



Conservation Commission
of Western Australia



Performance assessment of Phytophthora dieback
management on lands vested in the Conservation
Commission of Western Australia

Commission function

Conservation Commission performance assessments are undertaken primarily to fulfill the functions described in S 19(g) of the *Conservation and Land Management Act 1984*. That is to “assess and audit the performance of the Department and the Forest Products Commission in carrying out and complying with the management plans”. They will also help inform its policy development function and its responsibility to advise the Minister on conservation and management of biodiversity components throughout the State.

The use of Department of Environment and Conservation (DEC) data for the production of maps in this report is acknowledged.

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Summary, findings and recommendations

Summary

Over the last decade there have been many reports and reviews of dieback policy and protocols. The Commission believes there are opportunities to protect vulnerable but uninfested areas in the medium to long term, to protect rare taxa at risk and to engage the community and other land managers.

Despite the lack of guidelines outlining dieback risk assessment approaches to be adopted relevant to different situations, the Commission is satisfied that in areas of State forest that systems are in place, particularly with respect to forestry operations. It should be acknowledged that DEC faces an almost overwhelming task of controlling the spread of dieback by overcoming illegal use of these areas by trail bikes and other vehicles. And that these systems are effective when properly resourced and implemented.

With regard to lands primarily managed for conservation the Commission is concerned that many operations involving soil disturbance proceed without adequate assessment of the risks. It is difficult to assess improvement or otherwise in relation to dieback environmental outcomes as there are few monitoring records available for the conservation estate.

In this assessment the Conservation Commission reviewed the strategies, plans, policies and procedures with regard to the management of *Phytophthora* dieback ("dieback" caused by *Phytophthora cinnamomi*) by the Department of Environment and Conservation (DEC).

The Conservation Commission findings have been formulated from this review and from the evidence presented by the Centre for *Phytophthora* Science and Management (CPSM) who undertook a performance assessment study of dieback in 2009 for the Conservation Commission (Attachment 1). The Conservation Commission has given consideration to all CPSM recommendations noting that they vary from being overarching to specific.

From this process the Conservation Commission has identified 18 findings:-

- Finding 1** The Dieback Consultative Council and the Dieback Response Group created to advise the Minister for Environment on dieback management have become inactive. Neither the Council nor the Response group has met over the last year.
- Finding 2** The *Policy Statement No 3 Threat abatement for Phytophthora cinnamomi and disease caused by it in native vegetation* (draft) was endorsed by the Commission in 2004 as an interim policy with the understanding that it would be further developed for final endorsement within 12 months. The Commission is aware of no action by DEC to review the policy over the last 6 years.
- Finding 3** DEC is yet to report on the application and evaluation of a protocol for the identification and prioritization for management of dieback "protectable"

areas. The current definition of 'protectable' is not suitable for defining priority areas for dieback protection in many of the dieback management situations occurring across the State.

- Finding 4** DEC does not have a dieback management strategy which clearly states strategic goals of management for the department.
- Finding 5** The current *Dieback Manual* and protocols are dated with some sections remaining as drafts. There has been no apparent updating of the manual since 2004.
- Finding 6** There is no evidence of a standardized approach to hygiene planning with respect to various operations and activities which involve soil movement on Conservation Commission vested lands outside the *Forest Management Plan 2004-2013* area.
- Finding 7** It is not possible to determine whether objectives of conservation reserve management plans in relation to plant disease have been achieved as little dieback monitoring has been formally completed and evaluated.
- Finding 8** It has not been routine for districts to formally register 'protectable' uninfested areas of vegetation and to develop with ongoing commitment to implementation, hygiene management plans.
- Finding 9** A number of significant infrastructure projects have commenced prior to hygiene management plans being in place.
- Finding 10** There is an inadequate commitment to dieback training and education in DEC.
- Finding 11** There does not appear to be an appropriate standardized guideline for utilizing dieback free gravel for DEC management activities.
- Finding 12** The Conservation Commission is particularly concerned that systems to insure that dieback is not spread during the course of departmental fire management are inadequate.
- Finding 13** The Conservation Commission is concerned that key messages in relation to dieback are not being communicated adequately through the DEC website and key strategies such as the Good Neighbour policy.
- Finding 14** There is a lack of readily available information on the current distribution and potential distribution of the disease.
- Finding 15** There is no public information system relating to the conservation estate (and associated infrastructure within the conservation estate) aimed at minimizing the risk of spreading the disease.

- Finding 16** DEC does not have an overall system for collating, and being made readily available, areas that have been deemed “protectable” (or priorities for management as a result of operational mapping).
- Finding 17** It is not possible to directly assess any progressive improvement or otherwise in relation to dieback environmental outcomes as there is no system for monitoring and recording disease spread across the Conservation estate.
- Finding 18** Staff responsibilities for dieback management are spread over a number of divisions. DEC has not had a full time dieback coordinator since 2006.

Introduction

In formulating this report the Conservation Commission has examined documentation relating to policy, protocols, guidelines and local area dieback management planning. In 2009 the CPSM undertook a dieback study under a contract with the Conservation Commission. The full CPSM report is included as Attachment 1 to this report and is referred to extensively throughout. The CPSM report provides background and context information which has not been reiterated in this main report. The Conservation Commission has given consideration to all CPSM recommendations noting that they vary from being overarching to specific. An overview of the CPSM report is also provided in Appendix A.

DEC has provided a formal response to findings 1 – 18 as presented in the main body of this report. The full DEC response has been included as Appendix D. Where the DEC response refers to documentation which became available after the assessment interviews, a copy has been requested by the Conservation Commission. A review of this documentation and other indications or commitments given by DEC in relation to the findings will be undertaken at the time of this performance assessments 12 month review. The Conservation Commission also advised DEC to consider the main CPSM recommendations along with suggestions embodied in the text, when reviewing policy and manuals.

The report findings are formulated using a 'top down' approach following the Phytophthora dieback planning hierarchy as listed below.

Legislation
<i>Conservation and Land Management Act 1984 (WA)</i>
Regulations
<i>Conservation and Land Management Regulations 2002 (WA)</i>
<i>Forest Management Regulations 1993 (WA)</i>
<i>Environment Protection (Clearing of Native Vegetation) Regulations 2004 (WA)</i>
Policies
Policy Statement No. 3: Threat Abatement for <i>Phytophthora cinnamomi</i> and Disease Caused By It in Native Vegetation (CALM 2004a) – draft/interim policy- see Finding 2.
Guidelines
Best Practice Guidelines for the Management of <i>Phytophthora cinnamomi</i> (CALM 2004b)
<i>Phytophthora cinnamomi</i> and Disease Caused by It. Volumes 1-4 (CALM 2003) – some sections still in draft form – see Finding 5.
Management Plans
<i>Forest Management Plan 2004-2011 (Conservation Commission 2004)</i>
National Park and Conservation Reserve plans
Recovery plans for threatened flora and threatened ecological communities

Legislation and regulations

Legislative powers

DEC's management efforts are guided by the *Conservation and Land Management Act 1984 (WA)* (CALM Act) and the *Wildlife Conservation Act 1950 (WA)* (WC Act). The CALM Act creates a system for managing the conservation estate in Western Australia, while the WC Act protects flora and fauna in the State. Together they form the primary

legal basis for conserving biodiversity values in Western Australia.

Disease Risk Areas

Disease Risk Areas (DRAs) are one of several legislative mechanisms available to DEC to manage *Phytophthora* dieback. Powers to establish and manage DRAs are derived from the CALM Act and *Forest Management Regulations 1993* (WA). Part VII of the CALM Act provides DEC with powers to control and eradicate forest diseases on public land through the establishment of 'forest disease risk areas' and 'disease areas'. DRAs are areas that may be, or may become, infected with a forest disease, whereas disease areas are those already infected (Section 83, CALM Act).

DRAs only apply to State forests. All vehicles entering DRAs are required to obtain a permit from DEC. The permits typically stipulate the hygiene management practices required of a person entering a DRA. DEC may also place restrictions on mining tenements in DRAs or disease areas.

Activity permits

Through the issuing of permits, DEC has the power to regulate activities such as beekeeping, fire wood collecting, wildflower picking, land clearing, and timber harvesting within the conservation estate. Permits are issued in accordance with the CALM Act. The permits, in some instances, have conditions attached that require permit holders to follow specific hygiene management practices.

Clearing native vegetation is prohibited, unless the person intending to clear has a permit from DEC or the clearing is for an exempt purpose. Under the *Environment Protection (Clearing of Native Vegetation) Regulations 2004* (WA) [and the Environmental Protection Act 1986], DEC can grant clearing permits. As a condition of the clearing permits, an individual may be required to follow specific hygiene management requirements.

The National Threat Abatement Plan

The pathogen is recognized as a key threatening process to biodiversity and other economic and social values in Australia by the Australian Government under the *Commonwealth Environmental Protection and Biodiversity Conservation Act 2000*. A national *Threat Abatement Plan* was prepared in 2001, revised in 2006 but then 'disallowed' by the Federal Parliamentary Senate in 2009. It would be hoped that there is some coordinated input from Western Australia into the current process of review.

Council and coordinating groups

Over the last decade there have been two bodies established to coordinate dieback management in the State; the Dieback Consultative Council (DCC) and the Dieback Response Group (DRG). The DCC was formed in 1997 in response to recommendations from the Western Australian Dieback Review Panel (Podger et al, 1996). Membership has included representatives with expertise in *Phytophthora* dieback management and research as well as representatives from key industry and other interest groups concerned with *Phytophthora* dieback. The primary function of the Council is to provide advice to the Minister for Environment regarding the development of policy, research priorities and funding, and raising public awareness about *Phytophthora* dieback. DEC provides executive support to the DCC. The DCC in the past did work with the DRG (below) and had a number of members in common.

The Dieback Response Group (DRG) was established in 2004 by the State Environment Minister to:

- Seek resources for implementing management actions and periodically reviewing management actions.
- Maintain open communication lines with key organizations involved in the management of *Phytophthora dieback*.
- Report on progress to the Minister for the Environment.

Over the last year these committees have ceased to meet. The DCC met in August 2007, again in August 2008 and once in 2009 at the instigation of Project Dieback South Coast NRM Inc.

Over the last year an informal group has been established which meets at DEC to discuss grant applications and to ensure that their efforts are complimentary. This group is called the "Dieback Coordinating Group". Individuals active in dieback management have found the need to meet to ensure a degree of informal cooperation occurs amongst stakeholders representing DEC, Natural Resource Management groups, Murdoch University and the Dieback Working Group¹.

Finding 1

The Dieback Consultative Council and the Dieback Response Group created to advise the Minister for Environment on dieback management have become inactive. Neither the Council nor the Response group has met over the last year.

Policy

Dieback framework (March 2004)

The then Minister for the Environment Judy Edwards launched a framework of commitments for dieback management in the State. The elements of the framework were:

1. A new dieback response group to include representatives from the Dieback Consultative Council, the Dieback Working Group, the Conservation Commission of Western Australia, the Murdoch University Centre for *Phytophthora* Science and Management, the Department of the Environment and CALM was proposed.
2. Development of a dieback atlas for WA.
3. Preparation of guidelines for other land tenures such as private and Local Government land; preparation of a generic dieback risk assessment methodology for broad community use.
4. An action plan specifically to tackle the dieback threat to Fitzgerald River National Park, one of our most significant conservation reserves.
5. A whole of Government policy on dieback management.

Progress was made in relation to points 1 and 2 although the response group no longer meets.

¹ The Dieback Working Group (DWG) was formed in 1996 by local government authorities, community groups and State government land management agencies concerned with the management of *Phytophthora dieback*

The Commission has noted that a generic dieback risk assessment methodology for broad community and/or departmental use has not been developed.

An action plan was written for the Fitzgerald River National Parks but concentrated on investment to tackle the large infestation at Bell Track, and not for the whole of the national park.

A whole of government policy for dieback management is yet to be developed and a process for this to occur has yet to be decided upon.

Whole of government policy framework

A reason that the State does not have an overarching dieback management strategy or a whole of government policy framework is that no statutory body has had the resources and been formally given the responsibility for whole of government or cross land-tenure dieback policy development. In 2001 the Environmental Protection Authority (EPA) in Bulletin 1010 made a number of comments and recommendations and noted that the *Policy Statement No 3* (CALM 2004a) should be extended to apply to lands of all tenure and all landowners.

It should be noted also that in the current Forest Management Plan action 18.1 states that the “Conservation Commission will develop a whole of Government policy framework for the management of dieback”. The Commission is of the opinion that this is a major task and beyond its resources and allocated responsibility and recommends that the EPA consider taking on this much needed task. This task needs to be resourced or the management of the greatest threat to biodiversity across the high and medium rainfall zones of the South West will continue to be inadequate over most land tenures.

Two versions of Policy No 3 1998 and 2004 (Appendix C)

The policy situation relating to *Phytophthora* dieback is unsatisfactory. The policy statement dated 1998 *Management of Phytophthora and disease caused by it* is still attached to the Dieback Manual which guides managers whereas a policy drafted after public consultation in 2003 and approved as interim policy by the Conservation Commission in 2004 remains unproclaimed. It can be found on NatureBase but is referred to as “draft”. It is titled *Threat abatement for Phytophthora cinnamomi and disease caused by it in native vegetation*.

The draft policy had been released for 7 months for public comment by the then Minister for the Environment in March 2004, with three comments received.

The differences in the policy documents 1998 and 2004 are significant. In the drafting of the 2004 version the department did embrace risk management, the precautionary principle and sustainability as platforms guiding decisions making. Such approaches are fundamental for managers aiming to embrace best practice environmental management in the twenty first century.

With this lack of clarity on policy versions it is not surprising that the CPSM (2009) found that managers in the department were not sure which version of policy they should be adhering to. In addition it is noted that the provisions of the 2004-2013 Forest Management Plan (FMP) required Policy No 3 to be reviewed with public participation before December 31 2008 (Action 18.2). It is also evident that DEC have not updated

and reviewed management guidelines to support the implementation of the 2004 version of the policy statement.

The unsatisfactory dieback policy position seems unnecessary as there is little controversy or disagreement amongst experts as to the principles most relevant to dieback management.

Finding 2

The *Policy Statement No 3 Threat abatement for Phytophthora cinnamomi and disease caused by it in native vegetation* (draft) was endorsed by the Commission in 2004 as an interim policy with the understanding that it would be further developed for final endorsement within 12 months. The Commission is aware of no action by DEC to review and finalise the policy over the last 6 years.

Defining priorities for management ‘the protocol’

Part of the process of developing policy and procedures post 1998 was the drafting of a *Protocol for the identification and prioritization for management of Phytophthora cinnamomi ‘protectable areas’* - a system for ensuring that management effort was directed to areas which represented the best opportunities for the maintenance of vulnerable flora in disease free areas over the medium to long term. This protocol has resulted in the classification of some areas as ‘protectable’ in hygiene plans prepared prior to logging in native forest. A primary management requirement of ‘protectable areas’ is that all vehicles and machinery should be clean on entry to them. Such a system has not however been clearly demonstrated as applying across the conservation estate.

The protocol along with the Policy Statement No 3 (1998) was presented to the Dieback Consultative Council in 1998. This protocol along with the policy statement was referred to the EPA and subject to public review and analysis.

As a result of the EPA advice [Bulletin 1010, 2001] to the Minister an Expert Working Group was established by the Conservation Commission to advise on a process of determining if the new policy and application of the associated protocol was sound. The EPA recommended a trial be conducted comparing the new and former systems and stated that it should be rigorously demonstrated that the new system was resulting in ‘an improvement in the management of *Phytophthora cinnamomi* in State Forest areas’. The *Report of Expert Working Group to Design a trial of the Protocol for the identification and prioritisation for management of Phytophthora cinnamomi ‘protectable’ areas* was prepared (Appendix B).

The then Department of Conservation and Land Management (CALM) advised that it agreed in principle with the recommendations of the Expert Working Group, except for recommendation 7 which was about funding. The Conservation Commission determined that implementation of the Expert Working Group key recommendations would result in two overriding Conservation Commission objectives being met. Firstly, that any significant and large disease free areas of native vegetation vulnerable to disease caused by *Phytophthora cinnamomi* be given management priority to ensure that the risk of infection as a result of human vectoring of the pathogen into them was minimised. Secondly, that effective management processes would be in place resulting in ongoing refinement and improvement of the protocol for identification of disease free areas of native vegetation which can be managed in the medium to long term and be given a

priority with regard to minimising the risks of becoming infested through the actions of people.

For logging and the management of State forest and nature reserves the Commission still awaits results of monitoring the effectiveness of the protocol adopted in 1998.

Finding 3

DEC is yet to report on the application and evaluation of a protocol for the identification and prioritization for management of dieback 'protectable' areas. The current definition of 'protectable' is not suitable for defining priority areas for dieback protection in many of the dieback management situations occurring across the State.

Management implementation

The need for an overarching departmental dieback strategy

The lack of reporting/evaluation on protectable areas as outlined in Finding 3 has implications for the DRA system. The current DRA system has merit but the areas designated pre-date the formation of both CALM and DEC. Many of the DRA areas for which district managers have additional authority to restrict entry are extensively infested. Areas containing high biodiversity assets and which are disease free that should be protected are not included in the system.

As discussed in the report from the Auditor General Department *Rich and Rare*, DEC should address the task of getting 'the right balance between programs that benefit large numbers of species at once with those that target individual species'. The need to address this issue is an important one for an overarching departmental strategy. The balance between putting resources into protection of uninfested areas versus recovery programs for areas badly degraded needs to be addressed.

These aspects point to a lack of strategy in relation to dieback management, for instance a current review and rationalization of the roading system across Conservation Commission lands should be influenced by regional priorities for dieback management and the protection of areas considered 'protectable'. The Donnelly District is conducting a pilot project to rationalize road systems on Conservation Commission lands. This is the kind of program would benefit from an overarching dieback management strategy being in place. The dieback situation in some areas should influence the selection of roads to be maintained as all weather roads. And the dieback risk has influenced roading strategies in the past. Such considerations should be guided by an overarching strategy.

Finding 4

DEC does not have a dieback management strategy which clearly states strategic goals of management for the department.

Best practice guidelines (DEC's Dieback Manual)

DEC guidelines (extract from Attachment 1)

The *Best Practice Guidelines for the Management of Phytophthora cinnamomi* (CALM 2004b) support the implementation of *Policy Statement No. 3*. The guidelines are intended to provide DEC staff with a concise, clear and explicit statement of the best

practice methods and standards for managing the threat to biodiversity posed by the introduced plant pathogen [Phytophthora cinnamomi] and disease caused by it. These guidelines have also been written to form the basis of guidelines for adaptation and use by other land managers, proponents of activities and others (CALM 2004b p.1).

The manual *Phytophthora cinnamomi and the Disease Caused by It. Volumes 1-4* (CALM 2003) provides DEC staff with a single source document that includes the following information:

- Volume I: Management Guidelines (e.g. best management practices);
- Volume II: Disease detection, diagnosis (interpretation), demarcation and mapping guidelines;
- Volume III: Phosphite operational guidelines (draft form only); and
- Volume IV: training curriculum and syllabi.

The Dieback Manual is dated and in urgent need of review. The current manual dated 2003 does not give guidance to managers on how to implement the draft policy of 2004. Volume III *for the use of the fungicide Phosphite in departmental operations* is marked draft only and dated 1999. Considerable research and development of prescriptions have been done over the last decade and this is a specific example of information not being updated in a timely way.

In the Dieback Manual section 8.3 guidelines for infested areas section, are the words 'To be developed'. The current manual does cover impacts in the forest ecosystems and management guidelines for logging in detail, however, there are gaps relating to management in other ecosystems.

There is limited guidance on application of risk assessments to be used at different levels of planning and the writing of local area dieback management plans for the conservation estate to ensure a consistent approach is used across the department.

The Conservation Commission is aware that there have been attempts to develop a guide for managers on applying dieback threat and risk assessments but to date nothing has been finalized and incorporated into the guidelines. Dieback risk assessments will always be technical due to the complex systems being managed, however a system that gives both guidance to managers and involves a checklist would improve processes. For instance there is no evidence of a standardized approach to hygiene planning with respect to various operations and activities which involve soil movement on Conservation Commission lands outside the Forest Management Plan (2004-2013) area.

Manuals and guidelines should be developed to guide activities across the conservation estate.

Finding 5

The current *Dieback Manual* and protocols are dated with some sections remaining as drafts. There has been no apparent updating of the manual since 2004.

Finding 6

There is no evidence of a standardized approach to hygiene planning with respect to various operations and activities which involve soil movement on Conservation Commission vested lands outside the Forest Management Plan (2004-2013) area.

Key management aspects

Phytophthora dieback management plans and hygiene planning

Instructions in the Dieback Manual volume 1 are quite explicit as to the process and purpose of Phytophthora Dieback Management Plans. The responsibilities of disease hygiene coordinators and district managers are defined and administrative procedures to be followed are outlined. The Dieback Manual states the following *the Department's management objective is to progressively prepare and implement Phytophthora cinnamomi Management Plans for all uninfested 'protectable' areas.*

The Conservation Commission, in the course of undertaking previous performance assessments, has determined that dieback management plans have not been prepared in advance of operations in a number of areas of the conservation estate. For example a new road was made into the Mt Lesueur National Park without a *Phytophthora cinnamomi* management and hygiene plan.

In West Cape Howe National Park the Shelley Beach lookout area redevelopment (2000-2001) was the largest capital project undertaken in the management plan area over the life of the plan and no records of a dieback mapping or a hygiene management plan were available for the project. Management plan requirements in relation to dieback mapping occurrence have also not been undertaken in certain instances.

The reasons why hygiene plans are not being written and implemented needs some analysis but it would seem that many proposals, particularly for tourism and recreation infrastructure, are planned without adequate budget for disease hygiene planning which is dependent of field interpretation and mapping.

Finding 7

It is not possible to determine whether objectives of conservation reserve management plans in relation to plant disease have been achieved as little dieback monitoring has been formally completed and evaluated.

Finding 8

It has not been routine for districts to formally register 'protectable' uninfested areas of vegetation and to develop, with ongoing commitment to implementation of hygiene management plans.

Finding 9

A number of significant infrastructure projects have commenced prior to hygiene plans being in place.

Training

Many people, internal and external to the department, seek dieback management training but courses are not readily available. DEC's Forest Management Branch (FMB) currently trains its own officers but the branch does not have the funds or human resources to conduct a wider program.

Most aspects of dieback management require experience and skills, hence training is essential. There are a number of aspects of training which include field disease status interpretation, systems for managing risk associated with any operations involving soil movement and general dieback awareness and knowledge of management options. DEC utilizes dieback interpreters from FMB and the private sector to interpret the disease status of forest areas prior to logging or areas subject to other planned operations involving soil disturbance. DEC and FMB will only use interpreters who are certified to be proficient due to training and experience. Accreditation is based on periodic assessment of interpretation standards by field staff.

There is also a demand for dieback interpretation from other land managers such as other government departments, local government authorities, mining companies and individual land owners. There are a number of private businesses providing this service, most with interpreters who have had a history of employment with DEC.

There is no system outside DEC's internal system for the certification of people in the private sector offering professional dieback management skills. The only place which offers dieback interpretation training which can result in departmental certification for disease interpreters is DEC.

DEC in recent years has not developed the capacity for internal training or training external people wishing to develop skills. Internal dieback management training courses are being conducted infrequently as there is no longer a full time dieback coordinator or person with adequate time to allocate to training. Expertise outside the districts managing State forest and timber reserves is not high and will only be corrected by more internal training.

A recent initiative of Albany DEC district in managing a major project in the Fitzgerald River National Park is introduction of the 'green card' program and an environmental code of conduct. Contractors are given approximately a half day training in environmental threats and appropriate responses. This could be reviewed and developed for use across the department as a standardized approach to briefing and training all people working on the conservation estate.

Policy Statement No 3 states 'in order to successfully manage to minimize the impacts of *P. cinnamomi* on conservation lands, all people accessing these lands need to have an awareness of the threat it poses to biodiversity and how it can be spread'. This will only happen with a developed internal and external training program. The policy 'encourages DEC staff to prepare and deliver education, training and information programs'. There is no evidence of DEC addressing the training and education programs essential if progress is to be made in sharing the responsibility of ensuring uninfested areas remain disease free.

Finding 10

There is an inadequate commitment to dieback training and education in DEC.

Detection, diagnosis and mapping

The first step in any dieback management planning is determining the disease status of the area and mapping findings. There is the potential for a system to be developed indicating the degree of confidence of mapping. Low confidence mapping can inform strategic planning whereas high confidence of accuracy is required when operations are planned which involve soil movement.

The isolation of pathogens from soil samples is done by the Vegetation Health Service within DEC and the officers of this unit have considerable expertise and provide an important service. They isolate and identify a range of *Phytophthora* species which are impacting around the State. Some such as *Phytophthora multivora* (formerly *P. citrocola*) are thought to be endemic. Although a range of *Phytophthora* species have been implicated in plant deaths around the State the Conservation Commission is of the opinion that DEC should persist with a policy statement written primarily to guide the management of *P. cinnamomi* rather than a policy statement applied to many species, until the ecology of these species is better understood.

A DEC internal audit of 'Dieback Identification and Interpretation' standards was conducted in 2007 (Report No 2007_14). The objective of the audit was to evaluate the effectiveness of the system in place for dieback identification and interpretation and to evaluate compliance with procedures and guidelines. The accuracy of interpretation completed at 15 sites was assessed, with 13 assessments to inform hygiene planning in native forest. One third of the areas assessed in this audit contained major errors of interpretation.

Recommendations from the audit included:

- Implement a program of regular monitoring and supervising interpreter's work in the field. The program should be linked to interpreter training requirements and include performance indicators.
- The Disease Standards Officer's position operates on a full time basis with the primary emphasis on monitoring the standard of interpreters work in the field.
- Determine and set a frequency for checking the standard of each interpretation teams work in the field and include this in the manual Volume II Interpreter Guidelines. The checking should also include any private interpreters working on departmental lands.
- Introduce a consistent and methodical sampling program to verify interpretation decisions made in the field.

The Conservation Commission fully endorses the recommendations from the DEC internal audit report.

Risk reduction, pathogen spread associated with management activities

Considerable background information and details of operations are provided in Chapter 10 of Attachment 1. Fire management is covered in some detail below in part because of the events described for the Fitzgerald River National Park (FRNP) fire of 2008 for which there is circumstantial evidence that a new infestation resulted from breakdowns in hygiene processes. With regard to commercial forestry, road works and maintenance and the identification and use of dieback free gravel, these management activities

require appropriate guidelines in a departmental Dieback Manual and be covered in both departmental strategies and guidelines.

Finding 11

There does not appear to be an appropriate standardized guideline for utilizing dieback free gravel for DEC management activities.

Fire Management

Attachment 1 (CPSM report) page 100 states that 'fire management efforts can contribute to the spread of Phytophthora dieback during prescribed burns, wildfires and firebreak maintenance'.

The finding from Attachment 1 in relation to this is that 'current strategies for minimizing dieback spread and new infestations in the event of wildfires are inadequately developed'.

The description of the wild fire event at the FRNP was particularly disturbing considering the biodiversity assets at risk in that Park. It also raises the important issue of integrated risk management across a range of DEC activities. Page 31 of Attachment 1 states:

Currently, it takes time to compile all of the necessary information (e.g. rare flora maps, Phytophthora dieback maps) when a wildfire occurs, this would be easily overcome if all information was in the one place. Hence, it was not determined until day two of the fire that a DEC environmental officer was needed. However, due to the workload of the environmental officer, by day four a team was established. Prior to that there was no replacement when the environmental officer took breaks. One of the primary functions in relation to Phytophthora dieback management was inspecting heavy machinery before entering the Park to ensure it was clean on entry. Many contractors did not understand the meaning of 'clean on entry'. The underside of the vehicle must be appropriately cleaned. Large machinery can take up to 5 hours to clean and in some instances can require dismantling the vehicle to properly clean it.

The heavy machinery contractors know that it is a requirement to be clean when they arrive on-site. They do not get paid for time spent cleaning their vehicles and some were not happy about being told to clean their vehicle better before it could enter the Park. When problems arose, the team occasionally had to seek support from more senior officers. DEC staff noted that it would have been ideal to have a wash down facility on-site with a ramp so that the undercarriage of vehicles could be inspected and cleaned. A mobile ramp would be useful for all fires.

Those who commented on the fire environmental team viewed it positively and believe it should be a model for other parks. Management of the fire was not without its problems as it was difficult to manage the various players (e.g. DEC staff from a variety of districts, contractors, local volunteers). As yet, there has been no evidence of disease spread, however, it can take a number of years before disease symptoms are expressed; therefore, close monitoring of the sites is required over the next few years.

*In the past Jacup Dam was used to provide water for fire fighting in the Park. Because the surrounding soils are infested with *P. cinnamomi*, water from the dam will unlikely be*

used for fire fighting purposes as DEC staff are unsure about the P. cinnamomi status of the water”.

Attachment 1 page xxx detailed that:

“Stakeholders indicated that when managing wildfires in the conservation estate the focus is first on protecting life; second is property and third is the environment. The use of an environmental team to protect conservation values in the 2008 fire in Fitzgerald River National Park was cited frequently. It was viewed as a positive model for wildfire management that should be adopted in other Parks. It was noted that while a single environmental officer might be sufficient for a small fire, larger fires warrant having an environmental team.

Lessons arising from the Fitzgerald River National Park experience included:

That it is not easy to have hygiene procedures as a key focus in the first shift of operations to control a wildfire; However, this could be improved if fire crews were given general hygiene prescriptions to follow prior to attending a fire in a region.

Not all heavy equipment operators will be happy with the hygiene requirements even though they are included in their contracts. Environmental teams members need the support of senior staff if conflicts over hygiene requirements (i.e. how clean is clean enough) occur.

Fire units could be provided with maps including GPS coordinates that would allow them to determine whether they were entering areas likely to be infested with Phytophthora dieback”.

Finding 12

The Conservation Commission is particularly concerned that systems to insure that dieback is not spread during the course of departmental fire management are inadequate.

Communication and engagement of the public and neighboring land managers

DEC’s website content in relation to dieback is out of date in certain areas with few recent updates. There is a lack of readily available information on the current distribution and potential distribution of the disease. This extends to a lack of a public information system particularly relating to the conservation estate (and associated infrastructure within the conservation estate) aimed at minimizing the risk of spreading the disease. It is not clear that key messages are being effectively conveyed to the public. For instance departmental strategies such as the Good Neighbour policy do not mention dieback as a threat.

Finding 13

The Conservation Commission is concerned that key messages in relation to dieback are not being communicated adequately through the DEC website and key strategies such as the Good Neighbour policy.

Finding 14

There is a lack of readily available information on the current distribution and potential distribution of the disease.

Finding 15

There is no public information system relating to the conservation estate (and associated infrastructure within the conservation estate) aimed at minimizing the risk of spreading the disease.

Information and knowledge management

The management of information is critical for the protection of areas from the disease, the protection of habitat for threatened species and the planning of operations to ensure human vectoring is minimized. Relevant information for *Phytophthora* dieback management should be readily available at differing stages of planning and environmental assessment.

Page xx from Attachment 1 states in relation to this: *data collected (i.e. on the occurrence of the disease) are currently stored in one of several ways, depending on who collects the data. For example, Sustainable Forest Management Division interpreters typically store their data in an electronic database maintained by the division. In other instances, data is stored electronically or in hard copy within a DEC regional or district office. In addition DEC is currently updating its intranet site to provide its staff with increased access to dieback occurrence maps and Phytophthora dieback hygiene management plans. Over time historical occurrence maps will be added to the data set. It will take time to convert existing maps into the appropriate digital format for inclusion in the system.*

The Dieback Working Group is also developing a framework for management and recording information on local government land. South Coast NRM also has NRM funding for the development of a cross land-tenure Information Management System.

DEC Vegetation Health Service does collate information on field isolations of *Phytophthora* species and some other pathogens and this is an extremely important State resource. The Vegetation Health Services records are to be made available to land managers through NatureMap which is a positive development which should be made a priority.

Officers of the Forest Management Division have indicated that their Forest Management Information System is only capturing operational dieback mapping for State Forest. A data collection system for the Conservation Commission estate has not been developed.

An information management system which can be rapidly interrogated could show location of uninfested areas and priorities for protection. Such information is needed in case of enquiry from other agencies or land managers and also in the case of wildfire or other unplanned emergencies.

Much historical information on the spread of the disease is in hand written district files. DEC's FMB, the custodians of all mapping in relation to logging, is not obligated to capture information collected by other stakeholders or DEC divisions, although in the Dieback Manual it is specified that district managers should forward any disease interpretation and *Phytophthora* Dieback Management Plans to the Forest Management Branch. In recent years few hygiene plans have been forwarded from the districts because either they have not been done or it is not a routine procedure.

DEC has developed a risk analysis system which indicates strategic areas that are at high threat and risk. Information could also be collated and made available on areas of the estate which have a high incidence of uninfested vegetation, which is at risk, but with hygiene can be protected.

Finding 16

DEC does not have an overall system for collating, and being made readily available, areas that have been deemed 'protectable' (or priorities for management as a result of operational mapping).

Monitoring and review

Management plans strategies, actions and Key Performance Indicators (KPI)

Many management plans are out of date and not prescriptive or specific with regard to dieback.

Attachment 1 summarizes and provides comment on the dieback management actions for the Stirling Range, Fitzgerald River, Lesuer and Wellington National Parks.

In relation to dieback management one of the goals which is commonly stipulated in management plans is to 'protect from infestation those areas currently free from *P. cinnamomi*'. The implementation of recovery plans and the maintenance of disease free areas of threatened ecological communities and species is given similar importance.

Effort is required to ensure reporting relevant to assessing management performance in relation to these planning goals. Firstly areas deemed uninfested and subject to investment in management must be recorded and their disease status monitored. Apart from several areas such as within the Fitzgerald River National Park and the special conservation zone of the Stirling Range National Park, the Commission is aware of no collated information which fulfils these goals. For these two areas the disease situation has deteriorated.

With regard to the Forest Management Plan, KPI 18, FMB is preparing a report on the disease status of protectable areas subjected to hygiene management plans. The reporting for this KPI was due at the end of 2008 five years after the commencement of the plan. The Conservation Commission has been given some verbal assurance that native forest logging prescriptions in the main have limited spread but it has not been routine for district managers to supply hygiene plans for operations elsewhere on lands vested in the Conservation Commission.

It is critical that the disease status of the conservation estate be reported on and that DEC have an efficient system whereby staff are encouraged to verify and record new infestations or extensions of infestations which threaten rare taxa, other assets or uninfested vegetation.

Adaptive management

By definition an adaptive management approach must include planning and guidance, activity, monitoring and review. It is important that new information is incorporated into risk analyses and prescriptions in a timely way. Monitoring should result in progressive improvement in environmental outcomes.

There have been some important research findings over the last decade and they should be applied to management. For example, findings on distribution of pathogen propagules with season in soil profiles of the south coast have important implications. The restriction of machine operations to dry soil conditions may not adequately reduce the risk of vehicles transporting the pathogen.

There has also been recent research on the impact of prescribed fire on disease expression in the Stirling Range. Issues raised by this work should be further investigated and the case for careful consideration of time intervals between burns be considered by those developing area burn plans.

There is a lack of available audits or assessments of the disease status of areas post operations. In real terms adaptive management has not been practiced. There has been no system for monitoring and recording disease spread in relation to different activities across the conservation estate.

Finding 17

It is not possible to directly assess any progress improvement or otherwise in relation to dieback environmental outcomes as there is no system for monitoring and recording disease spread across the Conservation estate.

Dieback management, coordination, capacity and funding

Dieback is a major threat to biodiversity that affects all the operations of most DEC divisions, in particular Nature Conservation, Parks and Visitor Services, Sustainable Forest Management, Regional Services and Science.

There is evidence of the loss over recent years of direction and coordination of dieback management in the department. An example of where integration could be improved is with regard to existing Regional Plans for Biodiversity Conservation, produced by the Nature Conservation Division, those involved with dieback coordination and training are not necessarily consulted or made aware of the contents.

The position of DEC's Dieback Coordinator is shared by an officer from the Division of Science and the Forest Management Branch. Repeated recommendations from previous reviews of dieback management in the State have highlighted the need for a departmental Dieback Coordinator (Podger *et al.* 1996). The Conservation Commission endorses these previous recommendations given the magnitude of risk to the biodiversity of the south west and considers this should be a priority.

The budget required by DEC to build capacity for efficient management of *Phytophthora* dieback is considerable. The number of staff working on the various aspects of dieback management has been eroded over the last decade. There is a backlog of work to be tackled in the area of policy, strategy, guideline development, and public liaison. These tasks are far beyond the capacity of a single departmental Dieback Coordinator. Dieback

management needs to become embedded in the 'culture' of organizations given the impact of this threatening process.

Some funding has become available for programs such as the Biodiversity Conservation Initiative which funded specific projects such as the Bell Track Project aimed at isolating a known and threatening infestation within the Fitzgerald River National Park. Some federal funding from the Natural Heritage Trust and Caring for our Country has gone towards dieback control, such as phosphite spraying in the Stirling Range, but in recent years dieback has not been a matter for targeted funding from the Commonwealth.

Finding 18

Staff responsibilities for dieback management are spread over a number of divisions. DEC has not had a full time dieback coordinator since 2006.

Whole of Government and Dieback Management across all land tenures

Attachment 1 page 13 report summarizes the roles of other groups and organizations involved in dieback management in the State. They include the Dieback Working Group which liaises closely with local government and the Natural Resource Management (NRM) groups which have been active in their regions on funds provided by both State and Federal governments. There are many stakeholders receptive to guidance and technical information which when provided would ensure that DEC could share the responsibility for the maintenance of biodiversity values with support of community.

Regional NRM groups have developed regional dieback management plans to guide investment based on a strategic approach. The plans are comprehensive and have been developed with consultation with key stakeholders including DEC staff in each region. They adopt frameworks consistent with risk management systems.

The Dieback Working Group also has State funding for a framework for managing information associated with the dieback management efforts of local governments. A system for recording and tracking mapping and management effort and investments which is applicable for all land tenures is being developed.

NRM effort has been made to develop a standardized dieback signage system with input from the Dieback Consultative Council and the Dieback Response Group, but since its development and promotion DEC has only adopted some elements of the system in some areas. A standardized dieback signage system is required.

Overall performance in relation to implementation of Dieback Policy Statement No 3 2004 (Interim)

Considering the detail on legislation, policy and management presented in the preceding sections the Conservation Commission has arrived at conclusions relating to DEC's implementation of the policy elements of the interim 2004 version Dieback Policy Statement No 3.

Key objectives of the policy are for the threat to the conservation of Western Australian biodiversity posed by *P. cinnamomi*, including the threat to uninfested areas of high conservation value and to the residual conservation values of infested areas to be addressed during all management activities across the estate under its management.

DEC *Policy Statement No. 3* applies to the preparation and implementation of management plans, interim management guidelines, interim recovery plans and recovery plans for threatened flora and threatened ecological communities, as well as plans for operations on lands managed by the DEC.

Each of the key policy commitments are underlined below with the Commission's conclusions as to the degree they are effectively guiding the dieback management of lands vested in the Conservation Commission.

- Assess and evaluate the risk of introduction of *P. cinnamomi* into uninfested 'protectable' areas.
Despite the lack of guidelines outlining dieback risk assessment approaches to be adopted relevant to different situations, the Commission is satisfied that in areas of State forest that systems are in place particularly with respect to forestry operations. And that these systems are effective when properly resourced and implemented. It should be acknowledged that DEC faces an almost overwhelming task of controlling the spread of dieback by overcoming illegal use of these areas by trail bikes and other vehicles. With regard to lands primarily managed for conservation the Commission is concerned that many operations involving soil disturbance proceed without adequate assessment of the risks. There is potential for this situation to be exacerbated by a poor understanding of the risks and impacts of dieback by DEC staff and the general public.
- Identify, evaluate and, where practical and reasonable, apply effective and efficient risk treatment measures to limit serious and irreversible environmental damage in uninfested areas.
The Commission is of the opinion that there is potential for the development of cost effective systems for identifying uninfested areas and implementing measures to afford them greater protection than currently occurring. Systems developed for commercial logging and mining should be adapted to give greatest return on investment dollars per hectare under management.
- Evaluate the degree of precaution to be used when applying preventative measures;
Best practice guidelines on application of the precautionary principle should be readily available to managers. Many elements of the 2004 Dieback Manual are open to varying interpretation as to what 'degree of precaution' is to be expected.
- Identify, evaluate and apply, where appropriate, measures for the restoration of infested areas with serious environmental damage, including recovery or re-introduction of populations of threatened flora and where necessary *ex situ* conservation of genetic resources;
The Commission is not aware of examples of different approaches to restoration of degraded areas and no guidelines have been developed. Recovery planning and the use of phosphite is occurring in some specific areas such as the montane heath of the Stirling Ranges. Budget allocations for the application of phosphite are limited and dependent on yearly allocations including Commonwealth funds.

- Evaluate the need for, and levels of, scientifically based monitoring and audit of the implementation of, and compliance with, preventative measures for the conservation of Western Australian biodiversity.
The Commission is not aware of any evaluations of preventative measures or management systems with regard to dieback and whether they are affecting rate of human vectoring or spread. The lack of monitoring of the disease situation is of utmost concern as without such information it is difficult for the department to leverage funding and resources to protect areas in the medium to long term.
- Develop and progressively implement agreed priority research programs that may reasonably be expected to impact on the effectiveness and efficiency of the abatement of the threat posed by *P. cinnamomi* to the conservation of Western Australian biodiversity;
The Commission has not assessed the research efforts of the department or associated institutions. It is aware of a number of important projects with regard to control and epidemiology particularly on the south coast. A summary of current research projects is provided on Nature Base.
- Design and implement appropriate programs for public consultation and education and for the provision of information.
Departmental officers have assisted with dieback projects funded by Natural Resource Management groups and the Dieback Working Group. However a dedicated program would assist in this area.

Appendix A

Dieback Management Issue Based Performance Assessment conducted by the CPSM for the Conservation Commission 2009

The Centre for Phytophthora Science and Management (CPSM) and Beckwith Environmental Planning Pty Ltd undertook a contract to report on dieback management within DEC. An issue based performance assessment was requested.

Topics requested for consideration included:

- Best management practices
- Resource availability
- Consistency of approach
- Hygiene management performance
- Operational awareness
- Disease Risk Area (DRA) strategy and status
- 'Protecting the protectable' – definition and performance
- Performance of other parties on DEC managed lands
- Accreditation of interpretation and relationship between DEC and private agencies
- Training
- Communication/Public awareness
- Knowledge
- Further areas of 'last stand'
- Known current issues and risk analysis
- Current knowledge at a scientific level

The report states that specific objective of the study was to analyse current legislation relating to Phytophthora dieback and dieback policies and any Phytophthora dieback management guidelines that apply to lands vested in the Conservation Commission. The analysis was to be evidence based and to include the incorporation of information relating to dieback management operations along with specific case studies.

The purpose of the report was to determine how effectively DEC has complied with legislation, regulations and policies that apply to the management of Phytophthora dieback in Western Australia. This includes the effectiveness of adaptive management procedures that have developed from common sense, experience, research, monitoring and the adjustment of practices based on what has been learnt. In the process the following aspects of Phytophthora dieback management (based on the '*Best Practice Guidelines for the Management of the Threat to Biodiversity Posed by Phytophthora cinnamomi and Disease Caused by it in Native Vegetation*' guidelines) were assessed:

- Use of adaptive management.
- Detection, diagnosis, demarcation and mapping of infested areas and the identification of un-infested areas.
- Assessment of the threat to the conservation of biodiversity posed by *P. cinnamomi* including areas of high conservation value that are uninfested.
- Analysis and evaluation of the risk of *P. cinnamomi* into uninfested areas.

- Identification, evaluation and application of effective and efficient risk treatment measures to limit the risk of *P. cinnamomi* being introduced into uninfested areas.
- Analysis of planning for, and the implementation of, the long-term management of uninfested areas.
- Application of repeated treatments of phosphite to protect, where possible, susceptible threatened species, threatened ecological communities and the habitat of threatened fauna.
- The planning and implementation of measures for restoration of serious environmental damage in infested area, including recovery or re-introduction of populations of threatened flora and where necessary ex-situ conservation of genetic resources.
- Identification of the need for appropriate programs for public consultation and education for the provision of information.

Part of the process of the performance assessment was gaining information from 56 individuals (26 from DEC and 30 representing other organizations) involved with or affected by the DEC's dieback management. The following questions were asked:

1. How effective are the various elements of the Phytophthora dieback management hierarchy?
2. To what extent are the Phytophthora diebacks Best Management Practices (BMPs) being applied?
3. What are the barriers to successful Phytophthora dieback management?
4. How is the success of the Phytophthora dieback management efforts determined?
5. How is the adaptive management process realised?
6. How effectively does the DEC collaborate with other Phytophthora dieback management stakeholders?

As a result issues were raised and evaluated. Evidence was also collated as a result of five case studies and through the interview process.

The CPSM report dealt with the case studies in detail including dieback management in the Fitzgerald River, the Stirling Range, Lesueur and Wellington National Parks along with a description of systems developed and implemented by Alcoa.

Background information for these case studies are detailed in the CPSM report.

The CPSM report made 21 recommendations and tabulated research priorities. In addition to the recommendations, suggestions were made throughout the text for better management of dieback across the Conservation Commission's estate.

Formulation of Conservation Commissions findings and recommendations

In addition to the CPSM assessment the Conservation Commission instigated further review of the disease management situation addressing the points and questions listed above. The Conservation Commission examined documentation relating to policy, protocols, guidelines and local area dieback management planning in formulating its key recommendations.

The Conservation Commission has given consideration to all 21 CPSM recommendations noting that they varied from being overarching to specific (relating to matters of an operational nature). DEC is advised by the Commission to consider the main CPSM recommendations along with suggestions embodied in the text of the CPSM report, when reviewing policy and manuals.

The CPSM report summarises planning hierarchy, responsibilities and elements, legislation, policy and DEC guidelines. When relevant the Commission overview refers to the CPSM document without reproducing the material provided.

On analyzing the CPSM report, the Commission has become aware of gaps in knowledge and information and concluded that few aspects of DEC's dieback management or the outcomes of management are adequately monitored or reported. For example:

- There is no or little collated information on the rate of spread of the disease in national parks and nature reserves.
- There is an absence of documented information on which to judge whether the DEC's dieback management is either efficient or successful in retarding spread or protecting uninfested areas from human vectoring.
- A report on the monitoring of the success of hygiene protocols for logging is yet to become available despite the importance of such information being emphasized by the EPA in 2001 (EPA Bulletin 1010) and the expert working group established in 2001 (Commission Advice and Recommendations to the Minister for the Environment on the Expert Working Group Report "Design a trial of the "Protocol for the identification and prioritisation for management of *Phytophthora cinnamomi* 'protectable' areas" August 2003).

The CPSM report suggests that DEC's dieback management has not been of a high enough standard to be respected by other land managers and stakeholders. Specific examples of dieback management issues requiring attention are described in the CPSM report. Of particular concern to the Conservation Commission is that new infestations have occurred in the Fitzgerald River National Park (FRNP) area over the last six years and at least two have been recorded in the wilderness zone of the park. The breakdown in hygiene management during fire event and fire-break maintenance was described as the likely cause of new infestations in the vicinity of Pabellup drive. It is reported by CPSM that new systems of environmental management during wildfire events have been developed as result. The FRNP is considered to be one of the most internationally important Mediterranean ecosystems reserves for biodiversity conservation and best practice hygiene management must be expected at all times. A finding from the CPSM report is that environmental guidelines (to ensure that dieback is not spread during all operations associated with both prescribed and wildfires) should be included in a revised dieback management manual as a matter of urgency.

The Wellington National Park case study did present description of dieback management in an area covered by a recent Management Plan (Wellington National Park, Westralia Conservation Park and Wellington Discovery Forest Management Plan, 2008). In these parks there is good recognition from both DEC staff of the threat of dieback. The plan has four specific objectives of dieback management and the detailed description of the disease management in these parks would seem more satisfactory than for parks outside the Forest Management Plan area where there has not been a history of dieback hygiene planning based on operational mapping conducted in the past. Comments

summarized in the CPSM (2009) report would suggest that managers do have clear and relevant direction as to what is possible with regard to managing the threat. Adequate funding will again determine the degree to which actions suggested in the plan (2008) are implemented.

The Commission notes that Alcoa has a management system based on what would appear to be an effective risk management approach with adaptive management being practiced based on ongoing monitoring and research. The Commission appreciates that the dieback management budget which Alcoa allocates per hectare is commensurate with the income generated by bauxite mining and such a level of investment for conservation alone would be unrealistic. However, there are lessons to be learnt from the demonstrated best practice of Alcoa.

No evidence is presented in the CPSM report that DEC has set attainable goals and monitored progress of dieback to inform management. From the report it would seem that neither Government nor community are being informed as to the degree that DEC has been successful in protecting either species or areas rich in biodiversity from dieback.

The Conservation Commission in formulating its key recommendations has addressed in particular material presented in the CPSM assessment relating to:

- Sustainability (P 15 Hope for the future: the Western Australian State Sustainability strategy (Western Australian Government 2003) recommended a comprehensive *Phytophthora* dieback strategy.
- Planning (management plans are often passed their planned date for use and managers have to fall back on dated documents for guidance. (FRNP).
- Departmental organization, leadership and coordination.
- Hygiene management performance.
- Disease Risk Areas (DRA) strategy and status.
- Wildfire management and system of environmental management.
- Policy No 3
- Monitoring and Adaptive Management (*section 9.4*)
- KPI's and monitoring. (*P91 table 9.1*)
- Setting priorities and the status and management of uninfested areas considered protectable.
- Standard of performance in relation to timber harvesting and other activities.
- Training
- Accreditation of interpretation and relationship between DEC and private agencies.
- Information management
- Land use pressures including tourism and recreation.
- Education and communications
- Departmental management capacity

The CPSM report also presents a 10 page summary of what are considered as high, medium and low research priorities but at this stage the Conservation Commission is not attempting to direct DEC as to its research priorities. This is not to say that the Conservation Commission does not acknowledge that research is fundamental to progressing sound management, control and containment of dieback.

CPSM Recommendations: Management, education and training

Management hierarchy

Recommendation 1

It is recommended that DEC districts consider the potential to be use existing legislative mechanisms for limiting access (e.g. wilderness areas).

Recommendation 2

It is recommended that DEC take advantage of its ability to manage recreational users.

Recommendation 3

A five year rolling plan should be developed to support implementation of *Policy Statement No. 3*.

Recommendation 4

It is recommended that the Conservation Commission consider imbedding dieback management in the State's land use planning processes. This could occur in a similar manner to what has been taken for acid sulfate soils (ASS), which are identified as an issue in SPP 2 and SPP 2.9. In addition, ASS guidelines (WAPC 2008) have been developed as well as a planning bulletin (WAPC 2009).

Recommendation 5

When a State Biodiversity Conservation Act does come into fruition, it should identify *Phytophthora* dieback as a key threatening process to biodiversity and provide powers to DEC to appropriately manage the threat.

Data storage and management

Recommendation 6

A *Phytophthora* dieback (and other diseases – e.g. *Armillaria*) data clearinghouse should be established and maintained by DEC, including mapped data and associated protocols (e.g. how to collect the data, limitations of the data). The clearinghouse should store data from and be accessible to the DEC and external stakeholders (e.g. proponents, consultants, NRM groups, LGAs).

Monitoring and compliance

Recommendation 7

To the extent possible, the DEC should increase monitoring of visitor access on the conservation estate.

Recommendation 8

The DEC should ensure that its own application of its *Phytophthora* dieback management procedures is well documented and periodically audited as part of an environmental management system.

Recommendation 9

It is recommended that Disease Risk Areas restrictions are enforced and extended to other areas of the conservation estate outside forests.

Recommendation 10

A review of the use of Disease Risk Areas and Forest Quarantine Policy is recommended.

Training

Recommendation 11

As part of an adaptive management approach, DEC staff should undertake periodic refresher training.

Recommendation 12

It is recommended that the DEC conduct Phytophthora dieback management training of external stakeholders applying a user pays system. Training needs to be accredited and targeted to managers, field staff, fire crews and other work gangs, and contractors.

Recommendation 13

It is recommended that the DEC continue to conduct on a regular basis dieback interpreter training in all major plant communities. This is to be accredited and to include external subscribers if required.

Recommendation 14

On ground hygiene prescriptions are required across all operations including: Fire control, road construction and maintenance, track construction and phosphite application

Education

Recommendation 15

The trial of Project Dieback's unified signage should include a formal evaluation to ensure its effectiveness.

Recommendation 16

The communication strategy should be broadened to a behavioural change strategy.

Recommendation 17

A long-term state communication strategy is required to raise community awareness about the pathogen and its impact on flora and fauna. These could include coverage (through DVDs, DRAs and dieback infected areas added to the local GPS maps, the Web, signage and bulletins) in schools, and relevant vocational and tertiary education. The communication strategy and its outputs will require regular updating to ensure messages remain current.

b) Other

Staff and Resources

Recommendation 18

A full-time Dieback Coordinator should be appointed, with the five year rolling plan a major responsibility for this person.

Phosphite

Recommendation 19

Expand 'Off-label' license from the Australian Pesticide and Veterinary Chemical Authority.

Recommendation 20

Apply for 'On label' license.

Recommendation 21

It is recommended that dedicated resources be allocated to *Phytophthora* dieback. In order to best utilise resources there is a need for:

- Greater co-ordination across all divisions, branches, regions and districts is required.
- Access to funds above the yearly allocation of funding to allow prompt response to new outbreaks and threats as they are identified.
- Regional base funding to be spent on the highest priority actions within the Regions.
- Annual reporting and auditing of resources spent on *Phytophthora* management is required.
- The interpreters to be moved out of the FMB so interpretation is not only harvesting based, but conservation based.
- A clearer commitment to on-going mapping and data collection on a regular and programmed basis (e.g. biannual in high rainfall areas).

Appendix B

Report of the Expert Working Group (EWG) August 2003

Conservation Commission advice and recommendations to the Minister for the Environment on the Expert Working Group report to design a trial of the “Protocol for the identification and prioritisation for management of *Phytophthora cinnamomi* ‘protectable’ areas”

Introduction

At the request of the Minister for the Environment, the Environmental Protection Authority (EPA) reviewed a protocol adopted by the Department of Conservation and Land Management (DCLM) in 1999 “for the identification and prioritisation for management of *Phytophthora cinnamomi* protectable areas” (EPA Bulletin 1010, 2000). The EPA recommended a trial be conducted comparing the new and former systems and stated that it should be rigorously demonstrated that the “new” system was resulting in “an improvement in the management of *Phytophthora cinnamomi* in State Forest areas”. The Conservation Commission convened an expert working group (EWG) to design a trial to compare the current and past systems of *Phytophthora cinnamomi* (dieback) management in accord with the EPA recommendation and to report on its findings. This report is attached.

Basis of the advice and recommendations

In preparing this advice the Conservation Commission sought comment on the EWG report from the Environmental Protection Authority (EPA), the Dieback Consultative Council (DCC) and the Department of Conservation and Land Management (CALM).

The EPA was supportive of the findings of the report and provided a number of specific points in relation to the individual EWG recommendations which have been considered by the Conservation Commission in formulating this advice.

The EWG report was endorsed by the DCC which also noted agreement with the contents of the comments from the EPA with one exception, that a generic reference be made to managing industries, groups and individuals who go upon the land in wet soil conditions rather than restricting requirements to the timber industry.

CALM advised its agreement in principle with the recommendations of the EWG, except for recommendation 7 “that funds required for implementing the recommendations be listed as a line item in the Departmental budget”. CALM has advised that it is not appropriate to list items of this nature in a departmental budget. CALM have advised that the EWG *Phytophthora cinnamomi* recommendations could be progressively implemented subject to budget availability. The Conservation Commission notes the CALM advice that some of the works proposed could be absorbed into the programs of existing staff and that additional funds would be needed for the remainder of the proposed new works.

The Conservation Commission has noted the EWG advice that it is not feasible to design a trial to effectively test the efficacy of the new protocol against the past systems of management. In addition, the Conservation Commission notes the Stage 3 report (June

2003) to the Conservation Commission of Western Australia by the Independent Panel Calculating Sustained Yield for the Forest Management Plan (2004-2013) that includes comments on recent work undertaken by CALM to monitor and model the autonomous rate of spread of *Phytophthora cinnamomi* in jarrah forest ecosystems as input to the calculation of sustained yield for the new forest management plan. In addition to commending the quality of the work undertaken by CALM the panel also recommended that the methodology and findings be published. The Commission acknowledges that the results of this work were unavailable at the time of the EWG deliberations and considers that this work will influence future decisions with respect to monitoring spread of the pathogen and developing the protocol.

Endorsement and implementation of the EWG key recommendations will result in two overriding Conservation Commission objectives being met. Firstly, that any significant and large disease free areas of native vegetation vulnerable to disease caused by *Phytophthora cinnamomi* be given management priority to ensure that the risk of infection as a result of human vectoring of the pathogen into them is minimised. Secondly, that effective management processes are in place that result in ongoing refinement and improvement of the protocol for identification of disease free areas of native vegetation which can be managed in the medium to long term and be given a priority with regard to minimising the risks of becoming infested through the actions of people.

Advice and recommendations

The Conservation Commission accepts the independent EWG's advice that it is not feasible to design a trial to effectively test the efficacy of the new protocol against the past systems of management and acknowledges the importance of recent work undertaken by the CALM to monitor and model the rate of spread of the pathogen. The following advice is provided in relation to the implementation of each of the EWG recommendations:

- 1. It is recommended that monitoring of the rate of spread be undertaken across a range of sites by remapping dieback occurrence over a broad range of vegetation complexes. These complexes should be in different climate zones on differing landform and soil types. Mapping for dieback presence should have occurred previously. Statistical analysis of rate of spread in relation to site and location specific variables should be used to determine the most influential variables for rate of spread. The findings should be used to review guidelines associated with the Protocol to make them more specific to site and location conditions.**

The Conservation Commission recommends that CALM implement this action building on the recent work undertaken within DCLM within timber production areas. This action should commence as soon as possible.

- 2. It is recommended that there be a critical review of the basis for the use of the time period of 2 or 3 decades as an influencing factor of the Protocol, taking into account trends in key influences including climatic, scientific and community attitudes towards conservation. This review should include a statement of the financial costs and the benefits of *Phytophthora cinnamomi* management. The results of this review should be used to review guidelines associated with the Protocol.**

The Conservation Commission recommends that CALM implement this review with consideration given to the most effective means of implementation particularly in the way it may be associated with work undertaken as part of recommendation 1.

- 3. It is recommended that the aspects of vulnerability as described in the Protocol Flow Chart be reviewed to specifically determine the appropriateness of using the example of the Spearwood Dune System as a non-vulnerable type (and to provide any additional types that are considered non-vulnerable). The use of rainfall isohyets as an aspect of vulnerability should also be reviewed to determine if this measure is best or whether the use of climatic zones would provide a more reliable measure of vulnerability.**

The Conservation Commission recommends that CALM implement this with consideration given to generating mapped information on vulnerability as part of the Protocol Flow Chart provided to land managers.

- 4. It is recommended that the flowchart as proposed in Figure 1 of the Protocol should be reviewed regularly and refined as more data become available on the values that may be affected.**

The Conservation Commission recommends that CALM implement this as soon as possible with emphasis given to any changes to operating conditions relevant to this that may flow on from the new forest management plan.

- 5. It is recommended that a program of monitoring the effectiveness of the Protocol be implemented through the assessment of outcomes at approximately five years after the implementation of activities.**

The Conservation Commission recommends that CALM implement this monitoring program in 2004 and that the program of monitoring be repeated as detailed in the EWG report at four to five yearly intervals. Key performance indicator 18 of the proposed forest management plan requires reporting after 5 years on the effectiveness of dieback hygiene. Reporting will also be a requirement of management plans being developed for other conservation areas.

- 6. It is recommended that there be annual auditing of the implementation of the Protocol and other *Phytophthora cinnamomi* management procedures and that this be undertaken by CLM with review by the Conservation Commission. Audit reports should be public.**

The Conservation Commission recommends that CALM implement annual auditing as soon as possible.

- 7. It is recommended that funding for the activities listed in this report be allocated by the Minister for Environment and Heritage and that it be included as distinct line items in relevant agency budgets and that these agencies report on progress in relation to these recommendations to the DCC.**

This recommendation is not supported. The position of the department that it is not appropriate to have activities such as this as line items in their budget is accepted. It is

recommended that as an alternative means of checking on the implementation of these recommendations that CALM reports details of activity, levels of input and outcomes to the DCC on an annual basis so that the Commission representative on the DCC can monitor and report on this back to the Commission.

- 8. It is recommended that the DCC review the means by which the recommendations of this report are further developed and implemented taking into account the desirability of improved coordination and the management system approach to developing knowledge and improving *Phytophthora cinnamomi* management described in this report.**

The Conservation Commission recommends that DCC provide the oversight of the implementation of these recommendations and report back to the Commission on an annual basis.

Phytophthora cinnamomi
Phytophthora cinnamomi
Phytophthora cinnamomi
Phytophthora cinnamomi
Phytophthora cinnamomi
Phytophthora cinnamomi

Public Consultation on the Draft replacement Department of Conservation and Land Management (CALM) Policy Statement Number 3:

Threat abatement for *Phytophthora cinnamomi* and disease caused by it in native vegetation.

What is the draft policy for?

This draft policy seeks to replace the existing Policy 3, which is appended. CALM Policies give guidance to staff in the performance of their management and decision making functions relating to the land managed under the *Conservation and Land Management Act 1984* and also in relation to the broader functions of the Department under the *Wildlife Conservation Act 1950*.

The draft policy is designed to give guidance to staff in order to limit the detrimental impacts of *P. cinnamomi* on the biodiversity of Western Australia in relation to Departmental responsibilities.

What are we seeking comments on?

CALM is seeking comments on the draft policy in terms of its accuracy and suitability for application to CALM operations.

Your comments are welcome and need to be submitted by 7 May 2004 to be considered in the preparation of the final policy.

How to comment

Please prepare your written comments, referencing specific sections in (or omissions from) the draft policy and forward them to one of the addresses below by 5 pm Friday 7 May 2004.

(by mail)

Phytophthora Policy Comments
Dieback Coordinator
Department of Conservation and Land Management
Locked Bag 104
BENTLEY WA 6983

(by facsimile)

9386 1286

(by e-mail)

biodivconsult@calm.wa.gov.au

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
DRAFT REPLACEMENT POLICY STATEMENT No. 3

THREAT ABATEMENT FOR *PHYTOPHTHORA CINNAMOMI*
AND DISEASE CAUSED BY IT IN NATIVE VEGETATION

INTERPRETATION

In this policy, unless the contrary intention appears:

“Adaptive management” means: a process of responding positively to change. The term adaptive management is used to describe an approach to managing complex natural systems that builds on common sense and learning from experience, experimenting, monitoring, and adjusting practices based on what was learned.

“Consequence” means: The outcome of the introduction of *Phytophthora cinnamomi* into an uninfested area of native vegetation being a loss, injury, disadvantage or gain.

“Hazard” means: a source of potential harm or a situation with the potential to cause loss.

“Management Plan” means: a management plan approved under section 60 of the *Conservation and Land Management Act 1984*.

“Precautionary Principle” has the meaning: Stated in the *Intergovernmental Agreement on the Environment (1992)*:

“Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In the application of the precautionary principle, public and private decisions should be guided by:

- (i) Careful evaluation to avoid, where-ever practicable, serious or irreversible damage to the environment: and,*
- (ii) An assessment of the risk-weighted consequences of various options.”*

“Precaution” means: an action(s) taken beforehand to avoid environmental degradation or to ensure a desirable environmental outcome.

“Protectable area” means: an area, including areas of high conservation and/or socio-economic value (e.g. a small uninfested area which contain a known population of a susceptible species of threatened flora) within the vulnerable zone that are:

- Situated in zones receiving > 600 mm per annum rainfall or are water gaining sites (e.g. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600 mm per annum rainfall zone;
- Not calcareous soil (e.g. not a Quindalup dune system);
- Determined to be free of the *P. cinnamomi* by a qualified Disease Interpreter (all susceptible indicator plant species are healthy, no plant disease symptoms normally attributed to *P. cinnamomi* are evident);
- Positioned in the landscape and are of sufficient size (e.g. > 4 ha with axis > 100m) such that a qualified Disease Interpreter judges that *P. cinnamomi* will not autonomously engulf them in the short term (a period of a few decades);
- Where human vectors are controllable (e.g. not an open road, private property)

“Risk” means: the chance of an uninfested area becoming infested through the autonomous actions of the pathogen (*Phytophthora cinnamomi*) or the actions of people and animals or a combination of these factors, measured in terms of the magnitude of consequences of that

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event should it occur and the likelihood of the event and its consequences occurring and assessed in the context of existing controls.

“Risk analysis” means: the systematic use of available information to determine how often specified events may occur and the magnitude of their consequences.

“Risk control” means: that part of risk management that involves the implementation of policies, standards, procedures and physical changes to eliminate or minimise adverse risks.

“Risk evaluation” means: the process used to determine risk management priorities.

“Risk management” means: the culture, processes and structures that are directed towards the effective management of potential opportunities and adverse effects.

“Risk treatment” means: the selection and implementation of appropriate options for dealing with risk.

“Susceptible” means: influenced or harmed by the pathogen *Phytophthora cinnamomi*.

“Threat” means: an indication that serious or irreversible environmental damage may occur.

“Uninfested” means: an area that an accredited person has determined may be free of plant disease symptoms that indicate the presence of the pathogen (*Phytophthora cinnamomi*).

“Vulnerable” means: susceptible to physical injury.

“Vulnerable zone” means: that part of the South West Land Division and the areas adjoining it to the north west and the south east that receive with mean annual rainfall greater than 400 mm in which susceptible native plants occur in conjunction with the environmental factors required for the pathogen *Phytophthora cinnamomi* to establish and persist.

1. OBJECTIVES

This policy provides guidance to CALM staff with a view to limiting the threat posed by *Phytophthora cinnamomi* and disease caused by it to the biodiversity conservation values of native vegetation in Western Australia.

2. BACKGROUND

2.1 The Pathogen (*Phytophthora cinnamomi*) and Disease Caused by it in Native Vegetation

The introduced soil borne water mould *P. cinnamomi* is known for its capacity to invade and destroy the function of the root systems of a wide range of Western Australia's native plants across numerous ecosystems. This slow moving epidemic of root disease in native vegetation in Australia is known as “*Phytophthora* dieback”. The impact of this now widespread pathogen varies greatly across the landscape but almost always results in the permanent removal from infested sites of one or more susceptible species. At worst, mass collapse of ecosystems occurs along with significant disruption to important ecological processes.

Dieback caused by the root-rot fungus *P. cinnamomi* has been listed as a 'key threatening process' under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999* effective from 16 July 2000.

It has been estimated through trials that 49% of the State's threatened flora species are susceptible to *P. cinnamomi*. In some cases the few remaining wild populations of susceptible threatened flora and some threatened ecological communities have been invaded by *P. cinnamomi*. Approximately 40% of the flora of the South West Botanical Province is susceptible.

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In Western Australia *P. cinnamomi* will continue its autonomous spread from all its established disease fronts via root to root growth amongst host plants and through the dispersal of zoospores in free flowing water. Native animals, feral animals and people, including their vehicles and machinery act as vectors for *P. cinnamomi*.

The most important means of limiting the impact of *P. cinnamomi* is through direct management action to reduce the incidence of human vectoring of *P. cinnamomi* into uninfested areas. This can be achieved by closing and rehabilitating unwanted roads from within uninfested areas and through the application of rigorous hygiene regimes that minimize the risk that people, who have a valid reason to enter uninfested areas are carrying *P. cinnamomi*. Effective management action depends upon the prior analysis of the likely presence or absence of *P. cinnamomi* and accurate demarcation of disease boundaries.

Limited control, but not eradication, of *Phytophthora cinnamomi* and the disease it causes is possible over small areas through repeat application of the chemical phosphite. Phosphite can be used to increase the resistance of some susceptible threatened flora, threatened ecological communities and, as a consequence, the habitat of threatened native fauna.

The options for the restoration of areas that have suffered serious environmental damage through the introduction of *P. cinnamomi* or for the successful translocation of threatened flora, are limited.

In the case of threatened flora that is susceptible to, and threatened by, *P. cinnamomi*, conservation actions include: collection and *ex situ* storage of germ-plasm for the purpose of maintaining gene pools and the investigation of germination processes, cultural requirements; and, field establishment methods for the species collected, including site selection protocols to determine the suitability of areas for the reintroduction of a particular species..

2.2 Principles of Sustainability

Section 19(2) of the *Conservation and Land Management Act 1984* establishes the principles of ecologically sustainable forest management and incorporates the precautionary principle. These principles have been used as a guide by the Department to ensure that this policy statement includes a clear commitment to the principles of sustainability.

3. LEGISLATIVE BASE

The Department is responsible for the administration and implementation of the *Wildlife Conservation Act 1950* and the *Conservation and Land Management Act 1984* that together provide the primary legal basis for the conservation of biodiversity in Western Australia.

4. POLICY

4.1 Risk Management

Management plans, interim management guidelines, interim recovery plans and recovery plans for threatened flora and threatened ecological communities, as well as plans for necessary operations or compatible operations on lands managed by the Department, and plans for the management of *P. cinnamomi* and disease caused by it in native vegetation will incorporate measures for:

- assessing the threat to the conservation of Western Australian biodiversity posed by *P. cinnamomi*, including the threat to uninfested areas of high conservation value and to the residual conservation values of infested areas;
- assessing and evaluating the risk of introduction of *P. cinnamomi* into uninfested 'protectable' areas;

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- identifying, evaluating and, where practical and reasonable, applying effective and efficient risk treatment measures to limit serious and irreversible environmental damage in uninfested areas;
- evaluating the degree of precaution to be used when applying preventative measures;
- identifying, evaluating and applying, where appropriate, measures for the restoration of infested areas with serious environmental damage, including recovery or re-introduction of populations of threatened flora and where necessary *ex situ* conservation of genetic resources;
- evaluating the need for, and levels of, scientifically based monitoring and audit of the implementation of, and compliance with, preventative measures for the conservation of Western Australian biodiversity;
- developing and progressively implementing agreed priority research programs that may reasonably be expected to impact on the effectiveness and efficiency of the abatement of the threat posed by *P. cinnamomi* to the conservation of Western Australian biodiversity; and,
- designing and implementing appropriate programs for public consultation and education and for the provision of information.

4.2 Commitment to the Principles of Sustainability

The decision-making processes used in the development of management plans, interim management guidelines, interim recovery plans and recovery plans for threatened flora and threatened ecological communities, plans for necessary operations or compatible operations on lands managed by the Department, and plans for the management of *P. cinnamomi* and disease caused by it in native vegetation, will:

- integrate both long-term and short-term economic, environmental, social and equity considerations;
- consider the need for the application of the precautionary principle;
- ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations; and
- ensure that the conservation of biological diversity and ecological integrity is a fundamental consideration in the decision-making process.

5. POLICY IMPLEMENTATION REQUIREMENTS

The Department will cross-reference this policy statement as appropriate with its other policy statements and encourage the:

- use of a consultative approach to determine the degree of threat posed by *P. cinnamomi*, in the assessment, evaluation and treatment of risk; and in the determination of the degree of precaution to be taken when applying preventative measures;
- progressive development of environmental management systems that comply with the *International Standards Organisation (ISO) 14000 Series of Standards for Environmental Management Systems*.
- use of adaptive management on lands managed by the Department that incorporates the results of monitoring of environmental effects to either confirm the appropriateness of continuing established environmental management programs or, where there is evidence of serious or irreversible environmental damage, ensure the modification or cessation of any deleterious practices.

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- development of manuals and guidelines that describe best practice management methods and standards and codes of practice that guide responsible environmental behaviour amongst industries, land user groups and the community.
- preparation and delivery of education, training and information programs.

6. ASSOCIATED POLICIES/STRATEGIES

Policy No. 9 - *Conservation of threatened flora in the wild, 1992*

Policy No. 29 - *Translocation of threatened flora and fauna, Revised July 1995*

Policy No. 33 - *Conservation of threatened and specially protected fauna in the wild, 1991*

Policy No. 56 - *Risk management, 2000*

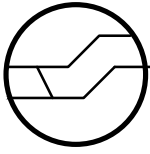
7. CUSTODIAN

The Director of Nature Conservation is accountable for the recording, storage and dissemination of this policy statement.

8. EXECUTIVE DIRECTOR APPROVAL

Approved on

By Keiran McNamara
EXECUTIVE DIRECTOR



DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

MANAGEMENT OF *PHYTOPHTHORA* AND DISEASE CAUSED BY IT

POLICY STATEMENT No.3 of OCTOBER 1998

PREAMBLE

This document replaces Department of Conservation and Land Management (CALM) Policy Statement No.3 of January 1991 and should be read in conjunction with other Policy Statements and the background paper :-

“Management of Phytophthora and disease caused by it: A revision of Department of Conservation and Land Management Policy Statement No.3 of January 1991” prepared by F.D. Podger & K.R. Vear July 1998

INTRODUCTION

1. CALM has a responsibility to monitor the health of native plants and ecological communities and respond according to need on a case by case basis.
2. At least 8 distinct species of *Phytophthora* recur at various places in native plant communities of Western Australia. Whilst the potential importance of several of them still require some further elucidation, *P. cinnamomi* alone represents by far the greatest ongoing threat to conservation and other benefits to society which native plant communities provide. This policy therefore concentrates on *P. cinnamomi*.

MANAGEMENT OBJECTIVES

1. Identify uninfested protectable areas and manage human access to them so that the role of humans as vectors in establishing new centres of infestation is reduced to the lowest possible level,

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Attachment 1: existing policy for comparison with proposed new policy only

2. Manage already infested and unprotectable areas in a manner which sustains an appropriate level of environmental and social benefits,
3. Implement, as a component of broader management programs to protect threatened flora, threatened ecological communities and the habitat of threatened fauna, a program for the use of the protective chemical phosphite,
4. Implement programs of interagency research and liaison which are closely linked with :-
 - a. management requirements, and
 - b. other Western Australian, interstate, Commonwealth and international institutions involved in research and management on Phytophthora.
5. Encourage community interest and participation particularly through support of the Dieback Consultative Council (DCC) and its prospective Regional Coordination Groups.

MANAGEMENT STRATEGIES

A. MANAGEMENT OF UNINFESTED AREAS WHICH ARE PROTECTABLE

1. Establish and maintain a set of protocols, founded on science and logic, which guide land managers in identifying and managing protectable areas and prioritise the allocation of available resources for protecting them.
2. Implement a long term management system of hygienic access to protectable areas which incorporates the following elements :-
 - a. The use of accredited Interpreters to prepare up-to-date maps of the distribution *P. cinnamomi* through the detection and analysis of the disease symptoms characteristic of root rot disease caused by *P. cinnamomi* in native plants.
 - b. The identification of protectable areas, which are free of the evidence of infestation by *P. cinnamomi*, and which are amenable to being protected from the establishment of new centres of infestation arising from the activities of man through the imposition of hygienic management practices.
 - c. The documentation, implementation and regulation of plans for hygienic human access to all protectable areas.
 - d. The implementation of appropriate monitoring and review programs.
3. Provide protection, as appropriate, through phosphite application.

4. Provide and maintain appropriate management guidelines and training programs.

B. MANAGEMENT OF LANDS ALREADY INFESTED WITH P. CINNAMOMI OR THOSE THAT ARE NOT PROTECTABLE

1. Develop and maintain a set of protocols, founded on science and logic, which establish guidelines for identifying and managing infested and unprotectable areas and for setting priorities among management options for them.
2. Where appropriate provide protection through the application of phosphite.
3. Provide appropriate management guidelines and training programs.

C. PROTECTION OF THREATENED FLORA, THREATENED ECOLOGICAL COMMUNITIES AND THE HABITAT OF THREATENED FAUNA BY THE USE OF A SCHEDULE OF TIMED APPLICATIONS OF THE PROTECTIVE CHEMICAL PHOSPHITE

1. Develop and maintain a set of protocols founded on science and logic which :-
 - a. guide land managers in identifying threatened flora, threatened ecological communities and the habitat of threatened fauna that may benefit from protection through phosphite application, and
 - b. may be used to establish realistic priorities for use of available resources.
2. Implement and monitor a program using scheduled applications of the protective chemical phosphite for protection of threatened flora, threatened ecological communities and the habitat of threatened fauna.

D. RESEARCH AND LIAISON

As a component of broader programs of research and liaison:-

1. Implement coordinated programs of research and collaboration, which are closely linked to management requirements, and involve other Western Australian, interstate, federal and international land management and research institutions.
2. Through interaction with the Phytophthora Research Coordinating Group establish clear research priorities and agreed allocation of those priorities amongst relevant institutions.

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Attachment 1: existing policy for comparison with proposed new policy only

3. Provide appropriate levels of support to the Dieback Consultative Council, the Regional Coordination Groups, and the team responsible for the implementation of the National Threat Abatement Plan for *Phytophthora spp.*

E. ENCOURAGE COMMUNITY INTEREST AND PARTICIPATION

1. Encourage community interest and participation particularly through support of the Dieback Consultative Council (DCC) and its prospective Regional Coordination Groups.
2. Provide appropriate levels of information to the public on the matters related to *P. cinnamomi* and root rot caused by it.

Responsibility for the maintenance and review of this policy rests with the Executive Director.

Dr S Shea
Executive Director

October 1998



PERFORMANCE ASSESSMENT OF *PHYTOPHTHORA* DIEBACK MANAGEMENT ON LANDS VESTED IN THE CONSERVATION COMMISSION: DRAFT REPORT

Thank you for your letter of 20 September 2010 seeking a response to the above performance assessment undertaken by the Conservation Commission. The Department of Environment and Conservation (DEC) has considered the report and its 18 findings. Responses to each of the findings are attached.

You will be aware that DEC manages approximately 26 million hectares of land across Western Australia, which equates to about 10.25 per cent of the State's land area. The management functions of the department are diverse and aim to address a broad range of conservation and land management issues.

Invasive species pose a significant threat to the biodiversity values of the State. DEC recognises in particular the threat that *Phytophthora* dieback poses to the State's biodiversity in the south-west of WA. The department undertakes a range of management initiatives to prevent the further spread of *Phytophthora* dieback and reduce its impact. This includes preventative measures in priority areas; intensive management within timber harvesting areas; impact amelioration in threatened ecological communities and rare flora/fauna populations; and community engagement.

It is widely accepted that the effective management of *Phytophthora* dieback requires a whole-of-community response involving a broad range of stakeholders including government agencies, utilities, industry, local government authorities, research organisations, community-based environmental groups, private landholders, and the general community.

DEC welcomes the review of *Phytophthora* dieback management and the recognition by the Conservation Commission that effective dieback management on DEC-managed lands is a complex task requiring substantial resourcing on an ongoing basis. DEC has previously recognised the need to improve delivery of some aspects of the dieback program and has established a *Phytophthora* Dieback Management Group (involving

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Regional Services, Sustainable Forest Management and Nature Conservation staff) to improve coordination and delivery of *Phytophthora* dieback activities across the department.

A recurring theme throughout the performance assessment and the Centre for *Phytophthora* Science and Management report is the level of budgetary constraint facing the department relative to the geographic scale, complexity of management and level of threat that the disease poses to biodiversity conservation in the State. While DEC is continuing to address some issues of administrative efficiency and process within available resources through the newly established *Phytophthora* Dieback Management Group, and working effectively with other stakeholders through various avenues including an informal liaison group involving Regional NRM groups, the Centre for *Phytophthora* Science and Management at Murdoch University and the Dieback Working Group, a number of the Commission's findings cannot be readily progressed without significant new resources.

Thank you for referring the report to the department for comment.

Yours sincerely

Att

DEPARTMENT OF ENVIRONMENT AND CONSERVATION RESPONSE TO THE DRAFT REPORT: *PERFORMANCE ASSESSMENT OF PHYTOPHTHORA DIEBACK MANAGEMENT ON LANDS VESTED IN THE CONSERVATION COMMISSION OF WESTERN AUSTRALIA*

Responses to the specific findings follow.

Finding 1: *The Dieback Consultative Council and the Dieback Response Group created to advise the Minister for Environment on dieback management have become inactive. Neither the Council nor the Response group has met over the last year.*

The Dieback Consultative Council (DCC) was formed in 1997 to provide the then Minister for the Environment with advice on *Phytophthora* management. The Department of Conservation and Land Management (CALM) and its successor, the Department of Environment and Conservation (DEC), provide executive support to the DCC but are not responsible for coordinating the activities of the Council, which is at the discretion of its Chair. The DCC held a meeting on 22 October 2010.

The Dieback Response Group (DRG) was formed in 2004 by the then Minister for the Environment to implement several elements of the then Minister's Dieback Response Framework. This framework had mostly been implemented prior to the 2008 State election, and the DRG was discontinued.

With the discontinuation of the DRG, DEC's *Phytophthora* Coordinator organised an informal *Phytophthora* dieback coordination and discussion group. This group has representation from DEC, the Centre for *Phytophthora* Science and Management at Murdoch University, the Dieback Working Group, Perth NRM Inc and the NRM-funded Project Dieback. The group has met four times and progressed a number of initiatives including the development of the priority protection areas concept across the south-west, scoping of major *Phytophthora* dieback related projects (including the major State NRM program project "Dieback Eradication Fitzgerald River National Park and Urgent Dieback Protection Actions" and also the engagement of key stakeholders (e.g. local government authorities).

Finding 2: *The Policy Statement No 3 Threat abatement for Phytophthora cinnamomi and disease caused by it in native vegetation (draft) was endorsed by the Commission in 2004 as an interim policy with the understanding that it would be further developed for final endorsement within 12 months. The Commission is aware of no action by DEC to review the policy over the last 6 years.*

CALM identified several concerns with the proposed 2004 dieback policy following the interim endorsement by the Conservation Commission. These were addressed as efforts continued to implement the Government's Dieback Response Framework. In 2010 DEC undertook further review of the 2004 draft Policy Statement and updated it into the new format developed for the department. The new proposed Policy 3 has been considered by DEC's Corporate Executive and it will be finalised in the near future for public release.

Finding 3: *DEC is yet to report on the application and evaluation of a protocol for the identification and prioritization for management of dieback "protectable" areas. The current definition of 'protectable' is not suitable for defining priority areas for dieback protection in many of the dieback management situations occurring across the State.*

DEC has undertaken a review of the 'protectable' areas protocol within the forest estate as part of the five-year review of the Forest Management Plan (FMP). This included an assessment of the department's hygiene management, including its effectiveness. DEC agrees that the protectable areas protocol is most suited to forest estate areas and is not necessarily applicable to other areas managed for conservation and non-DEC lands.

DEC has been involved in the development of the concept of *Phytophthora* dieback priority protection areas across the south-west with other stakeholders as a possible means to identify the highest priority areas for protection from *Phytophthora* dieback. Interim lists of these priority protection areas have been developed for some NRM regions in the south-west through the NRM group's Project Dieback. However, it is DEC's view that a more rigorous process for completing such a list is required. This work has been discussed within the informal *Phytophthora* dieback liaison group and is likely to be developed further for application in future *Phytophthora* dieback projects.

While the concept of priority protection areas requires further development, DEC has already undertaken significant *Phytophthora* dieback protection within identified priority areas including Fitzgerald River National Park, Cape Arid National Park, Stirling Range National Park and Lesueur National Park.

Finding 4: *DEC does not have a dieback management strategy which clearly states strategic goals of management for the department.*

DEC's revised Policy 3 gives an overview strategic direction for departmental *Phytophthora* dieback, as have previous policies in this area. *Phytophthora* dieback issues are also addressed in a variety of documents including:

- DEC Policy Statement No. 3 – *Phytophthora cinnamomi* and the disease caused by it in native vegetation managed by the department (2010 update);
- DEC Corporate Plan 2007-2009;
- DEC Strategic Plan for Biodiversity Conservation Research 2008-2017;
- 'area' plans (e.g. Managing Conservation Values of the Whicher Scarp – Report of the Expert Panel 2010);
- various national park and other reserve management plans, including Fitzgerald River National Park, Lesueur National Park and others;
- threatened ecological community recovery plans;
- threatened flora recovery plans and interim recovery plans;
- Nature Conservation Service Priorities 2010-2011 and Nature Conservation Service Five-Year Regional Plans; and,
- DEC Policy Statement No. 18 – Recreation, Tourism and Visitor Services (2006).

A number of strategic goals for dieback management have been articulated under the FMP. For example, on DEC-managed lands in FMP areas, the overall aim is to 'seek to sustain forest ecosystem health and vitality'. In relation to *Phytophthora* dieback, the objectives are to minimise the impact of *Phytophthora* dieback and keep uninfested areas free from *Phytophthora* dieback. Further, there is also a Key Performance Indicator for monitoring and reporting on *Phytophthora* dieback management actions and their effectiveness embedded within the FMP.

Finding 5: *The current Dieback Manual and protocols are dated with some sections remaining as drafts. There has been no apparent updating of the manual since 2004.*

Some revision of the Dieback Manual has been conducted by DEC's *Phytophthora* Coordinators on a priority basis. A number of other actions have also been undertaken including the development of a new hygiene management plan and environmental checklist, as well as the development of specific management protocols.

In early 2010, DEC formed the *Phytophthora* Dieback Management Group (involving Regional Services, Sustainable Forest Management and Nature Conservation staff) to further progress the department's dieback related protocols and procedures. The group has reviewed the policy, procedures and systems currently in place and has identified areas in need of further development. These areas include the development of a new hygiene guidance statement, updating of hygiene procedures, identification of departmental needs in terms of hygiene infrastructure, improved information management and record keeping and an updated Dieback Manual that can be regularly revised to keep its contents current. These matters will be progressively completed within available resources.

Finding 6: *There is no evidence of a standardized approach to hygiene planning with respect to various operations and activities which involve soil movement on Conservation Commission vested lands outside the Forest Management Plan 2004-2013 area.*

It has been DEC's experience that regionally-specific management needs and scenarios often arise which require flexible approaches to hygiene planning. For example, the South Coast Region has developed its own Hygiene Management Plan template as well as a "Green Card" hygiene accreditation program. While some alignment of hygiene planning across DEC's regions may improve *Phytophthora* dieback management outcomes, different hygiene management planning processes need to be developed for different operations and activities that involve the movement of soil. Further, there is an accepted need for improved systems and collation of *Phytophthora* dieback occurrence mapping data by the department and databasing of hygiene management plans. These needs have been identified by DEC and are currently being addressed through the work of the department's *Phytophthora* Dieback Management Group.

Finding 7: *It is not possible to determine whether objectives of conservation reserve management plans in relation to plant disease have been achieved as little dieback monitoring has been formally completed and evaluated.*

DEC undertakes *Phytophthora* dieback monitoring within a prioritisation framework. Monitoring is undertaken in highest priority sites or areas that are supported by additional grants for targeted *Phytophthora* dieback management. High priority sites include threatened flora populations under threat from *Phytophthora* dieback and DEC's aerial phosphite targets, threatened ecological communities, and locations such as the Fitzgerald River, Cape Arid, Lesueur and Stirling Range national parks.

In addition, DEC undertakes rate-of-spread monitoring for a large number of sites across the south-west as a requirement under the FMP. Additional monitoring of rate-of-spread is regularly conducted at Gull Rock, Stirling Range and Fitzgerald River national parks.

DEC also conducted an internal audit of "Dieback Identification and Interpretation Standards" in 2007. The four recommendations from the report have been implemented, with the exception of a full updating of the Dieback Manual, which is currently being addressed. The Conservation Commission fully endorsed these recommendations in the current Performance Assessment.

Finding 8: *It has not been routine for districts to formally register 'protectable' uninfested areas of vegetation and to develop, with ongoing commitment to implementation of hygiene management plans.*

DEC undertook an internal review of *Phytophthora* dieback management that identified deficiencies in cataloguing protectable areas, priority protection areas and hygiene management plans. The department's *Phytophthora* Dieback Management Group has considered the deficiencies in information management systems and measures are being planned for the significant improvement of current systems.

Finding 9: *A number of significant infrastructure projects have commenced prior to hygiene plans being in place.*

There have been some instances where significant infrastructure projects have commenced prior to the development of hygiene management plans. Actions to redress this oversight include an evaluation of current hygiene procedures by DEC's *Phytophthora* Dieback Management Group and the roll-out of hygiene training across the department for staff at all levels. DEC recognises that the management of *Phytophthora* dieback requires regular engagement and awareness raising to ensure all staff are aware of DEC's policy and procedures.

Finding 10: *There is an inadequate commitment to dieback training and education in DEC.*

DEC disputes a finding of "inadequate commitment" made without due regard to resourcing constraints and the other functions that the department is required to perform.

DEC undertakes a significant level of training, awareness raising and the provision of technical support across the department. This includes the following training and education courses:

- *Phytophthora cinnamomi* management training course (run twice a year);
- Dieback Detection and Mapping course for new *Phytophthora* dieback interpreters;
- Threatened Flora Management course; and
- Hygiene training currently being rolled out across different sections of DEC within the south-west.

Phytophthora dieback awareness is also part of the new employee induction process for South Coast operations staff, the Graduate Recruitment Program and Forest Management Branch staff. Substantial dieback training has been conducted informally as trained dieback interpreters have transferred into other roles within districts and specialist areas (e.g. fire management) of DEC. These officers play a key role in raising or maintaining awareness across the department, especially in the south-west.

Has very

DEC *Phytophthora* coordinators, disease interpreters and scientists regularly contribute at departmental conferences and provide technical input into a number of steering committees. All DEC staff are invited to the annual Dieback Information Group conference where information is presented on the latest management and research techniques on *Phytophthora* dieback in Western Australia and from around the world. Typically, over 30 departmental staff attend this yearly conference.

DEC also has extensive information on *Phytophthora* dieback on its website at <http://www.dec.wa.gov.au/content/view/5729/2305/>, and DEC's *Phytophthora* Coordinator maintains the State dieback web portal (www.dieback.org.au) and Dieback Working Group (www.dwg.org.au) website.

Improving the delivery of *Phytophthora* dieback education and training across the department is a priority for the management group.

Finding 11: *There does not appear to be an appropriate standardized guideline for utilizing dieback free gravel for DEC management activities.*

DEC provides a standardised guideline for dieback-free basic raw materials (BRM) within the publications "Best Practice Guidelines for the Management of *Phytophthora cinnamomi*" (CALM, 2004) and "*Phytophthora cinnamomi* and the disease caused by it – Management Manual Part I" (CALM, 2004).

DEC also supported the development of the Dieback Working Group publication "Management of *Phytophthora* dieback in Extractive Industries – Best Practice Guidelines" (DWG, 2004) and utilises the guidelines within this document when extracting BRM for DEC management activities or providing advice on new extractive industry licenses on non-DEC managed lands.

Road construction and maintenance associated with timber harvesting activities in State forest are managed under DEC and Forest Products Commission (FPC) guidelines that state "Gravel for use on roads in *Phytophthora cinnamomi* free forest must be obtained from *Phytophthora cinnamomi* free gravel pits, or as per an approved *Phytophthora cinnamomi* Hygiene Plan" (CALM Manual of Guidelines for Timber Harvesting in Western Australia) and "The Hygiene Management Plan often requires the use of BRM that is certified 'Phytophthora free'. The road construction and maintenance contractor must not use sources of BRM that have not had the hygiene status certified in areas or adjacent to areas specified in accordance with the Hygiene Management Plan. This includes even small scale works such as potholing" (FPC Contractors' Road Construction and Maintenance Manual).

Finding 12: *The Conservation Commission is particularly concerned that systems to insure that dieback is not spread during the course of departmental fire management are inadequate.*

Fire management operations by DEC have to balance the risk to human life, property and the environment. Over recent years, reviews of fire fighting activities have identified a number of deficiencies in environmental management systems during bushfire suppression. DEC has taken steps to address these deficiencies and continues to develop improved systems including the requirement for the formation of environmental teams to oversee procedures such as ensuring adequate dieback hygiene management before fire teams and equipment enter the fire ground.

Finding 13: *The Conservation Commission is concerned that key messages in relation to dieback are not being communicated adequately through the DEC website and key strategies such as the Good Neighbour policy.*

DEC has recently updated its website content on *Phytophthora* dieback and now has a substantial amount of information on the impact and management of dieback as well as research being undertaken by DEC: (<http://www.dec.wa.gov.au/content/view/213/548/>; <http://www.dec.wa.gov.au/content/view/5729/2305/>). Further, DEC's *Phytophthora* Coordinator maintains the State dieback web portal (www.dieback.org.au) and Dieback Working Group (www.dwg.org.au) website.

DEC also undertakes a significant amount of community engagement and awareness raising on *Phytophthora* dieback within the WA community. This includes *Phytophthora* dieback initiatives in the Land for Wildlife program, the activities of the DEC Community Involvement Unit, Roadside Conservation Committee, Perth Hills National Parks Centre education programs, visitor interpretation signage within DEC estate, the activities of the Tracks and Trails Unit and DEC Media Unit. Further, the department regularly organises *Phytophthora* dieback displays at community events such as the Dowerin Field Day and the Four Wheel Drive and Adventure Show. The new DEC Policy Statement No. 3 outlines the commitment of the department to supporting *Phytophthora* dieback management through its Good Neighbour Policy.

Finding 14: *There is a lack of readily available information on the current distribution and potential distribution of the disease.*

DEC recognises that good *Phytophthora* dieback management requires access to up-to-date occurrence mapping data. DEC produced the publicly available State Dieback Atlas in 2006. An online information management system is currently being developed as part of the current State NRM-funded Project Dieback, which is being led by DEC.

Currently, DEC's website has the *Phytophthora* dieback atlas maps available for download at: <http://www.dec.wa.gov.au/content/view/213/548/1/3/>. Specific information on *Phytophthora* species occurrence and mapping can also be obtained from DEC's Forest Management Branch and Vegetation Health Service.

Over one million hectares of native vegetation is currently infested by *Phytophthora cinnamomi* and at least another million hectares is at risk from infestation. DEC is investigating new remote sensing technologies that could be used to map *Phytophthora* dieback occurrence across the south-west of WA. This new technology still requires further development but we are hopeful that it will offer a more cost-effective procedure for mapping the occurrence and spread of *Phytophthora* dieback.

Finding 15: *There is no public information system relating to the conservation estate (and associated infrastructure within the conservation estate) aimed at minimizing the risk of spreading the disease.*

An online information management system is being developed as part of the current State NRM-funded Project Dieback, which is being led by DEC. It is planned that this system will have elements available for the general public with more detailed information available for specific land managers.

Finding 16: *DEC does not have an overall system for collating, and being made readily available, areas that have been deemed “protectable” (or priorities for management as a result of operational mapping).*

The following text on page 19 of the report is not correct “Officers of the Forest Management Division have indicated that their Forest Management Information System is only capturing operational dieback mapping for State Forest. A data collection system for the Conservation Commission estate has not been developed.” The author has misunderstood the context of the information discussed. Forest Management Branch (within the Sustainable Forest Management Division) is the nominated custodian of dieback occurrence data on DEC-managed lands. These data are maintained in a GIS environment named Forest Management Information System (FMIS), which is utilised for a broad range of planning and analysis purposes. The data and system do cover all land tenures managed by DEC, but the majority of new operational dieback mapping is associated with disturbance activities that occur in State forest. Funding to maintain the datasets beyond the forest regions remains an issue. The FMIS data and system were the primary basis for the risk analysis system developed for the South Coast and other NRM groups.

Finding 17: *It is not possible to directly assess any progress improvement or otherwise in relation to dieback environmental outcomes as there is no system for monitoring and recording disease spread across the Conservation estate.*

DEC recognises the importance of regular monitoring in order to quantify disease prevalence and spread but this needs to be considered in terms of competing priorities. This is an ongoing issue with *Phytophthora* dieback monitoring as field verification of spread and causative factors requires considerable resources.

DEC undertakes *Phytophthora* dieback monitoring within a prioritisation framework. Monitoring is undertaken in highest priority sites or areas that are supported by specific project funding. High priority sites have been discussed in response to other findings above.

The department also undertakes rate-of-spread monitoring for a large number of sites across the south-west as a requirement under the FMP. Additional monitoring of rate-of-spread is regularly conducted at Gull Rock, Stirling Range and Fitzgerald River national parks.

The protocol for the FMP Key Performance Indicator 18 will provide a methodology for monitoring and reporting the effectiveness of hygiene management plans (and, indirectly, management practices) for operations within the three DEC forest regions. The sampling methodology can be readily extended across the conservation estate and it is also being applied to specific projects such as the Wungong thinning trial.

Finding 18: *Staff responsibilities for dieback management are spread over a number of divisions. DEC has not had a full time dieback coordinator since 2006.*

Given the broad geographical area over which the department operates and the extensive land management functions it performs, it is reasonable that staff responsibilities for dieback management should be spread over the different divisions and regions. This is a strength, not a weakness.

Under current arrangements, with sharing of the coordinator position between Science and Nature Conservation divisions, there is better integration of science into dieback policy and management than has previously been the case. Policy

Statement No. 3 clearly outlines the different roles for the relevant divisions of the department and their respective responsibilities in implementing that policy. There are many areas of departmental activity where additional staff would be welcome, however, the current arrangements for dieback coordination and management are, with a few adjustments as identified above, reasonable and appropriate.

Further, the department's Dieback Management Group has recently reviewed the management framework for the implementation of the *Phytophthora* dieback policy. The group will be seeking to improve the systems for the better coordination of different dieback management activities across the department as well as the capture of *Phytophthora* dieback mapping in order to improve the monitoring and evaluation of DEC's *Phytophthora* dieback management performance.

Department of Environment and Conservation
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Dieback Management Issue Based Performance Assessment



Conservation Commission
of Western Australia





Dieback Management Issue Based Performance Assessment

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Contract Title

Consultant to Participate in a Dieback Management Issue Based Performance Assessment

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EXECUTIVE SUMMARY

Since the 1920's and possibly earlier, *Phytophthora* dieback has had, and is continuing to have, a major impact on ecosystem function and health in the South West Botanical Province of Western Australia. Consequently, it is critical that the Department of Environment and Conservation (DEC) and other environmental stakeholders continue to effectively manage *Phytophthora* dieback to ensure it does not spread into areas free of the disease, or to increase its impact in existing areas of infestation. The Conservation Commission of Western Australia retained the authors to conduct an assessment of *Phytophthora* dieback management in the State's terrestrial conservation estate. This includes National Parks, conservation parks, nature reserves, State forests and timber reserves. This was to be done through the analysis of current legislation, regulations, policies and *Phytophthora* dieback management guidelines that apply to lands vested in the Conservation Commission. This includes the effectiveness of adaptive management procedures that have developed from common sense, experience, research, monitoring and the adjustment of practices based on what has been learnt. The analysis was to be evidence based, to include interviews with personnel involved with *Phytophthora* dieback and to include specific case studies (Fitzgerald River, Lesueur, Stirling Ranges and Wellington National Parks, with Alcoa Australia Ltd. included as an industry based case study). The case studies were to be used to determine the effectiveness of *Phytophthora* dieback management. The study was to indicate the strengths and weakness of current management and to make recommendations for further improvement based on the interviews and reviews of the existing legislative and *Phytophthora* management guidelines.

Overall, there is a sense of urgency with regards to the management of *Phytophthora* dieback and to ensuring its spread and impact is minimised. This was especially so in the Lesueur National Park and the Fitzgerald River National Park, where *Phytophthora* dieback is yet to cause significant impact, but also elsewhere in the conservation estate. It was recognised that there are significant challenges to the management of *Phytophthora* dieback. It was also recognised that the DEC obtains significant support from the activities of other stakeholders such as the NRM regions, mining companies, the Dieback Working Group and others.

The stakeholder interviews revealed that not all DEC staff was using the correct version of *Policy Statement No 3* and that DEC needs to effectively communicate any changes in the policy to ensure everyone was working towards the same objectives. It was also suggested that all *Phytophthora* species not just *P. cinnamomi* should be addressed by *Policy Statement No 3*. Stakeholders indicated that there is no 'road map' for implementing the management objectives in *Policy Statement No 3* and that there is a gap between the



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objective set out in the Policy and the guidance provided by the *Best Practice Guidelines for the Management of Phytophthora cinnamomi*. The Dieback Manual – *Phytophthora cinnamomi and the Disease Caused by It, Volumes 1-4* received positive comments from everyone who used it and the information contained in it, especially relating to hygiene management which was considered particularly beneficial. Suggestions were made to where modifications would improve the document. In brief, stakeholders wanted: a better understanding of how all the dieback efforts fit together; mechanisms to evaluate effectiveness; a clear picture of strategic priorities and the supporting activities; and to know how the DEC's efforts are part of a larger integrated approach that extends beyond the conservation estate.

Stakeholders were particularly interested in *Phytophthora* dieback leadership from three perspectives. These were internal leadership, DEC leading by example and collaboration with other stakeholders. Stakeholders felt that *Phytophthora* dieback management has slipped dramatically on the DEC agenda and the public agenda. Signals included the reduction of the DEC Dieback Coordinator position from full-time to a 0.7 FTE position shared by two individuals; a reduction in the number of DEC training courses offered to external stakeholders; and less media coverage of *Phytophthora* dieback. These had, to some degree, impacted on those DEC staff passionate about dieback management. External stakeholders and the DEC staff thought the DEC should lead by example. The Wellington National Park case study was an excellent example of DEC working in partnerships at a local level.

With regards to adaptive management, there was an overall perception among stakeholders that it is not occurring as effectively as it should. For example, stakeholders were happy with the DEC's compliance monitoring of proponents on the conservation estate whose activities are controlled by regulation or the DEC issued access permits. However, they were more critical of the DEC's lack of effort to monitor the behavior of others using the conservation estate, in particular recreationalists. Although, it was acknowledged that there are insufficient DEC staff in the conservation estate who can manage users and compliance. It was frequently noted that more monitoring of the effectiveness of *Phytophthora* dieback management interventions and the need to 're-interpret' areas where disturbance had occurred (e.g. timber harvesting and road construction) is necessary. Stakeholders also indicated that more use should be made of targets and performance indicators to ensure that progress and effectiveness can be evaluated. Of the four National Park case studies, only the Wellington National Park Management Plan included specific targets and performance indicators. Stakeholders saw the need for a central and accessible *Phytophthora* dieback clearinghouse to store all data and have this freely available to all parties by intranet. Data to be included are *Phytophthora* occurrence maps, hygiene management plans and other data relevant to *Phytophthora* management. For example, a central and accessible database like this would provide rapid and relevant information in wildfire management such as occurred in 2008 in the Fitzgerald River National Park, reducing the risk of inadvertent *Phytophthora* spread. This clearinghouse could be extended to include other data such as rare flora maps.



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Inadequate succession planning (researchers and managers) was also highlighted as a barrier to effective *Phytophthora* dieback management. Additional training courses, including refresher courses were seen as critical for on-going effective *Phytophthora* dieback management, with the DEC seen as the preferred training provider. The Dieback Information Group's annual conference was seen as an effective mechanism for communicating research findings.

Stakeholders supported the continuation of restricting access to vulnerable high value conservation areas such as Disease Risk Areas (DRAs). Stakeholders would like to see DRAs extended into areas outside forested areas, and to see their effectiveness increased, with more monitoring and enforcement of infringements. DRAs were considered inadequately signposted and that signage should include details of penalties on infringements. There was also an emphasis on prioritising areas for management, with higher priority areas receiving more intense *Phytophthora* dieback management. Prioritisation was also viewed as a reasonable means of applying resources where they were needed most, especially in management context of limited agency resources.

The DEC's education efforts were seen to be complimented by those of other organisations, but stakeholders did indicate that the effectiveness of educational activities should be formally evaluated so that weaknesses could be acted upon and to ensure more effective awareness of *Phytophthora* dieback could be put in place. Stakeholders also indicated that *Phytophthora* dieback management measures should be integrated into other areas such as biodiversity conservation education efforts, weed management, industry codes of practice and private landholder incentive strategies. These were seen to be ways to more effectively achieve dieback outcomes, especially outside the conservation estate.

Fire management and road building were clearly highlighted as areas needing more input with regards to *Phytophthora* dieback management. Advanced planning, hygiene management plans and mapping were seen as critical aspects that need continued improvement and updating as lessons are learnt from both these activities. For example, the Fitzgerald River National Park wildfire in 2008 provides ideal lessons to be incorporated into adaptive management plans. Whilst, the new road to build in the same Park is also seen as a significant threat to the region with regards to *Phytophthora* dieback spread and where lessons could be learnt from monitoring and adaptive management. The sourcing of *Phytophthora* dieback-free gravels and other road building materials were seen as challenges especially with regards to the testing strategies (numbers of samples and isolation protocols) to be confident materials were free of *Phytophthora*, especially in pits located in cryptic areas. Stakeholders raised concern about the use of limestone as it is now known that *P. multivora* (and possibly other *Phytophthora* species) is not suppressed by calcareous materials.

All recreational activities were seen by the majority of stakeholders to pose significant risk of moving infested soils from infested to uninfested areas. There was consensus that



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managing the risk posed by recreational activities is not easy due to barriers like: no single peak body represents recreationalists and many recreational activities do not belong to a recreation organisation; not all recreationalists abide by the DEC signage; recreationalists do not understand how the disease spreads; appropriate signage does not always exist; and in most cases hygiene facilities were inadequate, especially in National Parks. For example, none of the case studies had wash down facilities for non-DEC vehicles and only two of the case studies had boot cleaning stations (Lesueur and Fitzgerald River National Parks). Stakeholders were very critical of 4WD and off-road vehicles. Education was the most frequent tool suggested as a way to change the behaviour of recreationalists with respect to *Phytophthora* dieback management.

Stakeholders identified a number of examples of research priorities and the need for on-going research to address some of the existing areas of uncertainty. Examples included: the DEC's Bell Track (in the Fitzgerald River National Park) containment and eradication work; and gravel sterilisation trials being conducted by Curtin University. Other research priorities linked to science and management are listed in the 'recommendations' section of this document.

Lack of resourcing for staff (especially succession planning) and for management activities were frequently highlighted by stakeholders. Some stakeholders also indicated it is important to evaluate the effectiveness of existing resources to determine if intended outcomes are being met. Continued support of the interpreters and the importance of training new staff and regular re-training of existing staff on *Phytophthora* dieback were highlighted as critical.

Overall, the effectiveness of the *Phytophthora* dieback management hierarchy is sound, though more 'articulate' leadership and support is required to reinvigorate stakeholders, and to ensure the continued enthusiasm for *Phytophthora* dieback management by the DEC's internal stakeholders as well as providing and strengthening leadership for external stakeholders. The DEC does effectively collaborate with external stakeholders; however, more resourcing is required to adequately enable continued growth in this area. The *Phytophthora* dieback Best Management Practices are being applied, but these need to be audited regularly and updated as research and management findings provide new information. There are a number of barriers to successful *Phytophthora* management; key barriers include fire and road building and maintenance management, lack of adequate on-going resources (human and monetary) within the DEC, effective communication, and education. Lastly, as the review of the DEC effectiveness in meeting the Forest Management Plan's Key Performance Indicator (No. 18) was not completed at the time of our study, it will be necessary to re-evaluate our findings in the light of this document when it is finally tabled.



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a) Management, Education and Training Recommendations

Management hierarchy

Recommendation 1

It is recommended that the DEC districts consider the potential to be use existing legislative mechanisms for limiting access (e.g. wilderness areas).

Recommendation 2

It is recommended that the DEC take advantage of its ability to manage recreational users.

Recommendation 3

A five year rolling plan should be developed to support implementation of *Policy Statement No. 3*.

Recommendation 4

It is recommended that the Conservation Commission consider imbedding dieback management in the State's land use planning processes. This could occur in a similar manner to what has been taken for acid sulfate soils (ASS), which are identified as an issue in SPP 2 and SPP 2.9. In addition, ASS guidelines (WAPC 2008) have been developed as well as a planning bulletin (WAPC 2009).

Recommendation 5

When a State Biodiversity Conservation Act does come into fruition, it should identify *Phytophthora* dieback as a key threatening process to biodiversity and provide powers to the DEC to appropriately manage the threat.

Data storage and management

Recommendation 6

A *Phytophthora* dieback (and other diseases – e.g. *Armillaria*) data clearinghouse should be established and maintained by the DEC, including mapped data and associated protocols (e.g. how to collect the data, limitations of the data). The clearinghouse should store data from and be accessible to the DEC and external stakeholders (e.g. proponents, consultants, NRM groups, LGAs).



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Monitoring and compliance

Recommendation 7

To the extent possible, the DEC should increase monitoring of visitor access on the conservation estate.

Recommendation 8

The DEC should ensure that its own application of its *Phytophthora* dieback management procedures is well documented and periodically audited as part of an environmental management system.

Recommendation 9

It is recommended that Disease Risk Areas restrictions are enforced and extended to other areas of the conservation estate outside forests.

Recommendation 10

A review of the use of Disease Risk Areas and Forest Quarantine Policy is recommended.

Training

Recommendation 11

As part of an adaptive management approach, DEC staff should undertake periodic refresher training.

Recommendation 12

It is recommended that the DEC conduct *Phytophthora* dieback management training of external stakeholders applying a user pays system. Training needs to be accredited and targeted to managers, field staff, fire crews and other work gangs, and contractors.

Recommendation 13

It is recommended that the DEC continue to conduct on a regular basis dieback interpreter training in all major plant communities. This is to be accredited and to include external subscribers if required.

Recommendation 14

On ground hygiene prescriptions are required across all operations including: Fire control, road construction and maintenance, track construction and phosphite application



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Education

Recommendation 15

The trial of Project Dieback's unified signage should include a formal evaluation to ensure its effectiveness.

Recommendation 16

The communication strategy should be broadened to a behavioural change strategy.

Recommendation 17

A long-term state communication strategy is required to raise community awareness about the pathogen and its impact on flora and fauna. These could include coverage (through DVDs, DRAs and dieback infected areas added to the local GPS maps, the Web, signage and bulletins) in schools, and relevant vocational and tertiary education. The communication strategy and its outputs will require regular updating to ensure messages remain current.

b) Other

Staff and Resources

Recommendation 18

A full-time Dieback Coordinator should be appointed, with the five year rolling plan a major responsibility for this person.

Phosphite

Recommendation 19

Expand 'Off-label' license from the Australian Pesticide and Veterinary Chemical Authority.

Recommendation 20

Apply for 'On label' license.

Recommendation 21

It is recommended that dedicated resources be allocated to *Phytophthora* dieback. In order to best utilise resources there is a need for:

- greater co-ordination across all divisions, branches, regions and Districts is required;
- access to funds above the yearly allocation of funding to allow prompt response to new outbreaks and threats as they are identified;
- Regional base funding to be spent on the highest priority actions within the Regions;



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- annual reporting and auditing of resources spent on *Phytophthora* management is required;
- the interpreters to be moved out of the FMB so interpretation is not only harvesting based, but conservation based; and
- A clearer commitment to on-going mapping and data collection on a regular and programmed basis (e.g. biannual in high rainfall areas).

c) Scientific

Adequate and sustained funding is required to ensure robust adaptive management strategies can be implemented across the range of ecosystems *Phytophthora* dieback is present. Currently, *ad hoc* funding through short term funding opportunities (e.g. Australian Research Council) means many of the most difficult questions which require long-term monitoring are not being addressed adequately. Understanding of the long term ecological impacts of the pathogen, the epidemiology and mechanisms of survival by *P. cinnamomi* in the range of ecosystems it affects and the effect of climate change on epidemiology is currently unknown, and required longer time periods of research than the current 1-3 year funding cycles provide. In addition, with short term funding cycles, significant intellectual property is lost as research scientists' move to positions where more sustained funding and track tenure is available.

High, medium and low research priorities (Tables 1, 2 and 3, respectively) are provided; they will assist in the management of *Phytophthora* dieback in the future.

Table 1 High research priorities for *Phytophthora* dieback

	Background	Objectives to be achieved	Criteria against which objectives will be measured
1.1	Determination of the effect of climate change on the impact and distribution of <i>Phytophthora</i> species in WA	Global climate change is recognised as a major threat to natural ecosystems and the south-west of Western Australia is predicted to have increased temperatures and reduced winter rainfall. It is also likely more extreme summer rainfall events will occur. Therefore, dryer winters are likely to result in less impact from <i>Phytophthora</i> dieback whilst extreme summer rainfall events (warm and wet conditions) are likely to exacerbate the impacts of <i>Phytophthora</i> dieback.	Models developed for the 2030 and 2070 predicted temperature and rainfall scenarios. Established long-term research plots to monitor rates of spread and impacts of <i>Phytophthora</i> dieback in different plant communities across rainfall and temperature isohyets. This project to be linked to 1.2.
1.2	Improved remote sensing tools to monitor rates of spread and impact of <i>Phytophthora</i> dieback throughout its range	An understanding through modelling and on-ground research on how climate change will impact on <i>P. cinnamomi</i> and other <i>Phytophthora</i> species in the different natural plant communities of Western Australia. An understanding of the effects of seasonal rainfall variation on the spread and expression of disease caused by <i>P. cinnamomi</i>	The ability to provide some predictive capability for disease spread and expression based on seasonal rainfall patterns Robust remote sensing technologies in place. Ability to differentiate key plant species to species level. Ability to differentiate between different stressors. Mapping database established. Alignment of remote sensing technologies with other threats (e.g. fire, weeds, salinity, drought, pests) and other agencies (e.g. Agriculture Dept, FPC, Shires) to ensure effective utilisation of the
	Improved remote sensing technologies (e.g. Digital Multi-Spectral Imagery, Lidar) to monitor canopy health and vegetation change in woodlands, forests heathlands are becoming increasingly more robust and cheaper. In addition to monitoring disease spread, they can be used to monitor and plan fire control, impacts of drought on plant communities, biodiversity and fauna habitat values and other 'on-ground' activities. Rapid monitoring together with the use of GIS platform technologies to detect early infestations across a range of plant communities is required. Such information is quantitative and will provide confidence in the information obtained and allow adaptive management strategies to be implemented	Test and ground-truth different remote sensing technologies (e.g. Digital and Multi-Spectral Imagery, Lidar) in a range of plant communities (e.g. forests, woodland and heathlands). Develop these technologies to differentiate between plant species, so highly susceptible plant species and communities can be monitored remotely. Determine if other stressors (e.g. drought, salinity, fire) can be differentiated from <i>Phytophthora</i> dieback.	

Background	Objectives to be achieved	Criteria against which objectives will be measured
around a strong science base. 1.3 Development of rapid diagnostic tools for the isolation and identification of <i>Phytophthora</i> species: The isolation of <i>Phytophthora</i> species from soil and plant material remains problematic especially during summer conditions and on cryptic sites (after fire, in the absence of susceptible indicator species, gravel pits and highly disturbed areas). In order to be confident that the pathogen is not present on a site, numerous soil samples are required. Currently, laboratories charge approximately \$100 to process an individual sample. These high costs and the lack of confidence of the tests result in inadequate sampling and can compromise 'best practice' activities. Molecular tools are available for the detection in soils, but sampling size remains problematic and different soil types can compromise or 'mask' detection. Therefore, there is a need to improve the existing isolation and identification techniques alongside molecular techniques to provide robust, rapid and cost effective tools for the isolation and identification of different <i>Phytophthora</i> species from soil and plant material.	Accurate, rapid and cost effective molecular technologies for the isolation and identification of <i>Phytophthora</i> species from soils and plant material.	technologies and to facilitate cost effectiveness. Commercial laboratories with the ability to diagnose different <i>Phytophthora</i> species from soil and plant material cost effectively and accurately. Ability to rapidly identify all <i>Phytophthora</i> species present in WA.
1.4 Understanding the biology, pathology and control of different <i>Phytophthora</i> species It is now estimated that at least 11 undescribed species are present in natural ecosystems in WA. Many of these have been present for many years based on the DEC Vegetation Health Services (VHS) Culture Collection and recent molecular sequencing of this collection. All of these species have been recovered from the rhizosphere soil of dead and dying native plants. Recently, <i>P. multivora</i> (previously identified as <i>P. citricola</i>) has been shown to have a wide host range and be active on a	All isolates in the VHS Culture Collection identified and named. Understanding of the biology and pathology of these isolates and their impact on native flora. Understanding of how they respond to phosphite.	A database listing all <i>Phytophthora</i> species, their distribution and host range.

Background	Objectives to be achieved	Criteria against which objectives will be measured
wider range of soil types than <i>P. cinnamomi</i>. It is likely that the other undescribed species have similar attributes. It is critical that these isolates are identified, their host range elucidated and their biology and control understood. For example, how effective is phosphite on these species? This knowledge is critical for management, especially in the face of climate change and for hygiene, quarantine and control purposes. In addition, recent baiting of rivers and other water bodies have indicated that <i>Phytophthora</i> hybrids are present in WA. Hybrids represent a potential threat to biodiversity values and more work is required to determine their role as pathogens.	The majority of research on rates of spread has been conducted in the jarrah forest and to a lesser extent the Swan Coastal Plain. Environmental factors (rainfall, soil type and chemistry) and plant community types vary considerably across south-west WA where <i>Phytophthora</i> dieback is present. The epidemiology of the pathogen(s) is poorly understood outside the jarrah forest. Therefore, it is critical for management reasons to have a sound ecological understanding of the pathogen and its rates of spread across the landscape.	Predictive models in place and being used by land managers.
1.5 Long term ecological impacts (models for disease development) - Estimate rates of spread and develop predictive models to describe the rate of disease development in different plant communities and to predict the risk of infection and disease impact.	The use of predictive models to describe the risk of infection in different plant communities and subsequent disease development.	
1.6 Investigate <i>ex situ</i> conservation techniques and determine germplasm storage	The development of suitable germplasm storage methods for plant taxa threatened by <i>Phytophthora</i>.	Adequate germplasm storage of all plant taxa threatened by <i>Phytophthora</i> particularly those taxa considered to be critically endangered.

Background	Objectives to be achieved	Criteria against which objectives will be measured
protocols for flora threatened by <i>Phytophthora</i>.		
1.7 Improvement of hygiene measures - Efficiency of hygiene/quarantine protocols	Hygiene and quarantine protocols have been implemented since the 1970's. However, we have little understanding of their effectiveness or how to ensure that the wider community conforms to and understands the reasons for these measures. But a lot can be learnt from the consistent use of hygiene practices by mining operations such as Alcoa, Worsley, Tiwest and Iluka. Therefore, it is essential we have a better understanding of their effectiveness and to ensure that we can improve their implementation and effectiveness.	Continued or improved implementation of appropriate hygiene/quarantine protocols. Successful use by land managers. Commitment at all levels - from management to operators in the field. Integration of dieback management as part of operating instructions. Adoption of a risk assessment process with input from a range of staff. Support of research and development into the management of <i>P. cinnamomi</i> Implementation of relevant monitoring and auditing programs.
1.8 Establish a register of all dieback research.	<i>Phytophthora</i> dieback research has been <i>ad hoc</i> and frequently driven without consideration of research priorities. Research programs and objectives are not adequately developed in consultation with land managers, and thus results are not addressing key management questions. For example, there is incomplete information on the susceptibility of flora and fauna (including rare and threatened) species and ecological communities to evaluate the extent of the threat and to predict long-term	To establish a database of all management and research activities related to <i>Phytophthora</i> species in Western Australia to ensure optimum use of limited resources. To prioritise research activities Database(s) in place and updated on a regular basis. Database used by research organisations and land managers. Priorities revisited on an annual basis.

Background	Objectives to be achieved	Criteria against which objectives will be measured
consequences of <i>P. cinnamomi</i>. It is essential to ensure <i>Phytophthora</i> dieback research continues to receive funding especially in a climate of declining resources and increased competition for funds from other environmental threats. A <i>Phytophthora</i> dieback register would allow for increased collaboration, reduce duplication and allow for basic and applied research needs to be regularly updated and prioritised.		

Table 2 Medium research priorities for *Phytophthora* dieback

Background		Objectives to be achieved	Criteria against which objectives will be measured
2.1	Long term ecological impacts (soil type; hydrology; models for disease development)- Effect of soil type on sporulation, survival and dispersal	In order to effectively manage <i>Phytophthora cinnamomi</i> and other <i>Phytophthora</i> species in different plant communities it is necessary to understand how and in what form the pathogen survives, how survival spores germinate and how different soil types and plant communities influence sporulation, dispersal and subsequent impact and severity? To date the majority of research on these questions has been undertaken in the jarrah forest. Therefore, it is essential that similar detailed long-terms studies are conducted in key areas such as the FRNP, the SRNP and in the northern sandplain plant communities.	Determine why gradients exist in impact from high to low in the jarrah forest, Swan Coastal Plain, and probably in the FRNP. Identify mechanisms to explain gradients in impact. Determine if knowledge gained can be incorporated into control strategies.
2.2	Long term impacts of the disease on various ecosystems?	We now have a reasonably good idea of how <i>Phytophthora</i> dieback impacts on flora. However, the indirect effects are poorly stood. For example, in different ecosystems we have very little knowledge on how the pathogen impacts on or exacerbates fire, salinity, beneficial microorganisms (e.g. mycorrhizal fungi), invertebrate and vertebrate fauna, and other pests and diseases. Without this knowledge we will not have the tools to manage many of the critical factors involved in supplying ecosystems services and maintaining ecosystem function.	Documentation of the impact of disease on flora, fauna and invertebrates in different ecosystems. Implementation of strategies (research and management) to reduce any long term impacts.
2.3	The long term survival of <i>P. cinnamomi</i> in a range of plant communities.	We still do not know how <i>P. cinnamomi</i> and other <i>Phytophthora</i> species survive in different plant communities and soil types across their range of activity. E.g., how: (a) important are chlamydospores for long-term survival; (b)	An understanding of the long term survival mechanisms of <i>P. cinnamomi</i> in a range of soil types and plant communities.

Background	Objectives to be achieved	Criteria against which objectives will be measured
frequently does <i>P. cinnamomi</i> 'self' to produce oospores and how important are these for long-term survival? (c) important are resistant or tolerant host plants for the long-term survival of <i>P. cinnamomi</i> in the absence of susceptible host plants?, and (d) long can <i>Phytophthora</i> survive in the absence of any living plants? Detailed knowledge on these aspects of the life cycle will allow robust management strategies (e.g. hygiene, containment, eradication) to be implemented in different ecosystems.		
2.4 Plant resistance to <i>Phytophthora</i> - Susceptibility of endangered flora	To systematically test taxa in the Threatened Flora Seed Collection for susceptibility to <i>P. cinnamomi</i> and other <i>Phytophthora</i> species perceived to be a threat to Threatened Flora.	Rank taxa according to susceptibility to <i>P. cinnamomi</i> and other <i>Phytophthora</i> species Identify those expressing intraspecific variation in resistance, and Identify taxa at risk.
2.5 Selection of resistant individuals from susceptible rare/endangered flora for subsequent rehabilitation.	The rehabilitation of rare and endangered flora into communities impacted by <i>P. cinnamomi</i>. Develop protocols for the rehabilitation of high impact sites in a range of vegetation types that can be readily used by land managers.	Strategies in place to rehabilitate resistant individuals of rare and endangered species into appropriate impacted sites. Protocols are in place and being implemented by land managers.

Background		Objectives to be achieved	Criteria against which objectives will be measured
those prior to <i>Phytophthora</i> infestation. Effective rehabilitation techniques will need to be developed alongside the selection of resistant individuals to ensure that they become effectively established on rehabilitated sites. The disease triangle or host-pathogen-environment interactions are critical components of whether disease will occur. In order to have disease, the pathogen and susceptible hosts need to be present and environmental conditions need to be conducive. Global climate change will influence the host and the pathogen through drier (mostly) or wetter (extreme summer rainfall events) conditions and increased temperatures. Therefore, the physiological status of the host at the time of infection will influence disease development and subsequent impact in plant communities.			
2.6	Host physiology and disease - Relationship between physiological status of host on infection and subsequent disease development	Determine the relationships between physiological status of the host, infection and subsequent pathogen and disease development.	An understanding of how changes in physiological status across seasons and with climate change can impact on infection, pathogen growth and disease development.
2.7	Mode of action of phosphite	Determine the mechanisms of molecular and biochemical modes of resistance induced by phosphite in the plant to <i>P. cinnamomi</i> and other <i>Phytophthora</i> species.	An understanding of the biochemical and molecular changes responsible for induced resistance. Improved use of phosphite, adjuvants and/or other chemicals.

Table 3 Low research priorities for *Phytophthora* dieback

Background		Objectives to be achieved	Criteria against which objectives will be measured
3.1	Phosphite research (control of spread; phytotoxicity; optimising application - surfactant, frequency; interaction with fire)	Phosphite is the only tool available to managers that can be used to protect plants growing in infested areas and to slow the rates of spread and other direct and indirect impacts of the pathogen. However, we still have a poor understanding of how it slows rates of spread, how frequently it should be applied in different plant communities, phytotoxicity and optimum applications, optimising its use through the use of surfactants/penetrants, its impact on beneficial microorganisms, invertebrates and vertebrate fauna, phenology of plants, fire and physiological status of plants at the time of application and subsequent efficacy. These issues still need to be addressed and particularly to ensure the Australian Pesticides and Veterinary Medicines Authority will continue to issue permits of its use.	
3.1.1	Optimising application (surfactants, frequency)	Test surfactants, frequency of application and any other factor that will improve the efficacy of phosphite in a range of plant species and ages.	Increased efficiency of penetration, longevity of protection and improved efficiency and economics of application.
3.1.2	Assessment of any deleterious effects of phosphite on biodiversity, particularly phytotoxic effects in native plant communities	Determine whether phosphite impacts on biodiversity in the long term. To identify plant taxa with greatest phytotoxic reaction to phosphite and the reasons for the	Field studies to determine the long term deleterious 'direct' and 'indirect' effects of phosphite in a range of plant communities on flora, fauna and invertebrates. Database listing species impacted.

Background	Objectives to be achieved	Criteria against which objectives will be measured
	response.	
3.1.3 Reduction of autonomous spread using phosphite	To ascertain the suitability of phosphite to reduce the rate of autonomous spread across a range of native plant community types.	Demonstrable outcome on whether the fungicide phosphite can be used 'safely' in the long term to reduce the rate of autonomous spread in native plant communities.
3.1.4 The effect of fire following use of phosphite in different plant community types and disease development	An understanding of how existing fire management practices impact on disease development and spread in a range of plant community types.	Implementation of fire practices by land managers that reduce disease impact in across plant communities impacted by dieback.



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1. INTRODUCTION

1.1 Phytophthora Dieback in Western Australia

Phytophthora cinnamomi was first observed killing jarrah along with understorey species near Karragullen 35 km south-east of Perth in 1921 (Podger 1968). In 1928, similar tree deaths were observed near Myara Hill, approximately 80 km south of Karragullen and the incidence of tree deaths continued thereafter. The disease became known as 'jarrah dieback' due to the losses of this economically important tree. It was not until 1964 that work by FD Podger (Forestry and Timber Bureau) together with RF Doepel (W. A. Department of Agriculture) and GA Zentmyer (Riverside, California, USA) diagnosed the causal agent as the soil-borne plant pathogen *P. cinnamomi*. Between 1921 and 1964, the pathogen was inadvertently spread widely through the south-west of Western Australia as forestry and associated infrastructure including road building increased, particularly with increased mechanization post World War I.

Outside the forest estate little attention was applied to dying vegetation in National Parks and Reserves and lack of resources prevented the occurrence of *Phytophthora* dieback being documented by State authorities. However, in the winter of 1976, *Phytophthora* dieback was identified as a serious problem in Cape le Grand National Park and by 1980 *Phytophthora* dieback was confirmed to be present in another eight National Parks (Avon Valley, D'Entrecasteaux, Fitzgerald River, Leeuwin-Naturaliste, Moore River, Scott River, Stirling Range and Yanchep) (Dell et al 2005). *Phytophthora* dieback is now widespread within the Southwest Australia Ecoregion (Figure 1.1). It is confined to areas with more than 400 mm annual rainfall, and extends between Eneabba in the north and Cape Arid east of Esperance (Dieback Working Group 2009).

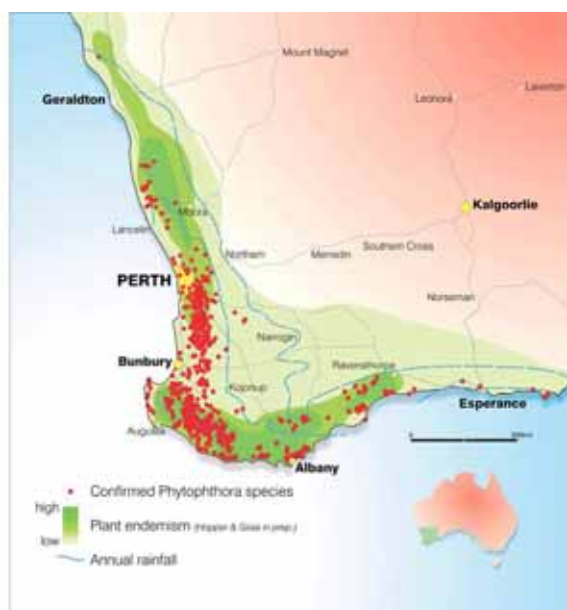


Figure 1.1

Distribution of *Phytophthora* species in southwest Australia



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The *Environment Protection and Biodiversity Conservation Act 1999* lists *P. cinnamomi* as a 'key threatening process to Australia's biodiversity'. *Phytophthora* dieback in native plant communities is recognised as a biological disaster of global significance and a major problem in horticulture, forestry, mining, extractive industries, plant production nurseries, domestic gardens, nature recreation and tourism based industries. Therefore, it is critical that research continues to feed into adaptive management to ensure the spread and impact of this pathogen (and other *Phytophthora* species) can be contained.

Since 1965 there has been substantial research conducted on the biology, ecology, pathology and management of *P. cinnamomi* (Colquhoun and Hardy 2000). It is now recognised that approximately 2284 and 800 of the 5710 described plant species in the South-West Botanical Province of Western Australia are susceptible or highly susceptible to the pathogen, respectively (Shearer et al 2004) and this host list continues to increase. Consequently, its impact on ecosystem function and health is devastating and particularly so in the banksia woodlands and heathlands. Despite its wide host range and impacts on different ecosystems, its direct and indirect impacts are still not fully understood. This lack of knowledge has implications for effective on-ground management. For example, research has only recently started to examine the impact of *Phytophthora* dieback on native fauna in Western Australia, with little to no research on invertebrate fauna and soil-borne microorganisms.

A detailed and comprehensive history of *P. cinnamomi* including policy, legislation, on-ground management (e.g. mapping, quarantine, and hygiene and control measures) and research specific to Western Australia are given in the review by Dell et al (2005).

1.2 Biology and Life Cycle of *Phytophthora cinnamomi*

In order to cause disease *P. cinnamomi* and susceptible hosts need to be present together with environmental conditions that favour infection and subsequent reproduction and dissemination of the pathogen. These factors operate together to form a disease triangle and if any one of these three factors is absent, disease will not occur. Time is an additional factor that combines with the disease triangle to form a disease pyramid. For example, time in which conditions are conducive to the pathogen and detrimental to the host is an important component of disease outbreaks. *P. cinnamomi* has a number of life cycle stages allowing it to either reproduce rapidly under optimum conditions or survive under adverse conditions. Under warm and moist conditions its vegetative state, the mycelia made up of strands of hyphae, will produce asexual sporangia that in turn produce and release motile zoospores. Zoospores are the major infective propagule of *P. cinnamomi*. They are microscopic and motile over relatively short distances, and are chemotactically attracted to roots of host-plants, where they encyst and germinate to form a germ tube that penetrates into the plant's roots. The hyphae colonise the root tissue and lower stems of plants, destroying the roots and vascular system which leads to it effectively cutting off the the plant's water and nutrient



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supply. Disease can also be spread by root-to-root contact which can occur even when conditions are not conducive for sporangial production and zoospore release.

Under adverse conditions, the vegetative hyphae will produce chlamydospores which are long-term survival structures which form in dead roots or in soil. These can germinate under optimum conditions to produce mycelia, sporangia and then zoospores. Chlamydospores are considered the primary structure responsible for the spread of the disease via the movement of infested soil and infected plant material through anthropogenic means such as road building, mining and forestry. *P. cinnamomi* is heterothallic and requires two mating types (A1 and A2) in order to produce oospores or sexual spores. There is no direct evidence of sexual reproduction occurring in Australia since the A2 mating type is common and the A1 is relatively rare. Recently, Jayasekera et al (2007) showed that *P. cinnamomi* was able to produce selfed oospores in the presence of *Acacia pulchella* roots. Oospores are thick walled survival structures and can survive for long periods in the absence of host plants. It is likely that oospores are substantially better 'survival' spores than chlamydospores. However, research is required to fully elucidate the role of 'selfed' oospores of *P. cinnamomi* and the oospores of homothallic species found in natural ecosystems in Western Australia.

1.3 Spread of *P. cinnamomi*

P. cinnamomi can spread under its own volition, without human or other vector assistance. It does this via (a) root-to-root contact, (b) via the movement of zoospores in saturated soils, and (c) through passive spread in surface water. However, the most significant means of spread is via human activity and can be rapid and large scale (Colquhoun and Hardy 2000). Such movement occurs through road construction and maintenance, earthmoving, timber harvesting, fire-fighting activities, mineral exploration and the use of infected nursery stock. Recreational activities such as bushwalking, four-wheel-drive vehicles, motorcycles and horse-riding also spread the pathogen. Domestic stock and feral animals and some native animals can potentially spread infected material to new disease-free locations. Research is required to determine the occurrence of spread by domestic, feral and native fauna.

1.4. Environmental factors that influence disease incidence

In Western Australia, *P. cinnamomi* can cause major impacts on native vegetation in areas with annual rainfall exceeding 400 mm; although, the most significant impacts occur in areas that receive greater than 700 mm annual rainfall. Despite this, the relationship between the presence of *P. cinnamomi* and disease onset is complex (Shearer et al 2007). This complexity is due to the considerable variation among and within native plant species in their response to *P. cinnamomi* which in turn, is overlain by temporal and spatial variations in the environment. It is likely that global climate change will increase the complexity of these temporal and spatial variations along with host plant responses. Temperature also plays and



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important role in growth and reproduction of *P. cinnamomi*. Zoospores can be released between 12 and 30°C with optima between 18 and 24°C. Disease severity tends to increase with increasing temperatures between 25 and 30°C.

1.5 Disease Control

Hygiene and quarantine remain the most effective control methods, together with good communication and education. Once an area is infested, the use of phosphite can be effectively used to protect susceptible plant species and reduce the rate of spread and impact of *P. cinnamomi* in natural ecosystems. However, over large areas phosphite is expensive and it does need to be reapplied on a regular basis. It protects susceptible host plants by inducing host resistance mechanisms that effectively contain the spread of the pathogen in the host but does not kill it. The pathogen is still able to sporulate and disseminate zoospores from these phosphite treated plants. We still do not understand the mechanisms by which phosphite induces susceptible host plants to contain and restrict the pathogen in their tissues. This lack of knowledge limits our ability to increase the efficacy and persistence of phosphite as well as developing new chemicals with similar modes of action.

More recently, trials have been successful in the containment and eradication of *P. cinnamomi* from spot infestations (Dunstan et al. 2009). The methods developed are currently being trialled on the Bell Track infestation in the Fitzgerald River National Park, and with industry in the sandplains north of Perth.

1.6 Other *Phytophthora* species

Recent work by the Centre for *Phytophthora* Science and Management (CPSM) and the Department of Environment and Conservation (DEC) indicate that there are at least 10 undescribed *Phytophthora* species present in native plant communities in south-west Western Australia. Some of these were previously ascribed to *P. megasperma* and *P. citricola* (Burgess et al 2009). However, molecular tools now indicate that *P. megasperma* and *P. citricola* are made up of species complexes of three or more species. Prior to molecular tools becoming available, species were described on their morphology. However, morphological characteristics alone are not robust enough to differentiate *Phytophthora* species and it is essential to use these alongside molecular tools. At least one new species, *P. multivora* (previously part of the *P. citricola* complex), is now known to have a broad host range, be wide spread and to be active on calcareous soils, unlike *P. cinnamomi* which is suppressed by calcareous soils (Scott et al 2009). The CPSM together with the DEC is currently describing three other *Phytophthora* species, all of which are pathogens to native plant species. Therefore, it is essential the biology, ecology, pathology and control of these new *Phytophthora* species are adequately researched to facilitate their effective management. For example, we do not know how effective phosphite is on these other *Phytophthora* species.



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1.7 Overview of *Phytophthora* dieback research and management

Since the 1970's there has been substantial research activity into the biology, ecology, pathology and control of *P. cinnamomi* in south-west of Western Australia. This research has resulted in numerous benefits to the management of *P. cinnamomi*. Some of these include mapping, quarantine, hygiene, phosphite applications, understanding of susceptible and resistant plant species, survival and spread, and host-pathogen-environment interactions. Many of these findings have been incorporated by the DEC in their management plans and by industry (mining and extractive industries), utilities and other organisations including shires and NRM organisations. However, despite these gains, the pathogen and the diseases it causes continues to spread, and no real long-term control solutions are apparent. Lack of continued and on-going resources, poor education and communication, the pathogen's ability to survive adverse environmental conditions and to infect a wide host range across diverse plant communities (woodlands, forests, heaths), from 400 mm annual rainfall and greater, across different soil types and in a changing environment a result of global climate change, are all likely contributors to the continued spread of the disease. It is a complex pathogen, and although it is perceived by many to be uncontrollable, the combination of research and management together with policy and legislation over the last four decades has certainly reduced the impact this pathogen would have otherwise had in Western Australia's biodiversity rich 'hotspot'. It is imperative that we continue to find ways to effectively mitigate this devastating plant pathogen.

1.8 Study Objective

The Conservation Commission of Western Australia retained the authors to conduct an assessment of *Phytophthora* dieback management in the State's terrestrial conservation estate. This includes National Parks, conservation parks, nature reserves, State forests and timber reserves.

The objective of the study was to assess *Phytophthora* dieback management on lands vested in the Conservation Commission. The specific role was to analyse current legislation relating to *Phytophthora* dieback and dieback policies and any *Phytophthora* dieback management guidelines that apply to lands vested in the Conservation Commission. Together with the Conservation Commission, the authors were to develop a team based approach to address the objectives. The analysis was to be evidence based and to include the incorporation of information relating to dieback management operations along with specific case studies.



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2. THE *PHYTOPHTHORA* DIEBACK PLANNING HIERARCHY

2.1 Responsibilities and Elements

The State's terrestrial conservation estate is vested in the Conservation Commission of Western Australia, an independent statutory authority. The terrestrial conservation estate includes National Parks, conservation parks, regional parks, State forest and timber reserves, and nature reserves. The DEC is responsible for managing the terrestrial conservation estate on behalf of the Conservation Commission.

The DEC aims to protect, conserve and, where necessary and possible, restore biodiversity values (DEC 2007). A key part of protecting and conserving biodiversity is managing the potential threats including *Phytophthora* dieback. The DEC applies a *Phytophthora* dieback planning hierarchy that includes legislation, regulations, policies, guidelines, management plans and operational plans (Figure 2.1). The specific elements of the hierarchy are listed in Table 2.1.



Figure 2.1 The Department of Environment and Conservation's planning hierarchy associated with *Phytophthora* dieback management



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Table 2.1 Department of Environment and Conservation's *Phytophthora* dieback planning hierarchy

Legislation
<i>Conservation and Land Management Act 1984 (WA)</i>
Regulations
<i>Conservation and Land Management Regulations 2002 (WA)</i>
<i>Forest Management Regulations 1993 (WA)</i>
<i>Environment Protection (Clearing of Native Vegetation) Regulations 2004 (WA)</i>
Policies
Policy Statement No. 3: Threat Abatement for <i>Phytophthora cinnamomi</i> and Disease Caused By It in Native Vegetation (CALM 2004a)
Guidelines
Best Practice Guidelines for the Management of <i>Phytophthora cinnamomi</i> (CALM 2004b)
<i>Phytophthora cinnamomi</i> and Disease Caused by It. Volumes 1-4 (CALM 2003)
Management Plans
<i>Forest Management Plan 2004-2011</i> (Conservation Commission 2004)
National Park and Conservation Reserve plans
Recovery plans for threatened flora and threatened ecological communities

2.2 Legislative Powers

The DEC's management efforts are guided by the *Conservation and Land Management Act 1984 (WA)* (CALM Act) and the *Wildlife Conservation Act 1950 (WA)* (WC Act). The CALM Act creates a system for managing the conservation estate in Western Australia, while the WC Act protects flora and fauna in the State. Together they form the primary legal basis for conserving biodiversity values in Western Australia.

2.2.1 Disease risk areas

Disease risk areas (DRAs) are one of several legislative mechanisms available to the DEC to manage *Phytophthora* dieback. Powers to establish and manage DRAs are derived from the CALM Act and *Forest Management Regulations 1993 (WA)*. Part VII of the CALM Act provides the DEC with powers to control and eradicate forest diseases on public land through the establishment of 'forest disease risk areas' and 'disease areas'. DRAs are areas that may be, or may become, infected with a forest disease, whereas disease areas are those already infected (Section 83, CALM Act).



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DRA only apply to State forests. All vehicles entering DRAs are required to obtain a permit from the DEC. The permits typically stipulate the hygiene management practices required of a person entering a DRA. The DEC may also place restrictions on mining tenements in DRAs or disease areas.

2.2.2 Activity Permits

Through the issuing of permits, the DEC has the power to regulate activities such as beekeeping, fire wood collecting, wildflower picking, land clearing, and timber harvesting within the conservation estate. Beekeepers are required to have a permit from the DEC to operate on land vested in the Conservation Commission. Permits are issued in accordance with the CALM Act, the *Forest Management Regulations 1993* (WA) and the *Draft Policy Statement No. 41: Beekeeping on Public Land* (CALM draft). The permits, in some instances, have conditions attached that require beekeepers to follow specific hygiene management practices.

Clearing native vegetation is prohibited, unless the person intending to clear has a permit from the DEC or the clearing is for an exempt purpose. Under the *Environment Protection (Clearing of Native Vegetation) Regulations 2004* (WA), the DEC can grant clearing permits. As a condition of the clearing permits, an individual may be required to follow specific hygiene management requirements.

2.3 Policy Statement No. 3

The key DEC *Phytophthora* dieback policy is *Policy Statement No. 3: Threat Abatement for Phytophthora cinnamomi and Disease Caused by It in Native Vegetation* (CALM 2004a). The policy provides

...guidance to [DEC] staff with a view to limiting the threat posed by Phytophthora cinnamomi and disease caused by it to the biodiversity conservation values of native vegetation of Western Australia (CALM 2004a, p. 3).

The policy's management objectives are to:

- Assess the threat to the conservation of Western Australian biodiversity posed by *P. cinnamomi*, including the threat to uninfested areas of high conservation value and to the residual conservation values of infested areas;
- Assess and evaluate the risk of introduction of *P. cinnamomi* into uninfested 'protectable' areas;
- Identify, evaluate and, where practical and reasonable, apply effective and efficient risk treatment measures to limit serious and irreversible environmental damage in uninfested areas;



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- Evaluate the degree of precaution to be used when applying preventative measures;
- Identify, evaluate and apply, where appropriate, measures for the restoration of infested areas with serious environmental damage, including recovery or re-introduction of populations of threatened flora and where necessary *ex situ* conservation of genetic resources;
- Evaluate the need for, and levels of, scientifically based monitoring and audit of the implementation of, and compliance with, preventative measures for the conservation of Western Australian biodiversity;
- Develop and progressively implement agreed priority research programs that may reasonably be expected to impact on the effectiveness and efficiency of the abatement of the threat posed by *P. cinnamomi* to the conservation of Western Australian biodiversity;
- Design and implement appropriate programs for public consultation and education and for the provision of information.

The DEC is to apply *Policy Statement No. 3* in its preparation and implementation of management plans, interim management guidelines, interim recovery plans and recovery plans for threatened flora and threatened ecological communities, as well as plans for operations on lands managed by the DEC.

2.4 DEC Guidelines

The *Best Practice Guidelines for the Management of Phytophthora cinnamomi* (CALM 2004b) support the implementation of *Policy Statement No. 3*. The guidelines are intended to provide DEC staff with

a concise, clear and explicit statement of the best practice methods and standards for managing the threat to biodiversity posed by the introduced plant pathogen Phytophthora cinnamomi and disease caused by it.....these guidelines have also been written to form the basis of guidelines for adaptation and use by other land managers, proponents of activities and others (CALM 2004b p.1).

The manual *Phytophthora cinnamomi and the Disease Caused by It. Volumes 1-4* (CALM 2003) provides DEC staff with a single source document that includes the following information:

- Volume I: Management Guidelines (e.g. best management practices);
- Volume II: Disease detection, diagnosis (interpretation), demarcation and mapping guidelines;
- Volume III: Phosphite operational guidelines; and
- Volume IV: training curriculum and syllabi.



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The manuals are designed to be dynamic documents to be updated as new information arises. DEC staff issued with a manual are responsible for ensuring that their copy is up-to-date through regular liaison with the *Phytophthora* Dieback Coordinator and by regularly downloading updated versions from the Department's website.

2.5 Management Plans

The Conservation Commission and DEC produce several categories of management plans that can include actions to manage *Phytophthora* dieback. These are:

- The *Forest Management Plan 2004 – 2013* (Conservation Commission 2004);
- National Park and conservation reserve plans;
- Recovery and Interim Recovery Plans prepared by the DEC; and
- Operational plans.

2.5.1 Forest Management Plan

The *Forest Management Plan 2004 – 2013* (Conservation Commission 2004) applies to land vested in the Conservation Commission within the DEC's Swan, South West and Warren regions. Its primary focus is on the management of State forest and timber reserves. The Plan seeks to conserve biodiversity, commercial and other social and economic values of the forests through ecologically sustainable forest management.

The plan describes *Phytophthora* dieback due to *P. cinnamomi* as the most serious disease in the forest areas and a significant threat to ecosystem health and vitality. Management of the threat to ecosystem health from *P. cinnamomi* focuses on identifying protectable areas and instituting measures to minimise the risk of infesting them when operations are planned (Conservation Commission 2004).

The DEC and the Forest Products Commission (FPC) are to conduct their operations having regard to *Policy Statement No. 3* and Volume I of the DEC Guidelines. At an operational scale, the Plan proposes to:

- Minimise, as far as practicable, the impact of pathogens and their associated diseases on forest ecosystem health; and
- Protect from infestation those areas currently free from *P. cinnamomi*.

The Plan includes several commitments to develop or review key policies related to *Phytophthora* dieback. The Conservation Commission was to develop a whole-of-government policy framework for managing *Phytophthora* dieback. Further, by the end of 2008, the DEC was to review *Policy Statement No. 3* and its guidelines. These have not been completed as of November 2009.



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As described in Table 2.1, the *Forest Management Plan 2004 – 2013* includes a *Phytophthora* dieback management key performance indicator, commonly referred to as KPI 18. As part of the Conservation Commission's review of the DEC's *Phytophthora* dieback management efforts, the DEC is conducting a review of the effectiveness of disease hygiene management associated with disturbance activities on DEC-managed lands. That review will provide the basis for reporting on Key Performance Indicator (No. 18) of the Forest Management Plan.

Table 2.1 Key performance indicator 18 of the *Forest Management Plan 2004 – 2013* (Conservation Commission 2004)

Performance measures	The number of areas sampled and found to be uninfested with <i>P. cinnamomi</i> that remain uninfested following operations with approved hygiene management plans.
Performance target(s)	No uninfested protectable areas to become infested as a result of management actions.
Reporting	After five years, results for State forest and timber reserves, and conservation reserves are to be reported separately.
Response to target shortfall	The Department (DEC) is to investigate and report to the Conservation Commission and to the Minister for the Environment. The Conservation Commission is to evaluate the need for revision of management practices in the context of its assessment and auditing function, in consultation with the Department.

2.5.2 National Park and Reserve Management Plans

National Park and conservation reserve management plans guide the efforts of DEC staff for specific parks or reserves. In cases where conservation values are under threat from *Phytophthora* dieback, the management plans include specific *Phytophthora* dieback management actions. Chapters 4-8 of this report examine four National Park plans in which *Phytophthora* dieback is a significant management issue.

2.5.3 Recovery Plans

The DEC prepares and implements Recovery Plans or Interim Recovery Plans to conserve Critically Endangered taxa. The plans outline the recovery actions required to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or threatened ecological communities (TECs), and begin the recovery process. *P. cinnamomi*



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is listed as a 'key threatening process' under the Commonwealth's *Environment Protection and Biodiversity Conservation Act 1999*.

2.5.4 Operational Plans

For operations where *Phytophthora* dieback is an issue, hygiene management plans are developed. The plans outline the hygiene management practices to be followed during an operation (e.g. harvesting).

2.6 The Bigger *Phytophthora* Dieback Management Picture

The DEC and the Conservation Commission play a major role in *Phytophthora* dieback management in Western Australia. However, these are two components of a larger *Phytophthora* dieback management effort in the state that involves an array of stakeholders (Figure 2.2).

2.6.1 Federal Government

The Department of Environment, Water, Heritage and the Arts (DEWHA) is responsible for developing and implementing national policy and programs to protect and conserve Australia's environment and heritage and to promote Australian arts and culture. This includes protecting biodiversity from key threats, such as *Phytophthora* dieback.

Under Section 183 of the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act), DEWHA has the power to list 'key threatening processes' and then introduce a plan to manage the threat. Key threatening processes are those that threaten the continued existence of threatened species and ecological communities. *Phytophthora* dieback caused by *P. cinnamomi* is listed as a key threatening process.

A threat abatement plan is developed for a listed threatening process if it is considered a 'feasible, effective and efficient way to abate the process' (Section 270A of the EPBC Act). The original 2001 National Threat Abatement Plan for *Phytophthora cinnamomi* was reviewed in 2005 (CPSM 2006) and a revised plan was published in 2009 entitled *Threat Abatement Plan for Disease in Natural Ecosystems Caused by Phytophthora cinnamomi*. The revised plan identifies two management priorities: "(1) to mitigate the spread of *P. cinnamomi* to uninfested sites and (2) to mitigate the impact of *P. cinnamomi* at infested sites" (DEWHA 2009, p. 2). Table 2.2 lists the goals and objectives of the 2009 Threat Abatement Plan that is currently in the approval process.



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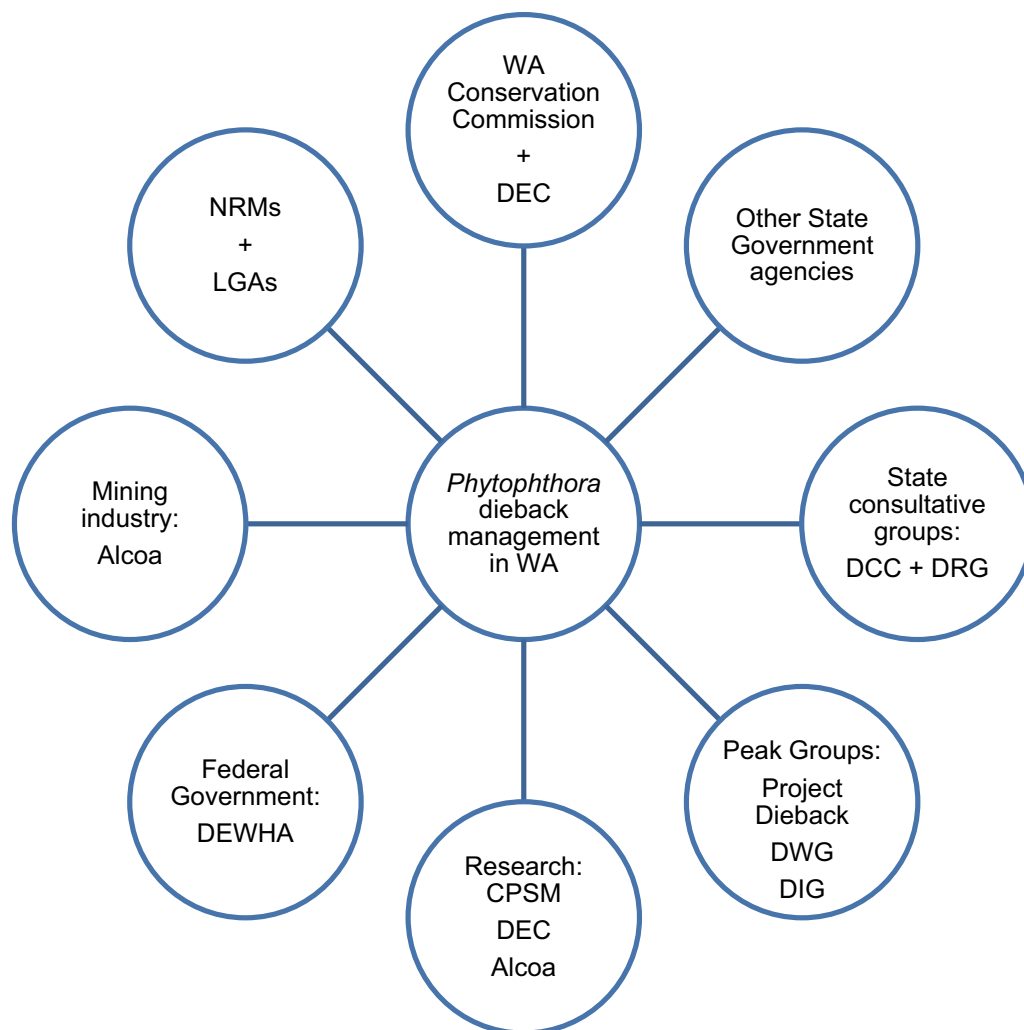


Figure 2.2 Key stakeholders in *Phytophthora* dieback management in Western Australia



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Table 2.2 Goals and objectives of the National Threat Abatement Plan for *Phytophthora cinnamomi*

Goals
1. Protection of species and ecological communities which are listed as threatened under the EPBC Act. 2. Minimisation of the spread of <i>P. cinnamomi</i> infestation so that further species and ecological communities do not become threatened. 3. Protection of areas of high conservation value. 4. Mitigation of the impacts of <i>P. cinnamomi</i> in currently infested areas of high conservation value.
Objectives
1. To monitor sites of high conservation value under threat from <i>P. cinnamomi</i>. 2. To develop and apply management actions that will minimise or mitigate the threat of <i>P. cinnamomi</i>. 3. To strengthen training and education of land managers in science and management of <i>P. cinnamomi</i>. 4. To assess <i>P. cinnamomi</i> impacts in Australia.

The National Threat Abatement Plan recommends that areas of high conservation value be given management priority. This includes:

- Areas with threatened species and ecological communities and habitat for threatened fauna susceptible to *P. cinnamomi*;
- Areas that support high numbers of endemic species, a diversity of vegetation types and remnant vegetation; and
- Large ecologically intact and mostly undistributed areas.

The DEWHA is responsible for facilitating the implementation of the plan that applies only to Federal agencies and Federal land. Federal agencies must not take actions that contravene threat abatement plans (Section 268). The Commonwealth is required to implement threat abatement plans to the extent to which they apply to Commonwealth areas (e.g. land owned by the Commonwealth or a Commonwealth agency) (Section 269).



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2.6.2 Other State Government Agencies

The Environmental Protection Authority (EPA) is an independent Authority responsible for a broad range of environmental protection activities. This includes providing advice to the Minister for the Environment, developing policies, assessing development proposals and management plans and monitoring compliance with Ministerial conditions. Under the *Environmental Protection Act 1986* (WA), the EPA has the power to place conditions on approvals sought through the environmental assessment process (Part V of the EP Act). This may include requiring a proponent to develop a *Phytophthora* dieback management plan or to follow specific hygiene management practices.

The EPA also produces State of the Environment Reports that identify key threats to the State's natural environment and provides recommendations. Since July 2000, the EPA has identified *Phytophthora* dieback as a key threat to biodiversity values.

State Government agencies engaged in activities that could contribute to the spread of *Phytophthora* dieback have internal policies and guidelines for *Phytophthora* dieback management. These agencies include the Forest Products Commission, Water Corporation, Western Power, Main Roads, and other utilities. Guidelines include the following:

- *Mining Environmental Management Guidelines: Management of Dieback Disease in Mineral Exploration* (DoIR¹ 2006);
- *Disease in Mineral Exploration* (DoIR 2006);
- *Dieback Management Guideline* (Water Corporation 2008);
- *Contractor Timber Harvesting Manual – South West Forests* (FPC 2007); and
- *Manual of management guidelines for timber harvesting in Western Australia* (CALM 1999)

Hope for the future: the Western Australian State Sustainability Strategy (Western Australian Government 2003) strategy recommends that a comprehensive *Phytophthora* dieback strategy be created to:

- Establish and maintain a database on the distribution of *Phytophthora* species in the south west;
- Develop and implement rehabilitation plans for selected disease-affected areas;
- Promote the use of best practice hygiene procedures in the WA nursery industry;

¹ The Department of Industry and Resources is now the Department of Mines and Petroleum.



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- Work with relevant Commonwealth agencies to prevent the introduction of new plant diseases in Australia;
- Develop an education program for the general public and private and public organisations that use land susceptible to the disease; and
- Examine the possible establishment of a Centre of Excellence for *Phytophthora* research.

2.6.3 State Government consultative groups

Dieback Consultative Council

The Dieback Consultative Council (DCC) was formed in 1997 in response to recommendations from the Western Australian Dieback Review Panel (Podger et al, 1996). Membership includes representatives with expertise in *Phytophthora* dieback management and research as well as representatives from key industry and other interest groups concerned with *Phytophthora* dieback. The primary function of the Council is to provide advice to the Minister for Environment regarding the development of policy, research priorities and funding, and raising public awareness about *Phytophthora* dieback. The DEC provides executive support to the DCC. The DCC works closely with the Dieback Response Group (below) and has a number of members in common.

Dieback Response Group

The Dieback Response Group (DRG) was established in 2004 by the State Environment Minister to:

- Seek resources for implementing management actions and periodically reviewing management actions;
- Maintain open communication lines with key organisations involved in the management of *Phytophthora* dieback; and
- Report on progress to the Minister for the Environment.

2.6.4 Multi-stakeholder Peak Groups

Dieback Working Group

The Dieback Working Group (DWG) was formed in 1996 by local government authorities, community groups and State government land management agencies concerned with the management of *Phytophthora* dieback. The group seeks to:

- Increase awareness and understanding about *Phytophthora* dieback within the community;
- Encourage the adoption of *Phytophthora* dieback prevention and management policies; and



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- Encourage the implementation of management procedures to reduce the spread and impact of the disease.

The DWG has undertaken considerable work with local government authorities and schools in the Perth metropolitan area (e.g. training for staff, presentations to students). It has also produced a widely used series of guidelines:

- *Managing Phytophthora Dieback in Bushland: A Guide for Private Landholders and Community Conservation Groups* (Edition 5) (Dieback Working Group 2009);
- *Management of Phytophthora Dieback in Extractive Industries: Best Management Practices* (Dieback Working Group 2005); and
- *Managing Phytophthora Dieback: Guidelines for Local Government* (Dieback Working Group 2000).

Project Dieback

Project Dieback was a West Australian Natural Resource Management (NRM) initiative to protect environmental, social and economic values from *Phytophthora* dieback. *Phytophthora* dieback is present in five NRM regions; South Coast, South West, Perth, Avon, and Northern Agricultural. Project Dieback has (1) increased the awareness of the impact and threat posed by *Phytophthora* dieback, (2) identified areas with significant biodiversity, community and industry assets threatened by *Phytophthora* dieback, and (3) developed regional and community capacity to manage the disease.

Over the past four years Project Dieback has:

- Developed a strategic map of *Phytophthora* dieback occurrence in the south west;
- Completed a risk analysis identifying priorities for management;
- Developed hygiene management protocols for local government and Aboriginal managed lands; and
- Designed and has trialled a standardised *Phytophthora* dieback signage system.

Project Dieback has developed a Regional Strategic Dieback Management Plans for each of the five NRM regions. The South Coast and Northern Agricultural Region plans have been completed with the others in progress.



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2.6.5 NRM

NRM groups contribute significant resources to on-going management of *Phytophthora* dieback. Examples include:

- Development of a Local Area Stakeholder Engagement and *Phytophthora* Dieback Action Plan – Esperance (East) by the Shire of Esperance in conjunction with the South Coast NRM Inc; and
- Development of a *Phytophthora* dieback policy by the Shire of Ravensthorpe with support from the South Coast NRM Inc.

2.6.6 Local Governments

A number local government authorities (LGAs) are contributing to the management of *Phytophthora* dieback. Examples include, but are not limited to:

- Establishment and implementation of the Shire of Denmark *Town Planning Scheme No.3* Policy No. 1 Dieback Disease Management (Shire of Denmark 1997);
- Development of a *Local Area Stakeholder Engagement and Phytophthora Dieback Action Plan – Esperance (East)* by the Shire of Esperance in conjunction with the South Coast NRM Inc;
- Development of a *Phytophthora* dieback policy by the Shire of Ravensthorpe with support from the South Coast NRM Inc; and
- Installation of *Phytophthora* Dieback Hygiene Stations for walkers in local reserves by the City of Armadale.

2.6.7 Mining

There are several mining approval processes through which conditions can be placed to undertake *Phytophthora* dieback management. These are:

- Permits to undertake land clearing;
- State Environmental Impact Assessment processes;
- Exploration licences; and
- Mining leases.

Mining interests exploring in areas that receive more than 450 mm in the south west of Western Australia are required under DoIR policy to produce a dieback management plan. This occurs through a condition placed on the mineral exploration license by the Minister for State Development (DoIR 2006).



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Many large mining projects in Western Australia operate under a State Agreement Act. This provides an avenue through which the State Government can place conditions for *Phytophthora* dieback on a mining proponent. Alcoa Australia Limited, Tiwest Joint Venture and Iluka Resources Limited all have conditions placed on them. They are all expected to conduct research where appropriate.

Mining companies contribute to the management of *Phytophthora* dieback through appropriate hygiene management practices, staff training, and research (e.g. eradication trials, modes of action of phosphite).

2.6.8 Research

The Centre for Phytophthora Science and Management

The Centre for Phytophthora Science and Management (CPSM), based at Murdoch University, was launched in 2003. The CPSM is a collaborative effort between scientists, government agencies and industry to provide science, management and training to ameliorate the threat posed by *Phytophthora* dieback. Recent research includes the interaction between fire and *Phytophthora* dieback, survival of *P. cinnamomi* in black gravel soils, the interaction between fire and *P. cinnamomi* expression on infested sites, spread of *P. cinnamomi* in water bodies, impact of *P. cinnamomi* on native fauna, the potential of eradicating *P. cinnamomi* from spot infestations, understanding how phosphite induces plant defence mechanisms at a molecular and biochemical level, the contribution by wild pigs to the spread to *Phytophthora* dieback, identification of new *Phytophthora* species, and studies on their biology, ecology and pathology, fishing for *Phytophthora* to determine what *Phytophthora* species are present in water bodies around Western Australia, and determining if *Phytophthora* species are associated with declines in *Eucalyptus rudis*, *Agonis flexuosa*, and *Corymbia calophylla*.

Dieback Information Group

Formed in 2001, the Dieback Information Group (DIG) organises an annual conference where stakeholders (e.g. government agencies, industry groups, researches, local government and conservation groups) share the latest research and advancements in the management of *Phytophthora* dieback in Western Australia.



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3. METHODS

3.1 Multiple-Case Study Design

Case studies are a preferred research strategy when “how” or “why” questions are being posed, when the researcher has little control over events and when the focus is on contemporary phenomenon within some real-life context (Yin 1994).

The assessment employed a descriptive multiple-case study design. Evidence from multiple cases is considered more compelling, and the overall study is therefore regarded as more robust (Herriott and Firestone 1983). Table 3.1 indicates how issues of construct validity, external validity and reliability were addressed in the research design.

Table 3.1 Case study tests

Test	Approach
Construct validity	Use of multiple sources of evidence. Key informants reviewed case study notes.
External validity	Use of multiple cases rather than one case.
Reliability	Application of a case study protocol for data collection. Development of a case study data base from interview notes.

3.1.1 Selection of case studies

The following considerations were used to select the cases for in-depth analysis:

- Each case is from a different DEC district;
- At least one case needed to include Disease Risk Areas; and
- The cases collectively allow an examination of the key human vectors of *Phytophthora* dieback transmission (i.e. forestry, road works, mining, recreation and fire management).

The four cases chosen were Lesueur National Park, Wellington National Park, Fitzgerald River National Park and Stirling Ranges National Park (Table 3.2, Figure 3.1). The case studies are documented in Chapters 4-8.



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Table 3.2 Selected case studies

Case Study	DEC District	Key Factors	Reasons for selection
Lesueur National Park	Jurien	Roads	Is on the sandplains with different disease expressions than in the south. TECs present. Infestations near the park including along roadways. Construction of the Park's loop road did not follow all DEC <i>Phytophthora</i> dieback management guidelines. This area has low visitor usage.
Wellington National Park	Collie	Recreation	High visitor numbers for recreation. Impacted by illegal activities – pig hunting, informal camping, 4WD, firewood collection. Major infrastructure put in place – with strict <i>Phytophthora</i> dieback hygiene. Disease Risk Areas. Surrounded by forest.
Fitzgerald River National Park	Albany	Fire and roads	One of only two International Biosphere Reserves in WA. Bell Track infestation Proposed new road through the Park Mostly <i>P. cinnamomi</i> free but surrounded by <i>Phytophthora</i> infestations.
Stirling Range National Park	Albany	Recreation and fire	Park is mostly infested. Proximity to Fitzgerald River National Park. TECs present.
Alcoa of Australia, Huntly Mine		Mining	They have been managing <i>Phytophthora</i> dieback since 1963. They have achieved an admirably low rate of spread considering the amount of earth moved in an infested part of the forest. They have been actively involved in R&D They openly communicate their methods, research findings and successes/failures.



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Figure 3.1

Map of case study locations



3.1.2 Key questions

The following questions were examined in each case study:

1. How effective are the various elements of the *Phytophthora* dieback management hierarchy?
2. To what extent are the *Phytophthora* dieback Best Management Practices (BMPs) being applied?
3. What are the barriers to successful *Phytophthora* dieback management?
4. How is the success of the *Phytophthora* dieback management efforts determined?
5. How is the adaptive management process realised?
6. How effectively does the DEC collaborate with other *Phytophthora* dieback management stakeholders?



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3.1.3 Sources of Evidence

Interviews

The list of stakeholder interests to be covered by the interviews was developed in consultation with the Conservation Commission. Key *Phytophthora* dieback management interests consulted through the interview process were:

- DEC
- Local governments
- Road construction
- Mining
- NRMs
- Recreation
- Ecotourism
- Apiary industry
- Regional or local *Phytophthora* dieback groups.

In addition to interviews with stakeholders associated with a specific case study, the study team conducted interviews with:

- Individuals with a long involvement with *Phytophthora* dieback management in WA; and
- Individuals who represent interests that cut across the case studies.

In total, 56 individuals were interviewed (Appendix A). A pair of researchers conducted most interviews. One researcher led the interview while the other took handwritten notes. Where feasible, the interviews were conducted face-to-face at a location convenient for the stakeholder. A small number of interviews (i.e. 3) needed to be conducted by telephone. Some stakeholders on the initial list of potential interview subjects were not interviewed due to their unavailability or if they indicated they could not make a useful contribution to the study.

Prior to an interview, the stakeholder received a brief background document outlining the purpose of the study and the topics to be covered. The interviews were semi-structured with all interviews covering the same set of themes. The use of an interview guide aided in the systematic collection data across interviews and case studies.

All those interviewed signed a Murdoch University human ethics subject's consent form.

Document Review

For each case study, relevant documents were reviewed. This included park management plans, annual reports, recovery plans, EPA bulletins, consultant reports, policies, guidelines and legislation. The documents provided background information in advance of the interviews and were used to corroborate evidence from other sources (i.e. interviews and site visits).



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3.1.4 Data Management

The typed interview notes were sent to the person interviewed for their comment. The data collected in the interviews were entered into an Excel spreadsheet and organised by theme. The study team reviewed the typed interviews at least three times to identify additional themes not contained in the original interview guide.

3.2 Evaluation of the Best Management Practices

3.2.1 Purpose

A purpose of this document is to determine how effectively the DEC have complied with legislation, regulations and policies that apply to the management of *Phytophthora* dieback in Western Australia. This includes the effectiveness of adaptive management procedures that have developed from common sense, experience, research, monitoring and the adjustment of practices based on what has been learnt. In the process the following aspects of *Phytophthora* dieback management (based on the '*Best Practice Guidelines for the Management of the Threat to Biodiversity Posed by Phytophthora cinnamomi and Disease Caused by it in Native Vegetation*' guidelines) will be assessed:

- Use of adaptive management;
- Detection, diagnosis, demarcation and mapping of infested areas and the identification of un-infested areas;
- Assessment of the threat to the conservation of biodiversity posed by *P. cinnamomi* including areas of high conservation value that are uninfested;
- Analysis and evaluation of the risk of *P. cinnamomi* into uninfested areas;
- Identification, evaluation and application of effective and efficient risk treatment measures to limit the risk of *P. cinnamomi* being introduced into uninfested areas;
- Analysis of planning for, and the implementation of, the long-term management of uninfested areas;
- Application of repeated treatments of phosphite to protect, where possible, susceptible threatened species, threatened ecological communities and the habitat of threatened fauna;
- The planning and implementation of measures for restoration of serious environmental damage in infested area, including recovery or re-introduction of populations of threatened flora and where necessary ex-situ conservation of genetic resources; and
- Identification of the need for appropriate programs for public consultation and education for the provision of information.

These were evaluated through the five case studies (Table 3.2) and more generally through the interview process.



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3.2.2 Alcoa Australia's Experience

No industry proponent in WA has been more active in *Phytophthora* dieback management research than Alcoa of Australia, Ltd. It has had to manage the risks associated with bauxite mining in the jarrah forest where *P. cinnamomi* has been widespread. Chapter 8 documents the lessons from Alcoa's *Phytophthora* dieback management programs, including a research and development (R&D) program in operation at Alcoa's largest mine, Huntly near Dwellingup, since 1990.

3.3 Study Limitations

3.3.1 Workshops

The original study design included several regional workshops to obtain additional data on the case studies and further explore with the DEC and other stakeholders' key issues arising from the stakeholder interviews. In October, the Conservation Commission decided not to proceed with the workshops due to budgetary constraints. The gap created by the loss of the workshops was partially filled by additional telephone interviews with regional staff and face-to-face interviews with senior DEC managers in Perth.

3.3.2 The Forest Management Plan 2004 – 2013, KPI18 Review

The review of the DEC effectiveness in meeting the Forest Management Plan's Key Performance Indicator (No. 18) had yet to be completed at the time of our study. This will determine the effectiveness of hygiene management and will evaluate the need for revision of management practices in the context of its assessment and auditing function.

3.3.3 Reliance on handwritten notes

The original study design included tape recording all interviews to complement the handwritten interview notes. In the initial round of interviews, some individuals refused the request to tape record their interviews. The request to allow tape recording was subsequently dropped from the remaining interviews. The accuracy of the notes was confirmed by sending the type written notes to the individual interviewed providing them an opportunity to correct any errors or omissions.



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4. FITZGERALD RIVER NATIONAL PARK

4.1 Background

Fitzgerald River National Park (FRNP) covers an area of about 329,039 ha and lies on the central south coast between Bremer Bay and Hopetoun in the Shires of Jerramungup and Ravensthorpe. The Park is one of only two International Biosphere Reserves² in Western Australia. Officially gazetted in January 1973, the Park has been described as “the most important Mediterranean ecosystem reserve in the world³”.

The vegetation varies from woodland on the richer soils through to mallee and mallee heath. The flora of the Park is exceptionally rich and diverse, containing over 20% of WA's plant species. There are more than 1800 species of plants including 62 endemic plant species including 17 Threatened flora species. Many species are either very rare or geographically restricted. The Park holds the most complete mammal fauna (22 species) in the southwest. The Park is one of the State's most important in terms of faunal conservation, with seven declared rare native mammals, over 184 species of bird, 41 species of reptile, 12 species of frog and four species of inland fish, Australia's second rarest parrot, the western ground parrot, and the Western Bristle Bird are two threatened bird species in the Park.

Management of the Park is guided by the *Fitzgerald River National Park Management Plan (1991-2001)*. The Park is divided into four management zones - special conservation, wilderness, natural environment and recreation. The principal management goal is to “conserve all flora and fauna, particularly the large number of rare species and those in need of special protection”. The Plan identifies dieback disease as the “greatest management concern in FRNP” (CALM 1991 p.iv). Further, that “it cannot be stressed too strongly that the vegetation and recreation values of the Park are largely dependent on retention of the vegetation, much of which is susceptible to dieback disease” (CALM 1999 p.62).

DEC's management of the Park is aided by the Friends of the Fitzgerald River National Park⁴. An independent volunteer community group with approximately 130 active members, the Friends group organises study and recreational weekends, hosts University extension courses, undertakes flora and fauna studies and rehabilitation projects, produces educational leaflets, and supports the DEC Rangers and advocacy for appropriate management.

² The other International Biosphere Reserve is the Prince Regent River Nature Reserve.

³ Dr. Bernd von Droste of UNESCO (<http://www.gondwanalink.org/fitz.html>).

⁴ The Ongerup Conservation Organisation formed in 1971 in response to the threat of mining in the then unmanaged “C” class Nature Reserve. The group re-formed in 1980 as the Fitzgerald River National Park Association, and became the Friends of the Fitzgerald River National Park in 1999.



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A number of factors place the FRNP at risk from dieback disease:

- The area's warm, relatively moist climate;
- High clay content in the soils impedes drainage causing subsurface ponding and a suitable environment for the proliferation of the disease;
- Ponding results in muddy conditions causing infected soil to adhere to vehicles;
- Due to the clay layer, water tends to drain laterally, spreading the pathogen further; and
- Many of the access roads leading to the Park are gravel and of uncertain dieback status and management.

4.2 *Phytophthora* Dieback Status

Phytophthora dieback was first confirmed in the Park in the early 1980s (Dell et al 2005). Over 40% of the species in the Park are likely to be susceptible to infection by *P. cinnamomi* (Shearer et al 2004). A number of *Phytophthora* species other than *P. cinnamomi* are present in the Park and their role in plant deaths still need to be adequately defined.

In the early 1990s there was only one major infestation, the Bell Track infestation – this is discussed in more detail (see section 4.4). *Phytophthora* dieback infestations have since been confirmed at Susetta River within the wilderness zone, near Pabelup and there are more than three infestations outside the Park. *Phytophthora* dieback is suspected along closed tracks within the zone. *Phytophthora* dieback in a firebreak near Pabellup Drive was probably introduced by the installation of firebreaks during the 2003 wild fire. Further spread occurred in 2008, due to firebreak maintenance, wildfire operations and subsequent rehabilitation activities. The size of the outbreak is unknown, with three infestations identified up to 400 m apart. If the infestation is small, the DEC will consider killing the infested plants (and a buffer) and leaving it sterile for five years. It is estimated that the infestation is 1-4 ha in size. The CPSM will be conducting sampling in December 2009 to obtain a more accurate estimate. Much of the area is uninterpretable and has required extensive soil sampling in order to try to accurately map the infestation (W Dunstan pers comm.). A new infestation has recently been detected on Ongerup Drive just outside the Park. There are a few uninterpretable areas along the Drive. Soils sampling is required to determine the extent of the infestation.

Figure 4.1 displays the strategic mapping of dieback distribution undertaken by Project Dieback in 2008 for FRNP. With more interpretation and a review of all *Phytophthora* species isolated in and around the Park underway, a more up-to-date map will be available in 2010.

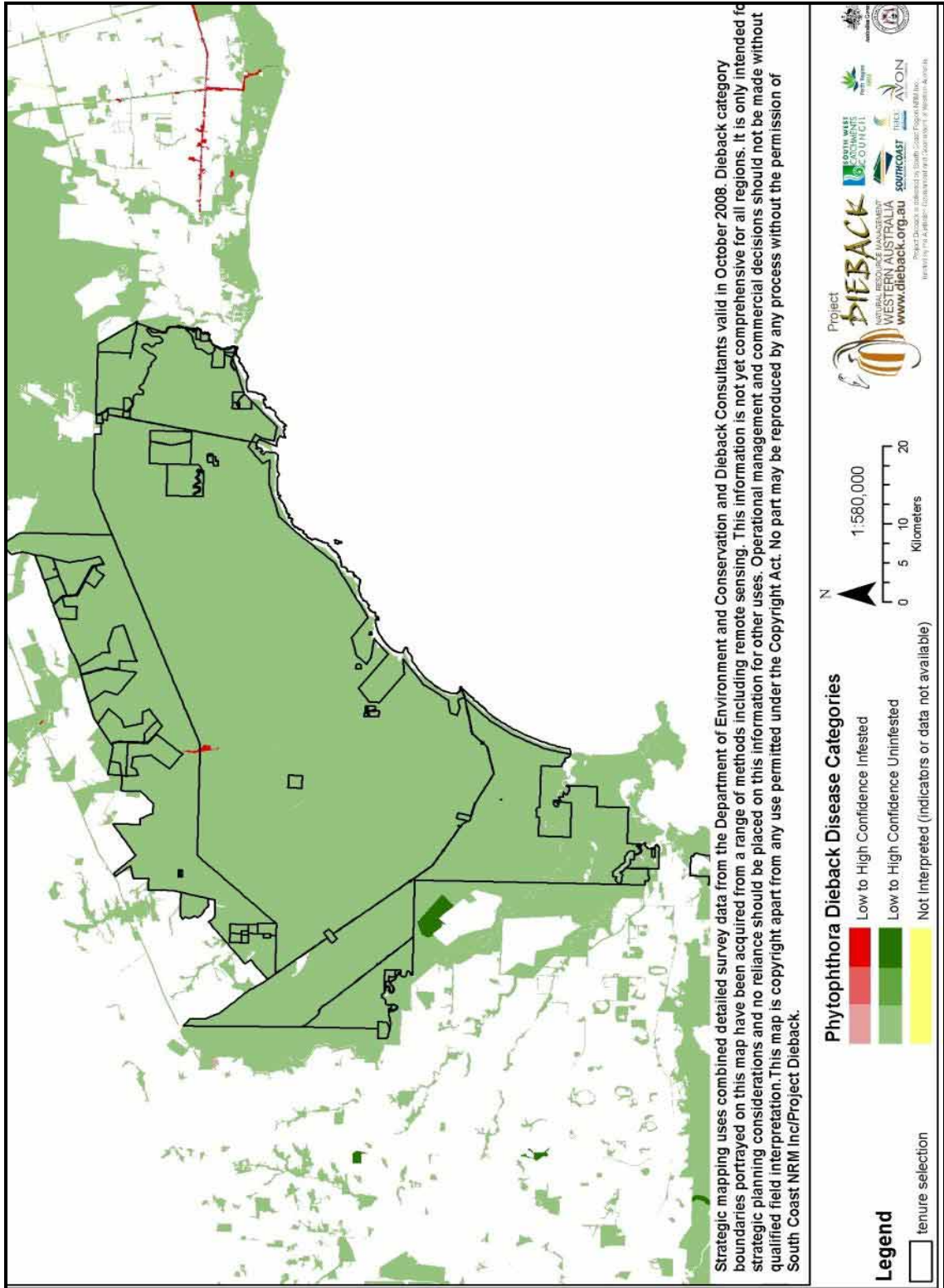


Figure 4.1 Distribution of *Phytophthora* dieback in Fitzgerald River National Park as at 2008



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4.3 *Phytophthora* Dieback Management Actions

The Management Plan contains an array of *Phytophthora* dieback management actions. Table 4.1 lists the actions and gives their status based on the case study interviews.

Table 4.1 Fitzgerald River National Park Management Plan *Phytophthora* dieback strategies and status

Strategies	Status
Produce a <i>Phytophthora</i> dieback hygiene map and regularly update with research and monitoring findings.	Produced for specific operations
Subject all proposed maintenance and development activities to the Seven Way Test.	The Seven Way Test is no longer used by the DEC.
In all operations, follow the hygiene practices given in the CALM <i>Phytophthora</i> Dieback Hygiene Manual	Predominately yes. There have only been a few new infestations in recent years.
Ensure Park staff is trained in dieback recognition, sampling and management techniques.	All new staff receive <i>Phytophthora</i> dieback training.
Exclude public vehicles from Dempster, 'Lake Nameless' and Twin Bays, Red Islet and Marshes catchments	Public vehicles are excluded. Public still access Telegraph Track/Twin Bays
Ensure 2WD roads, 4WD tracks and paths are well-located and well drained.	On-going road maintenance occurs depending on the availability of funding.
Ensure 2WD roads are all-weather and treat as a priority upgrading sections which do not meet these standards.	On-going road maintenance occurs depending on availability of funding.
Close roads, tracks and footpaths in the Park during/following rain, if they present a dieback risk	Roads are closed under variable criteria and dependent on ranger availability
Close Mid Mt Barren, Woolbernup Hill and Thumb Peak to walkers because of the potential dieback risk	Closed. However, new planned coastal walk will pose a risk to these areas.
If dieback is found on roads, tracks or footpaths, undertake one or more of the following actions: temporary or permanent closure; resurfacing to decrease water ponding; drainage to prevent ponding in side drains; and relocation lower in the landscape.	Conflict between closure and other issues (e.g. northern fireline, Quiss Road, Fitzgerald Inlet Road)
Erect permanent signs at Park entrances that can be used to indicate which roads and tracks are open or closed and the reasons why.	However the signs do not mention <i>P. cinnamomi</i> .
Place signs at trailheads, particularly for peaks, asking walkers to keep boots free of mud and provide a waterproof rubbish bin for the purpose.	A boot cleaning station and accompanying sign have been erected at the Mt. Barren trailhead (Figure 4.2).
Establish a 'Code of the Coast' in conjunction with local associations that use the Park.	Unsure of status



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Strategies	Status
Ensure that publications and displays associated with the Park explain why it is important to minimise the introduction and spread of dieback disease.	There has been virtually no interpretation regarding <i>P. cinnamomi</i> to date.
Provide washdown facilities at ranger stations. Investigate means by washdown can be achieved at all Park entrances.	The ranger stations have washdown facilities. However, the facilities not ideal and it is proposed that they be amended. There are no washdown facilities for others to use.
Accurately determine boundaries of, and regularly monitor, known infestations and develop a comprehensive description.	Infestations have been mapped and the boundaries are monitored.
Continue to survey and sample Park roads, tracks and footpaths for signs of dieback disease.	Completed in 2009.
Quantify the impact of each <i>Phytophthora</i> sp.	Work is on-going.
Focus research effort on determining practical methods for preventing dieback introduction and spread and accurately identifying high hazard locations.	This has been done, but is being investigated.
Establish a Research and Monitoring Group that includes an expert on dieback disease in South Coast vegetation (CALM 1999).	Bell Track Group established. A new FRNP <i>P. cinnamomi</i> group being formed following the Pabelup Drive infestation.



Figure 4.2

Sign at Mt Barren advising of *Phytophthora* dieback with request to clean boots near the boot cleaning station.



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4.3.1 Fire management

Over the past several decades, the Park has experienced a number of major fires, most recently in 2008. The Fitzgerald River National Park Fire Advisory Group was formed in 1994 by the Minister for the Environment to provide advice on fire prevention for the Fitzgerald River National Park.

The lessons from the 2008 Jacup fire in FRNP are now being applied in other National Parks. The 2008 fire started in a sensitive, disease free area. A DEC environmental team was set-up as part of the wildfire management response. The environmental team focused on three issues: (1) protecting threatened flora and TECs, (2) dieback management, and (3) protecting critical Western Ground Parrot habitat.

A fence already existed around the Bell Track infestation so that trucks could not drive through the infested area. The environmental team put in markers to demarcate and protect rare flora. Exclusion zones were established to protect flora and Western Ground Parrot habitat.

Currently, it takes time to compile all of the necessary information (e.g. rare flora maps, *Phytophthora* dieback maps) when a wildfire occurs, this would be easily overcome if all information was in the one place. Hence, it was not determined until day two of the fire that a DEC environmental officer was needed. However, due to the workload of the environmental officer, by day four a team was established. Prior to that there was no replacement when the environmental officer took breaks. One of the primary functions in relation to *Phytophthora* dieback management was inspecting heavy machinery before entering the Park to ensure it was clean on entry. Many contractors did not understand the meaning of 'clean on entry'. The underside of the vehicle must be appropriately cleaned. Large machinery can take up to 5 hours to clean and in some instances can require dismantling the vehicle to properly clean it.

The heavy machinery contractors know that it is a requirement to be clean when they arrive on-site. They do not get paid for time spent cleaning their vehicles and some were not happy about being told to clean their vehicle better before it could enter the Park. When problems arose, the team occasionally had to seek support from more senior officers. DEC staff noted that it would have been ideal to have a wash down facility on-site with a ramp so that the undercarriage of vehicles could be inspected and cleaned. A mobile ramp would be useful for all fires.

Those who commented on the fire environmental team viewed it positively and believe it should be a model for other parks. Management of the fire was not without its problems as it was difficult to manage the various players (e.g. DEC staff from a variety of districts, contractors, local volunteers). As yet, there has been no evidence of disease spread, however, it can take a number of years before disease symptoms are expressed; therefore, close monitoring of the sites is required over the next few years.



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Two hundred litres of Phyto-clean is being stored in the National Park. The chemical can be added to water for washing down vehicles and will be used with emergency water sources. The chemical concentration is increased for 'dirty' water. Preliminary work conducted by the CPSM in 2006 compared Methylated Spirits with Phyto-clean and found that neither chemical at a concentration of 1:10 completely controlled *P. cinnamomi* growing out of colonised millet seed after 30 secs or 10 mins contact time. Although, the latter treatment did provide good control. More work is required to determine the effectiveness of Phyto-clean, especially in infested water used for fire fighting and on infested soil carried on vehicles. However, it should still be used until alternatives are developed.

In the past Jacup Dam was used to provide water for fire fighting in the Park. Because the surrounding soils are infested with *P. cinnamomi*, water from the dam will unlikely be used for fire fighting purposes as DEC staff are unsure about the *P. cinnamomi* status of the water.

4.3.2 Access

The Park Management Plan requires that "dieback control receives the highest priority in any access considerations" (CALM 1999 p.99). There are two 2WD loops plus spurs within the Park, with the remaining Park roads and tracks suitable for 4WD only. *Phytophthora* dieback management strategies are described in Table 1. Several road segments have been upgraded to bitumen in recent years (e.g. between Culham Inlet and Hamersley Inlet).

The DEC has "no control over the *Phytophthora* dieback status of roads outside the National Park and therefore has no control over the potential of vehicles to carry dieback and infected soil under wet conditions. This makes vehicle cleanliness a critical issue" (CALM 1999 p.62).

There is a wash down bay at the DEC offices in Albany for the DEC vehicles and each ranger station has a washdown facility. The DEC wash down facility in Albany needs to be modified so that the water does not run-off into the local stormwater drain. The DEC staff generally notify on-site rangers when going into the Park. Rangers provide up-to-date hygiene requirements.

The lack of wash down facilities for Park visitors is viewed by many stakeholders as a limiting factor in efforts to prevent the importation of *Phytophthora* dieback on vehicles. Non-DEC stakeholders made a number of suggestions and observations including:

- Using incentives such as free Park entry to encourage visitors to wash the vehicles at the car wash in Hopetoun before entering the Park;
- Rather than closing roads when there are "only a few puddles", the road should be sealed (bituminised) to allow access to remain open;
- When the DEC rangers erect gates to stop public access, some people go around the gates; and
- Two DEC Rangers are insufficient to adequately monitor the tracks (e.g. Drummond Track and Telegraph Track) for illegal access.



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In 2009, the State Government announced plans to construct a new road to improve tourist access from the western and eastern ends to the Fitzgerald River National Park. The project includes the reconstruction and sealing of existing roads including Hamersley Drive (from Hopetoun to Hamersley Inlet) and Bremer Bay to Point Ann. A tourist walk trail will be developed as part of the project.

Road construction will be undertaken by Main Roads WA which will engage local contractors. Main Roads indicated that is aiming to work with the DEC to ensure that appropriate precautions are taken to reduce the potential to spread *Phytophthora* dieback and protect biodiversity values. A former DEC interpreter has been contracted to conduct the disease assessment and a hygiene management plan will be prepared and implemented. Gravel pits will also be interpreted before gravel is extracted.

Construction is planned to start in January 2010 and will occur in stages to enable environmental issues to be managed. Stage 1 involves sealing and upgrading the existing tracks at either end of the Park and would be completed in 2011. Stage 2 involves constructing the middle section of the road through the Park. The proposed road works require approval under the EPBC Act. Approval has already been granted for the Hopetoun end of the road. Due to the environmental sensitivity of the FRNP, Stage 2 will require amendments to the Park's Management Plan (Commonwealth Parliamentary Debate 2009).

These road plans have attracted considerable opposition from some quarters. The Friends of Fitzgerald River National Park are vigorously opposed to the proposed road from Bremer Bay to Hopetoun. Their concerns include the likelihood of *Phytophthora* dieback introduction; impacts on pristine catchments; impacts on rainfall run-off and infiltration; and impacts on rare flora and rare fauna. The Wilderness Society (WA) Inc, WA Conservation Council and The Greens Party have also expressed their opposition.

4.4 The Bell Track Infestation Management

This infestation commenced in the early 1970s through the illegal construction of a track for mining exploration. A report containing all details of the Bell Track infestation is currently being prepared for a peer-reviewed publication expected to be completed in 2010. Here we present a brief outline of some of the history and management actions taken to date.

By 1991, it was a linear infection of more than 6 km. Since then, it has spread considerably and is now present in the Dempster catchment to the east and the Susetta Creek catchment to the west of Bell Track. By 1997, the infestation covered 175 ha. The infestation occurs in a micro-catchment and threatens to spill over into a much larger area, putting many thousands of hectares of flora in danger from *Phytophthora* dieback.

In March and April 1997, a 225 ha 'envelope' encompassing the entire infestation plus a buffer were aerially sprayed with phosphite. The area was sprayed again in 2000, then approximately every 18 months to two years since 2004. In 2007/2008 a high intensity



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phosphite application was used on approximately 4 - 5 km of dieback front. Regular interpretation was undertaken. Interpretation occurs every two years at the edge of the infestation to document the rate of spread.

A preliminary *Phytophthora* dieback survey was undertaken in response to high summer rainfall (summer 2006/2007), which had resulted in the major disease extension in the south-east corner of the existing infestation. By April 2009, *Phytophthora* dieback was estimated to affect 212 ha (C Dunne pers comm.). From the survey, the DEC was able to gain confidence that the disease had not yet escaped the micro-catchment (Figure 4.3). Figure 2 displays the cumulative spread of *Phytophthora* dieback along the disease front of the Bell Track infestation in relation to total annual rainfall in Fitzgerald River National Park, high summer rainfall events, phosphite applications, fence instalment and containment barriers.

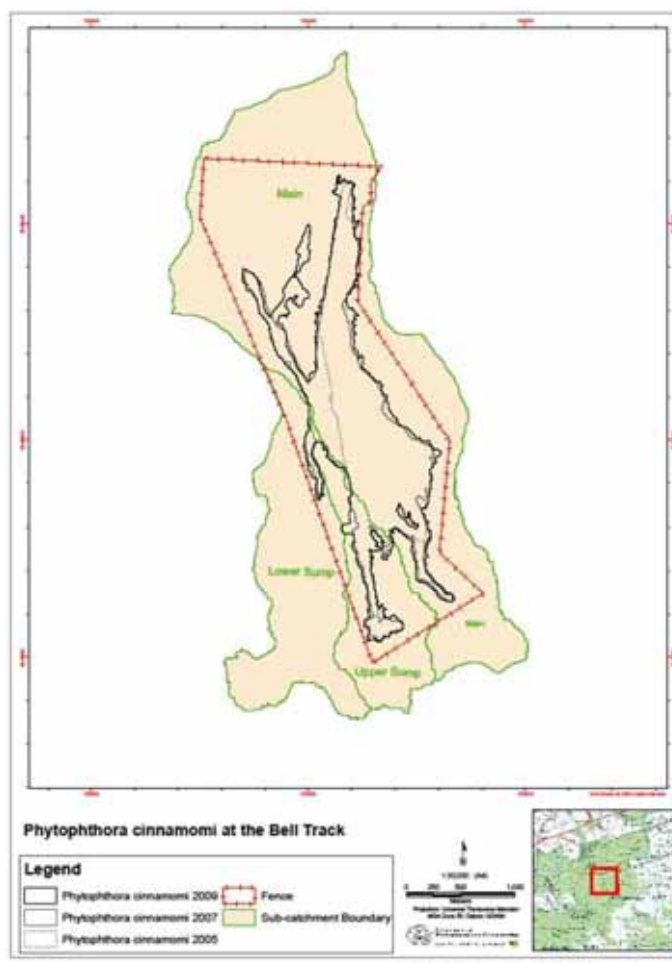


Figure 4.3

Map of the Bell Track *Phytophthora* dieback infestation in the Fitzgerald River National Park (2005-2009), showing fence, and spread attributed to heavy rainfall in summer of 2006/2007.



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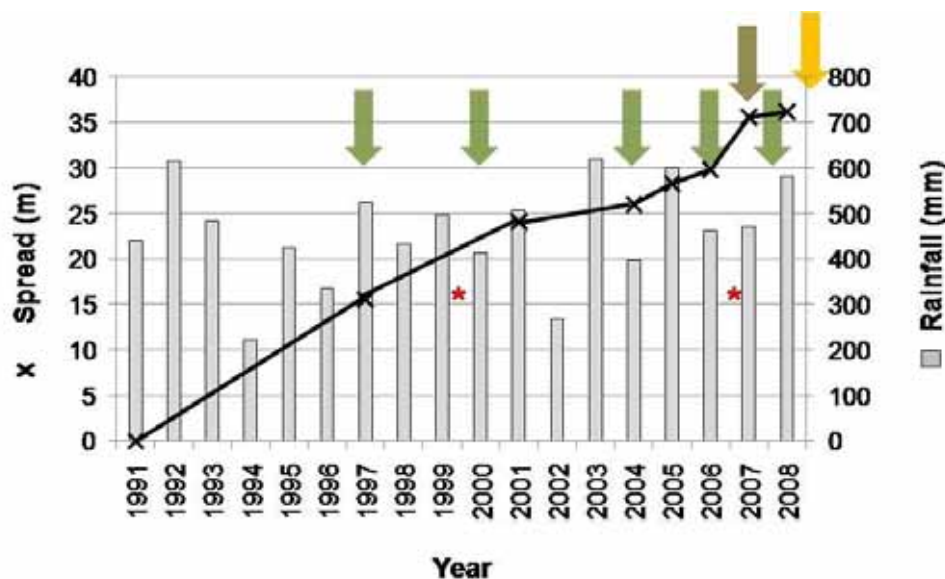


Figure 4.4 Cumulative spread of *Phytophthora* dieback along the disease front of the Bell Track infestation and total annual rainfall in the Fitzgerald River National Park. Treatment and containment measures are shown: green arrows - phosphite application; brown arrow - fence installed; orange arrow - containment barrier installed. Spread was determined from average of 9 measurements taken along the front. Data courtesy of S Barrett, DEC Albany. The red * indicate summers when rainfall recorded was twice the average ($84.7 \pm 34.9^\circ\text{C}$) summer rainfall (from Jacup station 10905). Data from BoM, Perth.

In 2006, a Response Plan for the management of the *P. cinnamomi* infestation at Bell Track, Fitzgerald River National Park was prepared (Barrett and Grant 2006). Actions included the application of phosphite, fencing, hydrological studies, eradication plans, fire and vegetation management plans, and a communication strategy and action plan.

In June 2006, the Biodiversity Conservation Initiative (BCI) – *Last Stand at Bell Track – Saving the FRNP* (DEC 2006) superseded the Response Plan. The primary objective of the initiative was to prevent the autonomous and vectored spread of *P. cinnamomi* outside the micro-catchment in which it is currently contained. Between 2006-2009 \$3 million has been spent on these management actions (C Dunne pers comm.).

Surface water diversion arresters and soil erosion measures were originally established in 1997. To reduce the spread of the pathogen, hydrology investigations were undertaken between 2006 and 2009. This included catchment volume calculations, data recording, ding bund maintenance, and maximising rainfall interception and evapo-transpiration on the infested site (DEC 2006).



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Some of the spread in the catchment was attributed to summer rains (i.e. unseasonal rainfall events). In some areas (e.g. in areas where low density shrubs and sedges were re-growing) *P. cinnamomi* tolerant species were planted to help manage surface water.

A high resolution digital elevation model was developed to determine the potential impacts of various rainfall scenarios on the spread of the disease within the Park (e.g. potential flow patterns). However, it was been found that a few of the original assumptions used in developing the model are incorrect (e.g. depth of sumps). The model has not yet been re-run with this new information.

In 2007, a 12 km fence was constructed around the entire Bell Track infestation to prevent animals such as kangaroos from spreading the disease. Kangaroos within the fenced area were removed. The fence also stops accidental human incursion during wildfire emergency response and other Park operations.

A three km plastic membrane, with a buffer zone where the vegetation has been removed, was installed in 2009 to prevent plants spreading *P. cinnamomi* through root-to-root transmission. A root-inhibiting chemical dispersion system was added to the installation trenches to discourage deeper roots growing under the membrane, and localised applications of the fungicides Terrazole and metham sodium have been completed (Dunstan et al 2009).

Limited monitoring of effectiveness has been completed. While some of the work currently planned along the Bell Track will be carried forward, "some of the activities may be ineffective". The example provided was the project designed to eradicate *Phytophthora* dieback through a chemical and physical barrier (membrane). The physical and chemical barriers did not extend deep enough to stop root spread under the plastic membrane. However, this still needs to be tested. Opportunities still exist to stop potential root spread through the delivery of herbicides and fungicides at the barrier interface.

Some stakeholders indicated that the work at Bell Track has monopolised the *Phytophthora* dieback management focus in FRNP. The committee overseeing the project will soon be re-convened to look at options for moving forward. There is a perceived need to look at the entire Park in terms of conserving biodiversity values and the potential impact of *Phytophthora* dieback.

4.5 Management Resources

Poor resourcing of the National Park, leaves the 330,000 ha Park with only two on site Rangers. The DEC Albany District has applied for additional funding for three key projects: for the Bell Track, for the Pabelup Drive infection, and for aerial phosphite spraying of priority sites.



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External organisations have helped in funding *Phytophthora* dieback management projects. The South Coast NRM Inc funded the digital and hydrology models for the Fitzgerald River National Park. However, the prospects for further funding from the Federal Government are poor as *Phytophthora* dieback has not been included in *Caring for Country*.

The South Coast NRM Inc has provided funds for developing a local *Phytophthora* dieback strategy for the Shires of Ravensthorpe and Jerramungup. While this is welcomed by local governments, they have over stretched budgets, thus any proposed actions must be “realistic and affordable” and “accompanied by potential funding streams”.

The South Coast NRM funded the preparation of the *Phytophthora Dieback Management Plan for the South Coast Region 2010-2017* (SCNRM 2008), strategic plan to help coordinate and direct the efforts of many stakeholders in managing *Phytophthora* dieback. The 25 year plan sets priorities for managing dieback in the region. The first 7 years of implementation would cost \$14 million but at this stage there is no money to implement the plan. *Phytophthora* dieback interpretation and mapping updates (biannually) should be conducted to ensure accurate records of rates of spread and new incursions are kept.

4.6 Conclusion

The Fitzgerald River National Park is one of two International Biosphere reserves in WA. It has significant flora and fauna species diversity, with many of the plant species and communities being susceptible to *Phytophthora* dieback. The Park is surrounded by *Phytophthora* dieback infestations, with some infestations present in the Park itself. Together, with increasing visitor use, increasing fire events and management, a warm moist climate, the incidence of extreme summer rainfall events and soils with high clay content, the Park is significantly threatened by continued *Phytophthora* dieback infestations. Consequently, proactive and continued best management practices are vital. This is especially so, now a new road is to be built to improve tourist access from the western and eastern ends to the Fitzgerald River National Park. The *Fitzgerald River National Park Management Plan (1991-2001)* identifies dieback disease as the “greatest management concern in FRNP” and dieback control must receive the highest priority in any access considerations. The presence of other *Phytophthora* species in the Park require consideration in terms of their pathology, host range, survival and management.

There is significant support for the management of *Phytophthora* dieback in the Park from the Friends of the Fitzgerald River National Park and the South Coast NRM. These provide significant activities to increase the awareness and participation of the wider community and consequently huge opportunities to disseminate information on *Phytophthora* dieback and its management. The Management Plan is comprehensive with regards to *Phytophthora* dieback with strategies, actions and status of actions (including dieback mapping, training, road/track closures, road maintenance, fire management, signage, and communication tools) for its management clearly articulated.



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Fire management is, and will remain, one of the biggest threats for the introduction of *Phytophthora* dieback into uninfested areas of the Park. However, significant lessons have been learnt from recent wildfire management (particularly the 2008 wildfire) with regards to *Phytophthora* dieback, and the fact that intensive reviewing of the recent fires in relation to *Phytophthora* dieback has occurred is positive. It remains to be seen if these lessons will be implemented in the future.

The Bell Track infestation, though inadequately managed in the early 1970's when opportunities were available to control a small infestation (which is now large), has presented an ideal case study for the implementation of monitoring, mapping (including Digital Multi-Spectral Imagery and, digital elevation modelling), GIS modelling, development of climate change scenarios, phosphite treatments, containment and eradication, fire management and restoration to reduce ground water levels and surface flows. It has allowed for best management practices to be undertaken and learnt from. Consequently, the Bell Track study has, and will continue to, provided enormous opportunities to effectively manage *Phytophthora* dieback elsewhere when infestations occur. The Bell Track infestation should be considered as a 'world first' with regards to active implementation of 'best management practices' relating to a soil-borne plant pathogen in a natural ecosystem.



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5. LESUEUR NATIONAL PARK

5.1 Background

Lesueur National Park contains more than 820 species and represents 10% of the State's known flora. The National Park was gazetted as a Class 'A' reserve (No. 42032) for national park on 24 January 1992. The 26,987 ha Park is located 23 km north east of Jurien in the Shires of Dandaragan and Coorow.



Lesueur National Park

(Photo: K Howard)

The Lesueur-Coomallo area ranks as one of the three⁵ most important areas for flora conservation in southwest Western Australia (Burbidge et al 1990). The National Park contains more than 820 species and represents 10% of the State's known/described flora. It contains at least 5 endangered species, 7 species of declared rare flora, 9 endemic taxa, 111 regionally endemic taxa and 81 taxa at their geographical range. The Park is a rich habitat for 15 species of native mammals, including four species of dunnart, four species of bat and it is prime honey possum habitat. In addition, there are more than 50 species of reptiles, nine frog species and more than 120 species of birds. These woodlands are important for birds such as cockatoos and corellas, including one of the few remaining breeding habitats in the district for Carnaby's black cockatoo (CALM 1995).

⁵ The other two most important conservation areas are the Stirling Range and Fitzgerald River National Parks.



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The *Lesueur National Park and Coomallo Nature Reserve Management Plan (1995-2005)* describes *Phytophthora* dieback as the greatest management concern in the Park and Reserve. In the longer term, “dieback disease has the potential to degrade the ecosystems of these areas more than fire because plant species and community losses are permanent” (CALM 1995 p.28).

There are no DEC rangers based in the National Park. Parks and Visitors Services staff monitors the Park once a week and collects rubbish.

5.2 *Phytophthora* Dieback Status

The National Park and its surrounds are at risk of *Phytophthora* dieback disease due to the following factors:

- Much of the regional flora is highly susceptible to the disease;
- The area’s warm, relatively moist climate favours the production of spores, particularly the five months of winter, provides time for *Phytophthora* dieback to become established and spread;
- Harsh summer conditions do not preclude the survival of the pathogen once inside plant tissue or in moisture gaining sites in the topography;
- Soil horizons may impede drainage allowing water to drain laterally spreading the pathogen further; and
- Muddy conditions in winter can cause infected soil to stick to vehicles.

There are no known infections of *P. cinnamomi* in Lesueur National Park, but at least three infections of *P. multivora* (formerly thought to be *P. citricola*) have been reported (CALM 1995). *P. multivora* is able to establish on drier sites but usually has less impact on vegetation than *P. cinnamomi*. The roads servicing and surrounding the Park all exhibit signs of infection at various points (CALM 1995). One of the *P. multivora* infections occurs along Cockleshell Gully Road. Spot infections of *P. multivora* and *P. sp. 9* (formerly attributed to *P. megasperma* var. *megasperma*) and *P. drechsleri*, a less common species, have been recorded along Jurien Road.

The loop road in the National Park was interpreted in 2004, during construction, and all fire breaks east of Cockleshell Gully Road were interpreted in 2007 with a reinterpretation of the loop road. There were no positive recoveries of any *Phytophthora* species.

Given the activities that occurred in the area before the Park was established (i.e. raising of horses and mining exploration), some stakeholders were surprised that Lesueur National Park is not infested with *P. cinnamomi*. It was speculated that the lack of infestation may be due to climatic factors (e.g. no summer rains).

In 2008, Project Dieback undertook strategic mapping of dieback distribution as part of the Dieback Atlas. Figure 5.1 displays the current understanding of the distribution of *Phytophthora* dieback in Lesueur National Park and its surrounds.

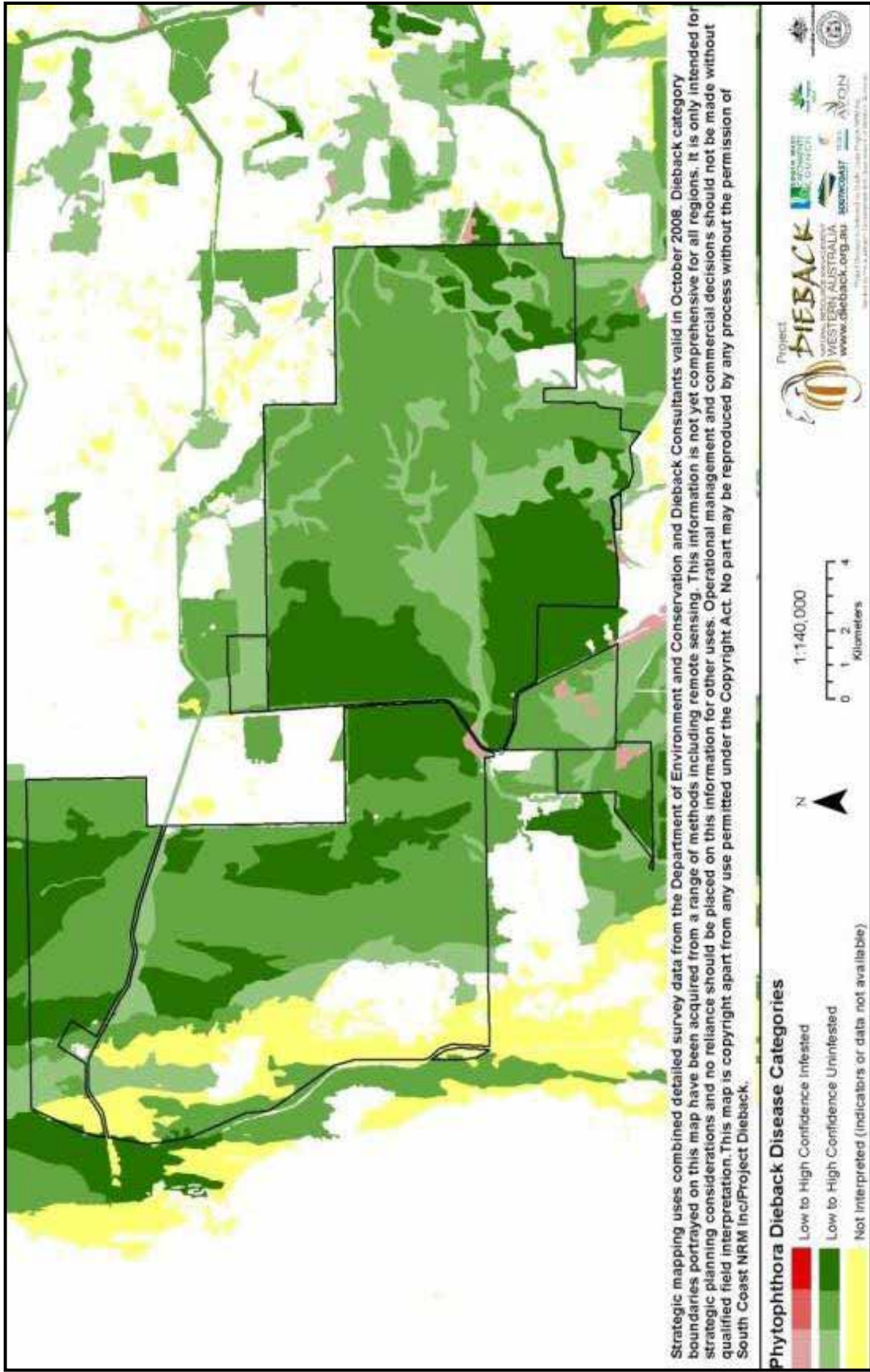


Figure 5.1 Distribution of *Phytophthora* dieback in Lesueur National Park as at 2008.



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5.3 Dieback Management Strategies

The Park's *Phytophthora* dieback management objective is "to prevent introducing plant diseases into disease-free areas and to control their spread where they are already present" (CALM 1995 p.23). Managers apply Policy Statement No. 3 and the Moora District Dieback Protection Plan. Table 5.1 displays the other dieback management strategies listed in the Park's Management Plan and their current status.

Table 5.1 Status of the Lesueur National Park Management Plan with regards to *Phytophthora* dieback strategies at November 2009.

Management Plan dieback strategies	Status
Continue to investigate, and regularly monitor, known infections.	Moora District is developing a <i>Phytophthora</i> dieback plan to support the Park's Management Plan.
Implement a program of opportunistic survey to determine whether other infections occur.	Three DEC vehicles have sampling kits. Most staff are trained in sample collection in case they suspect they have found an infestation. They usually process 10-12 samples a year.
Instigate control and eradication procedures while not placing other areas or values at risk.	At present there are no infestations of <i>P. cinnamomi</i> within the Park, however, other <i>Phytophthora</i> species have been found.
Train staff in dieback recognition, sampling and management techniques.	Staff training has occurred.
Include disease management specifications in contract documents and job prescriptions where appropriate.	Hygiene requirements (e.g. clean on entry) are part of contracts with heavy equipment operators.
Close particular areas, roads, tracks and walks if the presence of dieback is suspected or confirmed, or if a high risk of introducing dieback is identified.	Signs are posted on management tracks where no access is allowed due to dieback management (Figure 5.2).
Inform Park users about dieback and its management, and why it is important to prevent its introduction and spread.	A boot cleaning station and signage were added at the bushwalking trailhead in 2006 (Figure 5.4).
Investigate means by which cost effective and efficient wash down facilities for public use can be installed, especially at the entrance to Lesueur National Park.	No vehicle wash down station has been installed.



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Figure 5.2

Restricting access to area with *Phytophthora* in Lesueur National Park

(Photo: K Howard)

A Conservation Commission performance assessment of the Lesueur National Park and Coomallo Nature Reserve Management Plan revealed that

...overall management of the area had been effective in providing for both conservation and recreation outcomes within a relatively constrained budget. However, there had been relatively poor implementation of dieback hygiene planning requirements as it was found that during the construction of a road in Lesueur National Park a hygiene management plan had not been developed (Conservation Commission of WA 2007 p.26).

In response, the DEC's Moora District is developing a *Phytophthora* dieback plan that will support the existing Park Management Plan by formalising much of what is already occurring.

5.4 TECs and *Phytophthora* Dieback

P. cinnamomi is a potential threat to the critically endangered *Grevillea batrachioides* and the vulnerable *Hakea megalosperma*. The Interim Recovery Plan for Mt Lesueur *Grevillea* (*Grevillea batrachioides*) notes that changes in habitat structure caused by *Phytophthora* dieback may impact the *G. batrachioides* population (Stack and English 2002).

In 2000, the Lesueur-Coomallo Floristic Community D1, a species-rich low heath, was assessed as a Critically Endangered Threatened Ecological Community (TEC). The TEC is only known from one 0.1 ha occurrence on private freehold land immediately adjacent (south) to Lesueur National Park. Dieback disease is a serious threat as there are a high number of susceptible species in and surrounding the TEC. The Interim Recovery Plan includes monitoring, at least every five years, of the location of the moving front of the *Phytophthora* infestation near the TEC and assessing the need for disease treatment (Hamilton-Brown 2002).



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5.5 Fire Management

The Management Plan recognises fire management as a potential vector of *Phytophthora* dieback spread. It notes that the construction and maintenance of mineral earth firebreaks must be kept to a minimum, and only conducted in summer, to reduce the risks associated with soil movement. Fire protection strategies are to use 'open edge' techniques rather than traditional methods of burning between parallel mineral earth breaks in order to minimise the risk of introducing *Phytophthora* dieback (CALM 1995).

During planning phases of a prescribed burn, the DEC completes a checklist of environmental issues for consideration in the planning process, including *Phytophthora* dieback disease. The documentation is signed off by the DEC's Nature Conservation Coordinator and District Manager. Hygiene practices are required for prescribed burns. If a prescribed burn is to occur next to an infested area, the infestation boundary is to be demarcated by tape and vehicles are not to enter the site via the infested area.

Prescribed burns in the Park are managed primarily by DEC staff with volunteers occasionally asked to provide assistance. This was described as a good team building opportunity in advance of a wildfire situation occurring. Pre-burn briefings of involved persons include the application of appropriate *Phytophthora* dieback management measures.

There is a DEC briefing for all wildfires that addresses issues such as *Phytophthora* dieback and rare flora. When wildfires occur, such as the 5,000 ha fire in 2007, the DEC uses contract earth moving machinery and operators. The same contractor is used for all fires and to maintain firebreaks in the park. There is a contract requirement that machinery arrive clean on entry. The contractor is aware of *Phytophthora* dieback and its management requirements, but has not had formal training.

The DEC often supervises the firebreak work and can inspect machine hygiene. The DEC staff indicated that interpretation is not always required when doing maintenance on firebreaks because much of this work is done during dry soil conditions when the risk of spread is low.

The planned *Phytophthora* dieback management plan for the Park will include a specific attachment addressing requirements and procedures for all fire fighting in the park.

5.6 Roads

Establishment of Lesueur National Park effectively opened up a recreation resource that up to that time had a low level of use (i.e. 4WD-based activities, and informal camping and bushwalking). The Park Management Plan notes that in providing Park access the most important consideration is the possible impact of *Phytophthora* dieback.



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In order to minimise the spread of the disease, vehicle activity must be strictly controlled, and road alignments, wherever possible, should remain low in the landscape. Visitor numbers are expected to increase as the area becomes better known, increasing the risk of dieback being brought in or spread in the Park. If current access is not rationalised and visitor numbers increase as expected, the risk of introducing and spreading dieback in the Park and Reserve will be greatly increased (CALM 1995 p.35).

Measures in the Park Management Plan to reduce the risk of spreading *Phytophthora* dieback include:

- Restricting the use of vehicles off-road in Lesueur to the low hazard natural environment zone west of Cockleshell Gully Road. In practice, the DEC has excluded off-road vehicles from the Park; and
- Subjecting vehicle access to strict control depending on soil condition. If the presence of *Phytophthora* dieback is suspected or confirmed on or adjacent to the tracks then further surfacing of the track, or its realignment should be considered. At present, access by both the DEC and external stakeholders are subject to control.

In 2004, an 18 km tourist loop road was completed in Lesueur National Park (Figure 5.3). The road has a limestone base covered by bitumen. Limestone was identified as the "preferred road building material because of its resistance to *Phytophthora* dieback" (CALM 1995 p.35). Road drainage was designed to limit the opportunities for the establishment and movement of *Phytophthora* dieback. The one-way loop road funnels visitor use of the area in one direction to aid in reducing the spread of *Phytophthora* dieback and weeds.

The sealed road passes through several areas identified as "Dieback Risk Areas" in the Park Management Plan. DEC staff applied appropriate hygiene practices (e.g. clean on entry) but the road construction commenced before the interpretation was completed. This contravened the requirements of the Management Plan and violated accepted best practice for *Phytophthora* dieback management.

The DEC has acknowledged that the approach taken in constructing the road was not correct and the incident is also documented in the Conservation Commission's 2006-2007 Annual Report. In interviews, DEC staff noted that once the error was realised, steps were quickly taken to address the issue. The interpretation was completed a couple of weeks after the road was started with about 12 soil samples collected from a few suspect spots, all of which proved negative in subsequent testing for *Phytophthora*. Since this incident, DEC's FMB worked jointly with the Moora District office to write a hygiene management plan. The hygiene management plan is available for anyone needing to access the area.



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Figure 5.3 Tourist loop road in Lesueur National Park (adapted from Google Earth). 1: park entrance, 2: park exit, 3: car park with toilets, walk trails and boot cleaning station and, 4: car park and walk trails, * areas of sand and gravel extraction.

5.7 Recreation

There were 9,820 visitors to the National Park in 2007/2008. When the Indian Ocean Drive project is completed in mid-2011, it will provide improved access to the many coastal communities between Perth's northern suburbs and the town of Dongara. This is expected to increase domestic and international visitation to Parks such as the Lesueur National Park (Pracsys n.d.).

There is no camping allowed in the National Park, and bushwalking is the only approved recreation activity. The Management Plan acknowledged bushwalking as a potential vector of *Phytophthora* dieback and advocated minimising the risk through the sensitive location and design of walks and suitable education. Within the Park there are two formal walk trails to Mt Lesueur. A third walk trail was identified in the Park Management Plan but has not yet been developed.

In 2005/2006, new interpretation nodes and day use sites were established on the loop road. A boot cleaning station and signage was installed at the common trailhead to the two walk trails (Figure 5.4). Feedback from non-DEC interviews on the loop road and signage was positive during interviews. It was suggested that more signage is needed at the entrance to the Park as well as a vehicle wash down facility. Currently there is no wash down facility at the National Park. To be clean on entry, DEC vehicles are washed down at its Jurien station.



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This means however that they drive over Cockleshell Gully Road which is infected before entering the National Park.

During the interviews, DEC staff noted that the popularity of off-road-vehicles (ORVs) in the region (e.g. Cervantes and Lancelin) is a management problem. ORV operators like to use fire breaks and there is some evidence they are using fire breaks in the National Park.



Figure 5.4 Boot cleaning station and signage at Lesueur National Park. (Photos: K Howard)

When the Park Management Plan was prepared in 1995, the potential for commercial nature-based nature-based tours in the Lesueur National Park was described as immense (CALM 1995 p.40). To date that potential remains largely unrealised but this may change in time. The only identified tour operator was interviewed for the study. The operator was familiar with *Phytophthora* dieback management procedures and indicated he/she only visited the park in dry periods when it was low risk for *Phytophthora* dieback.

5.8 Extraction of Raw Materials

Road construction and maintenance, and recreation site developments within the Park require basic raw materials, including gravel, limestone, marl sand and rock aggregate. Good quality gravel is a limited resource in the Lesueur region (CALM 1995). The Management Plan states a preference for raw materials to be obtained from outside the Park and Reserve or from areas already disturbed or of lower conservation value. The plan acknowledges that extracting and moving gravel and other industrial materials can spread *Phytophthora* dieback disease and sets forth the following strategies:



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- The adoption of strict hygiene measures when extracting gravel from pits along Cockleshell Gully Road, due to the presence of *P. citricola* (now known to be *P. multivora*); and
- Enforcing *Phytophthora* dieback hygiene measures when extracting raw material and maintaining dieback free pits in a dieback free condition.

One of the gravel pits operated by the Shire of Dandaragan is within the Lesueur National Park. Under its DEC issued licence, the Shire is required to be clean on entry when using the pit. The Shire used to operate its own bulldozer but this work is now undertaken by a contractor. The contractor must arrive with a clean machine on the back of his truck.

5.9 Other Management Issues

5.9.1 Apiculture

In 1995, there were about 36 registered apiary sites in Lesueur National Park and Coomallo Nature Reserve (CALM 1995). For *Phytophthora* dieback reasons, the Management Plan states that, in consultation with apiarists, apiary sites should be cancelled or relocated in the Special Conservation Zone in Lesueur National Park. In addition, no additional apiary sites were to be approved before a management review of existing apiary sites in 1995.

As of 2006, when the Conservation Commission undertook an audit, all but three of the 36 apiary sites had been relocated. The three remaining sites are located on the perimeter of the Park. It was determined that permits for these sites would not be re-issued in the future.

5.9.2 Feral pigs

There are feral pigs in the park, although the numbers appear to be low based on reports over the past 12 months. There will be pig baiting over the summer. It is easiest to bait in summer as the pigs seek out water sources in the warm weather. There are a few reports of pig hunting in the area, but it is not at a level commensurate with Wellington National Park.

5.10 Beyond the Park Boundary

The Park Management Plan states that:

The Park and Reserve management objectives cannot be achieved in isolation but must be complementary to managing these surrounding areas. In particular, disease and fire management must be approached from the broader perspective in order to achieve specific objectives (CALM 1995 p.5).

Other land uses in the vicinity of the park include agriculture, other DEC managed reserves, bushland in private ownership and mining exploration. As discussed earlier, *Phytophthora* dieback infestations have been reported in other parts of the Moora District and the unsealed roads servicing and surrounding the Park (e.g. Cockleshell Gully Road and Coorow Green Head Road) exhibit signs of infection at various points (CALM 1995).



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Applying its Good Neighbour Policy (2007), the DEC works to maintain working relationships with the Park's neighbours through discussions about conservation issues (e.g. kangaroos, emus, fence maintenance and fire). Although, *Phytophthora* dieback does not feature in the Good Neighbour Policy, it should be included.

The Shire manages large areas of land within its borders including over 800 km of road reserves. The Shire manages a number of reserves for recreation purposes, some of which abut DEC managed lands. These recreation reserves do not have management plans. High turnover of on-ground Shire staff has hampered DEC efforts to maintain strong working relationships with the Shires.

The DEC works closely with Iluka and Tiwest in ensuring their mineral sand mining operations are meeting environmental requirements, including *Phytophthora* dieback management.

The main forum bringing key *Phytophthora* dieback management stakeholders together in this vicinity is the Northern Sandplains Dieback Working Party (NSDWP). The group includes representatives from Iluka, Tiwest, Main Roads, APA group, Western Power, NACC, DEC and DMP. There is a heavy focus on industry, which reflects the group's membership. There has been talk of appointing a community member and a local government representative to the committee to add a local community perspective.

The NSDWP has focused its efforts on raising *Phytophthora* dieback awareness and sharing knowledge. By combining resources to fund activities (e.g. research), members share the cost burden and the outcomes (e.g. new knowledge). The group is interested in developing training videos⁶ to be used by *Phytophthora* dieback management stakeholders including private landholders.

The NSDWP was very active until about 2001 but between 2001 and 2005 very little happened, due in part to a number of changes in member representation. The lack of executive support is another barrier to the group moving forward. After a short hiatus, the group reformed and is re-incorporating. The group has met two to three times a year since it reformed.

The group is working to develop networks with other *Phytophthora* dieback stakeholders in the State. Since 2007, the NSDWP has had greater interaction with the DEC, DRG, CPSM and Project Dieback. This includes contributing to the *Phytophthora* dieback plan for the Northern Agricultural Region, which is currently in draft form (Steady State Consulting 2009).

⁶ Iluka has developed a few site specific videos (e.g. how to clean a vehicle).



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The draft regional plan recommends that:

- The DEC lead the implementation of the regional plan in collaboration with the NSDWP;
- Membership of the NSDWP be expanded to include local governments; and
- NACC facilitate efforts with local government, private landowner and community.

Stakeholders expressed concern that NACC and other NRM groups are receiving less funding for *Phytophthora* dieback management under the national program Caring for Country. Due to its short funding cycles, NACC cannot commit to implementing the regional plan, leaving the DEC to carry more of the burden.

5.11 Conclusion

The Lesueur National Park is recognised as a biodiversity 'hotspot' with significant flora and fauna present, many endemic. Much of the flora is susceptible to *Phytophthora* dieback; consequently if *P. cinnamomi* entered the Park, its impact could be significant over time. It is free of *P. cinnamomi* although *P. multivora* is present which should be managed as a 'threatening process' like *P. cinnamomi*. Research should be conducted on the biology, pathology, survival and control of *P. multivora* as research to date has only been in the *Eucalyptus gomphocephala* woodlands. Consideration should be given to treat the *P. multivora* infestation with phosphite.

The Park is surrounded by a range of *Phytophthora* species including *P. cinnamomi*, therefore, there is a threat of inadvertent introduction through road maintenance, vehicle access, ORVs using fire breaks and activities such as beekeeping, and the presence of feral pigs. The installation of a *Phytophthora* dieback wash down bay at the beginning of the one-way loop road is suggested. Particularly as *Phytophthora* species are present on Cockleshell Gully Road. It is recommended that regular surveillance be conducted by Rangers at key spots in the Park and significantly more soil and plant samples than the current 10-12 samples per year should be collected for isolation when there are suspect deaths observed. These should where possible be collected when soils are still moist. Sampling intensity and sample numbers are key factors in ensuring confidence in 'negative' results.

Despite these threats, *Phytophthora* dieback management is a high priority in the Park and best practice is actively followed by DEC particularly in relation to fire management, visitor services and road maintenance with significant support from the local community. The main challenges will be adequate resources over time (e.g. a dedicated DEC ranger(s) to the Park) to manage increasing visitor use of the Park. It is recommended that the DEC encourage continued participation and involvement with organisations like the Northern Sandplains Dieback Working Party to assist in continued community awareness raising and resourcing for *Phytophthora* dieback in the region.



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6 STIRLING RANGE NATIONAL PARK

6.1 Background

Located 76 km north of Albany, the Stirling Range National Park (SRNP) is regarded as an area of great biogeographical and evolutionary interest and has one of the richest floras in the world. The Park encompasses the Stirling Range and straddles the boundary between the Shires of Plantagenet, Cranbrook and Gnowangerup. Stirling Range National Park was included in the National Heritage List in 2006.

Although the 115,661 ha Reserve A14792 was set aside for a National Park in 1913, it officially became Stirling Range National Park in 1970. Reserve 1090 (259 ha) was added to the Park in 1994.

The Park is home to five major vegetation communities – thicket and mallee-heath on the higher ground, and woodlands, wetlands and salt lake communities on the lower slopes and plains. As an internationally significant hotspot for biodiversity, the SRNP represents one of the most important remnants of the rich flora of the south-west with exceptional endemism of plant species (Hopper et al 1996). With 1500 floral species recorded, the Park contains almost one fifth of all the flora species found in the south-west. There are 87 endemic plant species and 123 orchid species (38% of known WA orchids).

The diverse vegetation of the SRNP provides valuable shelter for many bird species including parrots, honeyeaters and thornbills. The range is also a haven for many native Australian mammals including the western pygmy possum and the western grey kangaroo. The Park is one of most important areas in Australia for endemic mygalomorph (spider) species and for land snail richness (CALM 1999).

Phytophthora dieback management efforts in the Park are guided by the Management Plan: *Stirling Range National Park and Porongurup⁷ National Park 1999-2009* (CALM 1999).

6.2 *Phytophthora* Dieback Status

It is unknown when the first *Phytophthora* infestation in SRNP occurred but the pathogen may have been widely dispersed when management tracks were constructed in the 1960s (Wills 1993). An intensive program of mapping occurred in 1992/1993. By 1995, about 60% of the Park was infested and 25% of the remaining uninfested vegetation had no natural barrier to future infestation (Grant and Barrett 2003, Shearer et al 2007). In 2009, it was estimated that the Stirling Ranges are 80% infested (C Dunne; DEC 2009).

⁷ The Porongurup National Park is not part of the case study. It contains species of flora that are generally much less susceptible to dieback (CALM 1999).



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Conditions in the Stirling Range are conducive to the survival and activity of *Phytophthora* dieback disease. This includes a species rich, susceptible flora and an average rainfall of 500-600 mm, including heavy unseasonal falls in warm summer months. Soils susceptible to waterlogging are common, increasing the susceptibility of sites to *Phytophthora* dieback (CALM 1999). The pathogen has spread to many of the peaks through the transport of infected soil, mainly by foot access (Barrett 2000) (Figure 6.1).

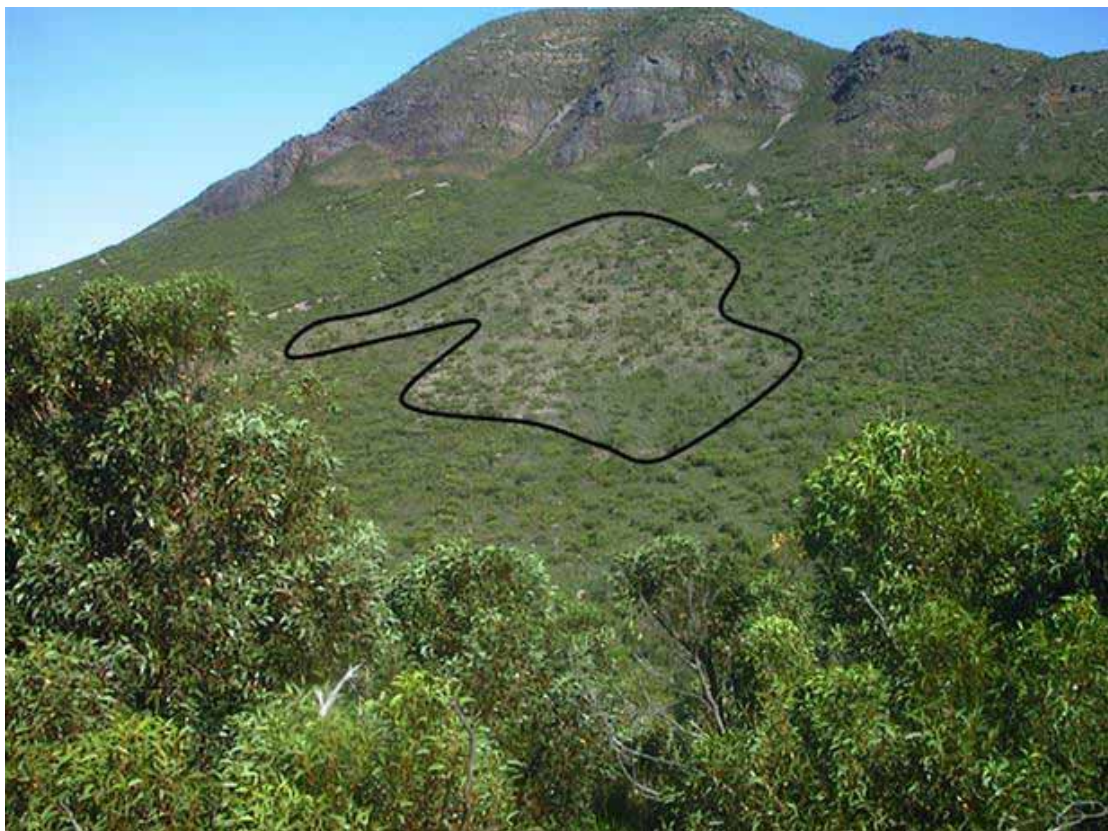


Figure 6.1 *Phytophthora* dieback infestation (black outline) spreading downslope at Stirling Range National Park (Photo: G Hardy)

In 2008, Project Dieback undertook strategic mapping of *Phytophthora* dieback distribution as part of the Dieback Atlas. Figure 6.2 displays the current understanding of the distribution of *Phytophthora* dieback in SRNP and its surrounds.

Phytophthora dieback disease has had a major impact on the flora of the Park resulting in changed vegetation floristics and structure. This has significant implications for some plant species and for fauna reliant on them for food and shelter (Wills 1993). Although the impact of *Phytophthora* dieback on native fauna has not been directly studied in the Stirling Ranges, some impact is assumed based on findings from studies in Victoria (Newell et al 1991).

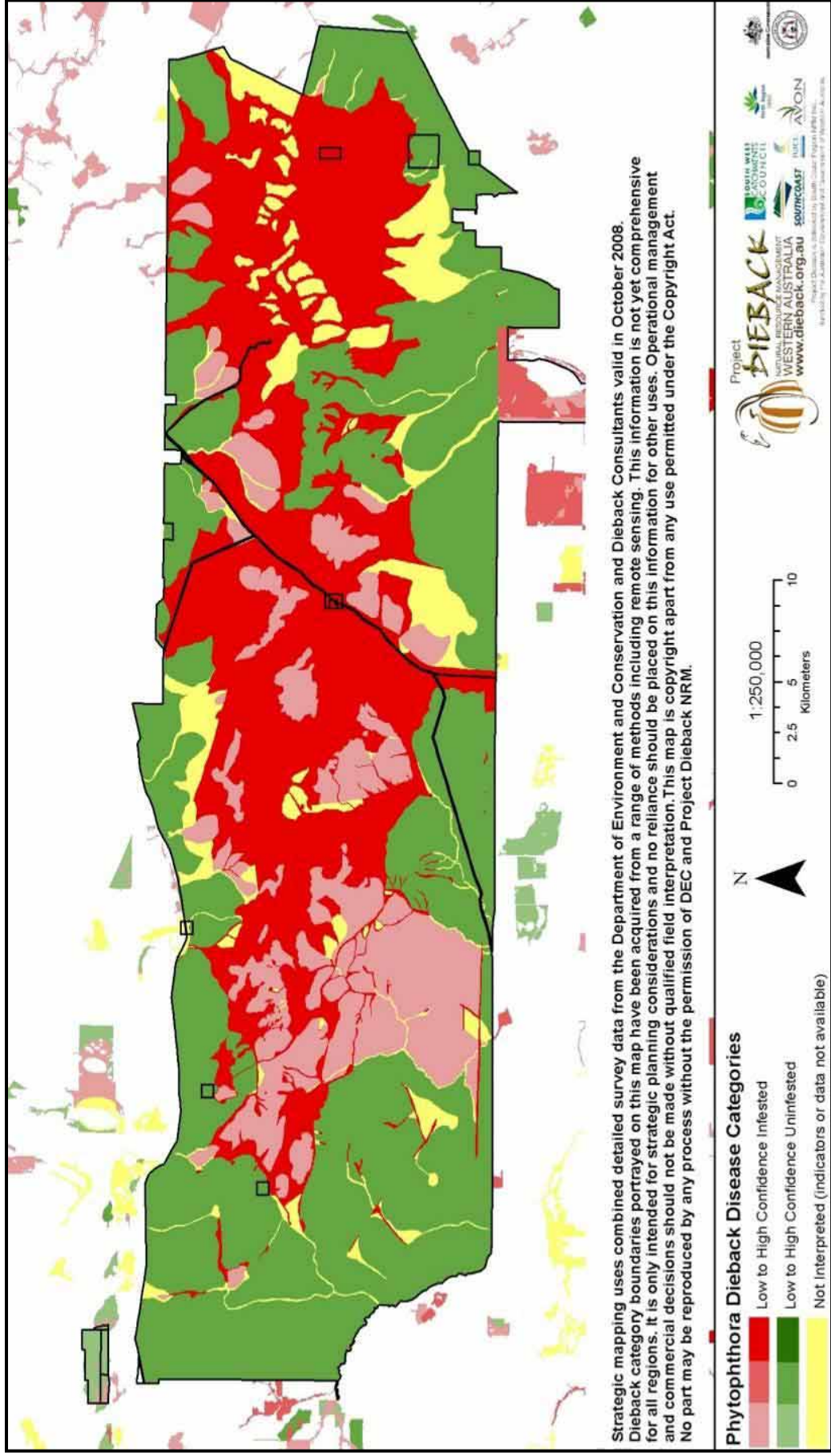


Figure 6.2 Distribution of *Phytophthora* dieback in Stirling Range National Park as at 2008



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The implications of further climate change are uncertain for this region. If winters become drier due to climate change this could reduce the spread of the disease. However, extreme weather events, such as high levels of summer rainfall, resulting in warm and wet conditions could lead to a significant spread of *Phytophthora* dieback and cause a mass collapse in native vegetation communities (G Freebury and S Barrett pers comm.).

6.3 *Phytophthora* Dieback Management Strategies

The objectives for *Phytophthora* dieback management in the Park plan are to:

- Prevent as far as practicable, the introduction of *Phytophthora* dieback and other plant pathogens into disease-free areas;
- Minimise spread of the dieback and other plant pathogens where they are already present;
- Minimise, where practicable, the risk of plant disease intensification;
- Protect populations of threatened flora and threatened ecological communities from plant disease; and
- Increase knowledge of the impacts and control of plant disease (CALM 1999).

The Management Plan contains an array of *Phytophthora* dieback management actions. Table 6.1 lists the actions and gives their status based on the case study interviews.

Table 6.1 The Stirling Range National Park Management Plan *Phytophthora* dieback strategies and status

Management action	Status
Preventing, as far as practicable, the establishment of <i>Phytophthora</i> dieback disease in new areas and minimise additional spread in areas where the disease already occurs by controlling access and operations in susceptible areas.	Ongoing. Procedures could be better in some cases.
Undertaking management actions, such as the application of phosphite, to protect threatened or priority listed flora and threatened ecological communities that are being affected by <i>Phytophthora</i> dieback.	Ongoing. Program expanding but always dependent on available funding.
Identifying priority areas within the Park for protection from <i>Phytophthora</i> dieback disease based on conservation values, risk of introduction and predicted impact. Implementing the zoning proposals in the plan that seek to protect areas from the introduction of the <i>P. cinnamomi</i> .	Completed. Still a few additional areas that would ideally be protected



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Management action	Status
Improving understanding by the public and by DEC personnel of the <i>Phytophthora</i> dieback problem and protection measures in the Parks.	Ongoing. Panels installed 2008/2009. New park brochure started (Figure 6.3).
Encouraging research on the susceptibility of threatened and priority listed flora species and threatened ecological communities to dieback disease.	Ongoing research
Undertaking <i>Phytophthora</i> dieback management in accordance with the current Albany District Dieback Protection Plan, the Albany District Threatened Flora Management Program and other relevant recovery plans and guidelines.	Ongoing. Operational protocols could be better at times.
Assessing all operations and uses with an evaluation test for potential <i>Phytophthora</i> dieback impact and consequences.	Variable.
Improving, where possible, pedestrian and vehicle access to minimise the risk of infected soil being picked up and spread.	Ongoing maintenance of Bluff Knoll and other walk trails dependent on available resources. Ongoing vehicle track maintenance dependent to available funding.
Gazetting the 'Special Conservation' Zone as a plant disease management area.	Unsure.
Continuing to ensure that staff associated with the Park is comprehensively trained in <i>Phytophthora</i> dieback recognition, sampling and management.	No. There is limited training.
Undertaking <i>Phytophthora</i> dieback mapping and assist with dieback research.	Mapping occurs for operations and some TECs.
Continuing to ensure that all DEC staff and visiting scientists working in the Park follow <i>Phytophthora</i> dieback hygiene procedures.	Efforts made to ensure this occurs, but compliance is difficult to assess. Science division believe that scientists consistently follow procedures.
Reviewing management prescriptions in the light of any new research findings.	N Moore's work on <i>P. cinnamomi</i> and fire being considered to some extent in fire management (Moore 2005).
Developing and adopting appropriate strategies for other plant diseases including other <i>Phytophthora</i> species.	No new strategies adopted.



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Figure 6.3

Boot cleaning station being used in 2003.



6.4 TECs and *Phytophthora* Dieback

SRNP contains a number of threatened and priority listed plant species and threatened ecological communities, most of which are susceptible to *Phytophthora* dieback disease. *P. cinnamomi* is known to be seriously affecting a number of these populations and is the primary extinction threat to the critically endangered Eastern Stirling Montane Heath and Thicket Community (EPA 2007).

The TEC Interim Recovery Plan for the Eastern Stirling Montane Heath and Thicket Community (Barrett 2000) includes the following *Phytophthora* dieback related actions:

- A ground based survey and mapping of the *Phytophthora* dieback status of the TEC.
- A *Phytophthora* dieback risk assessment in terms of conservation value, the degree of threat posed, and the likelihood of success of management actions.
- The provision of information to Eastern Peaks Route users regarding the values of the TEC and necessary hygiene practices.
- A review of the Code of Conduct for backcountry use in the Stirling Range National Park with particular reference to *Phytophthora* dieback hygiene.
- A phosphite spraying program, including a monitoring program to evaluate its effectiveness.
- Research into dieback-fire interactions.
- Reconstruction of the Bluff Knoll track from the Coyanarup Saddle to the summit to ensure a suitable surface and good drainage.

All of the above actions have been undertaken or are currently on-going.



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Populations of threatened and priority listed plant species and TECs are being treated with phosphite spray to increase resistance to the effects of the disease. Aerial phosphite spraying started in 1997 with five mountain tops targeted. The spray program was expanded in 1998, and additional targets have been added since. Since the fires of 2000, some areas are sprayed annually but at lower concentrations (small seedlings are sensitive to excess phosphite), while other areas are sprayed every 2 years. There are approximately 150 ha treated per annum targeting protection of TECs and critical flora. Combined funding from the Saving Our Species program, the Biodiversity Conservation Initiative and NRM has enabled an annual full phosphite application program for the 150 ha in the period 2006-2009. However, resources beyond 2009 for phosphite applications are not guaranteed.

6.5 Fire Management

There have been a number of major fires in the SRNP over the past 30 years and it poses a major threat to the conservation values of the Park. Fire in areas where the disease is already present, may increase the susceptibility of TECs to *P. cinnamomi* but there has been no detailed study of fire-dieback interactions (Barrett 2000).

A recent study by Moore et al (in prep), indicates that fire increases the incidence and severity of *P. cinnamomi* to susceptible plant species and communities on recently burnt sites, as compared to long un-burnt sites. This could be due to the sites being warmer and wetter for longer due to canopy loss and less evapo-transpiration or changes to the conduciveness of the burnt areas to *Phytophthora* dieback if the pathogen is present. The study also showed that recently burnt soils were more conducive to sporangial production and zoospore release than long un-burnt sites. Therefore, it is recommended that controlled burns should consider burning sections rather than entire areas where there are susceptible 'rare' or 'threatened' plant species. Especially, if their remaining populations are only known to be present in infested areas.

The Park Management Plan states that a system of strategic firebreaks for fire and other management access was to be established and subject to *Phytophthora* dieback hygiene requirements for any management use. In addition, the construction of any emergency firebreaks is subject to strict *Phytophthora* dieback hygiene principles using minimum impact techniques. Planned fire operations are to be subject to strict *Phytophthora* dieback hygiene principles (CALM 1999). DEC staff indicated that the implementation of hygiene management practices is variable, depending on the available personnel and the circumstances of the fire.

6.6 Access Permits

Access restrictions were introduced in the SRNP in mid-1994 to help manage the risk of infected soil being moved into *Phytophthora* dieback disease free areas. Disease free areas are closed to vehicles and walkers except those in possession of an access permit. Permits are only issued during dry soil conditions when the risk of soil adhering to walker's boots is minimal. According to the Management Plan, the access restrictions were well respected by Park users. Due to the Peak's very significant environmental values, the Mondurup Peak



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path would be permanently closed to prevent infection. Only those with the DEC issued access permits (e.g. scientific and management purposes) are allowed.

Permits are still required and are issued with strict conditions. However, due to limited resources for compliance monitoring, in reality it is difficult to control access.

6.7 Recreation

The Park offers a range of outdoor recreation opportunities and is particularly well known as a destination for nature observation, bushwalking and rock climbing. The Park offers significant 'back country' mountain recreation opportunities. Visitor numbers were estimated at 72,000 in 2007/2008. There are two resident rangers in the Park but there is no major visitor centre as a focal point for information, interpretation and education.

6.7.1 Bushwalking

There are six formal bushwalking trails providing access to mountain peaks. The most popular is Bluff Knoll, listed as one of Australia's 25 best hikes. The Ridge Walk from Ellen Peak to Bluff Knoll is a popular long distance walk (Barrett 2000). The path to Toll Peak was permanently closed due to concerns about the spread of *Phytophthora* dieback disease.

Phytophthora dieback management strategies in the Management Plan include:

- Restricting recreation activities to suitable zones of the park;
- Conducting research on visitor use patterns;
- Designating appropriate management access tracks for bushwalking; and
- Providing adequate information at the trail-heads of all major paths.

6.7.2 Adventure activities

Gliding (e.g. hang gliding, paragliding) and rock climbing are popular sports in the park. Management measures in the Management Plan include:

- Limiting these activities to approved sites;
- Requiring leaders and instructors of commercial and educational visitor services to hold the appropriate level of accreditation for their activities; and
- Establishing and promoting regular contact with tour operators so that they are kept abreast of regional and local management initiatives, access restrictions and road conditions.

6.8 Gravel Extraction

Gravel extraction occurs within the Park to supply gravel for road maintenance. The Management Plan says relatively little about the association of gravel extraction and *Phytophthora* dieback. It has as an objective to "Endeavour to ensure that the use or extraction of gravel and industrial minerals within the Parks, by CALM or by other agencies, does not contribute to the spread of dieback disease" (CALM 1999 p.75).



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The plan suggests that the sealing gravel roads in the Park be considered, especially Stirling Range Drive. The reason provided is the high cost of maintaining gravel roads rather than *Phytophthora* dieback management. This work has not yet been undertaken, nor is it likely to be undertaken in the near future.

6.9 Conclusion

The Stirling Range National Park has one of the richest floras in the world and is of considerable biogeographical and evolutionary interest. It is made up of five major vegetation communities and is recognised as an international hotspot for biodiversity. Approximately 80% of the Park, including many of the mountain peaks is now infested with *P. cinnamomi* and recent strategic mapping provides us with key knowledge of the distribution of *Phytophthora* dieback in the Park and its surrounds. Along with a huge diversity of flora that is susceptible to *Phytophthora* dieback, the environmental conditions are very conducive to the survival and disease causing activity of *Phytophthora* dieback. Therefore, for this Park there is substantial pressure to ensure that *Phytophthora* dieback does not spread into the few remaining disease-free areas.

The Park's Management Plan contains an array of *Phytophthora* dieback management actions based around the 'Best Practice Guidelines for the Management of the Threat to Biodiversity Posed by *Phytophthora cinnamomi* and disease caused by it in native vegetation'. These are on-going and new actions are regularly put in place. A number of threatened and priority listed plant species and threatened ecological communities susceptible to *Phytophthora* dieback are treated regularly with phosphite to increase their resistance. However, there are no plans to extend this spray program beyond 2009 through the lack of resources. Previously, the Biodiversity Conservation Initiative and NRM have contributed resources to allow approximately 150 ha to be treated annually.

Fire and fire management remains a significant threat to the spread of *P. cinnamomi*, especially since so much of the Park is infested. The construction of emergency firebreaks increases the likelihood to inadvertently spread *Phytophthora* dieback into uninfested areas. However, planned fire operations are subject to strict *Phytophthora* dieback hygiene principles. Although this can be variable depending on available personnel and the circumstances of the fire. In addition to fire management, of concern are the results of a recent study which indicates that fire increases the incidence and severity of *P. cinnamomi* to susceptible plant species and communities on recently burnt sites compared to long un-burnt sites. Clearly more research is required to determine how to manage controlled burns in susceptible plant communities, especially those which have threatened or rare species which are now only present on infested sites. Fire outbreaks are likely to increase with climate change.

The Park is a very popular location for tourism and a range of recreational activities and considerable emphasis has been placed on ensuring these activities are managed to ensure *Phytophthora* dieback is not spread. For example, some mountain peaks have been permanently closed. Further consideration should be given to closing other walking trails and to sealing the gravel roads in the SRNP.



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7. WELLINGTON NATIONAL PARK

7.1 Background

Wellington National Park is situated in the Shires of Collie and Dardanup and is approximately 8 km from the town of Collie. The National Park falls within the DEC's Wellington District of the South West Region and lies within the Jarrah Forest bioregion. The Park surrounds the Wellington Reservoir.

Wellington National Park was gazetted in 2000 as a class A reserve (No. 46213) set-aside for the purpose of 'national park'. In 2004, 13,745 ha of State forest No. 25 was added to the Park. Subsequent additions increased the total area to 17,420 ha.

Management is guided by the *Wellington National Park, Westralia Conservation Park and Wellington Discovery Forest Management Plan* (DEC 2008). The plan covers the National Park, as well as the Westralia Conservation Park, Wellington Discovery Forest and the proposed Westralia Forest Conservation Area. The comprehensive Management Plan covers an area of 20,089 ha. The Plan's vision statement notes that, over the life of the plan, a balance will exist between the conservation of natural values and the public demand for recreation and water supply.

Wellington National Park is located on the boundary of the northern and southern jarrah forests. The vegetation consists of a mosaic of forest, wetland and woodland vegetation types ranging from tall open forest to open forests and open woodlands of jarrah, marri and yarri/Blackbutt. There is one Priority 1 flora species (*Hemigenia rigida*), three Priority 3 species (*Acacia oncinophylla* subsp. *oncinophylla*, *Tetratheca parvifolia* and *Meeboldina thysanantha*) and two Priority 4 species (*Grevillea ripicola* and *Senecio leucoglossus*) (DEC 2008).

Threatened fauna include the Chuditch, Western ringtail possum, Quokka, Brush-tailed phascogale, Woylie, Forest red-tailed black cockatoo, Baudin's cockatoo and Carnaby's cockatoo (DEC 2008).

The Management Plan identifies a significant number of threatening processes:

- spread of disease (e.g. *P. cinnamomi*);
- inappropriate fire regimes;
- development pressures from nearby townsites and adjoining land use;
- informal recreation;
- widening of utility corridors;
- dumping of rubbish, firewood collection and weed invasion;
- salinisation to the east of the planning area; and
- climate change.

The most significant plant pathogen in the National Park and its surrounds is *P. cinnamomi*.



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*Jarrah forests and wetland habitats of the planning area have been affected by *P. cinnamomi* and *P. cinnamomi*-induced death of susceptible plants continues to result in the irreversible decline in the diversity of vegetation communities (DEC 2008 p.52).*

7.2 Dieback Status

Prior to 1976, *Phytophthora* dieback surveys, using aerial photography, indicated expressions of the disease scattered throughout the area. Later surveys revealed further areas infested with *P. cinnamomi*. The current extent of infestation is unknown as most of the area has not been surveyed since 1983 (DEC 2008). Figure 7.1 displays the strategic mapping of *Phytophthora* dieback distribution undertaken by Project Dieback in 2008 for Wellington National Park and its surrounds.

7.3 *Phytophthora* Dieback Management Strategies

The Management Plan's *Phytophthora* dieback objectives are to:

- Contain or retard further autonomous spread at the boundaries of existing infestations;
- Progressively identify significant uninfested (protectable) areas;
- Reduce the rate of vectored spread and establishment of new infestations within significant uninfested (protectable) areas; and
- Manage disease according to DEC policies and operational guidelines.

The strategic approach taken is to focus on the reduction of vectored spread and the human-assisted establishment of new centres of infestation within 'protectable'⁸ areas'. These areas are to be managed to ensure their uninfested status and protectability is not compromised. In areas already infested, but containing significant residual values, ecosystem restoration may be considered if there is serious environmental damage. In areas that remain unsurveyed or are 'unprotectable' and uninfested, standard hygiene practices are to apply (DEC 2008).

Phytophthora dieback management strategies in the Management Plan include:

1. Preparing *P. cinnamomi* management plans for new developments (e.g. recreational infrastructure or realignments of management roads and tracks).
2. Implementing seasonal road closures to minimise disease spread.
3. Developing *P. cinnamomi* hygiene management plans prior to commencing any operation that requires soil or plant movement such as the construction of roads, firebreaks and tracks.
4. Progressively identifying, mapping and assessing uninfested areas and then rationalising and managing access roads and/or tracks into them.

⁸ Areas likely to remain uninfested by the autonomous spread of the pathogen in the medium term are known as 'protectable areas'.

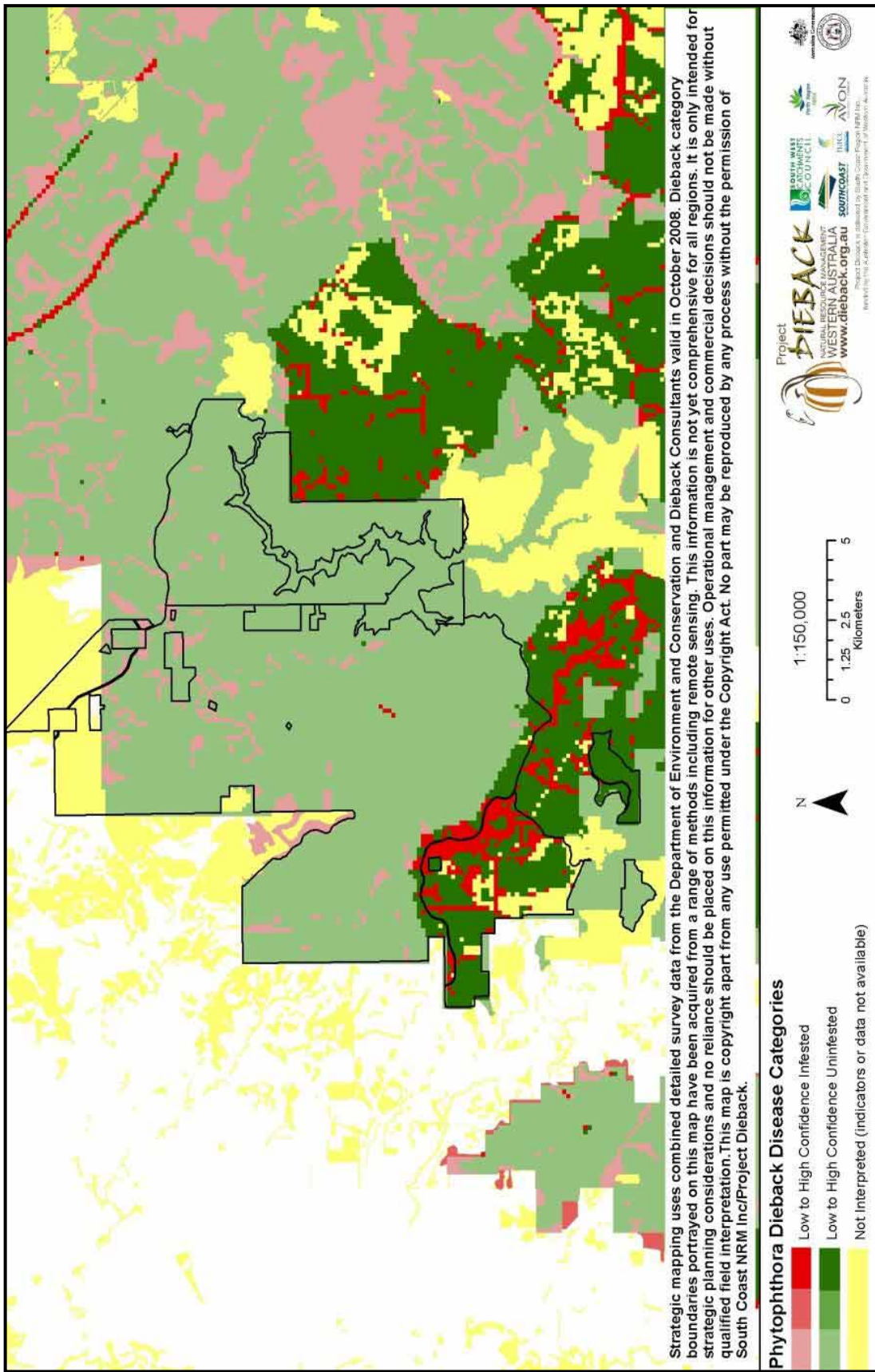


Figure 7.1 Distribution of *Phytophthora* dieback in Wellington National Park as at 2008



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5. Treatments with phosphite⁹, or other appropriate treatments, or trialling the reconstruction of badly affected ecosystems.
6. Restricting vehicle access into areas designated as Disease Risk Areas through the issuing of Disease Risk Area permits.
7. Controlling feral animals (e.g. pigs).
8. Monitoring plant and animal diseases and using standard hygiene practices where necessary.
9. Restricting operations to dry soil conditions where possible.
10. Providing public and industry with information about plant disease, emphasising the need to be clean on entry to uninfested areas and to stay on approved roads and tracks.
11. Encouraging research into the effects of *P. cinnamomi* on key conservation values.
12. Documenting any new outbreaks and implementing appropriate management responses.
13. Applying the DEC's *Good Neighbour Policy* (DEC 2007) to build and maintain mutually beneficial relationships with neighbours to deal with cross-boundary management issues.

7.4 Tourism and Recreation

Recreational uses in the National Park include picnicking, swimming, fishing, marroning, white-water canoeing, mountain biking, bushwalking, horseback riding, rock climbing, abseiling, scenic and four-wheel driving and camping (Figure 7.2). The main period of visitation is in the summer months between October and April, with peak visitation in April.

7.4.1 Camping

Formal camping areas and facilities exist at Honeymoon Pool and Potters Gorge. Honeymoon Pool (Figure 7.3) receives more than 30,000 visitors, annually. In 2007, there was a \$530,000 upgrade of its facilities at Honeymoon Pool. Cycle-in campsites with limited facilities and services are also available along the Munda Biddi Bike Trail that passes through the National Park.

A number of informal campsites have developed, particularly around the backwaters of the Reservoir. Some sites have existed for over 20 years and become traditional camping areas, used by generations of visitors for marroning, fishing and other water-based activities. These sites are unmanaged and have a high intensity of visitor use, particularly during the marron season. Site degradation has occurred including the loss of vegetation, erosion and soil compaction (DEC 2008).

The Management Plan notes that the collection of firewood in the park is a concern, in part due to the risk of spreading *P. cinnamomi*, and is prohibited under the plan.

⁹ At present no phosphite is applied in the National Park.

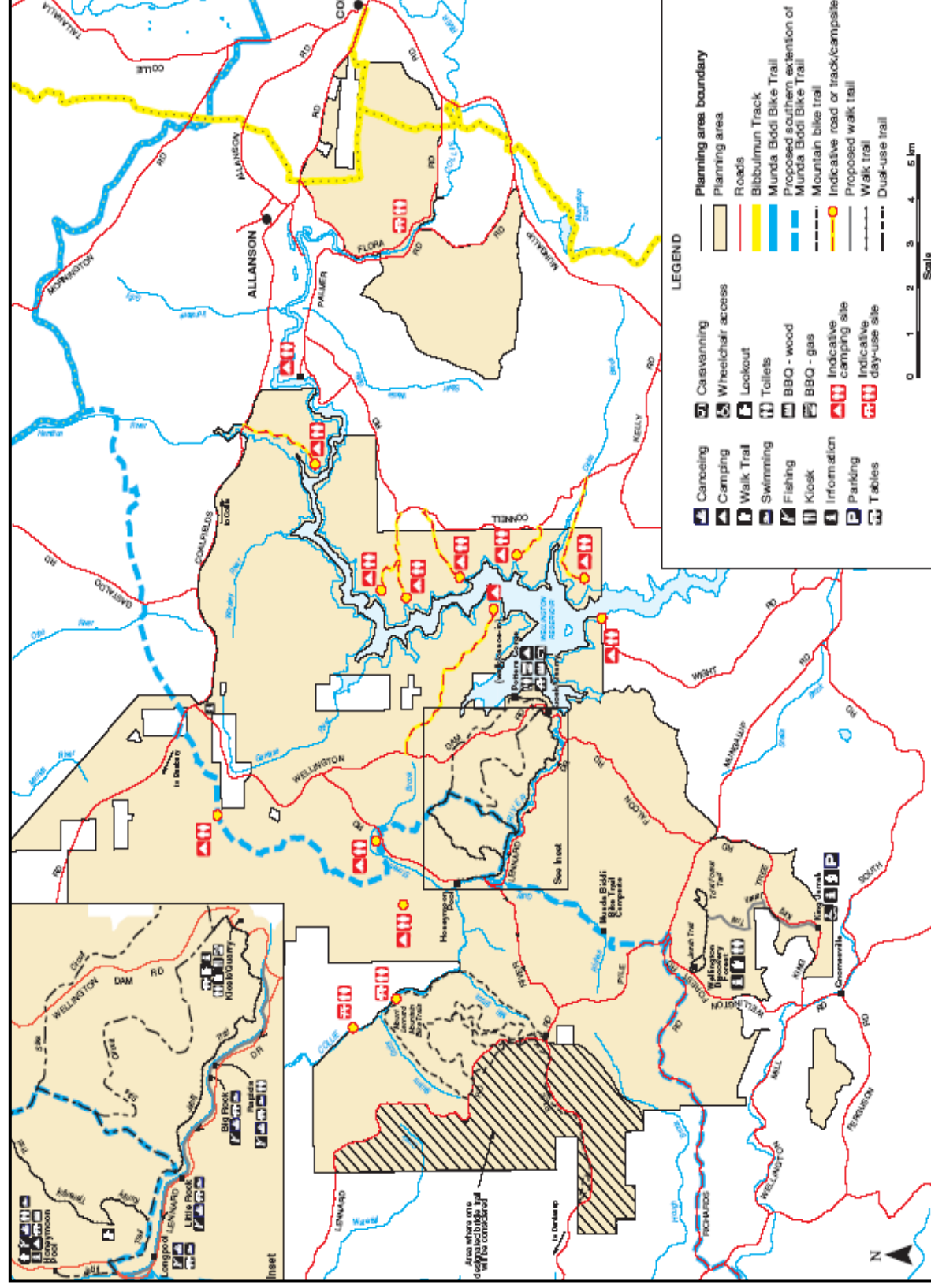


Figure 7.2 Recreation facilities and sites in the Wellington National Park (DEC 2008)



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Figure 7.3

Honeymoon Pool
swimming area in
Wellington
National Park



(Photo: K Howard)

7.4.2 Bushwalking

The National Park includes a number of formal and informal walking trails. The Management Plan notes that where use levels are high, bushwalking has the potential to introduce and/or spread plant diseases (e.g. *P. cinnamomi*).

The existing network of tracks is to be expanded, providing short to medium length walking opportunities and in areas with multiple informal paths these are to be consolidated and formalised (DEC 2008). In 2009, the State Government awarded \$30,000 to the Bibbulmun Track Foundation to construct a new spur trail connecting the Wellington National Park trails to the Bibbulmun track (DEC 2009).

Management strategies in the plan include:

- Sensitive location and design of paths; and
- Adoption of environmental codes of conduct such as those for the Bibbulmun Track.

7.4.3 Other recreation activities

Cycling, including mountain biking, is permitted on specially designated tracks, dedicated roads and DEC-managed roads and tracks open to the public. Bicycles are considered vehicles under the Road Traffic Act 1974 and are not allowed in Disease Risk Areas (DRAs) without a permit.



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There is a history of recreational horseback riding in the National Park, mainly on bush tracks and fire breaks/access roads south of the Collie River. Horse-riding activities occur in the former Lennard and Davis blocks, the latter of which is a DRA (DEC 2008).

Recreational abseiling and rock climbing are popular with commercial operators and organised groups. Instructors have a responsibility to ensure that all members of the group observe safety, environmental and ethical standards. All commercial operators and groups conducting rock climbing and abseiling activities must be registered under the National Outdoor Leader Registration Scheme or hold current equivalent accreditation recognised by the DEC. A permit is required and commercial operators must obtain a commercial activity licence (DEC 2008).

Although motor sports are generally not permitted in National Parks and Conservation Parks, where there has been a change in land tenure from State forest and a history of use, consideration is given to allowing the activity to continue (e.g. South-West Car Club Hill Climb event). The suitability of events is assessed on a case-by-case basis and considered against a set of criteria that includes the potential to spread disease (DEC 2008).

The recreational hunting of animals is not permitted in the National Park but illegal hunting, particularly for feral pigs, does occur.

7.5 Access

7.5.1 Tracks and trails

Most tracks for 4WD vehicles are not maintained on a regular basis. Heavy use and increasing traffic volumes, combined with steep slopes and erodible soils, is accelerating erosion. The condition of many tracks has deteriorated (DEC 2008). Where natural values are under threat (e.g. by disease, erosion or loss of vegetation) the following actions can apply:

- Tracks can be subject to seasonal closure on a trial basis. If the values continue to be threatened, access may be restricted to a permit system or be temporarily or permanently closed to all public use or selected classes of vehicles. The DEC is trialling the seasonal closure of Lennard Track. The trial is ongoing.
- Roads/tracks may be designated as 'management purposes only' (e.g. fire management).
- Signs and gates are to be erected in DRAs and areas of restricted use.

While most Park visitors want to do the 'right thing' and abide by the signs restricting access, not every Park visitor does. The DEC tries to provide adequate signage but this is often pulled down by vandals. Interviewed DEC staff view "recreationalists as a bigger threat than other proponents because they are harder to control" and some "just don't care". Illegal pig hunters, motorbike riders and 4WD operators attracted specific mention.



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ORV and 4WD operators prefer to use wet, steep areas and muddy tracks during winter when they should stay away from tracks to reduce the spread of *Phytophthora* dieback. Many of the motorbikes entering DRAs are unregistered. The recourse taken with those caught without a permit depends on the situation at hand but in some cases includes infringement notices.

Many tracks on (and off) the conservation estate have been established illegally. The DEC is working to consolidate the trails or bring them up to standard.

The DEC has adopted the attitude that it is better to work with clubs/associations than to not work with them. There is a Memorandum of Understanding between the WA 4WD Association and the DEC. This relationship addresses issues such as when tracks will and will not be used and the potential impacts of using tracks during wet conditions.

The DEC works cooperatively with 4WD clubs and Trackcare¹⁰ to rehabilitate and reinforce eroded tracks (e.g. Lennard Track) and encourage positive behaviours. The DEC believes this collaborative approach is paying significant dividends. Several staff described the DEC's collaboration with recreation groups on works such as the tracks at Mt Lennard. This has involved a lot of education of the recreation club/association members, including how to establish a sustainable track and related environmental issues, including *Phytophthora* dieback.

7.5.2 Disease Risk Areas

Within the National Park, several areas of former State forest are designated as DRAs (Figure 7.4). All vehicles entering a DRA must have a DEC issued permit, which can be purchased at petrol stations. The permit includes the person's name and their vehicle registration number. The 12-month permit includes a set of requirements such as conditions for accessing an area, access routes, and required clean down procedures.

The Management Plan notes that the relevance of DRAs, including the possibility of replacing them with 'limited access areas', may be reviewed during the life of the plan (DEC 2008). Interviewed DEC staff also indicated a need to re-examine DRAs as a *Phytophthora* dieback management tool. They indicated that a lot has changed since DRAs were introduced and the initial purpose of 'locking-up' areas to manage and monitor the spread of *Phytophthora* dieback no longer applies. When they were created in the 1970s, there were dedicated officers to maintain the fences, gates and signage associated with DRAs but few of these signs and gates remain. DRAs are not viewed as a form of on-ground management but as an administration system and even an "administrative nightmare". One individual posed a rhetorical question: "With the entire conservation estate susceptible to the disease; why should specific areas [DRAs] be managed differently?"

¹⁰ Track Care WA Inc is a non-profit volunteer organisation. It was formed in 1997 to promote issues about the repair and upkeep of off-bitumen tracks throughout Western Australia.

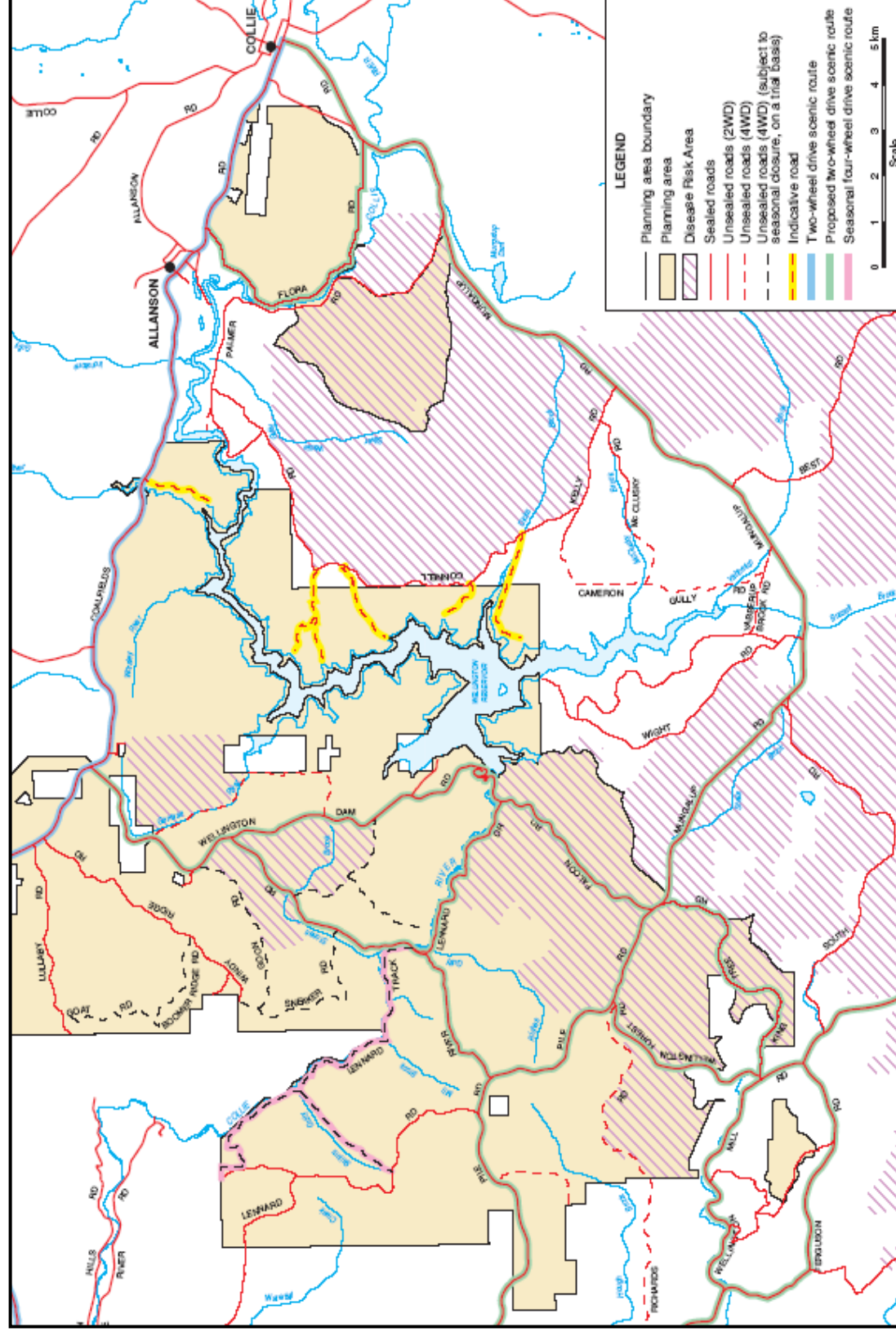


Figure 7.4 Disease Risk Areas in the Wellington National Park and surrounds (DEC 2008)



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7.5.3 Fire Management

Where temporary roads, fire access tracks or fire lines are constructed during fire suppression activities, these are to be rehabilitated after the fire event to minimise the threat of soil erosion, weeds or spread of disease and unauthorised use. However, the plan concedes that, “in some cases, strict adherence to disease hygiene plans may be difficult (e.g. construction of emergency fire access tracks in wildfire situations)” and wildfire suppression plans will need to include appropriate tactics (DEC 2008 p.53).

During interviews, DEC staff observed that there is clear guidance on *Phytophthora* dieback management procedures for prescribed burns, with hygiene management covered in the pre-operations documentation. In terms of wildfire management, it highest priority is the protection of human life and property and this is the major focus of any first shift during a wildfire. It is in the second shift that hygiene management becomes part of the fire management effort.

7.5.4 Basic Raw Materials (BRM)

To minimise disturbance to conservation areas, alternative sources of BRM, located outside the planning area, are preferred. Where extraction of BRM occurs within the conservation estate, best practice hygiene management is to be applied consistent with the DEC *Phytophthora* dieback manual. The Shire of Collie stipulates in all their contracts that gravel must be certified as *Phytophthora* dieback free.

7.5.5 Utilities and Services

A variety of utility and service infrastructures transverse the National Park including; the Wellington-Harris water pipeline, powerlines and a railway line. The Management Plan notes that in the future, there may be pressure to provide essential infrastructure to supply potable water (e.g. a treatment plant and associated facilities), distribute electricity and/or to provide telecommunication services.

Strategies in the Park Management Plan include:

- To the extent feasible, accommodating outside the planning area any new utility infrastructure that is not servicing the planning area itself;
- Encouraging the prime users of infrastructure and utility corridors to be responsible for management of environmental problems (e.g. weed and disease management); and
- Liaising with utility and service providers to ensure that development proposals, and their subsequent establishment, operation and maintenance is in accordance with Department policy and minimise environmental impacts.

In general, DEC officers were satisfied with the performance of utility and service providers in the Park. They noted that utilities such as Western Power and the Water Corporation have their own guidelines and procedures for *Phytophthora* dieback management.



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The DEC Collie Office has been operating a small informal hygiene certification program for approximately 5 years. DEC officers train the program participants (e.g. staff from mining companies) on how to properly clean down vehicles. Once the DEC officers are satisfied, participants are certified as competent in cleaning vehicles. The participants are still spot checked on jobs but due to their 'certification' fewer spot checks are needed than for 'non-certified' operators. DEC officers indicated that this informal program helps reduce agency management costs.

The Wellington Reservoir is used primarily to supply water to the Collie River Irrigation District. In the future, the Reservoir could be used as a source of public water supply for Perth and/or the South West. Such a decision would have significant implications for the National Park including additional public water supply infrastructure (e.g. a treatment plant), and changes to recreational use in what would then be a drinking water catchment subject to *Statewide Policy No. 13¹¹ – Policy and Guidelines for Recreation within Public Drinking Water Source Areas on Crown Land* (Water and Rivers Commission 2003).

7.5.6 Works and Rehabilitation

Rehabilitation within the planning area may be required for mined gravel pits, other mining activities, road works, previous silviculture activities, track closure, recreation site closure or redevelopment, or activities associated with fire suppression. There is no specific mention of managing for *Phytophthora* dieback in the Management Plan, although it indicates that rehabilitation efforts are to apply DEC Policy Statement No. 10 *Rehabilitation of disturbed land*. The policy includes management statements about the spread of weeds but not *Phytophthora* dieback disease (CALM 1986).

DEC staff provided additional information on procedures. Prior to undertaking any works, an environmental checklist is completed to evaluate the potential impact of the proposed works. The checklist helps determine if a hygiene management plan is needed for the proposed works. If required, a hygiene management plan is developed prior to work commencing. When contractors are used to undertake works on behalf of the DEC:

- The required hygiene practices are set forth in the tender documents for contracted work;
- The contractors are briefed on the required hygiene practices, before works are undertaken; and
- DEC officers are on-site throughout a project (each day or every second day) to ensure compliance with any site requirements (e.g. hygiene practices).

Prior to developing tracks along Mt Lennard, the DEC completed an impact checklist. The tracks were designed to reduce the potential for spread of *Phytophthora* dieback. Grates were installed at key locations (e.g. between infested and un-infested areas). When bikes or vehicles pass over the grates some of the accumulated mud falls off.

¹¹ Statewide Policy No. 13 is currently under review by the State Government.



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7.6 Public information and education

Currently there is no visitor centre for the Park although the Management Plan notes that potential for one in the kiosk precinct. There are no DEC rangers based full time in the National Park.

There is an information bay at the Park's northern entrance. It is located on a small turn off from the main road - Wellington Dam Road. However, the bay does not have information about *Phytophthora* dieback or its management.

Next to the National Park is the Wellington Discovery Forest, designed to raise community awareness and understanding of the natural values and management of the jarrah forest. Most visits to the Wellington Discovery Forest are by tertiary, secondary and primary educational institutions (including teacher professional development programs). The centre conducts a variety of hands-on eco-education programs that include incursions and excursions and have sections devoted to *Phytophthora* dieback:

- The 'My South West Forests' program offers an excursion for year 10 students and includes showing students *Phytophthora* dieback maps, discussing how *Phytophthora* dieback is spread and talking about appropriate hygiene practices (e.g. using bleach and methylated spirits).
- In the Caring for Places¹² education package *Phytophthora* dieback is identified as a key challenge for park managers. The package includes a case study about *Phytophthora* dieback management and the WWF Biological Bulldozer booklet (Carter 2004).

7.7 Beyond the Park Boundary

Other land uses in the vicinity of the park include mining, agriculture, forestry, water supply, rural residential subdivision, other DEC managed reserves, and the transmission of electricity.

Located north of Wellington National Park is the Worsley Alumina Refinery. Bauxite mining occurs near Boddington. The DEC works closely with Worsley Alumina in ensuring their mining and refining operations are meeting environmental requirements, including *Phytophthora* dieback management.

7.8 Conclusion

The Wellington National Park is located within jarrah forest and *Phytophthora* dieback is scattered throughout. The Park and the surrounding region receive high visitor access for a range of diverse recreational activities both legal and illegal. The Park has a comprehensive Management Plan (*Wellington National Park, Westralia Conservation Park and Wellington*

¹² Caring for Places is also available on the DEC website.



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Discovery Forest Management Plan, 2008). The plan is balanced between conservation of natural values, public demand for recreation and water supply. *Phytophthora* dieback is recognised as a threatening process in the plan which has specific and well defined *Phytophthora* dieback objectives. There is an emphasis on focusing on the reduction of vectored spread and the human-assisted establishment of new centres of infestation within 'protectable areas'. These areas are to be managed to ensure their uninfested status and protectability is not compromised. The plan addresses the majority of the DEC's 'Best Practice Guidelines' for the management of *Phytophthora* dieback.

Overall, the DEC staff was happy with *Phytophthora* dieback management procedures, especially for prescribed burns, with hygiene management covered in the pre-operations documentation, utilities and services, and works and rehabilitation. However, it was recognised that public information and education could be improved and there were recommendations for a visitor centre for the Park. Recreational use of tracks and paths presented challenges especially with off-road-vehicles. The DEC has adopted an attitude to work with clubs and associations. Clearly, education and communication are key elements to the management of *Phytophthora* dieback in the Park which has significant recreational use, increasing the likelihood of inadvertent introduction of *Phytophthora* dieback.



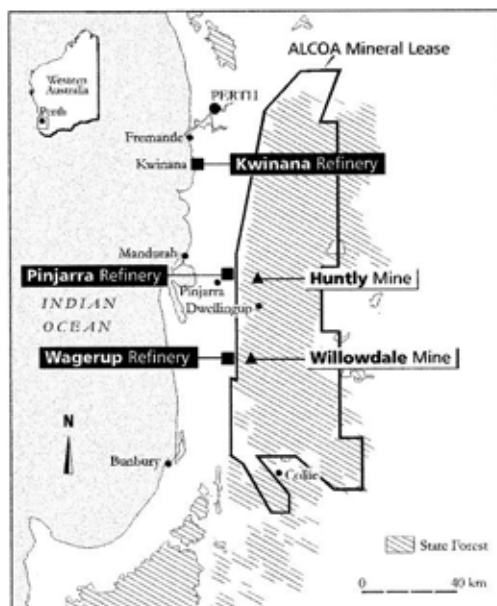
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8. DIEBACK MANAGEMENT AT ALCOA OF AUSTRALIA'S HUNTLY MINESITE

8.1 Introduction

The jarrah forest in WA is the location of one of the largest and most productive bauxite mining operations in the world. The bauxite mining and alumina refining company, Alcoa of Australia Ltd., has two mines, Huntly and Willowdale (Figure 8.1). Managing the risks associated with mining in a forest where *P. cinnamomi* is widespread has been a major challenge to Alcoa since mining started in 1963. Although widespread, *P. cinnamomi* has been estimated to be present in approximately 14% of the forest (Davison and Shearer 1989); many areas of upland forest remain free of the disease. However, many ore bodies lie beneath dieback-free forest.



Two of Alcoa's major environmental objectives are to minimise the spread of *P. cinnamomi* and to revegetate minepits to achieve a high botanical diversity composed of only species present in the forest surrounding the mine. These objectives have driven the environmental research and development (R&D) program to develop effective procedures to manage dieback. To be endorsed by management, these procedures also needed to be economic and practicable.

An intensive dieback management program has been operating since 1990 at Huntly, Alcoa's biggest mine. This case study reviews the risk assessment process used, the management procedures being implemented, and the results of recent monitoring to assess the effectiveness of dieback management.

Figure 8.1 Alcoa of Australia
Australia's two Western Australian
mines, Huntly and Willowdale (from
Colquhoun and Hardy 2000).

Alcoa manages this pathogen during an operation that moves about 6M m³ of soil and clearing about 600 ha of forest a year. The shallow ore bodies tend to be 5 to 40 ha and are located on the flanks of hill slopes. These ore bodies are connected by 18-m-wide haul roads used to transport the ore. At the Huntly mine, 85% of the mining area is in dieback-free forest, but many ore bodies have dieback forest on the lower slopes. The presence of *P. cinnamomi* may also be associated with forest roads that dissect the ore bodies. After



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mining, the aim is to maintain the area of dieback-free vegetation that existed prior to clearing for mining. *P. cinnamomi* may also interfere with Alcoa's efforts to meet its biodiversity objective, as many vascular plants in the jarrah forest are susceptible to *P. cinnamomi* (Shearer and Dillon 1995) there is a potential for it to greatly reduce the number of plant species re-established in the rehabilitated areas. The following section summarises Alcoa's mining and rehabilitation processes, highlighting the magnitude of risk of spreading *P. cinnamomi* during mining.

8.1.1 Mining processes

The first stage in the mining process is exploration drilling. Drill rigs mounted on tractors traverse about 2500 ha/year to collect samples of the regolith. Once the locations of the ore bodies have been mapped, the sequence of mining and rehabilitation is planned, ensuring that rehabilitation operations are scheduled for the most appropriate time of year. It is important that the topsoil is moved in a manner, and at the time of year, that maintains the viability of the seeds it contains.

There are two timber extraction operations within the mines, removing all large logs, with the follow up operation removing wood for charcoal production. The remaining trees and stumps are either stockpiled ready for returning when the site is rehabilitated or burned. Scrapers remove the topsoil (0 - 15 cm) and usually transport it immediately to a recently rehabilitated minepit. The gravel layer (overburden) below the topsoil contains very few seeds and it is stockpiled nearby. The hard duricrust layer is either blasted or broken and it is loaded onto dump trucks.

8.1.2 Rehabilitation

Once mined, a typical pit will be a 10 ha depression with 3- to 5-m-high pit faces. The pit floor is landscaped with a surface topography that blends with the adjacent forest. The pit floor is ripped to remove truck-caused compaction and provide roots with access to deeper parts of the regolith. The overburden is spread first then the topsoil. Finally the pit is ripped on the contour with multiple tine equipment to create a surface that will improve deep drainage and control surface water movement to reduce the risk of erosion. A mixture of seed from over 90 plant species endemic to the locality of the mine is spread to supplement the seed that is present in the topsoil. Plant species that do not establish well from seed are planted. The rehabilitated areas are fertilised by helicopter.

Under the agreements of the mining lease, Alcoa and DEC have a program to treat dieback affected jarrah forest. The areas rehabilitated are not suitable for mining but occur within the bauxite mining lease (Anon 1996). Alcoa invests approximately \$300,000 per year in the program in which 50-100 ha of disease affected jarrah forest are rehabilitated with a focus on biodiversity values.

8.1.3 Risk Assessment

In 1978, it was predicted that the spread of *P. cinnamomi* during mining was inevitable and would be high. Scientists from State Government departments and CSIRO (Technical Advisory Group 1978) declared that 1- to 4- ha spread for every hectare mined was



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expected. It was also predicted that the presence of *P. cinnamomi* would decrease the species richness in rehabilitated minepits.

The major risks during each stage of mining that could spread *P. cinnamomi* are:

- contaminating *P. cinnamomi*-free soil with *P. cinnamomi*-infested soil;
- *P. cinnamomi* spores in drainage water spreading along haul roads and from there into the forest;
- introducing *P. cinnamomi* from infested soil clinging to vehicles;
- surface water draining from cleared areas into the forest; and
- errors in mapping the dieback boundaries.

In the 1970s most mining occurred in areas predominantly infested with *P. cinnamomi*. Further dieback control procedures were introduced to better control soil and water movement. By the mid-to-late 1980s it was realised that bauxite mining would not necessarily lead to extensive spread of *P. cinnamomi* and death of jarrah, and that revegetation procedures could use entirely local tree and understory species with minimal risk of high mortality.

In 1989, the State Government decided that Alcoa's mining at Huntly should move into areas of mainly dieback-free forest. In this new mine envelope, virtually all vegetation communities adjacent to streams were infested, but most of the mid and upper slopes were free of *P. cinnamomi*. Methods were available to reliably map the presence of *P. cinnamomi* throughout the mine envelope. Some dieback control procedures, such as washing vehicles (Figure 8.2) and marking disease fronts, had been in place for the previous 5 years, and these procedures were perceived to be successful at minimising spread of *P. cinnamomi*.



Figure 8.2

Washdown facilities at minesite entrance

(Photo: G Hardy)

A team of mining practitioners and environmental scientists from within the company developed dieback management procedures for each stage of mining. Alcoa contracts DEC-accredited contractors to undertake detection, diagnosis and mapping of land leased in the jarrah forest for bauxite mining, to enable the company to develop *P. cinnamomi* management plans for their operations.



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8.2 R&D Program to Minimise Spread and Impact of Pathogen

To assess the potential impact of *P. cinnamomi* on revegetated minepits, monitoring programs were upgraded and a research program was commissioned by Alcoa at Murdoch University.

8.2.1 Monitoring projects

Earthmoving and roads

Gravel from haul road surfaces and minepit floors were monitored monthly for 3 years using a soil baiting method. The water in sumps that received runoff from haul roads also was monitored monthly. The monthly haul road and minepit sampling found less than 1% of the samples to be infested by *Phytophthora* species. *P. cinnamomi* was never isolated from water in haul road sumps. However, *P. cinnamomi* was found in water in the Huntly dam, which is used to suppress dust on the haul roads. Forest tracks were also screened and *P. cinnamomi* and other *Phytophthora* spp. were found on the tracks where water ponded frequently in ruts.

Although the monitoring programs were limited, considering the length of haul roads and the frequency of monitoring, it was concluded that levels of *P. cinnamomi* are low but the pathogen is still present. Therefore, the presence of *P. cinnamomi* on the haul roads and in the dam that supplies water to suppress dust on the haul roads reinforced the need to clean vehicles before they entered dieback-free forest and the need to chlorinate the water supply.

Vegetation monitoring

Monitoring in the 1990s indicated that the presence of *P. cinnamomi* did not decrease the species richness in rehabilitated minepits. Species richness is monitored annually in 50 plots at each mine commencing 15 months after revegetation. The treatment of the topsoil had the biggest impact on species richness. Directly returning topsoil resulted in significantly greater species richness than using stockpiled topsoil. Surprisingly, using soil infested with *P. cinnamomi* did not significantly decrease species richness.

An intensive program in 1995 monitored the survival of jarrah in 5- to 16-year-old rehabilitated minepits. Generally, survival was high and mortality tended to be patchy, coinciding with the areas where water ponded in riplines. The minepits with the lowest survival tended to have the greatest occurrence of water ponding. Glasshouse and field trials were conducted to determine whether *P. cinnamomi* could infect trees through the lower stem under conditions of temporary ponding in rehabilitated areas. 100% of the trees inoculated via water ponded around their stems became infected. Only 7% of trees died as a result, consistent with the percentage of deaths normally observed in rehabilitated minepits.

Alcoa monitors dieback spread that happens adjacent to their mining operations. This is demarcated in the field and mapped with GPS co-ordinates. Sites are monitored every 5 years.



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8.2.2 *P. cinnamomi*–resistant clonal jarrah

Soon after mining began in 1963, Alcoa identified the need to establish tree species resistant to *P. cinnamomi* in the rehabilitated areas. In the 1980s, a program was established by Alcoa, CALM, and Murdoch University to identify and propagate jarrah plants with an increased resistance to *P. cinnamomi*. Individual plants have been selected for high resistance and these have been cloned in Alcoa's laboratory at Marrinup Nursery. Seed orchards of these clones have been established at Huntly, Pinjarra and Manjimup. Seedlings grown from seed from these orchards are being used in a pilot study with community conservation groups located in the southwest of the State. There is no need to use the seed from these orchards in rehabilitated mined areas because of the high survival of 'unselected' jarrah in these areas.

8.2.3 Research program for potential methods to eradicate the pathogen from the soil

High soil temperatures

Surface soil temperatures of haul roads and other cleared mining areas reach 60°C. Laboratory studies showed that *P. cinnamomi* was killed when a temperature of 50°C was maintained for 0.5 h, or 40°C for 24 h (Colquhoun et al 1993) indicating that the high soil temperatures on the haul road surface will kill *P. cinnamomi* inoculum in the surface layer during summer.

Burning residue wood after logging operations on forest tracks could increase soil temperatures to a depth of 80 cm as shown in other research (Tunstall et al 1976). Two large field trials to monitor the survival of *P. cinnamomi* in wood plugs below burning piles of residue logs (Colquhoun et al 1993) produced, and maintained for days, soil temperatures of 40°C at 64 cm below the fire. The wood plugs were retrieved 9 days after the fire was lit. *P. cinnamomi* could not be reisolated from the wood plugs to a depth of 80 cm directly below the fire. Although this procedure was shown to be effective it has not been used routinely because of operational complexities and location of dieback tracks in the current mine envelope.

Disinfectants

It is possible to kill *P. cinnamomi* with chemicals such as sodium hypochlorite, copper compounds, and disinfectants such as quaternary ammonium compounds (Smith 1979; Howard et al. 1998). However, the concentration required for these compounds to kill *P. cinnamomi* in soil would be phytotoxic to plants (Gerritse et al. 1992; Howard et al. 1998). There is limited opportunity for eradication to be an effective management tool in a large mining operation (Colquhoun and Hardy 2000). Therefore, the focus for management must be on minimising the spread of the pathogen.

Phosphite treatments

New spot infections (<1 ha) in the forest caused by mining and other forest users are a threat to adjacent uninfested forest. These spots may be as small as one or two individual plants. Phosphite can minimise the risk of spreading the pathogen, and conserve the trees and understory plants in the infested areas. As a result of CALM's early success with phosphite, Alcoa initiated a number of studies to examine the potential of phosphite to



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control *P. cinnamomi* in native plant communities in and adjacent to mining including information on: rate, frequency, and season of application, plus a description of the expected benefits. Their research has shown:

- phosphite sprayed on plants can contain the spread of *P. cinnamomi* in many native shrubs from a range of susceptible families (Pilbeam et al 2001, Wilkinson et al 1999a);
- it is likely that phosphite will need to be sprayed every 1 to 2 years; and
- from glasshouse studies and in field studies, it was surmised that phosphite treatment of infested sites may prevent deaths of plants but may not prevent the spread of inoculum downslope (Wilkinson et al 1997, 1999b).

The phosphite research is continuing.

The development of a method to contain or eradicate *P. cinnamomi* in such sites will help Alcoa meet its environmental objectives of minimising the spread of the pathogen and also by reducing costs associated with hygiene measures.

8.3 Management of *P. cinnamomi* During Mining

In the new mining envelope the frequency of vehicle cleaning required was much greater, especially when moving from the haul road to the forest. Consequently, the “dieback-free” or “*green bridge*” strategy was developed. This strategy was based on all haul roads being built of uninfested material, with strict hygiene procedures being imposed during construction and use with all vehicles being cleaned when entering from public roads and forest tracks. Vehicles can travel from the haul roads to uninfested areas without cleaning.

A detailed manual of dieback management procedures for each stage of mining was produced by the risk assessment team and is fully integrated into the Environmental Management System (EMS; AS/NZS ISO 14001:1996). The procedures make use of the following strategic approach:

- *Know where the pathogen is present* - Reliable, up-to-date maps and field demarcation of diseased sites are the backbone of the control measures. Alcoa requires that the dieback boundaries be rechecked within a 12-month period prior to a major mining operation in the forest. All the data on dieback boundaries are stored on a GIS and is updated frequently to ensure that mine planners and environmental scientists have the best maps for their planning tasks.
- *Schedule high-risk operations during low-risk periods of the year* - The control measure of scheduling high-risk operations during low-risk periods is seen as an extremely valuable tool, so detailed planning ensures that high-risk operations, and operations in areas where the consequences of ineffective control are assessed to be high, are undertaken when the soil is dry. It decreases the risk of inadvertently spreading infested soil on machinery and the risk of infested water draining into adjacent dieback-free forest. Exploration drilling operations in dieback free forest also occur when the risk of tires moving soil is very low.



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Other planning issues are also addressed to reduce the risks of spreading the pathogen; these include: the location of roads, the duration that a minepit is left active, the sequence of mining a large minepit, and the location of stockpiles. The mine planner and mine environmental scientist work as a team to develop plans to ensure that mining is economic but the risk of spreading *P. cinnamomi* is low.

- *Restrict vehicle movement from dieback-infested to dieback-free areas* - The unknown presence of *P. cinnamomi* on a wet haul road has the potential to introduce *P. cinnamomi* to every dieback-free area that vehicles visit. Controlling access to all dieback-free areas is essential. This is achieved by blocking tracks so they cannot be used, using signs and bunting to limit access and inform users of access conditions, putting gates on all entry points to the mine, and constructing “green bridges” across infested areas using gravel and rocks from uninfested sites (Figure 8.3a,b).
- *Clean vehicles before entering dieback-free areas* - Before any vehicle or mobile equipment moves from dieback to dieback-free sites, as much soil as possible is removed (Figure 8.3c). The most effective cleaning occurs in the workshop, so scheduling is optimised to exploit workshop cleaning. Cleaning occurs at all stages of mining where vehicles are required to cross dieback boundaries. Large trailer-mounted high pressure water pumps are used in the field (Figure 8.3d).
- *Prevent water draining from infested to uninfested areas* - Surface water is never allowed to drain freely into the forest, irrespective of the dieback status of the water or forest, discharge is always controlled. A system of drainage channels and high bunds prevents surface water from haul roads flowing directly into the forest. Instead, the water is directed into sumps. In the rehabilitated minepits, the ripping pattern directs all surface water back into the minepit, away from the forest. If an infested ore body site is located above an uninfested site, then a “drainage slot” is constructed to intercept and prevent water running into the forest downslope.
- *Train all field staff and planners* - Dieback control measures for each stage of mining and rehabilitation are documented during the risk assessment team meetings. There is a strong commitment to implement these procedures because most managers and field supervisors were directly involved in their preparation. All operators and contractors are trained in the control procedures relevant to their duties. There is strong senior management commitment to the procedures, so any breach of the rules is regarded as important and requiring disciplinary action.

Training in *P. cinnamomi* management is compulsory for Alcoa staff and is delivered to staff via a computer-based Learning Management System, part of the company's overall EMS. The training modules were developed specifically for the WA mining operations by the company's Senior Environmental Consultant. The training covers biology and ecology of the pathogen,



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procedures for management during all mining operations and a self-test process. Re-testing is undertaken every two years. Field-based personnel receive similar training/refreshers in a classroom setting which is triggered at appropriate intervals by the Mine Environmental Scientist at the mine.

- *Monitoring compliance* - Every year a series of environmental audits are performed – these audits include sections on dieback management for every procedure. Compliance with the critical procedures by operators, field supervisors, and planners is assessed. These audits have identified opportunities to improve the procedures to increase their effectiveness or decrease the cost.

An evaluation of the effectiveness and review of management requires knowledge of the level of compliance to standard operating procedures. Alcoa in WA has adopted an accredited EMS through which independent auditing of *P. cinnamomi* management procedures is undertaken every 4 years. Alcoa also undertake annual internal audits of operational performance and procedural compliance in relation to *P. cinnamomi* management.

Figure 8.3

a) Sign indicating *Phytophthora* dieback-free area



b) Gate to stop access to *Phytophthora* dieback infested area

(Photos: G Hardy)



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Figure 8.3

c) Washing down before entering a *Phytophthora* dieback-free area using a mobile spray unit

d) Washing down machinery in the field



(Photos: G Hardy)

8.4 Effectiveness of *Phytophthora* Dieback Management

As the economic cost of implementing dieback management procedures at Huntly is high, estimated to be more than \$1.5M US per year in 2000, it is important to know how effective they are. Alcoa has three monitoring projects i) to find out if *P. cinnamomi* was spreading from Alcoa operations into the adjacent uninfested forest, ii) to determine if the soil stripped from uninfested forest sites remained uninfested throughout the various mining stages leading up to revegetation and, iii) to quantify the area that had been “rationalised” from uninfested to infested during the mining operations.

Rationalisation occurs when operational constraints prevent uninfested soils from being handled separately from infested soils (eg when a large scraper is unable to turn without driving across a dieback boundary). Rationalisation also occurs if there has been a breach in dieback management procedures and we believe the area is no longer free of *P. cinnamomi*. The opportunity is also taken during rehabilitation to spread uninfested soil over a larger area than it came from.



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8.4.1 Spread to uninfested forest

Determining the rate of spread of *P. cinnamomi* in the forest cannot be regarded as a direct measure of the effectiveness of dieback management procedures. Infested soil could be transferred from mined areas into uninfested forest without the pathogen becoming established and infecting susceptible plants. Instead, Alcoa uses the results of this monitoring project as an indicator of effectiveness. In the past, scientists and foresters predicted that the spread of *P. cinnamomi* from mining would be high; rates from 1 to 4 ha of spread for every hectare mined were proposed (Technical Advisory Group 1978).

Field interpreters assessed the 119 km boundary between uninfested forest and 1261 ha land cleared for mining operations between 1999 and 2002 inclusive, and forest adjacent to areas that were restored from 1998 to 2001. A 50-m-wide strip of forest abutting mining areas (including minepits and roads) within uninfested forest was interpreted for the presence of dieback symptoms. New infestations were marked in the field, their location surveyed, and the data transferred to Alcoa's GIS. The total area of new infestations was 1.06 ha which equates to 0.0008 ha for every hectare cleared for mining (Table 8.1). If the pathogen moves downslope from these new infestations, the area would increase to 28 ha; this equates to 0.014 ha for every hectare cleared for mining. The main causes of spread were thought to be water draining from stockpiles, transfer of infested soil during vehicle movement, and drainage from mining and rehabilitated areas (Crosbie and Colquhoun 1999, Colquhoun and Kerp 2007).

Table 8.1 Summary of the spread of *P. cinnamomi* from mining operations at Huntly.

Measurement	Spread
Clearing	1261 ha
Infestation	1.06 ha
Infestation/clearing	0.0008 ha/ha
Total potential spread	1.22 ha
Total potential spread/clearing	0.001 ha/ha
Length of interpretation	119366 m
Infestation length	53 m
Clearing length infested	0.04%

Total Potential Spread = the area of infestation added to the area of high potential risk.
 Infestation length = the length of previously uninfested forest abutting clearing boundaries that is now infested as a result of mining.



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8.4.2 Spread within rehabilitated mined areas

If dieback management procedures are effective, then uninfested soil removed before mining should be returned to the minepit during rehabilitation in the same uninfested condition. To test this, every 1-year-old rehabilitated area with uninfested soil was surveyed for dead or dying dieback susceptible plants. Of the 29 rehabilitated minepits monitored, only four were found to have *P. cinnamomi* present. This indicates that, in most cases, the dieback management procedures have been effective. Opportunities for improvement were identified.

8.4.3 Rationalisation of infested and uninfested areas

Three large areas at Huntly were selected for this study. The area of uninfested forest within the minepit boundaries before mining was calculated. This area was then compared with the area where uninfested soil was returned to the rehabilitated mined areas. The area cleared for mining was 450 ha, of which 359 ha were dieback-free prior to mining. The total area of dieback-free rationalised to dieback within clearing was 13.6 ha. Most of this increase was caused by an error in soil handling procedures.

8.4.4 Success

The results of these three monitoring projects indicate that the dieback management procedures are effective. A major outcome of this work is the identification of opportunities to improve the procedures. These projects will be repeated every 3 - 5 years.

8.5 Conclusion

Alcoa of Australia Ltd. operates one of the largest productive bauxite mines in the world. The Huntly minesite is located in the jarrah forest and their mining operations occur in a mosaic surrounded by pockets of *Phytophthora* dieback infested forest. The majority of ore bodies vary in size from 5 to 40 ha and are surrounded by jarrah forest. Approximately 600 ha are mined and rehabilitated each year, with a further 2500 ha drilled for exploration purposes. Consequently, there is an enormous challenge to mine uninfested areas without spreading *Phytophthora* dieback from infested areas. This challenge is further exacerbated by the presence of many susceptible plant species including jarrah being present.

Alcoa has shown that it is possible for a large mining operation to manage and contain *P. cinnamomi* in a native forest environment. They have used an integrated approach to ensure that objectives are well defined, and by actively involving on ground staff and researchers in the development of management procedures to ensure that the program is well targeted to the present and future needs of the operations. Regular monitoring of the effectiveness of the procedures has allowed Alcoa to assess the benefits and identify opportunities for improvement. They respond rapidly when improvements are required.

Minimising the spread of *P. cinnamomi* is a major environmental goal of Alcoa – so achieving the low measured rate of 0.0008 ha of spread of the pathogen for every hectare cleared during mining at Huntley (0.0001 ha/ha at Willowdale minesite) is regarded as a successful outcome. This measurement of spread is for one point in time, 2-8 years after clearing has occurred. The eventual rate of spread from the new infestations is difficult to



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estimate. Alcoa believe that sources of error in the calculation of spread will increase the rate of spread for some new infestations but also decrease the rate of others.

The other major outcome of this monitoring project is an applied one; Alcoa was able to identify the causes of many of the new infestations. Many causes were not related to errors in the procedures but to errors in complying with the procedures, e.g. when water drained from the restored area into the forest due to ripping not being 'on contour', when earthmoving vehicles drove into the native forest from an infested area without removing soil from the vehicle. These findings were directly entered into training packages for operators to demonstrate what happens when the procedures are not properly implemented.

Alcoa attribute their success of the disease management program to:

- Commitment from all levels from management to operators in the field;
- Integrating environmental procedures as part of operating instructions;
- Adopting a risk assessment process with input from a range of staff;
- Supporting research and development into management of *P. cinnamomi*; and
- Implementing relevant monitoring and auditing programs.

Alcoa have demonstrated substantial 'attention to detail' with their approach to 'best management practice' for *Phytophthora* dieback at all stages of the mining and rehabilitation process. This is from mapping the forest for the presence of *Phytophthora* dieback prior to any mining activities to subsequent auditing of disease spread for a number of years after rehabilitation.

They have invested substantially in research and development both 'in-house' and through Universities and the DEC. Research activities have included the monitoring of earth moving and roads, vegetation monitoring, management of *Phytophthora* dieback during mining, screening for *Phytophthora* dieback resistant jarrah, long-term survival and spread, phosphite use and efficacy, efficacy of disinfectants, and eradication methods. They have also looked closely at effective education and training. These activities have benefited Alcoa but also other mining industries, the DEC and many NGO's. Alcoa's commitment to managing is on-going and they have clearly indicated that through applied and basic research and through adaptive management that it is possible to minimise the spread of *Phytophthora* dieback despite moving many millions of tons of soil each year.



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9. HIERARCHY EFFECTIVENESS

9.1 Management Philosophy

Prior to 1998, a 'belt and braces' (or 'bib and braces') approach was applied to *Phytophthora* dieback management on the conservation estate. The approach required multiple forms of hygiene management for a single site (e.g. clean on entry and low profile roads). The intent was that if one hygiene practice failed there was a back-up (i.e. a belt and a brace). A key part of the approach was the Seven Way Test used to assess the risk of introducing or spreading *Phytophthora* dieback when undertaking disturbance activities. The focus was on road works and logging operations.

In 1996, the "Podger Report" (Podger et al 1996) recommended that the DEC focus its attention on 'protecting the protectable'. It recommended that:

Government adopts a dieback management strategy which identifies significant protectable areas (those for which the values at risk are significant and the benefits of hygiene are likely to be sustained for more than a few decades), prioritises them and concentrates available resources on rigorous application of hygiene for their protection" (Podger et al 1996 p.2)

Based on this recommendation, a protocol was developed to guide land managers in identifying and managing "protectable areas". This approach was adopted in the 1998 version of Policy Statement No. 3 and has been retained since. Among the objectives in Policy Statement No.3 (CALM 2004) are the following:

- Assess the threat to the conservation of Western Australian biodiversity posed by *P. cinnamomi*, including the threat to uninfested areas of high conservation value and to the residual conservation values of infested areas;
- Assess and evaluate the risk of introduction of *P. cinnamomi* into uninfested 'protectable' areas;
- Identify, evaluate and, where practical and reasonable, apply effective and efficient risk treatment measures to limit serious and irreversible environmental damage in uninfested areas;

'Protectable areas' are described in the policy as "areas of high conservation and/or socio-economic value (e.g. a small uninfested area which contain a known population of a susceptible species of threatened flora) within the vulnerable zone that are:

- Situated in zones receiving >600 mm per annum rainfall or are water gaining sites (e.g. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600 mm per annum rainfall zone;
- Not calcareous soil (e.g. not on the Quindalup dune system);
- Determined to be free of the *P. cinnamomi* by a qualified Disease Interpreter (all susceptible indicator plant species are healthy and no plant disease symptoms normally attributed to *P. cinnamomi* are evident);



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- Positioned in the landscape and are of sufficient size (e.g. >4 ha with axis >100 m) such that a qualified Interpreter judges that *P. cinnamomi* will not autonomously engulf them in the short term (a period of a few decades); and
- Where human vectors are controllable (e.g. not an open road, private property).

Stakeholders indicated that as a result of the change in philosophy, there has also been a change in how hygiene management practices are applied. As described by one stakeholder: "No longer are multiple hygiene management measures required at a single site. It is assumed that if you are clean when entering a protectable area there is no need to take further precautions once you have entered the area".

Several views emerged from stakeholder comments on the shift in management approach from belts and braces to protecting the protectable:

- Some thought the change was positive. With limited resources it is best to concentrate on managing one entry point well, instead of trying to manage multiple entry points;
- Some believe the newer philosophy increases the likelihood of spread. These individuals advocated the use of multiple hygiene measures for a single site in order to provide redundancy in the system as back up. These stakeholders commented that "no one hygiene measure is fool proof";
- Some were concerned that areas deemed 'unprotectable' would "simply be written-off"; and
- Some recommended a compromise whereby areas are prioritized for management and the management of the priority areas adopts a risk management approach (e.g. the Seven Way Test¹³).

There was general support for the policy's philosophy of prioritising areas for management, with higher priority areas receiving more intense *Phytophthora* dieback management. In a management context of limited agency resources, prioritising efforts is viewed as a reasonable means of applying resources where they are needed most.

9.2 Satisfaction with Policy Statement No. 3

9.2.1 Goals and objectives

A planning hierarchy should include clear goals and objectives. A goal is a long-term vision or organisational end-point to be achieved. Management objectives are the steps by which the goals of a policy or plan are to be achieved and often focus on outcomes.

¹³The test provided DEC staff with a mechanism to assess the risk of introducing or spreading *Phytophthora* species when undertaking disturbance activities. The focus was on roads works and logging operations.



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While not explicitly labelled as a goal, *Policy Statement No. 3* includes the following goal statement. The policy is to provide

*... guidance to [DEC] staff with a view to limiting the threat posed by *Phytophthora cinnamomi* and disease caused by it to the biodiversity conservation values of native vegetation of Western Australia (CALM 2004, p.3).*

Stakeholders recommended that the DEC's *Phytophthora* dieback management goal should be to reduce the rate of spread caused by humans. They also indicated that autonomous spread cannot be managed at this point in time. Further, that fauna induced spread is too difficult and costly to manage.

Management objectives suggested by stakeholders to support this goal included:

- Undertaking research to answer management questions.
- Educating the community and proponents on appropriate *Phytophthora* dieback management.
- Undertaking appropriate hygiene management.

The suggested objectives are consistent with the following objectives contained in *Policy Statement No.3*:

- *Develop and progressively implement agreed priority research programs that may reasonably be expected to impact on the effectiveness and efficiency of the abatement of the threat posed by *P. cinnamomi* to the conservation of Western Australian biodiversity;*
- *Design and implement appropriate programs for public consultation and education and for the provision of information.*
- *Evaluate the degree of precaution to be used when applying preventative measures.*

9.2.2 Stakeholder suggestions

Stakeholders recommended several changes to improve *Policy Statement No. 3*:

- The policy should address the management of all *Phytophthora* species rather than only *P. cinnamomi* as is the current situation. Since the policy was prepared, researchers have identified a number of new *Phytophthora* species in WA. Some of these species, such as *P. multivora*, do not behave in the same manner as *P. cinnamomi* and thus may require different management actions¹⁴.
- Simplify the text of the policy to clarify how DEC staff is to achieve its goal.

¹⁴ For example, recovery of isolates suggests that *P. cinnamomi* is suppressed in limestone while *P. multivora* is not.



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- Include clear management objectives on how to implement the policy's key concepts such as adaptive management, sustainability and the precautionary principle.
- Harmonise the terminology in the policy with that contained in other documents.

The stakeholder interviews revealed that some DEC staff were working from the 1998 version of the policy rather than the 2004 version. This situation appears to stem from confusion over the official status of the 2004 policy with some questioning whether it is still draft or has been finalised¹⁵.

The confusion over which version of *Policy Statement No. 3* is in force, heightened DEC staff concerns that any changes in DEC policy need to be more effectively communicated in order to ensure everyone is working towards the same objectives.

9.2.3 DEC *Phytophthora* dieback manual

The manual *Phytophthora cinnamomi* and the Disease Caused by It, Volumes 1-4 (CALM 2003) received positive comments from those who use it. It was described as a useful source of information, particularly when questions arise about hygiene management.

When asked how it might be improved, the following modifications were suggested:

- Provide clarification on the application of green bridges (e.g. under what circumstances and how should they be applied).
- Reduce the emphasis on forestry practices and broaden the focus to include any disturbance activity.
- Provide clear definitions of open and closed roads.
- Provide guidance regarding when a road is 'protectable' and when it is not.

9.2.4 Gap between Policy and guidance documents

Stakeholders expressed frustration that there is no road map for implementing the management objectives in *Policy Statement No.3*. There is a gap between the objectives set out in the Policy and the guidance provided by *The Best Practice Guidelines for the Management of Phytophthora cinnamomi* (CALM 2004) and the DEC manual.

¹⁵ In 2006, the Conservation Commission accepted the 2004 amended version, on the understanding that it be an interim policy that would be reviewed and finalised after 12 months. The DEC continues to comply with the interim policy (J Renwick pers comm).



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They described wanting:

- A better understanding of how all the dieback efforts fit together.
- Mechanisms to evaluate effectiveness.
- A clear picture of strategic priorities and the supporting activities.
- To know how the DEC's efforts are part of a larger integrated approach that extends beyond the conservation estate.

9.3 DEC Leadership

Stakeholders discussed leadership from three perspectives: Internal leadership, DEC leading by example, and collaboration with other stakeholders.

9.3.1 Internal leadership

There was a strong perception among stakeholders that *Phytophthora* dieback management has slipped dramatically on the public agenda and the DEC's agenda. Events described as signals of reduced status were:

- Reduction of the DEC Dieback Coordinator position from full-time to a 0.7 FTE position shared by two individuals.
- A reduction in the number of DEC training courses offered to external stakeholders.
- Less media coverage of *Phytophthora* dieback management.

To some degree, this has negatively impacted the morale of those DEC staff passionate about dieback management, although they remain committed to their efforts. There is also a desire among stakeholders that senior ranks within the DEC provide greater leadership in clarifying the agency's vision for *Phytophthora* dieback management. Some stakeholders recalled the years when Dr Syd Shea headed the organisation, describing him as a champion for *Phytophthora* dieback management, helping to position *Phytophthora* dieback at the forefront of the public conscientiousness.

9.3.2 Leading by example

Both DEC staff and external stakeholders thought it important that the DEC lead by example through its own *Phytophthora* dieback management efforts. "The DEC needs to walk the walk not just talk the talk". There were some criticisms of the DEC's hygiene practices within the conservation estate. Anecdotal evidence was provided that the DEC did not always follow the procedures that they required others to perform. The veracity of these claims could not be tested by the study team; however, one incident that was cited by many stakeholders and has been documented is the construction of the Loop Road in Lesueur National Park. The fact that so many stakeholders were aware of that mistake is evidence that any failure by the DEC to rigorously apply best management practices will damage its credibility and authority of the DEC to impose requirements on others.



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9.3.3 Collaboration

At the peak stakeholder level, the DEC has been active in providing leadership through its participation in the DCC, DRG and Project Dieback. At a regional level, the DEC has contributed to NRM efforts to prepare regional *Phytophthora* dieback management plans. The Wellington National Park case study highlighted DEC efforts at a local level through its partnership with Track Care WA Inc¹⁶ and working relationships with recreation groups that use the Park.

9.4 Adaptive Management

Policy Statement No. 3 defines adaptive management as:

A process of responding positively to change. The term adaptive management is used to describe an approach to managing complex natural systems that builds on common sense and learning from experience, experimenting, monitoring, and adjusting practices based on what was learned (CALM 2004 p.2).

Further, the Policy encourages the:

Use of adaptive management on lands managed by the Department that incorporates the results of monitoring of environmental effects to either confirm the appropriateness of continuing established environmental management programs or, where there is evidence of serious or irreversible environmental damage, ensure the modification or cessation of any deleterious practices (CALM 2004 p.5).

Overall the perception among stakeholders was that adaptive management is not occurring as effectively as it should. Contributing factors were:

- In general, stakeholders were satisfied with the DEC compliance monitoring of proponents on the conservation estate whose activities are controlled either by regulation (e.g. FPC) or DEC issued access permits (e.g. utilities). They were however more critical of the DEC's efforts to monitor the behaviour of others using the conservation estate, especially recreationalists. It was acknowledged that at current staffing levels, there is an insufficient DEC presence in the conservation estate (e.g. rangers in National Parks) to monitor the degree to which visitors are complying with restrictions such as road and track closures.
- There is a need for greater monitoring of the effectiveness of *Phytophthora* dieback management interventions in order to "learn from doing". This would include longer periods of monitoring in areas where disturbance has occurred (e.g. construction of roads, timber harvesting). It was recommended that such

¹⁶ Track Care WA Inc is a non-profit volunteer organisation formed in 1997 to promote issues about the repair and upkeep of off-bitumen tracks throughout Western Australia.



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areas be re-interpreted after five¹⁷ years to determine if they have become infested.

- There should be greater use made of targets and performance indicators¹⁸ to ensure that progress and effectiveness can be evaluated. Many stakeholders were aware of the KPI 18 review but indicated that additional performance indicators and targets are needed. Of the four case studies, only the Wellington National Park Management Plan (DEC 2008) included specific targets and performance indicators.
- The lack of a central and accessible clearinghouse for data on *Phytophthora* dieback occurrence. Currently some data are stored electronically while some older some data are still in paper form. The DEC is updating its intranet site to give staff increased access to dieback occurrence maps and hygiene management plans. While data are generally available to DEC staff, data are only made available to third parties on request and these are not always granted. Many stakeholders recommended that all *Phytophthora* dieback data collected by DEC and others be stored in a centralised repository accessible not only to DEC staff but to others working in dieback management. There were, however, several stakeholders who raised concerns that if data was made more widely available it could be misinterpreted if it was out of date. Others noted this issue but believed that proper documentation of data sets would sufficiently address this issue.
- Inadequate succession planning was another barrier identified during interviews. It was noted that much of the DEC's expertise in *Phytophthora* dieback is held by a small number of individuals. The loss of one of these individuals would create a void in institutional knowledge that would be difficult to fill. It was recommended that the DEC engage in succession planning in order to mentor new leaders and retain institutional knowledge.
- Stakeholders wanted to see the DEC offer additional training courses, including refresher courses, for the DEC staff and external stakeholders. Refresher training would provide a venue for new knowledge about *Phytophthora* dieback to be fed into the management system. The DEC was identified as the preferred training provider due to their expertise in *Phytophthora* dieback and its management. There were however some in the DEC who felt the department should not be in the business of providing training courses to others. They saw that need better filled by another organisation such as NRM.

At present, research findings are fed into the adaptive management cycle through the Dieback Information Group's annual conference, peak consultative groups (e.g. the Dieback Consultative Council and the Dieback Response Group) and informal relationships between

¹⁷ It typically takes up to 5 years before the symptoms of *Phytophthora* dieback emerge.

¹⁸ Targets are the outcomes that management objectives seek to achieve and may be short or long-term. Performance indicators are measures used to determine if the targets are being met.



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key stakeholders. Stakeholders view the DIG annual conference as an effective mechanism for communicating research findings.

9.5 Restricted Access and Activities

9.5.1 DRAs and other mechanisms

Stakeholders supported continuing the approach of restricting access to vulnerable high value conservation areas of the conservation estate through mechanisms such as DRAs. As described in Table 9.1, the *CALM Act (1984)* and *Conservation and Land Management Regulations 2002* (WA) allows a range of options for controlling access within the conservation estate. These include disease risk areas, limited access areas, wilderness areas, temporary control areas and prohibited areas.

The only mechanism that stakeholders were at all familiar with was DRAs, which only apply to State forest. *Phytophthora* dieback was the 'forest disease' that instigated the creation of DRAs to establish quarantine areas for research (J Bailey pers comm). In January 1976, 507 600 ha of areas that were diseased and/or areas that needed to be protected from becoming infested were proclaimed as DRAs. At the end of 1977, following the preparation of working plans for the southern jarrah forest and consultation, a further 211 961 ha were proclaimed (Dell et al 2005).

Stakeholders supported the continued use of DRA but wanted their effectiveness increased. It was often noted that when DRAs were first established they were regularly monitored by weekly 'Quarantine patrols'. Over time the level of monitoring declined to the current situation in which it occurs on an "opportunistic basis", sometimes as part of multi-agency enforcement blitzes on the conservation estate¹⁹. This was not viewed as an acceptable alternative to regular monitoring of DRAs.

In the absence of regular monitoring, the level of compliance with access restrictions is uncertain as is the condition of the DRA. Some stakeholders questioned if the DEC knows whether DRAs have maintained their dieback free status. It was recommended that DRAs be reinterpreted with only uninfested DRAs retained.

¹⁹ For example, in Wellington NP the DEC joins forces with other agencies with a regulatory interest in the park (e.g. Water Corporation, Department of Fisheries, WA Police) to conduct blitzes to ensure park users are abiding by the rules (e.g. fishing, marroning, hunting, motorbike helmets).



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Table 9.1 Mechanisms to control access to vulnerable high value conservation areas

Mechanism	Description
Disease Risk Areas (DRAs)	DRAs are designated areas of State forest at risk of infection with a forest disease, including <i>Phytophthora</i> dieback. Vehicle access to DRAs is limited through a permit system, with those seeking access required to obtain an access permit from the DEC. The permit defines the hygiene management requirements that are a condition of entry to a DRA. Entering a DRA without a permit; operating contrary to a condition of the permit; operating contrary to instructions or directions from an authorised person or the Executive Director; unable to produce the appropriate permit when asked; and not cleansing and disinfecting a vehicle as asked result in a penalty of \$150 to \$1000 for the first offence and \$200 to \$2000 for the second and subsequent offences. To establish a DRA, the DEC's CEO must make a recommendation to the Environment Minister who then makes a recommendation to the Governor who makes the final determination.
Limited access areas	A person is not allowed to enter a limited access area (by foot or vessel) without lawful entry (Section 42, CALM Regulations). A penalty of up to \$2000 applies. To establish a limited access area, the DEC's CEO must make a recommendation to the Environment Minister who makes the final determination.
Wilderness areas	A person is not allowed to enter a wilderness area (by vehicle, powered vessel or animal) without lawful entry (Section 43, CALM Regulations). A penalty of up to \$1000 applies. To establish a wilderness area, the DEC's CEO must make a recommendation to the Environment Minister who makes the final determination.
Temporary control areas	A person must not enter a temporary control area without lawful authority. Temporary control areas, when applied to land, can only be established for the purposes of public safety or the protection of flora and/or fauna. When applied to forest products, temporary control areas are to be established for the purposes of public safety or safety of person engaged in the harvesting or stockpiling of forest products or in the construction or maintenance of roads. They last for a period of 90 days. A penalty of up to \$2000 applies (Section 41, CALM Regulations). To establish a temporary control area, the DEC's CEO must make a recommendation to the Environment Minister who makes the final determination.
Prohibited areas	A person must not enter a prohibited area without lawful authority. A penalty of up to \$2000 applies (Section 41, CALM Regulations). To establish a prohibited area, the DEC's CEO must make a recommendation to the Environment Minister who makes the final determination.



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Stakeholders also observed that:

- In some instances, DRAs are not clearly signposted resulting in unintentional access to restricted areas by unknowing visitors to the conservation estate.
- Where gates and signage are used to highlight access restrictions, too often they are the subject of vandalism.
- Non-DEC staff can easily misinterpret the term 'Disease Risk Area' to mean an area already infected.

Rather than using the mechanisms described above, in the case studies, Park managers had adopted a zoning approach. The National Parks are broken into zones (e.g. special conservation, wilderness, natural environment, and recreation) with different levels of access assigned to each zone. However, these zones have no statutory backing (i.e. legal standing).

9.5.2 Fines

Gates, barriers and signage are used on the conservation estate to designate areas where visitors are not to have access due to the risk of spreading *Phytophthora* dieback (e.g. conditions are too wet and muddy). Stakeholders lamented that while most visitors abide by these measures there is a certain constituency that will disregard the signage and gates and enter areas vulnerable to the spread of *Phytophthora* dieback. There is also vandalism of signage (e.g. removing signs, knocking down signs, shooting holes through signs).

Many stakeholders were unaware of the available options to issue fines under the *CALM Regulations 2002* (WA) (Table 9.2). Table 9.3 provides indicates the number of offences recorded against the CALM Act and CALM Regulations in the 2008/2009 financial year, including 31 offences related to DRAs (DEC 2009).

Stakeholders viewed education as first recourse when an offence is identified with fines used if education efforts failed. It was recommended that restricted access signs indicate the penalty for not abiding by the sign.

9.5.3 Activity Permits

Through the issuing of permits, the DEC has the power to regulate activities such as beekeeping, fire wood collecting, wildflower picking and land clearing within the conservation estate. Where appropriate, the permits include conditions requiring that proponents follow specified hygiene management practices.

Under the *Environment Protection (Clearing of Native Vegetation) Regulations 2004* (WA), the DEC can grant a permit to clear native vegetation. As a condition of the clearing permits, specified hygiene management may be a requirement. The Water Corporation has a Statewide Clearing Permit, which enables them to undertake land clearing when required, rather than applying for an individual permit each time land is to be cleared. The permit requires that appropriate *Phytophthora* dieback hygiene precautions be taken for activities that occur below the 26th Parallel. The Water Corporation provides an annual audit of its permit compliance to the DEC.



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Table 9.2 Offences under the *CALM Regulations 2002* (WA)

Offence	Penalty	Section No.
If an entrance to DEC land is controlled by a gate or other barrier a person must not, without lawful authority, enter the area other than through the gate or barrier.	\$500	47
A person must not, without lawful authority, unlock, dismantle or break down a locked gate or locked barrier on DEC land.	\$500	47
A person must not, without lawful authority, open, remove, dismantle or breakdown a gate or barrier on DEC land if it is clear (by signs) that the gate or barrier is not meant to be opened or removed.	\$500	47
Off-road vehicle (ORV) users must hold a permit (as defined under the <i>Control of Vehicles (Off-road Areas) Act 1978</i> (WA)) to ride on DEC land	\$1000	52
Persons driving a vehicle on a DEC road or track must not breach, without lawful authority, the <i>Road Traffic Act 1974</i> (WA)	\$500	54
A person must not, without lawful authority, camp on DEC land except in camping areas	\$500	66
An authorised officer may direct a person on DEC land to cease behaviour that: (a) is contrary to the lawful use of the land, (b) disturbs or annoys another person or in the opinion of the authorised officer is disorderly or offensive or (c) in the opinion of the authorised officer is dangerous.	\$500	72
On DEC land a person must not: (a) create or commit any nuisance, (b) behave in a disorderly or offensive manner, (c) use abusive, offensive or insulting language, or (d) otherwise act in such a way to cause or be likely to cause a nuisance or annoyance to other persons on the land	\$500	73
It is unlawful to take ²⁰ of flora and fauna (other than fish).	\$2000	8

Some State government agencies that regularly need to conduct operations in the conservation estate, such as the Water Corporation, have adopted their own internal dieback management guidelines and plans (Water Corporation 2008). Compliance is audited as part of its environmental management system (EMS).

Stakeholders did not raise any concerns about the performance of proponents operating in the conservation estate under an activity or clearing permit. DEC staff noted that new proponents tend to quickly adopt appropriate management practices once they understand the requirements.

²⁰ As defined in Section 2 of the CALM Regulations, to take includes "to injure, destroy or otherwise interfere with or cause or permit the doing of any of those things".



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Table 9.3 Reported offences against the CALM Act and Regulations in the 2008-2009 financial year (DEC 2009)

Charges	Reported Offences	Infringement notice	Letter of warning	Cautious notice	No further action	Pending
Illegal taking or possession of forest produce	29	4	1	13	--	7
Offence relating to the occupation of CALM land	1	--	--	1	--	--
Offences against officers	2	--	2	--	--	--
Offences relating to DRAs	31	--	1	29	1	--
Offences relating to activities on State Forests, Nature Reserves and National Parks	700	375	16	274	12	13
Total	766	380	20	319	13	20

9.6 Resources to Implement *Phytophthora* dieback Policy

Stakeholders highlighted the importance of having adequate resources to implement *Policy Statement No.3*. This included having sufficient knowledgeable staff and the financial resources to carry out the management.

9.6.1 Dieback Coordinator

Within the DEC, the Nature Conservation Division (NCD)²¹ is responsible for implementing the DEC *Phytophthora* dieback management hierarchy. This is supported by a Dieback Coordinator. At present, this is a 0.7 FTE position shared between two DEC staff (i.e. 0.2 and 0.5 FTEs). There were calls for the position to be returned to a FTE position. It was also suggested that the Dieback Coordinator be supported by other dedicated full time staff based in those Districts where *Phytophthora* dieback is an issue.

9.6.2 Interpreters

Phytophthora dieback interpreters receive rigorous training. After taking the DEC dieback training course, interpreters spend six to twelve months being mentored, followed by up to three years of regular spot checks by an experienced interpreter. Within the DEC, the

²¹ Other responsibilities of the Division include management of native vegetation, threatened species and communities.



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dieback interpreters reside within the Sustainable Forest Management Division which receives funding from the FPC to conduct interpretations of its coupes.

Some stakeholders expressed concern about the declining number of interpreters based within DEC. The loss of interpreters to the private sector was attributed to limited career paths within the DEC which provided little incentive to remain with the agency. Others were less concerned about the drift of interpreters from the DEC to the private sector, noting that what is important is that a pool of interpreters is available. One of the limiting factors is that in-field training qualifies an interpreter to interpret only in the region in which their training takes place. This is because *Phytophthora* dieback expresses differently in different areas.

9.6.3 Available mapped data

Stakeholders identified the Dieback Atlas as a good step towards more comprehensive mapping of the extent of *Phytophthora* dieback infestation. However, the Atlas in many cases is based on old, historical data, aerial photo interpretations, or other mechanisms which provide a low level of confidence. Stakeholders indicated that more on-ground mapping by trained interpreters is needed to support decisions making processes (e.g. the selection of hygiene management practices is based on the extent of disease occurrence). However, there are typically not the funds available for this to occur.

9.6.4 Phosphite applications

Typically dieback is managed through controlled access and phosphite application. Over the past 10 years, phosphite applications have helped protect threatened flora and TECs. A decision support model based on good science was developed. The Bayesian Belief Network model supported the need to continue with good hygiene practices, continued phosphite applications and restricting access. So funding will be used to continue aerial spraying. However, in the last 18 months the cost of phosphite had increased substantially as has its application. The budget has not necessarily increased at the same rate as the treatment. It was also noted in the Stirling Range National Park case study that there is uncertainty about phosphite treatments being continued beyond 2009 due to the lack of resources.

9.7 Education

Policy Statement No. 3 states that “in order to most successfully manage to minimise the impacts of *P. cinnamomi* on conservation lands, all people accessing these lands need to have an awareness of the threat it poses to biodiversity and how it can be spread” (CALM 2004, p. 13). It encourages DEC staff to prepare and delivery education, training and information programs.

The DEC has put in place a number of mechanisms to educate visitors, including:

- Signage (e.g. information bays)
- Boot cleaning stations with appropriate signage
- Education programs run at Wellington Discovery Centre for school students



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In the case studies, signage was inconsistent, with some national parks having excellent signage (i.e. Lesueur National Park) while some others (e.g. Wellington National Park) provided little information about dieback or what visitors should do. The DEC is part of the trial of the new unified signage developed by Project Dieback.

The DEC's education efforts are complemented by those of other organisations, including the following examples:

- Unified signage developed by Project Dieback
- Signage and boot cleaning stations in reserves in the Shire of Armadale
- Training provided by NRM groups to community groups, school students and local government authorities
- 'Discovering Dieback', an education kit for upper primary school students developed for teachers by teachers from Armadale Primary School. This award winning Dieback Education Kit is a term long, integrated, sequential program for upper primary. The kit is available online (www.dwg.org.au).

Stakeholders complimented the work that has been done to date but would like to see its effectiveness evaluated. The trial of the unified signage should include a formal evaluation of its potential impact and identify how it might be further refined.

Stakeholders noted that in order to implement the desired behaviours (e.g. hygiene management practices), people must have the skills and tools to do so (e.g. boot cleaning stations, vehicle wash down facilities). A number of stakeholders indicated that it was unlikely that many vehicle wash down facilities would be constructed due to the costs and logistics (e.g. where would the water be sourced if the facility was located at the entrance to the Fitzgerald River National Park) associated with constructing and maintaining a facility.

Stakeholders believed that by heightening community awareness of dieback and its management this could encourage the State government to provide more funding for management of the disease.

9.8 Integration in Other Planning Frameworks

Integrating *Phytophthora* dieback management measures into other areas (e.g. biodiversity conservation education efforts, weed management, industry codes of practice, private landholder incentive strategies etc) was seen as a way: to more efficiently achieve *Phytophthora* dieback outcomes, and to improve management of *Phytophthora* dieback outside of the conservation estate.



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Stakeholders highlighted examples of where this is already occurring:

- Land for Wildlife²²;
- State Sustainability Strategy;
- NRM run school education programs on biodiversity conservation; and
- Bibbulmun Track volunteer's training.

However, stakeholders thought more could be done through greater linkages to biodiversity conservation and industry regulation:

- Work is already being done on biodiversity in the State, particularly on private property (e.g. Local government biodiversity incentive strategies). Stakeholders thought it important that these efforts include *Phytophthora* dieback.
- Stakeholders noted that some, but not all, industry codes of practice include mechanisms to manage *Phytophthora* dieback. They thought that industries that contribute to the spread of *Phytophthora* dieback should identify management strategies for the disease.

²² A voluntary program run by the DEC to encourage and assist private landholders to provide habitat for wildlife on their properties.



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10. PATHOGEN SPREAD AND MANAGEMENT

This chapter discusses recurrent themes from the stakeholder interviews pertaining to the activities that contribute to the spread of *Phytophthora* dieback in the conservation estate. These activities are fire management, forestry, mining, road construction and recreation.

10.1 Fire Management

Fire management efforts can contribute to the spread of *Phytophthora* dieback during:

- Prescribed burns;
- Wildfires; and
- Firebreak maintenance.

The DEC is responsible for fire management on the conservation estate. Outside of the estate, Fire and Emergency Services Authority (FESA) and local fire brigades²³ are responsible for managing fires. In rural areas, local fire brigades typically manage fires on private property.

For large fires on the conservation estate, the DEC, FESA and local fire brigades often work together as part of an incident management team. Stakeholders highlighted the positive working relationships forged by these on-ground joint efforts.

10.1.1 Prescribed burns

A prescribed burn is the controlled application of fire at a pre-determined area, time, intensity and rate of spread to achieve specific management outcomes. The DEC uses prescribed burns to maintain biodiversity values, reduce fuel loads, rehabilitate vegetation after disturbance activities (e.g. timber harvesting) or undertake fire research.

Advance planning occurs for all prescribed burns. In cases where *Phytophthora* dieback is an issue, a hygiene management plan is prepared. The plan documents the required procedures (e.g. all vehicles must be clean on entry). The plan's requirements apply to both DEC staff and any contractors involved. Prior to the burn, involved DEC staff and contractors receive a briefing to ensure everyone is aware of the issues covered in the hygiene plan.

Stakeholders provided anecdotal evidence that the process followed for prescribed burns is effective in minimising the spread of *Phytophthora* dieback. The management of wildfires was viewed as more problematic in that there is not the same lead time to do advance planning as with a scheduled prescribed burn.

²³ Local government authorities are responsible for establishing local fire brigades.



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10.1.2 Wildfires

DEC Environmental Teams

Stakeholders indicated that when managing wildfires in the conservation estate the focus is first on protecting life; second is property and third is the environment. The use of an environmental team to protect conservation values in the 2008 fire in Fitzgerald River National Park was cited frequently. It was viewed as a positive model for wildfire management that should be adopted in other Parks. It was noted that while a single environmental officer might be sufficient for a small fire, larger fires warrant having an environmental team.

Lessons arising from the Fitzgerald River National Park experience included:

- That it is not easy to have hygiene procedures as a key focus in the first shift of operations to control a wildfire; However, this could be improved if fire crews were given general hygiene prescriptions to follow prior to attending a fire in a region.
- Not all heavy equipment operators will be happy with the hygiene requirements even though they are included in their contracts. Environmental teams members need the support of senior staff if conflicts over hygiene requirements (i.e. how clean is clean enough) occur.
- Fire units could be provided with maps including GPS coordinates that would allow them to determine whether they were entering areas likely to be infested with *Phytophthora* dieback.

FESA and local fire brigades

When wildfires occur outside of the conservation estate, FESA and/or local fire brigades are responsible for their management. Similar to the DEC, the focus is on protecting life and property.

FESA's Standard Assessment Procedures (SAP) includes a requirement that *Phytophthora* dieback management hygiene practices be applied when managing a fire. However, few FESA personnel would be familiar with this requirement.

Some stakeholders speculated that local fire brigades are unlikely to know the proper hygiene procedures when managing fires outside the conservation estate. It was suggested that FESA staff and local fire brigades receive training in how to avoid spreading *Phytophthora* dieback and how to protect environmental values when managing a fire. FESA and local brigades could also be provided *Phytophthora* dieback maps and GPS coordinates to determine whether they were entering areas with *Phytophthora* dieback present. This information could be accessed on the way to treat fires.

10.1.3 Firebreak maintenance

Stakeholders indicated that firebreaks on the conservation estate are generally well maintained, with work often occurring during dry soil conditions to reduce the potential for spreading *Phytophthora* dieback.



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Unfortunately, firebreaks are popular with OVR operators who disregard signage. This can contribute to either the introduction of *Phytophthora* dieback to the estate or the spread of the disease from infested to uninfested areas of the estate.

10.2 Commercial Forestry

Since 2000, the Forest Products Commission (FPC) is the statutory authority responsible for managing the State's commercial forestry activities. DEC and FPC representatives described the process the FPC applies before commencing harvesting operations in a coupe:

- Step 1: Completions of a pre-harvest checklist to ensure consideration of key environmental issues such as *Phytophthora* dieback.
- Step 2: Interpretation of the coupe and associated roads to prepare a *P. cinnamomi* Occurrence Map. FPC contracts DEC interpreters to undertake this work, although contractors are used if DEC interpreters are unavailable.
- Step 3: Preparation of a road network map for the harvesting operations.
- Step 4: A *P. cinnamomi* Management Plan is prepared identifying the hygiene practices required. The Plan is to be consistent with the manual *Phytophthora cinnamomi and Disease Caused by It - Volumes 1-4* (CALM 2003). The FPC plan is reviewed and signed-off by the DEC district office.

Generally, stakeholders thought this process worked well. The end product (i.e. the hygiene management plan) is implemented by FPC and is regularly (e.g. weekly) monitored by the DEC.

The FPC Coupe Officer in Charge (OIC) is responsible for on-site implementation of the *P. cinnamomi* Management Plan. At the start of an operation, the Coupe OIC holds an on-site briefing to ensure that all staff, including contract staff, is familiar with the required site hygiene practices. The FPC attempts to use the same contractors repeatedly. This is viewed as a means of achieving a higher level of compliance with hygiene requirements.

Once harvesting operations are complete, FPC is responsible for regenerating the coupe. FPC and DEC stakeholders indicated that, while there is no requirement that the *P. cinnamomi* management plan be applied during regeneration activities, the FPC typically follows the management plan when regenerating a coupe as part of being a "good environmental steward".

FPC harvesting operations can extend across more than a single DEC District. A concern was raised that this sometimes resulted in somewhat different advice being provided by different organisations/agencies. A specific example provided was the concept of Green Bridges. This strategy is based on roads being built of uninfested material, with strict hygiene procedures being imposed during construction and use, with all vehicles being cleaned when entering from public roads and forest tracks. Vehicles can then travel from the Green Bridge road to uninfested areas without further cleaning. Both FPC representatives



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and some DEC staff indicated that DEC advice to the FPC was at times inconsistent on this issue. This may, at least in part, reflect the fact that Green Bridges is a relative new concept.

Stakeholder estimates of the frequency with which DEC staff monitor FPC operations for compliance with the *P. cinnamomi* management plan ranged from daily to monthly. If the monitoring raises a flag, DEC District staff contact their opposite number at the FPC and attempt to informally resolve the issue. In most instances, this process effectively resolved the problem. When it does not, the DEC notifies the FPC through either a management letter or a work improvement notice. A management letter is issued in instances where a problem or incident cannot be undone (e.g. use of *Phytophthora* dieback infested gravel). The aim is to ensure that the practice does not occur again. Work improvement notices are issued when the problem or action can be rectified (e.g. establish a new sign in a given location). It is very unusual for disputes to be taken to the CEO or ministerial levels for resolution. Some stakeholders were did not understand the process by which interagency conflicts were resolved and suggested the need for an arbitrator.

Some FPC representatives mentioned that the DEC keeps a close eye on FPC compliance but demonstrates less vigilance in its monitoring of other proponents in the conservation estate. However, overall, both FPC and DEC stakeholders indicated that the agencies have a strong working relationship.

10.3 Road Works

The case studies, especially the Lesueur National Park and Fitzgerald River National Park, highlighted that road works both within and outside the conservation estate is a critical *Phytophthora* dieback management issue.

10.3.1 Within the conservation estate

The DEC managed road network extends for approximately 40,000 km. The DEC is currently developing a database of its road network (e.g. the condition of the roads) to enable better management in the long term.

10.3.2 Main Roads

Main Roads Western Australia manages the State Road Network and typically does not undertake road works in the conservation estate, although there are exceptions such as the proposed road through Fitzgerald River National Park.

At part of Main Roads WA internal policies, for any road proposal an environmental issue screening checklist must be completed. The checklist includes the potential for the spread of *Phytophthora* dieback. If any environmental issues are identified an environmental management plan is developed.

If a proposed road is in an environmentally sensitive location, it typically goes through the State and/or Federal environmental impact assessment processes. Project approvals typically include conditions. This provides a mechanism for *Phytophthora* dieback hygiene management requirements to be attached to a road project.



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For example, the Cervantes-Jurien Coastal Road, currently being developed by Main Roads, was assessed by the WA Environmental Protection Authority. The EPA required that Main Roads develop and implement a Dieback Hygiene Management Program and acquire construction materials from areas free from *Phytophthora* dieback.

Main Roads has a Statewide Clearing Permit allowing it to undertake land clearing when required. In instances where *Phytophthora* dieback is an issue, the permit requires the preparation and implementation of a hygiene management plan. The agency is required to report annually to the DEC on its compliance with the conditions of the clearing permit.

Main Roads applies the *Phytophthora* dieback management measures for roads described in the Dieback Working Group's *Managing Phytophthora Dieback: Guidelines for Local Government* (Dieback Working Group 2000). The agency requires that all its contractors abide by all environmental requirements, including any hygiene management requirements via contractual conditions. The Project Manager is typically on-site to ensure that all requirements are met.

10.3.3 *Phytophthora* dieback-free gravel

The challenges in obtaining *Phytophthora* dieback free gravel was the most commonly discussed road management issue in interviews. This was consistent with an earlier CPSM finding that the inability to secure dieback-free construction materials, particularly gravel, is "... the most significant factor preventing the full implementation of disease management procedures by local governments in Western Australia" (CPSM 2006, p. 54). It is a management issue for the DEC, LGAs and Main Roads.

Stakeholders identified the following barriers to ensuring that road works are applying gravel and other raw materials that is not infested:

- There are few gravel pit operators that provide *Phytophthora* dieback free gravel. The Nursery Industry Association certifies *Phytophthora* dieback free suppliers. However, some questions remain about the effectiveness of their audit and compliance regimes.
- For those that extract their own gravel (e.g. Main Roads), it can be difficult to determine a pit's *Phytophthora* dieback status.
- Some stakeholders were unsure of the appropriate process for determining if gravel is uninfested.
- There is a need for a standard sampling protocol for determining if a gravel pit is infested.
- A certification program is needed to ensure the purchased gravel is uninfested as advertised by the vendors.

To minimise the risk of using infested gravel, Main Roads and LGAs typically try to take the gravel from a pit close to the area where it will be used. If they are uncertain as to the status of a pit, a small number of samples are taken for testing. In order to avoid clearing land, pits are sometimes created in pastures but it is difficult to know if it is infested or not as the vegetation provides no clues.



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It was noted that the Curtin University of Technology has been looking at whether sterilisation techniques could be used to make gravel *Phytophthora* dieback free. Treating gravel with metham sodium to kill *P. cinnamomi* was investigated with the intent to develop more gravel sources that would be *Phytophthora* free. The positive results enabled an application to be made to the Australian Pesticides and Veterinary Medicine Authority to register metham sodium to treat gravel (Davison et al 2007).

10.3.4 Limestone

As in the Lesueur National Park case study, limestone is frequently used as a road base. The perception among many stakeholders is that limestone is a preferred material to use due to high pH that is believed to suppress *Phytophthora* dieback. Although limestone is suppressive to *P. cinnamomi*, it is not suppressive to *P. multivora*. *P. multivora* is widely distributed and has a wide host range. It is associated with deaths of tuart and *Banksia attenuata* and other species on calcareous soils. Therefore, building roads out of limestone can no longer be recommended. It is likely that one or more of the currently undescribed *Phytophthora* species in the south-west of Western Australia will also behave like *P. multivora* and not be suppressed by limestone. Consequently, it is important that prior to use limestone quarries should be checked to determine they are absent of *Phytophthora* species.

10.4 Recreational Use

10.4.1 The challenges

In all the case studies, but most notably in the Stirling Range and Wellington National Parks, recreation uses are a significant vector of *Phytophthora* dieback. All recreation activities pose a risk of moving infested soils by foot or vehicle from infested areas to uninfested areas. Three perspectives emerged from the interviews regarding the risk posed by recreation uses in the conservation estate and the preferred approach to managing the risk:

1. Recreationalists present little risk and the limited management resources of the DEC should be spent managing other vectors.
2. Recreationalists are contributing to the spread of *Phytophthora* dieback, however, little can be done to manage them. Again, it was argued that management efforts would be better spent on other vectors.
3. Recreationalists pose a significant risk to the conservation estate and greater effort should go into managing that risk.

There was consensus that managing the risk posed by recreationalists is not easy. Management barriers include:

- No single peak body represents all recreationalists and most recreationalists do not belong to a recreation organisation (e.g. Recreational Trail Bike Riders Association).
- Recreationalists do not always abide by DEC signage of track closures. Most National Parks do not have full time rangers on site. Even those Parks that do,



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the rangers must cover vast areas, limiting their ability to observe the behaviour of recreation users. The DEC can fine people who go around gates or drive through locked gates but the DEC officer must see the person undertaking the act.

- Concern was expressed that many recreationalists do not understand how the disease spreads or how they contribute to the problem. It was felt that many would do 'the right thing' (e.g. wash their boots) if they knew why it was important and what is expected of them.
- Appropriate signage does not always exist. For example, interviewees felt that at present too often the DRAs are not clearly demarcated. As a result people may unknowingly enter DRAs.
- In most instances, there are inadequate hygiene facilities in National Parks. None of the case studies had wash down facilities for non-DEC vehicles and only two had any boot cleaning stations (i.e. Lesueur and Fitzgerald River National Parks)

Stakeholders were particularly critical of operators of 4WD vehicles and off-road vehicles (ORVs) (i.e. quad bikes and trail motorbikes). The ORV operators received the harshest criticisms with one stakeholder commenting "hoons tear through the bush disturbing the native flora and fauna and probably contribute to spreading *Phytophthora* dieback with little regard for the natural environment". Wellington National Park attracted the most comments about bad behaviour on the part of the operators of 4WD vehicles and ORVs.

It was acknowledged that problem operators comprise a small proportion of all vehicles in the Parks but they can generate a disproportionate amount of damage. While several stakeholders noted that DRAs are not always well sign-posted, the bigger problem is drivers choosing to ignore signs and barriers restricting access to areas of the park where conditions are unsuitable (e.g. too wet). The vandalism of signage is also a common problem.

Education was most frequently suggested as the key to changing the behaviours of recreationalists with respect to *Phytophthora* dieback management. Stakeholders indicated that the general public and by default most recreationalists have a poor understanding of *Phytophthora* dieback and its management. Those interviewed tended to believe that by educating park visitors about *Phytophthora* dieback, its impact on biodiversity and what steps they should take, most would adopt positive behaviours.

Other actions suggested by stakeholders were:

- Having outdoor recreation organisations follow the example of the Bibbulmun Track Foundation in providing their members with training in *Phytophthora* dieback management.
- Having peak recreation groups adopt *Phytophthora* dieback policies as has occurred with the Federation of Western Australia Bushwalkers.



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- More collaborative initiatives such as the joint effort by Track Care WA Inc²⁴ and the DEC to establish new trails and maintain existing trails.
- Developing good working relationships with organised groups that recreate in particular parks as has occurred in Wellington National Park.
- Continuing to offer DEC eco-education programs that include *Phytophthora* dieback management (e.g. Wellington Discovery Forest).
- Issuing infringement notices (i.e. fines) for repeated bad behaviour (e.g. ignoring gates) rather than just giving warnings.
- The creation of additional designated areas²⁵ for off road experiences either within or outside the conservation estate. Currently there are only a few such areas²⁶.
- Making information about access in the conservation estate (e.g. DRAs, open access tracks) available for download to hand-held GPS systems used by drivers.
- Ensuring greater consistency between tourist maps and DEC maps with respect to indicating which tracks are open to the public and which are management only (i.e. closed to the public).

10.5 Local Governments

Local governments undertake a variety of operations for which *Phytophthora* dieback is a management issue. This includes road construction and maintenance, permitting extractive industries, managing local reserves, and supporting local fire brigades.

Examples of positive efforts by LGAs identified in interviews included:

- Establishment and implementation of the Shire of Denmark Town Planning Scheme No.3 Policy No. 1 Dieback Disease Management (Shire of Denmark 1997)
- Development of a Local Area Stakeholder Engagement and *Phytophthora* Dieback Action Plan – Esperance (East) by the Shire of Esperance in conjunction with the South Coast NRM Inc
- Development of a *Phytophthora* dieback policy by the Shire of Ravensthorpe with support from the South Coast NRM Inc
- Installation of *Phytophthora* Dieback Hygiene Stations for walkers in local reserves by the City of Armadale
- Requirement by the Shire of Collie that contractors use *Phytophthora* dieback free gravel

²⁴ Track Care WA Inc is a non-profit volunteer organisation. It was formed in 1997 to promote issues about the repair and upkeep of off-bitumen tracks throughout Western Australia.

²⁵ The DEC is currently exploring whether there are suitable areas between Perth and Collie.

²⁶ Sites near Perth include Lancelin, Pinjar, Gngara, Kwinana and York.



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Each of the case study LGAs has washdown facilities at their depots. Unfortunately none of the LGAs associated with the case studies have *Phytophthora* dieback management policies or guidelines. One of the Shires was largely unaware of the threat posed by dieback and the fact that it cannot be eradicated like other pests. While the others were aware of the need for hygiene practices, they indicated that they had insufficient funds to map infestations and undertake additional *Phytophthora* dieback management measures. One Shire ensures the use of *Phytophthora* dieback materials in road construction and maintenance through contract requirements with contactors.

Stakeholders indicated that with appropriate training, LGA staff could implement hygiene management practices in their day to day activities (e.g. clean on entry). It was noted that NRM groups and the DWG have provided some training opportunities but this has occurred on an ad hoc basis rather than as part of a comprehensive strategy to upskill LGAs. The South Coast NRM Inc is working with shires such as Ravensthorpe and Jerramungup to establish local *Phytophthora* dieback management policies or guidelines.

10.6 Mining

Large mining proponents operating in the south west (e.g. Alcoa of Australia Ltd and TiWest) were described as leaders in terms of best management practices, funding on-going research and providing on-going training staff in the implementation of dieback hygiene management practices. The industry-based Northern Sandplains Dieback Working Group was cited as a positive example of mining industry leadership.

Best management practices – The Alcoa case study provides a very good example of best management practices. However, this said, mining companies have the ability to fence and gate their lease land to prevent access. Although there are incidences of breaches of this access restriction it seems to be less frequent than is seen on the conservation estate. It is in industry best interests to restrict the spread of *Phytophthora* dieback, so strict adherence to best management practices are provided for and enforced. For example, this means that Green Bridges are successfully maintained and policed, and general hygiene measures are monitored regularly for compliance.



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11. BARRIERS TO SUCCESS

11.1 Scientific Understanding

It was not until the mid-1960s that the causal relationship between large scale tree decline and death and the pathogen *P. cinnamomi* was established (EPA 2007). Considerable research has occurred since to further our understanding of the pathogen, however, more work is needed. The fact that much is still unknown means that there is a degree of uncertainty inherent in the *Phytophthora* dieback decision-making process. These include:

- An understanding of pathogen biology and survival across different plant communities;
- The development of effective containment and eradication techniques, especially for spot infestations or the protection of key species/plant communities;
- The development of robust remote sensing tools for forest, woodland and heathland health; and
- Improved isolation and identification.

Other research priorities are listed in Recommendations.

Stakeholders identified examples of on-going research that is helping to address some of the existing uncertainty. Examples included:

- The work being done by DEC and others along Bell Track in the Fitzgerald River National Park (Chapter 4);
- Containment and potential eradication trials being undertaken by Tiwest in conjunction with the CPSM;
- Gravel sterilisation trials being undertaken by Curtin University; and
- Alcoa of Australia Ltd is undertaking research to understand how *P. cinnamomi* survives in 'black gravel soils' and is developing ways to restore these sites with jarrah forest species susceptible and resistant to the pathogen.

DEC's review of effectiveness in meeting the Forest Management Plan's Key Performance Indicator (No. 18) will also help to determine the effectiveness of hygiene management.

However, there are still other management questions that need to be addressed through research. Stakeholders identified the following issues:

- Hygiene management practices. Stakeholders are required or asked to apply hygiene practices when operating in the bush. However, interviewees indicated that it is not clear how effective these hygiene management practices are in reducing the rate of spread. It was noted that if for example bushwalkers could contribute by using boot cleaning stations, they would be



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more likely to use the stations. One interviewee thought it important that the true cost of applying hygiene practices be included in this work.

- Eradication. A few interviewees thought it important that efforts continued to identify a method of eradication.
- Vectors. A few interviewees wanted to better understand the true risk posed by the various vectors, in particular fauna and recreationalists. It was noted that with this information, management efforts could be better targeted.
- Climate change. A couple of interviewees questioned the impact that climate change will have on the spread of *Phytophthora* dieback.
- Infested raw materials. A couple of interviewees thought it important that standardised sampling procedures be developed for determining the extent of infestation of raw materials. These interviewees also wanted to see continued efforts in finding a method to sterilise raw materials.

11.2 Data Management

It is important that data be properly stored and maintained to support on-going management. Easy access to appropriate data means that management decisions are better informed. This is particularly important in the case of *Phytophthora* dieback, as hygiene management practices are typically selected based on the occurrence or extent of the disease.

Stakeholders thought it important that data be available not only to DEC staff but also external stakeholders. They emphasized the importance of having reliable data available when making management decisions. For example, hygiene practices are typically selected based on the extent of *Phytophthora* dieback in a given location. This assumes that decision-makers know the extent of *Phytophthora* dieback within the area.

Many stakeholders recommended that a clearinghouse be established to house all *Phytophthora* dieback data (e.g. maps showing the extent of disease occurrence) collected by DEC and others engaged in dieback management in WA. This centralised data repository should be accessible not only to DEC staff but to others working in *Phytophthora* dieback management.

Data collected (i.e. on the occurrence of the disease) are currently stored in one of several ways, depending on who collects the data. For example, Sustainable Forest Management Division interpreters typically store their data in an electronic database maintained by the Division. In other instances, data are stored electronically or in hard copy within a DEC regional or district office. The data are generally available to DEC staff and on request is sometimes made available to third parties.

Once data are collected it starts to become out of date. In the case of *Phytophthora* dieback mapped data can only be assumed as accurate for a 12 month period. For this reason, some were nervous about making the data available to external stakeholders. However, other stakeholders recognised this problem and believe that careful documentation of data sets in the storage system and warning to potential data users of its limitations would sufficiently



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address concerns regarding the misuse of stored data. Most believed the benefits of making the data available outweigh the risks.

The DEC is currently updating its intranet site to provide its staff with increased access to dieback occurrence maps and *Phytophthora* dieback hygiene management plans. Over time historical occurrence maps will be added to the data set. It will take time to convert existing maps into the appropriate digital format for inclusion in the system.

11.3 Resource Issues

Stakeholders highlighted the importance of having adequate resources to manage *Phytophthora* dieback. This included having appropriately trained to implement management requirements and having the financial resources to carry out the management.

Stakeholders emphasised the need to ensure that the existing limited resources are spent on priorities so that the “biggest bang for buck can be achieved”. This is not to say that the current resources are not being used appropriately. Instead, stakeholders thought it important that evaluation of existing use of resources be evaluated to ensure that the intended outcomes are in fact being achieved.

11.3.1 Staff

Within the DEC, the Nature Conservation Division²⁷ is responsible for implementing the DEC *Phytophthora* dieback management hierarchy. This is supported by a dieback coordinator. The coordinator is responsible for running the DEC *Phytophthora* dieback training, providing advice on *Phytophthora* dieback management issues etc. For example, at present the coordinator is working with the Bibbulmun Track Foundation to evaluate and potentially upgrade the boot cleaning stations along the Bibbulmun Track.

In DEC districts where *Phytophthora* dieback is an issue a staff person could be employed to support the efforts of the *Phytophthora* dieback coordinator. These additional staff members could undertake monitoring and compliance with dieback hygiene management practices, run on-going training for DEC staff and key stakeholders (e.g. contractors, local government authority staff, State government agency staff), and maintain data on the extent of dieback across the conservation estate. Currently, monitoring of DRAs is done on an opportunistic basis rather than through a consistent, planned approach.

11.3.2 Interpreters

Although the Nature Conservation Division is responsible for implementation of the *Phytophthora* dieback planning hierarchy, other divisions within the DEC play a role in managing *Phytophthora* dieback. For example, DEC *Phytophthora* dieback interpreters are located, within the Sustainable Forest Management Division.

²⁷ Other responsibilities of the Division include management of native vegetation, threatened species and communities.



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As part of the existing funding arrangement, the FPC provides financial assistance to the DEC for hiring interpreters, who interpret the coupes.

A few stakeholders expressed concern about the declining number of interpreters within the organisation. There was particular concern about the number of experienced interpreters (e.g. 3+ years) that have left considering the amount of time required to train new interpreters.

Interpreters receive rigorous training. After taking the DEC dieback training course, interpreters spend six to twelve months being mentored in the field. This is followed by up to three years of regular spot checks. The spot checks are conducted by an experienced interpreter.

It was clear from the interviews that the in-field training qualifies an interpreter to interpret only in the region in which their training takes place. This is because *Phytophthora* dieback expresses differently in different areas. For example, in the northern agricultural sandplains the disease expression is much more cryptic than in the Manjimup area because the northern agricultural sandplains are much drier. Plant deaths due to *P. cinnamomi* on the northern sandplains can be more 'spotty' rather than along 'fronts' also making interpretation difficult and deaths easily confused with drought.

Stakeholders attributed the high turn-over rate of interpreters to the fact that the job requires long days of solitary work in the field (rain or shine) and there is limited room for promotion within the organisation. A couple of interviewees recommended that the organisation develop a better screening process to identify those most suited to the job and provide incentives to retain them once they become interpreters.

11.3.3 Training

Nearly half of the stakeholders highlighted the importance of training DEC staff and external stakeholders. Without appropriate training, it is difficult to effectively manage *Phytophthora* dieback.

At present, the DEC offers training to new DEC and FPC staff. However, this has not always been the case. Stakeholders indicated that when the DEC had a full-time *Phytophthora* dieback coordinator that more training courses were offered.

Stakeholders wanted to see additional training courses be available for interested DEC staff and external stakeholders. This included refresher training. Over time *Phytophthora* dieback management techniques change the *Phytophthora* dieback management hierarchy is updated. Refresher training can ensure that staff is made aware of these changes.

Stakeholders thought it important that training not be limited to the classroom. For example, it was recommended that courses be offered on how to clean vehicles. This would help ensure that vehicles are in fact clean on entry.

The DEC was most often identified as the appropriate training provider. This was because they were seen as the organisation with the most expertise in the area of *Phytophthora* dieback and the most likely provider to be around for the long-term.



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11.3.4 Succession planning

A number of stakeholders identified an individual (or two) as their 'go-to person' when they have a question about *Phytophthora* dieback. For example, an individual may have a strong working knowledge about the occurrence of *Phytophthora* dieback in a region. This person is often contacted by both DEC and external stakeholders (e.g. NRM, mining, forestry) for advice on upcoming in-field activities.

If these key individuals were to leave the DEC, even for a lengthy holiday, a gap in knowledge would likely be created. Succession planning helps retain institutional knowledge and enables mentoring of new leaders. A few stakeholders recommended that a program be developed within the DEC to facilitate succession planning.



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APPENDIX A: CASE STUDY INTERVIEWS

Table A1 Interviewees

Case study	Name	Affiliation
Wellington National Park	Jason Foster	DEC
	Tom Kenneally	DEC
	Leon Price	DEC
	Chaz Newman	FPC
	Merv McNamara	FESA
	Ross Bradshaw	FESA
	Peter Swanson	Main Roads WA
	Peter Thompson	Southern Road Services
	Les Vidovich	Shire of Collie
	Marie Short	Shire of Harvey
	Steve Vlahos	Worsley
	Ron Coleman	Mundi Biddi Trail Foundation
	Stewart Nicolson	Mundi Biddi Trail Foundation
	Geoff Couper	Track Care
	Steve Sertis	Bibbulmun Track Foundation
	Hannah Hampson	Wellington Discovery Forest
Fitzgerald River and Stirling Range National Park	Bruce Bone	DEC South Coast Region
	Mike Shepard	DEC
	Sarah Barrett	DEC Stirling
	Nicole Dwyer	DEC Stirling
	Greg Freebury	DEC Stirling
	Maria Lee	DEC Fitzgerald
	Deon Utber	DEC
	Pascoe Durtanovich	Shire of Ravensthorpe
	Bill Parker	Shire of Jerramungup
	Melissa O'Toole	Main Roads WA



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Case study	Name	Affiliation
	Paul Donovan	South Coast NRM Inc
	Annabelle Bushell	South Coast NRM Inc
	Gill Craig	Friends of the FRNP
Lesueur National Park	Kelly Gillen	DEC
	Benson Todd	DEC
	Jodie Watts	DEC
	Clinton Strugnell	Shire of Dandaragan
	Nick Sibbel	TiWest Northern Operations/Northern Sandplains Dieback Working Party
	Don Williams	Eco-tourism operator
	Ken West	Apiary interests
	Robyn Nicholas	Northern Agriculture Catchments Council
Interviews that crossed all case studies	Joanna Young	South Coast NRM
	Ian Colquhoun	Alcoa
	Gordon Wyre	DEC
	Geoff Stoneman	DEC
	Michael Pez	DEC
	Chris Dunne	DEC
	Greg Stelein	DEC
	Grant Lamb	DEC
	Carol Dymond	DEC
	Bob Hagan	DEC
	Kevin Helyar	DEC
	Roger Armstrong	DEC
	Steve Raper	DEC
	Stuart Harrison	DEC RCC
	Mark Graves	DEC roads
	Alan Seymour	FPC



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Case study	Name	Affiliation
	Melanie Dybala	FPC
	Tony Carlino	Water Corporation
	Steve Pretzel	Trail Bike Association