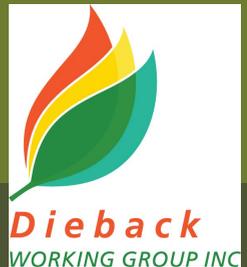


EDITION 7.1, 2019



Managing Phytophthora Dieback in Bushland

(Fy-tof-thora Dieback)



A Guide for Landholders and
Community Conservation Groups



The Dieback Working Group Inc.

Phytophthora Dieback is a significant disease affecting native, ornamental and horticultural plants across southern Australia. The Dieback Working Group Inc. (DWG) is a not for profit organisation dedicated to increasing the awareness and management of Phytophthora Dieback to minimise its impact on our environment. The south-west of Western Australia is an international biodiversity hotspot and one of the most impacted landscapes in the world by Phytophthora Dieback.

The DWG partner with Local Government, State Government agencies, industry, academia, community conservation groups and landholders and to protect bushland across Southwest Australia. Since its formation in 1996 the DWG has worked effectively with these partners to:

- i. increase awareness and management Phytophthora Dieback by key stakeholders;
- ii. be a source of knowledge and facilitate the development of best management practices for Phytophthora Dieback;
- iii. promote best practice in Phytophthora Dieback management by government, industry, community groups, utilities and landholders;
- iv. encourage the adoption of Phytophthora Dieback best practice policy in government, industry, utilities and community groups; and
- v. apply for, and coordinate funding applications and facilitate effective partnerships.

There are many ways that you can get involved with the management of Phytophthora Dieback in your local bushland. The DWG run community workshops, Green Card Hygiene training, school education programs, phosphite treatment days and an annual Dieback Information Group (DIG) conference.

The DWG are always keen to partner with other like-minded organisations that are involved in the management of pests, weeds and diseases within native plant ecosystems across Australia.



Please visit our website
www.dwg.org.au



CONTENTS

Introduction	1
Phytophthora Dieback: A Deadly Disease of Native Plants	3
What is Phytophthora Dieback?	3
Where does the pathogen live?	3
How does the pathogen spread?	4
Which plants does the pathogen kill?	5
History	7
Geography	7
Bushland values affected by Phytophthora Dieback	8
Protecting Your Bushland	9
Step 1. Assess Your Bushland	9
Step 2. Develop & Implement Management Guidelines	14
<i>Scenario 1</i> - Your bushland is healthy and disease free	16
<i>Scenario 2</i> - You have Phytophthora Dieback in some areas	19
<i>Scenario 3</i> - All of your bushland is infested with Phytophthora Dieback	23
<i>Scenario 4</i> - You are unsure if Phytophthora Dieback is present	26
Case Studies	29
Sampling Procedures	31
Treating Your Plants with Phosphite	33
1. Injecting trees	34
2. Spraying plants	36
Guidelines for Cleaning and Sterilising	38
Guidelines for Propagating Plants	40
Guidelines for Recreation	42
Guidelines for Bushwalking	43
Guidelines for Cycling	44
Guidelines for Horse Riding	45
Green Card Training Sessions	46
Contacts and Further Information	47
Community Group Work Day Checklist	49
Other Useful Resources	50
Project Dieback - Priority Protection Areas	51
References	52



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Dept of Parks and Wildlife

Introduction

Phytophthora Dieback is a deadly plant disease that can devastate our forests, woodlands and heathlands. The disease is caused by the introduced plant pathogen *Phytophthora cinnamomi*. Phytophthora Dieback is causing significant damage in the Southwest Australia Ecoregion of Western Australia (WA) because:

- More than 40 percent (2,284) of native plant species in the region are susceptible (Shearer et al., 2004).
- The climate and soils of the Southwest Australia are suitable for the survival and spread of the pathogen.
- The pathogen was spread widely before it was identified as the cause of permanent damage to our ecosystems.

Organisations such as the Department of Parks and Wildlife, Alcoa and Main Roads WA follow procedures to minimise the risk of their activities spreading the pathogen. Many local governments are also adopting Phytophthora Dieback management policies and implementing management procedures.

Mondurup Peak,
Stirling Ranges
where 48 percent of
woody plant species
are susceptible
to *Phytophthora*
Dieback.



©Rob Olver

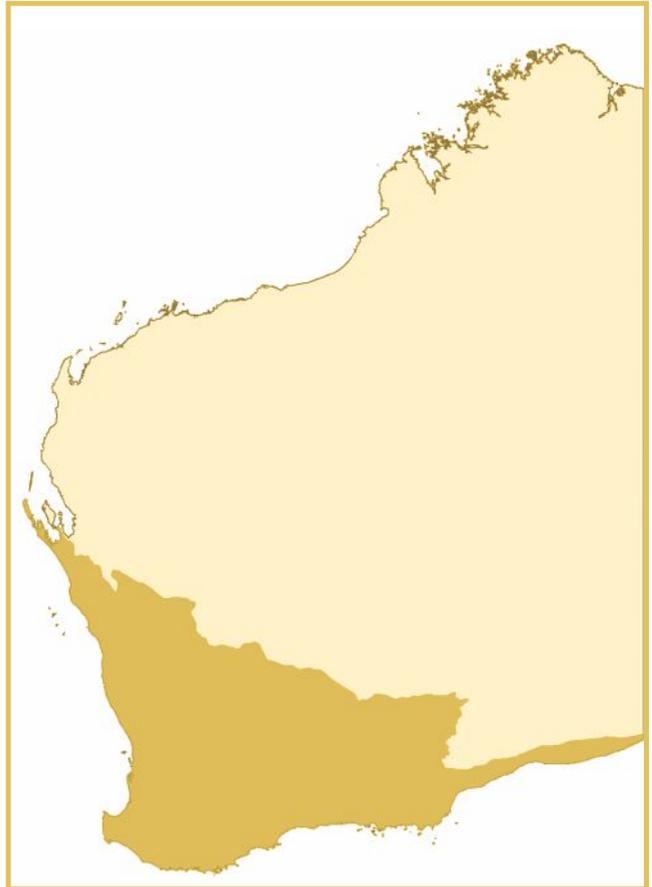
Anyone who owns, manages or uses a bushland area can take some steps to minimise the risk of introducing or spreading the pathogen. It does require a considerable amount of knowledge to effectively identify and map an infestation. It may be best to seek the help of trained professionals if you have little background in Phytophthora Dieback interpretation or management.

Southwest Australia

The Southwest Australia is one the world's top 34 'biodiversity hotspots'. This classification is based on the diversity of the region's flora. The region is characterised by an exceptional concentration of endemic species found nowhere else.

More than 4,000 species of endemic plants have been recorded in the region, and new plant species continue to be discovered. The region also has 100 endemic vertebrate species. Many of these endemic species are rare and endangered, giving the Southwest Australia the highest concentration of rare and endangered species on the continent.

Unfortunately, Phytophthora Dieback is having a devastating impact on the biodiversity of this region.





Phytophthora Dieback:

A Deadly Disease of Native Plants

What is Phytophthora Dieback?

Phytophthora Dieback refers to the deadly introduced plant disease caused by *Phytophthora cinnamomi* (pronounced Fy-tof-thora - meaning 'plant destroyer' in Greek). There are more than 100 named species of *Phytophthora*, but the species that causes the most severe and widespread damage to native plants in WA is *P. cinnamomi*.

In the past, Phytophthora Dieback has been known as 'dieback' and 'Jarrah dieback'. Unfortunately, these names have contributed to confusion about the pathogen. For example, in other parts of Australia, the term 'dieback' is used to describe tree decline caused by such factors as salinity, drought or insect damage. Furthermore, the disease affects a huge number of introduced and native plant species other than Jarrah. Therefore, to overcome this confusion, the term 'Phytophthora Dieback' is now used.

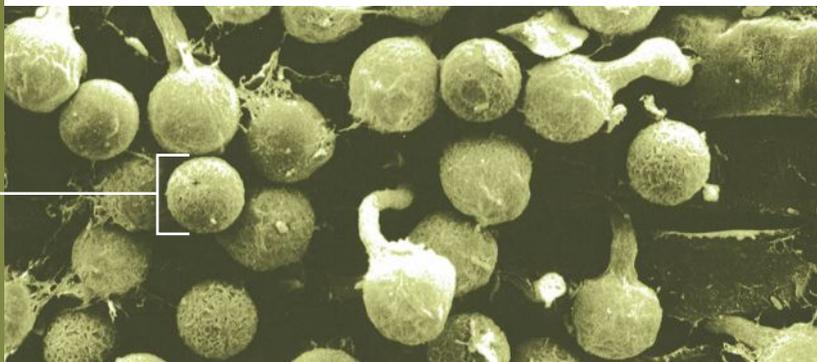
Originally *P. cinnamomi* was classified as a fungus, however, it is now classified as an Oomycete or water mould.

Where Does the Pathogen Live?

P. cinnamomi spends its entire life in soil and plant tissue. It attacks the roots of plants and causes them to rot. This kills the plant by limiting or stopping the uptake of water and nutrients. The pathogen is able to survive within plant roots during the dry soil conditions commonly experienced during the summer months.

An electron microscope image of zoospores encysting on a host plant's roots.

Zoospores measure approximately 8µm (micrometres) in diameter



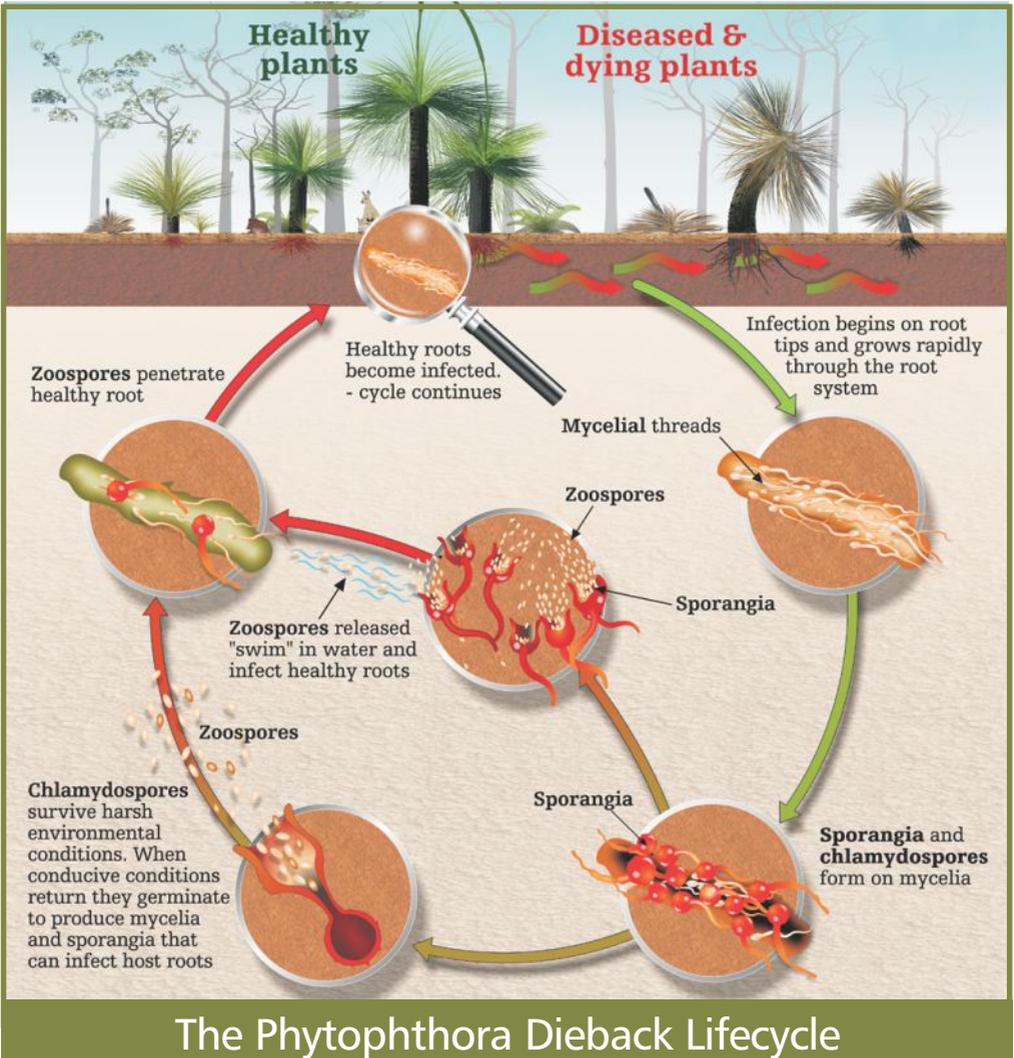
© Giles Hardy

How Does the Pathogen Spread?

In sloping areas *Phytophthora Dieback* spreads quickly when the microscopic spores move downwards in surface and sub-surface water flows. The disease can also spread uphill autonomously through root to root contact at one metre per year.

However, it is human activity that causes the most significant, rapid and widespread distribution of this pathogen. Road construction, earth moving, driving vehicles on bush roads and stock movement can all contribute significantly to the spread of *Phytophthora Dieback*. Bush restoration projects may also inadvertently spread the pathogen through the use of contaminated mulches and diseased plants.

Soil that is warm and moist provides the best conditions for *Phytophthora Dieback*. These conditions allow the pathogen to produce millions of spores that are attracted to plant roots and actively swim through the soil water.



Phytophthora Dieback:

A Deadly Disease of Native Plants

Which Plants Does the Pathogen Kill?

Over 40 percent of native WA plant species are susceptible to *Phytophthora cinnamomi* (Shearer et al., 2004), while more than 50 percent of the WA's rare or endangered flora species are susceptible. Many of these susceptible plants are only found in Southwest Australia. Some of the regions, more common plants are also susceptible, including jarrah, banksias, grasstrees (*Xanthorrhoea*) and zamia palms.

A more extensive list of susceptible plants is available www.dwg.org.au. Many other plants, although not susceptible, can act as a host for the pathogen. This enables it to persist indefinitely in an area once it has been introduced.

A range of horticultural crops and garden plants are also susceptible to *P. cinnamomi* including apple, peach, apricot and avocado trees, grapevines, radiata pine, camellias, azaleas, roses, proteas and rhododendrons (Cahill, 1993; Erwin & Ribeiro, 1996).

Banksia woodland heavily impacted by *Phytophthora Dieback*.

©DWG



Gull Rock near Albany is extensively infested by *Phytophthora Dieback*.

©DWG



Jarrah forest free
of Phytophthora
Dieback

©DWG



Jarrah Forest
infested with
Phytophthora
Dieback

©Kat Sambrooks, DWG

Mondurup Peak,
Stirling Ranges
infested with
Phytophthora Dieback

©Damian Rathbone/
Dept of Parks and Wildlife



Phytophthora Dieback:

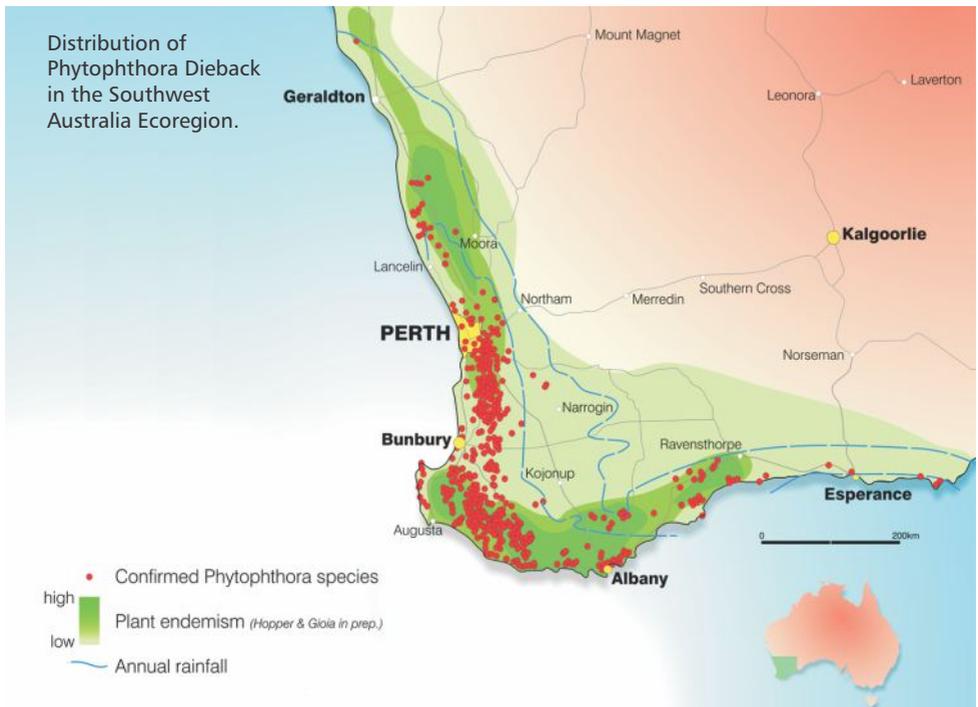
A Deadly Disease of Native Plants

History

Phytophthora cinnamomi is not native to WA. It is thought to have arrived in the State shortly after European settlement in soil around the roots of live plants. Before it was realised that *P. cinnamomi* destroyed native vegetation, it had been spread extensively throughout the south west. The disease was first recognised killing jarrah (*Eucalyptus marginata*) in the jarrah forest near Karragullen in 1921. It wasn't until the mid 1960s that *P. cinnamomi* was identified as the cause of the disease.

Geography

Phytophthora Dieback is now widespread throughout the Southwest Australia Ecoregion. It is confined to areas with more than 400 mm annual rainfall, and extends between Eneabba in the north and Cape Arid near Esperance in the east. The pathogen causes the highest impact in areas that receive more than 600 mm of annual rainfall. It has infested forests, heathlands and woodlands. Phytophthora Dieback is also widespread in the bushland in and around Perth, but there are still large uninfested areas that require protection.



Bushland Values Affected by Phytophthora Dieback

When *Phytophthora Dieback* spreads to bushland, it kills many susceptible plants, resulting in a permanent decline in the diversity of the bushland. It can also change the composition of the bushland by increasing the number of grasses and reducing the number of shrubs. Native animals that rely on susceptible plants for survival are reduced in numbers or are eliminated from sites infested by *Phytophthora Dieback*.

However, it is important to realise that bushland infested with *Phytophthora Dieback* still retains important conservation values. It contains remnant vegetation that provides habitat for many native animal species and provides environmental services, such as protecting the landscape from the effects of salinity and erosion. Therefore, it is important to retain and maintain remnant bushland even when it is affected by *Phytophthora Dieback*.



Native animals such as the pygmy possum (top) and the honey possums (below) are reliant on susceptible Proteaceous species for their survival.



©Babs&Bert Wells/Dept of Parks and Wildlife (top)
©Emma Adams/Dept of Parks and Wildlife Esperance (bottom)



Many birds rely on plants affected by *Phytophthora Dieback*.

© Keith Lightbody



© Nicole Moore

Protecting Bushland

To manage *Phytophthora Dieback* in bushland, you need to plan ahead. The introduction or human assisted spread of the pathogen in bushland can be avoided if activities are well planned and management procedures are in place. *Phytophthora Dieback* management procedures must be integrated into all bushland management activities if the spread and impacts of this disease are to be minimised.

This guideline has primarily been developed for land owners and community groups looking to manage their own private bushland. The DWG recommends that professional environmental officers and land managers in charge of bushland reserves do not undertake any "do it yourself" actions. Professional environmental officers and land managers should seek the services of Department of Parks and Wildlife registered *Phytophthora Dieback* interpreters and reputable diagnostic laboratories.

There are three simple steps involved in managing *Phytophthora Dieback* in bushland. These are:

1. Check your bushland for *Phytophthora Dieback*.
2. Develop management and hygiene plans based on the status of your bushland
3. Undertake the actions outlined in your management and hygiene plans.

The steps are discussed in detail below.

Assessing Your Bushland

Managing *Phytophthora Dieback* in bushland is most successful when you have determined whether the pathogen is present or absent, and if present, identified which areas are infested. Management procedures can still be implemented if you are unsure if the pathogen is present. However, without knowing the location of the *Phytophthora Dieback*, management will not be as effective, it will be difficult to monitor the success of your work, and you may be taking some precautions that are not necessary.

Remember that when you have had bushland surveyed for *Phytophthora Dieback*, the result will only be accurate at that point in time. The disease will spread autonomously and new infections can occur. When planning management procedures for controlling *Phytophthora Dieback* it is important to re-survey for disease movement and new disease outbreaks every one to two years.

Protecting Bushland

There are two options for determining whether Phytophthora Dieback is present in bushland:

1. Engage a professional consultant.
2. Do it yourself.

Professional Consultants

Professional consultants determine the presence of Phytophthora Dieback by using indicator (susceptible) plants and by testing soil and plant samples. Refer to page 47 of this booklet for a list of Phytophthora Dieback interpreters. The consultants listed have undertaken registered training with the Department of Parks and Wildlife and have many years of experience in completing Phytophthora Dieback surveys.

The cost of a consultant survey will vary, depending on the size and location of the bushland, and the degree of difficulty experienced in interpreting disease symptoms. Consultant fees usually do not include the cost of processing the soil and plant samples (sample processing usually costs between \$110 to \$200 per sample). Discuss costs with the consultant prior to the work being undertaken.

Land managers in professional capacities should use registered Phytophthora Dieback interpreters and consultants for assessing their bushland. Community groups can consider applying for funding from various sources to cover the cost of Phytophthora Dieback surveys. For more information on these potential funding sources contact the environmental officer at your local government or the Dieback Working Group.

Do it Yourself

You can complete your own disease survey by studying the plants in the bushland. You will need to have a very good knowledge of native plants, various disease symptoms and other causes of plant deaths for the results of your assessment to be accurate and reliable.

The presence of Phytophthora Dieback is determined by observing susceptible plants that are killed by *P. cinnamomi*. These susceptible plants are called "indicator species". Dead jarrah, banksia, grasstrees, zamia palms, dryandra and hakea are commonly used indicator species. You must be able to discount other factors that could have caused the plant death, such as fire, insects, flood, drought, nutrient deficiencies or toxicities, and other plant disease, for example, Armillaria root rot. If non-susceptible trees, for example red gums, flooded gums or wandoo are dying then its likely that the cause of poor plant health is not Phytophthora Dieback.

Table 1 (Page 11) list common plant genera that are susceptible to Phytophthora Dieback, and can be used as Phytophthora Dieback indicator species. For a detailed list on resistant and susceptible plant species please consult www.dwg.org.au.

Protecting Bushland

Table 1. Plant genera with species known to be affected by *Phytophthora* species - including *P. cinnamomi* (CALM, 1999b).

Proteaceae	Myrtaceae	Ericaceae	Other
Adenanthos	Agonis	Andersonia*	Allocasuarina
Banksia*	Beaufortia	Astroloma*	Anarthia
Conospermum	Calothamnus	Leucopogon*	Boronia
Dryandra	Calytrix	Lysinema*	Conostylis
Franklandia	Eremaea	Monotoca*	Dampiera
Grevillea	Eucalyptus	Sphenotoma*	Dasypogon
Hakea	Hypocalymma	Styphelia*	Daviesia
Isopogon*	Kunzea		Eutaxia
Lambertia*	Melaleuca		Gastrolobium
Persoonia*	Regelia		Hibbertia*
Petrophile*	Scholtzia		Hovea
Stirlingia*	Thryptomene*		Jacksonia
Synaphea	Verticordia*		Lasiopetalum*
Xylomelum			Latrobea
			Macrozamia
			Oxylobium
			Patersonia
			Phlebocarya
			Xanthorrhoea
			Xanthosia

* many species in the genus are severely affected



Healthy jarrah forest, many of the key understorey, mid and overstorey species are susceptible to *Phytophthora cinnamomi*

© DWG

Protecting Bushland



Xanthorrhoea preisii is a *Phytophthora cinnamomi* indicator species as it is highly susceptible to the disease.

© DWG

Healthy *Banksia menziesii* trees in flower, this species is susceptible to *Phytophthora cinnamomi*.



© DWG

Protecting Bushland

FAQs and tips

1Q) How fast do plants die when infected with Phytophthora Dieback?

1A) Phytophthora Dieback kills most plants completely and quickly, for example, an infected banksia often suffers from a sudden death.

2Q) How can I tell the difference between plant deaths caused by Phytophthora Dieback and those that aren't?

2A) Localised plant deaths are more likely to be caused by Phytophthora Dieback than odd scattered individual deaths in otherwise healthy vegetation.

3Q) What patterns appear in my bushland if Phytophthora Dieback is killing the plants?

3A) Look for old deaths and recently killed plants, that is, an 'age range' in the deaths. This is because Phytophthora Dieback moves from plant to plant over time, killing each plant as it goes.

4Q) How should I check my bushland for Phytophthora Dieback and map an infestation if the disease is present?

4A) Unless you have the appropriate experience, the DWG recommend you engage a Department of Parks and Wildlife registered interpreter and use a reputable diagnostic laboratory.

5Q) How would I begin to check for Phytophthora Dieback?

5A) Look for recent plant deaths and check to see if these plant species are susceptible to Phytophthora Dieback by looking on the susceptible plant species lists. These lists can be found at www.dwg.org.au/publications and http://www.cpsm-phytophthora.org/resources_supRes.php.

6Q) How do I locate the source of the infestation?

6A) Look for recent or historic activities in the area could have introduced the pathogen, for example, a track, road, vehicle activity or planting.

Laboratory Testing

Like the professional consultants, you can also take plant and soil samples and have them tested in a laboratory (refer to pages 47 - 48 for a list of diagnostic laboratories). Sample results that are positive for Phytophthora Dieback mean either the disease is present at the site or that the incorrect sampling procedure has been followed giving 'false positive' results.

Protecting Bushland

Negative results do not necessarily mean that the site is free of the pathogen, as it may simply have been missed when the sample was taken. The chance of a positive sample being recorded can be significantly increased if the tissue sample is collected from a plant that has a lesion (decaying tissue) present underneath the bark at the base of the main trunk.

Refer to pages 31- 32 for correct sampling procedures. You may need to get further instructions from a laboratory on when and how to take a sample, storage, and transportation. Sampling usually involves digging up a dead plant to get to the roots. This can be quite a physically demanding task if you are sampling a banksia or grasstree.

Develop & Implement Management Plan

The way Phytophthora Dieback is managed in bushland depends on your knowledge of its presence. Select the most appropriate scenario for your situation from the four listed below and refer to the appropriate page.

- Scenario 1 Your bushland is healthy and disease free (Page 16)
- Scenario 2 You have Phytophthora Dieback in some areas (Page 19)
- Scenario 3 All of your bushland is infested with Phytophthora Dieback (Page 23)
- Scenario 4 You are unsure if Phytophthora Dieback is present (Page 26)

Each of these situations will require slightly different management to ensure that the pathogen is not introduced, or does not spread further. However, all management guidelines are based on minimising movement of soil, plant material and water, and protecting plants by treating them with phosphite.



Road construction with Phytophthora Dieback infected soil or gravel can lead to the introduction of the disease into adjacent bushland.

© DWG

Protecting Bushland

Signage and Communication

WA's Project Dieback team with the Dieback Consultative Council, Dieback Working Group and Department of Parks and Wildlife have developed a unified communications system for Phytophthora Dieback. For further information and protocols for installing signage for Phytophthora Dieback management purpose go to www.dieback.org. For the contact details of businesses producing dieback signage visit the contacts page at www.dwg.org.au.

DIEBACK PROTECTION AREA



The presence of Phytophthora dieback is being mapped to help prevent further spread of dieback by human activity.

Phytophthora dieback is an introduced plant killing water mould that lives in soil and plant material. It is devastating the natural heritage of southwest Australia, threatening not only plants but also many unique animal habitats. Banksia communities are particularly susceptible.

Phytophthora dieback can be transported by human activity, carried on boots and tyres and moved in plant material.

You can help to prevent the further spread of Dieback:

- Stay on tracks and trails.
- Clean all soil from your shoes and vehicle.
- Avoid wet soil conditions.

These symbols marked in the field denote areas that are:

 DIEBACK FREE	 DIEBACK INFESTED	 DIEBACK UNKNOWN
--	--	---

THIS AREA IS MANAGED BY

www.dieback.org.au



Scenario 1

Your bushland is healthy and disease free

The following control measures will help to keep the bushland free of Phytophthora Dieback.

Planning

Ensure activities are scheduled to prevent work during high risk times of the year and develop a hygiene plan.

- Schedule activities that involve soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks through the bushland and ensure that all tracks are well drained. Avoid constructing tracks on the upper slopes of the bushland.
- Minimise soil disturbance during fire break maintenance. Mow, slash or use herbicide rather than grade or plough.
- Ensure that water doesn't drain into the bushland from other areas, e.g. roads. Phytophthora Dieback impact is greatest in wet sites.

For all Activities

Plan all activities to reduce the risk of introduction and spread of Phytophthora Dieback.

- Vehicle access to bushland should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil when entering bushland.
- Footwear should be free of mud and soil when entering bushland.

Earthworks

Infested materials such as gravel can often introduce Phytophthora Dieback and earthworks can spread the pathogen.

- Avoid bringing soil, gravel or sand into the bushland. If this material must be introduced, ensure that it is free of Phytophthora Dieback. (refer to page 47 - 48 for information about soil testing).

Bushland Restoration

Contaminated nursery stock and materials such as mulch and sand are one of the largest disease risks to healthy bushland.

Weeding

- If weeds are being manually removed they should be immediately placed in a container to ensure that plant material or soil is not dropped in other parts of the bushland.

Scenario 1

(continued)

Bushland Restoration (continued)

If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. Revegetation has a high risk of introducing Phytophthora Dieback, so should be avoided in bushland that has not been infested. However, if revegetation is required:

- Consider direct seeding rather than planting seedlings.
- Complete planting when soil is moist but not wet.
- Work with your nursery to ensure a high standard of green stock for revegetation.
- Purchase plants from nurseries with Nursery Industry accreditation, or good hygiene standards.
- Test some of the plants that will be used in the revegetation for Phytophthora Dieback before planting
- Do not use mulch or only use mulch that has been well composed (the heating part of the composting process kills *Phytophthora cinnamomi*). Test all mulch for Phytophthora Dieback before bringing it into the bushland.
- You should ensure irrigation water is pathogen free. Ideally water should be from mains water supplies and other sterile water sources.

Access

Phytophthora Dieback is often spread on vehicles and footwear.

- Minimise walking in the bushland when the soil is wet and muddy
- Stay on tracks. Consider up-grading tracks to a hard well-drained surface that does not allow for the easy movement of soil around the bushland.
- If walks pass through high parts of the bushland ensure all boots are cleaned beforehand and plan the event so it begins at the high point moving to the low areas of the bushland.

Communication

Place signs at reserve entrances to highlight the disease situation in the bushland and recommend avoiding access when the soil is wet and sticking to footwear.

- In public reserves, hold a 'wildflower walk' in Spring. Highlight the potential impact of Phytophthora Dieback and how visitors can prevent its introduction.
- Look out for activities occurring near the bushland that could introduce the pathogen, for example, road building.

Scenario 1

(continued)

Communication (continued)

- Find out if the activity is operating under hygienic conditions. If not, contact your local Department of Environment or Department of Parks and Wildlife officer or the relevant authority.
- Discuss the *Phytophthora Dieback* status of the bushland with neighbouring landholders.

Protecting Vegetation

Preventing an infestation is the best way to protect vegetation. Phosphite can be used to reduce the impact of *Phytophthora cinnamomi*.

- Monitor susceptible plants and note any deaths. Implement phosphite treatment if plant death occurs (refer to page 33-37).
- Do not dump rubbish or green waste into bushland.

Horses and Livestock

Horses are livestock can transport *Phytophthora cinnamomi* on hooves.

- Keep horses and other stock out of bushland.
- If horses and other stock need to enter infested areas ensure they don't move into uninfested parts of the bushland

Fire

Phytophthora cinnamomi is often introduced and spread during an emergency response to bushfire and fire prevention activities.

- Mow, slash or use herbicide on fire breaks rather than rip or grade.
- Require contractors to clean their equipment and machinery before entering and after leaving bushland.
- Preventing vehicle access into healthy bushland can prevent the accidental introduction of *Phytophthora Dieback*.



Scenario 2

You have Phytophthora Dieback in some areas

Managing Phytophthora Dieback in this situation is most successful when the presence of the pathogen in the bushland has been clearly identified and mapped. To minimise the risk of new infestations occurring, the following control measures should be implemented:

Planning

Ensure activities are scheduled to prevent work during high risk times of the year and develop a hygiene plan.

- Survey the bushland and mark the infection boundary.
- Schedule activities involving soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks through bushland and ensure that all tracks are well drained.
- Plan or realign tracks so they don't pass from infested to uninfested areas of bushland, or from low areas to higher areas.
- If large portions of your area are infested, keep the tracks within areas that are already known to be totally infested. If the majority of your area is uninfested, keep your tracks in dry areas adjacent creeks or adjoining already cleared areas.
- Minimise soil disturbance during firebreak maintenance. Mow, slash or use herbicide rather than grade or plough.
- Ensure that drainage does not enter the bushland from other areas, eg, roads. Disease impact is greatest in wet sites.

For all Activities

Plan all activities to reduce the risk of introduction and spread of Phytophthora Dieback.

- Vehicle access should be avoided. If a vehicle must enter bushland, ensure it stays on hard, well-drained tracks, and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil on entry and exit from bushland, and when moving from infested to uninfested areas.
- Footwear should be free of mud and soil when entering and exiting the bushland and when moving from infested to uninfested areas.

Earthworks

Infested materials such as gravel can often introduce Phytophthora Dieback and earthworks can move the disease.

- Avoid bringing soil, gravel or sand into bushland. If this material must be introduced, ensure that it is free of Phytophthora Dieback. (refer pages 47 - 48 for information about soil testing).
- Do not move soil or plants from infested to uninfested parts of the bushland.

Scenario 2

(continued)

Bushland Restoration

Contaminated nursery stock and materials such as mulch and sand are one of the largest disease risks to healthy bushland.

Weeding

If weeds are being manually removed, they should be immediately placed in a container to ensure that plant material or soil is not dropped into other parts of the bushland.

Revegetation

If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. Revegetation has a high risk of introducing *Phytophthora Dieback*, so should be avoided in disease-free bushland. However, if revegetation is required:

- Consider direct seeding rather than planting seedlings.
- Select plants that are resistant to *Phytophthora Dieback* for the infested parts of the bushland (for a list please refer to the publications section of the *Dieback Working Group* website: www.dwg.org.au)
- Purchase plants from nurseries with Nursery Industry accreditation, or good hygiene standards.
- Do not use raw mulch, or only use mulch that has been well composted (the heating part of the composting process kills *Phytophthora cinnamomi*).
- Water used should be from the mains supply. If from a creek, dam or river, the water should be sterilised (refer to page 39).

Access

***Phytophthora Dieback* is often spread on vehicles and footwear.**

- Minimise walking in the bushland when the soil is wet and muddy.
- Stay on tracks. Consider realigning tracks to avoid wet and muddy areas while still trying to keep the track low within the profile.
- Avoid walking between infested and uninfested parts of bushland when soil is wet, clean footwear beforehand and plan walks to start high in the bushland and move to lower parts.
- Close and block off unnecessary tracks infested with *Phytophthora Dieback*.
- Plan all machine movements and the route vehicles take through bushland to avoid introducing or spreading *Phytophthora Dieback*.

Scenario 2

(continued)

Communication

Place signs at reserve entrances to highlight the disease situation in the bushland and recommend avoiding access when the soil is wet and sticking to footwear.

- In public reserves, place signs at reserve entrances highlighting the disease situation at the reserve and recommend avoiding access when the soil is wet and sticking to footwear.
- In public reserves, hold a 'wildflower walk' in Spring. Highlight the potential impact of *Phytophthora Dieback* and how visitors can prevent it spreading.
- On walking tracks, place signs next to susceptible plants and dead plants that have been killed by the pathogen.
- Look out for activities occurring near the bushland that could spread the disease, for example road building. If the activity is not operating under hygienic conditions, contact the Environment or Parks Officer at your local government or the relevant authority.
- Discuss the *Phytophthora Dieback* status of the bushland with neighbouring landholders.

Protecting Vegetation

Preventing an infestation is the best way to protect vegetation. Phosphite can be used to reduce the impact of *Phytophthora cinnamomi*.

- Treat susceptible vegetation in the bushland with phosphite. Susceptible trees should be injected, and all other vegetation sprayed (refer to pages 33 - 37). Consider strategic buffer treatment to protect vegetation at the greatest risk if total area is too large to treat in a cost-effective manner.
- Do not dump rubbish or green waste into bushland.

Horses and Livestock

Horses are livestock can transport *Phytophthora cinnamomi* on hooves.

- Keep horses and other stock out of bushland.
- If horses and stock must enter bushland, hooves should be free of mud and soil when entering and exiting and animals should be kept on hard, well drained tracks.

Scenario 2

(continued)

Fire

Phytophthora cinnamomi is often introduced and spread during an emergency response to bushfire and fire prevention activities.

- Mow, slash or use herbicide on fire breaks rather than plough or grade.
- Require contractors to clean their equipment and machinery before entering and after leaving bushland.
- Construct or maintain fire breaks in the uninfested part of the bushland first, then move into the infested area.
- Diverting run-off or drainage into bushland can provide ideal conditions for the establishment of *Phytophthora Dieback*.



© Dieback Working Group

Scenario 3

All of your bushland is infested with Phytophthora Dieback

If Phytophthora Dieback is present in all parts of a bushland area, it is important that any remaining susceptible vegetation is protected and that the pathogen is not spread to other bushland. The following control measures should be implemented:

Planning

Ensure activities are scheduled to prevent work during high risk times of the year and develop a hygiene plan.

- Schedule activities that involve soil disturbance for low rainfall months (November to March) when the soil is dry.
- Ensure soil disturbance activities will not take infested soil into other adjoining areas of bushland, that may contain uninfested areas.
- Minimise the number of tracks through the bushland and ensure that all tracks are firm and well drained.
- Minimise soil disturbance during fire break maintenance. Mow, slash or herbicide rather than grade or plough. If fire breaks are being upgraded ensure this is done with hard, free draining, and uninfested materials.
- Ensure that water does not drain into other adjoining bushland bushland.

For all Activities

Plan all activities to reduce the risk of introduction and spread of Phytophthora Dieback.

- Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks, and avoids muddy areas.
- Vehicles, tools, equipment and machinery should be free of all mud and soil when exiting the bushland.
- Footwear should be free of mud and soil when exiting the bushland.

Earthworks

Infested materials such as gravel can often introduce Phytophthora Dieback and earthworks can move the disease.

- Do not remove landscaping materials, soil or plant material from the bushland.

Bushland Restoration

Contaminated nursery stock and materials such as mulch and sand are one of the largest disease risks to healthy bushland.

Revegetation

If weeds and other unnecessary disturbances are controlled, revegetation should not be necessary in bushland. However, if revegetation is required:

- Purchase plants from nurseries with Nursery Industry accreditation to prevent other diseases being introduced.
- Select plants that are resistant to Phytophthora Dieback.
- Ensure tools and equipment are sanitised before and after use.

Scenario 3

(continued)

Access

Phytophthora Dieback is often spread on vehicles and footwear.

- Minimise walking in the bushland when the soil is wet and muddy.
- Stay on tracks. Consider up-grading tracks to a hard well drained surface that does not allow for the easy movement of soil out of the bushland.
- Clean footwear and equipment when moving between infested and uninfested bushland.

Communication

Place signs at reserve entrances to highlight the disease situation in the bushland and recommend avoiding access when the soil is wet and sticking to footwear.

- In public reserves, place signs at reserve entrances highlighting the disease status of the reserve and recommend avoiding access when the soil is wet and sticking to footwear.
- In public reserves, place signs along tracks next to dead plants that have been killed by Phytophthora Dieback, and explain the impact the disease is having, and how visitors can prevent spreading further.
- Look out for activities occurring in the bushland that could spread the pathogen, e.g. road building. Inform those responsible that Phytophthora Dieback is present at the site.
- Discuss the Phytophthora Dieback status of the bushland with neighbouring landholders.

Protecting Vegetation

Preventing an infestation is the best way to protect vegetation. Phosphite can be used to reduce the impact of *Phytophthora cinnamomi*.

- Treat any remaining susceptible vegetation in the bushland with phosphite. Susceptible trees should be injected, and all other vegetation sprayed (refer to page 33-37).
- Do not remove plants from the bushland.

Horses and Livestock

Horses and livestock can transport *Phytophthora cinnamomi* on hooves.

- Keep horses and other stock out of bushland.
- If horses and stock must enter bushland, ensure that the hooves are free of mud and soil when exiting and animals should be kept on hard, well drained tracks.

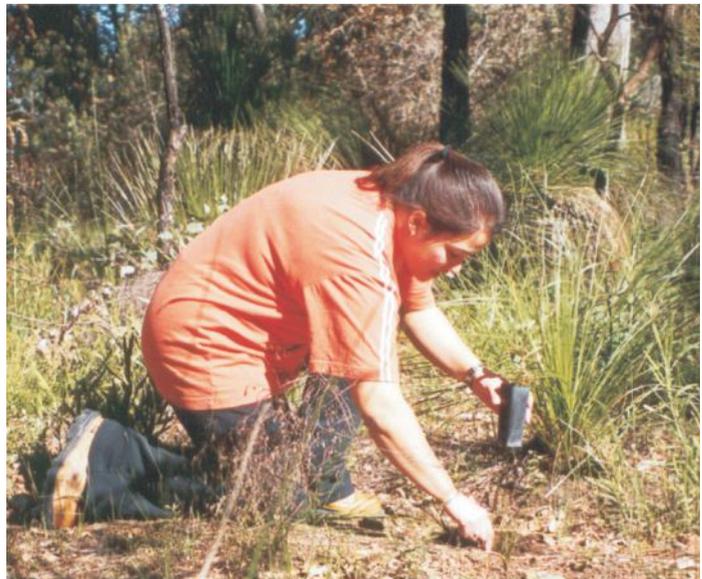
Scenario 3

(continued)

Fire

Phytophthora cinnamomi is often introduced and spread during an emergency response to bushfire and fire prevention activities.

- Mow, slash or use herbicide on fire breaks rather than plough or grade.
- Require contractors to clean their equipment and machinery before entering and after leaving bushland.
- Particular care needs to be taken when revegetating dieback free bushland so the disease is not introduced by way of contaminated plants, soil or mulch.



Scenario 4

You are unsure if Phytophthora Dieback is present

The following procedures should be undertaken in bushland to minimise the risk of the Phytophthora Dieback being introduced and prevent the disease spreading to another site:

Planning

Ensure activities are scheduled to prevent work during high risk times of the year and develop a hygiene plan.

- Schedule activities involving soil disturbance for low rainfall months (November to March) when the soil is dry.
- Minimise the number of tracks in the bushland and ensure that all tracks are well drained. Avoid constructing tracks on the upper slopes of the bushland.
- Minimise soil disturbance during fire break maintenance. Mow, slash or herbicide rather than grade or plough.
- Ensure water does not drain into the bushland from other areas, e.g., roads. Disease impact is greatest in wet sites.

For all Activities

Plan all activities to reduce the risk of introduction and spread of Phytophthora Dieback.

- Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks, and avoids puddles.
- Vehicles, tools, equipment and machinery should be free of all mud and soil when entering and exiting the bushland.
- Footwear should be free of mud and soil when entering and exiting the bushland.

Earthworks

Infested materials such as gravel can often introduce Phytophthora Dieback and earthworks can move the disease.

- Avoid bringing soil, gravel or sand into bushland. If this material must be introduced, map the area for Phytophthora Dieback first and if the area is uninfested and ensure it is free of Phytophthora Dieback. (refer pages 47 - 48 for information on testing).
- If Phytophthora Dieback mapping information is unavailable and moving soil with a blade is necessary, (e.g. grader or loader) only push the material down slope and never push soil upslope. Stop pushing soil after crossing creeks (lift blade/tip bucket) and ensure the machine is clean prior to proceeding. Move the machine up slope with the blade/bucket lifted and return to pushing the material down slope.

Scenario 4

(continued)

Bushland Restoration

Contaminated nursery stock and materials such as mulch and sand are one of the largest disease risks to healthy bushland.

Weeding

- If weeds are being manually removed they should be placed immediately in a container to ensure that plant material or soil is not dropped in other parts of the bushland.

Revegetation

If weeds and other disturbances are controlled, revegetation should not be necessary in bushland. Revegetation has a high risk of introducing *Phytophthora Dieback*, so should be avoided in bushland that is disease free. However, if revegetation is required:

- Consider direct seeding rather than planting seedlings.
- Purchase plants from nurseries with Nursery Industry accreditation.
- Complete planting when soil is moist, but not wet.
- If moving from one area of the bushland to another, ensure that all equipment and shoes are free of mud and soil.
- Do not use mulch, or only use mulch that has been well composted (the heating part of the composting process kills *Phytophthora cinnamomi*).
- Water used in bushland should be from the mains supply. If from a creek, dam or river, the water should be sterilised first (refer to page 39).

Access

Phytophthora Dieback is often spread on vehicles and footwear.

- Minimise walking in the bushland when the soil is wet and muddy.
- Stay on tracks. Consider up-grading tracks to a hard well drained surface that does not allow for the easy movement of soil out of the bushland.
- If walks pass through high parts of the bushland ensure all boots are cleaned before starting and plan the walk so it begins at the high point moving to the low areas of the bushland.

Communication

Place signs at reserve entrances to highlight the disease situation in the bushland and recommend avoiding access when the soil is wet and sticking to footwear.

- In public reserves, place signs at reserve entrances to recommend avoiding access when the soil is wet and sticking to footwear.

Scenario 4

(continued)

Communication (continued)

- Look out for people undertaking activities in or near the bushland that could introduce the pathogen, road building for example. Find out if these activities are operating under hygienic conditions. If not, contact the Environment or Parks Officer at your local government, or the relevant authority.
- Discuss the *Phytophthora* Dieback status of the bushland with neighbouring landholders.

Protecting Vegetation

Preventing an infestation is the best way to protect vegetation. Phosphite can be used to reduce the impact of *Phytophthora cinnamomi*.

- Treat susceptible vegetation in the bushland with phosphite. Susceptible trees should be injected and all other vegetation sprayed (refer to page 33 - 37).
- Do not remove plants from bushland.
- Do not dump rubbish or green waste into bushland.

Horses and Livestock

Horses are livestock can transport *Phytophthora cinnamomi* on hooves.

- Keep horses and other stock out of bushland.
- If horses and stock must enter bushland, ensure that the hooves are free of mud and soil when entering and exiting and keep animals on hard, well drained tracks.

Fire

***Phytophthora cinnamomi* is often introduced and spread during an emergency response to bushfire and fire prevention activities.**

- Mow, slash or herbicide fire breaks rather than plough or grade.
- Require contractors to clean their equipment and machinery before entering and after leaving bushland.

Case Studies

Management Scenarios for Small Properties

Scenario 1

Joan and John own a $\frac{1}{4}$ acre urban block and have noticed that their rose bushes are slowly dying one by one and that they have also lost a much loved grass-tree.

Management suggestion

Sample the most recent death for Phytophthora Dieback and, if the test is positive, treat all host plants with phosphite, including rose bushes.

Scenario 2

Mike and Sarah own a semi-rural $\frac{1}{2}$ acre bush block and have lost a number of banksias, grass-trees and mature jarrah trees. Most of the plants die suddenly and totally with the exception of some jarrah trees which appear to be dying slowly. Mike has noticed that most of the deaths occur in the lowest section of the property but they are slowly spreading upslope. The plants tend to die in spring and autumn, although there have been deaths throughout the year. Sarah has noticed she has trouble keeping her azaleas and rhododendrons alive.

Management suggestion

Total treatment of all host plants every 3 years with phosphite as patterns of death indicate Phytophthora Dieback.

Treat all susceptible plants (refer to pages 33-37).

Do not remove tree stumps and minimise soil movement.

Seek the assistance of a Department of Parks and Wildlife registered Phytophthora Dieback interpreter to map the infested bushland.

Ask for Phytophthora Dieback free gravel, mulch and plants and use a reputable laboratory to confirm these materials and plant stock are Phytophthora Dieback free.

Case Studies

Management Scenarios for Small Properties

Scenario 3

Kate and Matthew own a hobby farm of 10 acres in a semi rural location and have noticed their small grove of avocados have wilting branches even though they are getting plenty of water and nutrients. They have also noticed their surrounding bush experiences ongoing scattered deaths in jarrah, grass-tree and sheoak. Locals recall a time when *Banksia* species were dominant in the midstory but now there are hardly any to be seen. Kate and Matthew aren't overly concerned as their bush gardens look in good condition.

Management suggestion

Symptoms indicate the property has an old established infestation around it and that the property itself may be infested. It would be advisable to treat vegetation adjacent to any vector that could introduce the *Phytophthora* spores onto the property to a distance of 10 to 15 metres depending on slope (the steeper the downslope angle the greater the treatment buffer) with phosphite. These vectors could be driveways, drainage lines, firebreaks, pathways or areas adjacent to introduced soil or mulch.

Avocados are very susceptible to Phytophthora Dieback and these symptoms are indications of infection in avocados (quite different to most native expression). Ideally they would be treated twice yearly with 20 percent phosphite concentration via stem injection (refer to pages 33-37 for treatment instructions).

Seek the assistance of a Department of Parks and Wildlife registered Phytophthora Dieback interpreter to map the infested bushland.

Ask for Phytophthora Dieback free gravel, mulch and plants and use a reputable laboratory to confirm these materials and plant stock are Phytophthora Dieback free.

Sampling Procedures

for a domestic situation



1. Select an appropriate dead plant

Ideally your dead plant will be:

- Freshly dead or as fresh as possible;
- Totally dead (if it is not totally dead it may not be Phytophthora Dieback);
- Possibly one of many that have died over a period of time indicating that the cause of death is an on going process (like Phytophthora Dieback) rather than something that has come and gone (like fire, drought or frost); and,
- Be a plant that is susceptible to Phytophthora dieback, see www.dwg.org.au.



2. Sanitise your sample tool

In order to have confidence in the result of your sample, be sure you aren't infecting the sample with a dirty sample tool. 70 percent methylated spirits is an ideal sanitising medium. Remove any loose soil and plant material from the tool and spray on the methylated spirits until the digging part of the tool is saturated and allowed to dry.



3. Dig around the base of your sample plant

You now need to dig down 20cm - 30cm past the collar (the main stem of the plant that goes underground), of the plant into the roots preferably into moist soil. The depth will vary depending on the plant, and if the plant is small ensure you are taking the sample from the lowest roots. Be sure to take chips of root and enough soil to half fill a standard takeaway food container from two or three sides of the plant to increase your chances of recovering a positive sample.

The best roots to sample are the fine feeder roots of the plant which do not have a hard woody coating.

Sampling Procedures

for a domestic situation

4. Place your soil and roots into a suitable bag

Your bag needs to be strong enough to ensure it will not split open during transport to the laboratory (geologists bags are ideal for this purpose) and be sealed with a cable tie or any other means that will prevent accidental opening. Make sure you have your details written on the bag in clear print, include the date and the sample number if you are taking more than one sample.

Make sure your sample does not get hot during transit, ideally keep your sample in an esky with no ice, in an insulated house or an air-conditioned car out of direct sunlight until you can get it to the lab.



5. Record and mark sample location

You may also wish to record your sample site with a Global Positioning System (GPS), you can use a metro UBD to find a GPS reference in the metro area. Physically mark your sample site with a piece of flagging tape with your details on it for easier relocation.



6. Sanitise your sample tool

It is a good idea to get in the habit of re-sanitising your sample tool to avoid cross contamination or introduction of *Phytophthora* into another site. flagging tape with your details on it for easier relocation.

Protecting Bushland

Treating Your Plants with Phosphite

Phosphite (Phosphonate) is a biodegradable fungicide that protects plants against Phytophthora Dieback. Phosphite works by boosting the plant's own natural defences, thereby allowing susceptible plants to survive within Phytophthora Dieback infested bushland.

It is important to note that Phosphite treatment will not eradicate Phytophthora Dieback. However, an integrated approach can successfully control the spread and impact of the disease. Within bushland an integrated approach may combine the use of strategic phosphite treatment, controlling access, correcting drainage problems and implementing excellent hygiene protocols.

Phosphite controls many species of Phytophthora, including *Phytophthora cinnamomi*. Phosphite is not toxic to people or animals (Shearer et al., 1991) and its toxicity has been compared to table salt. Nevertheless, wear personal protective equipment (PPE) to protect your eyes and skin when injecting or spraying phosphite. There is a very low pollution risk associated with phosphite. When phosphite is sprayed on the foliage of plants, it is applied at a very low rate, so any phosphite that reaches the soil is bound to the soil and does not reach the water table.

Phosphite is available from most large nurseries and rural supply stores. Treating plants with phosphite is inexpensive, a medium sized jarrah tree costs less than a dollar in chemical to treat.

Phosphite needs to enter a plant's water transport system in order for it to be effective. This can be done by injecting phosphite into trees, or spraying the leaves of understorey plants. In bushland the most common tree species injected include jarrah, snottygobbles, banksias, sheoak and woody pears. Only inject trees with a diameter at chest height of 10-14 cm or greater. Phosphite not only protects a plant from Phytophthora Dieback, it can also help a plant to recover if it is already infected. If a jarrah tree is showing signs of infection, treatment with phosphite can help to save it.

Injecting a tree with phosphite provides three to five years protection from Phytophthora Dieback. In contrast, spraying with phosphite provides protection for only one to two years. Because it only provides temporary protection, treatment needs to be ongoing and included in bushland management and future action plans.

Injecting and spraying a large reserve can be a large task for a small community group, so consider applying for funding to employ a private contractor (refer to pages 47-48 for dieback treatment contractors), Conservation Volunteers Australia, Greencorp or similar labour forces, to assist your group to complete the treatment.

Protecting Bushland

Precautionary Note

This section outlines current best practice of managing Phytophthora Dieback as developed through research by the Department of Conservation and Land Management [now the Department of Parks and Wildlife] (CALM 1999a). For more information please contact the Science Division at the Department of Parks and Wildlife. For information about more research please contact the Ecosystem Health Branch at the Department of Parks and Wildlife.

In some cases stressed plants treated with phosphite will show signs of leaf burning. In most cases this is a short-term effect and the plant will recover with the change of the seasons. In a small number of cases the plants that are already infected may be killed by the added stress of the phosphite treatment. To reduce the likelihood of any potential leaf burning the phosphite rates described are chosen from the lower end of the prescribed range. For injecting that is five per cent, and for spraying one half of one per cent. If the diameter at breast height is less than 10cm the susceptible tree will need to be sprayed.

Prior to undertaking any phosphite treatment of bushland for commercial gain, a contractor must contact the Australian Pesticides and Veterinary Medicine Authority and the WA Department of Health for further information.

1. Injecting Trees

Equipment

- Phosphite injection is usually done with large 'Chemjet' syringes
- Cordless electric drill with appropriate drill bit and syringes (the correct drill bit size is 4 - 4.5 mm. Follow safety instructions associated with the use of the drill.



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Protecting Bushland

- Phosphite is sold in a 20, 40 or 60 per cent solution, and is commonly sold under the label Fos-ject® or Agri-Fos®. For a list of common phosphite products please refer to the phosphite treatment section at www.dwg.org.au.
- Ensure you are wearing personal protective equipment including safety glasses, gloves, well covered shoes and protective clothes.

Timing

The best time to inject a tree is when water is moving within it. Water movement is usually greatest in spring and early summer. Injecting in the morning is usually more successful than in the afternoon.

Preparation

- If using 20 per cent phosphite, dilute one part phosphite with three parts water.
- If using 40 percent phosphite, dilute one part phosphite with seven parts water.
- If using 60 percent phosphite, dilute one part phosphite with eleven parts water.
- Use a good quality water source, preferably scheme water or rain water.

For further information on storage, disposal of containers and first aid consult the material safety data sheet for your phosphite product.

Procedure

1. Drill a hole into the tree. Injection needs to be in the sapwood, so do not drill any deeper than 2-3 cm. Usually the wood colour will change from the brown bark to cream at the correct depth. Drill the hole at waist height so that injecting will be comfortable for you. The hole should be drilled at a slight downward angle.

This video additionally shows how to inject phosphite into the stem of trees - <https://www.youtube.com/watch?v=8zxySYAE044>

2. Drill a hole every 20 cm around the tree trunk (approximately one hand span). Multi-stemmed trees need holes in all stems.
3. Follow the instructions that come with the tree injector regarding its set up and use.
4. Insert the nozzle of the syringe or injector into the drilled hole and twist slightly to get a good seal. Slowly release the plunger of the syringe to push/pump the solution into the tree. Make sure the solution is taken up by the tree and does not run out. Inject 20 mL of the solution into each hole.
5. Monitor plant health. If there is no sign of a decline in plant health, repeat in three to five years' time. If plants show a decline in health prior to three years, repeat treatment.

Protecting Bushland

2. Spraying Plants

The solution for spraying is much weaker than for injecting and contains a small amount of penetrant or sticking agent to hold the droplets on the leaf surface until they are absorbed. Not all understorey plants are at risk but it is easier to spray all plants. Phosphite spraying should not be conducted along creek lines and streams as the penetrant can cause adverse effects on some amphibious animals.

Equipment

- Backpack sprayer - ensure it is clean and has not recently contained herbicides or other chemicals.
- Phosphite - sold in a 20, 40 or 60 percent solution, commonly sold under the label Fos-ject or Agri-Fos.
- Synertrol or BS1000 (available from Mirco Bros 08 9410 2233) or another penetrant or sticking agent approved for use on native plants. Use rates recommended by the manufacturer.

DWG Inc. recommends employing a WA Health Department licensed business, skilled in the application of Phosphite, for spraying bushland areas.

Timing

Spraying is most effective from winter to spring in spring and summer. Spraying should not occur one day after rain or one day before rain.

Preparation

Dilute phosphite to approximately 0.5 per cent phosphite for spraying.

For a 20 percent phosphite solution this is one part phosphite to 40 parts water. Therefore, to make 10 litres of solution, add 250 mL phosphite to 10 litres of water.

For a 40 percent phosphite solution this is one part phosphite to 80 parts water. Therefore, to make 10 litres of solution add 125 mL phosphite to 10 litres of water.

Protecting Bushland

- For a 60 per cent phosphite solution this is one part phosphite to 120 parts water. Therefore, to make 10 litres of solution, add 85 mL phosphite to 10 litres of water.
- Shake well.
- Be sure to add penetrant or wetting agent before use as per the manufacturer's instructions.
- Use the solution immediately and mix frequently.

Procedure for backpack/hand-held spray unit

1. Place the backpack spray unit on your back and adjust the straps so it is comfortable and the pumping lever is on your preferred side. Adjust the nozzle so it gives a coarse spray to ensure the spray doesn't blow away from the plants.
2. Soak the plants so all leaf surfaces are wet and the solution is seen to be running off. All understorey plants, including grass trees, should be sprayed. 10 litres of solution should last about 15-20 minutes.
3. Monitor plant health. If there is no sign of a decline in health, repeat in one to two years' time.

Larger spray units, for example a spray trailer, can be used and may be more efficient when treating large areas. The chemical concentration should be the same as the concentrations listed above and the chemicals should be kept well mixed.

Phosphite being applied with a hand-held spray unit.

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Guidelines for cleaning and sanitising

Cleaning vehicles and machinery

The following guidelines provide information on the most effective way to clean down.

Use the following wash down principles to guide your wash-down process:

- Always clean down at a wash-down facility rather than in the bush.
- Remove as much soil and plant material as possible with a brush before sanitising
- Use the minimal amount of water
- Separate the vehicle from the wash-down effluent (runoff) – don't drive through it
- Control drainage of effluent – ensure it doesn't re-enter bushland

When cleaning a typical car, ute or off-road vehicle, pay particular attention to the following parts of the vehicle:

- Wheels, spare wheels and wheel arches
- Mud flaps and suspension
- Scrub bar and side bars/ steps
- Underside protection/ belly plates
- Fenders
- Cargo space/ tray
- Interior floor

A simple wash down unit consists of a high pressure water system, concrete pad, and a drainage system to collect the potentially contaminated water.

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Guidelines for cleaning and sanitising

Cleaning footwear

- Try to remove mud and soil when it is dry.
- Remove as much mud and soil as possible with a brush, and minimise the amount of water used.
- Collect all mud and soil removed in a bag or bucket, and do not allow it to enter bushland.



If you are entering very high value bushland or have come from an area that is infested with *Phytophthora Dieback* you should take the extra precaution of sanitising tools and footwear. If you are propagating plants then sterilising tools and footwear is essential. Anything to be sanitised should first be cleaned so that all soil and mud is removed.

Cleaning boots and spraying with methylated spirits or bleach can reduce the spread of *Phytophthora Dieback*.

Sanitising equipment

- 70 percent Methylated spirits in a spray bottle is suitable for sanitising small hand tools and footwear in the field. Tools should first be brushed clean then sprayed to cover all surfaces. Allow a few minutes for spray to dry. Refer to the manufacturers safety instructions when using disinfecting chemicals.
- Equipment can also be soaked in a disinfectant such as diluted household bleach or Phytoclean®. Household bleach (typically containing 3-6% Sodium Hypochlorite) should be diluted to one part bleach to 10 parts water for soaking tools. Alternatively, Phytoclean® should be diluted to 200ml per 10L of water for soaking tools. Tools should be first brushed clean then soaked in disinfectant for at least 3 minutes before being rinsed. Refer to the manufacturers safety instructions when using disinfecting chemicals.
- To sanitise water, add six millilitres of pool chlorine to every 10 litres of water and allow five minutes before use (follow manufacturers safety instructions). If the water is turbid, a higher rate of chlorine may be required for successful sterilisation.

Sanitising water



Guidelines for Propagating Plants

Plants used in revegetation should be grown using hygienic methods. Nursery Industry Accreditation Scheme Australia (NIASA) businesses maintain very high hygiene standards. Not all nurseries are accredited as the scheme requires very high standards.

Therefore, if your local nursery is not accredited, ask the owner what procedures are in place to ensure that their plants remain free of Phytophthora Dieback. Further information on the requirements for NIASA accreditation can be obtained from the Nursery & Garden Industry (see contact on page 48).



To be confident that plants are Phytophthora Dieback-free, only purchase them from nurseries accredited under the Nursery Industry Accreditation Scheme Australia (NIASA), or those with good hygiene standards.

Guidelines for Propagating Plants

Many community groups propagate their own plants for bushland revegetation. If community groups wish to continue this practice and introduce the plants to disease-free reserves, they should implement the following procedures into their propagation methods.

Potting Mix

- Use a quality potting mix. Ensure it is sterilised and is free of Phytophthora species. In WA there are only a limited number of accredited media suppliers, including Bailey's, Biowise and Richgro.
- Use a well draining potting mix.
- Store potting mix in sterilised, covered bins on a hard dry surface.

Water

- Water obtained from dams and streams or recycled water should be filtered (5µm) and/or sanitised (e.g. UV; chlorine).
- Water from scheme supply, deep bores or rain water does not usually require treatment.

Diseased Plants

- Any plants that appear unhealthy should be removed immediately (including the soil surrounding the plant). Unhealthy plants should be placed into a bin to be transferred to landfill.

Equipment and Hygiene

- Wash equipment, tools and pots well away from the propagation and nursery area.
- Disinfect the workbench daily.
- Clean and sanitise propagation tools daily, or if possible, between batches of seedlings. Sanitise any tools used to dispose of unhealthy plants.
- To reuse pots, wash them first, soak them in a bleach solution for an hour, and then rinse in clean water.

Storage

- Do not store plants on bare ground. Plants should be stored so that water cannot flow between the bottom of pots. An elevated, mesh covered table is ideal.

Watering Plants

- Avoid over watering.



Guidelines for Recreation

Leave No Trace Australia is a national non-profit organisation dedicated to promoting and inspiring responsible outdoor travel and recreation through education, research and partnerships. Leave No Trace builds awareness, appreciation and respect for our natural and cultural heritage, and are dedicated to promoting attitudinal change and the empowerment of individuals, companies and communities to accept responsibility for the conservation of their natural environment. This is achieved by forming partnerships to foster the development of Leave No Trace minimal impact skills and ethics.

recreation GUIDELINES

The seven principles of Leave No trace

- Plan ahead and prepare
- Travel and camp on durable surfaces
- Dispose of waste properly
- Leave what you find
- Minimise the impact of fire
- Respect wildlife
- Be considerate of your hosts and other visitors

These principles are recommended as a guide to minimise the impact of your visits to the natural and cultural heritage areas of Australia. For more substantive information on these principles please go to www.lnt.org.au. You should consider the proceeding Phytophthora Dieback management guidelines for bushwalking, cycling and horse riding in conjunction with the Leave No Trace principles, for best practice activity management.



www.lnt.org.au



Guidelines for Bushwalking

If you are planning to bushwalk in your local bushland reserve, in state forest, or in a national park, you can minimise the risk of spreading the pathogen by following these guidelines:

bushwalking GUIDELINES

Plan ahead and prepare

- Contact Department of Parks and Wildlife or the local government about suitable bushwalking areas.
- Avoid bushwalking when the soil is wet and muddy (following rain).
- Make sure your footwear, walking poles and tent pegs are free of all mud and soil when arriving at a bushwalking site.
- Make sure your vehicle is clean when arriving at bushwalking sites.
- Park your vehicle in designated car parks.

Travel and camp on durable surfaces

- Keep to tracks.
- Avoid muddy areas and puddles.

Dispose of waste properly

Leave what you find

- Avoid transporting soil and mud on the soles of your boots, tent pegs and walking poles by using boot-wash stations where provided or your personal hygiene kit where 'Clean on entry' and 'Clean on exit' are required.

Minimise the impact of fire

Respect wildlife

Be considerate of your hosts and other visitors

- Obey 'track closed' signs.
- Report any faulty boot-wash stations or damaged signage to the land manager.

Frequent bushwalkers may find it useful to carry equipment in their packs and/or vehicle to help keep their footwear clean. A 'bushwalking hygiene kit' should contain a bag to collect scraped off soil/mud, large and small brushes and a bottle of water (from mains supply). Diluted methylated spirits can be applied using a spray bottle to sterilise the soles of shoes.



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Guidelines for Cycling & Horse Riding

Bicycle tyres can pick up soil and mud and therefore contribute to the spread of Phytophthora Dieback. To minimise this risk, cyclists should follow these guidelines:

cycling GUIDELINES

Plan ahead and prepare

- Contact Department of Parks and Wildlife or the local government about suitable cycling areas.
- Avoid cycling when the soil is wet and muddy (following rain).
- Make sure your bike (frame and tyres) is free of all mud and soil when you begin your bike ride.
- Make sure your vehicle is clean when arriving at your bike ride location.
- Park your vehicle in designated car parks.

Travel and camp on durable surfaces

- Keep to designated tracks.
- Avoid muddy areas and puddles.

Dispose of waste properly

Leave what you find

- Avoid transporting soil and mud on the soles of your boots, tyres and frame during your ride by using boot-wash stations where provided or your personal hygiene kit where 'Clean on entry' and 'Clean on exit' are required.

Minimise the impact of fire

Respect wildlife

Be considerate of your hosts and other visitors

- Obey 'track closed' signs.
- Do not enter areas that have been closed off to bike riders.
- Do not enter Department of Parks and Wildlife Disease Risk Areas – it is illegal for bicycles to enter Disease Risk Areas.



Guidelines for Horse riding

Horse riding is a popular activity, particularly in rural and bushland areas. Unfortunately, horse riding can contribute to the spread of *Phytophthora Dieback* through the spread of soil via the horse's hooves. To minimise the risk, horse riders should follow these guidelines:

horseriding GUIDELINES

Plan ahead and prepare

- Contact Department of Parks and Wildlife or the local government about suitable riding areas.
- Avoid riding when the soil is wet and muddy (following rain).
- Make sure your horse's hooves are free of all mud and soil when you begin your ride.
- Make sure your vehicle and float are clean when arriving at your riding location.
- Park your vehicle and float in designated car parks.

Travel and camp on durable surfaces

- Keep to designated tracks.
- Avoid muddy areas and puddles.

Dispose of waste properly

Leave what you find

- Avoid transporting soil and mud on the soles of your boots and your horse's hooves during your walk by using boot-wash stations where provided or your personal hygiene kit (including horse's hoof brush) where 'Clean on entry' and 'Clean on exit' are required.

Minimise the impact of fire

Respect wildlife

Be considerate of your hosts and other visitors

- Obey 'track closed' signs.
- Do not enter areas that have been closed off to horse riders.
- Do not enter Department of Parks and Wildlife Disease Risk Areas – it is illegal for horses to enter Disease Risk Areas.



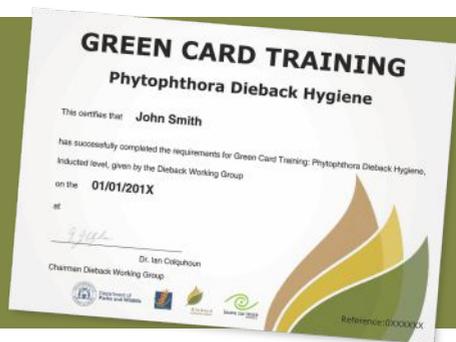
Green Card Training Sessions

The Dieback Working Group regularly conduct training for government, industry and community organisations involved in the management of Phytophthora Dieback. The DWG are currently rolling out the Green Card training program that covers hygiene procedures and other aspects of Phytophthora Dieback management.



The Green Card is conducted as a half day training course that can be conducted on site and involves a vehicle wash down practical session. There is an extended option to include a field trip to a Phytophthora Dieback infestation within nearby bushland.

Further training
details and where to
get this training are
on our website:
info@dwg.org.au





Contacts and Further Information

Dieback Working Group

General enquiries | Email: project.officer@dwg.org.au

Dieback interpretation contractors (DBCA Registered)

The Dieback Working Group recommends Phytophthora Dieback interpreters in Western Australia that are registered with the Department of Biodiversity, Conservation and Attractions to map and report on the disease to a high standard.

Dieback Treatment Services
Phone: 1300 785 311
E: info@diebacktreatments.com
Web: diebacktreatmentservices.com

Ficifolia Nominees
Phone: 0447 431 223
E: sime@sam@bigpond.com

Glevan Consulting
Phone: (08) 9582 7772
E: mail@glevan.com.au
Web: www.glevan.com.au

Great Southern Bio Logic
Phone: 0400 113 093
Email: jeremy@gsbiologic.com.au
Web: www.gsbiologic.com.au

NPC Consulting
Phone: 0405 737 278
E: Gavin@npcconsulting.com.au
Web: www.NPCConsulting.com.au

Southern Ecology
Phone: 0408 802 404
E: Damien@southernecology.com.au
Web: www.southernecology.com.au

Terratree Pty Ltd
Phone: 0400 003 88
E: admin@terratree.com.au
Web: www.terratree.com.au

Dieback treatment contractors

Bark Environmental
Phone: 0400 208 582
E: barkenv@gmail.com
Web: www.barkenviro.com

Dieback Treatment Services
Phone: 1300 785 311
E: info@diebacktreatments.com
Web: diebacktreatmentservices.com

Laboratories for testing soil and plants for Phytophthora Dieback

DBCA, Vegetation Health Service
Phone: (08) 9219 9587
E: juanita.champini@dbca.wa.gov.au

Murdoch University, Centre for Phytophthora Science and Management
Phone: (08) 9360 7537 Dr Treena Burgess
E: T.Burgess@murdoch.edu.au
www.cpsm-phytophthora.org

Please check the DWG website for the most current list of contacts.
<https://www.dwg.org.au/about-dwg/expert-directory/>



Contacts and Further Information

Laboratories for testing soil and plants for Phytophthora Dieback

Plant Diseases in Natural Ecosystems
Phone: 0423 088 826 Email: colinc57265@gmail.com

Richgro Laboratory Services Phone: (08) 6258 7100
Web: www.richgro.com.au/richgro-laboratory-services/

Nursery accreditation scheme

Search the Nursery & Garden Industry Australia website for an updated list of NIASA accredited production nurseries, greenlife markets and growing media suppliers as well as further information about the scheme.
Web: www.ngia.com.au

For further information

The Environment Officer or Parks Officer at your local government.

Dieback Working Group – Bruno Rikli Phone: 0400 208 582

Your local Conservation Group or recognised Biosecurity Group.

Web sites of interest

Centre for Phytophthora Science & Management (CPSM)
www.cpsm-phytophthora.org

Department of Biodiversity, Conservation and Attractions (WA)
Parks and Wildlife Service www.dpaw.wa.gov.au

Department of Environment and Energy (AU)
www.environment.gov.au

Dieback Information Delivery and Management System (DIDMS)
www.didms.gaiaresources.com.au

South Coast Natural Resource Management Inc.
<https://southcoastnrm.com.au>

Project Dieback | www.dieback.net.au

Please check the DWG website for the most current list of contacts.
<https://www.dwg.org.au/about-dwg/expert-directory/>



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Checklist for a Community Group Work Day

General

- A hygiene management plan has been prepared.
- No soil will be moved between areas within the bushland.
- Activities are scheduled for days when the soil is too dry to stick to footwear and tools.
- Equipment, tools and footwear are free of soil and mud.
- Footwear will be free of mud and soil when entering the bushland, and when moving between areas within the bushland.
- No vehicles will be taken into the bushland. If vehicles are necessary, they will be clean on entry and confined to hard, well drained surfaces.
- Techniques that minimise soil disturbance will be used.

Planting

- Direct seeding has been considered.
- Tree planting will be conducted in moist, not wet, soil conditions.
- Plants have been grown using hygienic methods and tested before planting.
- Mulch is from a NIASA accredited supplier or has been well composted.
- Mains or sterilised water is being used to water plants.

Weeding

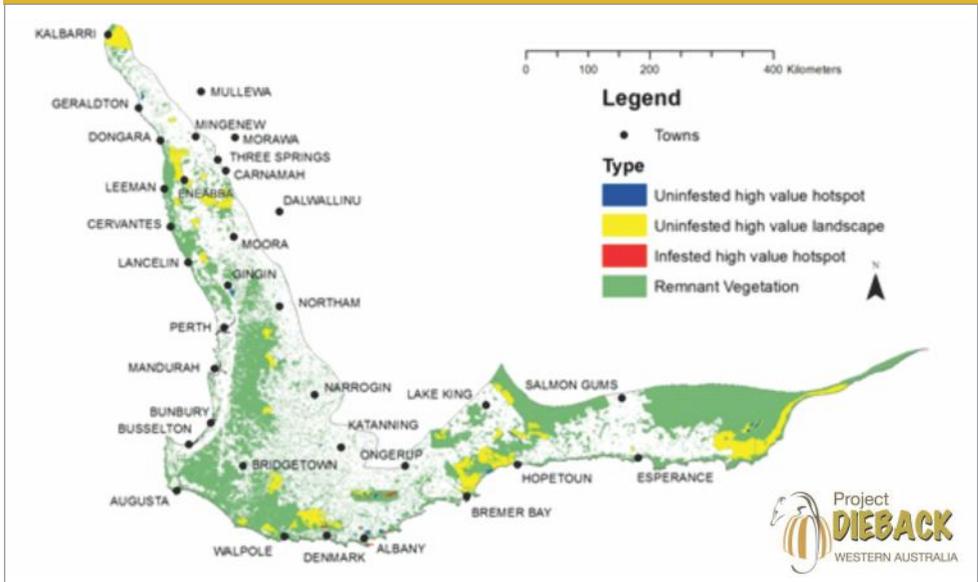
- Weeding is scheduled for dry soil conditions if practical.
- Weeds will be immediately placed in a bag or container so soil doesn't drop out during transport.

Project Dieback

Protecting the indicative Top 100 priority protection areas

Project Dieback is a statewide initiative aimed at identifying the indicative Top 100 Priority Protection Areas (PPAs) in Western Australia under threat from Phytophthora Dieback and managing their preservation over the next 50 years. The PPAs are shown in the map below. Visit www.dieback.net.au for more detailed maps and information.

Priority Protection Areas



Project Dieback resources have developed a Dieback Management and Investment Framework to identify the indicative Top 100 PPAs for targeted ongoing investment and management over the next 50 years and the management actions required. In addition, South Coast NRM has developed an information database for the distribution of Phytophthora Dieback disease across the project area. Project officers across the south west have developed brochures and other information products, upgraded Phytophthora Dieback management on-ground in priority areas and held community engagement and training events for participants.

The Framework provides a logical process and operational toolkit to develop area specific management actions including on ground activity, planning, engagement, communication and structured training to prevent the further spread of Phytophthora Dieback at a landscape scale.

Project Dieback

Protecting the indicative Top 100 priority protection areas

How can you get involved?

- Come along to one of the many community activities occurring around the south west.
- Encourage your local school to become involved in DWG's award-winning Discovering Dieback education package
- Encourage your community group to attend a one of our phosphite treatment or Green Card hygiene training sessions.
- Register and become a user of the Phytophthora Dieback distribution mapping at: didms.gaiaresources.com.au
- Find out more at www.dieback.net.au or talk to your local friendly project officer.

Project Dieback is a collaboration between project leaders South Coast Natural Resource Management Inc, the Department of Parks and Wildlife, Fitzgerald Biosphere Group, Murdoch University and the Dieback Working Group Inc.

Project Dieback is supported by funding from the Western Australian Government's State NRM Program.

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- Shearer, B., Wills, R., and Stuke, M.** (1991) Wildflower Killers. Landscape Magazine. Department of Conservation and Land Management.
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natural resource
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Department of
Parks and Wildlife

