DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

PHYTOPHTHORA CINNAMOMI

AND DISEASE CAUSED BY IT

Volume I – Management Guidelines

2000

CONTENTS

SECTION

SECTION 1 - INTRODUCTION

1.1 BACKGROUND

The colourless microbe known to science as *Phytophthora cinnamomi* is infamous world wide for its capacity to invade and destroy the function of the root systems of an extraordinary range of plants. The slow moving epidemic of destructive root disease the pathogen causes in native vegetation in Australia is known as dieback.

The impact of this now widespread pathogen, believed by many to have been first introduced to Western Australia at or soon after European settlement in 1828, varies greatly across the landscape.

In Western Australia *Phytophthora cinnamomi* will continue its autonomous spread from all its established disease fronts. The rate of uphill spread via root to root contact amongst host plants has been reported as approximately one meter per annum under idea environmental conditions. The cross slope and down-slope rate of spread occurs at a faster rate due to the influence of surface and sub-surface water-flows on the dispersal of zoospores. Native animals, feral animals and people act as vectors aiding the wide and rapid spread of *Phytophthora cinnamomi*, thereby enabling it to establish new centres of infestation in previously uninfested areas.

Limited control of *Phytophthora cinnamomi* and disease it causes is possible over small areas through repeat application of phosphite. Phosphite can be used to increase the resistance of threatened flora, threatened ecological communities and the habitat of threatened native fauna.

The only other direct management action that CALM and other land managers can take at present is to control human vectoring of the pathogen. This can be achieved through the application of rigorous hygiene to ensure that all who have a valid reason to enter uninfested areas are clean upon entry. (i.e. do not carry the pathogen with them into uninfested areas).

1.2 PURPOSE OF THIS MANUAL AND EACH OF ITS VOLUMES

This manual :-

- Provides CALM with a single source document on :-
  a) information about the pathogen *Phytophthora cinnamomi* and diseases it causes (Volume I - Management guidelines and Volume II - Interpreter's guidelines for detection, diagnosis and mapping),
  b) management guidelines (Volume - Management guidelines),
  c) interpretation and mapping guidelines (Volume II - Interpreter's guidelines for detection, diagnosis and mapping)
  d) phosphite operational guidelines (Volume III - Phosphite Operational guidelines), and
  e) training curriculum and syllabi (Volume IV - Training curriculum and syllabi)

- Eliminates the need for detailed information about the pathogen, the diseases it causes hygiene practices and phosphate use being included in CALM's harvesting and other manuals.

- Replaces Administration Instruction No. 46 "Departmental Procedures for Approval of 7-Way Tests", the Hygiene Evaluation Proforma and the Hygiene Manual.

1.3 PROCEDURE FOR UPDATING AND MAINTAINING THIS MANUAL

1.3.1 Manual Updates

Each page of this manual is numbered and date stamped. CALM's *Phytophthora* Management Coordinator is responsible for authorising all updates to the manual.

1.3.2 Maintaining manuals

Manuals are issued to individual managers and their staff who are responsible for ensuring that their copy is up to date through regular liaison with the *Phytophthora* Management Coordinator and by regularly down loading updated versions from the CALMWeb.

SECTION 2 – TERMINOLOGY, CONCEPTS AND GLOSSARY

2.1 NEED FOR USE OF PRECISE TERMINOLOGY

Understanding the correct meaning of words prevents confusion in the use of terms and their conceptual basis. Correct word use stops the invention of new ambiguous words that in turn encourage tautological and counter intuitive language. Clear, concise and accurate communication leads to major savings and improved conservation outcomes.

2.2 GLOSSARY OF COMMON WORDS

Infested areas

- Areas that a accredited Interpreter has determined have plant disease symptoms consistent with the presence of the pathogen *Phytophthora cinnamomi*.

Uninfested areas

- Areas that an accredited Interpreter has determined to be free of plant disease symptoms which would indicate the presence of the pathogen *Phytophthora cinnamomi* .

'Protectable' areas

Defines areas of CALM land over which the hygiene rule, for the plant pathogen *Phytophthora cinnamomi*, of clean on entry will apply. May be an area suitable for phosphite application.

- Can include uninterpretable areas.
- Are situated in areas receiving > 600 mm per annum rainfall or are water gaining sites (eg. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600 per annum rainfall zone.
- Does not have a calcareous soil (ie not Spearwood Sand dune)
- Has been determined to be free of the pathogen *Phytophthora cinnamomi* by a qualified Interpreter (all susceptible indicator plant species are healthy, no plant disease symptoms normally attributed to *Phytophthora cinnamomi* are evident)
- Are positioned in the landscape and are of sufficient size such that a qualified Interpreter judges that the pathogen will not autonomously engulf them in the short term. (eg. > 4 ha with axis > 100m)
- Consists of areas where human vectors are controllable (eg. not an open road or private property)
- Includes high value areas (eg. a small uninfested area which contains a species of susceptible threatened flora)

'Un-protectable' areas

- Consist of all areas not classed as 'protectable'

Uninterpretable areas

- Are situated in areas receiving > 600+ mm per annum rainfall or are water gaining sites (eg. granite outcrops, impeded drainage or engineering works which aggregate rainfall) in the 400-600mm per annum rainfall zone.
- Indicator plants are absent or too few to determine the presence or absence of disease caused by *Phytophthora cinnamomi.*

Landscape unit

- Used in the analysis of the need for, and the determination of the boundaries of, areas to be mapped for *Phytophthora cinnamomi* Occurrence, for determining 'protectable' Areas and their appropriate boundaries, and for preparing *Phytophthora cinnamomi* Hygiene Plans. A landscape unit is an area bounded by features such as creeks, ridges, saddles, open roads and/or freehold land.

***Phytophthora cinnamomi* Occurrence Map**

- This is the main map produced by Interpreters. It shows *Phytophthora cinnamomi* occurrence, *Phytophthora cinnamomi* free areas, uninterpretable areas and may show un'protectable' areas.

'Protectable' Areas Map

- Defines areas of CALM land over which the Hygiene rule for the pathogen *Phytophthora cinnamomi* of clean on entry will apply. May be an area suitable for phosphite application.

***Phytophthora cinnamomi* Hygiene Plan**

- Is a document (includes appended maps) that describes and controls how human access to uninfested 'protectable' areas is to be managed so that the role of humans as vectors in establishing new centres of infestation will be reduced to the lowest possible level. May also specify the need for the application of phosphite.

***Phytophthora cinnamomi* Hygiene Management Map**

- Prepared as part of 'protectable' Areas *Phytophthora cinnamomi* hygiene planning process. It records details of planned management actions and is placed in District and FMB records systems.

Disease

- A combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

Environment

- The sum of all the factors which act on an individual organism during its lifetime.

Host

- The plant which is invaded by a pathogen and from which the pathogen derives its energy

Pathogen

- Any organism or factor causing disease within a host.

Hyphae

- A singular tubular filament of a fungus, oomycete, or chytrid; the hyphae together comprise the mycelium.

SECTION 3 - *PHYTOPHTHORA CINNAMOMI* BIOLOGY

3.1 DESCRIPTION OF *PHYTOPHTHORA CINNAMOMI*

Phytophthora cinnamomi and other members of the genus *Phytophthora* are not part of the Fungi kingdom but instead belong to the water moulds or Oomycota (class Oomycetes) which are placed in the Kingdom Chromista (or Stramenopila). Despite this, Taxonomist's advice is that *Phytophthora* species be referred to as fungi.

Phytophthora cinnamomi is an introduced soil-borne pathogen that kills a wide rage of plant species in the South West by attacking their root system. *Phytophthora cinnamomi* can also survive and reproduce on a wide range of native plants without killing them. It has a widespread but discontinuous distribution in areas of the South West with an annual rainfall above 400mm.

There are over 50 species of *Phytophthora* which occur around the world and all of them cause plant diseases. *Phytophthora cinnamomi* is the *Phytophthora* species most frequently isolated from areas of dead vegetation in the South West.

Phytophthora cinnamomi has a superficial resemblance to fungi but they are different in that their cell walls are cellulosic rather than chitinous. The fungus grows as microscopic sized filam ents (mycelium) within susceptible host plants. Their food source is the root and basal stem tissue of living plants.

The fungus consumes the host plant causing lesions (areas that appear rotten). This weakens or kills the plants by reducing or stopping the movement of water and nutrients within the plant. Once attacked susceptible hosts rarely recover. Most succumb to a “sudden death” syndrome, rather than a “dying back or dieback” syndrome.

Figure 3.1 Hyphal swellings of *Phytophtora cinnamomi*

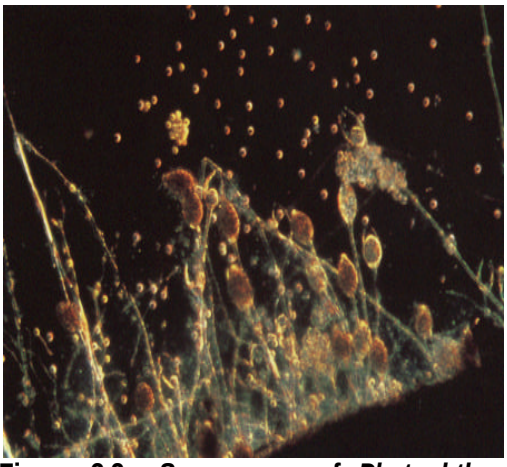


Figure 3.2 Spore sacs of *Phytophthora cinnamomi* release zoospores that swim in free water and infect nearby roots.

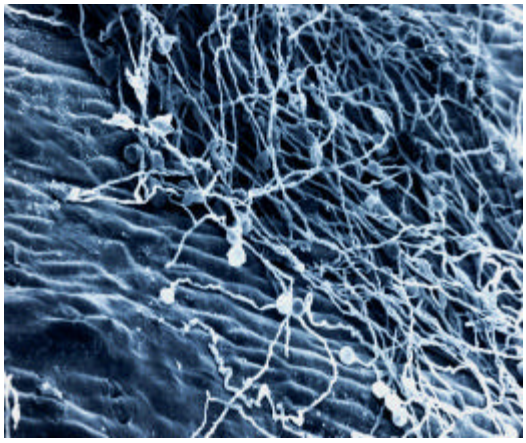


Figure 3.3 Hyphae covering root surface

Figure 3.4 Zoospore germ-tubes penetrating a root

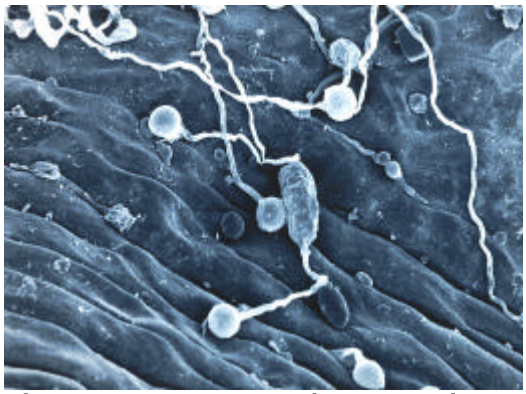


Figure 3.5 Zoospore growing sporangia

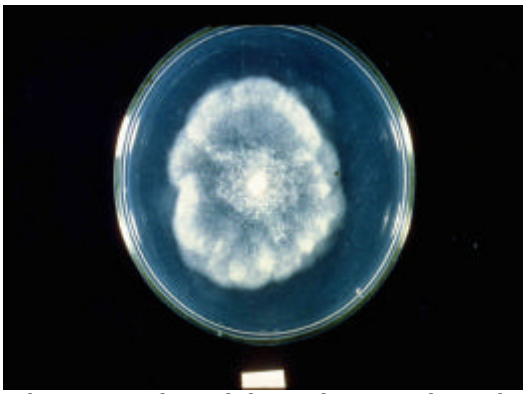


Figure 3.6 *Phytophthora cinnamomi* growing on agar plate

3.2 LIFE CYCLE OF *PHYTOPHTHORA CINNAMOMI*

The life cycle of *Phytophthora cinnamomi* (Fig. 3.4) depends on moist conditions that favour survival, sporulation and dispersal.

The pathogen is not capable of photosynthesis and so it needs to extract food from living plant tissue. It does this via a mass of microscopic threadlike mycelium that form the body of the organism that grows through host tissue. Mycelia continue to growth within the host tissue when it is above 80% moisture ambient. Mycelia may be transported in soil and host tissue and deposited where it may infect new hosts. The mycelium, given warm, moist conditions are capable of producing the millions of tiny spores that reproduce the fungus. Two kinds of spores are likely to be found.

Zoospores

Very small spores that can actively swim very short distances towards new hosts and initiate new infections. They are short-lived and fragile but produced in large numbers, and are the mode for the spread of the disease from one plant to the next. They can also be carried along in moving water over large distances. As they move through the soil zoospores lodge on plant roots, infect them, and in susceptible plants produce mycelia. The mycelium grows, feeding on the host, rotting the roots and cutting off the plant's water supply. The mycelium may grow from plant to plant via root to root contact points and/or root grafts.

Chlamydospore

Larger spores that are tough and long-lived (within dead plants and the soil). They are produced under unfavourable conditions and are the resistant resting phase of the fungus. They may be transported in soil or roots and then germinate to cause a new infection when they encounter favourable conditions. The chlamydospores produce mycelium and zoospores.

When conditions are warm and moist, microscopic spore sacks called sporangia and thick walled chlamydospores are produced vegetatively from mycelia strands that form the body of the fungus in the soil or host tissue. The sporangia release motile zoospores in free water to infect host roots. Mycelia of different mating types may grow together inducing the production of thick walled sexual spores called oospores. The mating types are called A1 or A2. Only one mating type (A1) occurs in WA. Currently the pathogen cannot reproduce sexually in WA and relies on vegetative reproduction for survival and dispersal.

After infection, the fungus invades root bark and forms lesions that may extend in to the plants stem collar. In susceptible species infection of roots and collar results in death of the host. Once dispersed, the spores of the fungus may infect a wide range of resistant and susceptible hosts.

Figure 3.7

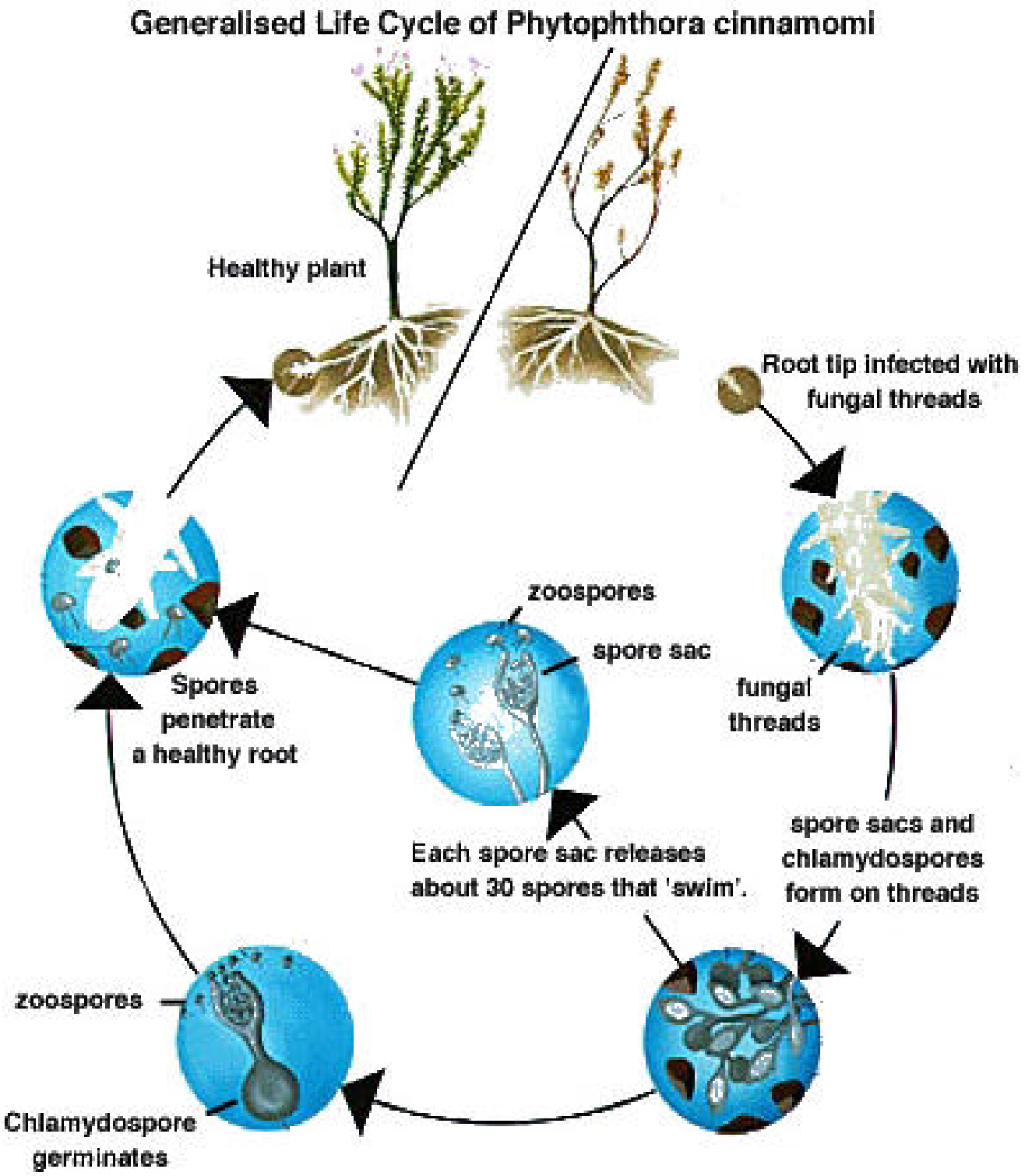
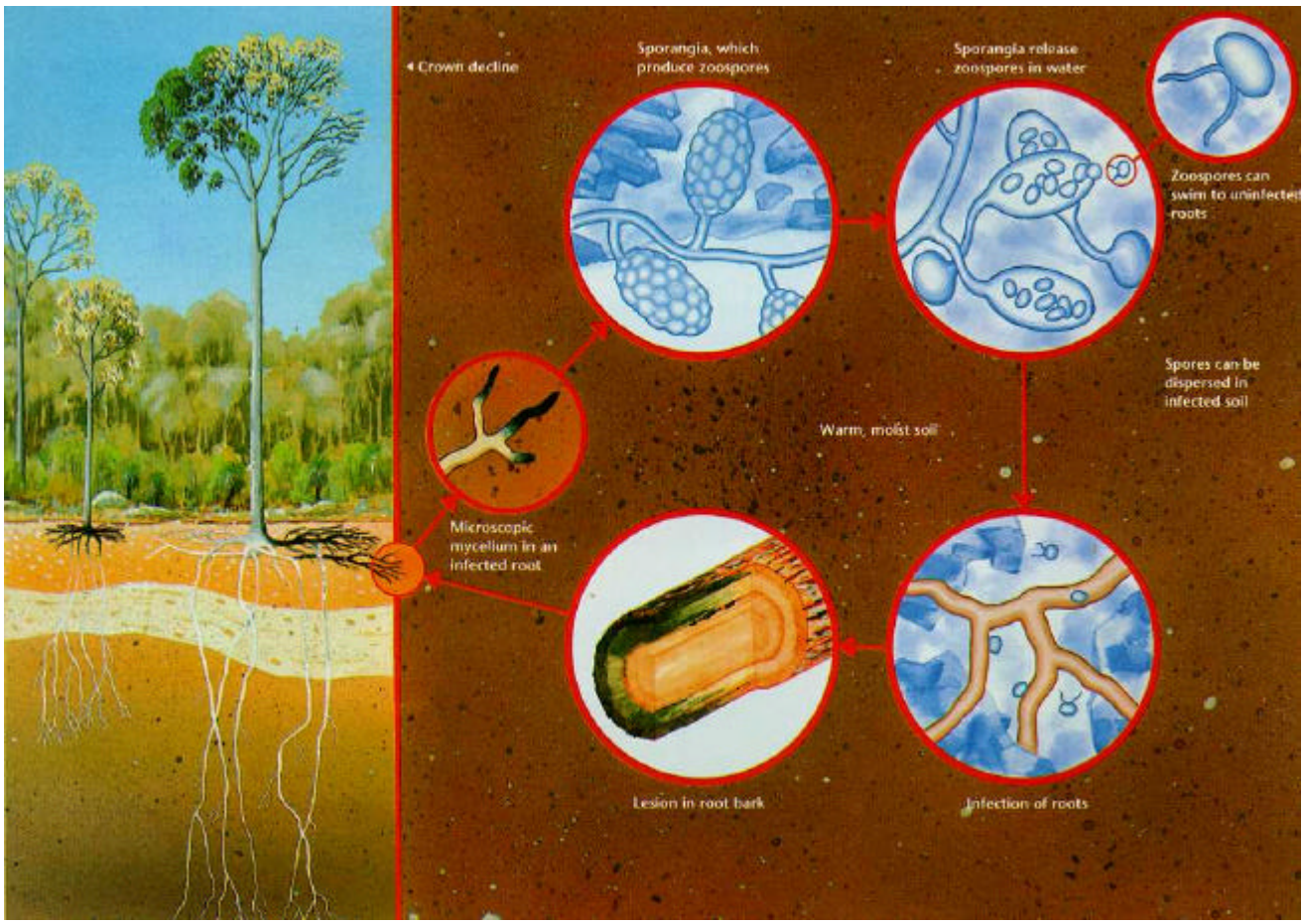

Generalised Life Cycle of Phytophthora cinnamomi
Healthy plant
Root tip infected with fungal threads
fungal threads
spore sacs and chlamydospores form on threads
Each spore sac releases about 30 spores that 'swim'.
zoospores
spore sac
Spores penetrate a healthy root
zoospores
Chlamydospore germinates

Figure 3.8



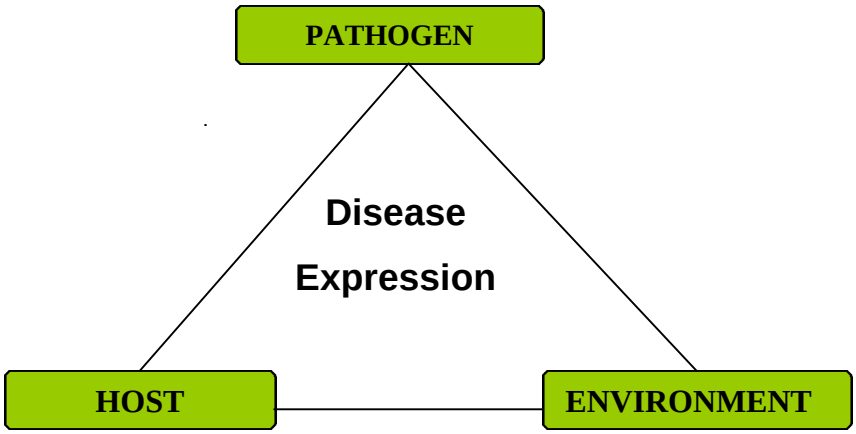
3.3 DISEASE TRIANGLE

DISEASE: A combination of a pathogen, host and correct environmental conditions, which results in the expression of disease symptoms in the host.

ENVIRONMENT: The sum of all the factors that act on an individual organism during its lifetime.

HOST: The plant which is invaded by a pathogen and from which the pathogen derives it's energy.

PATHOGEN: Any organism or factor that derives its energy or nutrients from a host, often causing disease in the host.



Removal of any factor from the equation of this triangle means that disease cannot exist at the site

3.4 Interaction with the Host

Phytophthora cinnamomi has a very wide host range. At least 1000 species from taxonomically diverse families have been reported as hosts for *Phytophthora cinnamomi* of which nearly half have been recorded from research in Australia

Indigenous species most affected belong to four families:-

- Proteaceae
- Epacridaceae

- Papilionaceae/Fabaceae
- Myrtaceae

Not all genera within a family or all species within a genus are necessarily susceptible. E.g. some species of Eucalyptus are highly resistant (including Karri, Marri, Wandoo and Tuart) while some, such as Jarrah, are affected but have the ability to resist the invasion of the fungus under certain conditions (Tissue moisture content < 80%).

Broad estimates are that perhaps 1500 to 2000 species of the estimated 8000 species of vascular plants in the South West of WA may be susceptible to the degree that successful infections result in the death of the host.

The interaction between pathogen and host starts with infection, with zoospores and mycelium growth via root to root contact initiating most infections. Zoospores are attracted to the growing tips of roots chemotacticly, they encyst and germinate to produce germ tubes which penetrate roots. Hyphae proliferate within roots, macerating tissues and causing the roots to rot. The mycelium feeds on sugars within the plant's cells

Once the fungus has established within the roots of a prospective host, it establishes within unlignified cortical tissue and the phloem. This blocks the conductive tissue and prevents the uptake of water and nutrients

Host plants can resist the attack with the formation of blocking lesions or resist entry by having tough epidermal cells on root hairs. Those that do not die will, once the destruction of their conductive tissue reaches the point where they are unable to sustain themselves.

Figure 3.9 illustrates the progressive spread of *Phytophthora cinnamomi* and its impact on various elements of the vegetation.

The top section of figure 3.9 shows a horizontal view of a transect in uninfested jarrah forest prior to introduction of *Phytophthora cinnamomi.* The three tiered stand structure of ground cover, dense *Banksia* understorey, and eucalypt overstorey. Three structural arrangements are shown.

1. Selection logged old growth.
2. Seventy year old uniform regrowth arising from clear felling of old growth.
3. Virgin old growth. Note also dead branches protruding above the canopy of a number of the large veteran old-growth trees.

The lower section of Figure 3.10 shows the same transect 3-5 years after introduction *of Phytophthora cinnamomi* at point X, with concurrent death ("mass collapse") of understorey of *Banksia grandis* and mature jarrah of the overstorey on a high impact site. The distribution of *Phytophthora cinnamomi* in soil beneath the forest is indicated by circles, the vertical columns indicate the relative intensity of infestation. Arrows indicate the direction of spread and relative rates of spread downslope left and upslope right.

Figure 3.10 illustrates the movement of a “wave front” of high density *Phytophthora cinnamomi* at the perimeter of a diseased area and the decline in pathogen numbers in the wake of infection.

The top section of figure 3.10 shows the relationship of infestation to disease expression and hygiene zones.

a) outer limit of pathogen free buffer zone (wider downslope left than upslope right)
b) outer limit of cryptic infection and disease symptoms.
c) inner limit of wave of active disease.

The lower section of figure 3.10 shows the variation in disease impact on jarrah trees:

1) e-f low impact on jarrah but elimination of *Banksia* .
2) f-g "graveyard" site of high impact on both jarrah overstorey and *Banksia* understorey with gradual colonisation by marri in an open woodland.

Figure 3.9

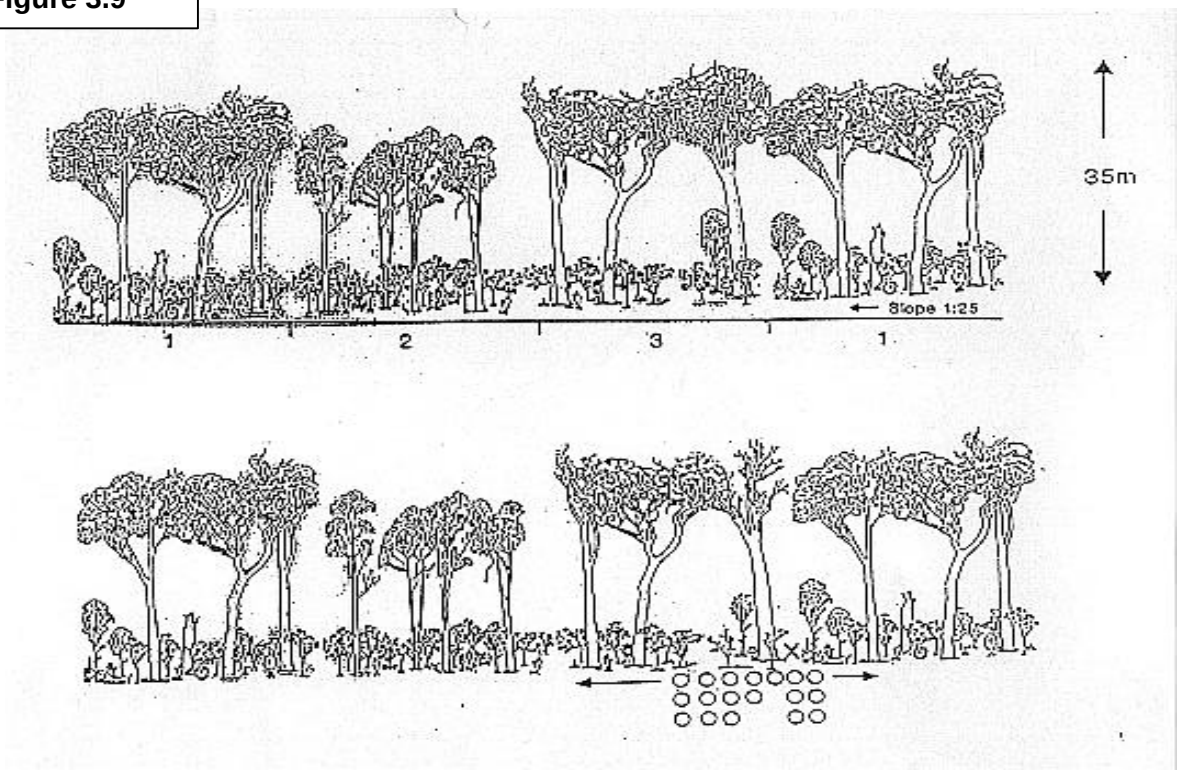
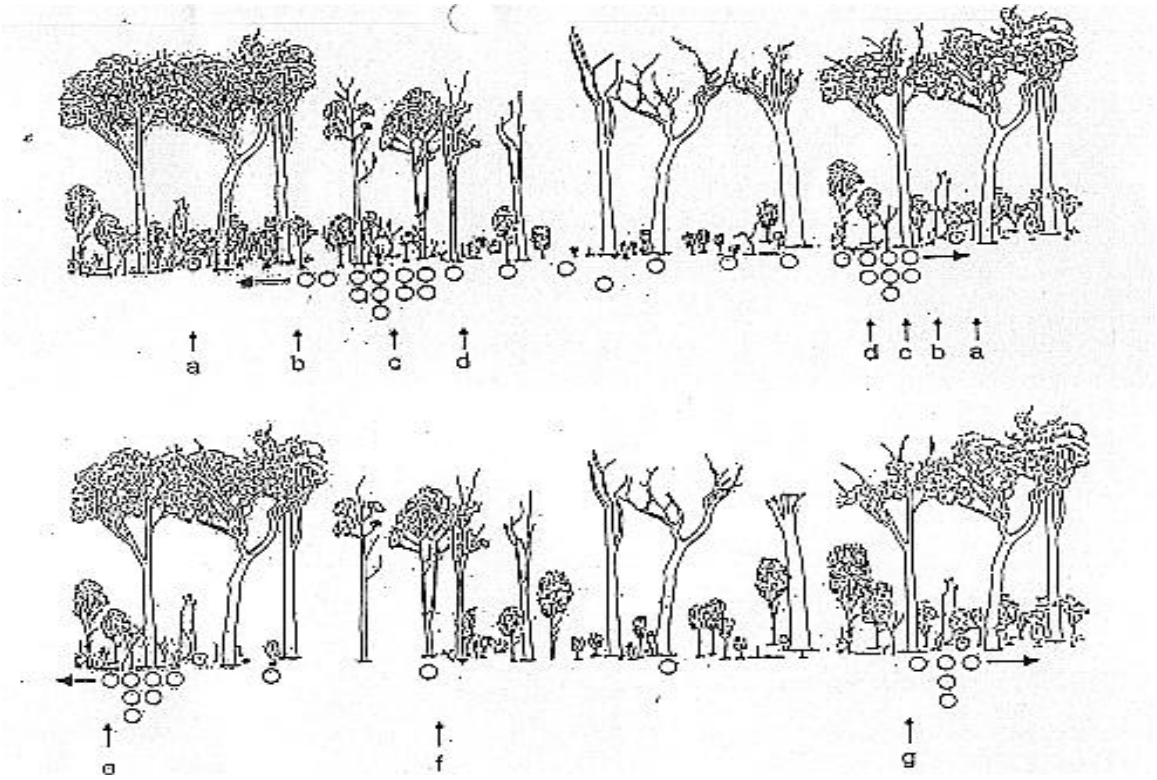


Figure 3.10



3.5 DETECTION, DIAGNOSIS AND MAPPING

Detection of disease symptoms, sampling of soil and plant tissue for laboratory analysis, diagnosis and mapping for the presence of *Phytophthora cinnamomi* is described in detail in "Volume II - Interpreters guidelines for detection, diagnosis and mapping".

SECTION 4 - THE NATURE OF THE THREAT POSED BY *PHYTOPHTHORA CINNAMOMI* IN WA

4.1 HISTORY OF INTRODUCTION AND SPREAD

Since 1921 it has been evident that an increasing number of patches of formerly healthy jarrah forest have become afflicted with a lethal disease known as "jarrah dieback" ('JDB').

Until 1964, the cause of this malady had been the subject of contending speculation. In that year proof of the role of the plant pathogen *Phytophthora cinnamomi* as the cause of 'JDB' was established. At the same time, it was recognised that this exotic microbe was also intimately associated with similar damage in other plant communities of sclerophyllous natives, whether jarrah was dominant, a minor component only, or not present at all. The period of intensive research that followed is ongoing and has resulted in revised perceptions of the nature of the pathogen and of the diseases that result from its interactions with the enormously diverse native vegetation of southwestern Australia.

Phytophthora cinnamomi is a soil-borne micro-organism of foreign origins. It almost certainly entered Western Australia for the first time on soil around the roots of cultivated plants, shortly after European settlement in 1827. Until the effective implementation by Australia of quarantine of import of exotic soil and plant products, there must have been innumerable introductions at many points of entry around the continent and its redistribution within the country over a period of some 150 years.

Phytophthora cinnamomi has now extended its largely unfettered colonisation of the southwest by human and animal (native and feral) movement of infested soils and autonomous spread (the latter largely by growth of the pathogen in the root systems of

highly susceptible native plants, but also assisted by sub-surface and over land flow of water carrying zoospores). This epidemic of colonisation, which has produced a complex mosaic of infested and uninfested areas, is now well on its way toward the middle stages of its ultimate potential to occupy all of those sites which are environmentally suited to its establishment, survival and multiplication. Such sites are very widely distributed over some 20% or more of the natural vegetation in areas throughout that part of the South West Land Division that receives mean annual rainfall in excess of 800mm and occur sporadically at lower rainfall.

Within the 600 – 800mm rainfall zone the occurrence of *Phytophthora cinnamomi* is also widespread but much less extensive. In this zone, severe damage to native vegetation is largely confined to water-gaining sites or to years with an abnormally high summer rains. In these circumstances localised patches of the vegetation may periodically suffer severe damage with intervals of recovery during drier periods.

In areas receiving < 600mm rainfall per annum, root rot caused by *Phytophthora cinnamomi* is restricted to circumstances where localised hydrological effects, such as the shed from granite bosses or rising ground water tables associated with up-slope land clearance in the catchment, cause effective rainfall to substantially exceed the regional patterns.

There is no record of *Phytophthora cinnamomi* establishing in natural ecosystems in regions receiving < 400mm rainfall per annum. It may occur in irrigated horticultural activities.

4.2 DISEASE SYNDROMES

The effect of *Phytophthora cinnamomi* upon the health of plant communities, and upon the species in them, varies greatly. In many places, lethal root-disease destroys the structure of many native communities, reduces their floristic diversity, decimates their primary productivity and destroys habitat for much dependant native fauna, particularly its value as protection against feral predators. In some places the pathogen causes

little damage at all. Unfortunately the extent of susceptible communities in vulnerable environments is much greater than that of communities which occur in environments which are inherently unfavourable to the pathogen.

No simple or single relationships exist between the presence of *Phytophthora cinnamomi* and the development of disease because of :-

i) the considerable variability which exists within and between native plant species in their responses to the presence of *Phytophthora cinnamomi*,
ii) the differential influence of temporal and spatial variation in environmental forces,

However, within the spectrum of variable disease, response of numerous hosts to particular environmental circumstance, at least four specific nodes can be recognised. These are due to either distinct processes or to different stages in the development of disease which occur upon and after the arrival of the pathogen and its persistence in previously uninfested areas. Each of these circumstances presents a different problem that requires a separate management response. It is now evident that among the variety of plant communities, which occur within that part of the South West Land Division that receives more than 800mm mean annual rainfall the four sets of distinctive consequences are:

I) **<u>No apparent disease at all</u>** :

This applies *inter alia* to those areas of karri and wandoo forest which contain no floristic elements of the dry sclerophyll (jarrah) forest type and to plant communities on the calcareous soils of the Spearwood and Quindalup Dune Systems and of the Swan Coastal Plain and pedogenically related landscapes.

II) **<u>An extremely destructive epidemic of root rot</u>** :

This applies within the highly susceptible understorey elements of the dry sclerophyll forest, in *Banksia* woodland and in heathland on podsols, podsolic and lateritic landform. It is characterised by:

a) devastation soon after the first arrival of the wave front of infestation,
b) steady extension of epidemic disease soon after arrival of the pathogen,

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

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

iii) <u>A variable epidemic within the dominant jarrah tree component of the forest</u> :

This is characterised by :-

a) a much more erratic and often protracted onset of mortality ranging from early localised onset of mass collapse (similar to type above) through delayed and patchy mortality to no apparent effect at all on health of the jarrah overstorey.

b) high sensitivity to subtle differences in soil characteristics particularly those effecting drainage.

All variants in the response of jarrah are coincident with, or preceded by, mass deaths in susceptible elements of the understorey. In jarrah, their behaviour varies from that characteristic of epidemics of disease due to invasion by an exotic organism to which the vegetation has not been previously exposed to that typical of long established endemic disease.

iv) <u>An 'endemic' pathogen</u>

Where *Phytophthora cinnamomi* has been long established (some 50 years or more) in sites formerly dominated by jarrah/banksia forest and has been very heavily impacted *Phytophthora cinnamomi* behaves in a manner characteristic of endemic pathogen. The forest is often replaced by an open woodland of marri/parrot bush. Periodic outbreaks of mortality in parrot bush (*Dryandra sessilis)* follow, with subsequent regeneration by seed. At this late stage, *Phytophthora cinnamomi* causes more muted disease than at the wave front.

4.3 PROGNOSIS – SPREAD, ERADICATION AND CONTROL

CALM has accepted that eradication and prevention of the establishment of new centres of infection is not a realisable objective, even were it to involve both a socially acceptable strategy of denial of human access for any purpose and an eradication program of native animals which vector the pathogen. Similarly insurmountable problems of scale and cost would attend efforts to map and treat the thousands of kilometres of invasion front now established within 17 million ha of remnant native vegetation in the Southwest Land Division.

Further, despite intensive research and extensive field tests over three decades (1970 to 2000), the delivery of ameliorative treatments (which might favourably modify those environmental influences responsible for destructive interaction between plant species which are susceptible to the pathogen) though biologically well founded have so far proved to be impracticable.

Ultimately this pathogen will occupy through autonomous and vectored spread all of the sites where the correct combination of host and environment occur (See figure 4.1 and 4.2)

4.4 IMPACTS

Estimates of annual losses caused by *Phytophthora* in WA provided by officers of Agriculture WA for a Rural Resources Development Corporation survey in 1993 total $1,200,000 for horticulture and $500,000 for floriculture. Losses due to *P. clandstina* in clover crops have not been estimated but are believed to be substantial.

Plant Crops, even to longer lived perennials such as avocado, are amenable to a variety of techniques of control including drainage, organic amendment, chemical treatment and the use of resistant lines.

The arrival and spread of *Phytophthora cinnamomi* in the native vegetation of WA is now seen to be a biological disaster of global significance for conservation of areas of great bio-diversity and a major problem for wood-based and other extractive industries. A number of plant species face extinction unless the use of programs of phosphite treatments, cryogentic storage of genetic material and the use of appropriate fire regimes to exploit the phenomenon known as “disease escape” are effectively implemented and maintained.

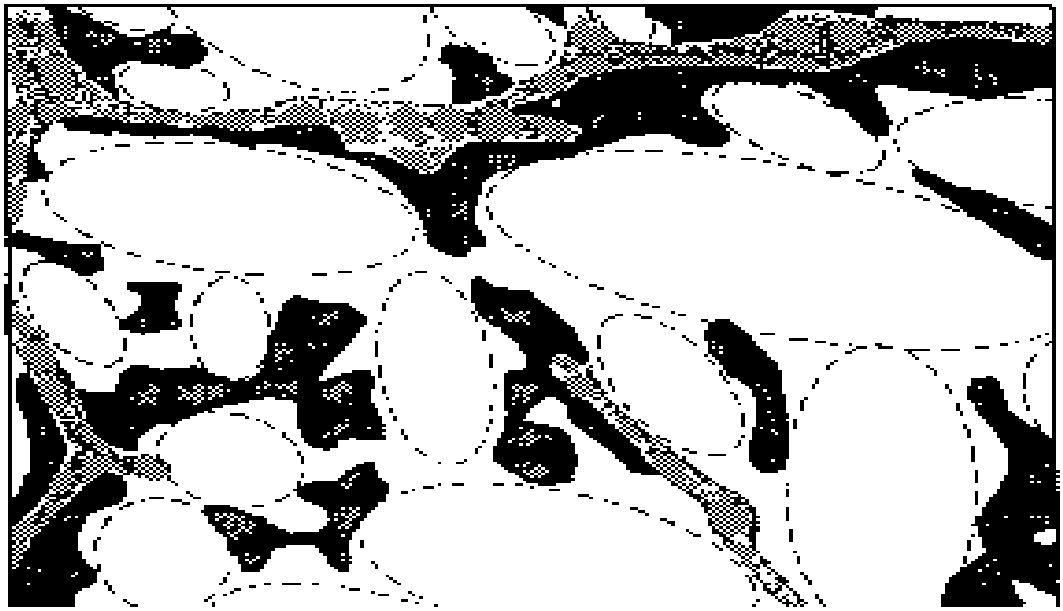


Figure 4.1 Sample area of pre 1976 dieback mapping (after Shea, 1975), with notional compact areas of dieback-free forest (shown as dashed ellipses). Light grey : riparian non-forest communities; Dark grey: *Phytophthora* affected jarrah forest.

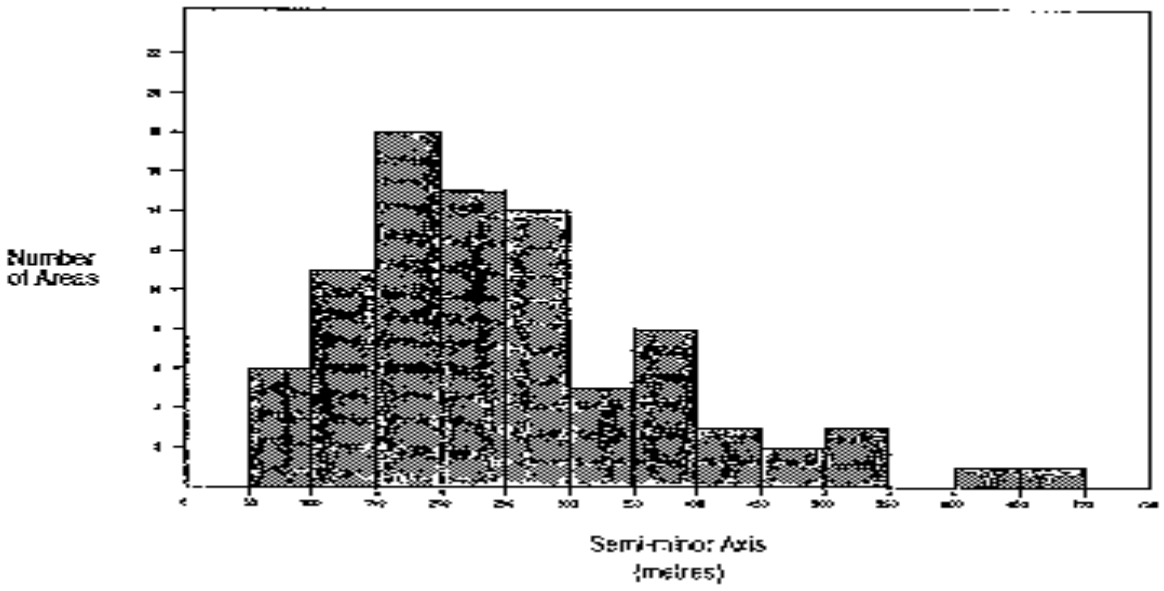


Figure 4.2 Histogram showing the frequency of compact areas (approximated as ellipses) verses the distance of their most remote point from the nearest dieback (semi minor axis of the ellipse). The behaviour at the lower end of the distance axis is strongly influenced by the cut-off in the sampling of small areas.

SECTION 5 - CALM ACT AND REGULATIONS AND CALM POLICY

5.1 CALM ACT AND REGULATIONS

The Department of Conservation and Land Management is responsible for administering the CALM Act 1984 and the Forest Management Regulations 1993.

The long title of this Act is:

> "*An Act to make better provisions for the use, protection and management of certain public lands and waters and the flora and fauna thereof, to establish authorities to be responsible therefor, and for incidental purposes*".

This Act establishes the Department of CALM, the National Parks and Nature Conservation Authority, the Lands and Forsets Commission and the Forest Products Council.

The Department of CALM is established as a management authority charged with the management of lands, waters and wildlife under policies and directions set by the Minister and the above advisory bodies.

The CALM Act influences (Management of *Phytophthora* and diseases caused by it) through the following areas of the Act.

- Part 7 (Sections 79 - 86)
- Section 45
- Section 62
- Section 120
- Section 124-125

Classification of Land (Section 62)

The Minister may classify land on the recommendation of the controlling body as:

- a wilderness
- a prohibited area
- a limited access area
- a temporary control area
- a recreation area

or other classification as the Minister and controlling body see fit.

Control of access under the Section can be applied to any land or waters vested in the NPNCA or the LFC.

A temporary control area classification for land or water shall only be for the purpose of public safety or the protection of flora and/or fauna. Temporary control areas cannot exceed a period of 90 days, however, can be made more than once for the same area and purpose.

For Section 62 to be applied there needs to be a broad provision for it in the management plan applicable to the area. There is also no Regulation to enforce Section 62.

Restriction of access for disease purposes is best carried out under Part 7 of the CALM Act.

5.1.1 Control and Eradication of Forest Diseases - Part Vll (Sections 79 - 86)

The purposes of Part Vll are to identify the areas of public land in which trees may already be, may become, or are infected with any forest disease and to control and eradicate such forest diseases as are detected in such areas.

Public land includes State forest and Timber Reserves, Crown land including pastoral leases and mining tenements and other land dedicated under the Land Act of 1933.

Steps to be taken before Minister makes recommendation

Extension, reduction or abolition of risk and disease areas

A risk area or a disease area may be extended, reduced or abolished by order of the Governor made on the recommendation of the Minister.

Mining tenements in risk or disease area

If the holder of the tenement intends to explore or exploit a part of it they have to give three months written notice before the date they intend on doing so to the Minister.

If the holder of the mining tenement is given written authority from the Minister to explore or exploit they may do so only by entering that part by a route described in the written authority or subject to conditions in the written authority.

5.1.2 Permits, licences, contracts, leases etc. - Section 8 (Section 120,124,125)

Sect 120 - Power to enter and inspect land

An authorised forest officer may enter land held or occupied by virtue of a permit, licence, agreement or forest lease for the purpose of making inspections, carrying out silviculture operations, or other forest work, and preventing or suppressing fires.

Sect 124- Powers of rangers and conservation and land management officers

(1) A ranger or conservation and land management officer who finds a person committing a relevant offence on or in any land or waters or who on reasonable grounds suspects that such an offence has been committed or is about to be committed, may without warrant -

(a) stop, detain and search any vehicle, vessel or conveyance;
(b) remove any vehicle, vessel, animal or other thing from the land or waters;
(c) require the person to give to him the person's name and address;
(d) require the person to leave the land or waters and,
(e) in addition, a ranger may enter and search any hut, tent, caravan or other erection which is not a permanent residence.

(2) A ranger may detain the person until he can be delivered to a police officer if, when required to do so, he does not give to the ranger or officer his name and address, or gives him a false name and address.

(3) Instead of so detaining the person the ranger may take him into custody himself, to be dealt with according to the law, pursuant to section 50 of the Police Act 1892, as if he had not given his name and address, or had given a false name and address to a police officer

(4) A person shall not remain on or in any land or waters after being required to leave the same by a ranger or conservation and land management officer.

(5) A ranger or conservation and land management officer shall not exercise any power specified in subsection (1) (a) or (b) and a ranger shall not exercise the power to enter and search conferred by that subsection unless he has first taken all reasonable steps to communicate to the person who

owns or is in charge of the vehicle, animal, vessel, conveyance, hut, tent, caravan or other thing concerned (if the identity of that person can reasonably be ascertained) his intention to exercise the power and his reasons for believing that he is authorised to exercise the power.

(6) Nothing in this section derogates from the powers of a ranger who is a police officer

Sect 125 - Powers of wildlife officers

The powers of a wildlife officer under Sections 20 and 20A of the Wildlife Conservation Act 1950, and other provisions of those sections, extend to offences against regulations made under Part X.

Enforcement Officers (Section 45)

The Minister can designate any person employed in CALM to be

a) a wildlife officer;
b) a forest officer;
c) a ranger
d) a conservation and land management officer

Wildlife officers, forest officers, rangers and conservation and land management officers have the functions conferred in theme respectively by or under this Act.

In addition, wildlife officers, have the functions conferred on them by the Wildlife Conservation Act 1950.

5.1.3 Forest Management Regulations

Part 16 - Control and Eradication of Forest Diseases

The following is a summary of the control and eradication of forest disease regulations.

106 1. An authorised person in writing may authorise
- the taking of a potential carrier into a risk area
- the possession, use or movement of a potential carrier in a risk area

2. Written authorisation may be subject to conditions
3. Authorised person may revoke a written authorisation or vary, or remove conditions.

107 Verbal authorisation may be given in an emergency to take into and move around a potential carrier in a risk area.

108 It is an offence to enter, use or move around a potential carrier in a risk area or disease area contrary to instruction or direction.

110 An authorised person may erect signposts or barricades to prohibit or restrict admission or potential carriers into risk or disease areas.

111 Written authorisation must be carried, by a person in charge of a potential carrier in a risk area, at all times. It is an offence not to produce written authorisation when requested by an authorised person.

112 Written authorisation will terminate immediately on breach of any condition.

113 A person shall provide information upon request by an authorised person or any occurrence or suspected occurrence of a Forest Disease. It is an offence not to do so.

114 An authorised person may stop and examine a potential carrier whether or not it is infected and may erect signs or barricades on roads:

- in or leading to a risk area.
- In or leading out of a disease area.

115 An authorised person may direct an infected or potential carrier entering or leaving a risk area to a quarantine station.

116 An authorised person may direct a person in charge of an infected or potential carrier entering a risk area or leaving a disease area to cleanse and disinfect the carrier.

117 The Executive Director may establish or arrange for the establishment and maintenance of a quarantine station for the cleaning of carriers entering a risk area or leaving a disease area.

118 The period for which an infected or potential carrier is kept in quarantine for cleansing is determined by an authorised person.

119 It is an offence if a person does not cleanse or disinfect a carrier as directed by an authorised person.

120 Owner of a potential carrier to inform an authorised person of the identity and address of a person in charge of a potential carrier at the time of the offence.
If the information is not provided within 14 days the owner will be deemed to have committed the offence.

121 An authorised person may detain, control or remove a potential carrier from a risk or disease area if:

- in contravention to any part of these Regulations or conditions of written authorisation
- failed to comply with directions of an authorised person

- Authorised person considers there is a greater risk of the spread of infection

122 Authorised person may remove a person from a risk area if suspected of contravening these Regulations or written conditions.

123 It is an offence for a person to refuse giving their name and address to an authorised person while in a disease risk area.

124 A driver or potential carrier commits an offence if they:

- fail to stop when requested by an authorised person
- ignores or fails to comply with a signpost
- avoids or breaks through a barricade

125 It is an offence for a person to hinder or obstruct, or fail to comply with a direction given by any authorised person.

5.2 GOVERNMENT POSITION – WESTERN AUSTRALIAN DIEBACK REVIEW PANEL [WADRP]

In 1996 an independent review of the matter of dieback in Western Australia was conducted for the Government, a process of public input completed, and an appraisal of the recommendations of the WADRP (Podger *et al*) completed by CALM.

The WADRP report was endorsed by Government in 1998 and CALM is progressively implementing all 33 of the Review Panel Recommendations

5.3 DIEBACK CONSULTATIVE COUNCIL

The Dieback Consultative Council (DCC) is an independent body appointed by the Hon. Minister for The Environment Cheryl Edwardes in November 1998 to advise her on the matter of *Phytophthora cinnamomi* (Dieback) and disease it causes in Western Australian native vegetation.

The Minister established the DCC in November 1998 in response to recommendations no. 24 of the Western Australian Dieback Review Panel in its report to government.

The DCC has a current membership of 14 drawn from a wide cross section of interest groups and agencies.

5.4 COPY OF CALM POLICY STATEMENT NO.3 OF DECEMBER 1998

This section (following pages) is a reprint of CALM's current policy document.

MANAGEMENT OF *PHYTOPHTHORA* AND DISEASE CAUSED BY IT

POLICY STATEMENT No.3 of DECEMBER 1998

BACKGROUND

This document replaces Department of Conservation and Land Management Policy Statement No.3 of January 1991 and should be read in conjunction with other Policy Statements and the background paper (see Appendix 12.6) :-

" **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, ecological communities and fauna habitat and to respond according to need on a case by case basis.

2. At least 8 distinct species of *Phytophthora* occur at various places in native plant communities of Western Australia. Whilst the potential importance of several of them still require some further elucidation, *Phytophthora 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 *Phytophthora cinnamomi*.

MANAGEMENT OBJECTIVES

1. Progressively 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,

2. Manage already infested and un'protectable' 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, supported by the Vegetation Health Service, to prepare up-to-date maps of the distribution of *Phytophthora cinnamomi* through the detection and analysis of the disease symptoms in native plants characteristic of disease caused by *Phytophthora cinnamomi*.
   b) The progressive identification of 'protectable' areas, which are free of the evidence of infestation by *Phytophthora 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 *Phytophthora 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 un'protectable' 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, Commonwealth and international land management and research institutions.

2. Through interaction with the *Phytophthora* Research Advisory Group establish clear research priorities and agreed allocation of those priorities amongst relevant institutions.

3. Provide appropriate levels of support to the Dieback Consultative Council, its 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 *Phytophthora cinnamomi* and disease caused by it.

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

Dr S Shea

Executive Director

December 1998

5.5 WRITTEN AUTHORITY TO ENTER DRA

Any member of the public and/or CALM staff member, who has a valid and legal reason to enter a Risk Area or Disease Risk Area (DRA), must gain a written authority from an authorised officer prior to entry and must carry the written authority when entering a Risk Area or DRA.

5.4.1 Definition of Disease Risk Area

Is any area of public land where the Executive Director considers that the earth, soil or trees may be, or may become infected with a forest disease.

5.4.2 Process for authorising entry to DRA

FIRST STAGE

Ascertain whether the applicant has had authority previously. If they haven't then they need to be briefed on why authority is required. In all cases assertion wether the person has a valid and legal reason for wishing to take a carrier into the DRA.

If the applicant has previously had authority given to them then reiterate the reasons as to why authority is required.

SECOND STAGE

Take details from applicant as per "authority"

NOTE:

- "Forest Officer" or "CALM Officer" only has authority to approve
- Applicant must be made aware 'authority' must be carried at all times whilst in DRA
- Applicant must be made aware of all conditions on authority
- Authority only valid for dates indicated on permit

5.4.3 Conditions which the Forest Management Regulations, 1993 place on entry to disease Risk Areas.

There are at least 21 Regulations governing DRA's. Authorising Officers must be aware of all their requirements. In particular the Forest Management Regulations require:-

- **Written Authorisation may be issued subject to such conditions as are specified in the authorisation**

- **Written authorisation to be carried and produced upon request**

  A person in charge of a potential carrier in a risk area, shall carry any written authorisation issued in respect of that potential carrier, at all times when the potential
  carrier is being used, operated or moved in that area, and shall produce that authorisation when requested to do so by an authorised person

- **Written authorisation to terminate on breach of condition**
  Written authorisation shall terminate immediately on the breach of any condition specified in that authorisation

- **Person to provide information upon request**
  A person shall when requested to do so by an authorised person, provide all information within that person's power relating to any occurrence or suspected occurrence of a forest disease

- **Authorised person may stop and examine potential carrier**
  An authorised person may stop and examine any potential carrier to determine whether or not it is infected and may, for that purpose, erect signposts or barricades, or both, on roads -
  (a) in or leading to a risk area; or
  (b) in or leading out of a disease area

SECTION 6 - NATIONAL THREAT ABATEMENT PLAN FOR *PHYTOPHTHORA SPP*

6.1 EXECUTIVE SUMMARY

(To be added)

6.2 KEY THREAT ABATEMENT ACTIONS FOR WESTERN AUSTRALIA

(To be added)

SECTION 7 - MANAGEMENT OF UNINFESTED ''PROTECTABLE'' AREAS

7.1 MANAGEMENT OBJECTIVE

The Western Australian Government and CALM have adopted a strategy for the management of *Phytophthora cinnamomi* and the diseases caused by it, that identifies significant ''protectable'' areas (those for which the values at risk are significant and the benefits likely to be sustained for more than a few decades), prioritises them, and concentrates available resources on protecting them.

CALM's objective is to progressively identify uninfested ''protectable'' areas and to protect them by managing human access and hygiene on entry into them, and in some cases through the application of phosphite.

7.2 MANAGEMENT STRATEGY

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 of *Phytophthora cinnamomi* through the detection and analysis of the disease symptoms characteristic of root rot disease caused by *Phytophthora cinnamomi* in native plants. This is to be supported by the laboratory analysis of soil and tissue samples by the Vegetative Health Service.

b) The identification of ‘‘protectable’’ areas, which are free of the evidence of infestation by *Phytophthora cinnamomi* , and which are amenable to being protected from the establishment of new centers of infestation arising from the activities of man through the imposition hygienic management practises.

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. Where appropriate provide protection through phosphite application.

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

7.3 RISK MANAGEMENT

The risk that the strategy of being clean on entry may fail will vary between ‘‘protectable’’ areas.

Each step in the management of *Phytophthora cinnamomi* has its attendant risks. These risks are illustrated in Figure 7.3.1 – *Risk Management*

High risk is associated with the following factors :-

1. Activities involving earth moving
2. Activities that are carried out when soil readily adheres to vehicles and machines in large amounts.
3. Situations where more than one access point into any given ‘‘protectable’’ area is required – the difficulties associated with the design, location, construction, sign posting, management and regulation of cleandown points multiplies with an increasing number of access points.
4. Permanent roads are constructed – creates the need for ongoing hygiene management of potential human vectors.

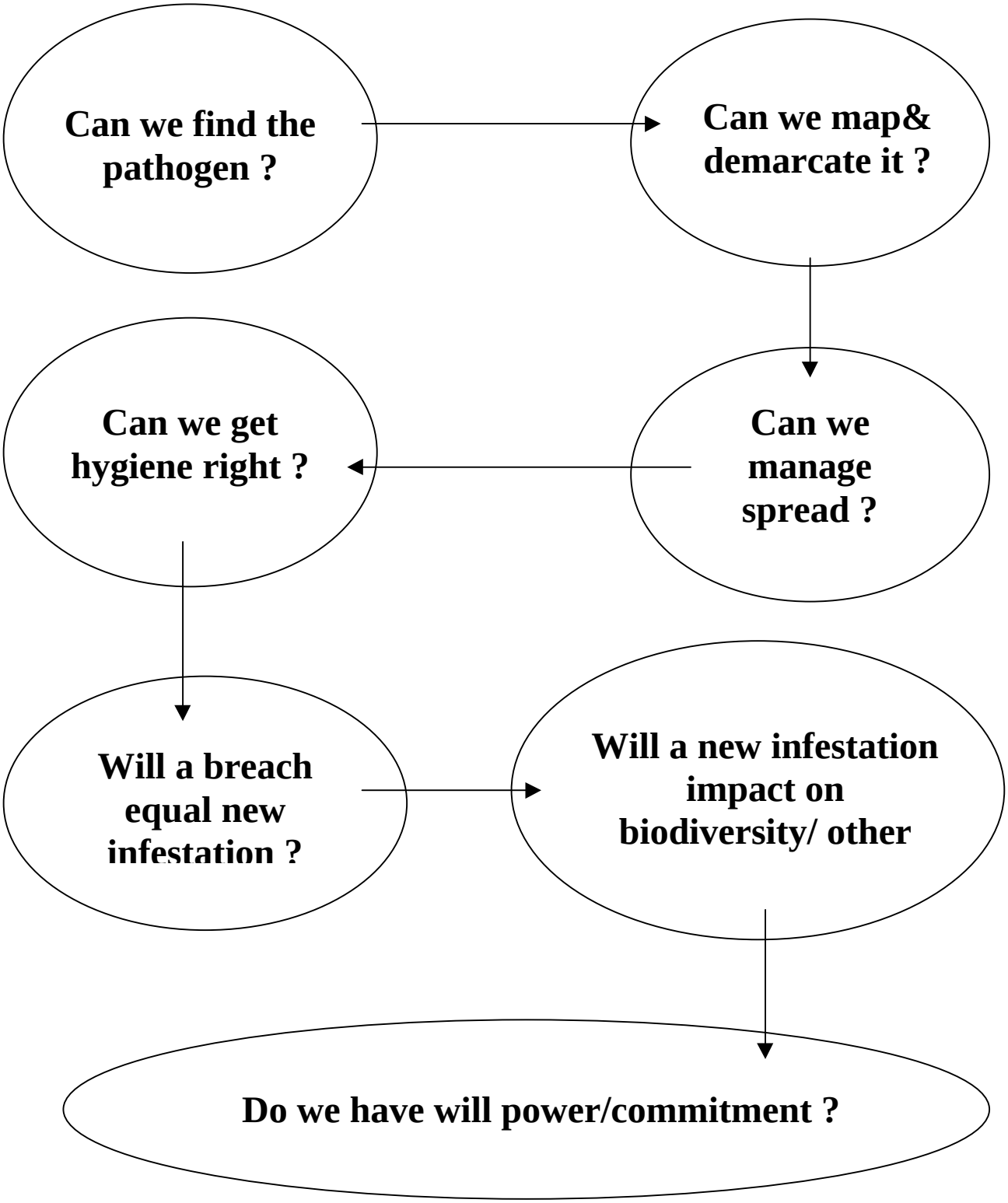
5. Multiple and ongoing entry is required by legitimate activities – multiplies the number and difficulty of cleandowns.
6. Heavy trucks and machines involved – increased complexity and cost of each cleandown.
7. High level of illegal access occurs – may exceed CALM's resources and ability to control.

A winter activity with soil movement or the construction of a permanent road in a ''protectable'' area, will always be characterised as having a high risk of a hygiene breakdown.

When preparing *Phytophthora cinnamomi* Hygiene Plans Managers should consider the need for applying the following risk mitigation tactics :-

1. Permanently close and rehabilitate roads.
2. Restrict access to summer only.
3. Plan the minimum possible number of access points – this minimises the number of interfaces between infested and uninfested areas.
4. Implement seasonal closure of roads in ''protectable'' areas.
5. Plan for increased management and supervision of cleandown points.
6. Construct, manage and audit standard high quality cleandown points (see specification section 7.4.6)
7. Increase enforcement patrols.

Figure 7.3.1 - Risk Management



7.4 PROTOCOL FOR IDENTIFYING ‘‘PROTECTABLE’ AREAS’ AND THEIR PRIORITY FOR MANAGEMENT

CALM will progressively develop a set of protocols for the objective identification of ‘‘protectable’’ areas (see Table 1 - *Definition of* “protectable” *areas*) and for their prioritisation and management. In the interim ‘‘protectable’’ areas will be identified using the following process :-

7.4.1 On a case by case analysis of landscape units establish the need for, and scope of, the mapping required and use accredited Interpreters to prepare *Phytophthora cinnamomi* Occurrence Maps based on three categories – Infested with *Phytophthora cinnamom*i, Uninfested and Uninterpretable.

7.4.2 Use accredited Interpreters and managers to identify ‘‘protectable’’ areas and rationalise their management boundaries.

7.4.3 The steps accredited Interpreters use in determining ‘‘protectable’’ areas on CALM managed land are described in Volume 11 – Interpreter’s guideline for detection, diagnosis and mapping.

Table 1. Definition of ''protectable'' areas

Defines areas of CALM land over which the hygiene rule, for the plant pathogen *Phytophthora cinnamomi* , of clean on enter will apply. May be an area suitable for phosphite application.

- Are situated in areas 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.
- Does not have a calcareous soil (i.e. not Spearwood Sand dune)
- Have been determined to be free of the pathogen *Phytophthora cinnamomi* by a qualified Interpreter (all susceptible indicator plant species are healthy, no plant disease symptoms normally attributed to *Phytophthora cinnamomi* are evident)
- Are positioned in the landscape and are of sufficient size such that a qualified Interpreter judges that the pathogen will not autonomously engulf them in the short term. (e.g. > 4 ha with axis > 100m)
- Consists of areas where human vectors are controllable (e.g. not an open road, private property)
- Includes areas of high conservation and/or socio-economic value (e.g. a small uninfested area which contains a known population of a susceptible species of threatened flora)

7.5 HYGIENE MEASURES AND STANDARDS

CALM's objective in uninfested ''protectable'' areas is to manage hygiene by planning, implementing and enforcing the rule for all human activities of being clean on entry and having entered clean to avoid cross contamination from infested to uninfested areas. This is often enhanced by removing or controlling options for access into 'protectable' areas.

The hygiene measures available to land managers preparing *Phytophthora cinnamomi* Hygiene Plans are :-

1. The temporary seasonal closure of roads and walk trails with barriers and signs.
2. The permanent closure, removal and rehabilitation of roads and walk trails.
3. Establish and maintain entry points that ensure all potential human vectors enter ''protectable'' areas hygienically and where necessary enter via effectively designed, located and managed cleandown points.
4. The use, during specific activities, of split phase systems of work that physically and/or temporally separate infested and uninfested areas. (see Figure 7.5.4 Examples of split phased activities)
5. Use of uninfested basic raw materials [BRM]

7.5.1 Permanent Road Closure

When permanently closing a road sufficient work must be done to ensure that illegal use of the old road in discouraged. Ripping of the road surface for a minimum of 100 metres and covering ripped area with logs, branches and rocks is often necessary to discourage illegal entry. (See Figure 7.5.1 Example of effective road closure)

Where past use of a road has been at high levels safety warning signs may need to be installed at the time of the road closure.

Figure 7.5.1 Example of effective road closure **Figure 7.5.2 Gate and warning sign**

7.5.2 Temporary Road Closure

Temporary road closures are best effected using a system of gates and signs. Gates must be designed to be easily readily visible to oncoming vehicles. Signs that provide clear information and guidance to potential road users must be installed with all gates. The need for "gate ahead" warning signs to be installed must be evaluated. (See Figure 7.5.2)

In some bush operations it may be appropriate to place logs over roads as a method of temporary closure. Line off sight and safety aspects must be evaluated when using this method of road closure.

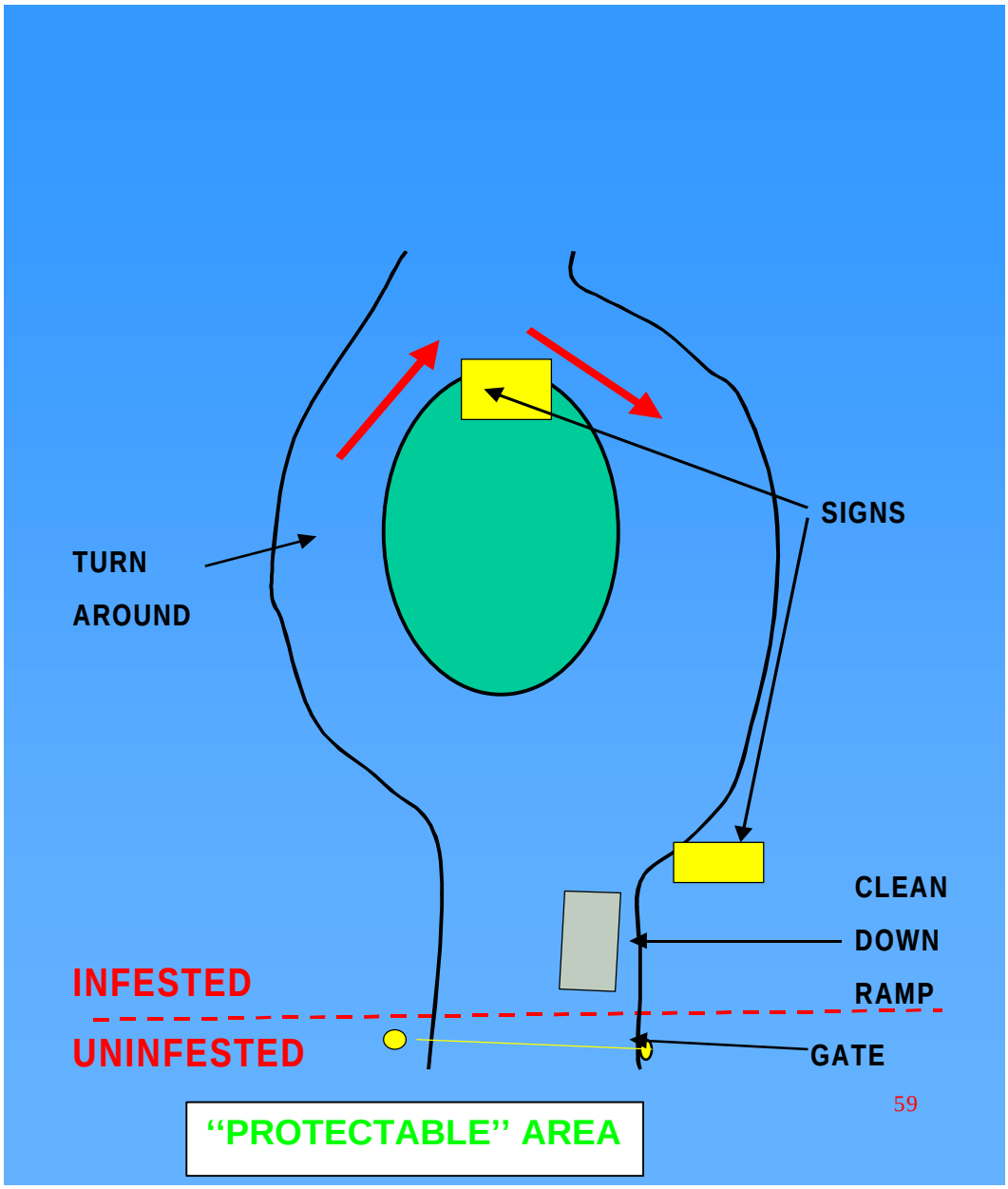
7.5.3 Entry Points into ''protectable'' Areas

All entry points, both temporary and permanent (see Figure 7.5.3 – Ideal entry point) into ''protectable'' areas will be characterised by :-

a) Signs (Appendix 12.5 for approved wording)
b) A cleandown point suitable for vehicles up to the size of a 5 tonne truck
c) A gate, and
d) A turnaround point suitable for articulated trucks.

The timing of the installation of the entry point facilities is critical to the success of the *Phytophthora cinnamomi* Hygiene Plans for the ‘‘protectable’’ areas. The District Manager is responsible for ensuring that the sequencing of the work is adequately specified in the *Phytophthora cinnamomi* Hygiene Plan. In the case of new roads being built into ‘‘protectable’’ areas the entry point facilities must be installed where practicable on the same day as the commencement of the clearing of the road alignment.

Figure 7.5.3 – Entry Point into a ‘‘protectable’’ area



Cleandown Specification

An object (boots, vehicles, plant, or equipment) is judged to be free of soil and plant tissue, which may be infested with *Phytophthora cinnamomi,* when a visual inspection by an authorised officer reveals that it is free of a build up of :-

a) clods of soil and/or
b) slurry consisting of soil and water.

Dust and grime adhering to the sides of vehicles need not be removed before entering a 'protectable' area.

Field Cleandown Point – Construction and Location Standards

All cleandown points will be inspected and approved by an authorised officer. An approved cleandown point will meet the following minimum standards.

A. Construction standards

1.1 Provides physical separation between the object being cleaned and the effluent being produced.
1.2 Provides physical separation from the object being cleaned and infested soil and plants
1.3 Provides easy and safe access for both the placement of the object to be cleaned and for the person conducting the cleandown.

B. Field location standards

2.1 Sited for safe entry and departure of vehicles and plant
2.1 Sited either to allow effluent to fall directly onto infested soil or is constructed to capture effluent for later transport and correct disposal.
2.2 Sited to enable cleaned objects to enter uninfested areas without becoming re-infested.

7.5.4 Split Phase Work Methods

The aim is to have vehicles, machinery and equipment enter ‘‘protectable’’ area when they are clean. Once within a ‘‘protectable’’ area split-phase work methods can be used to minimise the number of inspections and cleandowns and to minimise the risk of cross contamination occuring.

Figure 7.5.4 illustrates examples of split-phase logging activities.

New road construction into ‘‘protectable’’ areas

Managing hygiene when building a new road into a ‘‘protectable’’ area is a critical element in the long term protection of the area.

Where possible first 50 meters of the new alignment should be left un-cleared until after the remainder of the clearing has been completed. Light vehicle and machine tender vehicle access to the new alignment can be provided with appropriate attention to the hygiene requirements, provision of clean-down facilities and signage.

The retained section should be maintained relatively undisturbed for as long as is practicable.

Often it will be necessary for the bull-dozer that clears the alignment to open up the retained section prior to the commencement of the road formation and gravelling works e.g. to allow logs in pushed trees to be cut and removed. The bull-dozer should work from inside the ‘‘protectable’ ‘ area towards the boundary of the infested area.

At the time of opening up the retained section *Phytophthora cinnamomi* information signs need to be set-up and portable traffic control barriers placed across the road at the demarcated boundary of the ‘‘protectable’’ area. If gravelling operations are to be delayed over substantial periods (e.g. winter)

consideration should be given to temporarily blocking the new alignment with several substantial logs.

During the formation of the road the graders should work from inside the ‘‘protectable’’ area up to the demarcated boundary working infested areas last.

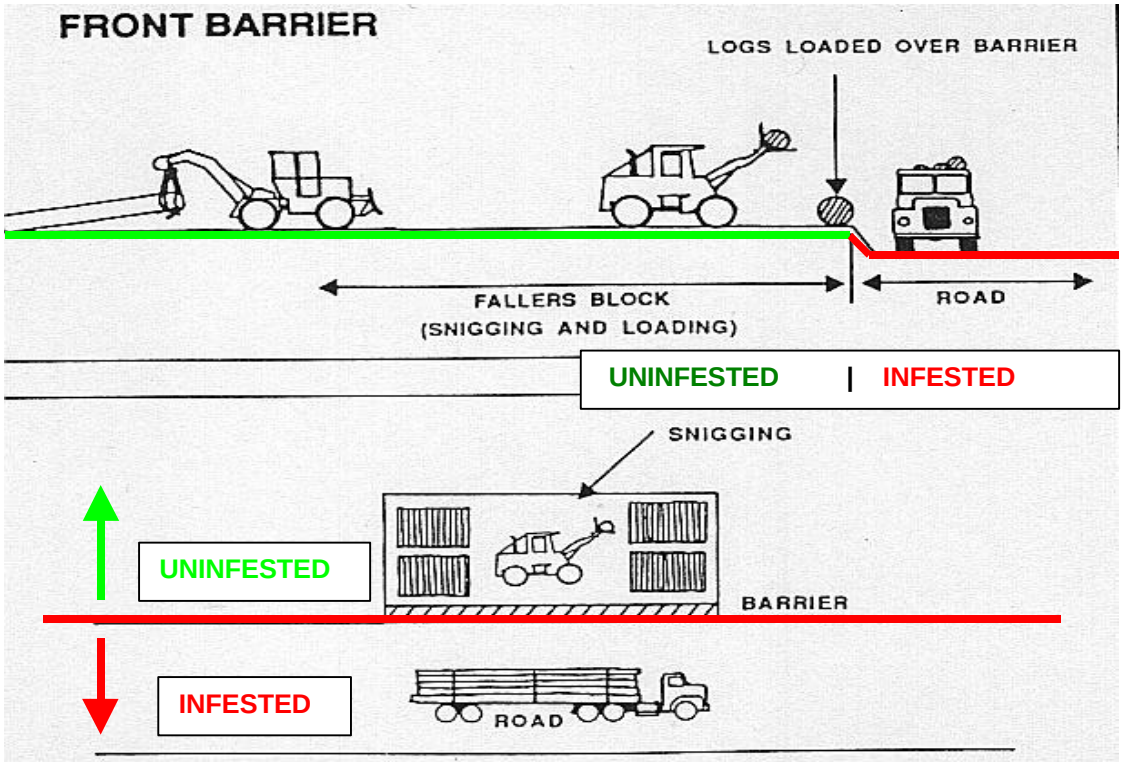
Where possible to simplify the process on being clean on entry gravelling activities should work from the ‘‘protectable’’ area into the infested area, e.g. especially where the gravel pit is within the ‘‘protectable’’ area.

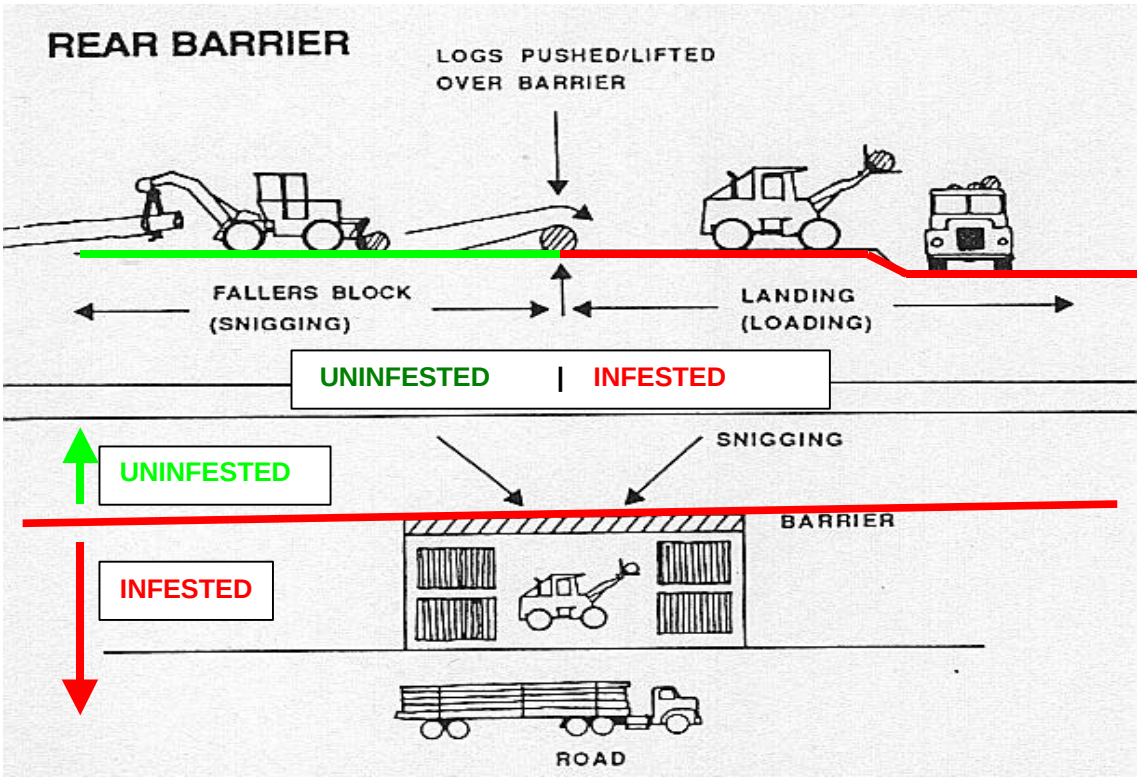
The installation of permanent gates and signs is to be programmed to coincide with the completion of the surface gravelling activities and the removal of the temporary signs and barriers.

Water binding

Water binding should be kept to a level where run-off into does not occur. The early installation of correctly designed table drains will ensure that unseasonal rainfall does not flush material from the road building operation across large areas of adjoining land.

Figure 7.5.4 - Examples of split phase activities





7.5.5 Basic Raw Materials

Management Plans and *Phytophthora cinnamomi* Hygiene Plans often require the use of basic raw materials [BRM] such as sand, gravel and soil in road construction, building site works etc. which are certified as "*Phytophthora* free".

On CALM lands accredited plant disease Interpreters are available to assess and certify BRM borrow pits. Interpreters will only certify borrow pits as *Phytophthora* free under the following circumstances :-

a) For a new pit to be located in undisturbed areas where sufficient indicator plants are available for a determination to be made or
b) For an existing pit that has records confirming that it was originally *Phytophthora* free, and for which sufficient evident exists that an effective system of hygiene has been in place to ensure that the pit has remained *Phytophthora* free.

Existing pits without a known history that can be effectively placed in quarantine and kept free of all living and dead plant material of all species for a period of three years may then have their status reviewed. *Phytophthora cinnamomi* requires plant tissue from which to derive its energy (food source) to survive in the long term. I.e. The pathogen does not photosynthesise so it cannot survive free in soil in the long term without access to plant tissue. A three year quarantine period, during which no new plant tissue (living or dead), mycelia, chlamydospores or zoospores are introduced into to pit by either through autonomous spread or human vectoring, in most cases will allow sufficient time for any previously introduced mycelium, chlamydospores and zoospores to desiccate and die.

Where BRM is being extracted from deep pits, such as mines and quarries, where there is no obvious source of innoculum (e.g. mixing of top-soil and plant material, sub-surface water flow from adjacent infested areas likely to be

carrying zoospores or unhygienic entry of vehicle, machine or equipment into the area) this material may also be certified as *Phytophthora* free.

Owners of private pits or developers may wish to have CALM Interpreters review and certify pits using this methodology.

Phytophthora free BRM is a valuable resource and managers are encouraged to ensure the integrity if the sites are maintained by ensuring foot-ware, vehicles, machinery and equipment entering these sites is clean (i.e. *Phytophthora* free).

7.6 HYGIENE GUIDELINES

7.6.1 Hygiene guidelines for ‘‘protectable’’ areas

Using a process that analyses entire landscape units (the boundaries of landscape units are established by such features as creeks, ridges, saddles, open public access roads and/or freehold land) Managers must plan for, deploy and enforce the rule of being clean on entry for all human activities in ‘‘protectable’’ areas and control access into them. It is not possible to survey the entire CALM estate for the presence of *Phytophthora cinnamomi,* therefore areas to be mapped annually and their boundaries will be determined on a case by case analysis of likely ‘‘protectable’’ areas and the amount of information needed to prepare a *Phytophthora cinnamomi* Hygiene Plan for them. In most cases a whole landscape unit approach to mapping and planning will be required

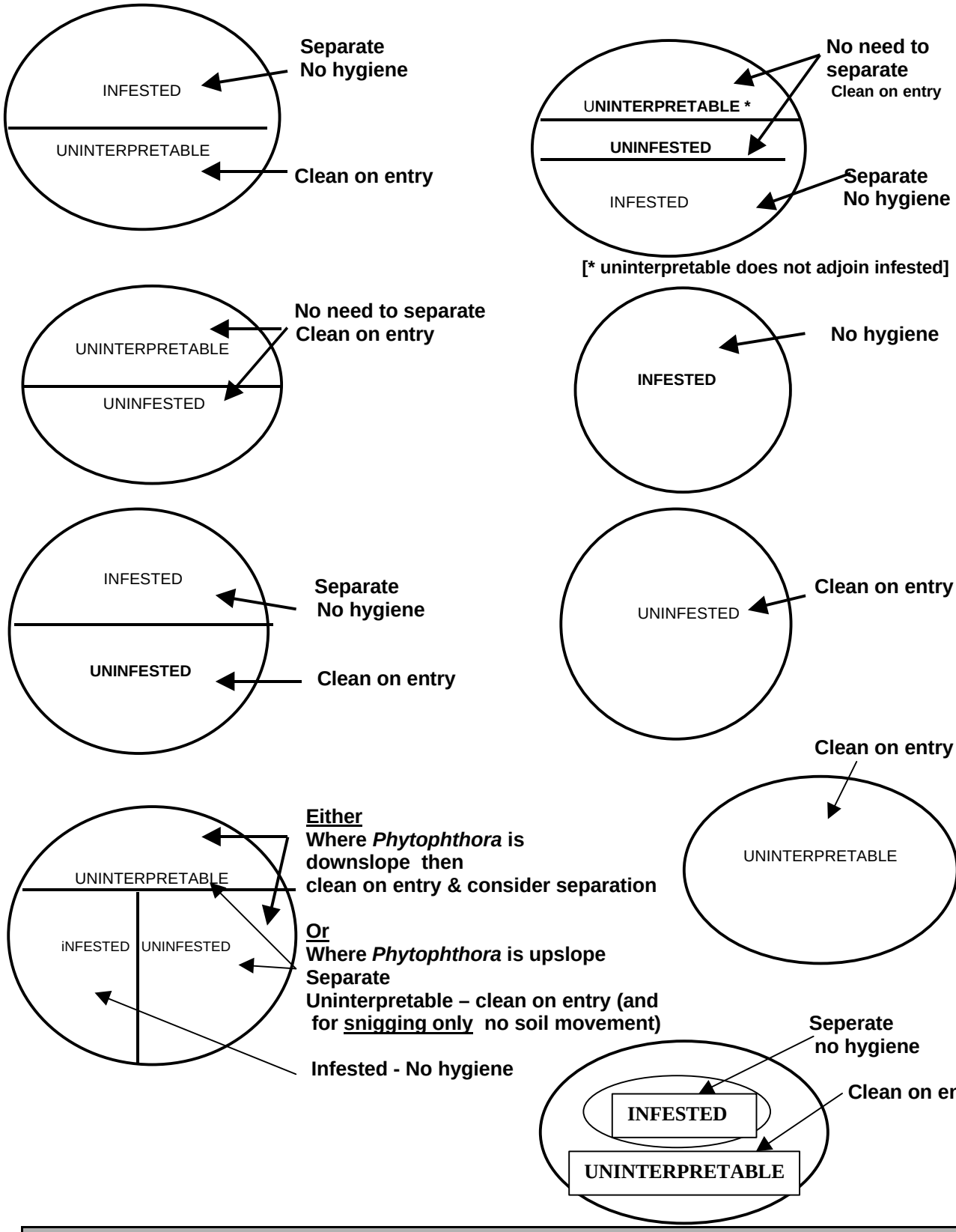
Linear mapping of *Phytophthora cinnamomi* Occurrence may be adequate for prescribed burn boundaries and utility easements. However, Interpreters will be required to survey at least 150 meters either side of the disturbed areas to be able to make a reliable determination of ‘‘protectable’’ areas adjoining them.

Having prepared a *Phytophthora cinnamomi* Occurrence Map and established the ‘‘protectable’’ areas which may reasonably be protected from human

vectoring by the use of controlled and hygienic access. Table 2 – *Hygiene Guidelines for ‘Protectable’ Areas* (see below), is used by Managers as a guide for determining appropriate hygiene strategies for each ‘protectable’ area.

The aim of Table 2 - *Hygiene guidelines for ‘Protectable’ Areas* is to indicate how managers may best minimise the human vectored spread of *Phytophthora cinnamomi* into ‘‘protectable’’ areas. Where the entire landscape unit consists of a single category – infested, uninfested or uninterpretable, the analysis and determination of an appropriate hygiene strategy is made simpler. In the cases where the landscape unit consists of a mosaic of any one of the possible combinations of these categories the task is more complex.

TABLE 2 - HYGIENE GUIDELINES FOR ''PROTECTABLE'' AREAS



7.6.2 Hygiene Guidelines for areas adjoining ''protectable'' areas

Having identified each ''protectable'' area, rationalised their boundaries and determined the access and hygiene measures appropriate for each one Managers must also consider how the areas immediately adjoining the ''protectable'' areas are to be managed. This requires a case by case analysis of the areas during the preparation of the *Phytophthora cinnamomi* Hygiene Plan for the ''protectable'' areas.

Professional judgement will be required as to the risk posed by a given activity and the reasonable measures appropriate to mitigate the risk. Due to the greatly differing circumstances that occur across CALM managed lands it is not possible to prescribe set procedures. Managers are required to balance risk against the cost and effectiveness of measures prescribed in given circumstances. Managers must be careful not to impose costly restrictions on lawful activities that serve little or no purpose in slowing the advance of *Phytophthora cinnamomi* into ''protectable'' areas from the adjoining areas, in particular where the adjoining areas are known to be infested.

7.7 PREPARING *PHYTOPHTHORA CINNAMOMI* HYGIENE PLANS FOR ''PROTECTABLE'' AREAS

7.7.1 MANAGEMENT OBJECTIVE

CALM's management objective is to progressively prepare and implement *Phytophthora cinnamomi* Hygiene Plans for all ''protectable'' areas.

Phytophthora cinnamomi Hygiene Plans enable land mangers to determine :-

a) The practical management boundaries for each area,
b) The hygiene measures to be taken to minimise human vectoring of the pathogen into each area, and
c) The efficacy of protection through phosphite application.

7.7.2 MANAGEMENT STRATEGY

CALM's management strategy is to implement a system of management for ''protectable'' areas based upon the following elements :-

a. The use of accredited Interpreters to find and examine indicator plants for the symptoms of disease caused by *Phytophthora cinnamomi*, to interpret disease symptoms, and to prepare maps of *Phytophthora cinnamomi* Occurrence.

b. The use of accredited Interpreters and managers to identify ''protectable'' areas and determine their boundaries.

c. The use of accredited staff to prepare, implement and regulate *Phytophthora cinnamomi* Hygiene Plans for all ''protectable'' areas.

d. The use of accredited staff to analyse the need for protection through the application of phosphite.

7.7.3 PREPARATION OF *PHYTOPHTHORA CINNAMOMI* OCCURRENCE MAPS AND ''PROTECTABLE'' AREA MAPS

CALM's *Phytophthora cinnamomi* Occurrence Maps will be prepared by accredited Interpreters using the methods outlined in Volume II - Interpreter's guidelines for detcetion, diagnosis and mapping.

Below is an extract from in Volume II - Interpreter's guidelines for detcetion, diagnosis and mapping that summaries :

STEPS INTERPRETERS USE IN DETERMINING 'PROTECTABLE' AREAS ON CALM MANAGED LANDS

1. Prepare the *Phytophthora cinnamomi* Occurrence Map based on landscape units unless otherwise agreed by the District Manager.
   1.1 Use only three map categories: -
      a) *Phytophthora cinnamomi* infested,
      b) *Phytophthora cinnamomi* free, and
      c) Uninterpretable.
   1.2 All roads and tracks are to be categorised using the same three categories as 1.1 above.
   1.3 Other *Phytophthora's* and *Armillaria* are to be recorded and digitised into separate GIS files for future use.

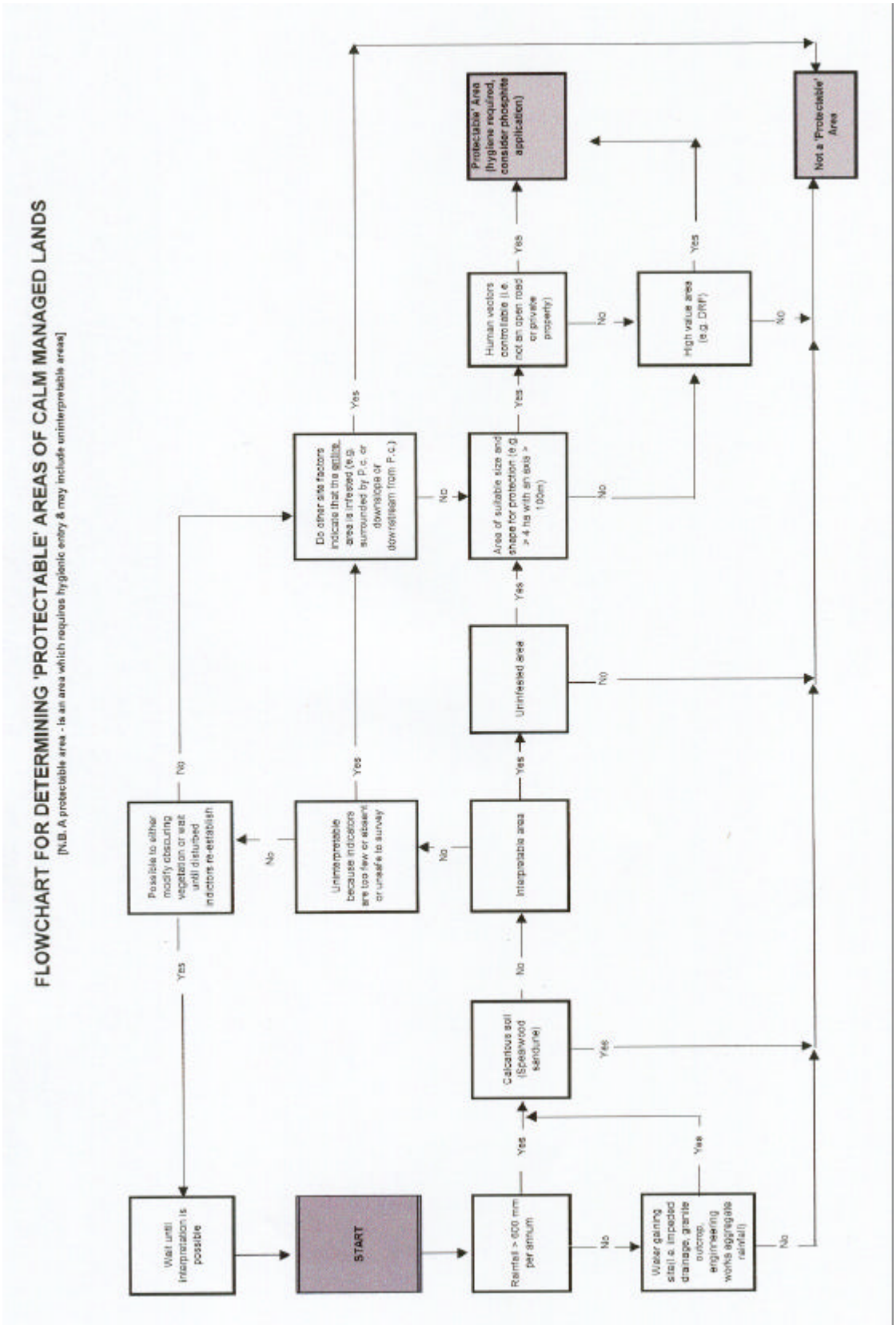
2. Identify areas of uninfested and uninterpretable that are greater than 4 ha with axis greater than 100m. Exclude any areas of uninterpretable and/or road surfaces that are determined to be infested.

3. Test each area against the flowchart (see below) and establish the 'protectable' areas. Hatch the areas that are not 'protectable' areas.

4. Where the uninterpretable area adjoins an infested area exclude any areas of uninterpretable that are likely to be infested (e.g. downstream areas and/or approximately 150 m of the uninterpretable.

5. Determine the appropriate boundaries for each 'protectable' area.

6. Hatch the areas that are not 'protectable'


FLOWCHART FOR DETERMINING 'PROTECTABLE' AREAS OF CALM MANAGED LANDS
[N.B. A protectable area - is an area which requires hygienic entry & may include uninterpretable areas]
START
Rainfall > 600 mm per annum
Water gaining sites i.e. impeded drainage, granite outcrop, engineering works aggregate rainfall)
Calcarious soil (Spearwood sandune)
Interpretable area
Uninterpretable because indicators are too few or absent or unsafe to survey
Possible to either modify obscuring vegetation or wait until disturbed indictors re-establish
Wait until interpretation is possible
Uninfested area
Area of suitable size and shape for protection (e.g. > 4 ha with an axis > 100m)
Do other site factors indicate that the entire area is infested (e.g. surrounded by P.c. or downslope or downstream from P.c.)
Human vectors controllable (i.e. not an open road or private property)
High value area (e.g. DRF)
'Protectable' Area (hygiene required, consider phosphite application)
Not a 'Protectable' Area
Yes
No

7.7.4 GUIDELINES FOR PREPARING *PHYTOPHTHORA CINNAMOMI* HYGIENE PLANS

The *Phytophthora cinnamomi* Hygiene Plan allows managers to analyse areas, identify 'protectable' areas, and for each ''protectable'' area to determine:-

a) The practical management boundaries,

b) The hygiene measures to be taken to minimise human vectoring of the pathogen into the area, and

c) The efficacy of providing protection through phosphite application.

The following steps are used by the District Manager, in consultation with the various activity proponents and accredited Interpreters, when preparing *Phytophthora cinnamomi* Hygiene Plans for a given area of CALM land :-

a) Use a whole of landscape unit approach to analyse the *Phytophthora cinnamomi* Occurrence Map and identify the ''protectable'' areas and rationalise their management boundaries. (See Section 7.3 above)

b) Identify all activities current and planned for the ''protectable'' areas.

c) Use Table 2. – "Hygiene Guidelines for ''protectable'' Areas" as a basis for planning, implementing and enforcing the rule of being clean on entry for all human activities within ''protectable'' areas and controlling access into them.

d) For each ''protectable'' area Managers must determine :-
   i) The hygiene requirements,
   ii) The control of access into each,
   iii) The measures to be taken to minimise human vectoring of the pathogen into it, and

iv) The efficacy of providing protection through phosphite application.

e) Analyse the risk of a hygiene failure (see 7.3) and adopt appropriate hygiene tactics (see 7.5) with a view to minimising the risk of cross contamination from infested to uninfested areas. And the consequence to the ''protectable'' area.

f) Document the *Phytophthora cinnamomi* Hygiene Plan (using the form "*Phytophthora cinnamomi* Hygiene Plan" - see Appendix 12.1) listing the required management actions and accountabilities for each of the

''protectable'' areas. This will include the preparation of a *Phytophthora cinnamomi* Hygiene Management Map (to be attached to the completed form) which uses the standard legend (see appendix 12.3).

g) Review the results and periodically audit compliance.

7.7.5 *Phytophthora cinnamomi* Hygiene Management Map – Legend and ID Number

For the standard map legend refer to Appendix 12.3 "*Phytophthora cinnamomi* Hygiene Management Map – Legend"

7.7.6 Administration and Management of P*hytophthora cinnamomi* Hygiene Plans

The administration process of managing *Phytophthora* cinnamomi Hygiene Plans is triggered by a request to go upon the land anywhere within the South West Land Division. District Managers are responsible for determining whether there is a current *Phytophthora cinnamomi* Hygiene Plan in place and if not whether one is required before authorising entry to the CALM estate.

A fundamental requirement is the need for the District Manager as an integrator and the custodian of CALM estate to:-

a) Ensure that broad agreement is reached early in the process with the activity proponent on the scope of the planning task.
b) Undertake a preliminary analysis of likely ‘‘protectable’’ areas and risk of new centres of infestation being initiated within them,
c) Initiate an early reconnaissance and input from an accredited Interpreter, and
d) Program works to effect immediate road closures where appropriate.

Once the *Phytophthora cinnamomi* Occurrence Map and the ‘‘protectable’’ Areas Map are prepared, the District Manager should re-convene, as appropriate, the working session with the proponent to analyse and agree on the details of the hygiene plan. At this point consideration must be given to integrating the hygiene management of all the activities occurring within each ‘‘protectable’’ area. Proponents may signify their understanding and agreement by counter-signing the plan.

The District Manager is accountable for designing and implementing an appropriate review of each *Phytophthora cinnamomi* Hygiene Plan and ensuring that there is a reliable feedback loop in the planning and management process so that new information is incorporated into the ongoing management of the ‘‘protectable’’ areas and the activities that occur within them.

Copies of current and past *Phytophthora cinnamomi* Hygiene Plans should be available in the District Office record system. The District Manager is accountable for ensuring that copies are forwarded to FMB for inclusion into CALM’s Corporate data base systems.

7.7.7 Review of P*hytophthora cinnamomi* Hygiene Plans

CALM's *Phytophthora* Management Coordinator and District Managers will conduct regular reviews of *Phytophthora cinnamomi* Hygiene Plans using the checklist in Appendix 12.4 "*Phytophthora cinnamomi* Hygiene Plans – Review Checklist".

Any corrective action is recorded on the checklists.

SECTION 8 – MANAGEMENT OF INFESTED AND UN'PROTECTABLE' AREAS

8.1 MANAGEMENT OBJECTIVE

CALM's objective is to establish and maintain a state of protocols, founded on science and logic, which establishes guidelines for identifying areas already infested and those areas that are not ''protectable'' from root rot caused by *Phytophthora cinnamomi* and sets priorities among management options for them.

8.2 MANAGEMENT STRATEGY

For the infested and un'protectable' areas CALM will adopt the following :-

1. Develop and maintain a set of protocols, founded on science and logic, which establish guidelines for identifying and managing infested 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.

8.3 MANAGEMENT GUIDELINES

[to be added]

SECTION 9 - PROTECTION OF THREATENED FLORA, THREATENED ECOLOGICAL COMMUNITIES AND THREATENED FAUNA HABITAT USING PHOSPHITE

9.1 MANAGEMENT OBJECTIVE

As a component of it's broader management program of threatened flora, threatened ecological communities and the habitat of threatened fauna, CALM will develop and implement as appropriate programs for the use of the protective chemical phosphite for their protection.

9.2 MANAGEMENT STRATEGY

1. Develop and maintain a set of protocols founded on science and logic which:-
   a) guide land managers in identifying of 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.

3. Refine and maintain appropriate management guidelines and training programs.

9.3 PHOSPHITE OPERATIONS GUIDELINE

Strategies for management of the impacts of *Phytophthora cinnamomi* in native ecosystems may be placed in two broad but distinct approaches. The simplest approach and one that has been used in Western Australia for over 20 years directs effort at containing the human vectored spread of the pathogen. The second involves using techniques to reduce the destructive interaction between the pathogen and its hosts. Most of these theoretically available techniques for modifying the host-pathogen interaction are prospective only, are too expensive or are unsuitable for use in native plant communities.

One technique that has reached the operational stage is the application of phosphite to either single plants or whole plant communities to give a degree of protection against root rot disease caused by *Phytophthora cinnamomi*. Since the first trials of phosphite (then called phosphonate) by stem injection into jarrah and *Banksia grandis* were conducted in 1989 by researchers at CALM's Dwellingup office a great deal has been learnt about the methodology of its use in treating native vegetation.

The objectives, strategy, methodology and procedural guidelines for applying phosphite in the protection of native plants in the wild is described in detail in Volume III - Phosphite Operations Guidelines.

SECTION 10 - RESEARCH, PUBLIC EDUCATION AND LIAISON

10.1 MANAGEMENT OBJECTIVES

As a component of it's broader programs of research, public education and liaison CALM's objective is to :-

1. Implement programs of interagency research and collaboration, which are closely linked with :-
   a) management requirements, and
   b) other Western Australian, interstate, federal and international institutions involved in research and management on *Phytophthora.*

2. Encourage community interest and participation particularly through support of the Dieback Consultative Council (DCC) and its prospective Regional Coordination Groups.

C. Provide appropriate levels of information to the public on the matters related to *Phytophthora* and disease caused by it.

10.2 MANAGEMENT STRATEGIES

1. Implement coordinated programs of research and collaboration, which are closely linked to management requirements, and involve other Western Australian, interstate, Commonwealth and international land management and research institutions.

2. Through interaction with the *Phytophthora* Research Advisory Group establish clear research priorities and agreed allocation of those priorities amongst relevant institutions.

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*.

10.3 RESEARCH PRIORITIES

Eighteen of the 33 Recommendations contained in the Western Australian Dieback Review Panel Report endorsed by Government in 1997 are concerned with research. In 1999 the Dieback Consultative Council (DCC) examined the immediate need for research, and the mechanisms that will facilitate research, in order to further enhance the appropriate management of disease caused by *Phytophthora cinnamomi* in the Western Australian flora.

A. RESEARCH PRIORITIES

The DCC identified 10 areas of priority research (Table 1) for the next five years. Seven projects are related to short-term management needs (Targeted research) and three projects can be described as basic research fundamental to the understanding of the behavior of the pathogen which may lead to break through solutions for the management of problems it causes.

Table 1. PRIORITY RESEARCH AREAS

TARGETED RESEARCH PROJECTS	NON-TARGETED RESEARCH PROJECTS
1. Optimising phosphite application regimes	1. Mode of action of phosphite
2. Reduction in autonomous spread of the pathogen using phosphite	2. Long term ecological impacts of the pathogen
3. Fire - phosphite interactions	3. Variability in phosphite tolerance of the pathogen population
4. Improving the effectiveness of hygiene/quarantine protocols	
5. Ex situ conservation and germplasm storage of *Phytophthora* - susceptible flora	
6. Role of fire in managing susceptible threatened species	
7. Seasonal and geographic variation in rate of pathogen spread and disease expression	

B. METHOD FOR RANKING RESEARCH PROJECTS

The DCC used seven criteria were used to identify the projects listed in Table 1.

1. Does the project have a demonstrated applied focus?
2. Is the project likely to contribute significantly within five years?
3. Does the project build on the results of previous work?
4. Are the objectives of the project measurable?
5. Are the project objectives able to be delivered?
6. Is the project affordable?
7. Does the project contribute to any of the following?

- Protection of threatened flora, threatened ecological communities and/or the habitat of threatened fauna.
- Review or improvements to hygiene measures.
- Operational improvements in both the delivery and the effectiveness of protecting plants using phosphite.
- Understanding the mode of action of phosphite.

The DCC suggested that the above criteria would be useful in the future ranking of research proposals for funding or other purposes.

SECTION 11 – MANAGEMENT ROLES AND RESPONSIBILITIES

11.1 CALM *PHYTOPHTHORA* MANAGEMENT COORDINATOR

- Assists with policy development and interpretation.
- Develops and maintains management systems and sets standards
- Develops and maintains management guidelines.
- Develops, maintains and delivers accredited training programs.
- Liaises with managers, proponents, agencies and organisations on the problem of *Phytophthora cinnamomi* and disease caused by it.
- Plans and implements a program to protect threatened Declared Rare Flora, threatened ecological communities and the habitat of threatened fauna using phopshite treatments.
- Assists in the development of research priorities.
- Provides executive support for the Dieback Consultative Council
- Develops a strategy for CALM to progressively implement the recommendations of the Western Australian Dieback Review Panel Report.
- Develops and implements an effective communication plan for staff, contractors, agencies and the general public.

11.2 DISTRICT MANAGER

- Interprets CALM's policy and management guidelines and ensures that all management activities within the District comply with them.
- Accountable for the initiation, preparation, approval and effective implementation of *Phytophthora cinnamomi* Hygiene Plans for each ''protectable'' area.
- Responsible for the regular review of *Phytophthora cinnamomi* Hygiene Plans.

- Establishes and maintain effective administration and records systems for of *Phytophthora cinnamomi* Hygiene Plans.
- Ensures staff are nominated and trained as District *Phytophthora* Management Coordinator.

11.3 DISTRICT *PHYTOPHTHORA* MANAGEMENT COORDINATOR

- Coordinates and assists with the preparation, approval and effective implementation of *Phytophthora cinnamomi* Hygiene Plans for ‘‘protectable’’ areas.
- Monitors hygiene implementation standards and undertakes reviews of *Phytophthora cinnamomi* Hygiene Plans.
- Administers the records systems for *Phytophthora cinnamomi* Hygiene Plans including any amendments made to the plans.
- Liaises with Forest Management Branch.
- Provides advice on hygiene planning and implementation standards, work methods and policy.
- Maintains an up to date copy of the manual of guidelines titled *“Phytophthora cinnamomi* and disease caused by it. Volume 1 – Management Guidelines” and destroy all out of date copies.

11.3 DISEASE STANDARDS OFFICER (Forest Management Branch)

- Develops and maintains disease detection, diagnosis and mapping systems and standards.
- Monitors systems and standards and approves *Phytophthora cinnamomi* Occurrence maps.
- Develops and maintains procedures manuals for plant disease Interpreters.
- Develops, maintains and implements training programs for plant disease Interpreters
- Advises on the determination of ‘protectable’ areas and their management boundaries.

- Advises on disease biology and epidemiology and hygiene management strategies and hygiene measures.
- Conducts workplace assessments and accredits plant disease Interpreters.

11.4 SENIOR INTERPRETER

- Manages plant disease Interpreter training and works programs
- Assists with the development and maintenance of disease detection, diagnosis and mapping systems and standards.
- Assists with the approval of *Phytophthora cinnamomi* Occurrence maps.
- Assists in training and evaluating staff.
- Assists with the development of *Phytophthora cinnamomi* Hygiene Plans for 'protectable' areas.
- Advises on the determination of 'protectable' areas and their management boundaries.
- Advises on disease biology and epidemiology and hygiene management strategies and hygiene measures.

11.5 FOREST MANAGEMENT BRANCH

- Provide up to date *Phytophthora cinnamomi* Occurrence maps of a consistent standard.
- Provides *Phytophthora cinnamomi* Hygiene Management maps.
- Develops and maintains an effective Corporate data base.

11.6 PROPONENT

- May assist with the preparation of *Phytophthora cinnamomi* Hygiene Plans.
- Complies with the hygiene requirements for 'protectable' areas

11.7 PHOSPHITE OFFICER

- Assists with policy development and standards setting.
- Assists with policy development and interpretation
- Develop and maintain management systems, data bases and sets standards.
- Develops and maintains management guidelines.
- Develops, maintains and delivers accredited training programs.
- Liaises with managers, proponents, agencies and organisations on the problem of *Phytophthora cinnamomi* and disease caused by it.
- Plans and implements a program to protect threatened Declared Rare Flora, threatened ecological communities and the habitat of threatened fauna using phopshite treatments.
- Assists in the development of research priorities.

SECTION 12 - APPENDICES

12.1 *PHYTOPHTHORA CINNAMOMI* HYGIENE PLAN – BLANK FORM

See below.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

PHYTOPHTHORA CINNAMOMI HYGIENE PLAN

DISTRICT PLAN IDENTIFICATION NUMBER : .....

District: .....Tenure: ..... Block: ..... *Phytophthora cinnamomi* Occurrence Map ID No : .....

(Use FMB Codes)

Plan prepared by : ....

(PRINT NAME) (SIGNED) (DATE)

OBJECTIVE : To manage access and hygiene to ensure human activities are an inconsequential vector for establishment of new centres of infestation in *Phytopthora cinnamomi* free ‘‘protectable’’ areas.

‘PROTECTABLE’ AREAS AND THEIR BOUNDARIES :

The occurrence of *Phytophthora cinnamomi* and the “protectable” areas are recorded on FMB Map No. ..... approved by CALM’s Senior Interpreter

....

(PRINT NAME) (SIGNED) (DATE)

Disease boundary checks are due on: ..... Re-mapping of disease occurrence is due on: .....

APPROVAL OF ‘PROTECTABLE’ AREAS

The “‘protectable’” areas and their boundaries are approved.

District Manager : ....

(PRINT NAME) (SIGNED) (DATE)

ACCESS CONTROL AND HYGIENE MEASURES :

a) List the access control and hygiene measures required to minimise human vectoring of *Phytophthora cinnamomi* into the ''protectable' areas', &

b) Prepare and attach a *Phytophthora cinnamomi* Hygiene Management Map that records the details specified in this plan

HYGIENE MEASURES (What will be done)	**LOCATION** (Use legend in management guidelines)	**WHEN** (Target date)	**WHO** (Name of the accountable person for each task)	**COMPLETED** (Date and Initials)
1. Hygiene (see Table 2 –- Hygiene Guidelines) 1.1''protectable'' areas where "clean on entry" rule is to apply. 1.2''protectable'' areas where clean on entry & "no soil movement snigging" is required. 1.3 Split-phase activities required - front barrier - rear barrier 1.4 Areas adjacent to ''protectable'' use uninfested materials				

HYGIENE MEASURES (Cont.) (What will be done)	LOCATION (Use legend in management guidelines)	WHEN (Target date)	WHO (Name of the accountable person for each task)	COMPLETED (Date and Initials)
2. Roads 2.1 Roads to be closed permanently before other activities commence. 2.2 Roads to be closed as part of the activity. 2.3 Roads to be closed immediately after other activities are completed. 2.4 New roads/walktrails - Split phase method of road construction to be used - clean on entry - uninfested raw materials to be used 2.5 Culvert, bridge or cause-way needed to assist being clean on entry				

HYGIENE MEASURES (Cont.) (What will be done)	**LOCATION** (Use legend in management guidelines)	**WHEN** (Target date)	**WHO** (Name of the accountable person for each task)	**COMPLETED** (Date and Initials)
3. Entry Points 3.1 Gates required 3.2 Daily gate closure required 3.3 Signs required 3.4 Turn around point required for trucks required 3.5 Cleandown point to be constructed				
4. pply phosphite				
5. Briefings required				
6. Other – specify				

***PHYTOPHTHORA CINNAMOMI* HYGIENE PLAN RECOMMENDED FOR APPROVAL :**

Attachments: Tick (✓) the items that have been completed and attached

Phytophthora cinnamomi Hygiene Management Map	☐
Sign Management Checklist	☐
Specifications for road closures	☐
Record of entry into a 'protectable' area	☐

District *Phytophthora* Management Coordinator :

.....	.....	.....
(PRINT NAME)	(SIGNED)	(DATE)

APPROVAL :

I certify that this *Phytophthora cinnamomi* Hygiene Plan adequately protects the nominated areas and that the hygiene measures can be uniformly applied for all activities within the ''protectable'' areas.

This plan is approved for implementation.

District Manager:	.....	.....
(PRINT NAME)	(SIGNED)	(DATE)

Distribution : Copy of approved *Phytophthora cinnamomi* Hygiene Plan to Proponent (s), FMB data base, file

12.2 *PHYTOPHTHORA CINNAMOMI* HYGIENE PLAN – COMPLETED EXAMPLE

See below.

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT

PHYTOPHTHORA CINNAMOMI HYGIENE PLAN

DISTRICT PLAN IDENTIFICATION NUMBER : 97/1999

District : E Tenure : SF Block: RB *Phytophthora cinnamomi* Occurrence Map ID: 03/2000

Prepared by : B. Logger & J Walker *Basil Logger Johny Walker* **12/01/00**

(PRINT NAME) **(SIGNED)** **(DATE)**

OBJECTIVE : To manage access and hygiene to ensure human activities are an inconsequential vector for establishment of new centres of infestation in *Phytopthora cinnamomi* free ‘‘protectable’’ areas.

‘PROTECTABLE’ AREAS AND THEIR BOUNDARIES :

The occurrence of *Phytophthora cinnamomi* and the “‘protectable’” areas are recorded on FMB Map No. **3/2000** approved by CALM’s Senior Interpreter

ALEX MOYLETT	*Alex Moylett*	**14/3/00**
(PRINT NAME)	(SIGNED)	(DATE)

Disease boundary checks are due on: **7/00** Re-mapping of disease occurrence due on: **7/2/03**

APPROVAL OF ‘PROTECTABLE’ AREAS :

The “‘protectable’” areas and their boundaries are approved.

District Manager : **K Teideman**	*K P Teideman*	**15/4/00**
(PRINT NAME)	(SIGNED)	(DATE)

ACCESS CONTROL AND HYGIENE MEASURES:

c) List the access control and hygiene measures required to minimise human vectoring of *Phytophthora cinnamomi* into the ''protectable'' areas, &

d) Prepare and attach a *Phytophthora cinnamomi* Hygiene Management Map that records the details specified in this plan

HYGIENE MEASURES (What will be done)	MAP LOCATION (Use legend in management guidelines)	WHEN (Target date)	WHO (Name of the accountable person for EACH TASK)	COMPLETED (Date and Initials)
1. Hygiene (see Table 2 –- Hygiene Guidelines)				
1.1''protectable'' areas where "clean on entry" rule is to apply.	P1, P2, P3	15/4/00	Forester Logger	*15/4 BRL*
1.2''protectable'' areas where clean on entry & "no soil movement snigging" is required.	U1	15/4/00	Forester Logger	*15/4 BRL*
1.3 Split-phase activities required - front barrier - rear barrier	N/A			
1.4 Areas adjacent to ''protectable'' use uninfested materials	N/A			

HYGIENE MEASURES (Cont.) (What will be done)	LOCATION (Use legend in management guidelines)	WHEN (Target date)	WHO (Name of the accountable person for each task)	COMPLETED (Date and Initials)
2. Roads				
2.1Roads to be closed permanently before other activities commence.	**R1, R2, R3, R4**	**30/0/00**	**John Dozer**	***20/0 JD***
2.2Roads to be closed as part of the activity.	**N/A**			
2.3Roads to be closed immediately after other activities are completed.	**R5**	**3/4/00**	**Forester Works**	
2.4 New roads/walktrails - Split phase method of road construction to be used - clean on entry - uninfested raw materials to be used	**R6** **BB1 – BB2** **W1 – W2** **W3 – W4**	**30/4/00** ✓ ✓ ✓	**Forester Logger** ✓ **Ranger Walker** ✓	
2.3 Culvert, bridge or cause-way needed to assist being clean on entry	**BC1** **BC2**	**30/4/00** ✓	**Forester Logger** ✓	

HYGIENE MEASURES (Cont.) (What will be done)	MAP LOCATION (Use legend in management guidelines)	WHEN (Target date)	WHO (Name of the accountable person for each task)	COMPLETED (Date and Initials)
HYGIENE MEASURES (Cont.) (What will be done)	**MAP LOCATION (Use legend in management guidelines)**	**WHEN (Target date)**	**WHO (Name of the accountable person for each task)**	**COMPLETED (Date and Initials)**
3. Entry Points				
3.1 Gates required	EP1 EP2	30/4/00 ✓	Forester Works Ranger Walker	
3.2 Daily gate closure	EP1	30/4/00	Forester Logger	
3.3 Signs required	EP1 EP2	30/4/00 ✓	Forester Logger Ranger Walker	
3.4 Turn around point for trucks required	EP1	30/4/00	John Dozer	
3.5 Cleandown point to be constructed	EP2	30/4/00	Ranger Walker	
5. Apply phosphite	DRF1	30/4/00	Forester Works	
5. Briefings required	N/A	30/4/99	Forester Logger Forester Works Ranger Walker	
6. Other – specify				

PHYTOPHTHORA CINNAMOMI HYGIENE PLAN RECOMMENDED FOR APPROVAL :

Attachments: Tick (✓) the items that have been completed and attached

Phytophthora cinnamomi Hygiene Management Map	☐✓
Sign Management Checklist	☐✓
Specifications for road closures	☐✓
Record of entry into a 'protectable area	☐

District *Phytophthora* Management Coordinator :

Ben Hart	Benjamin R Hart	17/3/00
(PRINT NAME)	(SIGNED)	(DATE)

APPROVAL :

I certify that this *Phytophthora cinnamomi* Hygiene Plan adequately protects the nominated areas and that the hygiene measures can be uniformly applied for all activities within the ''protectable'' areas.

This plan is approved for implementation.

District Manager: K Teideman	K P Teideman	12/3/99
(PRINT NAME)	(SIGNED)	(DATE)

Distribution : Copy of approved *Phytophthora cinnamomi* Hygiene Plan to Proponent (s), FMB data base, file

SIGN MANAGEMENT CHECKLIST

Signage Requirements for : RIVER BLOCK

1.	Sign Type/Name of Sign	Number Required
S1	Clean on Entry	**3**
S2	Clean on Entry. Do not pick up and move soil.	
S3	Control and Eradication of Forest Diseases	
S4	Gate warning sign	**1**
S5	Road Closed	
S6	Cleandown Point	
S7	Other - Specify	
	Boot clean down point	**1**
	***Phytophthora cinnamomi* information panels**	**2**

2. Sign Ordering

To be ordered by **Forester Logger** by **15/4/00**

(Print name) (Date)

3. Field Details (Sketch details of sign field placements; add pages as required)

[TO BE ADDED]

4. Sign Placement and Removal Checklist

SIGN ID	ERECTED BY	DATE	REMOVAL Yes/No & When	REMOVED BY	Date
S1	Forester Logger	25/4/00	Yes – 30/5/01		
S4	"	"	"		
S7	Ranger Walker	"	No		

Phytophthora cinnamomi Hygiene Management Map

[Completed example - To be added]

12.3 *PHYTOPHTHORA CINNAMOMI* HYGIENE MANAGEMENT MAP – LEGEND

[See below]

CALM DISTRICT
FOREST
BLOCK

Compartment 182

PHYTOPHTHORA CINNAMOMI OCCURRENCE MAP

MAP LEGEND

UNINFESTED (PROTECTABLE)
Determined by a qualified interpreter to be free of plant disease symptoms which indicate the presence of *P. cinnamomi*

UNINTERPRETABLE
Where susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

INFESTED
Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of *P. cinnamomi*

BOUNDARY OF INTERPRETATION

*NB - Boundaries determined from field interpretation by qualified Interpreters and transferred from large scale Diapositives or Base plots.

Map Limitations - The smallest areas of interpretation that can be portrayed on this map are 1 millimetre in diameter, representing 12.5 metres diameter on the ground. Areas less than this are symbolised to this size.

Interpreted & Compiled By - J. Miller, I. Mason, H. Withnell, C. Mahoney, J. Webb & C. Hooper.
Completed - 6 September 1999.
Digitised By - Jodie Millen on 14 October 1999

INTERPRETED USING LINEAR SURVEY.
INTERPRETED USING 230 mm PHOTOGRAPHY FLOWN - DD/MM/YY.
INTERPRETED USING STRIP LINE SURVEY.
INTERPRETED USING PROBABILITY SURVEY.
BOUNDARIES CAPTURED USING GPS.
BOUNDARIES POSITIONED RELATIVE TO MAP FEATURES.

This File - mch0199.dxb
Related Files - mch0199a.doc
Print File - mch0199a.ps

AREA STATEMENT

Categories	Area ha	Notes
UNINFESTED	[illegible]	
UNINTERPRETABLE	[illegible]	
INFESTED	[illegible]	
UNPROTECTABLE	[illegible]	(28.0) Overlaps other Categories
TOTAL AREA	[illegible]	

AGE LIMITS FOR THIS MAP

Map Boundaries should be checked before Operations proceed if this map is older than 1 year (September 2000)

This map should not be used if it is older than 3 years (September 2002)

Areas that have had an Operation in them become unreliable and should be checked prior to Further / New activities.

CALM
CONSERVATION and LAND MANAGEMENT

CALM DISTRICT
FOREST
BLOCK

Compartment 182

PHYTOPHTHORA CINNAMOMI HYGIENE MANAGEMENT MAP

MAP LEGEND

UNINFESTED (PROTECTABLE)
Determined by a qualified interpreter to be free of plant disease symptoms which indicate the presence of *P. cinnamomi*

UNINTERPRETABLE
Where susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

INFESTED
Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of *P. cinnamomi*

UNPROTECTABLE
Where current *P. cinnamomi* symptoms may spread into these areas autonomously

BOUNDARY OF INTERPRETATION
ROAD CLOSURE
CLEAN ON ENTRY
AREA BOUNDARY
CONSTRUCTION POINT
PROPOSED ROADS
WASHDOWNS

*NB - Boundaries determined from field interpretation by qualified Interpreters and transferred from large scale Diapositives or Base plots.

Map Limitations - The smallest areas of interpretation that can be portrayed on this map are 1 millimetre in diameter, representing 12.5 metres diameter on the ground. Areas less than this are symbolised to this size.

Interpreted & Compiled By - J. Miller, I. Mason, H. Withnell, C. Mahoney, J. Webb & C. Hooper.
Completed - 6 September 1999.
Digitised By - Jodie Millen on 14 October 1999

INTERPRETED USING LINEAR SURVEY.
INTERPRETED USING 230 mm PHOTOGRAPHY FLOWN - DD/MM/YY.
INTERPRETED USING STRIP LINE SURVEY.
INTERPRETED USING PROBABILITY SURVEY.
BOUNDARIES CAPTURED USING GPS.
BOUNDARIES POSITIONED RELATIVE TO MAP FEATURES.

This File - mch0199.dxb
Related Files - mch0199a.doc
Print File - mch0199a.ps

AREA STATEMENT

Categories	Area ha	Notes
UNINFESTED	[illegible]	
UNINTERPRETABLE	[illegible]	
INFESTED	[illegible]	
UNPROTECTABLE	[illegible]	(28.0) Overlaps other Categories
TOTAL AREA	[illegible]	

AGE LIMITS FOR THIS MAP

Map Boundaries should be checked before Operations proceed if this map is older than 1 year (September 2000)

This map should not be used if it is older than 3 years (September 2002)

Areas that have had an Operation in them become unreliable and should be checked prior to Further / New activities.

CALM
CONSERVATION and LAND MANAGEMENT

CALM DISTRICT
FOREST
BLOCK

Compartment 182

PHYTOPHTHORA CINNAMOMI PROBABILITY SURVEY

UPLANDS HAVE NOT BEEN MAPPED BUT ARE PROBABLY P.C. FREE

MAP LEGEND

UNINFESTED PROBABILITY
Appropriate hygiene strategies should be considered, as *P. cinnamomi* free status has not been established by intensive survey. Contact FMB if mapping is required. (Creek lines and swamps roads or tracks are surveyed for infestations. Uplands unassociated with swamps are considered unlikely to exhibit symptoms.)

UNINTERPRETABLE
Where susceptible plants are absent or too few to enable the interpretation of *P. cinnamomi* presence or absence.

INFESTED
Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of *P. cinnamomi*

BOUNDARY OF INTERPRETATION

*NB - Boundaries determined from field interpretation by qualified Interpreters and transferred from large scale Diapositives or Base plots.

Map Limitations - The smallest areas of interpretation that can be portrayed on this map are 1 millimetre in diameter, representing 12.5 metres diameter on the ground. Areas less than this are symbolised to this size.

Recheck Interpreted By - J. Miller, I. Mason, H. Withnell, C. Mahoney, J. Webb & C. Hooper.
Recheck Completed - 6 September 1999.
Recheck Digitised By - Jodie Millen on 14 October 1999

INTERPRETED USING LINEAR SURVEY.
INTERPRETED USING 230 mm PHOTOGRAPHY FLOWN - DD/MM/YY.
INTERPRETED USING STRIP LINE SURVEY.
INTERPRETED USING PROBABILITY SURVEY.
BOUNDARIES CAPTURED USING GPS.
BOUNDARIES POSITIONED RELATIVE TO MAP FEATURES.

Recheck File - mch0199.dxb
Recheck Related Files - mch0199a.doc
Recheck Print File - mch0199a.ps

AREA STATEMENT

Categories	Area ha	Notes
UNINFESTED	[illegible]	
UNINTERPRETABLE	[illegible]	
INFESTED	[illegible]	
UNPROTECTABLE	[illegible]	(28.0) Overlaps other Categories
TOTAL AREA	[illegible]	

AGE LIMITS FOR THIS MAP

Map Boundaries should be checked before Operations proceed if this map is older than 1 year (September 2000)

This map should not be used if it is older than 3 years (September 2002)

Areas that have had an Operation in them become unreliable and should be checked prior to Further / New activities.

CALM
CONSERVATION and LAND MANAGEMENT

12.4 *PHYTOPHTHORA CINNAMOMI* HYGIENE PLAN – REVIEW CHECKLIST

See below.

PHYTOPHTHORA CINNAMOMI HYGIENE PLAN REVIEW

1. DETAILS

District : ..... **Plan ID's .....**

Review conducted by : ..... **.....** **.....**

(PRINT NAME) **(SIGNATURE)** **(DATE)**

2. OFFICE IMPLEMENTATION

Tick (✓) the appropriate box when inspection completed

		COMPLIES	ACTION REQUIRED	NOT APPLICABLE
2.1	Correct version of *Phytophthora cinnamomi* Hygiene Plan form used			
2.2	Map attached to plan			
2.3	All sections signed before access occurred			
2.4	DRA authority issued			
2.5	Original of *Phytophthora cinnamomi* Hygiene Plan available at DHQ			
2.6	Copies held all activity managers, FMB			
2.7	Amendments recorded & communicated effectively			
2.8	Analysis of 'protectable' areas & their boundaries correct			
2.9	Table 2 Hygiene Guidelines for 'protectable' Areas correctly applied			
2.10	Reason for retaining and/or building roads correct			
2.11	New roads in/into 'protectable' areas minimised			
2.12	Effective road closure specified – standards, timing, responsibility			
2.13	Minimum number of entry points specified			
2.14	Entry points correctly sited on map			
2.15	Entry point details correct - gates, signs, turn-around, cleandown point			
2.16	Accountability for gate closure assigned			
2.17	Culvert, bridge, causeways correctly specified			
2.18	Correct work sequence specified			
2.19	Briefings adequately specified & accountability assigned			
2.20	All hygiene tasks completed on time & initialed as completed			
2.21	Local review adequately specified & completed, results applied			
2.22				
2.23				

3. FIELD IMPLEMENTATION

	Tick (✓) the appropriate box when inspection completed	COMPLIES	ACTION REQUIRED	NOT APPLICABLE
3.1	Entry point correctly sited for effluent control			
3.2	Vehicles not re-infested before entering 'protectable' areas			
3.3	Gates installed correctly, on time and are being closed			
3.4	Signs installed on time			
3.5	Turn around point installed and being correctly used			
3.6	Cleandown point installed on time & to standard			
3.7	Cleandown or inspection occur to standard			
3.8	Effective road & snig track closures completed on time			
3.9	Briefings completed on time, copy of plan provided			
3.10	Split-phase appropriate, barriers effective and correctly located			
3.11	Demarcation tapes/blazes effective and correct colour			
3.12	Hygiene guidelines for 'protectable' areas (Section 7.6) correctly applied			

4. ACTIONS

ITEM	DESCRIBE ACTION TO BE TAKEN	ACTION BY (NAME)	DATE ACTION REQUIRED	INITIALS & DATE COMPLETED

5. CLOSE OUT

5.1 District Manager provided with a copy of the review (circle) YES NO

5.2 District Manager's acknowledgement ....

(PRINT NAME) (SIGNATUE) (DATE)

5.3 Contractor/Operator/Coup OIC provided with copy of completed checklist (circle) YES NO

ORIGINAL – DISTRICT MANAGER DUPLICATE – ACTIVITY MANAGERS TRIPLICATE – DIRECTOR REGIONAL SERVICES

12.5 STANDARD SIGN WORDING

Sign Type - S1: Clean on Entry

NO UNAUTHORISED ENTRY

All vehicles and machines must be free of soil before passing beyond this point

Enquiries to District Manager, CALM #######

CALM LOGO

Sign Type – S2: Clean on Entry. Do not pick up and move soil

NO UNAUTHORISED ENTRY

All vehicles and machines must be free of soil before passing beyond this point.
Access beyond this point is restricted to times when vehicles will not pick up soil.

Enquiries to District Manager, CALM #######

CALM LOGO

Sign Type – S3: Control and Eradication of Forest Diseases

Control and Eradication of Forest Diseases

NO ENTRY
WITOUT WRITTEN AUTHORISATION

Forest Management Regulations

Enquiries to District Manager, CALM #######

CALM LOGO

Sign Type – S5: Road Closed

ROAD CLOSED

Enquiries to District Manager, CALM #######

CALM LOGO

Sign Type – S6: Cleandown point

CLEANDOWN POINT

Enquiries to District Manager, CALM #######

CALM LOGO

S7: Other Signs

See CALM sign Manual to add other safety and/or management messages as required.

12.6 SIGN MANAGEMENT CHECKLIST

SIGN MANAGEMENT CHECKLIST

REQUIREMENTS FOR ..... BLOCK

1. Sign Type/Name of Sign	**Number Required**
S1 Clean on Entry	
S2 Clean on Entry. Do not pick up and move soil.	
S3 Control and Eradication of Forest Diseases	
S4 Gate warning sign	
S5 Road Closed	
S6 Cleandown Point	
S7 Other - Specify	

2. SIGN ORDERING

To be ordered by **.....** by **.....**

(Print name) (Date)

3. FIELD DETAILS (Sketch details of sign field placements; add pages as required)

4. SIGN PLACEMENT AND REMOVAL CHECKLIST

SIGN ID	ERECTED BY	DATE	REMOVAL Yes/No & When	REMOVED BY	Date

12.7 RECORD OF ENTRY INTO A 'PROTECTABLE' AREA

RECORD OF ENTRY INTO A 'PROTECTABLE' AREA

I agree to implement the *Phytophthora cinnamomi* hygiene measures applicable to the activities I manage within the 'protectable' areas described in this plan.

1.Activity ……..

Print name …….. Signed …… Date : ……..

2.Activity ……

Print name ……..…Signed…… Date : ……...

3. Activity ……..

Print name ……..…Signed…….…… Date : ……

4. Activity ……..

Print name ……..…Signed…… Date : ……

5. Activity ……..

Print name ……..…Signed…… Date : ……

6. Activity ……..

Print name ……..…Signed…… Date : ……

7. Activity ……..

Print name ……..…Signed…… Date : ……

12.8 BACKGROUND TO THE REVISION OF CALM POLICY STATEMENT No. 3 "MANAGEMENT OF *PHYTOPHTHORA* AND DISEASE CAUSED BY IT"

F.D. Podger & K.R. Vear - July 1998

HISTORICAL BACKGROUND

Since 1921 it has been evident that an increasing number of patches of formerly healthy jarrah forest has become afflicted with a lethal disease now known as "jarrah dieback" ('JDB').

Until 1964, the cause of this malady had been the subject of contending speculation. In that year proof of the role of the plant pathogen *Phytophthora cinnamomi* as the cause of 'JDB' was established. At the same time, it was recognised that this exotic microbe was also intimately associated with similar damage in other plant communities of sclerophyllous natives, whether jarrah was dominant, a minor component only, or not present at all. The period of intensive research which followed is ongoing and has resulted in revised perceptions of the nature of the pathogen and of the diseases which result from its interactions with the enormously diverse native vegetation of southwester Australia.

Phytophthora cinnamomi is a soil-borne micro-organism of foreign origins. It almost certainly entered Western Australia for the first time on soil around the roots of cultivated plants, shortly after European settlement in 1827. Until the effective implementation by Australia of quarantine of import of exotic soil and plant products there must have been innumerable introductions at many points of entry around the continent and its redistribution within the country over a period of some 150 years.

Phytophthora cinnamomi has now extended its largely unfettered colonisation of the southwest by both human movement of infested soils and autonomous spread, the latter largely by growth of the pathogen in the root systems of highly susceptible native plants. This epidemic of colonisation, which has produced a complex mosaic of infested and uninfested areas, is now well on its way toward the middle stages of its

ultimate potential to occupy all of those sites which are environmentally suited to its establishment, survival and multiplication. Such

sites are very widely distributed over some 20% or more of the natural vegetation in areas throughout that part of the Southwest Land Division which receives mean annual rainfall in excess of 800mm and occur sporadically at lower rainfall.

Within the 600-800mm rainfall zone the occurrence of *Phytophthora cinnamomi* is also widespread but much less extensive. In this zone severe damage to native vegetation is largely confined to water-gaining sites or to years of abnormally high summer rains. In these circumstances localised patches of the vegetation may periodically suffer severe damage with intervals of recovery during dryer periods.

In areas receiving <600mm dieback due to *Phytophthora cinnamomi* is restricted to circumstances where localised hydrological effects, such as the shed from granite bosses or rising ground water tables associated with upslope land clearance in the catchment, cause effective rainfall to substantially exceed the regional patterns.

There is no record of *Phytophthora cinnamomi* in regions receiving <400mm.

NATURE OF THE EFFECT OF THE PATHOGEN ON CONSERVATION AND COMMERCIAL VALUES

The effect of *Phytophthora cinnamomi* upon the health of plant communities, and upon the species in them, varies greatly. In many places, lethal root-disease destroys the structure of many native communities, reduces their floristic diversity, decimates their primary productivity and destroys habitat for much dependant native fauna, particularly its value as protection against feral predators. In some places the pathogen causes little damage at all. Unfortunately the extent of susceptible communities in

vulnerable environments is much greater than that of communities which occur in environments which are inherently unfavourable to the pathogen.

No simple or single relationships exist between the presence of *Phytophthora cinnamomi* and the development of disease because of :-

a) the considerable variability which exists within and between native plant species in their responses to the presence of *Phytophthora cinnamomi*,
b) the differential influence of temporal and spatial variation in environmental forces,

However, within the spectrum of variable disease, response of numerous hosts to particular environmental circumstance, at least four specific nodes can be recognised. These are due to either distinct processes or to different stages in the development of disease which occur upon and after the arrival of the pathogen and its persistence in previously uninfested areas. Each of these circumstances presents a different problem which require separate sets of management response. It is now evident that among the variety of plant communities which occur within that part of the South West Land Division which receives more than 800mm mean annual rainfall the four sets of distinctive consequences are:-

1. No apparent disease at all: this applies *inter alia* to those areas of karri and wandoo forest which contain no floristic elements of the dry sclerophyll (jarrah) forest type and to plant communities on the Spearwood Dune System of the Swan Coastal Plain and pedogenically related landscapes.

2. An extremely destructive epidemic of root rot: this applies within the highly susceptible understorey elements of the dry sclerophyll forest, in *Banksia* woodland and in heathland on podsols, podsolic and lateritic landform. It is characterised by :-

a) devastation soon after the first arrival of the wave front of infestation,
b) steady extension of epidemic disease soon after arrival of the pathogen,

c) complete or near complete elimination of important structural elements of the plant community.
d) a relative insensitivity of the degree of damage to variation in soil characteristics.

3. A much more variable epidemic occurs within the dominant jarrah tree component of the jarrah forest. - this is characterised by :

a) a much more erratic and often protracted onset of mortality ranging from early localised onset of mass collapse (similar to type above) through delayed and patchy mortality to no apparent effect at all on health of the jarrah overstorey.
b) high sensitivity to subtle differences in soils characteristics particularly those effecting drainage.

All variants in the response of jarrah are coincident with, or preceded by, mass deaths in susceptible elements of the understorey. In jarrah, their behaviour varies from that characteristic of epidemics of disease due to invasion by an exotic organism to which the vegetation has not been previously exposed to that typical of long established endemic disease.

3. Where *Phytophthora cinnamomi* has been long established (some 50 years or more) in sites formerly dominated by jarrah/banksia forest and has been very heavily impacted *Phytophthora cinnamomi* behaves in a manner characteristic of endemic pathogen. The forest is often replaced by an open woodland of marri/parrot bush. Periodic outbreaks of mortality in parrot bush (*Dryandra sessilis)* follow, with subsequent regeneration by seed. At this late stage, *Phytophthora cinnamomi* causes more muted disease than at the wave front.

RATIONALE OF THE NEED FOR A REVISION OF POLICY.

Statements of policy , protocols for management, and manuals of practice first developed in the early 1970's have been periodically revised to take account of advances in knowledge and wider managerial experience.

Prior to the present document the most recent statement of policy was encapsulated in CALM Policy Statement No. 3. "*Phytophthora* Dieback" of January 1991.

The objective of that statement read :-

> "To **prevent the introduction, spread or intensification** of the plant diseases caused by *Phytophthora* species **throughout the state**, with particular emphasis on the southwest... (and to monitor for *Phytophthora*)....activity in the remainder of the state, **especially in tropical areas**."

In 1996 an independent review [the WA Dieback Review (Podger *et al*)] was conducted for the government, a process of public input completed, and an appraisal of the recommendations of the review panel completed by CALM.

CALM has now accepted that eradication and prevention of the establishment of new centres of infection is not a realisable objective, even were it both a socially acceptable strategy of denial of human access for any purpose and involved an eradication program of native animals which vector the pathogen. Similarly insurmountable problems of scale and cost would attend efforts to map and treat the thousands of kilometers of invasion front now established within 17 million ha of remnant native vegetation in the Southwest Land Division.

Further, despite intensive research and extensive field tests over three decades, the delivery of ameliorative treatments (which might favourably modify those environmental influences responsible for destructive interaction between plant species which are susceptible to the pathogen) though biologically well founded has so far proved to be impracticable.

Earlier concerns that other species of *Phytophthora* might cause similarly severe and extensive damage are largely unsubstantiated. *P. citricola* and *P. drechsleri* are known to cause very minor damage despite their widespread distribution. Several taxa within each of the species complexes usually assigned to "*P. megasperma"* or *"P. cryptogea"* are generally restricted to seasonally inundated sites. Records of *P. nicotianae* are few and derived almost entirely to native plants in cultivation. Whereas research to clarify the role of *"P .cryptogea"* and *"P. megasperma"* is on-going, the current revision of policies is focussed on *Phytophthora cinnamomi.*

A further question, of now reduced concern, is the extent to which species of *Phytophthora* might threaten native vegetation in tropical latitudes. Nowhere on earth has any species of *Phytophthora* proved to be a serious pathogen of undisturbed native vegetation in the wet-dry tropics (eg. the Kimberley and Northern Territory) or in the arid zone (eg. Hamersley and McDonnell Ranges.). There are no records of *Phytophthora* species from any source other than irrigated crop culture in these climatic regions within W.A. and none at all of *P. cinnamomi*. This assessment does not however preclude effort to diagnose the cause of any unusual disease in naturally occurring native plant ecosystems that might occur in the future in these regions.

As a result of these processes it is now accepted that Policy No 3 of 1991 is founded on outdated concepts and is both unaffordable and unattainable and should be revised.

CHOICE AMONG POLICY ALTERNATIVES

Three alternative strategies, other than to retain the existing and extremely optimistic policy No 3 of June 1991, are available.

a. The first alternative

"Acceptance of the inevitability of defeat and liquidation of material assets"

is argued by very few and is extremely unlikely to be socially acceptable.

b. A second alternative

"Prohibition of all human access"

is expected to be attractive to a very small minority. Apart from its impracticality it has serious adverse socio-economic consequences.

c. The third alternative

"Adoption of attainable objectives within a framework of socially affordable cost"

will of necessity prove less optimistic than the present policy and will require improved methods of priority setting and greater operational efficiencies including the removal of unnecessary constraints on access and a simplification of operational guidelines.

ESSENTIAL ELEMENTS OF A NEW POLICY.

1. Focus effort principally on *Phytophthora cinnamomi* ?

Whereas it is now recognised that at least eight distinct species of P*hytophthora (P. boehmeriae, Phytophthora cinnamomi, P. citricola, P. cryptogea, P. drechsleri, P. gonapodyides, P. megasperma & P. sojae)* occur at various places in native plant communities of Western Australia (and that the potential importance of several of them still require some further elucidation). *Phytophthora cinnamomi* represents by far the greatest ongoing threat to conservation and other benefits to society which native plant communities provide. This policy should concentrate therefore on *Phytophthora cinnamomi*.

2. A uniform policy across the State ?

The policy should apply uniformly across the South West Land Division only. There is no problem to address in the Eremaea or the wet/dry tropics. Furthermore the distinction in Policy No 3 between lands north and south of the Preston River should be abandoned together with guidelines based upon it. The scientific basis for that distinction has never been apparent and there is little evidence that it has been beneficial.

CLARITY OF CONCEPTS AND TERMINOLOGY

1. The existing confusion in the use of terms and their conceptual basis needs urgent address. This includes tautological and counter-intuitive usage and extends to an entrenched lexicon which inhibits rather than promotes understanding of underlying principles and processes.

2. Use of the term '7 way test' implies some form of mathematical calculation and encourages a false sense of prescriptive rigour. It is in fact no more than a checklist based on flawed concepts and terminology. It would be

better to refer to a set of guidelines for consideration of factors that should normally be taken into account in planning operations.

3. Much of the classification for hygiene purposes is now seen to be superfluous. A particular example is the confusion of risk and hazard. The former is a vital consideration for planning hygienic access. The latter refers only to a forecast of the probable level of damage should *Phytophthora cinnamomi* establish in an area not yet colonised by it. Hazard is determined by both site factors and host susceptibility. Even in the same place it differs depending upon the plant species under consideration. Hazard for jarrah for example may vary greatly over an area which is of uniformly high hazard for species of *Banksia*. Furthermore it has been clearly demonstrated that it is unreasonable to expect that even trained

and experienced interpreters should be able to diagnose hazard with any degree of reliability at all. Its use should be abandoned.

4. The matter of reform of terminology will not be simple due to more than 20 years of indoctrination and recital. An organised program of retraining is required.

12.9 LIST OF OTHER RELEVANT MANUALS

- Timber Harvesting in Western Australia
- W.A Dieback Review Panel Report

12.10 WRITTEN AUTHORISATION TO TAKE A POTENTIAL CARRIER INTO A RISK AREA OR DISEASE RISK AREA

See below

Authorisation to Take a Potential Carrier into a Risk Area or Disease Risk Area

In accordance with regulation 106 of the *Forest Management Regulations 1993*, the potential carriers (vehicles) and drivers listed below may enter a proclaimed risk area or disease risk area subject to the conditions contained in this document.

Authority Number: **Issued at:**

Period during which the authority to enter may be used:

Start Date **Expiry Date**

Authority to Enter Holders

Name:……..

Address:……

Suburb:…….Postcode…….

Phone

Number……..

Reason for Reason for Entry :

……..

……

Potential Carriers Authorised to be used:

Registration Number	Make	Colour

Authorised Access Route(s) (Map must be attached):

No No soil Movement :

…….

……

……

Soil Movement :

……

……

……..

Hygiene Requirements:

- Are access conditions, requirements and other activities in accordance with the approved *Phytophthora* Hygiene Plan Yes No

For No Soil Movement:

- All vehicles, plant and equipment must be free of soil and root material prior to entering and whilst in the restricted access areas.
- No soil or root material may be moved at any time.
- After a rain event, the authority holder must obtain specific endorsement from an authorised person in the district from which the authority to enter was issued prior to entering the forest.

Rainfall Endorsement

Date:……..

Officer:…….

For Soil Movement Conditions:

- All access and other activities must be in accordance with the approved hygiene plan access routes.
- Soil movement may not occur in any areas not specifically approved as soil movement.

General Requirements:

- The authority holder must be able to interpret a CALM map and be able to navigate the designated route(s)
- The authority holder is only authorised to travel the roads and tracks as specifically authorised in the authority to enter.
- Vehicles and plant may only enter or remain in the restricted access areas with a valid authority to enter.
- All conditions and information contained in hygiene approvals, sign posts and gates must be adhered to.
- All operations must be undertaken in accordance with the Conservation and Land Management Act 1984, Forest Management Regulations 1993, Wildlife Conservation Act and Regulations and Bush Fires Act.

Authority to Enter Approved:

Officers Name:…….

Officer's Signature:…….

Date……..

I have read and understood the above authority to enter and I agree to observe the conditions of this authority to enter and regulations made under the Conservation and Land Management Act 1984.

…….. **.....**

Signature of Authority Holder **Date**