521, north of the east west track, which was recorded as recently burnt in the 2019 study was observed to remain in a state of post-fire recovery at the time of this December 2023 field survey. As such, it is difficult to interpret accurately for the presence and condition of the Banksia Shrubland (100% Kwongkan TEC) or Mallee Heath (50% Kwongkan TEC).

Vegetation Condition (EPA 2016; Appendix A) was found to be Pristine at all relevé locations except one, site 18 off the western end of the existing runway. Relevé site 18 had been mechanically slashed to reduce its height, and as such scored as Excellent (Figure 4; Appendix A).

The 2019 study found all of the vegetation to be in 'Excellent' condition, noted as 'no obvious signs of permanent disturbance, some kangaroo browsing and trampling and no obvious symptomatic evidence of *Phytophthora Dieback* due to the position of the area high in the landscape'. It is not stated in Southern Ecology (2019) but assumed here that 'Excellent' condition is the EPA (2016) definition (Appendix A). Notwithstanding, this 2023 Kwongkan TEC survey found the vegetation at the 32 relevé sites in all but one case, to meet the EPA (2016) definition of *Pristine Condition*, and site 18 to meet *Excellent Condition* given its human impact history.

As shown in Figure 4, Vegetation in the majority of the Survey Area and surrounds was found to be in *Pristine Condition*, save for some sites alongside and otherwise adjacent to tracks, fences and the existing runway including drains, which were found to be in *Excellent* and *Very Good Condition* (EPA 2016; Appendix A). The presence of *Phytophthora Dieback* in one location to the north of the existing runway was confirmed during this survey (see Section 5). The confirmed presence of the pathogen results in this area being graded as *Very Good Condition*. This includes relevé site 17.

A significant vegetation conservation and management challenge is presented by the presence of *Phytophthora Dieback* confirmed by this survey, particularly due to the range of susceptible plants in the S1 Banksia Shrubland (100% Kwongkan TEC) and M1 Mallee Heath (50% Kwongkan TEC) vegetation types (Figure 2), and the Airfield site's relatively high topographic.

4.3 Vegetation Clearing Impact

The Kwongkan TEC vegetation of Reserve 24521 is locally significant and a conservation asset. The area is recognised in the conservation community for its quality and accessible Kwongkan vegetation and as habitats for rare birds (Prof. J. Watson UQ pers comm).

Impact on S1 Banksia Shrubland (100% Kwongkan TEC) and M1 Mallee Heath (50% Kwongkan TEC) by the cross-runway development will be significant on a local scale. While both Kwongkan communities are relatively common in the district, in parts of Fitzgerald River National Park adjacent and further afield (DoE 2014b), in road and river reserves and as remnants on private land adjacent and nearby (FBG 2010; N. McQuoid pers. obs.), the impacts of the proposed cross runway clearing will remove areas of both the S1 Kwongkan and M1 Kwongkan. However, while the impact is locally significant and unavoidable in the circumstances (critical airfield runway infrastructure), it can be partially mitigated through the implementation of relevant *Priority Conservation Actions* identified within the *Approved Conservation Advice* (DoE 2014b), either wholly or partially. The *Priority Conservation Actions* are presented below:

- Support existing research, mapping and monitoring and control methods for *Phytophthora cinnamomi* (or dieback from other plant pathogens, such as *P. multivora* or aerial canker-causing fungi) within the ecological community.
- Support existing research into fire histories of patches and identify appropriate fire regime requirements of both flora and fauna in the ecological community for biodiversity conservation.

- Protect and conserve remaining areas of the ecological community. Further clearance of this Endangered ecological community and nearby native vegetation including connecting corridors should be prevented.
- Ensure that remnants of particularly high quality, connectivity or importance in a landscape context are carefully managed, and include in reserve tenure, where possible.
 - The S1 and M1 Kwongkan TEC vegetation in Reserve 24521 will remain connected post clearing, which will assist with its function for ecological connectivity and as habitat.
- Monitor known sites to identify key threats and determine changes in condition.
- Liaise with local councils and State authorities to ensure road widening and maintenance activities (or other infrastructure or development activities) involving substrate or vegetation disturbance in areas where the ecological community occurs do not adversely impact the ecological community. This includes avoiding the introduction or spread of weeds and *Phytophthora cinnamomi* into areas not yet infested, for example by ensuring appropriate hygiene practices are in place.
 - Further infestation of *Phytophthora* Dieback to uninfested vegetation during the implementation of this cross-runway development and associated works (access tracks, fencing) is a major concern. As such strict Dieback Hygiene protocols, including development and implementation of an *Operational Hygiene Management Plan* is required.
- Liaise with local councils and State authorities to ensure that cumulative impacts, from activities undertaken as part of broader or related projects (e.g., road works, developments), are reduced when planning individual activities.
- Support local patch management through local conservation groups and regional bodies (e.g., Natural Resource Management agencies, Landcare and catchment groups, local government).
- Target control of key weeds that threaten the ecological community using appropriate methods. Manage sites to prevent the introduction of new, or further spread of, invasive weeds.
- Ensure chemicals, or other mechanisms used to manage weeds, do not have significant adverse, non-target impacts on the ecological community.
- Manage fires in adjacent vegetation and buffer zones e.g. ensure appropriate fuel load and buffer management in adjacent ecological communities is undertaken to minimise the risk of inappropriate fire regimes in the ecological community. Exclude fire where appropriate (most Kwongkan is long-lived and fire return at intervals closer than at least three or more decades is detrimental).
- Negotiate appropriate operating procedures with local fire authorities, in relation to establishing and maintaining fire control lines, to avoid destruction of the ecological community or potential introduction of plant pathogens from contaminated machinery or other means.
- Raise awareness about important fauna habitat, such as large native shrubs and Proteaceous species.

- Support seed harvesting and propagation techniques (having acquired the necessary permits and land access permission required) for Proteaceae Dominated Kwongkan Shrubland species not already available from nurseries to facilitate the species diversity in revegetation sites.
- Ensure that any revegetation is undertaken in an appropriate manner (e.g. with no significant detrimental impacts on local hydrology or threatened species).
 - Cleared plant material and topsoil availability provides a rare and vital opportunity for Kwongkan restoration on cleared and degraded lands nearby. This donor material gathered up, transported and spread onto prepared sites (shallow scalps in sandy sites in paddocks) in dry soil conditions, is ideal for high-quality restoration. The opportunity to implement such a program would bring some conservation value to this infrastructure development program. Local land owners interested in vegetation restoration on their properties are willing to assist with the development of this program through the supply of restoration sites for the donor material (P. Wishart pers. comm.).

4.4 Limitation of Results

In accordance with the EPA (2016) Technical Guidance – Flora and Fauna Surveys for Environmental Impact Assessment, an assessment of potential limitations was undertaken and provided (Table 3), No limitations were identified that might affect the reliability of the results of the field survey reported herein.

Table 3. Assessment of potential survey limitations (EPA 2016)

Potential for Limitation	Assessment
Availability of contextual information	Previous survey (Southern Ecology 2019), which included vegetation descriptions, hard copy mapping and floristics data, was available to provide an appropriate level and amount of contextual information.
Personnel experience	The Botanist undertaking the field survey has 35 years-experience in nature conservation management, including 16 years-experience in flora and vegetation surveys, primarily in the Esperance Plains and Mallee Bioregions of WA. This experience includes developing the application that supported the listing of the Kwongkan TEC in 2014.
Proportion of flora recorded or identification issues	Flora comprising Kwongkan vegetation types and their condition, as the focus of this survey, are able to be identified relatively easily regardless of their flowering status due to their habit, habitat and structural characteristics within the context of the vegetation and soil types they occupy. The information available as Southern Ecology (2019) report was adequate for collaborating field identification.
Survey extent and site access	The Survey Area was able to be identified due to mapping and spatial data provision and was well-accessed by vehicle and on foot. The area was covered with sufficient intensity over three days to investigate vegetation types and condition.
Survey timing	The survey was conducted in early summer, which is adequate for a vegetation type and condition follow up assessment of this type.

Seasonal conditions	Below average rainfall had occurred at the site since June 2023, although the high rainfall in in June provided conditions suitable for limited flowering. Seasonal conditions were appropriate for a vegetation type and condition assessment in the area and its vegetation types.
Disturbance	The majority of the Survey Area was long unburnt and otherwise undisturbed, save for a small area of slashing to maintain low vegetation. The surrounding area to the north was some ten years post-fire and still recovering, limiting an accurate interpretation of the presence, extent and condition of Banksia Shrubland and Mallee Heath (Kwongkan) vegetation types, and as such it was excluded from this survey.

5 RESULTS AND DISCUSSION - DISEASE OCCURRENCE SURVEY

The disease occurrence, protectable vegetation and location of soil and tissue samples across the Bremer Bay Airfield Survey Area are shown in Figure 5. Appendix E presents the VHS laboratory certificates for all samples collected during the 2023-24 survey.

All comprehensive scale disease occurrence data and field demarcation have an operational life of 12 months. Following this, a recheck assessment will be required to assess active disease fronts and all uninfested categories.

5.1 Desktop Assessment

5.1.1 Previous interpretation data

The original survey undertaken in 2020 is the only previous survey across the Survey Area. There was no *Phytophthora Dieback* identified during that survey which included the collection of six soil and tissue samples that all returned negative results. There were several small areas of vegetation that were classified as uninterpretable due to an absence or low densities of susceptible species, however, the majority of the Survey Area was classified as uninfested.

A review of the VHS sample database identified multiple historic positive recoveries of the disease within ten kilometres of the airfield. Historic positive recoveries only represent confirmed disease presence at a specific location and do not define the extent of disease occurrence within an area. The nearest positive recovery of *Phytophthora* is *P. cinnamomi* located on Don Ende Drive approximately 100m south of the main entrance. This is in an area that is draining away from the Survey Area so will not result in disease vectoring through drainage. It is also on a sealed road so does not present a risk of being picked up by vehicles using the road to access the airfield.

5.1.2 Assessable remnant native vegetation

As defined in the assessment criteria presented in Section 2.2.2, only areas with suitable remnant native vegetation can be assessed for disease presence. Areas that have been cleared or significantly altered are excluded from survey (i.e., those classed as degraded or completely degraded under the Keighery (1994) condition scale). The extent of areas considered to be assessable due to the presence of remnant vegetation was initially determined during a review of available aerial imagery.

All cleared areas associated with the existing runway, the runway taxi strip, aircraft hangars and associated infrastructure at the entrance from Don Ende Drive have been excluded from survey as shown on Figure 5.

5.1.3 Climate

The Bureau of Meteorology (the Bureau) broadly classifies the climate across the south west region of Western Australia as warm summers with cold winters. The Bureau maintains a network of weather stations across Australia to record weather data, with the nearest station to the project area being Bremer Bay. The long-term average annual data from Bremer Bay shows that the annual average rainfall is 627 mm/yr however it also identifies that from the last 10 years only 2021 and 2022 recorded average rainfall with four years recording rainfall below 460mm with the lowest being only 381mm recorded in 2019.

Further analysis of the Bureau data also shows several recent months with significant monthly records, identifying recent high rainfall events. These include August 2020; 172 mm, May 2021; 130 mm, June 2021; 104 mm and July 2021; 110 mm. These figures contrast the highest long term monthly average rainfall for any month of only 87 mm, for the month of July.

Phytophthora requires warm and moist soil conditions to be active. The accepted distribution of *Phytophthora* is generally restricted by the 400 mm isohyet with distribution in the 400-600 mm/yr zone further restricted to sites with high summer rainfall averages or associated with water gaining sites. Based on the Bureau climate classification and rainfall data the Survey Area experiences suitable climatic conditions for *Phytophthora* to have an impact in water gaining sites, however the low rainfall records between 2010 and 2020 suggest likelihood of drought stress and limited historical disease expression in infested areas during that time period.

5.2 Comprehensive Transect Assessment

5.2.1 Vegetation

Vegetation across the assessed area is described below in terms of interpretability for *Phytophthora* Dieback occurrence assessment. The descriptions are not botanical classifications and should not be used as vegetation unit descriptions.

Three general vegetation types were noted. The majority of the Survey Area is defined as a low coastal heath under an open overstorey of *Eucalyptus pleurocarpa* (Tallerack Mallee). On the minor hilltop areas there was often a low coastal heath under an open *Banksia* woodland consisting of *Banksia attenuata*, *B. baxteri* and *B. coccinea*. The understorey in these areas was dominated by proteaceous species and *Xanthorrhoea platyphylla*, making them highly interpretable for the occurrence of *Phytophthora* Dieback. In limited small areas, there was a low closed heath dominated by *Melaleuca* species. These areas were uninterpretable due to lack of sufficient numbers of indicator species.

Disease indicator species used to determine the presence/absence of *Phytophthora* Dieback across the Survey Area included:

- *Banksia attenuata*
- *Banksia baxteri*
- *Banksia coccinea*
- *Banksia falcata*
- *Banksia media*
- *Banksia nutans*
- *Banksia dryandroides*
- *Banksia repens*
- *Isopogon longifolia*
- *Isopogon trilobus*
- *Lambertia inermis*
- *Xanthorrhoea platyphylla*

5.2.2 Disease Occurrence and Hygiene categories

As shown in Figure 5, a single *Phytophthora* Dieback infestation was identified across an area associated with a drainage line that carries stormwater away from the runway. The infestation was not identified during the 2020 survey, which recorded the area as containing healthy disease indicator species at the time of survey. The infested area closely aligns with evidence of surface water flows from the existing runway, evident through significant deposition of gravel silt consistent with the gravels on the existing runway. It is possible that this infestation was present in 2020 but was significantly smaller and not expressing due to a series of consecutive dry years preceding the 2020 survey (less than 410 mm in

both 2018 and 2019). It is also possible that this is a new infestation introduced through site maintenance activities. In either case, it appears that significant stormwater flows from the existing runway have carried the infestation into the adjoining vegetation, following the pattern formed by dispersal of the stormwater. The survey determined the infestation extends from the drain associated with the existing runway and continues to the north. The infestation exits the reserve and enters the large creek line that forms the boundary of the reserve with the FRNP.

The large creek line is external to Reserve 24521 and is therefore outside of the survey area, however it was considered in the field assessment. Vegetation in the creek line generally consisted of unsusceptible species that would result in the vegetation being classified as uninterpretable, however, some disease indicator species were present. Disease expression was noted within the creek line, downstream of the location the infested area joins the creek. There were however, no deaths of susceptible species noted within the creek line, upstream of the point of intersection between the creek line and infested drainage line. This suggests that the creek upstream of the infested drain remains uninfested, also suggesting the infestation is associated with drainage from Reserve 24521.

As shown in Figure 5, the identified infestation traverses the northern alignment of the proposed new cross runway and associated perimeter fence alignments. Therefore hygiene strategies will be required to be developed to ensure proposed clearing and construction works do not extend the spread. These hygiene strategies will also need to be applied to ongoing maintenance of the airfield infrastructure, specifically the drainage system and firebreaks, as these represent potential vectors of future disease spread. Appropriate hygiene strategies are presented in the Operational Hygiene Management Plan (GSBL 2024).

The remaining assessable vegetation within the survey areas is classified as either Uninfested by Phytophthora Dieback or Uninterpretable. Several small Uninterpretable areas previously mapped in 2020 around the western end of the existing runway and south eastern end of the proposed new runway have been reclassified as uninfested. The vegetation in these areas does contain species that are known to have susceptibility to Phytophthora Dieback under certain environmental conditions but are not generally relied upon by the author as reliable disease indicators, such as *B. falcata* and *B. dryandroides*. Densities of these species vary which is why the areas were previously classified Uninterpretable, despite these species being present and healthy. The re-classification of these areas from Uninterpretable to Uninfested is justified following the identification of disease expression observed in the infested vegetation which shows these species to be impacted by disease in the environment across the Survey Area. Therefore, the presence of healthy *B. falcata*, *B. dryandroides* and associated Isopogon species is now considered suitable evidence for applying the Uninfested category.

5.2.3 Disease Expression and Vegetation Condition

In the infested vegetation, the disease was expressing through multiple fresh deaths of all susceptible species that were occurring in the area. These include:

- *Banksia falcata*
- *Banksia nutans*
- *Banksia dryandroides*
- *Banksia repens*
- *Lambertia inermis*
- *Xanthorrhoea platyphylla*

Nearly all observed plant deaths attributed to impact by Phytophthora Dieback were recent deaths, estimated to have died within the last 3 years. Very occasional older deaths were noted, however, these

were generally large mature plants while the observed disease expression was generally through younger plants. The deaths of mature plants can often be associated with other causes, including natural plant death, insect attack and drought, while the death of younger plants is more likely to be associated with the disease. This evidence does suggest that the infestation is new, however, it covers an expansive area suggesting periods of very rapid spread, far greater than the typical rates of 0.5 m to 1 m per year. Major spread events associated with high rainfall events have been previously noted in other locations across the region including sites in the adjoining FRNP. In these locations disease spread has been noted to cover several hectares and up to two km over several years (pers. comm. Greg Freebury, DBCA). As discussed in Section 5.1.3, there have been several locally significant rainfall events in the past three years that may have assisted the observed disease spread.

The observed disease expression is resulting in high numbers of the understorey dying which is consistent with the definition of Moderate disease impact as defined in the *Phytophthora Dieback Management Manual (PDMM)*. The vegetation structure in the infested area is a heath that does not include an overstorey layer, which is the layer that is required to be impacted by the disease if higher impact ratings are to be allocated in accordance with definitions in the PDMM. If the disease were to be spread into vegetation areas including an overstorey, such as nearby communities of *B. attenuata*, the predicted disease impact would be Very High.

The uninfested vegetation presented as generally healthy, however, scattered old deaths of susceptible species were noted broadly across the surveyed area and have been attributed to drought stress.

The other areas with scattered deaths of susceptible species were considered to be associated with long term drought stress. In some locations this impact was significant, with major impact on the *B. coccinea* communities in particular. In areas where the impact was greatest, soil and tissue samples were collected to confirm the deaths were not *Phytophthora* related.

5.2.4 Soil and tissue sampling program

A total of eleven soil and tissue samples were collected from across the Survey Area, as shown on Figure 5. The VHS laboratory reports are presented in Appendix E. Samples 1, 3 and 6 returned positive results for *Phytophthora cinnamomi* and are all within the impacted area associated with the stormwater drainage.

The remaining samples returned negative results which were then used to support the disease-free status of all uninfested areas.

5.3 Limitation of Results

The disease occurrence data presented in this report is representative of the distribution of *Phytophthora Dieback* within assessable vegetation in the Bremer Bay Airfield Survey Area at the time of assessment. In accordance with DBCA guidelines (2015, 2020) *Phytophthora Dieback* occurrence data is valid for a period of 12 months from the date of assessment. After 12 months a disease re-check assessment is required and after three years a full re-assessment of the Survey Area will be required.

6 RESULTS AND DISCUSSION – WEED SURVEY

6.1 Weed Field Survey

Following an assessment of all vegetation and infrastructure areas within the proposed Bremer Bay airfield assessment area, no weed species listed in the DCCEE request for additional information and no other species classified as either Declared Plants or WoNS were identified. Introduced plant species including various introduced grasses and naturalised agricultural weed species were noted along Don Ende Drive and within disturbed areas across the Bremer Bay Airfield Survey Area.

6.2 Limitations

Factors likely to influence survey results for species or species groups include timing (seasons), duration of the survey period and preceding weather conditions. The current survey was undertaken on a single day during December 2023 when target species were not flowering, however, all target species are recognisable in the field when non-flowering. *Asparagus asparagoides* plants become dormant over summer, resprouting in autumn, however, it was noted that plants were evident in other nearby areas at the time of survey.

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8 DISCLAIMER

This report was prepared for the Shire of Jerramungup, solely for the purposes set out in the scope of works and it is not intended that any other person use or rely on the contents of this report.

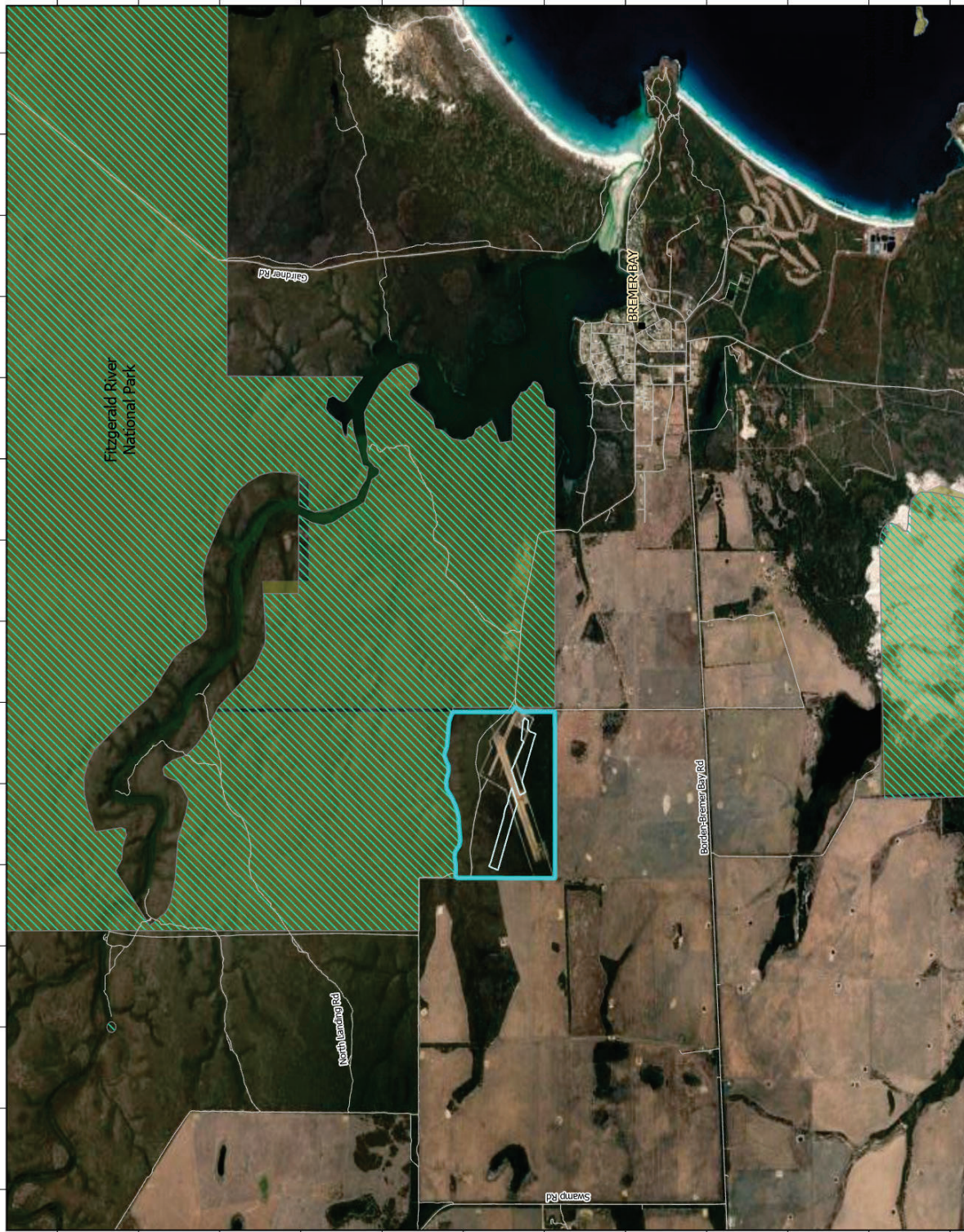
Whilst the information contained in the Report is accurate to the best of our knowledge and belief, Great Southern Bio Logic and its agents cannot guarantee the completeness or accuracy of any of the descriptions or conclusions based on the information supplied to it or obtained during the site investigations, site surveys, visits and interviews. Furthermore, field and / or regulatory conditions are subject to change over time, and this should be considered if this report is to be used after any significant time period after its issue.



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Figures

Bremer Bay Cross Runway Construction – Environmental Surveys 2024



-  Clearing Boundary
-  Survey Area V2
-  Environmentally Sensitive Areas DWER
-  Legislated Lands and Waters DBCA

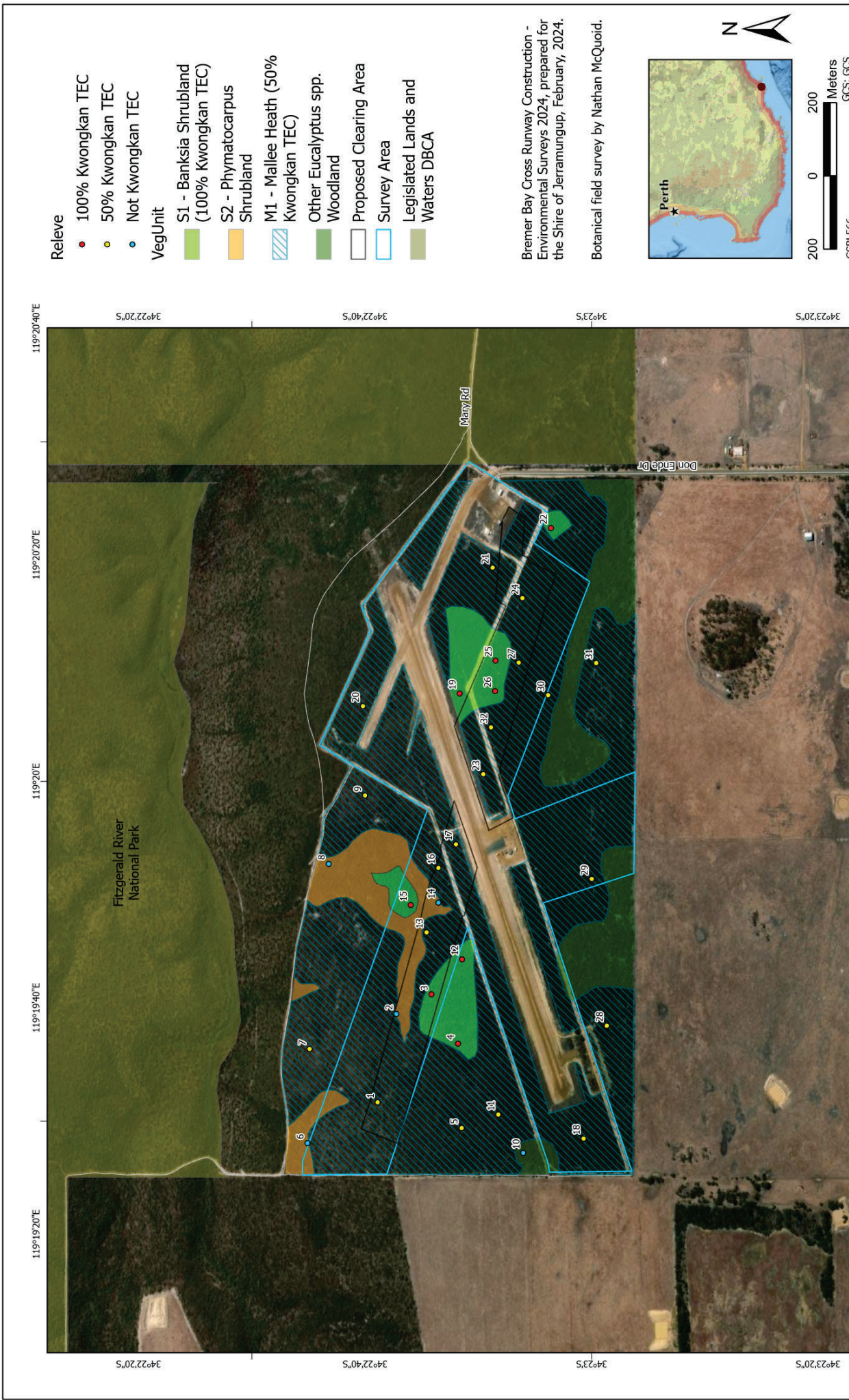
Bremer Bay Cross Runway Construction - Environmental Surveys 2024 V2, prepared for the Shire of Jerramungup, May, 2024.



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Figure 1: Regional Location





Releve

- 100% Kwongkan TEC
- 50% Kwongkan TEC
- Not Kwongkan TEC

VegUnit

- S1 - Banksia Shrubland (100% Kwongkan TEC)
- S2 - Phymatocarpus Shrubland
- M1 - Mallee Heath (50% Kwongkan TEC)
- Other Eucalyptus spp. Woodland
- Proposed Clearing Area
- Survey Area
- Legislated Lands and Waters DBCA

Bremer Bay Cross Runway Construction - Environmental Surveys 2024, prepared for the Shire of Jerramungup, February, 2024.

Botanical field survey by Nathan McQuoid.



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Figure 2: Flora Releve Locations showing Vegetation Units including TEC occurrences

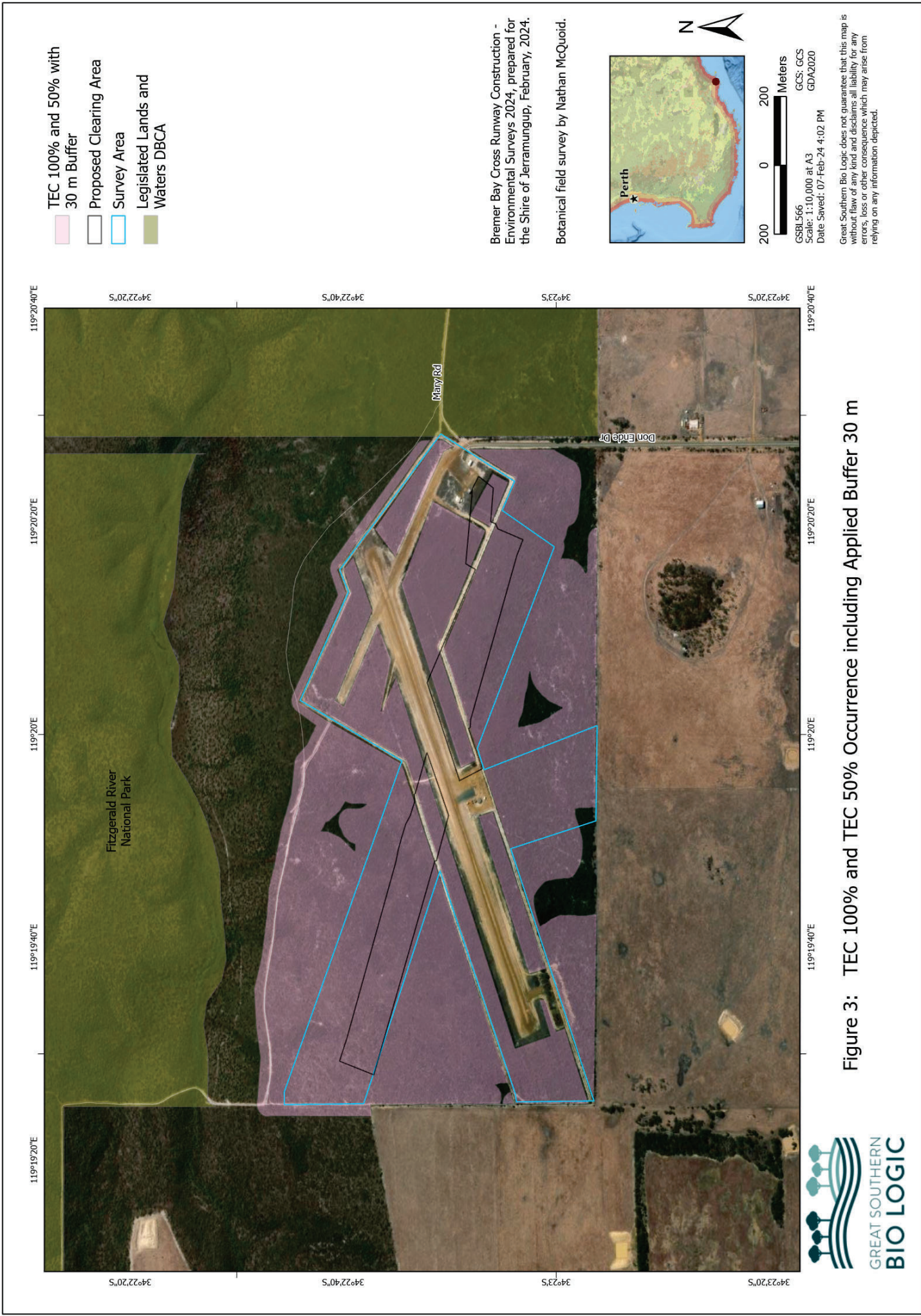


Figure 3: TEC 100% and TEC 50% Occurrence including Applied Buffer 30 m



- Vegetation Condition**
- Pristine
 - Excellent
 - Very Good
 - Proposed Clearing Area
 - Survey Area
 - Legislated Lands and Waters DBCA

Bremer Bay Cross Runway Construction - Environmental Surveys 2024, prepared for the Shire of Jerramungup, February, 2024.
 Botanical field survey by Nathan McQuoid.

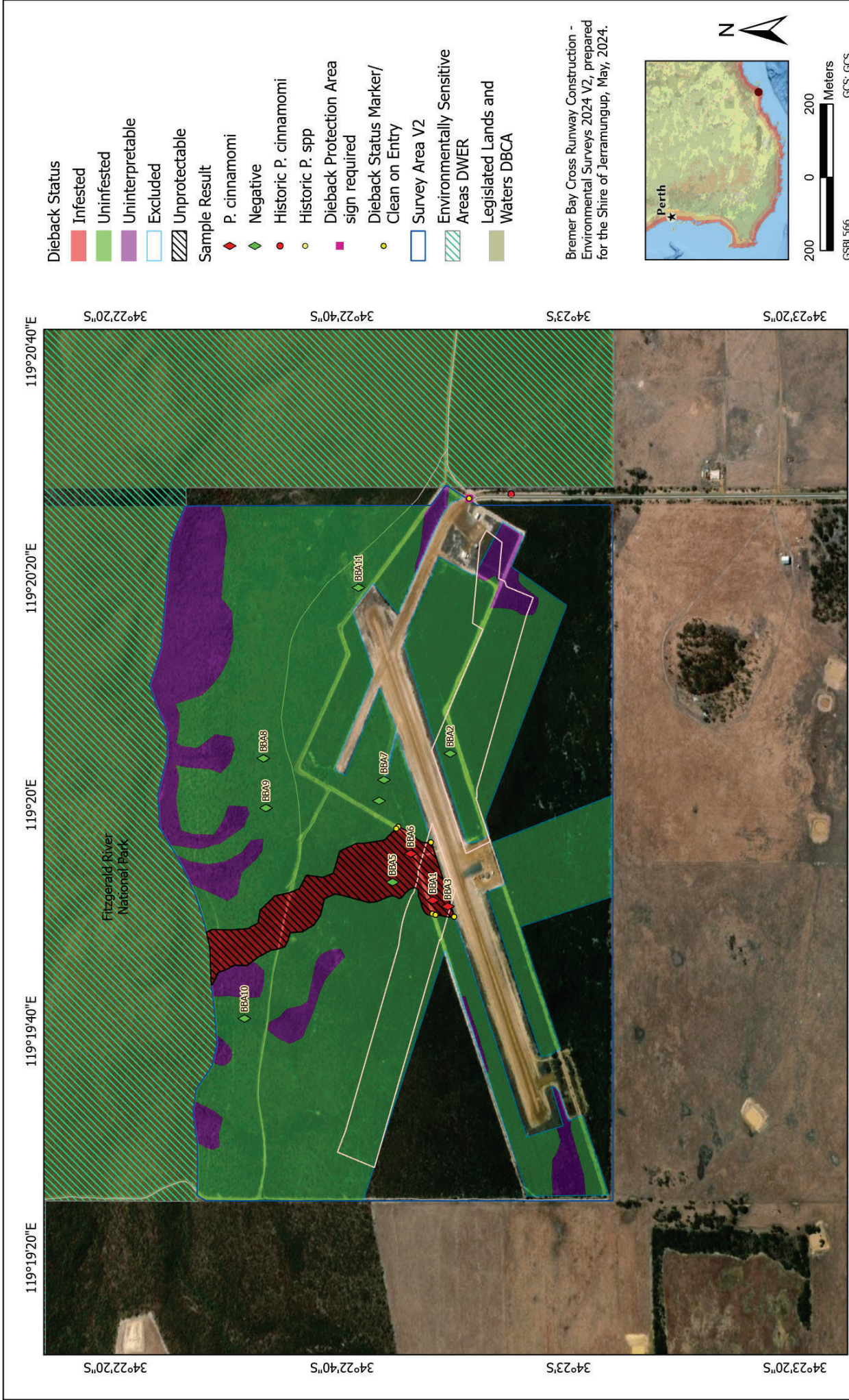


Scale: 1:10,000 at A3
 Date Saved: 07-Feb-24 4:04 PM
 GCS: GCS GDA2020
 GSBL566

Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequences which may arise from relying on any information depicted.

Figure 4: Vegetation Condition





Bremer Bay Cross Runway Construction - Environmental Surveys 2024 V2, prepared for the Shire of Jerramungup, May, 2024.

Scale: 1:10,000 at A3
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 GCS: GCS GDA2020
 GSBL566

0 200 Meters

North Arrow

Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Figure 5 - V2: Phytophthora Dieback Occurrence showing Sample Results, Protectability, and Clean Down Locations



Appendix A

*Perth Bushlands (Keighery 1994) vegetation and floristics Condition
Categories*

Classification	Description
1. Pristine	Pristine or nearly so, no obvious signs of disturbance
2. Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. For example damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
3. Very Good	Vegetation structure altered, obvious signs of disturbance. For example disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging or grazing.
4. Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback or grazing.
5. Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing dieback or grazing.
6. Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as “parkland cleared” with the flora composing weed or crop species with isolated native trees or shrubs.

Appendix B

Kwongkan TEC Diagnostic Characteristics

Kwongkan TEC Diagnostic Characteristics

Occurs within the Southeast Coastal Floristic Province (sensu Hopper and Gioia, 2004; relating to south west Australian phytogeographic boundaries. Includes the islands of the Recherche Archipelago).

AND

2a) Characterised by Proteaceae species having 30% or greater cover of Proteaceae species across all layers where these shrubs occur (crowns measured as if they are opaque),

OR

2b) Two or more diagnostic Proteaceae species are present that are likely to form a significant vegetative component when regenerated (see list of diagnostic species in Table 1). The use of diagnostic species is for situations in which the cover of Proteaceae species is reduced due to recent disturbance (e.g., fire).

Condition Threshold:

High: Minimum of 1 ha patch size, ≤ 30% perennial weed cover; no known dieback infestation.

Buffer Zone:

A buffer zone is the area that lies immediately outside the edge of a patch but is not part of the ecological community. As the risk of damage to an ecological community is usually greater for actions close to a patch, the purpose of the buffer zone is to minimise this risk by guiding land managers to be aware when the ecological community is nearby and take extra care around the edge of patches. The recommended minimum buffer zone for the ecological community is 30 metres from the edge of a patch as determined from the outer edge of the shrub canopy. A larger buffer zone may be applied, where practical, to protect patches that are of very high conservation value.

The buffer zone is not part of the ecological community, so is advisory only. Where the buffer on a particular property is subject to existing land uses, such as cropping, ploughing, grazing, spraying, etc., they can continue. However, in the interests of protecting adjacent patches of the ecological community, it is requested that care be exercised in the buffer zone to minimise the risk of any significant adverse impacts extending into those patches.

Appendix C

Guidance, management and recovery plans, and conservation recommendations, relating to the Bremer Bay Airfield site

Appendix C.

Guidance, management and recovery plans, and conservation recommendations, relating to the Bremer Bay Airfield site.

The Kwongkan TEC Conservation Advice (2014b), priority recovery and threat abatement actions relevant to this airfield runway development project include:

- Protect and conserve remaining areas of the TEC including connecting corridors. Further clearance should be prevented.
- Where clearance is unavoidable, offsets should take into account consideration for the location of the TEC and qualities of the patch or patches being affected.
- Identify priority sites for formal conservation arrangements, management agreements and covenants;
- Create or restore wildlife corridors, linkages and ensure high quality remnants are carefully managed,
- Monitor known sites to identify key threats and determine changes in condition (a primary aspect of this study).
- Avoid disturbances to hydrology that may result in changes to the natural hydrological regime.
- Where appropriate, fence significant remnants adjacent to farming and development areas.
- Liaise with planning authorities to ensure that planning takes the protection of remnants into account.
- Liaise with local councils and State authorities to ensure road widening or other infrastructure development activities involving substrate or vegetation disturbance in areas of the TEC do not adversely affect it, including the introduction or spread of weeds into areas not yet infested.
- Liaise with local councils and State authorities to ensure that cumulative impacts from broader impacts such as road works and other developments are reduced when planning individual activities.
- Ensure chemicals, or other mechanisms used to manage weeds, do not have significant adverse non-target impacts on the TEC,
- Develop and implement appropriate fire regimes for priority site. Ensure a representative range of age classes and post-fire stages of the TEC are maintained across the landscape, including old growth/long unburnt Kwongkan.
- Manage fires in the area to minimise the risk of inappropriate fire regimes, in this case ecologically frequent fire – the order of less than three or more decades, including the exclusion of fire in much of the airfield reserve remaining as Kwongkan has been found to be a very long-lived community that stabilises with age (Barrett *et al.* 2009; Hopper 2009; Hopper *et al.* 2021).
- Maintain liaison with managers of land on which the ecological community occurs.

The Fitzgerald Biosphere Recovery Plan (DEC 2012) meets the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) requirements for

a recovery plan for 11 flora species listed as threatened under the EPBC Act that are endemic to the Fitzgerald Biosphere. In addition, this Plan provides recovery guidance for the further 29 threatened species/communities (21 of which are listed under the EPBC Act) that also occur in the Fitzgerald Biosphere.

The Recovery Plan was developed and published (2012) before the listing of the Kwongkan TEC (2014). Notwithstanding, the plan addresses threats to biodiversity of Fitzgerald Biosphere including some found within the Kwongkan TEC and its principles and priorities relate to the Kwongkan TEC.

Biodiversity in Fitzgerald Biosphere will benefit from the Plan through:

- an increased understanding and appreciation of landscape characteristics and management requirements,
- a reduction of the impacts of threatening processes,
- maintenance or restoration of the roles that current threatened species play in the functioning of the ecosystems, and
- improved community participation and awareness of biodiversity conservation.

The Recovery Plan's management priorities relevant to this Bremer Bay airfield development project for the abatement of threatening processes include:

- Ensure up-to-date GIS spatial data of threatened and priority species and ecological communities and their habitat critical is available to Incident Management Teams in the event of a bushfire.
- Regularly survey and mapping of the extent of *Phytophthora* sp. across the Biosphere.
- Implement a program of monitoring (at appropriate frequency and scale for the species) of known populations of threatened species and communities, including aspects such as population size, extent and potential threatening processes (e.g. weeds).
- Undertake survey and data analysis for priority species and ecological communities across the Biosphere to confirm conservation status.
- Improve the vegetation mapping for the Biosphere with an emphasis on areas containing habitat critical.
- Further develop and implement pre- and post-fire monitoring programs for threatened and priority species and ecological communities (see Barrett et al. 2009).

The Fitzgerald River National Park (which adjoins) Management Plan (CALM 1991) relevant management priorities include:

- The principal management goal for FRNP is to conserve all flora and fauna, particularly the large number of rare species and those in need of special protection. A complementary goal is to conserve the Park's landscapes, in particular, the extensive vistas free of human disturbance.
- Determining practical procedures for dieback control to protect the Park's flora, particularly the priority species.

The Identification and Conservation of Fire Sensitive Ecosystems and Species of the South Coast Natural Resource Management Region (Barrett *et al.* 2009) recognises two vegetation types that can be Kwongkan in the Bremer Bay area:

- 10.4 *Proteaceous Mallee-shrubland*, and
- 10.9 *Banksia shrubland, heaths and Proteaceous palusplain heath*

Management recommendations relating to these include:

- protection from *Phytophthora dieback*;
- protection from inappropriate fire regimes;
- research into fire frequency and intensity and seed bank dynamics as life histories to guide the latter;
- fire exclusion reference areas for benchmarking, to analogue, measure and compare change by;
- mapping and monitoring over the long term the health of kwongkan communities;
- recruitment following fire in drying trend due to climate change; and,
- training of fire suppression crews on recognising and protecting Kwongkan.

Appendix D

Relevé data sheets

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 1
Date: 11/12/23	GPS Wpt: 001	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old sparse mallee over dense kwongkan	
Location: Northwest end of proposed new runway footprint		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry, some shrubs poor	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 30% - 2 cm	Bare Ground (% cover): < 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	10-30	Eucalyptus pleurocarpa, E. uncinata, E. tetraptera
Shrub (S1)	> 2	2-10	Lambertia inermis
Shrub (S2)	1-2	30-70	Phymatocarpus maxwellii, Melaleuca striata, Hakea trifurcata, Lambertia inermis, Banksia falcata, Isopogon buxifolius, Allocasuarina humilis, Hakea pandanicarpa, Banksia plumosa
Shrub (S3)	0-1	10-30	Taxandria spathulata, Melaleuca suberosa, Banksia tenuifolia, Beaufortia micrantha, Leucopogon sp. Isopogon buxifolius, Petrophile rigida, Pultenaea sp., Isopogon trilobus, Banksia plumosa
Sedge/Rush (VR)		30-70	Mesomelaena stygia, Gahnia aristata. Xanthorrhoea platyphylla, Lepidosperma sp.? fine, Desmodcladus lateriflorus, Schoenus sp., Lepidosperma sp. flat 20cm, Anarthria laevis, Lepidosperma sp. flat 70cm
Herb (H)			
Grass (G)		<2	Neurachne alopecuroidea, Amphipogon turbinatus
Other (climbers) (C)		<2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 2
Date: 11/12/23	GPS Wpt: 002	Structural comm. type: Myrtaceae shrubland
Photo no. + dir: NSEWG	Habitat: Old dense to open patchy myrtle shrubland, with some kwongkan heath	
Location: Centre of northwest section of proposed new runway footprint		

Condition: Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	very dry, some shrubs poor						
Aspect: N	NE	E	SE	S	SW	W	NW	Slope: Flat	Gentle	Mod	Steep	
Geology: Gran	Lat	Lime	Other	Spongolite	Rock: 0	<2	2-10	10-20	20-50	>50		
Soil Colour: Grey	Dark Brown	Light Brown	Soil Type: C				CL	CLS	CS	L	LS	
Orange/Brown	Red/Brown	White	Yellow	S	SCL	SL	SP	ZCL	ZL	ZS		
Litter (% cover & depth): 30% - 2 cm						Bare Ground (% cover): < 10% bare						
Hydrology: Good drain				Poor drain	Topographic position: Upland				Wetland	Rock Outcrop	Breakaway	
Wet all year				Seas wet	Drainage Depression				Creepline	Riparian Bank	Gully	
winter/spring				Plain				Slope Lower	Slope Middle	Slope Upper	Valley	Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	<2	Nuytsia floribunda
Mallee (M1)	> 8		
Mallee (M2)	< 8	<2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	<2	Phymatocarpus maxwellii, Lambertia inermis
Shrub (S2)	1-2	30-70	Phymatocarpus maxwellii, Hakea corymbosa, Isopogon trilobus, Adenanthos cuneatus
Shrub (S3)	0-1	10-30	Taxandria spathulata, Banksia repens, Isopogon trilobus, Melaleuca suberosa, Verticordia densiflora, Allocasuarina humilis, Beaufortia empetrifolia, Hakea corymbosa, Isopogon buxifolius
Sedge/Rush (VR)		30-70	Mesomelaena stygia, Lyginia barbata, Lepidosperma sp. 40cm fine flat, Schoenus sp., Mesomelaena tetragona, Desmodcladus lateriflorus
Herb (H)			
Grass (G)		<2	Neurachne alopecuroidea
Other (climbers) (C)		<2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 3
Date: 11/12/23	GPS Wpt: 003	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Old low open kwongkan shrubland TEC	
Location: South side centre north west section of proposed new runway footprint		

Condition: Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	very dry, old vehicle track						
Aspect: N	NE	E	SE	S	SW	W	NW	Slope: Flat	Gentle	Mod	Steep	
Geology: Gran	Lat	Lime	Other	Spongolite	Rock: 0	<2	2-10	10-20	20-50	>50		
Soil Colour: Grey	Dark Brown	Light Brown			Soil Type: C	CL	CLS	CS	L	LS		
Orange/Brown	Red/Brown	White	Yellow		S	SCL	SL	SP	ZCL	ZL	ZS	
Litter (% cover & depth): 40% - 3 cm					Bare Ground (% cover): < 20% bare							
Hydrology: Good drain				Poor drain	Topographic position: Upland			Wetland	Rock Outcrop	Breakaway		
Wet all year				Seas wet	Drainage Depression			Creepline	Riparian Bank	Gully		
winter/spring					Plain			Slope Lower	Slope Middle	Slope Upper	Valley	Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	<2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	2-10	Banksia attenuata, B. coccinea
Shrub (S2)	1-2	30-70	Melaleuca striata, Banksia attenuata, B. baxteri, Adenanthos cuneatus, B. nutans, Calothamnus gracilis, Conospermum teretifolium, Isopogon trilobus
Shrub (S3)	0-1	2-10	Melaleuca striata, Taxandria spathulata, Isopogon trilobus, Calothamnus gracilis, Nuytsia floribunda, Lysinema ciliatum
Sedge/Rush (VR)		30-70	Anarthria scabra, Lepidosperma sp. terete, Schoenus sp., Anarthria prolifera, Desmocladus sp., Caustis dioica
Herb (H)			
Grass (G)			
Other (climbers) (C)		<2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 4
Date: 11/12/23	GPS Wpt: 004	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Kwongkan shrubland edge. TEC	
Location: North west section of proposed new runway footprint		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry, some plant deaths	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 1 cm	Bare Ground (% cover): 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	<2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	2-10	Banksia coccinea 10/24 dead
Shrub (S2)	1-2	30-70	Adenanthos cuneatus, Isopogon trilobus, Melaleuca striata, Banksia nutans, Hakea corymbosa, Conospermum teretifolium, Beaufortia empetrifolia
Shrub (S3)	0-1	2-10	Melaleuca striata, Taxandria spathulata, Adenanthos cuneatus, Banksia repens, Beaufortia empetrifolia, Petrophile rigida
Sedge/Rush (VR)		30-70	Anarthria scabra, Anarthria prolifera, Desmocladus sp., Caustis dioica, Cyathochaeta avenacea, Mesomelaena tetragona, Lyginia barbata
Herb (H)			
Grass (G)		< 2	Amphipogon turbinatus
Other (climbers) (C)		<2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 5
Date: 11/12/23	GPS Wpt: 005	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old low mallee emergent over Kwongkan shrubland. Tawny -crowned honeyeater, New Holland honeyeater	
Location: West section of proposed new runway footprint		

Condition: Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	very dry, some plant deaths				
Aspect: N	NE	E	SE	S	SW	W	NW			
Slope: Flat	Gentle	Mod	Steep							
Geology: Gran	Lat	Lime	Other	Spongolite	Rock: 0	<2	2-10	10-20	20-50	>50
Soil Colour: Grey	Dark Brown	Light Brown	Soil Type: C			CL	CLS	CS	L	LS
Orange/Brown	Red/Brown	White	Yellow	S	SCL	SL	SP	ZCL	ZL	ZS
Litter (% cover & depth): 20% - 1 cm					Bare Ground (% cover): 30% bare					
Hydrology: Good drain				Poor drain	Topographic position: Upland			Wetland	Rock Outcrop	Breakaway
Wet all year				Seas wet	Drainage Depression	Creepline	Riparian Bank	Gully		
winter/spring				Plain	Slope Lower	Slope Middle	Slope Upper	Valley	Flat	

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	10-30	Eucalyptus buprestium, E. pleurocarpa
Shrub (S1)	> 2	2-10	Lambertia inermis, Hakea obliqua, H. trifurcata
Shrub (S2)	1-2	10-30	Isopogon buxifolius, Hakea obliqua, H. trifurcata, H. ferruginea, Banksia falcata, B. nutans, Calothamnus gracilis, Taxandria spathulata, Isopogon trilobus, Banksia plumosa
Shrub (S3)	0-1	30-70	Taxandria spathulata, Allocasuarina thyoides, Calothamnus gracilis, Daviesia incrassata, Leucopogon sp., Melaleuca suberosa, Banksia repens, Lysinema ciliatum
Sedge/Rush (VR)		10-30	Mesomelaena stygia, Lepidosperma sp. 20cm flat, Xanthorrhoea platyphylla, Schoenus sp.
Herb (H)		< 2	Comesperma virgatum
Grass (G)		< 2	Amphipogon turbinatus, Neurachne alopecuroidea
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 6
Date: 11/12/23	GPS Wpt: 006	Structural comm. type: Myrtaceae shrubland
Photo no. + dir: NSEWG	Habitat: Old scattered to dense patchy Myrtaceae shrubland	
Location: West section of proposed new runway footprint		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS duplex S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 1 cm	Bare Ground (% cover): 30% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus ecostata, E. pleurocarpa
Shrub (S1)	> 2	2-10	Phymatocarpus maxwellii, Nuytsia floribunda, Lambertia inermis
Shrub (S2)	1-2	30-70	Phymatocarpus maxwellii, Adenanthos cuneatus, Isopogon trilobus, Calothamnus gracilis
Shrub (S3)	0-1	10-30	Beaufortia empetrifolia, Banksia nutans, Taxandria spathulata, Verticordia densiflora, Isopogon buxifolius, Banksia repens, Tetrapora preissii, Leucopogon sp.,
Sedge/Rush (VR)		30-70	Anarthria laevis, Desmocladus sp., Schoenus sp., Lyginia barbata, Caustis dioica, Anarthria prolifera, Xanthorrhoea platyphylla
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 7
Date: 11/12/23	GPS Wpt: 007	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old open shrubland, kwongkan and sparse mallee	
Location: North side outer airstrip envelope south of perimeter alongside area burnt 2012?		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 1 cm	Bare Ground (% cover): 40% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. tetraptera
Shrub (S1)	> 2	< 2	Hakea pandanica, Lambertia inermis
Shrub (S2)	1-2	10-30	Hakea trifurcata, Allocasuarina humilis, Lambertia inermis, Isopogon buxifolius, Hakea ferruginea, Banksia nutans, Taxandria spathulata, Persoonia teretifolia
Shrub (S3)	0-1	10-30	Taxandria spathulata, Melaleuca suberosa, Isopogon buxifolius, Petrophile rigida, Banksia nutans, Acrotriche sp., Daviesia striata, Daviesia emarginata, Banksia nivea, Verticordia densiflora
Sedge/Rush (VR)		30-70	Mesomelaena stygia, Lepidosperma sp. 40 cm flat, Gahnia aristata, Anarthria laevis, Xanthorrhoea platyphylla
Herb (H)			
Grass (G)		2-10	Amphipogon turbinatus
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 8
Date: 11/12/23	GPS Wpt: 008	Structural comm. type: Myrtaceae shrubland
Photo no. + dir: NSEWG	Habitat: Old closed Myrtaceae shrubland under mallee and some kwongkan. New Holland honeyeater, Tawny-crowned honeyeater	
Location: North side outer airstrip envelope south of perimeter alongside area burnt 2012?		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 2 cm	Bare Ground (% cover): 30% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus adesmophloia, E. pleurocarpa
Shrub (S1)	> 2	10-30	Lambertia inermis
Shrub (S2)	1-2	30-70	Phymatocarpus maxwellii, Lambertia inermis, Melaleuca striata, Isopogon trilobus, Calothamnus gracilis, Acacia harveyi, Beaufortia empetrifolia, Adenanthos cuneatus, Taxandria spathulata
Shrub (S3)	0-1	10-30	Melaleuca striata, M. subtrigona, M. thymoides, Phymatocarpus maxwellii, Banksia repens, Taxandria spathulata, Beaufortia empetrifolia, Lasiopetalum quinquinervium
Sedge/Rush (VR)		30-70	Desmocladus sp., Lyginia barbata, Lepidosperma sp. 60 cm flat, Lomandra hastilis
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 9
Date: 11/12/23	GPS Wpt: 009	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old open mallee over low kwongkan	
Location: North east corner of airstrip envelope, near fence and track edge		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 2 cm	Bare Ground (% cover): < 5% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. uncinata
Shrub (S1)	> 2	< 2	Lambertia inermis
Shrub (S2)	1-2	10-30	Hakea trifurcata, Lambertia inermis, Hakea denticulata, H. ferruginea, Isopogon buxifolius, Hakea pandanica, Melaleuca rigidifolia
Shrub (S3)	0-1	10-30	Banksia alliacea, B. tenuifolia, Melaleuca rigidifolia, Melaleuca suberea, Beaufortia gracilis, Daviesia striata, Isopogon buxifolius, Petrophile rigida, Taxandria spathulata, Banksia falcata, Allocasuarina thyooides
Sedge/Rush (VR)		30-70	Lepidosperma sp. 50 cm fine, L. sp. 40 cm flat, Mesomelaena stygia, Gahnia aristata, Schoenus sp.
Herb (H)			
Grass (G)		< 2	Amphipogon turbinatus
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 10
Date: 12/12/23	GPS Wpt: 010	Structural comm. type: Mallee woodland
Photo no. + dir: NSEWG	Habitat: Old low mallee woodland over melaleuca shrubs	
Location: Western corner of airstrip envelope, north of existing runway and fence and track edge		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS organic S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 30% - 2 cm	Bare Ground (% cover): < 5% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	10-30	Eucalyptus occidentalis mallee
Shrub (S1)	> 2		
Shrub (S2)	1-2	30-70	Melaleuca pritzelii (P3), M. calycina, Hakea marginata, H. varia
Shrub (S3)	0-1	10-30	Melaleuca calycina, Hakea marginata, M. pritzelii,
Sedge/Rush (VR)		70+	Ficinia nodosa, Lepidosperma sp. 60 cm terete
Herb (H)			
Grass (G)		< 2	Rytidosperma sp.
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 11
Date: 12/12/23	GPS Wpt: 011	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old open shrubland, scattered mallee, kwongkan patches	
Location: North west end of existing airstrip, north of fence and track edge		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 1 cm	Bare Ground (% cover): 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. buprestium
Shrub (S1)	> 2	2-10	Hakea obliqua
Shrub (S2)	1-2	10-30	Isopogon trilobus, Phymatocarpus maxwellii, Allocasuarina humilis, Calothamnus gracilis, Kunzea sp., Beaufortia empetrifolia, Taxandria spathulata, Hakea denticulata
Shrub (S3)	0-1	10-30	Melaleuca suberosa, Petrophile rigida, Taxandria spathulata, Allocasuarina thyoides, Beaufortia empetrifolia, Allocasuarina humilis, Verticordia habrantha, Banksia repens, Calothamnus gracilis, Daviesia incrassata
Sedge/Rush (VR)		30-70	Mesomelaena tetragona, Xanthorrhoea platyphylla, Desmodcladus sp., Lepidosperma sp. 30 cm flat, Lyginia barbata, Mesomelaena stygia, Anarthria prolifera
Herb (H)			
Grass (G)		< 2	Amphipogon turbinatus, Neurachne alopecuroidea
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 12
Date: 12/12/23	GPS Wpt: 012	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Old sparse banksia kwongkan shrubland. Tawny-crowned honeyeater, Bush rat burrows	
Location: North of existing airstrip, north of fence and track edge		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 30% - 1 cm	Bare Ground (% cover): 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	< 2	Nuytsia floribunda, Acacia harveyi, Calothamnus gracilis
Shrub (S2)	1-2	30-70	Banksia baxteri, Banksia attenuata, Conospermum teretifolium, Melaleuca striata, Adenanthos cuneatus, Calothamnus gracilis, Beaufortia empetrifolia, Banksia nutans
Shrub (S3)	0-1	10-30	Melaleuca striata, Calothamnus gracilis, Franklandia fucifolia, Adenanthos cuneatus, Banksia nutans, B. repens
Sedge/Rush (VR)		30-70	Anarthria prolifera, A. scabra, Tricostularia neesii, Cyathochaeta avenacea, Desmocladus sp.
Herb (H)		< 2	Haemodorum spicatum
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 13
Date: 12/12/23	GPS Wpt: 013	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old kwongkan and mixed shrubland. Western whipbird to east	
Location: North of existing airstrip, north of fence, south east end north west section of airstrip development		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 30% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	< 2	Lambertia inermis, Hakea corymbosa, Banksia baxteri
Shrub (S2)	1-2	30-70	Adenanthos cuneatus, Phymatocarpus maxwellii, Beaufortia empetrifolia, Isopogon trilobus, Lambertia inermis, Hakea corymbosa, Banksia nutans, Taxandria spathulata
Shrub (S3)	0-1	10-30	Taxandria spathulata, Beaufortia empetrifolia, Isopogon trilobus, Adenanthos cuneatus, Verticordia sp., Banksia nutans, Lysinema ciliatum, Melaleuca suberosa, Tricoryne sp., Actinodium sp. Fitzgerald River,
Sedge/Rush (VR)		30-70	Mesomelaena tetragona, Anarthria prolifera, A. scabra, Tricostularia sp., Gahnia sp., Desmocladus lateriflora
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 14
Date: 12/12/23	GPS Wpt: 014	Structural comm. type: Myrtaceae shrubland
Photo no. + dir: NSEWG	Habitat: Dense Myrtaceae shrubland	
Location: North of existing airstrip, north of fence, centre section of airstrip development		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): 30% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa, E. adesmophloia
Shrub (S1)	> 2	< 2	Hakea corymbosa
Shrub (S2)	1-2	30-70	Phymatocarpus maxwellii, Hakea corymbosa, Beaufortia empetrifolia, Banksia nutans, Isopogon trilobus, I. buxifolius, Hakea obliqua
Shrub (S3)	0-1	30-70	Phymatocarpus maxwellii, Isopogon buxifolius, Beaufortia empetrifolia, Banksia nutans, Lysinema ciliatum, Pimelea sp., Calothamnus gracilis, Taxandria spathulata, Leucopogon sp., Isopogon linearis, Verticordia sp., Melaleuca suberosa, Banksia tenuis
Sedge/Rush (VR)		30-70	Anarthria prolifera, A. gracilis, Tricostularia sp. Lepidosperma sp, Mesomelaena stygia, Desmodcladus lateriflora, Schoenus sp.
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 15
Date: 12/12/23	GPS Wpt: 015	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Dense old Myrtaceae and kwongkan shrubland	
Location: North of existing airstrip, north of fence, centre section of airstrip development		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 40% - 3 cm	Bare Ground (% cover): < 5% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	< 2	Banksia attenuata, Nuytsia floribunda
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus adesmophloia, E. pleurocarpa,
Shrub (S1)	> 2	10-30	Banksia attenuata, Nuytsia floribunda
Shrub (S2)	1-2	70+	Melaleuca striata, Taxandria spathulata, Calothamnus gracilis, Adenanthos cuneatus, Acacia harveyi
Shrub (S3)	0-1	< 2	Calothamnus gracilis
Sedge/Rush (VR)		30-70	Anarthria prolifera, Tricostularia sp., Lepidosperma sp. terete
Herb (H)			
Grass (G)			
Other (climbers) (C)		< 2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 16
Date: 12/12/23	GPS Wpt: 016	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old low kwongkan shrubland, emergent mallee	
Location: Centre north, north of fence, edge of airstrip development, just north of fence and track		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 1 cm	Bare Ground (% cover): 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa, E. incrassata
Shrub (S1)	> 2	2-10	Phymatocarpus maxwellii, Hakea corymbosa, Lambertia inermis, Hakea pandanica
Shrub (S2)	1-2	30-70	Hakea trifurcata, Phymatocarpus maxwellii, Isopogon trilobus, Hakea pandanica, H. obliqua H. corymbosa, H. ferruginea, Banksia plumosa, Isopogon buxifolius, Allocasuarina humilis, Banksia falcata, Calothamnus gracilis, Beaufortia empetrifolia
Shrub (S3)	0-1	10-30	Banksia nutans, Taxandria spathulata, Calothamnus gracilis, Isopogon buxifolius, I. trilobus, Adenanthos cuneatus, Lysinema ciliata, Banksia repens, B. alliacea, B. plumosa, Verticordia densiflora, Oligarrhena micrantha, Melaleuca subtrigona, Petrophile rigida
Sedge/Rush (VR)		70+	Anarthria laevis, Patersonia occidentalis, Schoenus sp., Tricostularia sp., Mesomelaena stygia, Desmodcladus sp., Lepidosperma sp. 50cm flat
Herb (H)			
Grass (G)		< 2	Amphipogon turbinatus
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 17
Date: 12/12/23	GPS Wpt: 017	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old low open kwongkan shrubland, scattered mallee	
Location: West of drain, north side of existing airstrip, inside existing fence		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 20% - 2 cm	Bare Ground (% cover): 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa
Shrub (S1)	> 2	2-10	Hakea obliqua, H. pandanica
Shrub (S2)	1-2	30-70	Hakea pandanica, Banksia plumosa, Phymatocarpus maxwellii, Isopogon buxifolius, Hakea nitida, H. ferruginea, Calothamnus gracilis, Leucopogon sp.
Shrub (S3)	0-1	30-70	Hakea nitida, Isopogon buxifolius, Beaufortia empetrifolia, Calothamnus gracilis, Banksia alliacea, Isopogon trilobus, I. linearis, Petrophile rigida, Taxandria spathulata, Melaleuca suberosa, Banksia plumosa
Sedge/Rush (VR)		30-70	Anarthria laevis, Xanthorrhoea platyphylla, Tricostularia sp. 20 cm, Gahnia aristata, Mesomelaena tetragona, Lepidosperma sp., Desmodcladus lateriflorus
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 18
Date: 12/12/23	GPS Wpt: 018	Structural comm. type: Mallee heath, regrowth
Photo no. + dir: NSEWG	Habitat: Kwongkan and Myrtaceae shrubland regrowth, low and dense	
Location: Off western end of existing airstrip 100 m, inside existing fence		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded chained regrowth	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. incrassata, E. occidentalis, E. phaenophylla, E. ecostata
Shrub (S1)	> 2	< 2	Lambertia inermis, Acacia cyclops
Shrub (S2)	1-2	2-10	Hakea ferruginea, Isopogon trilobus, Banksia falcata, Hakea trifurcata
Shrub (S3)	0-1	70+	Taxandria spathulata, Petrophile rigida, Beaufortia empetrifolia, Banksia tenuis, B. alliacea, Phymatocarpus maxwellii, Lysinema ciliatum, Allocasuarina humilis, Grevillea nudiflora, Gastrolobium bracteolosum, Isopogon buxifolius, Allocasuarina thyoides, Isopogon linearis, Melaleuca suberosa, Leucopogon sp.
Sedge/Rush (VR)		30-70	Gahnia aristata, Desmodcladus lateriflorus, Mesomelaena stygia, Xanthorrhoea platyphylla, Tricostularia sp. 20 cm, Lepidosperma sp.
Herb (H)			
Grass (G)		< 2	Amphipogon turbinatus
Other (climbers) (C)		< 2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 19
Date: 12/12/23	GPS Wpt: 019	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Old open Banksia Kwongkan shrubland and heath	
Location: Mid east centre, south side of existing airstrip, inside existing fence		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	< 2	Acacia cyclops
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	10-30	Banksia baxteri, B. coccinea, Nuytsia floribunda
Shrub (S2)	1-2	10-30	Banksia baxteri, B. plumosa, Hakea ferruginea, Isopogon trilobus, Allocasuarina humilis, Banksia nutans
Shrub (S3)	0-1	30-70	Allocasuarina humilis, Taxandria spathulata, Calothamnus gracilis, Beaufortia empetrifolia, Banksia nutans, Isopogon trilobus, Lysinema ciliatum, Banksia plumosa, Oligarrhena micrantha, Adenanthos cuneatus, Hakea corymbosa, Petrophile ericifolia, Isopogon sphaerocephala, Isopogon linearis
Sedge/Rush (VR)		30-70	Mesomelaena stygia, M. tetragona, Tricostularia neesii, Cyathochaeta avenacea, Lyginia barbata, Caustis dioica, Desmocladus sp.
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 20
Date: 12/12/23	GPS Wpt: 020	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old patchy Kwongkan shrubland and heath, sparse and dense, scattered mallee	
Location: East side of east cross airstrip, north side		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): 30% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa, E. uncinata to east
Shrub (S1)	> 2	2-10	Lambertia inermis
Shrub (S2)	1-2	2-10	Hakea ferruginea, Isopogon trilobus, Lambertia inermis, Allocasuarina humilis, Melaleuca rigidifolia, Isopogon buxifolius
Shrub (S3)	0-1	30-70	Allocasuarina humilis, Taxandria spathulata, Isopogon buxifolius, Isopogon trilobus, Banksia nutans, Melaleuca suberosa, M. subtrigona, Lysinema ciliatum, Banksia tenuis, Banksia plumosa, Verticordia sp., Calothamnus gracilis
Sedge/Rush (VR)		30-70	Mesomelaena stygia, Xanthorrhoea platyphylla, Tricostularia sp. 20 cm, Mesomelaena tetragona, Lepidosperma sp., Desmocladus lateriflorus
Herb (H)		< 2	Dampiera sp.
Grass (G)		< 2	Amphipogon turbinatus
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 21
Date: 12/12/23	GPS Wpt: 021	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old very sparse Kwongkan shrubland and heath, under emergent mallee	
Location: North west of hangars, inside fence south of existing strip		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 5% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. adesmophloia
Shrub (S1)	> 2		
Shrub (S2)	1-2	2-10	Hakea obliqua, H. corymbosa, Banksia falcata
Shrub (S3)	0-1	30-70	Banksia nutans, B. tenuis, Hakea corymbosa, Isopogon trilobus, Lysinema ciliatum, Beaufortia empetrifolia, Isopogon buxifolius, Allocasuarina humilis, Calothamnus gracilis, Isopogon linearis, Taxandria spathulata, Leucopogon sp., Banksia repens, Melaleuca suberosa, Phymatocarpus maxwellii, Actinodium sp. Fitzgerald River, Tricoryne sp.
Sedge/Rush (VR)		30-70	Anarthria laevis, Xanthorrhoea platyphylla, Tricostularia sp. 20 cm, Patersonia occidentalis, Desmodcladus sp., Conostylis setigera
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 22
Date: 12/12/23	GPS Wpt: 022	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Very old banksia Kwongkan shrubland over dense Myrtaceae shrubs	
Location: Off southeast fence corner, outside airstrip fenced area		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry									
Aspect: N NE E SE S SW W NW					Slope: Flat Gentle Mod Steep				
Geology: Gran Lat Lime Other Spongolite					Rock: 0 <2 2-10 10-20 20-50 >50				
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow					Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS				
Litter (% cover & depth): < 30% - 4 cm					Bare Ground (% cover): < 5% bare				
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring			Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat						

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10	10-30	Banksia attenuata, Nuytsia floribunda
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus adesmophloia, E. pleurocarpa
Shrub (S1)	> 2	2-10	Melaleuca thymoides, M. striata
Shrub (S2)	1-2	70+	Melaleuca thymoides, Adenanthos cuneatus, Hakea corymbosa, Banksia attenuata, Acacia harveyi, Lasiopetalum sp.
Shrub (S3)	0-1	2-10	Lasiopetalum sp.
Sedge/Rush (VR)		30-70	Anarthria prolifera, Xanthorrhoea platyphylla
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 23
Date: 12/12/23	GPS Wpt: 023	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Kwongkan heath under sparse mallee, old and stable	
Location: South of existing strip, east of water bomber station just west of previous study quadrat		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 5% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa
Shrub (S1)	> 2	< 2	Phymatocarpus maxwellii
Shrub (S2)	1-2	2-10	Isopogon trilobus, Allocasuarina humilis, Banksia plumosa, Isopogon buxifolius
Shrub (S3)	0-1	30-70	Phymatocarpus maxwellii, Banksia nutans, Isopogon trilobus, Calothamnus gracilis, Beaufortia empetrifolia, Hakea corymbosa, Lysinema ciliatum, Isopogon linearis, Oligarrhena micrantha, Isopogon buxifolius, Banksia obtusa, B. repens, B. falcata, Verticordia sp., Melaleuca subtrigona, Allocasuarina thyoides
Sedge/Rush (VR)		30-70	Mesomelaena stygia, M. tetragona, Xanthorrhoea platyphylla, Desmocladus sp., Anarthria prolifera, Anarthria gracilis, Lepidosperma sp.
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 24
Date: 12/12/23	GPS Wpt: 024	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old dense kwongkan heath with sparse emergent mallee	
Location: South of existing strip, outside south of fence and track		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. adesmophloia
Shrub (S1)	> 2	< 2	Hakea obliqua
Shrub (S2)	1-2	10-30	Hakea obliqua, H. denticulata, H. corymbosa, Regelia inops, Isopogon buxifolius
Shrub (S3)	0-1	70+	Beaufortia empetrifolia, Banksia plumosa, Phymatocarpus maxwellii, Banksia allioacea, B. nutans, Isopogon trilobus, I. buxifolius, I. linearis, Lysinema ciliatum, Calothamnus gracilis, Daviesia incrassata
Sedge/Rush (VR)		10-30	Tricostularia sp., Desmocladus lateriflorus, D. sp., Anarthria laevis
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 25
Date: 12/12/23	GPS Wpt: 025	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Old low dense kwongan shrubland	
Location: Midway south eastern leg of new airstrip area, outside southeast of fence and track		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 30% - 2 cm	Bare Ground (% cover): < 5% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creekline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8		
Shrub (S1)	> 2	2-10	Banksia baxteri
Shrub (S2)	1-2	30-70	Banksia baxteri, B. coccinea, B. nutans, B. plumosa, Melaleuca striata, Banksia falcata, Isopogon trilobus, Hakea ferruginea, Adenanthos cuneatus, Petrophile sp., Beaufortia empetrifolia, Allocasuarina humilis
Shrub (S3)	0-1	30-70	Beaufortia empetrifolia, Melaleuca striata, Isopogon trilobus, Banksia plumosa, Adenanthos cuneatus, Lysinema ciliatum, Taxandria spathulata, Leucopogon sp., Allocasuarina humilis, Daviesia incrassata, Calothamnus gracilis
Sedge/Rush (VR)		30-70	Tricostularia sp., Desmocladus sp., Cyathochaeta avenacea, Lyginia barbata
Herb (H)			
Grass (G)			
Other (climbers) (C)		< 2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 26
Date: 12/12/23	GPS Wpt: 026	Structural comm. type: Banksia shrubland
Photo no. + dir: NSEWG	Habitat: Old sparse banksia kwongkan shrubland over kwongkan heath	
Location: South eastern leg of new airstrip area, northern edge		

Condition: Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	Dry, but new growth					
Aspect: N	NE	E	SE	S	SW	W	NW	Slope: Flat	Gentle	Mod	Steep
Geology: Gran	Lat	Lime	Other	Spongolite	Rock: 0	<2	2-10	10-20	20-50	>50	
Soil Colour: Grey	Dark Brown	Light Brown			Soil Type: C	CL	CLS	CS	L	LS	
Orange/Brown	Red/Brown	White	Yellow		S	SCL	SL	SP	ZCL	ZL	ZS
Litter (% cover & depth): < 20% - 1 cm					Bare Ground (% cover): < 5% bare						
Hydrology: Good drain				Poor drain	Topographic position: Upland			Wetland	Rock Outcrop	Breakaway	
Wet all year				Seas wet	Drainage Depression			Creepline	Riparian Bank	Gully	
winter/spring					Plain	Slope Lower	Slope Middle	Slope Upper	Valley	Flat	

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	10-30	Banksia coccinea
Shrub (S2)	1-2	10-30	Banksia coccinea, Adenanthos cuneatus, Hakea corymbosa, Banksia baxteri (1), Isopogon trilobus, Isopogon sp., Hakea ferruginea
Shrub (S3)	0-1	30-70	Adenanthos cuneatus, Isopogon trilobus, Banksia nutans, Beaufortia empetrifolia, Melaleuca striata, Calothamnus gracilis, Lysinema ciliatum, Taxandria spathulata, Daviesia incrassata, Banksia falcata, Allocasuarina humilis
Sedge/Rush (VR)		10-30	Anarthria prolifera, Lyginia barbata, Desmocladus sp., Tricostularia neesii, Cyathochaeta avenacea
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 27
Date: 12/12/23	GPS Wpt: 027	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old low patchy kwongkan shrubland and heath	
Location: Near eastern end of new airstrip area, outside southeast of fence and track		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 10% - 2 cm	Bare Ground (% cover): < 20% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	< 2	Eucalyptus pleurocarpa
Shrub (S1)	> 2	< 2	Lambertia inermis
Shrub (S2)	1-2	2-10	Hakea trifurcata, Banksia falcata, B. plumosa, Hakea ferruginea, Adenanthos cuneatus, Hakea corymbosa
Shrub (S3)	0-1	30-70	Banksia nutans, Beaufortia empetrifolia, Isopogon trilobus, Hakea corymbosa, Adenanthos cuneatus, Banksia obtusa, Lysinema ciliatum, Daviesia incrassata, Phymatocarpus maxwellii, Hibbertia sp., Leucopogon sp. Verticordia sp., Melaleuca suberosa, Isopogon linearis
Sedge/Rush (VR)		30-70	Tricostularia neesii, Desmocladus sp., Anarthria prolifera, Xanthorrhoea platyphylla, Gahnia sp., Lepidosperma sp., Conostylis setigera
Herb (H)			
Grass (G)			
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 28
Date: 13/12/23	GPS Wpt: 028	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old patchy mallee with low kwongkan sheath and hrubland	
Location: South of west end of existing runway, south of fence and track		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): 30% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	10-30	Eucalyptus pleurocarpa, E. ecostata, E. angulosa, E. uncinata
Shrub (S1)	> 2	< 2	Hakea denticulata
Shrub (S2)	1-2	2-10	Hakea trifurcata, Banksia alliacea, Kunzea sp., Templetonia retusa
Shrub (S3)	0-1	30-70	Banksia alliacea, Beaufortia gracilis, Hakea trifurcata, Kunzea sp., Phymatocarpus maxwellii, Petrophile rigida, Banksia tenuis, Pultenaea sp., Darwinia sp.
Sedge/Rush (VR)		2-10	Xanthorrhoea platyphylla, Tetraria sp, Lepidosperma sp, 15cm flat, Mesomelaena stygia
Herb (H)			
Grass (G)		< 2	Neurachne alopecuroidea
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 29
Date: 13/12/23	GPS Wpt: 029	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old sparse mallee over kwongkan shrubland and kwongkan patches	
Location: South part of mid strip south of fence and track, southern part of reserve		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Very dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS duplex S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	10-30	Eucalyptus pleurocarpa, E. uncinata
Shrub (S1)	> 2	2-10	Lambertia inermis, Hakea laurina
Shrub (S2)	1-2	10-30	Lambertia inermis, Hakea denticulata, H. trifurcata, H. ferruginea, Banksia falcata, H. corymbosa, Isopogon buxifolius
Shrub (S3)	0-1	30-70	Banksia alliacea, B. tenuis, Isopogon buxifolius, Phymatocarpus maxwellii, Isopogon trilobus, Lysinema ciliata, Taxandria spathulata, Beaufortia gracilis, Pultenaea sp., Hibbertia sp., Melaleuca suberosa
Sedge/Rush (VR)		2-10	Xanthorrhoea platyphylla, Schoenus sp. 15 cm, Lepidosperma sp, 20 cm flat, Tetraria sp., Patersonia occidentalis
Herb (H)			
Grass (G)		< 2	Neurachne alopecuroidea
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 30
Date: 13/12/23	GPS Wpt: 030	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old sparse mallee over kwongan shrubland over Myrtaceae heath	
Location: South east centre, southern part of reserve, at side of airstrip development area		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS duplex S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): 30% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	10-30	Eucalyptus pleurocarpa, E. uncinata, E. tetraptera to south
Shrub (S1)	> 2	10-30	Hakea obliqua, H. pandanica
Shrub (S2)	1-2	10-30	Hakea obliqua, H. corymbosa, Isopogon buxifolius, Hakea pandanica, Regelia inops, Isopogon trilobus, Leucopogon sp.
Shrub (S3)	0-1	70+	Phymatocarpus maxwellii, Banksia alliacea, Isopogon trilobus, Banksia nutans, B. tenuis, Beaufortia empetrifolia, Lysinema ciliata, Daviesia incrassata, Regelia inops, Hibbertia sp., Hakea obliqua, Calothamnus gracilis
Sedge/Rush (VR)		10-30	Anarthria laevis, Mesomelaena stygia, Tricostularia sp., Xanthorrhoea platyphylla
Herb (H)			
Grass (G)			
Other (climbers) (C)		< 2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 31
Date: 13/12/23	GPS Wpt: 031	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old sparse mallee over kwongan shrubland patches and Myrtaceae heath	
Location: South side, towards southern edge, southern part of reserve, south of airstrip development area		

Condition: Pristine	Excellent	Very Good	Good	Degraded	Completely Degraded	Dry, several roo pads							
Aspect: N	NE	E	SE	S	SW	W	NW	Slope: Flat	Gentle	Mod	Steep		
Geology: Gran	Lat	Lime	Other	Spongolite	Rock: 0	<2	2-10	10-20	20-50	>50			
Soil Colour: Grey	Dark Brown	Light Brown			Soil Type: C	CL	CLS	CS	L	LS	duplex		
Orange/Brown	Red/Brown	White	Yellow		S	SCL	SL	SP	ZCL	ZL	ZS		
Litter (% cover & depth): 30% - 1 cm					Bare Ground (% cover): 30% bare – roo pads								
Hydrology: Good drain				Poor drain	Topographic position: Upland				Wetland	Rock Outcrop	Breakaway		
Wet all year				Seas wet	Drainage Depression				Creekline	Riparian Bank	Gully		
winter/spring					Plain				Slope Lower	Slope Middle	Slope Upper	Valley	Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. angulosa
Shrub (S1)	> 2	2-10	Lambertia inermis, Hakea denticulosa
Shrub (S2)	1-2	10-30	Hakea trifurcata, Banksia falcata, Regelia inops, Hakea ferruginea, H. pandanicarpa, H. corymbosa, Melaleuca rigidifolia
Shrub (S3)	0-1	30-70	Banksia alliacea, B. tenuis, Phymatocarpus maxwellii, Hakea trifurcata, Melaleuca rigidifolia, Beaufortia empetrifolia, Isopogon buxifolius, Melaleuca suberosa, Petrophile rigida, Calothamnus gracilis, Pultenaea sp., Hakea trifurcata
Sedge/Rush (VR)		10-30	Gahnia aristata, Mesomelaena stygia, Tetraria sp., Tricostularia sp., Desmodcladus lateriflorus, Xanthorrhoea platyphylla, Schoenus sp.
Herb (H)			
Grass (G)		< 2	Amphipogon turbinatus, Neurachne alopecuroidea
Other (climbers) (C)			

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

STRUCTURAL VEGETATION, FLORA – Relevé N McQuoid		SITE_ID: 32
Date: 13/12/23	GPS Wpt: 032	Structural comm. type: Mallee heath
Photo no. + dir: NSEWG	Habitat: Old low kwongkan shrubland and heath	
Location: South side of fence and track, central south of airstrip development area		

Condition: Pristine Excellent Very Good Good Degraded Completely Degraded Dry	
Aspect: N NE E SE S SW W NW	Slope: Flat Gentle Mod Steep
Geology: Gran Lat Lime Other Spongolite	Rock: 0 <2 2-10 10-20 20-50 >50
Soil Colour: Grey Dark Brown Light Brown Orange/Brown Red/Brown White Yellow	Soil Type: C CL CLS CS L LS S SCL SL SP ZCL ZL ZS
Litter (% cover & depth): < 20% - 1 cm	Bare Ground (% cover): < 10% bare
Hydrology: Good drain Poor drain Wet all year Seas wet winter/spring	Topographic position: Upland Wetland Rock Outcrop Breakaway Drainage Depression Creepline Riparian Bank Gully Plain Slope Lower Slope Middle Slope Upper Valley Flat

Layer	Height (m)	Cover	Plant Species (Dominant 3 first)
Tree (T2)	10-30		
Tree (T3)	< 10		
Mallee (M1)	> 8		
Mallee (M2)	< 8	2-10	Eucalyptus pleurocarpa, E. adesmophloia
Shrub (S1)	> 2	2-10	Hakea pandanica
Shrub (S2)	1-2	10-30	Hakea trifurcata, H. pandanica, H. corymbosa, H. ferruginea, Isopogon trilobus, Banksia plumosa, Adenanthos cuneatus
Shrub (S3)	0-1	30-70	Banksia alliacea, B. nutans, Isopogon trilobus, Beaufortia empetrifolia, Banksia tenuis, Melaleuca striata, Allocasuarina humilis, Lysinema ciliata, Phymatocarpus maxwellii, Melaleuca suberosa, Oligarrhena micrantha, Daviesia incrassata, Isopogon linearis, Banksia repens
Sedge/Rush (VR)		10-30	Tricostularia sp., Lyginia barbata, Schoenus sp., Mesomelaena stygia, Desmocladus sp., Cyathochaeta avenacea
Herb (H)			
Grass (G)			
Other (climbers) (C)		< 2	Cassytha sp. fine

Cover Codes: D >70% M 30-70% S 10-30% V 2-10% VV <2% E <5% Emergent

Appendix E

VHS Certificate of Sample Analysis

SEND TO: VHS Lab, Ecosystem Health Branch - DBCA, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9219 9587

CONTACT DETAILS of sender

Name: Jeremy Spencer
 Phone No: 0400 113 093 Email: jeremy@gbsbiologic.com.au
 DBCA Office or Company Name: GS Bio Logic

GDA (1)
 GDA 94 _____

Job Type (Please indicate)
 Private _____ Other _____

VHS use only
 Date received 18.12.23
 Date reported 24.12.23
21.24

Notify DPIRD? Y / N
 (VHS use only)

VHS Identification No. (VHS use only)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant Genus sampled	Plant Species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS 46490	11-12-23	Bremer Airfield Sample 1	Banksia Xanthorrhoea	nutans platyphylla	Low	50	714321 6193247	Res		CIN
VHS 46491	11-12-23	Bremer Airfield Sample 2	Banksia	coccinea	Low	50	714650 6193191	Res		NEG
VHS 46492	11-12-23	Bremer Airfield Sample 3	Banksia Xanthorrhoea	repens platyphylla	Low	50	714306 6193206	Res		CIN
VHS 46493	11-12-23	Bremer Airfield Sample 4	Banksia	dryandroides	Low	50	714549 6193387	Res		NEG
VHS 46494	11-12-23	Bremer Airfield Sample 5	Lambertia	inermis	mod	50	714365 6193355	Res		NEG
VHS 46495	11-12-23	Bremer Airfield Sample 6	Xanthorrhoea	platyphylla	Low	50	714428 6193304	Res		CIN

NOTES:
 1. Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used.
 2. Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
 3. An MGA map reference with prefixes **must** be supplied for all samples.
 4. Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
 5. Result codes used - CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, PSEUDOCRY = *P. pseudocryptogea*, PI = *P. inunda*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, PN = *P. nicotianae*, CON = *P. constricta*, ALT = *P. afflicta*, NEG = negative, SUB = subcultured for further tests
Please Note: a) It cannot be concluded that an entire site or an entire stockpile of basic raw material is dieback-free from a single or a small number of samples where *Phytophthora* was not detected (i.e. a NEG result), and; b) Information from your samples will be incorporated into the VHS database.

Please Double Bait 1 3 + 6 if Neg.

Vegetation Health Service – Phytophthora sample information sheet

FORM FEM046

SEND TO: VHS Lab, Ecosystem Health Branch - DBCA, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9219 9587

CONTACT DETAILS of sender

Name: Jeremy Spencer
 Phone No: 0400 113 093 Email: jeremy@gbiologic.com.au
 DBCA Office or Company Name: GS Bio Logic

GDA (1)

GDA 94 _____

Job Type (Please indicate)

Private

Other _____

VHS use only

Date received 15.1.24

Date reported 28.1.24

Notify DPIRD? Y / N

(VHS use only)

VHS Identification No. (VHS use only)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant Genus sampled	Plant Species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS 46549 ■■■■■ I ■■■■■ II ■■	11-01-24	Bremer Airfield Sample 7	Lambertia	inermis	Low	50	714596 6193373	Res		NEG

- NOTES:**
- Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
 - Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
 - An MGA map reference with prefixes **must** be supplied for all samples.
 - Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
 - Result codes used - **CIN** = *Phytophthora cinnamomi*, **MUL** = *P. multivora*, **PSEUDOCRY** = *P. pseudocryptoea*, **PI** = *P. inundata*, **ARE** = *P. arenaria*, **ELO** = *P. elongata*, **THE** = *P. thermophila*, **PN** = *P. nicotianae*, **CON** = *P. constricta*, **ALT** = *P. allicola*, **NEG** = negative, **SUB** = subcultured for further tests
- Please Note:** a) It cannot be concluded that an entire site or an entire stockpile of basic raw material is dieback-free from a single or a small number of samples where *Phytophthora* was not detected (i.e. a **NEG** result), and; b) Information from your samples will be incorporated into the VHS database.

Custodian: Plant Diseases Program Coordinator
 Approved by: Ecosystem Health Branch Manager



Vegetation Health Service – Phytophthora sample information sheet

FORM FEM046

SEND TO: VHS Lab, Ecosystem Health Branch - DBCA, 17 Dick Perry Ave KENSINGTON 6151 Phone: (08) 9219 9587

CONTACT DETAILS of sender

Name: Jeremy Spencer
Phone No: 0400 113 093 Email: jeremy@gbiologic.com.au
DBCA Office or Company Name: GS Bio Logic

Job Type (Please indicate)

Private
Other _____

GDA (1)

GDA 94 _____

VHS use only
Date received 29.4.24
Date reported 13.5.24

Notify DPIRD? Y / N
(VHS use only)

VHS Identification No. (VHS use only)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant Genus sampled	Plant Species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS 46987	23-04-24	Bremer Airfield Sample 8	Banksia	falcata	Low	50	714652 6193700	Res		NEG
VHS 46988	23-04-24	Bremer Airfield Sample 9	Xanthorrhoea	platyphylla	Low	50	714540 6193695	Res		NEG
VHS 46989	23-04-24	Bremer Airfield Sample 10	Banksia	dryandroides	Low	50	714067 6193765	Res		NEG
VHS 46990	23-04-24	Bremer Airfield Sample 11	Banksia	dryandroides	Low	50	715031 6193432	Res		NEG

NOTES:

- Please tick this box if your map references are supplied in the GDA 94 standard. If not, please specify the datum used.
 - Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
 - An MGA map reference with prefixes **must** be supplied for all samples.
 - Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
 - Result codes used - **CIN** = *Phytophthora cinnamomi*, **MUL** = *P. multivora*, **PSEUDOCRY** = *P. pseudocryptogea*, **PI** = *P. inundata*, **ARE** = *P. arenaria*, **ELO** = *P. elongata*, **THE** = *P. thermophila*, **PN** = *P. nicotianae*, **CON** = *P. constricta*, **ALT** = *P. alicola*, **NEG** = negative, **SUB** = subcultured for further tests
- Please Note: a) It cannot be concluded that an entire site or an entire stockpile of basic raw material is dieback-free from a single or a small number of samples where *Phytophthora* was not detected (i.e. a **NEG** result), and; b) information from your samples will be incorporated into the VHS database.

PLEASE DOUBLE BAIT XANTHORRHOEA SAMPLE 9

Custodian: Plant Diseases Program Coordinator
Approved by: Ecosystem Health Branch Manager

Last updated: 21 April 2020