DISEASE AND PATHOGEN MANAGEMENT GUIDELINES

CITY OF MELVILLE

October 2018

Major organisations involved in fighting Dieback in WA

(1) Dieback Working Group

(2) Dieback Response Group

(3) Dieback Consultative Council

(4) Project Dieback

(5) Department of Parks and Wildlife

(6) Centre for Phytophthora Science and Management

(7) NRM groups (e.g. Perth Region NRM)

The Dieback Working Group

The Dieback Working Group consists of representatives from local government, community conservation groups and state government agencies. The Group was formed in response to the lack of knowledge and management assistance about the plant disease in native vegetation known as 'dieback', which is caused by the introduced fungus *Phytophthora cinnamomi*. Since its formation in 1996, the Dieback Working Group has sought to:

(1) Increase awareness about the plant disease caused by *Phytophthora cinnamomi.*

(2) Encourage the adoption of disease prevention and management policies.

(3) Encourage the implementation of control measures to minimise the spread and impact of the fungus.

Acknowledgments

The content and design of these management guidelines were developed in accordance with the Dieback Working Group document *Managing Phytophthora Dieback; Guidelines for Local Government* (DWG 2000).

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1 INTRODUCTION

The purpose of this document is to provide specific guidelines regarding the management of diseases and pathogens within the City of Melville. This document covers only diseases and pathogens that affect native flora species, causing habitat loss through the eventual death and/or decline of individual species. Diseases and pathogens can vary in the severity and extent of their impacts and therefore, priority is given to high-risk diseases that are likely to have a large effect on natural areas.

The actions listed in these guidelines are to be implemented by anyone working in and around natural areas to minimise disease spread in infested areas and prevent the introduction of diseases to "clean" areas.

1.1 Impacts on Natural Areas

As the majority of the natural areas in the City of Melville are surrounded by residential and urban development, most reserves experience relatively high levels of disturbance. Although the spread of disease by natural processes cannot be easily managed, the risk of introduction and spread is increased by human influenced activities such as:

(1) Pedestrian and animal (pets) movement

(2) Vehicle traffic

(3) Rubbish dumping

(4) The use of contaminated equipment

(5) Road construction

(6) Drain construction

(7) Maintenance activities

(8) Parks and reserves maintenance

(9) Fire fighting activities

(10) Off-road vehicle use by ranger staff and other vehicles

Actions need to be taken to minimise the impact of these human-influenced activities. Hygiene protocols are outlined in Section 4 Management Techniques.

2 DISEASE AND PATHOGEN SPECIES

There are a number of disease and pathogen species associated with natural areas in Perth with the main species being:

(1) *Phytophthora* sp.

(2) Rusts

(3) Armillaria (Armillaria luteobubalina)

(4) Cankers

(5) Mundulla Yellows

2.1 *Phytophthora* (Dieback)

Dieback is the name used to describe the plant disease caused by the *Phytophthora* pathogen. There are many species of *Phytophthora* but *P. cinnamomi* has caused the most severe and widespread damage to native vegetation in the south west of Western Australia (WA), including the Swan Coastal Plain. *P. cinnamomi* will be referred to throughout this document; however, it is assumed that the other *Phytophthora* species recently identified in the City of Melville have similar characteristics and treatment methods.

Table 1 shows the locations of confirmed dieback infestations in the City of Melville.

Table 1 – Dieback infestations in the City of Melville

Infested Reserves	Dieback Free/Unknown Reserves
Partial Infestation	Harry Sandon Park
Wireless Hill Park	Blackwall Reach Reserve
Ken Hurst Park	Point Walter Bushland
Blue Gum Lake	Ern Stapleton
Attadale Quarantine Reserve	Wal Hughes
Piney Lakes Reserve	Quenda Wetlands
	Bateman Park
Full Infestation	Hatfield Reserve
Len Shearer Reserve	Booragoon Lake
Beasley Reserve	Heathcote Reserve
Ron Carroll Reserve	Connelly Park
Douglas Freeman Park	Ken Ingram Park
Bill Brown Reserve	Robert Crawford Reserve
Peter Ellis Park	
Peter Bosci Park	**Status Unknown**
Robert Weir Park	Bull Creek Reserve
Richard Lewis Reserve	
Harry Stickland Park	

P. cinnamomi spends its entire life in the soil and plant tissue (it is not spread by wind) and attacks the roots of plants and causes them to rot. This kills the plant by stopping the uptake of water and nutrients.

Soil that is warm and moist provides the best conditions for *P. cinnamomi* to produce millions of spores that then move in the soil water to infect plant roots. It spreads through plant tissue at a rate of about one metre each year on flat ground and moves more rapidly downslope. However, it is human activity that causes the most significant spread of *P. cinnamomi*. Road works; construction; earth moving; dirty vehicles; fencing; stock; and

landscaping all contribute significantly to its spread by moving *P. cinnamomi* spores along with the soil.

Up to 25% of native Western Australian plants are susceptible to *Phytophthora cinnamomi* (Komorek, 1994). Table 2 lists the major plant genera with species affected by *Phytophthora*.

Table 2 – Major plant genera with species affected by *Phytophthora* species

Proteaceae	Myrtaceae	Epacridaceae	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

* indicates many species in the genus are severely affected

A range of agricultural crops and ornamental plants are also susceptible to *P. cinnamomi*. These include peach and apricot trees, grapevines, avocados, radiata pine, camellias, azaleas and rhododendrons (Erwin & Ribeiro, 1996, Cahill, 1993).

P. cinnamomi is not native to WA. It first arrived in WA on soil around the roots of cultivated plants, shortly after European settlement. It was spread extensively throughout the South West when infected gravel was used for road construction and *P. cinnamomi* is now widespread throughout the South West. It is confined to areas with more than 400mm annual rainfall and extends between Eneabba and Esperance. It has infested forest,

heathland and woodland communities and is present in much of the bushland around Perth.

Three other species have recently been identified within the City of Melville (Barber 2011), which is cause for concern. Little is known about these species and while it is assumed that they are similar to *P. cinnamomi* in pathogenicity and treatment requirements, insufficient research has been conducted. The newly identified species are:

Phytophthora litoralis is a newly described species from south west WA. Its name refers to its frequent association with coastal and riparian vegetation and the littoral zone of water bodies. This species is the first to be associated with *Casuarina* in the Perth urban area. Previously, it has been described from water bodies and soil beneath dying *Banksia* spp. and *Xanthorrhoea preissii*.

Phytophthora inundata has been commonly isolated across the south west of WA and has been frequently isolated from waterways. It has been associated with dying *Adenanthos cuneata*, *Banksia littoralis* and *Xanthorrhoea preissii.* It was first described overseas as a pathogen able to cause sporadic, but severe, disease outbreaks on susceptible hosts such as *Aesculus, Salix, Olea* or *Prunus* after soil flooding or waterlogging. The pathogenicity of *P. inundata* to Australian native flora is currently not known as pathogenicity trials have not been carried out.

Phytophthora humicola-like (This is a new species yet to be described).

2.2 Rusts

Rust pathogens are fungi that are widespread in south west WA and are probably endemic. Their effects include growth deformities such as 'witches brooms' (the proliferation of small shoots at the end of branches), galls (swellings or elongated growth), early death of leaves, reduced flowering, fertilisation and seed set and the death of hosts in severe infections. The plants affected are frequently Acacias, Kangaroo Paws and orchids (Shearer, 1994).

The rust *Uromycladium tepperianum* was recorded by Davison (2010) on live *Acacia saligna* shrubs during 2008 and/or 2010 in the following nine reserves:

(1) Ern Stapleton Reserve

(2) Harry Sandon Reserve

(3) Richard Lewis Park

(4) George Welby Park

(5) Bull Creek Wetlands

(6) Booragoon Lake

(7) Piney Lake

(8) Blue Gum Lake

(9) Reg Bourke Park

Myrtle Rust is a group of rusts known as the '*Puccinia psidii complex*' or '*Puccinia psidii sens. Lat*.', which infect plants of the family Myrtaceae (ANPC, 2012). There are many

variants of this disease and are named according to the host species they affect. Some overseas variants are known as 'Eucalyptus Rust' or 'Guava Rust' (ANPC, 2012). The disease is not yet known to be in WA; however, it has been noted in both New South Wales and Queensland (Dumbrell and Asher, 2011). The Department of Agriculture and Food Western Australia (DAFWA) has banned all importation of plant material (dead or alive) from the Myrtaceae family to help prevent the disease entering WA.

The rust is transferred via spores; these spores can be spread by wind, movement of infected plants, on people, clothes, equipment or animals. Juvenile species and new growth are most susceptible to the rust; however, soft tissue parts of plants such as fruits, flowers and leaves or old growth may also be attacked. It usually appears as yellow pustules and the infected tissue quickly dies. Images for identification purposes are contained in Appendix 3.

Hygiene protocols similar to those for dieback should be followed to reduce the likelihood of spread. Myrtle Rust can be treated through chemical sprays which contain copper oxychloride, triforine and mancozeb; however, this is often not practical in a large bushland setting (Dumbrell and Asher, 2011).

In a worst case scenario, myrtle rust can devastate WA forests containing Eucalypts, such as Jarrah, Karri, Tuart and Wandoo (Dumbrell and Asher, 2011). It is therefore essential that the management and limitation in the spread of the disease is carried out within WA. If the disease is sighted within the City of Melville, photographs of the infected plant should be taken and sent to the Department of Parks and Wildlife (DPaW; formally known as Department of Environment and Conservation). It is advised that the plant not be disturbed unless otherwise authorised by the correct authorities, to ensure that spores are not spread.

2.3 Armillaria (*Armillaria luteobubalina*)

Armillaria luteobubalina is an indigenous parasitic mushroom that is widespread in south west WA, causing decay in roots and stems that can result in the death of the host plant. The plants affected are frequently from the families of Grevilleas, Eucalyptus and Acacias (Shearer, 1994).

Armillaria luteobubalina occurs most frequently in coastal dunes and forests east of the Darling Scarp (Shearer, 1994). It does occur in the Spearwood Dune System (which is in the west of the City of Melville) but rarely in the more acidic Bassendean Dune system (which is in the east of the City of Melville) (Shearer, 1994). No occurrences of *Armillaria luteobubalina* have been documented in the City of Melville.

2.4 Cankers

Cankers are a fungal disease that cause lesions (black patches and sunken or flattened areas) on stems. Although there are a number of fungi that cause cankers in Banksia, all of them are weak pathogens and therefore only take hold if the plant is stressed. It is important to take a close look at your management techniques if you see cankers in your Banksias (Reid, 2003).

Quambalaria coyrecup is a fungal pathogen which affects Corymbia species and is more commonly known as Marri Canker. The symptomatic cankers are formed in response to infection caused by Quambalaria species. Trees under stress are more susceptible to the

pathogen and usually die as a result however healthy trees may be able to fight off the pathogen for a number of years. Many street and verge trees can be infected with Quambalaria in addition to bushland trees.

2.5 Mundulla Yellows

Mundulla Yellows is a syndrome in which eucalypt trees decline or die in association with a characteristic yellowing of leaves. It has been hypothesised that a phytoplasma or virus is involved (Keane *et al*., 2000) but without knowing the exact cause or disease cycle, it is not possible to effectively treat it.

Until more specific knowledge is available, general plant hygiene practices will help to minimise the risk of human activity spreading these diseases such as Mundulla Yellows from plant to plant and, most importantly, into new areas (Hanold *et al*. 2002).

3 RISK

The natural area reserves vary greatly in condition and ecological importance. The Natural Areas Asset Management Plan (NAAMP) 2011 rates these reserves on conservation priority and these ratings should be considered when making management decisions.

One third of the reserves are rated as top priority areas within the City of Melville and some of these are recognised as areas of national and regional significance and hold great ecological importance. Several other reserves (e.g. William Reynolds Park and Red Gum Park) that are classified as natural areas are highly modified and, whilst containing some scattered remnant individual native plants, do not meet the definitions of a natural area or bushland. The remainder of the reserves are rated somewhere in between these two categories.

Foreshore reserves vary greatly in condition, with some areas containing little to no remnant vegetation and some areas containing a relatively healthy ecosystem. Refer to the Foreshore Restoration Strategy Review 2009 for assessments of foreshore area conditions.

The risk of spreading diseases and pathogens through the City of Melville natural areas can be determined through the following indicators:

(1) Public usage of reserves

(2) Extent and length of perimeters of Protectable Areas

(3) Topography

(4) Soil Type

(5) Number of host species present

High usage increases the likelihood of diseases being brought in or spread on people, vehicles and animals as they move through reserves. Topography, soil type and number of host species determine the ability of the disease or pathogen to move through the landscape. Those reserves with high usage and the appropriate topography, soil type and host species range for the pathogens will be most at risk.

Appendix 1 contains information on City of Melville reserves and their protectability status. Priority should be given to those reserves deemed protectable and that are priority 1 reserves under the NAAMP rating.

4 THREAT PREVENTION, ELIMINATION, CONTAINMENT AND/OR MANAGEMENT TECHNIQUES

As *Phytophthora* species are the most common plant infestations in the City of Melville, this section will focus primarily on the management of these species. Due to resource limitations, *Phytophthora* dieback is the only disease or pathogen currently actively controlled; however management actions taken for dieback are also likely to reduce the spread of other pathogens, which are often spread in similar ways.

The objective of *Phytophthora* management should be to minimise the further spread of the pathogen and to minimise the impact of existing infection. Preventing further spread

involves controlling any human influenced spread, as the natural movement through the soil cannot be controlled. To manage it effectively, the exact location of the pathogen must be determined which is achieved by assessing soils and vegetation. Minimising the impact of infested bushland can be done by treating trees and foliage with a phosphorus-based solution, Phosphite, to increase plant resistance to infection and enable symptoms to be minimised. Treatment does not kill the pathogen.

The City aims to manage the threat of diseases and pathogens in bushland reserves through the following techniques:

(1) Regularly surveying bushland for the presence and movement of dieback.

(2) Implementing management and hygiene protocols.

(3) Treating susceptible plant species with Phosphite.

Objectives for different levels of Management for disease control are listed in Table 3 below.

Table 3 – Tiered Objectives for Disease Control

Reserve / Site / Species Value	Reserve Status	Objective	Example Control Techniques
Low - Very High	Protectable - High priority	Prevention	▪ Surveys and Assessment ▪ Dieback Treatment ▪ Hygiene Protocols ▪ Signage
Very High	Protectable - low priority	Containment and Management	▪ Surveys and Assessment ▪ Dieback Treatment ▪ Hygiene Protocols ▪ Signage
High			
Medium		Containment	▪ Surveys and Assessment ▪ Dieback Treatment ▪ Hygiene Protocols ▪ Signage
Low			
Low – Very High	Unprotectable	Management	▪ Hygiene Protocols

4.1 Surveys and Assessments

City of Melville reserves have been assessed to determine their dieback status as either infested or uninfested; the presence of susceptible vegetation; the conservation value of the reserve; and the area of protectable vegetation available. Each of these factors have been considered and enabled the reserves to be prioritised for optimum management of pathogens given resource limitations. Appendix 1 details the assessment of all bushland reserves in the City of Melville.

Surveying of reserves for dieback should be conducted regularly, prior to treatment with phosphate, and may also be required prior to the writing of a Strategic Reserve Plan. Field observations for every reserve are made during field visits and should note the following information:

(1) Deaths of susceptible plant species (indicator species).

(2) Total deaths.

(3) An age range in the deaths; i.e. old deaths and recent deaths.

(4) The range of susceptible plant species deaths.

(5) A vector that could have introduced the disease.

(6) Any other factors that could have caused tree death.

If *Phytophthora* dieback is suspected in an area, soil and plant samples should be taken and tested by a laboratory to confirm field observations. The area surveyed is then categorised as infested or uninfested (or uninterpretable if results are inconclusive). This information is then collated and the active dieback infestation and disease edge is mapped by GPS for each reserve. This information is regularly input into the City of Melville Intramaps system so that up-to-date information on dieback locations can be accessed by staff.

4.2 Dieback Treatment

A program of phosphite treatment to be implemented and *P. cinnamomi* infestation monitored. Phosphite is a chemical that can protect plants that are susceptible to *P. cinnamomi* and works by boosting the plants natural defences.

(1) Phosphite treatment should be prioritised as follows:

(a) Priority 1 Treat susceptible vegetation that is priority or DRF listed, locally significant or has special significance to the park.

(b) Priority 2 Treat susceptible vegetation five metres downslope of the *P. cinnamomi* edge.

(c) Priority 3 Treat all susceptible vegetation within five metres of the *P. cinnamomi* edge.

(d) Priority 4 Treat all vegetation in the uninfested parts of reserves.

(e) Priority 5 Treat all susceptible vegetation in the reserve.

(2) Treatment can include, but is not limited to, stem injection of trees (diameter greater than 10cm) and foliar spray of understory species and small trees (less than 10cm in diameter).

(3) The health of plants in the treated areas should be monitored. If there is no plant death, injection should be repeated every three to five years,and spraying every two to three years.

(4) Plant health along the rest of the *P. cinnamomi* edge should be monitored six monthly to determine areas of rapid spread. Any areas where rapid spread is occurring should be treated with phosphite.

(5) If the dieback area is undefined, treat all susceptible vegetation in the reserve when treatment is due.

(6) The reserve should be resurveyed by an accredited dieback interpreter every three years to determine the success of phosphite treatment; the success of other dieback control measures; and identify areas where the infestation is spreading rapidly and requires treatment. See Appendix 1 for Treatment Records of Reserves.

Treatment should be carried out in spring and summer, when water uptake from the vegetation is at its greatest.

Injection and foliar spray should be conducted according to the methodology recommended by the Dieback Working Group.

4.3 Hygiene Protocols

City staff, contractors, Friends Groups and other groups undertaking on-ground works are to implement the following hygiene measures.

4.3.1 Vehicles

(1) Vehicle access should be avoided. If a vehicle must enter bushland, ensure that it stays on hard, well-drained tracks and avoids puddles.

(2) 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.

(3) Wash down on a hard, well drained surface (e.g. a road) and on ramps, if possible.

(4) Do not allow mud and 'wash down' water to drain into areas of bushland.

(5) Remove as much mud and soil as possible with a brush or stick and minimise the amount of water used.

(6) Soil and mud should be removed as much as possible whilst still dry, as dieback is a water-born pathogen that can easily spread through infected water.

(7) Pay particular attention to mud flaps and tyres and other areas of compacted soil.

(8) Do not drive through 'wash down' water when finished.

(9) A formal clean down of vehicles should be conducted at a wash down facility once site activities are completed, in addition to vehicle cleaning whilst on site.

4.3.2 Footwear

(1) Footwear should be free of mud and soil when entering and exiting the bushland and when moving from infested to uninfested areas.

(2) Minimise walking in the bushland when the soil is wet and muddy.

(3) Stay on tracks.

(4) Avoid walking between infested and uninfested parts of bushland when soil is wet and plan walks to start high in the bushland and move to lower parts.

(5) Remove as much mud and soil as possible with a brush when dry, and minimise the amount of water used.

(6) Collect all mud and soil removed in a bag or bucket and do not allow it to enter bushland.

(7) Methylated spirits (undiluted) or Phytoclean is suitable for sterilising small hand tools and footwear in the field. Place active ingredient in a spray bottle, spray to cover all surfaces and allow a few minutes to dry (follow manufacturer's safety instructions).

(8) Other equipment can be sterilised by soaking in the active ingredient. Dilution may be required; check the product MSDS for dilution quantities. Soak the tools for a few minutes then rinse in clean water (follow manufacturer's safety instructions).

(9) Portable dieback hygiene kits are available from the City on loan for those conducting on site activities. Contractors are expected to have their own dieback cleaning equipment.

4.3.3 Boot Cleaning Stations

(1) Boot cleaning stations may be installed at areas between infested and un-infested locations, or at the entrance to high value un-infested sites.

(2) Boot cleaning stations should have equipment for both manual soil removal and chemical cleaning (e.g. through PhytoClean).

(3) Boot cleaning stations should be installed over top of a limestone base, to capture any infected soil and prevent it running off into the surrounding bushland. This soil may need to be removed from time to time if it builds up, and should be checked regularly. This soil would be counted as hazardous waste and disposed of appropriately.

4.4 Track Construction

See the City's Path and Barrier Guidelines for information on how to reduce the spread of disease and pathogens whilst constructing tracks through bushland.

Sandy tracks should be prioritised for upgrades to limestone tracks if they run near or through a dieback infested area. Such a technique is known as "Green Bridging" and prevents contact with infected soil, thus minimising spread of the disease through use of tracks.

4.5 Materials

No materials (soil/mulch/plants) are to be brought into the uninfested reserves or parts of reserves, unless approved by the City if materials can be confirmed disease free. For example, those materials purchased from a supplier that is on the Nursery Industry Accreditation Scheme may be considered to be a lower risk than other suppliers because hygiene practices are put in place for dieback control. See Appendix 2 for a list of accredited suppliers.

Actions to be taken to reduce the risk of spread through introduction of materials:

(1) Identify activities that involve the movement or introduction of soil/mulch/plants; e.g. track maintenance and revegetation.

(2) Identify alternative techniques that could be used to avoid the movement of soil/mulch/plants.

(3) Carry out a risk assessment of materials if deemed necessary before they are approved to be let into the reserve.

4.6 Major Works

Any major works proposed in, or adjacent to, reserves that involves significant soil disturbance or involves the alteration of drainage patterns should be assessed to determine potential impacts.

(1) Any major works proposed in, or adjacent to, reserves should be assessed for risk by the Environmental Coordinator or Environmental Officer in conjunction with Works staff.

4.7 Maintenance Activities

Maintenance activities (such as fencing, track maintenance etc) should occur in dry soil conditions to limit the risk of spreading pathogens. Tools should be cleaned and free from soil prior to carrying out maintenance activities.

4.8 Communication

It should be communicated to surrounding residents, visitors, contractors, staff, facility providers and other stakeholders that *Phytophthora* is present in certain reserves and inform them on how they can assist in minimising its spread across the City.

4.8.1 Signage

(1) Standard Dieback Signage Protocols for Western Australia (as shown below) should be used in all reserves to communicate dieback information.

(2) “Dieback Protection” signage should be used in reserves with dieback infestations, along with the corresponding trail markers denoting the disease boundary in dieback status areas.

(3) Priority should be given to signage marking dieback infested areas over uninfested areas.

(4) “Dieback Boot Cleaning” signs may also be used if Boot Cleaning stations are to be installed.

(5) Other signs may be used from the Standard Signage depending on management objectives.

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

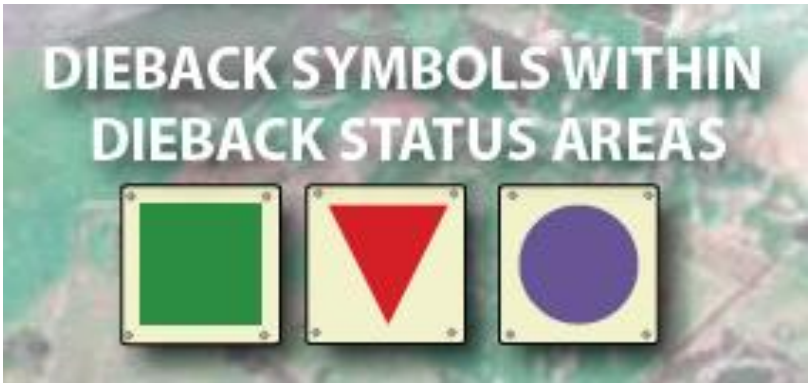
DIEBACK INFECTED

DIEBACK UNKNOWN

THIS AREA IS MANAGED BY

Department of Environment and Conservation
Our environment, our future

www.dieback.org.au



4.8.2 Other Means of Communication

(1) Determine the most frequently used entry point/s to reserves and erect signs at reserve entrances, giving priority to sandy tracks.

(2) Distribute information to neighbouring residents outlining the disease status of the reserve and how visitors to the park can reduce the risk of disease spread; e.g. remaining on tracks.

(3) Use local newspapers and letter box drops to invite surrounding residents or local schools to dieback treatment days, dieback information workshops or interpretive bushwalks.

5 RESOURCE OPTIMISATION

In order to optimise resources, dieback surveys and treatment should be carried out according to a three year treatment and mapping schedule (see Appendix 1) in only those reserves deemed to be protectable.

Hygiene protocols should be implemented for all staff, contractors and volunteers working in any bushland site. Signage should be installed in the coming years, marking out infestations of dieback within highly used reserves.

6 LIMITATIONS OF RISK ASSOCIATED WITH IMPLEMENTATION

To limit any risk of spread through the implementation of disease and pathogen actions, all staff, contractors and volunteers are required to follow these guidelines whenever they are working in natural areas.

7 KEY PERFORMANCE INDICATORS

(1) Bushland should be mapped by a dieback interpreter every three years, followed by dieback treatment as recommended by the consultant.

(2) All staff, contractors and volunteers should be made aware of hygiene protocols through provision of these guideline documents before conducting any site work.

(3) Hygiene kits are to be made available to all volunteer groups when conducting site work.

(4) Ensure all protectable reserves are treated over a three year period according to the treatment schedule.

(5) Boot Cleaning stations should be checked and maintained on a 6 monthly basis.

8 INDICATIVE COSTS

This is an estimate of the costs required to implement the *P. cinnamomi* management for 12 months (based on 2011 figures). Prices for phosphite treatment are based on a reserve size of approximately 20 hectares.

8.1 Management Actions Estimated Cost

Task	Who	Cost
Dieback surveys	External consultant – Infested/unifested assessment	$2,400.00
	External consultant – sample collection	$1,500.00
	External consultant – sample analysis	$1,500.00
Phosphite treatment – Dieback Working Group & volunteer labour	Chemicals (phosphite)	$400.00
	Equipment hire	$50.00
	Labour (volunteer @ $20.00/hr for 12 hours)	($2,700.00)
Phosphite treatment and reserve assessment by accredited DER disease interpreter	External contractor	$2,450.00
Dieback prevention	Boot cleaning station (each)	$2,000.00
	Boot brushes, chains (each)	$20.00
Signage (Tier 4, per sign)	COM Sign Shop	$300.00
Brochures (1,000)	External print shop	$1,200.00

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Appendix 1 – Dieback Status

Reserve Name	Size (ha)	Glevan Dieback Assessment (2011) Report Extract
Harry Sandon	3.9	Protectable high priority
Piney Lakes	30.6	Protectable high priority- fragmented vegetation, but enough protectable vegetation with higher profile public access
Bluegum Lake	7.3	Protectable high priority- generally good quality Banksia woodland with few suspicious deaths noted
Robert Crawford	1.07	Protectable high priority- long and narrow reserve with wide community frontage
Blackwall Reach	10	Protectable high priority- no infestations observed
Point Walter	10	Protectable high priority- no infestations observed
Ern Stapleton	0.57	Protectable high priority- no infestations observed
Connelly Reserve	0.38	Protectable high priority- no infestations observed
Wal Hughes	1.4	Protectable high priority- protectable vegetation
Olding Park	0.28	Protectable high priority- reasonable sized area of protectable vegetation
Ken Hurst Park	35	Protectable high priority- significant vegetation with large dieback infestation
Wireless Hill Park	33	Protectable high priority- small infestation insitu
Colleran Park / Ken Ingram	0.27	Protectable high priority- small reserve but appears complete with good vegetation
Attadale Bushland Reserve	2.8	Protectable high priority- some susceptible vegetation and right next to infested area
Peter Ellis	2	Protectable high priority- suspected infestation, but vegetation generally in good condition
Beasley Reserve	5.6	Protectable high priority- vegetation appears in poorer condition but higher profile community access
Attadale Quarantine Area	0.58	Protectable lower priority- infested but with some large trees able to be salvaged and restoration happening
Tom Firth	0.48	Protectable lower priority- infested, but has some vegetation of value
Robert Weir	1.36	Protectable lower priority- infested, but still has some vegetation of note in a cluster
Bill Brown	1.2	Protectable lower priority- infested, but still has some

Reserve Name	Size (ha)	Glevan Dieback Assessment (2011) Report Extract
		vegetation of note in a cluster
Harry Strickland	0.53	Protectable lower priority- infested, but still has some vegetation of note in a cluster
Peter Bosci	1.4	Protectable lower priority- infested, but still has some vegetation of note in a cluster
Len Shearer	2.64	Protectable lower priority- infested, but still has some vegetation of note in a cluster
Alec Lambert	0.4	Protectable lower priority- infested, but still has some vegetation of note in a cluster
Quenda Wetland	2.4	Protectable lower priority- infested, but still has some vegetation of note in a cluster, all upslope on north-eastern corner of reserve
Bateman Park	1.5	Protectable lower priority- Mostly wetland, but some vegetation adjacent to Leach Hwy of protectable value
Art Wright	0.24	Protectable lower priority- open reserve, but quantity of Xanthorrhoea of value
Hatfield Reserve	0.53	Protectable lower priority- protectable vegetation
Richard Lewis	3.9	Protectable lower priority- protectable vegetation
Ron Carroll	5.58	Protectable lower priority- reserve has recently been burnt, could be treated as priority 1
Bull Creek Reserve	7.55	Protectable lower priority- strip of vegetation in Brockman Park adjacent to road has some protectable value
Fred Johnson	0.36	Protectable lower priority- vegetation appears in poorer condition but possibly through water table lowering and not dieback
Phillip Jane	3.8	Protectable lower priority- vegetation on perimeter of reserve, some in good condition
Booragoon Lake	9.9	Unprotectable
Heathcote	11	Unprotectable
Reg Bourke	2.21	Unprotectable
George Welby	1.9	Unprotectable
Trevor Gribble	0.8	Unprotectable
Al Richardson	0.7	Unprotectable
Douglass Freeman	2.4	Unprotectable

Reserve Name	Size (ha)	Glevan Dieback Assessment (2011) Report Extract
Dudley Hartree	3.6	Unprotectable
Harold Field	1.29	Unprotectable
PJ Hanley	0.46	Unprotectable
Reg Seal	0.35	Unprotectable
Trevor Knowles	0.3	Unprotectable
Bainton Reserve	0.3	Unprotectable
Elisabeth Manion	0.48	Unprotectable
Red Gum Park/Ellis Rd Reserve	0.77	Unprotectable
Harry Baker	1.33	Unprotectable
Hugh Corbet	0.3	Unprotectable
Jim Ainsworth	0.4	Unprotectable
William Hall	2.1	Unprotectable
William Reynolds	0.1	Unprotectable
Arthur Kay	0.5	Unprotectable

Key – NAAMP Rating

Priority 1 Reserve

Priority 2 Reserve

Priority 3 Reserve

Priority 4 Reserve

Appendix 2 – Suppliers on the Nursery Industry Accreditation Scheme WA

These suppliers have been accredited to be carrying out satisfactory hygiene protocols to minimise the risk of their products spreading diseases, pathogens or weeds.

(1) Agricultural Department, South Perth
(2) Alcoa's Marrinup Nursery
(3) Apace Aid (Inc)
(4) Australian Native Nurseries Group
(5) Avon Sands and Minerals
(6) Baileys Fertilisers
(7) Birnam Nurseries
(8) Botanic Parks and Gardens Authority, Kings Park
(9) EMS Plant Production, Forrestdale
(10) G & S Seedling Nursery
(11) Men of the Trees
(12) Muchea Tree Farm
(13) Natural Area Management and Services
(14) Nuts About Natives
(15) Plantrite
(16) Richgro Garden Products
(17) The Seedling Factory
(18) Touchwood Nursery
(19) WA Cactus and Succulent Supply Co.
(20) Zanthorrea Nursery

Please see http://www.ngia.com.au for up-to-date information on accredited suppliers.

Appendix 3 – Myrtle Rust Recognition - What does it look like?

Source: http://www.dpi.nsw.gov.au/biosecurity/plant/myrtle-rust/image-gallery