Appendix C Dieback and Weed Management Plan

PERTH BASIN

DIEBACK AND WEED HYGIENE

MANAGEMENT PLAN

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Document Control

The HSE Manager is the custodian of this Dieback and Weed Hygiene Management Plan and is responsible for ensuring the approval and management of this document including any revisions.

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1 Introduction

Strike Energy Limited (Strike Energy), is undertaking a range of petroleum exploration and production activities within the northern portion of the Perth Basin, including 2D and 3D seismic surveys, exploration drilling, production wells and associated flowlines and trunklines subject to relevant regulatory approvals.

These activities occur across a number of permit areas, including but not limited to: EP447, EP469, EP 488, EP 489, EP 495, EP 503, EP 504 and EP 505 (Figure 1.1). Strike Energy's existing project locations are provided in Appendix A.

1.1 Purpose

This Dieback and Weed Hygiene Management Plan (DWMP) has been prepared to define the process for the control of dieback or weeds for exploration activities within the Perth Basin.

Strike Energy carries out all petroleum activities in accordance with approved Environmental Plans, Safety Management Systems, and other relevant regulations (*e.g.* Native Vegetation Clearing Permits). These plans form part of the legal requirements for its activities.

The aim of this management plan is to:

- prevent the spread of dieback or weeds where Strike Energy activities are taking place; and
- provide information about the practices required to abate and mitigate biosecurity threats.

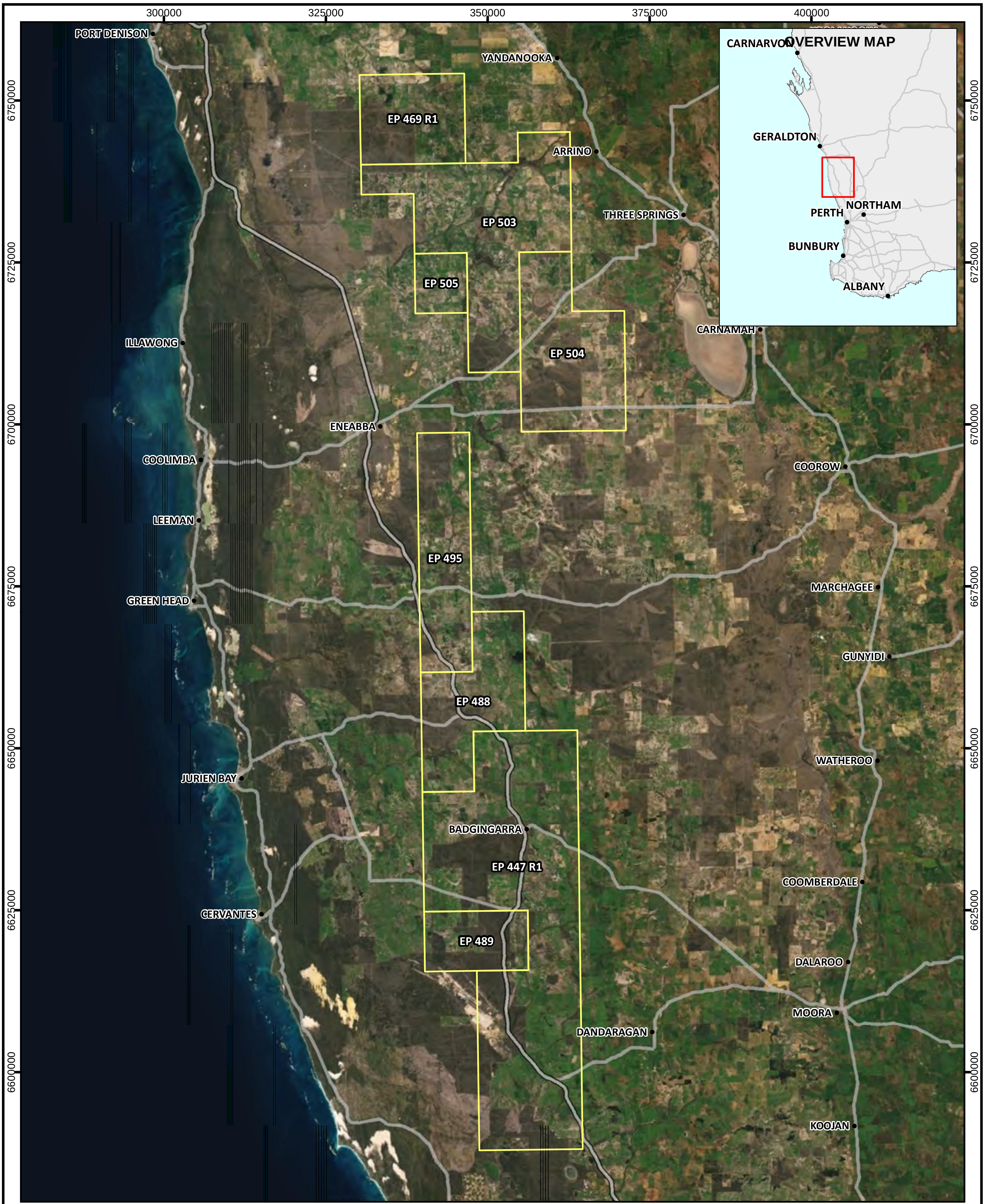
This DWMP should be read in conjunction with relevant approvals for Strike Energy's petroleum activities within the Perth Basin. The land over which these activities occur, includes:

- Areas within large, intact blocks of remnant vegetation on Unallocated Crown Land (UCL) in largely pristine condition within a region that has largely been cleared for agriculture, containing a number of different habitat types (such as EP469, EP495); and

- Land that has been predominantly cleared land with fragments of remnant vegetation within and surrounding freehold land, that is largely used for agricultural and pastoral activities.

Dieback is the name generally used in Western Australia to describe the disease symptoms of, and the causal agent, *Phytophthora cinnamomi* (Glevan Consulting, 2012). This DWMP refers to Phytophthora dieback and the main causal agent, *Phytophthora cinnamomi*.

The DWMP details the steps to be taken to avoid the introduction and/or spread of dieback and weeds within areas in which Strike Energy is undertaking petroleum activities. This includes steps to be taken if dieback or weeds are identified during monitoring resulting from the project's activities.



Legend

Strike Energy Permits

Highways

Main road

• Towns

Scale 1:775,000 at A4 (0 10 20 Kilometers)	**STRIKE ENERGY PERTH BASIN TENURE**
Coord. Sys. GDA 1994 MGA Zone 50	
Job No: 60964	
Client: Strike West	**FIGURE 1.1**
Version: A / Date: 17-Jun-2021	strategen JBS&G
Drawn By: cthatcher / Checked By: CT	

File Name: W:\Projects\1)Open\Strike West\60964 South Erregulla Drilling Approvals\GIS\Maps\R01_Rev_A\60964_01_1_Tenure.mxd
Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

1.2 Objectives and Targets

The objectives and targets of this DWMP are outlined in Table 1.1.

Table 1.1: Dieback and Weed Management Objectives and Targets

Objectives	Targets
Dieback management	
Avoid the introduction of dieback	No occurrences of dieback within the areas of native vegetation within native vegetation that can be directly attributed to project activities, detected within two years following completion of project activities.
Weed management	
Avoid the spread of environmentally significant weeds or declared pests	No new populations or, spread of, declared pests [1] or environmentally significant weeds [2] or new weed species that can be directly attributed to project activities within two years following completion of project activities.
Avoid the introduction of any new environmentally significant weed species	

1 Declared pests are those plants regulated under the *Biosecurity and Agriculture Management Act 2007.*
2 Environmentally significant weeds are considered to be Weeds of National Significance, declared pests, weeds with a high environmental weed rating and weeds prioritised as high in the weed prioritisation process.

2 Existing Environment

2.1 Regional Context

Current petroleum activities located within the Lesueur Sandplain (GS3) subregion of the Geraldton Sandplains bioregion, as defined by the Interim Biogeographic Regionalisation for Australia (IBRA). The Lesueur Sandplain subregion (GS3) comprises coastal Aeolian and limestones, Jurassic siltstones and sandstones (often heavily lateritised) of central Perth Basin (Desmond & Chant 2001).

2.2 Climate

The climate of the region is described as Mediterranean, with dry, warm summers and wet, cool winters (BOM, 2020). The nearest open weather station is Carnamah, approximately 56.6 km southeast of the closest Project (SE 1), shows the warmest period in the region is from December to March, with average maximum temperatures from 1991 to 2020 ranging from 33.0 °C to 36.7 °C during these months.

The lowest temperatures generally occur between June and September, with average minimum temperatures ranging from 7.2 °C to 8.7 °C during these months (BOM, 2021).

Average rainfall in the region from 1991 to 2020 is highest during the cooler months between June and July. Rainfall during these months' ranges from 49.6 mm to 57.6 mm per month. The driest months are between October and December, with rainfall ranging from 8.7 mm to 10.4 mm in this period. The average annual rainfall at Carnamah is 328.3 mm (BOM, 2021).

The monthly average temperature (°C) and rainfall (mm) is shown in Figure 2.1

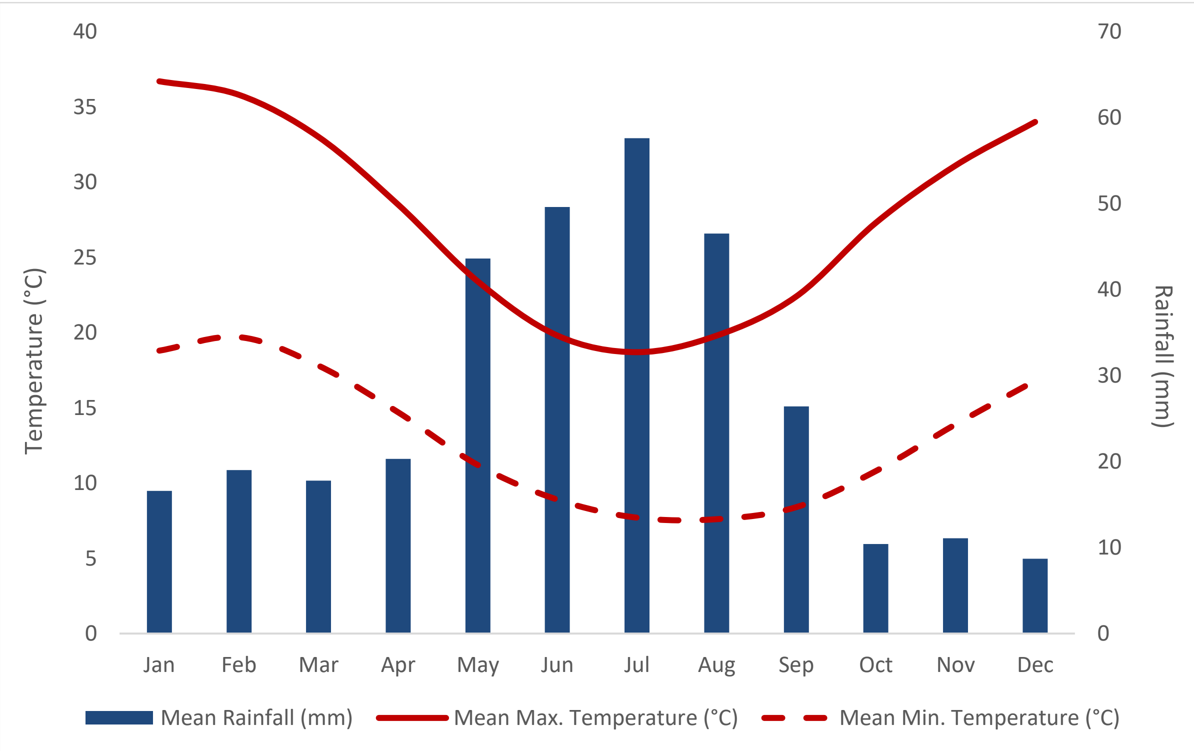


Figure 2.1 Monthly Average Rainfall and Temperature (Station 008025 - Carnamah)

2.3 Geology and Soils

The sites in which petroleum activities are occurring or will occur, are predominantly located in the Northern Sandplains Region (Irwin Botanical District) as described by Beard (1990). Soils are yellow sands inland and leached sandy soils near the coast, which overlay laterite and in which several isolated lateritic outcrops surrounded by generally flat or undulating sandplains occur (Coffey, 2015).

2.4 Surface Water

Numerous small watercourses dissect the surrounding areas, draining either westwards from the Arrowsmith Region onto the Swan Coastal Plain, or north or south towards the nearest river systems, the Arrowsmith, Irwin and Lockier Rivers. There are also several small ephemeral creeks in the surrounding area, including Sand Plain Creek and several unnamed watercourses (RPS, 2011).

2.5 Flora and Vegetation

The vegetation of the Northern Sandplains Region is broadly described as scrub on heath on sandplains near the coast with Acacia-Casuarina thickets further inland, Acacia shrub with scattered trees of *Eucalyptus loxophleba* on hard-setting loams (Beard, 1990).

2.6 Current Dieback Status

For the purpose of Strike Energy activities occurring within the Perth Basins, all areas of native vegetation will be considered as 'uninfested (Protectable)' unless otherwise determined by a site specific dieback survey. Where possible, preference will be given to undertaking activities within cleared land, and where activities within areas of native vegetation are required, the measures described in Section 3 will be undertaken to protect these areas.

For example, Glevan Consulting (2012) undertook an assessment for the presence of Phytophthora dieback within EP 469 (Appendix B). No areas of remnant vegetation within areas of native vegetation were observed to be affected, infected or altered by any previous introduction of Phytophthora dieback. Given this, the majority of the area surveyed was classified as 'uninfested (Protectable)'. The dieback status of private property (farmland) within EP 469 was not able to be determined due to a lack of native vegetation that can be used as indicator species and is therefore classified as 'Unmappable'.

Weed Status

Weeds are plants that are able to establish themselves and persist in a natural ecosystem where they did not previously exist. Weeds may, or may not, have detectable environmental or economic impacts (EPA 2016).

Weeds are localised around previously disturbed areas. As a result of prior flora and vegetation surveys within areas of native vegetation within the Perth Basin a number of weed species are known to occur. For example within EP 469, 22 species are known to occur and have been rated according to the descriptions in Sections 2.6.1 to 2.6.3 below (refer to Appendix D).

2.6.1 Weeds of National Significance

Weeds of National Significance (WONS) have been identified based on their invasiveness, potential for spread and environmental, social and economic impacts. No WONS have been recorded within Strike Energy's existing exploration locations.

2.6.2 Declared Pests

Plants that are prevented entry into the State or have control or keeping requirements within the State are known as Declared Pests. Introduced flora species are regulated under the *Biosecurity and Agriculture Management Act 2007* (BAM Act) and associated regulations and are grouped into four main classifications:

- declared pests (Section 22 of the BAM Act);
- permitted (Section 11 of the BAM Act);
- prohibited (Section 12 of the BAM Act); and
- permitted requiring a permit (Section 73 of the BAM Regulations 2013).

Under the BAM Act, all declared pests are placed in one of three categories, namely C1 (exclusion), C2 (eradication) or C3 (management):

- the C1 category (Exclusion) – Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State;
- the C2 category (Eradication) – Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility; and
- the C3 category (Management) – Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area that currently is free of that pest.

Of the weeds previously identified within EP 469, the following is a declared pest within Western Australia (DPIRD, 2020):

- *Echium plantagineum* L (Paterson's curse, salvation jane) – Category C3.

2.6.3 Environmental Weeds

An Environmental Weed is an introduced plant that establishes in natural ecosystems and adversely modifies natural processes, resulting in decline of invaded communities (CALM 1999).

The Department of Primary Industries and Regional Development (DPIRD), use a risk assessment procedure for environmental weeds for each of four regions, for which the Perth Basin falls within the South-west of Western Australia region. The risk score is based on climatic suitability for each species within each region and invasive and impacts criteria in the Future Farm Industries weed risk protocol, and multiplied across all three sections to produce the final score.

Of the weeds identified in previous surveys, only *Ehrharta calycina* (Perrenial Veldt Grass) is listed as an environmental weed listed by DPIRD, with a risk rating for the South-west of "Very high". This risk rating means that use of this species is not recommended and if used, requires a detailed management plan and there are significant environmental and management risks (DPIRD, 2020).

The Department of Biodiversity, Conservation and Attractions (DBCA) Parks uses a species-led prioritisation process for each region based on ecological impact, invasiveness, current and potential distribution and feasibility of control. The list of previously identified weeds within EP 469 has been compared to the current (December 2020) Mid-West Region priority weed listing (DBCA 2020), with a number being identified and rated for both ecological impact and invasiveness (Appendix D). The priorities for management of these weeds are as follows:

1. Early Detection/Rapid Response: Any new infestations and/or introductions of any weed species in an area, no matter their impact and/or invasiveness, should be eradicated immediately;
2. Eradication of those species which are still in small enough populations for this target to be achieved; and
3. Management of high impact, rapidly-moderately invasive species that are impacting on high value conservation assets.

The key focus for this DWMP is on those weeds identified as having high ecological impact and rapid invasiveness. The following species recorded within EP 469 fall within this criteria (DBAC, 2020):

- *Avena barbata* (Bearded Oat);
- *Brassica tournefortii* (Prickly Turnip, Mediterranean Turnip);
- *Bromus diandrus* (Great Brome);
- *Echium plantagineum* (Paterson's Curse, salvation jane);
- *Ehrharta caclycina* (Perrenial Veldtgrass); and
- *Ursinia anthemoides* (Ursinia).

3 Dieback Management

3.1 Potential Environmental Impacts

Dieback (*Phytophthora cinnamomi*) is a microscopic soil-borne organism that attacks the roots and collar of susceptible plants (DotE, 2014). Dieback kills a wide variety of plants in moist parts of Western Australia and is particularly well known for its detrimental effect on Jarrah forests. However, it seriously affects many plants in a wide range of environments.

The common indicator species used to determine the occurrence of Phytophthora Dieback that occurs within the Perth Basin region include *Banksia* and *Xanthorrhoea* species.

Introduction of *Phytophthora* Dieback into Protectable areas may occur as a result of the petroleum activities in the absence of appropriate management and mitigation measures.

3.2 Dieback Management and Mitigation Measures

The uninfested (Protectable) dieback management areas are assigned to the areas of native vegetation. This means that the UCL is currently considered free from the *Phytophthora* Dieback disease and is able to be protected from the introduction of dieback arising from project operations provided appropriate management measures are in place.

Cleared agricultural land is considered as Unmappable dieback management area due to lack of suitable indicator species.

Even though the dieback status of the unmappable area is not known, the management and mitigation measures outlined in the following sections are designed to protect both dieback management areas from the introduction of dieback associated with project operations. These measures will be implemented during all Strike Energy Northern Peth Basin project activities.

3.2.1 General Hygiene Requirements

The northern extent of the Perth Basin (which includes EP469, EP503, EP504 and EP 505) is located on the outer limits of *Phytophthora cinnamomi* preferred rainfall zone (greater than 600 mm per annum) (Hardy *et al*., 2001). Therefore, standard hygiene management measures are required to ensure the areas in proximity to activities remain uninfested. It is feasible to protect uninfested native vegetation from the introduction of dieback by project operations through active management of vehicle, machinery and equipment and personnel movement.

Best practice management of activities within native vegetation and farms that will be protected involves:

- training of personnel during environmental inductions and daily toolboxes, including specific requirements with regard to hygiene management;
- minimising (and clearly signposting) the number of entry points;
- establishing hygiene stations prior to entry to areas that must be protected;
- ensuring, by visual inspection and/or cleaning, that vehicles, plant, equipment, and footwear are clean when entering protectable areas;

- inspecting vehicle tyres / wheels, undercarriage, belly plates, and personal clothing and footwear;
- if contaminated with pests, clean down procedures will be implemented to remove any material prior to entry; and
- using and keeping records of inspection forms.

3.2.1.1 Training and induction

Inductions and discussions centred on *Phytophthora* Dieback management in toolbox meetings will ensure *Phytophthora* Dieback is not introduced or spread by project operations.

3.2.1.2 Signage

Phytophthora Dieback signs will be consistent with the Western Australian Standard Dieback Signage System and all staff, contractors and sub-contractors will be made aware of the signs and the restrictions they place on movement of vehicles and personnel.

3.2.1.3 Manage movement and activity

Restrict vehicle movements and access to existing tracks and roads where possible and practicable. Where tracks are specifically cleared of native vegetation for access, restrict movement to those tracks.

Avoid working during wet soil conditions, if possible, to minimise the risk of spreading or introducing pests such as dieback.

Movement between the two dieback management areas should not occur during wet soil conditions. Vehicle movement will also be limited within dieback categories (i.e. within the Protectable vegetation) during and immediately after heavy rainfall events, where practical.

Project activities will not occur within water-gaining areas (i.e. wetlands). Existing creek crossings will be used where required.

3.2.1.4 Importing Fill or Other Material

If material is brought onto a farm property or other protectable area, it must be free from dieback.

3.2.1.5 Hygiene Control Points

Vehicles, machinery, equipment and personnel will undergo a check designated hygiene control points to ensure they arrive on site clean of soil and plant material. Special attention should be paid to tyres and wheel arches, undercarriage, radiator grill, tipper bodies, blades and buckets of machinery, floors and footwear. If strictly adhered to, this will ensure *Phytophthora* Dieback is not introduced into the Project Area by project operations.

Vehicles, machinery, equipment and personnel must undergo hygiene control procedures when entering:

- Strike Energy project sites;
- uninfested (protectable) dieback management areas (native vegetation); and
- a private property (as per landowner agreement(s)).

3.2.2 Hygiene Facilities

Effective hygiene control involves the removal of all soil and plant material from machinery, vehicles, equipment and personnel so it cannot be transported from one area to another. The majority of soil and plant material collects along the running boards, belly plates, spare tyres and the wheels of vehicles, and on the footwear of personnel. To ensure these areas and the remainder of the vehicle, including machinery and equipment, is clean of soil and plant material, temporary or mobile hygiene facilities will be installed at strategic hygiene control points including the entrance point into Strike Energy project sites, and access points into and between unmappable areas (i.e. private property) and the Protectable areas.

Hygiene stations should:

- provide separation from native vegetation, crops, storage areas or waterways;
- provide for collection/capture of mud, soil and plant materials and effluent generated from clean down procedures (e.g. use of tarpaulin's, mats, bunding etc.) for treatment or disposal; and
- provide physical separation between the vehicle/equipment being cleaned and clean-down materials or effluents.

Two alternative hygiene facilities can be utilised depending on wet or dry soil conditions. The definition of dry and wet soil conditions specific to the Project Area Dry is as follows:

- Dry soils: Dry soil conditions are commonly regarded to be soils that do not readily adhere to surfaces due to moisture. The level of soil moisture required for soils to be classified as dry varies between soil types. A general rule is that greater than 5 mm of rainfall over a 24 hour period will result in moist soil conditions.
- Wet soils: The test for wet soil during activities occurring in proximity to Sand Plain Creek, water-gaining sites or within dieback categories is where a handful of topsoil is clasped in the hand and is moist enough to form a ball.

The hygiene stations under each of these conditions is discussed below:

- **Dry hygiene facility** – In most situations, especially during dry soil conditions, compressed air and a stiff-bristled brush is all that is required to remove soil and plant material from vehicles, equipment and footwear. The dry hygiene facility is the preferred method as Phytophthora Dieback is mobile in water. A diesel generator powered air compressor will supply the compressed air and a Hygiene Inspection Form will be completed for each vehicle or piece of machinery and equipment that passes through the station. Footwear to be checked and cleaned as required to remove dirt prior to entry/exit to areas of native vegetation; and
- **Wet hygiene facility** – Wet soil conditions occur when soils are sufficiently wet to form a cast or adhere in clumps to vehicles, machinery or equipment. When soil and plant material is wet it can be difficult to remove at a dry hygiene facility with compressed air and instead may need to be cleaned via a wet facility involving the use of a high-pressure hose. Sites selected for wet hygiene facilities will have a hard, well-drained surface directed towards a sump dug in close proximity to the hygiene facility to capture any wash-down effluent and prevent it draining into uninfested remnant vegetation. Vehicles will also be prevented from driving

through the wash-down effluent and a Hygiene Inspection Form will be completed for each vehicle or piece of machinery and equipment that passes through the station. Footwear to be checked and cleaned as required to remove dirt prior to entry/exit to areas of native vegetation.

3.2.3 Hygiene Kits

Except where machinery, vehicles and equipment will have to pass through a hygiene station prior to entry to a Protectable area, hygiene kits will be required, which include:

- stiff brushes;
- sterilising solution (e.g. methylated spirits or sodium hypochlorite solution);
- thick-walled bags;
- a small amount of water (less than 3 L); and
- Hygiene Inspection Forms.

These hygiene kits will be used to clean the vehicles and machinery for situations when wet/moist soil is encountered or when unavoidable movement between the unmappable and protectable areas occur outside of the designated hygiene control points. These kits will not be necessary in instances where all vehicles will have to pass through a hygiene facility ahead of entering a Protectable area.

Mud and soil should be removed from the vehicles and footwear with a stiff brush, and the amount of water used should be minimised. All mud/soil should be collected in the thick-walled bag and disposed of at a designated site approved by Strike Energy and the freehold landowners, as applicable.

Hand held equipment, tools and footwear can be sterilised using, for example, methylated spirits (minimum 70% solution) or a sodium hypochlorite solution (e.g. bleach (1 part bleach to 10 parts water) or chlorine (1 part pool chlorine to 100 parts water)). Water from the wash-down effluent can be sterilised by adding 1 part sodium hypochlorite (bleach or pool chlorine) to 100 parts water. Safety instructions of any chemicals used should be strictly followed.

If the hygiene kits are used a Hygiene Inspection Form will be completed. The forms will be retained for reporting purposes and a database will be maintained.

3.2.4 Dieback Monitoring

During rehabilitation monitoring a *Phytophthora* Dieback occurrence assessment will be undertaken to determine if *Phytophthora* Dieback has been introduced into the uninfested (Protectable) dieback management area as a result of Project activities. Areas of highest activity and the hygiene control points will be targeted for *Phytophthora* Dieback assessment.

Phytophthora Dieback assessments will be undertaken using Pocket Diagnostic plant disease detection kits and visual observations for impacted vegetation. The diagnostic kits will be used on plant material (root, leaf or cambium (bark) layer) for species that are potentially showing signs of *Phytophthora* Dieback.

This monitoring will confirm whether the *Phytophthora* Dieback objective and target in Table 1.1 has been met.

3.3 Summary of Dieback Hygiene Management and Mitigation Measures

A summary of the dieback hygiene management and mitigation measures described in Sections 3.1.1 to 3.1.4 is provided in Table 3.1.

Table 3.1: General Hygiene Management and Mitigation Measures

Dieback Hygiene Management and Mitigation Measures	
Measure	**General hygiene requirements**
D1	Signage consistent with the Western Australian Standard Dieback Signage System will be erected at the entry to the Project Area and access points between each dieback management area.
D2	Employee, contractor and sub-contractor inductions will include a component on *Phytophthora* Dieback. The component will include information on hygiene control points and facilities, restrictions on movement throughout the Project Area and the obligations and expectations that are placed on all employees, contractors and sub-contractors working on the project with regards to *Phytophthora* Dieback.
D3	Toolbox meetings will include information on the location of the hygiene control points in relation to the day's activities.
D4	All machinery, vehicles and equipment and personnel will be clean and free from dirt and plant material upon arrival at the Project Area. Records of hygiene inspections will be maintained within the Hygiene Register.
D5	All machinery, vehicles and equipment and personnel will be clean prior to moving from the unmappable area into the Protectable area, and when moving between private properties. Records of hygiene inspections will be maintained within the Hygiene Register.
D6	Soil and plant material should not be brought into the project area unless it is certified as dieback free.
D7	Soil and plant material will not be moved from one dieback management area to another unless it is verified as dieback free or private landowner consent has been granted.
Measure	**Hygiene Facilities**
D8	Mobile hygiene facilities will be installed at strategic hygiene control points prior to site activities in that area.
Measure	**Hygiene kits**
D9	Vehicle movement will be limited within the dieback categories (i.e. within the protectable UCL) during and immediately after heavy rainfall events. Soil conditions are considered to be dry if less than 5 mm of rain has fallen in the previous 24-hour period.
D10	Except where machinery, vehicles and equipment will have to pass through a hygiene station prior to entry to a Protectable area, they will carry a hygiene kit, which includes as a minimum: a stiff brush; sterilising solution (i.e. methylated spirits or sodium hypochlorite solution); a thick-walled plastic bag to dispose of contaminated soil/plant material; a small amount of water (less than 3 L); and Hygiene Inspection Forms.
D11	Hygiene kits to be used on encountering wet soils (as determined by a soil moisture test) or when unavoidable movement between the unmappable and protectable areas occurs outside of the designated hygiene control points. All soil and plant material will be collected and disposed of at the hygiene control points.
D12	Each time the hygiene kits are used a Hygiene Inspection Form will be filled in, the forms will be retained for reporting purposes and a database will be maintained.

Dieback Hygiene Management and Mitigation Measures	
Measure	**Dieback monitoring**
D13	Phytophthora Dieback monitoring will be undertaken annually (between August and September) for two years following completion of project activities in conjunction with the project rehabilitation monitoring.
Reference	**Related Forms / Maps**
Appendix C	Hygiene Inspection Form and Hygiene Register.

4 Weed Management

This DWMP will target weed species that are considered to be of significant environmental concern, this includes WONS listed under the EPBC Act, Declared Pests under the *Biosecurity and Agriculture Management Act 2007* (BAM Act), weed species that are classified as having a High environmental weed rating as defined by the Environmental Weed Strategy (CALM, 1999) and weeds ranked as high in the Weed Prioritisation Process (DPAW, 2013).

4.1 Potential Environmental Impacts

There are identifiable potential environmental issues associated with weed species, which may arise from project activities in the absence of appropriate management and mitigation measures. These include:

- introduction of new weed species, including WONS and declared pests;
- spread of known weed species through vehicle, heavy machinery movement; and
- increase in size of existing weed infestations caused by vegetation and soil disturbance.

4.2 Weed Management and Mitigation Measures

The presence of weeds is considered to be at their highest in association with previously disturbed areas, including tracks, roads and the cleared freehold land. As such, management and mitigation measures will be concentrated on these areas.

4.2.1 Hygiene Facilities

Weeds can be introduced and spread through the movement of seeds in soil or plant material trapped on vehicles, machinery and equipment and personnel clothing and footwear. Similar to managing the risk of spreading *Phytophthora* Dieback, discussed in Section 3, vehicles, machinery and equipment and personnel will be cleaned at strategic hygiene control points via a mobile hygiene facility to ensure they are clean on entry into project sites, when moving from unmappable (private property) into native vegetation and when moving between private properties in accordance with landowner requirements.

The Hygiene Register will be completed each time the vehicles, machinery and equipment and personnel pass through a hygiene control point, with the data being retained and entered into a database for reporting and auditing purposes.

4.2.2 Weed Monitoring

Following the completion of project activities, annual weed monitoring will be undertaken for two years within transects representative of the native vegetation of the project area, or until the project's rehabilitation criteria pertaining to weeds have been met, in accordance with the objectives and targets in Table 1.1.

Any weed monitoring within private properties will be subject to landholder approval and in accordance with landholder access agreements.

The weed monitoring will be concentrated along access tracks and hygiene control points and include the rehabilitation monitoring sites. A qualified botanist or appropriately skilled environmental officer will conduct the weed monitoring. Records of weeds will be kept and updated after each weed monitoring period. Records will detail the location, species, date of record and any management measures that have been implemented.

Based on current DBCA environmental weed ratings for the Midwest Region, the weeds listed in Table 4.1, if sighted in Perth Basin project areas, are to be reported to the local DBCA Office (Midwest):

Table 4.1: Midwest Region Priority Alert Weeds

Scientific name	Common Name
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed
Eichhornia crassipes	Water Hyacinth
Lantana camara	Lantana
Parkinsonia aculeata	Parkinsonia
Rubus anglocandicans	Blackberry
Salvinia molesta	Salvinia
Zantedeschia aethiopica	Arum lily

4.2.3 Weed Control

Weed control will focus on appropriate control measures for the following high risk environmental weeds, for which *Echium plantagineum* is also a Declared Pest:

- *Avena barbata* (Bearded Oat);
- *Brassica tournefortii* (Prickly Turnip, Mediterranean Turnip);
- *Bromus diandrus* (Great Brome);
- *Echium plantagineum* (Paterson's Curse, salvation jane);
- *Ehrharta caclycina* (Perrenial Veldtgrass); and
- *Ursinia anthemoides* (Ursinia).

DPIRD (Agriculture and Food) provide up-to-date information on the methods to control introduced weeds in Western Australia. Weed control is best achieved through an integrated pest management plan using a combination of biological, chemical, mechanical, physical and cultural methods.

Due to the varying extent of land over which petroleum activities may occur, a range of methods may be used to control current weed infestations and potential new infestations, including chemical (herbicides), mechanical (use of heavy machinery) and physical (hand-pulling) methods.

As a general rule, generic broad-scale spraying of weed species with Glyphosate (e.g. Roundup® or similar product) will assist in the control of weed species until further information is obtained on the particular weed species. More specific and current weed control methodology will be obtained from DPIRD Pest and Disease Information Service (https://www.agric.wa.gov.au/biosecurity/pest-and-disease-information-service-padis) as required. Any requirement for weed control based on the findings of the monitoring event, will be documented in the annual environmental monitoring report.

The weed control will be undertaken by appropriately trained personnel or external contractor at the discretion of the Strike Energy HSE Manager. The contractor's employees will be appropriately trained in the use of the herbicides used and the methods required to safely use the herbicides on the weeds located within the Project Area. The Safety Data Sheet (SDS) (previously referred to as a Material Safety Data Sheet) located on the labels of the herbicides will describe the relevant information necessary for the correct usage, handling and storage of the herbicide. The SDS labels will also instruct the handler of the correct personal protective equipment (i.e. gloves, overalls, respirator etc.) required for the herbicide in use and any information relevant for emergency situations (i.e. poisoning).

Consultation and agreement between Strike Energy and the freehold landowners will be undertaken to determine the appropriate time and method to undertake weed control within freehold land, if required.

4.3 Summary of Weed Hygiene Management and Mitigation Measures

A summary of the measures described in Section 4 is provided in Table 4.2.

Table 4.2: General Weed Management and Mitigation Measures

Weed Hygiene Management and Mitigation Measures	
Measure	**Weed monitoring**
W1	Monitoring of weeds within native vegetation within the project site will be undertaken annually for a minimum of two years following the completion of project activities and until monitoring demonstrates the weed rehabilitation criteria have been met.
W2	A qualified botanist or an appropriately skilled environmental officer will undertake the weed monitoring.
W3	Weed records will be maintained. Records will detail the identification and location of weed species, the date of the record and management measures that have been implemented, including follow-up monitoring.
Measure	**Weed control**
W4	Weed control will be undertaken on an as needs basis (in accordance with recommendations made in the annual monitoring reports) by an appropriately qualified, certified and experienced contractor, at the discretion of the Strike Energy Asset and HSE Manager.
W5	Weed control within native vegetation within the project site will continue until completion of the rehabilitation activities.
W6	Weed control within native vegetation within the project site will be undertaken in accordance with guidelines available from DPIRD.
W7	Any weed control measures and timing within freehold land will be negotiated between property owners, the Strike Energy Asset and HSE Manager and the Stakeholder Liaison Group, taking into account landholder requirements.
Reference	**Related Forms / Maps**
Contractor	Safety Data Sheets for herbicides.
Appendix C	Hygiene Inspection Form and Register.

5 Roles and Responsibilities

The key roles and responsibilities for the implementation of this DWMP are described in Table 5.1. The Strike Energy Asset Manager has overall accountability for compliance with this DWMP.

Table 5.1: Key roles and responsibilities

Role	Responsibilities
Strike Energy HSE Coordinator	To ensure that: • the project operates in compliance with this DWMP and other regulatory requirements for the duration of the project and that contractor procedures, where used, satisfactorily implement the requirements of this DWMP; • internal inspections and/or audits are undertaken to assess the effectiveness of the management and mitigation measures and assess the environmental performance of the DWMP (in conjunction with the Project Manager); • induction material addresses the requirements of this DWMP and appropriate induction records are maintained; • all routine and incident reporting requirements of the DWMP are met; • the performance of contractors and equipment are audited to ensure compliance with this DWMP and all relevant documentation and forms are completed and recorded; and • weed records are maintained.
Strike Energy Project Engineer	To ensure that: • all project work is carried out in accordance with this DWMP; • internal inspections and/or audits are undertaken to assess the effectiveness of the management and mitigation measures and assess the environmental performance of the project with regards to the DWMP; • personnel are adequately inducted prior to commencement of the project; • personnel are aware of this DWMP, the management and mitigation measures it contains and the environmental sensitivities associated with the project site; • all non-compliances reported by contractors are reported to the Strike Energy Asset Manager, and have been adequately investigated and addressed; and • Hygiene Inspection Forms are completed and documented with the Strike Energy Asset Manager.
Contractor Manager[1]	To ensure that: • all aspects of this DWMP relevant to contractor operations and associated contractor interface documents are properly complied with; • contractor personnel are adequately inducted and trained prior to commencement of the project; • contractor personnel are aware of this DWMP, the management and mitigation measures it contains and the environmental sensitivities associated with the project area; and • non-compliances are promptly reported to the relevant Strike Energy project manager and are promptly and adequately investigated and addressed.

1 Contractor Manager refers to a person working for a contractor to Strike Energy and who is responsible for managing all other personnel working for the same contractor on the same project.

6 Review and Reporting

6.1 Document Review

This DWMP will be reviewed and revised by Strike Energy at least every two years, or more frequently as may be required if:

- there are changes to the Project area or its operations including the addition of new exploration permits;
- non-compliance identified by the private landowners or regulators through the reporting of its project activities; and
- more recent external research and development programs out-date the current management and mitigation measures.

6.2 Reporting Requirements

6.2.1 Internal Reporting Requirements

Any non-compliance with this plan, including the record of the introduction or spread of weeds or dieback within the Project Area, will be reported to the Strike Energy HSE Coordinator.

6.2.2 External reporting Requirements

In accordance with the *Guideline for the Development of Petroleum and Geothermal Environmental Plans in Western Australia*, (DMP 2016), Strike Energy will report to DMIRS (petroleum.environment@dmirs.wa.gov.au) all reportable incidents that occur during the course of petroleum activities Strike Energy's work areas . Strike Energy will also notify DWER of all reportable incidents (midwestgascoyne@dwer.wa.gov.au).

Reportable incidents will be reported to DMIRS:

- verbally within two hours of the first occurrence of the incident, or of the time the operator becomes aware of the incident; and
- in writing within three days.

Reportable incidents for the purpose of this DWMP, as described in approved EPs relevant to the Project Area, are listed in Table 6.1.

Table 6.1: List of Reportable Incidents

Potential Environmental Impact(s)	Incident	Trigger for Reporting
Introduction and spread of weeds	Presence or suspected presence of declared pest reported to DPIRD: • Paterson's curse [*Echium plantagineum*].	• Paterson's curse found in within project site not previously known to occur within that area.

Potential Environmental Impact(s)	Incident	Trigger for Reporting
Introduction and spread of dieback	Presence or suspected presence of *Phytophthora* dieback.	• Site inspection records, including rehabilitation records, indicate or confirm the presence of dieback within the project site associated with Project activities; and • Recorded non-compliance with site hygiene requirements.

Reporting of reportable incidents regarding weeds and/or dieback presence will include the following information as a minimum:

- facility name, title, site name or location where the presence or suspected presence has occurred;
- name and business address of the company that manages the activity;
- time and date of the observed presence or suspected presence of weeds and/or dieback;
- names and contact details of observer;
- name, position and telephone number of person(s) reporting the incident details;
- incident details and description;
- activity being undertaken at the time of the incident;
- details of any environmental impacts, including weather at the time of the incident;
- immediate response actions taken to prevent further environmental impact; and
- corrective actions proposed to prevent recurrence of further or similar incidents.

Performance against this plan will be reported to DMIRS through the Annual Environmental Reporting requirements of EPs for approved activities with Perth Basin.

As noted in Section 4.2, in the event that any weeds listed in Table 4.1, are sighted within project areas, these observations will be reported to the local DBCA Office.

7 References

BOM 2020. Bureau of Meteorology, www.bom.gov.au; last accessed 31/1/20.

CALM 1999. *Environmental weed strategy for Western Australia*. Department of Conservation and Land Management. 1999

Coffey 2015. *Warrego Energy Pty Ltd, West Erregulla Exploration Program Dieback and Weed Management Program.* Prepared by Coffey Environments Australia. September 2015.

DBCA 2020. https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds. Last accessed 21 July 2020.

DBCA 2017. Phytophthora Dieback Management Manual. October 2017, Department of Biodiversity, Conservation and Attractions, Perth.

Desmond and Chant, 2001. A Desmond and A Chant, *A Biodiversity Audit of Western Australia's 53 Biogeographical Subregions in 2002:* https://www.dpaw.wa.gov.au/images/documents/about/science/Projects/waaudit/geraldton_sandplains03_p293-313.pdf; last accessed 31 January 2020.

DPIRD 2020. https://www.agric.wa.gov.au/organisms/117440. Last accessed 21 July 2020.

EPA 2016. Environmental Protection Authority. *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment,* December 2016.

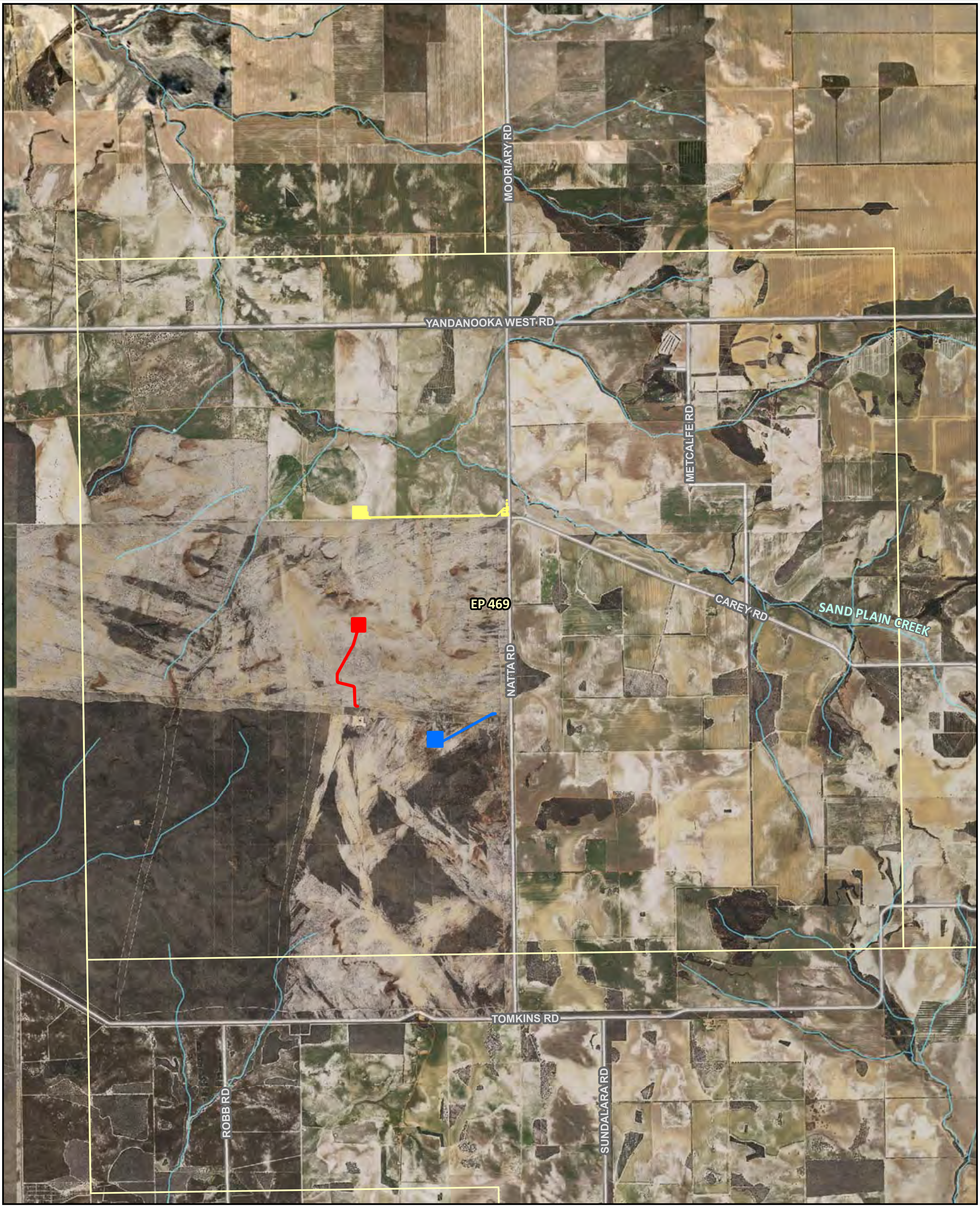
Glevan Consulting 2012. *Phytophthora* Dieback Occurrence Assessment. Unpublished report (Rev A) prepared for Warrego Energy Ltd and Woodman Environmental Consulting Pty Ltd.

Hardy *et al*. Hardy, G., Colquhoun, I., Shearer, B., and Tommerup, I. 2001. *The impact and control of Phytophthora cinnamomi in native and rehabilitated forest ecosystems in Western Australia*. Forest Snow and Landscape Research, 76(3), 337-343.

RPS. 2011*. West Erregulla Groundwater Assessment.* RPS Aquaterra for Warrego Energy, Perth.

Woodman Environmental 2013. Woodman Environmental Consulting Pty Ltd. *Warrego Energy Limited, West Errregulla Project Flora and Vegetation Assessment*, September 2013.

Appendix A Strike Energy Project Locations



Legend:

- WE5 well location
- WE4 well location
- WE3 well location
- Petroleum Titles (DMIRS)
- Watercourses
- Roads (MRWA)

Scale 1:100,000 at A4 — 0 1 2 Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 58115

Client: Strike West

Version: A | Date: 18-Jan-2021

Drawn By: cthatcher | Checked By: AL

WEST ERREGULLA PROJECT LOCATION EP469

FIGURE A1

strategen JBS&G

File Name: W:\Projects\1)Open\Strike West\58115 Perth Basin drilling EPs\GIS\Maps\WE5_Rev_A\58115_0x_WE5_RegLocnOSCP.mxd

Image Reference: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community & Client Imagery 3 July 2020

Legend:

- Development Envelope
- Study area
- Legislated Lands and Waters (DBCA)
- National Park
- Section 5(1)(h) Reserve
- Nature Reserve
- Watercourses
- Highways
- Main road
- Minor road

Scale 1:350,000 at A4 — 0 2.5 5 Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 60738

Client: Strike Energy

Version: A | Date: 16-Jun-2021

Drawn By: cthatcher | Checked By: LT

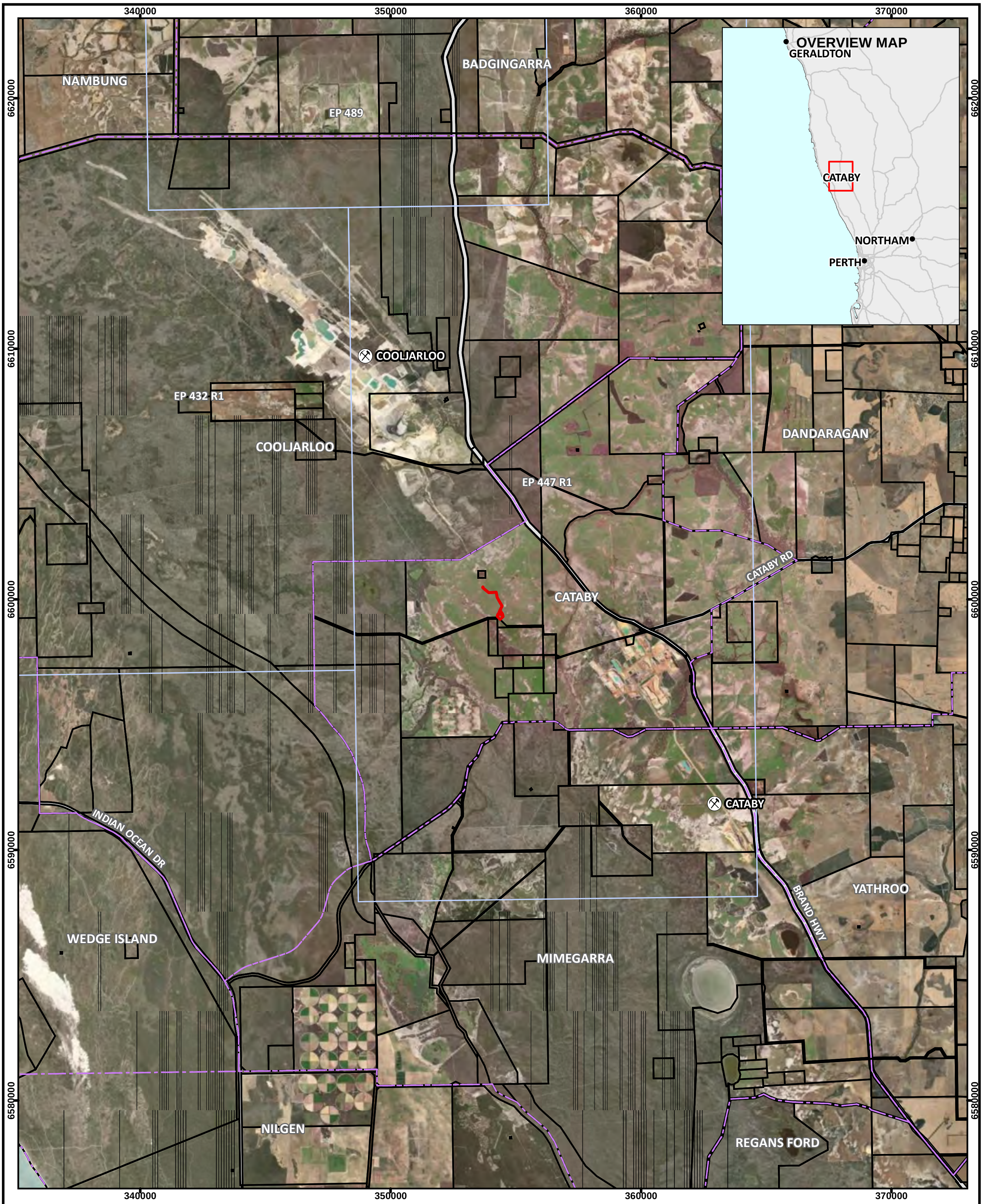
WEST ERREGULLA PROPOSED FIELD DEVELOPMENT PROGRAM, EP469

PROJECT LOCATION

FIGURE A2

strategen JBS&G

File Name: W:\Projects\1)Open\Strike West\60738 Field Development Program\GIS\Maps\R01_Rev_A\60738_0x_RegLocn.mxd
Image Reference: SLIP Public Services Locate 2020.



Legend

- Project Area
- Petroleum titles
- Locality
- Cadastral boundary
- Highways
- Main road
- Operating mines

Scale 1:200,000 at A4 — 0 2.5 5 Kilometres

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 60478

Client: Strike West

Version: A	Date: 20-May-2021
Drawn By: cthatcher	Checked By: RT

WALYERING 5 EXPLORATION WELL
EP447
PROJECT LOCATION

FIGURE A3

File Name: W:\Projects\1)Open\Strike West\60478 Waylering Drilling EP\GIS\Maps\R01_Rev_A\60478_1_1_RegLocn.mxd
Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- Project area
- Petroleum titles
- Minor road

Scale 1:100,000 at A4

0 1 2 Kilometers

Coord. Sys. GDA 1994 MGA Zone 50

Job No: 60964

Client: Strike West

Version: A | Date: 16-Jun-2021

Drawn By: jcrute | Checked By: CT

PROPOSED SOUTH ERREGULLA 1 EXPLORATION WELL, EP503

PROJECT LOCATION

FIGURE A4

strategen JBS&G

File Name: W:\Projects\1)Open\Strike West\60964 South Erregulla Drilling Approvals\GIS\Maps\R01_Rev_A\60964_01_01_RegLoc.mxd

Image Reference: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix B Dieback assessment

Woodman Environmental Consulting Pty Ltd

Warrego Energy

Phytophthora Dieback Occurrence Assessment

GLEVAN CONSULTING

Disclaimer

This report has been compiled by Evan Brown from Glevan Consulting and is prepared in accordance with the scope of work agreed between Woodman Environmental Consulting Pty Ltd and Glevan Consulting. The report may contain results and recommendations specific to the agreement. Results and recommendations in this report should not be referenced for other projects without the written consent of Glevan Consulting.

Procedures and guidelines stipulated in various Department of Environment and Conservation and Dieback Working Group manuals are applied as the base methodology used by Glevan Consulting in the delivery of the services and products required by this scope of work. These guidelines, along with overarching peer review and quality standards ensure that all results are presented to the highest standard.

Glevan Consulting has assessed areas based on existing evidence presented at the time of assessment. The *Phytophthora* pathogen may exist in the soil as incipient disease. Methods have been devised and utilised that compensate for this phenomenon; however, very new centres of infestation, that do not present any visible evidence, may remain undetected by dieback assessors.

Version Control

Document ID	Author	Date	Comments
A	EB	12/2012	Draft

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INTRODUCTION

Glevan Consulting was commissioned by Woodman Environmental Consulting Pty Ltd to conduct an assessment for the presence of *Phytophthora* Dieback in the Warrego Energy West Erregulla Exploration area (Project Area) as shown below in Figure 1. The project area covers approximately 9,400 hectares, of which 6,000 hectares is remnant vegetation on crown land and is located forty kilometres south-east of Dongara.

The greater majority of remnant vegetation occurs on Uninvested Crown Land (UCL) with small pockets of vegetation appearing on road reserves and private property. The remainder of the private property has been cleared.

The dominant indicator species used during this survey and that were expected to be reliable indicators to the presence of Dieback included *Banksia* and *Xanthorrhoea* species. A recent survey conducted by Glevan Consulting in similar vegetation communities and environmental conditions ten kilometres west of this project area used these same families of species to determine the presence of *Phytophthora* species.

The project area is expected to receive between 400mm to 500mm of annual rainfall based on rainfall maps and Bureau of Meteorology data (Bureau of Meteorology). The Department of Environment and Conservation Management Guidelines manual states that "there is no record of *Phytophthora cinnamomi* in regions receiving <400mm" and that "in areas receiving <600mm dieback due to *Phytophthora cinnamomi* is restricted to circumstances where localised hydrological effects, such as the shed from granite bosses or rising ground water tables associated with upslope land clearance in the catchment, cause effective rainfall to substantially exceed the regional patterns" (CALM, 2003). This is supported by previous surveys conducted in the greater area, with *Phytophthora cinnamomi* not recorded or observed within the general area, but other species of *Phytophthora* (*P. arenaria* and *P. constricta)* have been proven from soil and tissue samples.

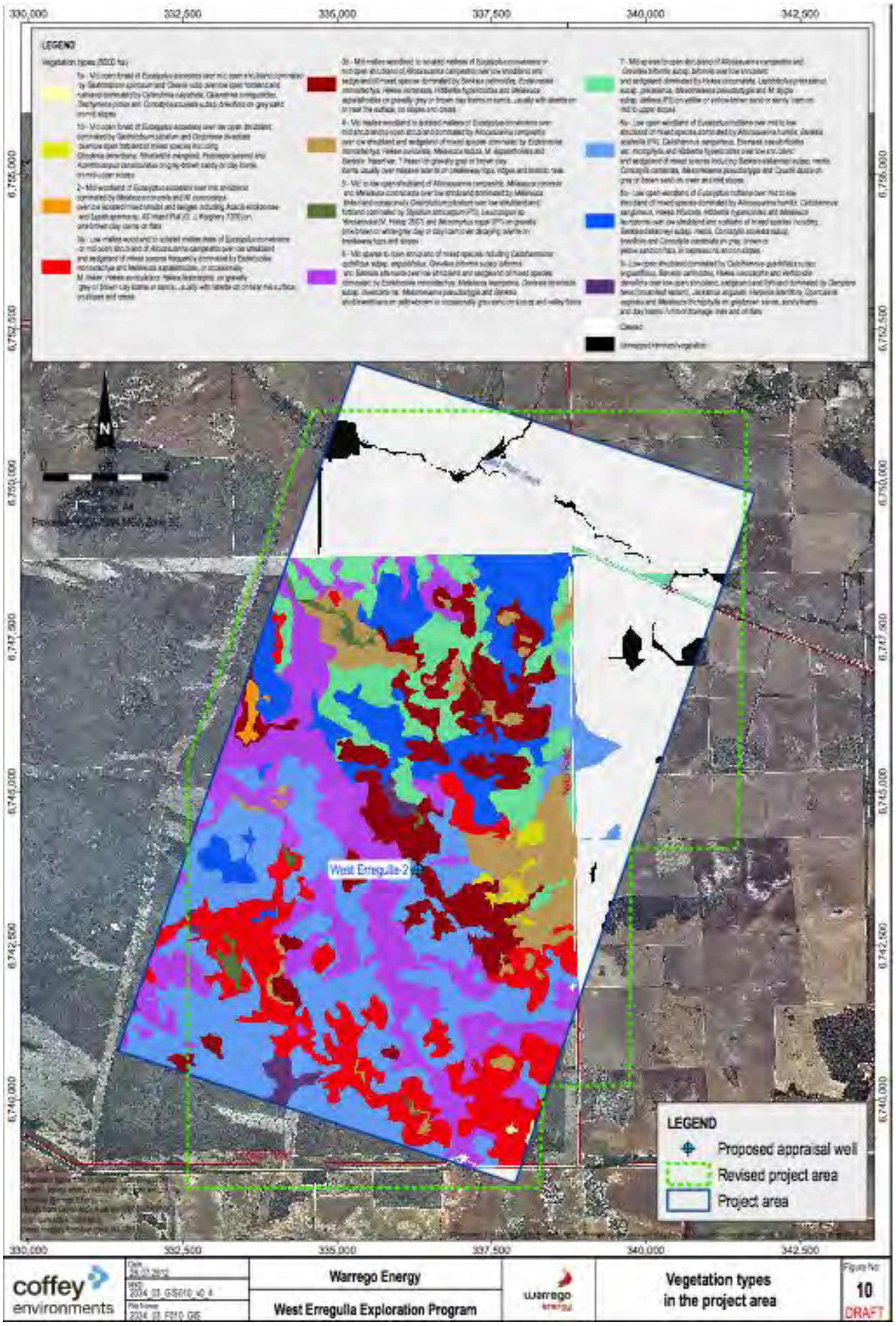


Figure 1 - Project Area

Study team

The assessment was conducted by Evan Brown and Liam Brown of Glevan Consulting in November 2012. Both members of the study team are accredited by the Department of

Environment and Conservation in the detection, diagnosis and mapping of the Dieback disease. This accreditation recognises the skills and experience of the study team. Both members have also conducted many previous surveys within the general proximity of the project area.

Background

Phytophthora Dieback is the name generally used in Western Australia to describe the disease symptoms of, and the causal agent, *Phytophthora cinnamomi*. This introduced soil-borne pathogen is a major threat to Australian vegetation, and in particular, the vegetation and dependent biota within the south west botanical province. This disease is listed as a key threatening process under the Environment Protection and Biodiversity Conservation Act 1999, with a subsequent threat abatement plan introduced in 2001 (Environment Australia, 2001).

It is generally believed that Phytophthora Dieback was introduced to Australia during the early European settlement. From 1921, patches of healthy jarrah forest were observed to be dying, with Frank Podger and George Zentmyer establishing in 1964 that *Phytophthora cinnamomi* was the causal agent for the forest decline (DWG, 2011).

The impact of the disease on the vegetation is dependent on climatic conditions along with host plant species and suitable soils (Keane & Kerr, 1997). This relationship, shown in Figure 1, describes all aspects required to create the disease.

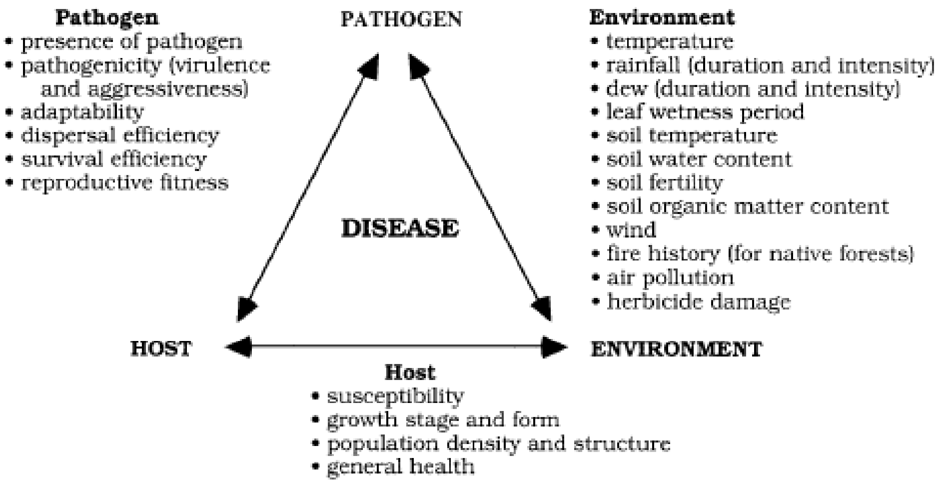


Figure 2 - Disease Triangle

This relationship is also described in Management of *Phytophthora cinnamomi* for Biodiversity Conservation in Australia Part 2 - National Best Practice Guidelines / Appendix 3 as the disease pyramid (O'Gara, Howard, Wilson, & Hardy, 2005). This figure includes the additional element of time to demonstrate the progressive impact of the disease on susceptible vegetation.

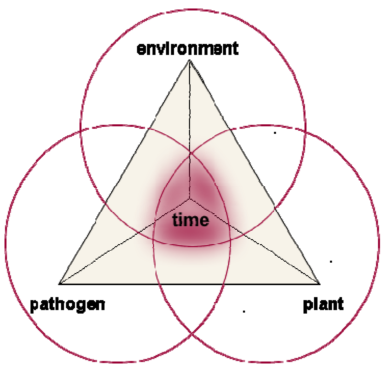


Figure A3.2 Disease pyramid showing disease epidemic (red shading) resulting from the convergence of virulent pathogen, susceptible host, suitable environment and time.

Figure 3 - Disease pyramid

It is recognised that Phytophthora Dieback has a greater and more widespread impact in areas of Western Australia where the average annual rainfall exceeds 600mm and the soil structure has a more acidic composition (Hardy, Colquhoun, Shearer, & Tommerup, 2001). The impact of the disease can be significant (but less widespread) in areas of lower rainfall if there are extra-ordinary rainfall events, or the pathogen is situated in a rainfall aggregating site, e.g. creek lines, water shedding from granite outcrops.

The impact of the pathogen on the Australian economy is significant, and is estimated to cost between $160 million (Carter, 2004) and $200 million annually (EPA, 2011).

The impact of the disease on animals is less understood, however the greatest impact is likely to be on those species that require relatively dense species-rich shrub lands or have restricted diets. There is a growing body of evidence that the dramatic impact of Phytophthora Dieback infestations on plant communities can result in major declines in some animal species due to the loss of shelter or food sources.

METHODS

During the assessment for the presence of Dieback caused by *P. cinnamomi*, the interpreter is specifically looking for those areas that are:

- Possibly infested with *Phytophthora* Dieback;
- Possibly infested by other *Phytophthora* species;
- Uninfested – free of plant disease caused by *Phytophthora* Dieback;
- Uninterpretable – those areas where presence or absence of *Phytophthora* Dieback cannot be determined because the vegetation is naturally void of sufficient numbers of disease indicating species, and;.
- Unmappable – those areas where presence or absence of *Phytophthora* Dieback cannot be determined at the time of the assessment, due to disturbance factors i.e. fire disturbance or forestry activity.

Detection of the plant pathogen *Phytophthora* Dieback involves the observation and interpretation of plant deaths (or reduction of biomass or perceived temporal change in vegetation structure) using a logical assessment of factors that imply pathogen presence above other possible causes of plant deaths or vegetation change.

The following table describes *Phytophthora Dieback* occurrence categories as defined by the Department of Environment and Conservation in the manual "*Phytophthora cinnamomi*. and disease caused by it, volume 1, Management Guidelines, 2003". The superior categories "Mappable" and "Unmappable" definitions are not yet published by the department, but are in general use at this time.

Table 1 - Dieback Occurrence Categories

<table>
<tr><td>Unmappable
Areas that are sufficiently disturbed so that Phytophthora Dieback occurrence mapping is not possible at the time of inspection.</td><td colspan="2">Further categorisation may be possible after variable regeneration periods for different types of disturbance.</td></tr>
<tr><td rowspan="3">Mappable
Natural undisturbed vegetation. Phytophthora Dieback occurrence mapping is possible. Three categories may result.</td><td>Infested</td><td>Areas that a qualified person has determined to have plant disease symptoms consistent with the presence of the pathogen Phytophthora Dieback.</td></tr>
<tr><td>Uninfested</td><td>Areas that a qualified person has determined to be free of plant disease symptoms that indicate the presence of the pathogen Phytophthora Dieback.</td></tr>
<tr><td>Uninterpretable</td><td>Areas where indicator plants are absent or too few to determine the presence or absence of disease caused by Phytophthora Dieback.</td></tr>
</table>

Pre survey desktop study

Known databases of *Phytophthora* locations retained by Vegetation Health Services (DEC) were searched to determine previous recoveries of *Phytophthora* within and adjacent to the project area.

Previous *Phytophthora* Dieback Occurrence reports and maps relating to areas within a reasonable proximity to the study area were also studied prior to undertaking the field work.

Field survey

Due to the large area involved, the marginal environmental conditions and the limited known infestations of *Phytophthora* in the greater area, a strategic assessment targeting higher risk sites was conducted in the study area. Those areas targeted included all navigable tracks and firebreaks and water-gaining sites.

Aerial photographs were utilised to determine tracks and particular water-gaining sites that could be field checked

Demarcation of hygiene boundaries

No demarcation was performed in the project area.

Factors indicating the presence of Phytophthora Dieback

In determining the possible presence of *Phytophthora* Dieback, the interpretation will consider the varied affects the pathogen may be having on the vegetation. This variation will be due to the considerable variability which exists within and between native plant species in their responses to the presence of *Phytophthora cinnamomi*, and the differential influence of temporal and spatial variation in environmental forces.

These possible degrees of impact of the disease range from no apparent disease, to post infection endemism and can be described as:

i) No apparent disease at all:

> This can apply to areas of vegetation which are considered not susceptible to the pathogen, or those areas of the landscape in which the soil is calcareous or the mean rainfall of the site places it outside the recognised vulnerable zone.

ii) An extremely destructive epidemic of root rot:

This can apply within the highly susceptible elements of the vegetation. It is characterised by:

a) devastation soon after the first arrival of the wave front of infestation,

b) steady extension of epidemic disease soon after arrival of the pathogen,

c) complete or near complete elimination of important structural elements of the plant community.

d) a relative insensitivity of the degree of damage to variation in soil characteristics.

iii) An 'endemic' pathogen

Where *Phytophthora cinnamomi* has been long established in sites and the pre-existing vegetation has been very heavily impacted, *Phytophthora cinnamomi* behaves in a manner characteristic of endemic pathogen. The susceptible vegetation can over time be replaced by non-susceptible species. Periodic outbreaks of mortality in existing susceptible species may still occur.

The interpretation process is therefore determining areas where:

Susceptible species are absent, inhibiting the opportunity for the disease to express if present; or,

There are areas of deaths in multiple susceptible species with a pattern and perceptible temporal movement in the progression of the disease; or,

Areas exist where it is perceived that the natural vegetation structure has been altered with the density of susceptible species reduced.

A combination of the following factors may indicate the presence of disease caused by *Phytophthora* Dieback or other *Phytophthora* species.

<u>Deaths of disease indicating species:</u>

An indicator species is a plant species, which is reliably susceptible to Phytophthora Dieback (i.e. will die). Common indicators include several species of *Banksia* and *Xanthorrhoea*. The distribution and composition of indicator species will vary from place to place according to vegetation types.

Chronology of deaths:

As the pathogen spreads through an area, some or all susceptible plants become infected and die. Consequently there will be an age range from more recent deaths with yellowing or brown leaves through to older leafless stags to remnant stumps in the ground.

Pattern of deaths:

The topography, soil type, vegetation type and drainage characteristics of an area together with the influence of climatic patterns and disturbances will influence the shape or pattern of an infested area over time. A typical recent infestation may show a small cluster of dead indicator species which, in time, will spread to become a small circular shape 'the ulcer effect' and then begin lengthening towards natural drainage channels. A fringe of recent deaths is often seen around the edge of the infested area. Patterns may be further highlighted by a paucity of ground cover within the infested area.

Environmental factors:

Sites will vary in the way that disease is expressed both spatially and temporally. Environmental conditions can either favour or disfavour the growth and spread of the pathogen. Sites that are moist but not saturated are most favourable, sites that are well drained and mostly dry are least favourable.

Other causes of indicator species death:

Phytophthora cinnamomi is not the only agent to cause death of native vegetation. Other agents include, but are not limited to:

- other *Phytophthora* spp, *Armillaria luteobubalina*, various cankers, insects;
- drought, wind scorch, frost, salinity, water logging, fire and lightning;
- senescence, competition, physical damage;
- herbicides, chemical spills (for example fuel).

Limitations of disease mapping

The assessment for the disease caused by *Phytophthora* Dieback is based on interpreting the vegetation for symptoms which can be ascribed to the disease presence. These observable factors must be present during the assessment period. Management recommendations may be included if it is considered that the disease may be cryptic, or the project area displays evidence of activities that are considered a high risk of introducing the disease.

RESULTS AND DISCUSSION

For the assessment, over ninety-four kilometres of tracks and roads were driven, and all creek crossings and other water-gaining sites were scrutinised for observable symptoms of the presence of *Phytophthora* Dieback.

As discussed in the methodology, the assessment process involved determining those areas where:

- The disease wouldn't express, if present;
- The Dieback is showing disease symptoms; or
- The disease may have been present for a considerable period and has altered the vegetation structure.
- The vegetation has been disturbed to a point where a confident assessment of the disease presence is not possible, or the vegetation is not currently being managed and protected against *Phytophthora* Dieback.

The project area is discussed as being that area situated on private property , and generally farmland, and the greater area (UCL area) which is contained on the Uninvested Crown Land, north of Tomkins Road and west of Natta Road.

Some sections of the UCL project area contain fewer species that would be considered reliable in determining the presence of Dieback, in particular *Banksia* and *Xanthorrhoea* species. These sections are dominated by *Allocasuarina campestris* and *Eucalyptus* species over mixed shrublands and sedgelands. Due to the low likelihood of *Phytophthora* Dieback being present in these areas, it was not considered necessary to demarcate these sites in the field, nor recommend specific hygiene procedures for the sites.

No areas on UCL were observed to be currently impacted and infested with *Phytophthora* Dieback.

No areas of vegetation on UCL were considered to be altered by the previous introduction of *Phytophthora* Dieback.

Areas of remnant vegetation on private property are not considered to be currently hygienically managed and are classified as Unmappable.

The vegetation throughout the UCL site appeared in good condition, and very few areas of plant stress were noted. Occasional deaths in *Banksia* and other proteaceous species were observed but these deaths were not considered to be caused by *Phytophthora* Dieback, with the absence of likely vectors of disease introduction or pattern associated with disease presence noted. The entire UCL site should be considered as being protectable from the *Phytophthora* Dieback disease and should be managed accordingly.

RECOMMENDATIONS

Below are several management recommendations that are applicable to the West Erregulla 2 project area.

- Soil and plant material of infested or unknown dieback status should not be introduced to uninfested or unmappable sections of the study area.

- Soil and plant material should not be transported from the unmappable sections of the study area for use at any other protectable area site.

- Soil movement within each category is permissible, but should not occur across category boundaries, except where the source is uninfested.

- Vehicles and machinery should be clean upon entry into any of the site categories and when moving across category boundaries. Moving from uninfested areas into other categories does not require clean down measures.

- Restrict access, where possible, to dry soil conditions only. Where vehicles or machinery are required to access the area during, or shortly after rainfall, they must carry clean down equipment, and remove any soil or plant material at designated hygiene points.

BIBLIOGRAPHY

Bureau of Meteorology. (n.d.). *Monthly Rainfall Dongara*. Retrieved from www.bom.gov.au: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_stn_num=008044

CALM. (2003). *Phytophthora cinnamomi and disease caused by it. Volume 1 - Management Guidelines.* Unpublished.

Carter, R. (2004). *Arresting Phytophthora Dieback: The Biological Bulldozer.* (K. Vear, & B. Dell, Eds.) WWF Australia.

DWG. (2011). *What is Dieback?* Retrieved October 13, 2011, from dieback.org.au

Environment Australia. (2001). *Threat Abatement Plan for Dieback caused by the root-rot fungus Phytophthora cinnamomi.*

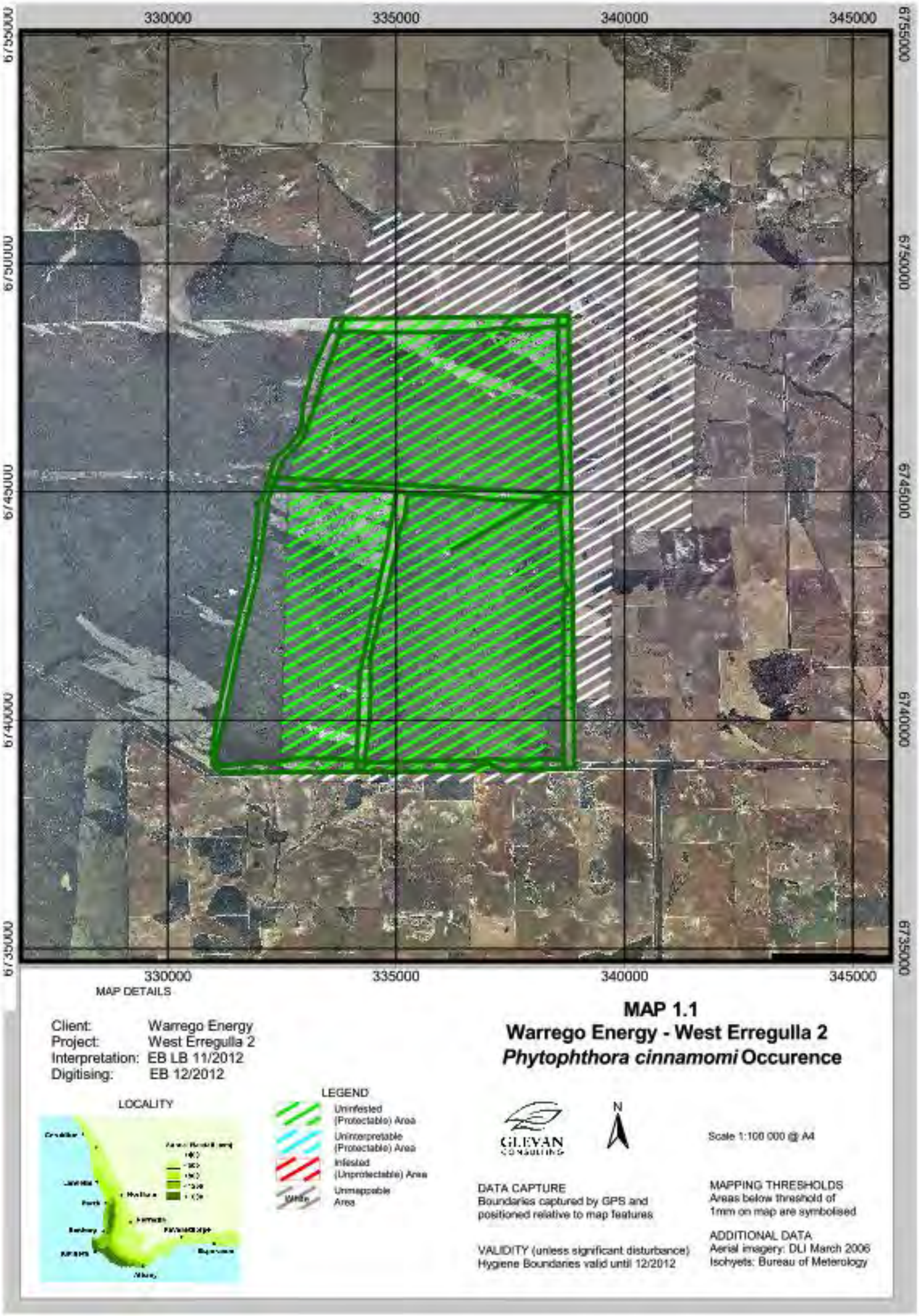
EPA. (2011). *Phytophthora Dieback*. Retrieved October 13, 2011, from State of the Environment Report 2007: www.soe.wa.gov.au/report/biodiversity/phytophthora-dieback.html

Hardy, G., Colquhoun, I., Shearer, B., & Tommerup, I. (2001). The impact and control of Phytophthora cinnamomi in native and rehabilitated forest ecosystems in Western Australia. *Forest Snow and Landscape Research, 76*(3), 337-343.

Keane, P., & Kerr, A. (1997). Factors affecting disease development. In APPS, J. Brown, & H. Ogle (Eds.), *Plant Pathogens and Plant Diseases* (pp. 287-298). Rockvale Publications.

O'Gara, E., Howard, K., Wilson, B., & Hardy, G. (2005). *Management of Phytophthora cinnamomi for Biodiversity Conservation in Australia: Part 2 - National Best Practice Guidelines.* CPSM. Department of Environment and Heritage.

MAPS



330000
335000
340000
345000
6755000
6750000
6745000
6740000
6735000
MAP DETAILS
Client: Warrego Energy
Project: West Erregulla 2
Interpretation: EB LB 11/2012
Digitising: EB 12/2012
LOCALITY
LEGEND
Uninfested (Protectable) Area
Uninterpretable (Protectable) Area
Infested (Unprotectable) Area
Unmappable Area
MAP 1.1
Warrego Energy - West Erregulla 2
Phytophthora cinnamomi Occurence
GLEVAN CONSULTING
N
Scale 1:100 000 @ A4
DATA CAPTURE
Boundaries captured by GPS and positioned relative to map features
VALIDITY (unless significant disturbance)
Hygiene Boundaries valid until 12/2012
MAPPING THRESHOLDS
Areas below threshold of 1mm on map are symbolised
ADDITIONAL DATA
Aerial imagery: DLI March 2006
Isohyets: Bureau of Meterology

Appendix C Hygiene Inspection Form and Register

North Perth Basin
Environmental Hygiene Inspection Form

Date of Inspection	
Company Name	
Driver Name	
Vehicle Type	
Model / Make	
Registration Number	

PART A: Hygiene Inspection		
Location of Inspection		
Odometer reading		
Clean and free of organic material upon initial inspection?		
If no, state the measures that have been undertaken to ensure vehicle/equipment is free of organic material:		
Following re-assessment, is the vehicle/equipment now clean of organic matter?		

Note: If the vehicle/equipment is carrying a load that may contain organic material, a weed hygiene declaration is needed for the load.

Signatures verify the clean status of the vehicle/equipment:			
Company Representative		Name:	
Driver:		Name:	

PART B: Return to Site Hygiene Inspections			
Return 1:			
Date			
Location of Inspection			
Odometer reading			
Clean down measures completed:			
Signature to verify the clean status of the vehicle/equipment:			
Driver:		Name:	

Return 2:			
Date			
Location of Inspection			
Odometer reading			
Clean down measures completed:			
Signature to verify the clean status of the vehicle/equipment:			
Driver:		Name:	

ENVIRONMENTAL HYGIENE REGISTER

SITE: ______________________________

	Date	Vehicle registration	Odometer reading	Inspected by	Action taken (Inspected / Cleaned)	Inspector's signature
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

NPB-HSE-REG-001

Appendix D Weed species known to occur within Perth Basin sites

Taxon	Family	Common name	Weed of National Significance[1]	WA Organism List Status (BAM Act)[2]	DPIRD Environmental weed risk rating[3]	DBCA Weed prioritisation[4]	
						Ecological Impact	Invasiveness
**Arctotheca calendula*	Asteraceae	Cape Weed	Not listed	Permitted s11	Not listed	Not listed	Not listed
**Avena barbata*	Poaceae	Bearded Oat	Not listed	Permitted s11	Not listed	High	Rapid
**Brassica tournefortii*	Brassicaceae	Mediterranean Turnip	Not listed	Permitted s11	Not listed	High	Rapid
**Briza maxima*	Poaceae	Blowfly Grass	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Bromus diandrus*	Poaceae	Great Brome	Not listed	Permitted s11	Not listed	High	Rapid
**Cuscuta epithymum*	Convolvulaceae	Dodder	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Echium plantagineum*	Boraginaceae	Paterson's Curse	Not listed	Declared s22(2)	Not listed	High	Rapid
**Ehrharta brevifolia*	Poaceae	Annual Veldt Grass	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Ehrharta calycina*	Poaceae	Perennial Veldt Grass	Not listed	Permitted s11	Very High	High	Rapid
**Ehrharta longiflora*	Poaceae	Annual Veldt Grass	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Erodium cicutarium*	Geraniaceae	Common Storksbill	Not listed	Permitted s11	Not listed	Low	Rapid
**Hypochaeris glabra*	Asteraceae	Smooth Catsear	Not listed	Permitted s11	Not listed	Low	Rapid
**Isolepis marginata*	Cyperaceae	Coarse Club-rush	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Lysimachia arvensis*	Primulaceae	Pimpernel	Not listed	Permitted s11	Not listed	Low	Rapid
**Monoculus monstrosus*	Asteraceae	Stinking Roger	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Parentucellia latifolia*	Orobanchaceae	Common Bartsia	Not listed	Permitted s11	Not listed	Medium	Rapid
**Pentameris airoides* subsp. *airoides*	Poaceae	False Hairgrass	Not listed	Permitted s11	Not listed	Unknown	Rapid

Taxon	Family	Common name	Weed of National Significance[1]	WA Organism List Status (BAM Act)[2]	DPIRD Environmental weed risk rating[3]	DBCA Weed prioritisation[4]	
						Ecological Impact	Invasiveness
**Petrorhagia dubia*	Caryophyllaceae	Velvet Pink	Not listed	Permitted s11	Not listed	Low	Rapid
**Trifolium campestre* var. *campestre*	Fabaceae	Hop Clover	Not listed	Permitted s11	Not listed	High	Medium
**Ursinia anthemoides*	Asteraceae	Ursinia	Not listed	Permitted s11	Not listed	High	Rapid
**Vulpia myuros*	Poaceae	Rat's Tail Fescue	Not listed	Permitted s11	Not listed	Unknown	Rapid
**Wahlenbergia capensis*	Campanulaceae	Cape Bluebell	Not listed	Permitted s11	Not listed	Unknown	Rapid

1 https://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/wons.html; last accessed 210720

2 https://www.agric.wa.gov.au/pests-weeds-diseases/weeds/declared-plants; last accessed 210720

3 https://www.agric.wa.gov.au/rangelands/environmental-weed-risk-assessments [South-west region]; last accessed 210720

4 https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-does-dpaw-manage-weeds [Midwest Region]; last accessed 210720