



**Broad scale survey of *Phytophthora*  
Dieback Distribution across the Mt  
Hallowell Reserve, Denmark and  
Reserve Hygiene Management Plan**

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Written and Submitted By

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## EXECUTIVE SUMMARY

In 2008, Green Skills was commissioned by South Coast NRM to conduct an assessment into the presence of the pathogen *Phytophthora* dieback within ten peri-urban reserves in the Shire of Denmark including the Mt Hallowell Reserve. Assessments were designed to identify healthy and infested reserves and to prioritise and develop recommendations for at least three reserves requiring pathogen management.

As a follow-up to the 2008 interpretation program, the Shire of Denmark engaged Great Southern Bio Logic to undertake a re-assessment of the Mount Hallowell Reserve (R46618) in April 2014. The objective of the project was to verify the original disease distribution information through the collection of soil and tissue samples, and also to survey the reserve for new areas of disease introduction and spread. This survey report presents the results of the Mount Hallowell survey and provides operational hygiene recommendations specific to Mount Hallowell. It is intended to be used as an addendum to the 2008 Green Skills report which covers all Shire reserves.

Mount Hallowell is the largest reserve vested under the Shire of Denmark. It is approximately 532 ha in area and situated approximately 5 km south west from the town of Denmark. There are several access points to the Reserve including via Harrington Break, Heather Road, the Sheila Hill Memorial Trail off Ocean Beach Road, Iluka Avenue and the Monkey Rock car park off Lights Road.

In accordance with the agreed project scope of works, field surveys were undertaken using a methodology referred to as broad scale survey. The broad scale interpretation method is defined in the Department of Parks and Wildlife (DPaW) operational draft guideline, *Manual for Detecting and Mapping Phytophthora dieback disease (Draft)* (Nov 2013). Broad scale survey focuses on disease distribution associated with areas of potential disease vectoring, including roads, tracks, drainage lines, gravel pits and other areas where soil moving activities and human traffic provide a potential for the introduction of the disease. Disease distribution information from surveyed areas is then extrapolated using the natural topography to provide a picture of the likely disease distribution across a larger area and to identify areas that can be protected from disease introduction and spread.

The current survey has identified several areas of disease spread and introduction. As a result the current disease distribution now extends from the creek to the west of Iluka Avenue on the southern boundary, heading east and north to include the vegetation adjacent to the Heather Road development, west along the Bibbulmun Track, north to the northern management access track and then west to the western boundary.

The disease boundary has not been operationally mapped in areas away from access points such as management access tracks and the Bibbulmun Track. It is, therefore, possible that the infested area as depicted on Figure 1 may contain some small areas of vegetation yet to show visible signs of infestation. Likewise, the full extent of the areas depicted as uninterpretable may also contain some infested soils that do not express due to the lack of susceptible species in the vegetation. This is particularly likely for the small pocket of *Kunzea* heath to the north of Bimbimbi Way.

In addition to the disease management recommendations presented by Green Skills in 2008, Great Southern Bio Logic have made recommendations to address the disease spread since 2008, operational activities in uninterpretable areas and community awareness.

# 1 INTRODUCTION

## 1.1 Background

In 2008, Green Skills was commissioned by South Coast NRM to conduct an assessment into the presence of the pathogen *Phytophthora* dieback within ten peri-urban reserves in the Shire of Denmark including the Mt Hallowell Reserve. Assessments were designed to identify healthy and infested reserves and to prioritise and develop recommendations for at least three requiring pathogen management.

The resulting report, *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark* (Green Skills, 2008), incorporates basic *Phytophthora* dieback information, the results of on-ground surveys and disease management recommendations which serve as a generic disease management plan with specific priority outcomes relating to Mount Hallowell (R46618), Peace Street Reserve (R46688), Wilson Inlet Heritage Trail, Foreshore Reserve (unallocated Crown land below R43923) and Redgum Lane Reserve (R41224).

The 2008 field assessment methodology relied on visual interpretation for the presence of *Phytophthora* dieback, involving observations of the general health and occurrence (or unusual absence) of known indicator species and the suspected infestations were subsequently mapped. The report then made key recommendations for management common to all reserves as well as more specific recommendations for each. No soil and tissue samples were collected to verify the disease hygiene categorisations.

As a follow-up to the 2008 interpretation program, the Shire of Denmark engaged Great Southern Bio Logic to undertake a re-assessment of the Mount Hallowell Reserve (R46618) in April 2014. The objective of the project was to verify the original disease distribution information through the collection of soil and tissue samples, and also to survey the reserve for new areas of disease introduction and spread. This survey report presents the results of the Mount Hallowell survey and provides operational hygiene recommendations specific to Mount Hallowell. It is intended to be used as an addendum to the 2008 Green Skills report which covers all Shire reserves.

## 1.2 Objectives

The objectives of the 2014 assessment were to survey the Mt Hallowell Reserve for the presence of *Phytophthora* dieback to:

- Validate the existing disease distribution information through a soil and tissue sampling program.
- Identify and map the extent of new infestations and disease spread from existing infestations, using a broad scale survey methodology.
- Review existing hygiene management within the reserve and provide recommendations to update the current hygiene management procedures.

## 1.3 Scope of Works

In order to achieve the objectives defined above the following scope of works was undertaken:

- A detailed desktop assessment of the Mount Hallowell Reserve involving an analysis of known infestations, topography, geology, land use and access.

- Completion of a field based, broad scale disease distribution survey across the reserve. The broad scale survey involved:
  - A linear survey of all internal tracks, walk trails and other potential vectoring infrastructure; and
  - Extrapolation of linear survey results to remaining areas to estimate the extent of uninfested areas.
- Mapping of disease fronts using a hand held GPS unit and demarcation of disease boundaries only where they intersected surveyed roads, tracks, access points and other site specific management areas.
- A soil and tissue sampling program to verify field interpretation decisions.
- Application of protectable area criteria to the surveyed areas to identify areas that are considered protectable from future infestation by *Phytophthora* species; and
- Development of this draft report detailing project methodology, results and providing recommendations for hygienic management.

It should be noted that the term *Phytophthora* dieback commonly refers to the pathogen *Phytophthora cinnamomi*. This is because *P. cinnamomi* is most commonly associated with widespread impact on native vegetation communities. The survey scope and methodology may however identify additional species of *Phytophthora* should they be present.

#### 1.4 Site Characteristics

Mount Hallowell is the largest reserve vested under the Shire of Denmark. It is approximately 532 ha in area and situated approximately 5 km south west from the town of Denmark. There are several access points to the Reserve including via Harrington Break, Heather Road, the Sheila Hill Memorial Trail off Ocean Beach Road, Iluka Avenue and the Monkey Rock car park off Lights Road.

The reserve is adjoined on all sides by private property consisting of agricultural land to the north and west, residential developments to the south and east and a quarry on the southern boundary to the west. There is a maintained fire break either on or near the reserve boundary along the northern and western edges.

The Bibbulmun Track runs through the reserve from an entry point in the south west and exits the reserve across the eastern boundary. The section of the Bibbulmun track within the reserve is locally known as the Sheila Hill Memorial Trail. This section extends to the peak of Mount Hallowell and traverses the main ridge line within the reserve. There are also several small and informal walk tracks and routes surrounding the adjoining residential areas.

The Mount Hallowell reserve is characterised by a series of steep granite peaks ranging from approximately 20m AHD to approximately 291m AHD. To the north the reserve runs into a broad, open creek line. The vegetation is broadly defined as a tall forest largely dominated by *Eucalyptus diversicolor* (Karri) which transitions into low open heath to the north. The vegetation within the Mount Hallowell Reserve was surveyed and described by the Denmark Environment Centre in 2004 as a part of the initial reserve survey (Denmark Environment Centre, 2004). The vegetation units defined in that report have been used to assist the development of disease hygiene categories.

## 1.5 Climate

The nearest Bureau of Meteorology (BoM) recording station is listed as Denmark, Western Australia. Data from this station shows an average annual rainfall of 1093.6mm with the wettest month being July (170.9mm) and February is recorded as the driest month (26.8mm). The online temperature data for this site was particularly limited, however, it did indicate that January was the warmest month and May was the coldest.

As *Phytophthora* distribution is closely aligned with climatic conditions these are important statistics. *Phytophthora* requires warm moist conditions and is limited to areas where average annual rainfall exceeds 400mm. From the available BoM data it can be seen that the project area falls within the accepted rainfall zone for *Phytophthora* occurrence.



## 2 METHOD

In accordance with the agreed project scope of works, field surveys were undertaken using a methodology referred to as broad scale survey. The broad scale interpretation method is defined in the Department of Parks and Wildlife (DPaW) operational draft guideline, *Manual for Detecting and Mapping Phytophthora dieback disease (Draft)* (Nov 2013). Broad scale survey focuses on disease distribution associated with areas of potential disease vectoring, including roads, tracks, drainage lines, gravel pits and other areas where soil moving activities and human traffic provide a potential for the introduction of the disease. Disease distribution information from surveyed areas is then extrapolated using the natural topography to provide a picture of the likely disease distribution across a larger area and to identify areas that can be protected from disease introduction and spread. As not all areas are covered by on-ground assessment, there is a possibility that small infestations may be present within large protectable areas.

While the information produced using this method of survey provides operational disease hygiene information for management access tracks and the Bibbulmun Track, the remaining areas have not been surveyed to operational standards and will require detailed survey should soil moving operations be planned in such areas.

### 2.1 Desktop Interpretation

The Mount Hallowell Reserve was subject to an initial desktop assessment involving a review of the Vegetation Health Service (VHS) *Phytophthora* sample database and examination of available aerial imagery to assess:

- The known distribution of *Phytophthora* dieback on or near the subject property;
- The distribution of site specific vectors including but not limited to roads, creek lines, gravel pits and other potentially threatening features; and
- Evidence of existing disease signatures such as areas of obvious vegetation decline.

### 2.2 Field Survey

The broad scale *Phytophthora* dieback survey involved a detailed assessment of all open vehicle tracks, management access tracks and walk trails including the Bibbulmun Track (also known as the Sheila Hill Memorial Walk Trail) by a DPaW certified disease interpreter. Disease distribution and hygiene classification information collected from areas of detailed survey was then extrapolated to unsurveyed areas using the principles of disease movement, natural topography and soil type. This method provides medium confidence disease distribution information and hygiene classification across large areas. As the survey does not cover all areas of the property, there is a potential for small infestations to be present in areas not classified as infested.

Field data was collected using a hand held GPS unit and converted into ArcGIS™ shape files. Collected field data included all sample locations, a point file of all identified individual plant deaths attributed to *Phytophthora* and track files of the area covered during survey.

### 2.3 Sampling Program

Sampling for *Phytophthora* dieback involves the collection of soil and tissue samples from fresh deaths of plants considered to be reliable indicator species. Where suspicious deaths were identified, soil and root tissue material was collected into heavy duty plastic bags,

moistened with sterilised water and forwarded to the Department of Parks and Wildlife VHS laboratory for analysis.

All sampling undertaken was performed in accordance with the methods described in the *Manual for Detecting and Mapping Phytophthora dieback disease (Draft)* (DPaW, Nov 2013).

## **2.4 Disease Distribution Mapping**

Broad scale interpretation as defined and described, together with interpretation of ortho-photography, existing vegetation mapping spatial data, contours and sampling analysis results were used to extrapolate the disease distribution extents and hygiene categories.

The large uninfested area at the height of Mount Hallowell was delineated by means of the 220mAHD contour line to encompass several small uninfested areas identified during the field survey.

The uninterpretable extents were determined with the aid of the vegetation mapping spatial data developed by the Denmark Environment Centre in 2004. A judgment of the interpretability of each vegetation unit was made, based on the vegetation description and component species lists. This judgement was then ground truthed prior to the application of the uninterpretable category, however, the full extent of the uninterpretable areas was not assessed by on ground survey.

### 3 ASSESSMENT CRITERIA

DPaW (2013) guidelines identify six potential disease hygiene categories based on presence/absence of the disease, or the unknown disease status of an area. An area can have an unknown disease status if the vegetation at the site is not susceptible to the disease or it cannot be assessed because of disturbance, eg fire; as a result, even if the pathogen is present, there may be no interpretable signs.

Only areas with suitable remnant native vegetation can be assessed. Areas that have been cleared or significantly altered are excluded from survey. In some cases small excluded areas may be afforded a hygiene category if they are small enough to be influenced by adjacent surveyed vegetation or situated such that topographical influences can be used to determine disease presence or absence.

The six possible disease categories are listed and described below:

**Infested** – Areas a Certified interpreter determines to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi*.

**Uninfested** – Areas determined by a Certified interpreter to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.

**Uninterpretable** – Natural, undisturbed areas where susceptible plants are absent, or are too few, to make a determination of the presence or absence of *P. cinnamomi*.

**Unmappable** – Areas where disease presence or absence cannot be determined due to a level and type of site disturbance that will recover within the short to medium term, eg Fire, rehabilitation.

**Not yet resolved** – *Phytophthora* occurrence diagnosis cannot be made because of inconsistent or incomplete evidence (including sample results). The category is only to be used in low interpretability zones (400mm to 600mm rainfall range).

**Disease Risk Roads (DRR)** – Interpreters will use the DRR category to show the disease status is unknown because of suspected or apparent recent use under unknown hygiene conditions.

Following the determination of disease categories, protectable areas are identified to determine areas that are likely to remain free from the disease with the application of appropriate disease hygiene as required.

Protectable areas are defined in the *Manual for Detecting and Mapping Phytophthora dieback disease (Draft)*, (DPaW, 2013) as areas that:

- Have greater than 600mm of annual rainfall or are water gaining sites in the 400mm - 600mm rainfall zone;
- Are determined to be free from *Phytophthora cinnamomi* by an accredited disease interpreter;
- Are positioned in the landscape and are of sufficient size that they will not be engulfed by *Phytophthora* via autonomous spread. Such an area is defined as being greater than 4ha with a minimum axis of 100m, and not down slope of an infested area;
- Have controllable human vectors; and
- Include high conservation and/or socio economic values.

## 4 RESULTS AND DISCUSSION

### 4.1 Disease Expression

*Phytophthora* dieback expression is defined as the visual representation of the disease within vegetation. Site variables that can influence disease expression include soil type, vegetation structure and composition and period of time since infestation. Expression will also vary from site to site as a result of regional variables such as rainfall and temperature.

The vegetation across the reserve is detailed in the 2004 Denmark Environment Centre survey and report. However, for the purpose of interpretation it can be described as granite communities surrounded by a tall forest of Karri transitioning into a mixed Karri/Jarrah/Marri forest over *Banksia grandis*. The forested areas transition into creek line and wetland vegetation dominated by sedges, *Melaleuca* and *Taxandria* species under open *Banksia* woodland on sandy soils.

Disease expression within the upland granite areas was obvious where indicator species were present in suitable densities to enable interpretation. However, indicator species densities were generally low and restricted to small clusters. Indicators used to determine disease presence included:

- *Andersonia caerulea*;
- *Xanthorrhoea platyphylla*.
- *Leucopogon revolutus*;

Disease expression within the Karri dominated forest was very subtle due to a low density of indicator species, very dense vegetation and fertile soils. Expression was via occasional individual plant deaths, often surrounded by healthy indicator species. Indicator species used to determine disease presence within the Karri forest included:

- *B. grandis*;
- *X. platyphylla*.
- *L. verticillatus*;

Disease expression within the Jarrah dominated forests and *Banksia* woodlands on the lower slopes was very obvious with multiple deaths of multiple indicator species. While some healthy individuals of indicator species persisted in infested areas there was also a pattern of disease spread consistent with an area that has been infested for some time. Indicator species used to determine disease presence in the lower slopes and sandy flats to the north of Mount Hallowell included:

- *B. attenuata*;
- *Persoonia longifolia*;
- *B. grandis*;
- *Petrophile diversifolia*;
- *B. illicifolia*;
- *X. gracilis*;
- *L. verticillatus*;
- *X. platyphylla*.
- *Patersonia umbrosa*;

### 4.2 Disease Distribution

The previous disease interpretation performed in 2008 identified *Phytophthora* dieback in three separate areas (Green Skills 2008):

- A large infestation along the northern boundary to the north of the management access track;

- A small infestation to the west of the Harrington Break residential subdivision, south of the management access track; and
- An infestation to the north of the Heather Road residential properties extending to the Bibbulmun track.

The disease distribution identified during the 2014 broad scale interpretation assessment and associated sampling program is shown on Figure 1. In addition to the previous distribution of *Phytophthora* dieback, disease expression was also confirmed in the creek line to the west of Iluka Avenue on the southern boundary, on a granite peak on the Bibbulmun Track and extending north from the previous infestations west of Harrington Break. As a result, the new disease distribution map shows the infested area as spreading from the creek to the west of Iluka Avenue, heading east and north to include the vegetation adjacent to the Heather Road development, west along the Bibbulmun Track, north to the northern management access track and then west to the western boundary.

The disease boundary has not been operationally mapped in areas excluding access points such as management access tracks and the Bibbulmun Track. It is, therefore, possible that the infested area as depicted on Figure 1 may contain some small areas of vegetation yet to show visible signs of infestation. Likewise, the full extent of the areas depicted as uninterpretable may also contain some infested soils that do not express due to the lack of susceptible species in the vegetation. This is particularly likely for the small pocket of *Kunzea* heath to the north of Bimbimbi Way.

### 4.3 Sample Program

Eleven soil and tissue samples were collected from across the Mount Hallowell Reserve. Sample locations and results are presented in Figure 1 and a summary of sample information is presented in Table 1 below.

It should be noted that Sample 9 is yet to be resolved. The result of this sample was not able to be determined using traditional agar plating techniques and has been sent for DNA analysis. This often occurs when a *Phytophthora* species other than *cinnamomi* is present. It is likely that the result of this sample will not be available for several weeks however as it is located within an area already classified as infested, the final result will not impact the final disease distribution and associated management.

Table 1: Mount Hallowell sample information

Sample Label	Sample Location		Species Sampled	Result
	Eastings	Northings		
Mt Hallowell 1	529173	6127202	<i>X. gracilis</i>	Positive
Mt Hallowell 2	529276	6126805	<i>L. verticillatus</i>	Negative
Mt Hallowell 3	529499	6126720	<i>B. grandis</i>	Positive
Mt Hallowell 4	528490	6127014	<i>X. platyphylla</i>	Positive
Mt Hallowell 5	527816	6127451	<i>B. grandis</i>	Negative
Mt Hallowell 6	529094	6126237	<i>B. grandis</i>	Positive

Sample Label	Sample Location		Species Sampled	Result
	Eastings	Northings		
Mt Hallowell 7	529443	6126645	<i>B. grandis</i>	Positive
Mt Hallowell 8	527826	6126568	<i>L. revolutus</i>	Negative
Mt Hallowell 9	529017	6126984	<i>L. revolutus</i>	Unresolved
Mt Hallowell 10	528431	6126904	<i>X. platyphylla</i>	Positive
Mt Hallowell 11	527986	6126546	<i>X. preissii</i>	Negative

## 5 DISEASE MANAGEMENT RECOMMENDATIONS

A series of management recommendations are presented in the 2008 Green Skills document *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark*. Specific recommendations for each reserve are presented in Section 7 and generic hygiene recommendations for application across the Shire are presented in tabular format in Section 8. A summary of the key recommendations to be applied across all Shire of Denmark reserves is provided in the Executive Summary of the Green Skills report and presented below.

1. *All works within and around priority reserves to strictly adhere to **Town Planning Scheme Policy No. 1 for Dieback Disease Management** (Shire of Denmark, 1997) hygiene controls including but not limited to:*
  - *No soil movement or extraction within priority reserves*
  - *No operations (firebreaks, earthworks, fencing etc) within or around the vicinity of the Phytophthora Dieback free protection areas unless extremely dry soil conditions*
  - *No unauthorized vehicular access to priority reserves (closure of vehicular access where applicable)*
2. *Installation of Project Dieback signage at Phytophthora Dieback free protection areas and at Phytophthora Dieback infested areas*
3. *Installation of Project Dieback signage at entry to priority reserves to inform users of how to reduce risk of Phytophthora Dieback spread*
4. *Treatment of disease frontlines to stabilize disease movement (once points 1 – 3 have been implemented)*
5. *Develop annual monitoring and treatment program in Phytophthora Dieback free protection areas*
6. *Host Phytophthora Dieback awareness forum (compulsory attendance by Shire works staff and open invitation to community members)*
7. *Assess and develop Phytophthora Dieback management recommendations for remaining Shire of Denmark reserves which were not assessed within this study (Green Skills, 2008)*

Great Southern Bio Logic has reviewed the Green Skills recommendations and believes that if applied, the generic hygiene recommendations made by Green Skills (2008) are suitable for effective mitigation of the risk of further non-autonomous vectoring of the disease.

The following recommendations are provided by Great Southern Bio Logic for implementation within the Mount Hallowell Reserve specifically. It is intended that these recommendations will replace any previous disease management recommendations for Mt Hallowell. Note that treatment with Phosphite is not recommended within the reserve due to the size of the infested area and the requirement for treatment of disease boundaries which cannot be accurately determined due to the uninterpretable nature of much of the reserves vegetation:

1. Operational Hygiene
  - a. All operational activities including firebreak maintenance are to be undertaken in dry soil conditions (see Section 5.2). Undertaking operational activities in dry soil will significantly reduce the risk of transporting infested soil from currently infested areas to uninfested areas in the Mt Hallowell Reserve and other Shire reserves.



- b. All vehicles, machinery, equipment and footwear are to be effectively cleaned down (See Section 5.1) prior to accessing protectable areas within the Mt Hallowell Reserve. Effective cleandown locations are shown in Figure 1.
  - c. All earthworks, road verge works and street sweeping conducted in any residential area adjoining the reserve is to be undertaken in accordance with *Town Planning Scheme Policy 1*, hygiene guidelines. These areas are also considered to be infested through the mechanisms of autonomous spread; therefore the movement of soil and vegetable matter from these areas presents a potential risk of disease vectoring. Private residents and contractors undertaking private works should also be urged to comply with this standard.
  - d. If soil moving activities are proposed in areas away from existing access tracks and trails then an operational survey must be undertaken prior to commencing the proposed works. The information in this survey provides operational disease distribution information for existing tracks and trails however this does not extend to all areas of the reserve. This is in accordance with the agreed project scope.
2. Track Rationalisation
- a. There are a large number of interconnected vehicle access tracks within the reserve, originating from the Heather Road and Iluka Avenue residential areas. These tracks are contained within the infested hygiene category and do not present an immediate threat to the protectable areas of the reserve. They do however present a source of infested soil that can be transported to other Shire reserves following moist soil access by 4 wheel drive vehicles. Closure of all non-essential tracks will reduce this risk and should be considered. Closure of tracks crossing moisture gaining sites (eg creeks) and clayey soils should be the highest priority.
3. *Bimbimbi Way Management Access Hygiene*
- a. The management access and fire break to the north of Bimbimbi Way is classified as uninterpretable due to insufficient indicator species to enable detection of the disease. As the eastern end of this access adjoins an infested creekline, it is likely that there is *Phytophthora* along this management access track which cannot be identified and demarcated. It is therefore a requirement that this section of management access be managed as a stand-alone area. Effective cleandown should be undertaken when entering and leaving this management access track and all operational activities in this area should be undertaken in dry soil conditions. If required, cleandown is to be performed on Shire land at the gate where the management access track enters private property as shown on Figure 1.
4. Project Dieback Signage
- a. Existing dieback demarcation signage was only noted on the northern firebreak. This signage is no longer applicable due to the amended disease boundaries and should be removed.
  - b. Project Dieback disease category demarcation signage posts should be installed along walk trails and management access tracks to mark the disease hygiene categories as shown on Figure 1. Signage should be placed where the track or trail enters the reserve and on the category boundaries within the



reserve. The Esri shapefiles provided electronically with this report and field demarcation of disease boundaries can be used to guide the installation.

- c. General disease information signage should be considered at reserve entry points in residential areas. Signage should highlight the issues associated with *Phytophthora* and the management actions required to minimise the spread. Signage may assist with communication of these messages but should not be relied on as a stand-alone communication strategy.

#### 5. *Phyto Fighter 1000* boot cleaning stations

- a. The *Phyto Fighter 1000* boot cleaning station positioned on the previously mapped disease boundary at the eastern end of the Bibbulmun Track is no longer in the correct location. It is recommended that this station be relocated to the disease hygiene boundary identified on Figure 1. This location is demarcated in the field using dayglow orange flagging tape and can be located using the ESRI Shapefiles provided with this report.
- b. The *Phyto Fighter 1000* boot cleaning station positioned at the western end of the Bibbulmun Track is currently situated just before walkers cross a small creek line which is uninterpretable and potentially infested due to its proximity to major disease vectors including a management access track, private property and Lights Road. Due to the uninterpretable nature of the vegetation in this area it is not possible to determine disease presence or locate a disease boundary should one exist. It is therefore recommended that the station be placed on the track to the north of the creek line. To reduce the influence of other potential vectors it is further recommended that the station be positioned north of the private property boundaries as shown on Figure 1.
- c. When relocated the *Phyto Fighter 1000* boot cleaning station positioned at the western end of the Bibbulmun Track will be able to be bypassed by walkers using the management access track which parallels the walk trail in this area. The Shire of Denmark should consider signage or other infrastructure to direct walkers to the cleandown station.

#### 6. *Community Awareness and Education*

- a. The current distribution of *Phytophthora* includes the surrounding residential developments on Harrington Break and Heather Road. Movement of infested soil from these areas poses a significant threat of disease vectoring to other areas within the Shire of Denmark. Consistent with the solutions to address the threat identified in *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark, Section 8, Limited Education and Awareness in the Community* (Green Skills, 2008), a public communication strategy is recommended for the immediate local community.

#### 7. *Re-Survey*

- a. Due to the movement of disease boundaries through autonomous spread and human vectoring, operational disease hygiene information is not to be used for operational purposes after 12 months from the date of interpretation. In accordance with DPaW guidelines (2013), operational disease boundaries must be re-checked every 12 months and a full re-interpretation must be undertaken after three years of the original survey.

## 5.1 Effective Clean Down Standards

The management solutions identified in Section 8 of *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark* also identify requirements for the clean down of vehicles when entering and exiting infested and uninfested sites. It is further recommended that requirements for cleandown be expanded to include all vehicles, machinery, equipment and footwear. Table 2 below has been provided as a guide for the requirement for cleandown when crossing disease hygiene category boundaries.

Table 2: Requirement to undertake effective cleandown when crossing disease category boundaries

Exiting Category	Entering Category	Cleandown Required
Uninfested	Infested	No
	Uninterpretable	No
	Un-mappable	No
Infested	Uninfested	Yes
	Uninterpretable	Yes
	Un-mappable	No
Uninterpretable	Uninfested	Yes
	Infested	No
	Un-mappable	No
Un-Mappable	Uninfested	Yes
	Infested	No
	Uninterpretable	Yes

Effective clean down involves the removal of all soil and plant material from machinery, vehicles, equipment, tools and footwear so it cannot be transported. Attention needs to be given to removing soil and plant material from under vehicles and machinery, especially from running boards, belly plates, spare tyres and wheels.

If operations are conducted in dry soil conditions the requirements for clean down are reduced as the soil material does not readily adhere, and clean down can be performed using a stiff brush or compressed air.

Mud and soil should be removed from footwear with a stick or brush, and the amount of water used should be minimised. All mud/soil should be collected in a bag/bucket and disposed of at an appropriate landfill facility. Drainage from clean down areas needs to be controlled so that effluent from clean down operations does not drain into uninfested or uninterpretable areas.

Hand held equipment, tools and footwear can be sterilised using methylated spirits. Place methylated spirits into a suitably labelled spray bottle, spray to cover all surfaces and allow a few minutes to soak in. Other equipment can be sterilised by soaking in a disinfectant such as bleach (active ingredient sodium hypochlorite). Dilute the bleach (1 part bleach to 10 parts water), soak tools for a few minutes then rinse, following the manufacturer's safety instructions.

Water can be sterilised by adding 6ml of sodium hypochlorite (bleach or pool chlorine) to every 10L of water. Safety instruction should be followed.

## **5.2 Dry Soil Conditions**

Dry soil conditions are when soil moisture content of open ground or on unsealed roads is not high enough to allow soil material to adhere to vehicles, machinery, equipment and footwear. The level of soil moisture required for soils to be classified as dry soil varies between soil types, however, a general rule commonly applied is that greater than 5mm of rainfall over a 24 hour period will result in moist soil conditions.

## 6 REFERENCES

**Bureau of Meteorology (BoM) (2014):** <http://www.bom.gov.au/climate/data/>

**Denmark Environment Centre (2004):** *Mount Hallowell Survey, Vegetation Structure and Composition (Map 4)*, Unpublished report

**Department of Parks and Wildlife (DPaW) (2013):** *Manual for Detecting and Mapping Phytophthora dieback disease (Operational Draft)*, Department of Parks and Wildlife, Bunbury

**Green Skills (2008):** *A Study into the Risk of Phytophthora Dieback in Ten Peri-Urban Reserves within the Shire of Denmark*, Unpublished report

## **7 LIMITATIONS**

This report was prepared for the Shire of Denmark, solely for the purposes set out in the scope of works and it is not intended that any other person use or rely on the contents of this report.

Whilst the information contained in the Report is accurate to the best of our knowledge and belief, Great Southern Bio Logic and its agents cannot guarantee the completeness or accuracy of any of the descriptions or conclusions based on the information supplied to it or obtained during the site investigations, site surveys, visits and interviews. Furthermore, field and / or regulatory conditions are subject to change over time, and this should be considered if this report is to be used after any significant time period after its issue.

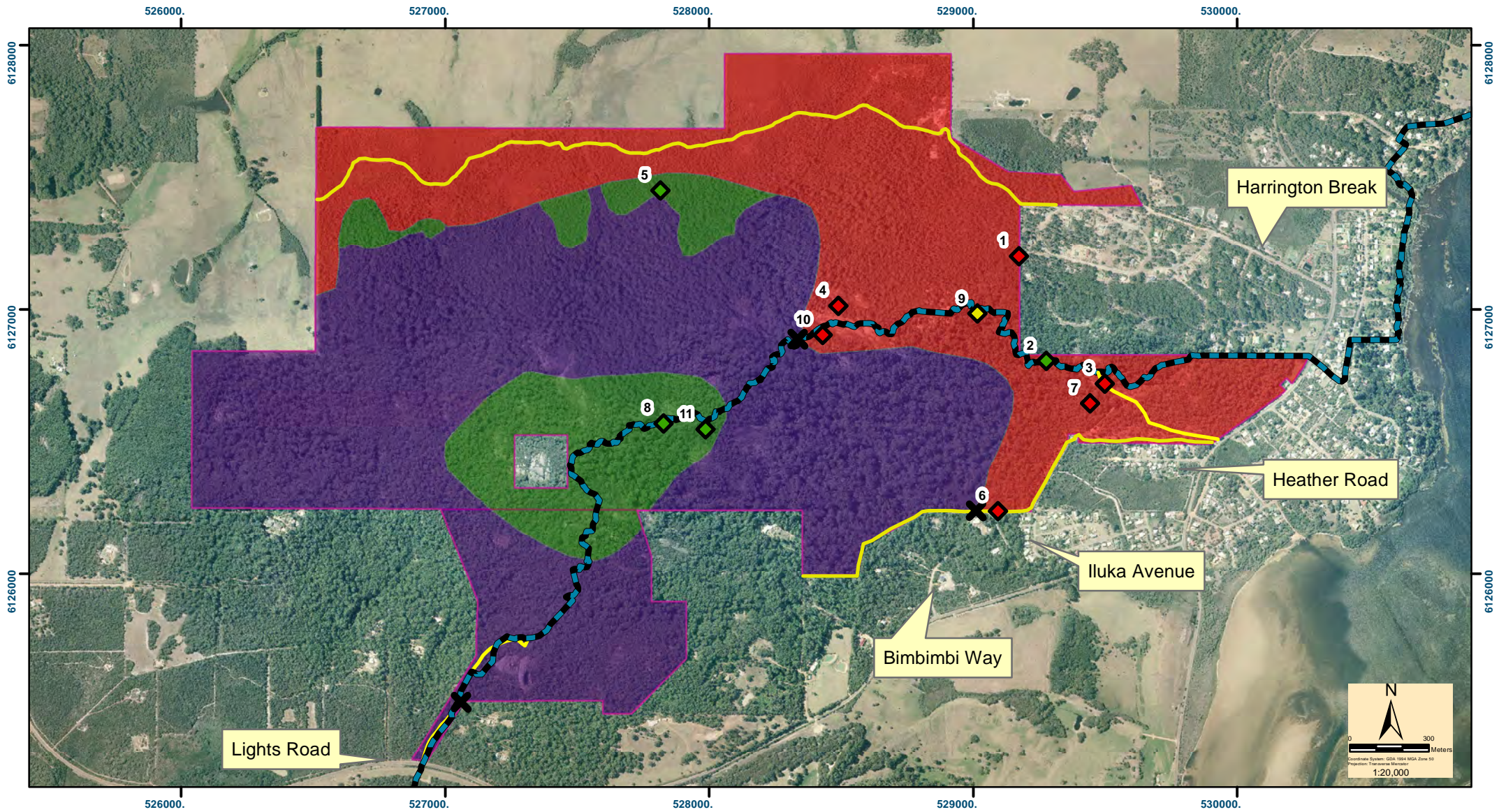
Great Southern Bio Logic and its agents have exercised reasonable care, skill and diligence in the conduct of project activities and preparation of this report. However, except for any non-excludable statutory provision, Great Southern Bio Logic and its agents provided no warranty in relation to its services or the report, and is not liable for any loss, damage, injury or death suffered by any party (whether caused by negligence or otherwise) arising from or relating to the services or the use or otherwise of this Report.

This report must be read, copied, distributed and referred in its entirety.

## Figures

***Broad scale survey of Phytophthora Dieback Distribution across the Mt  
Hallowell Reserve, Denmark and Reserve Hygiene Management Plan***





**Figure 1: Phytophthora dieback disease distribution showing sample and cleanup locations**



Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL133  
Date: 26/06/2014  
Image supplied by Shire of Denmark

Broadscale survey of Phytophthora Dieback Distribution across the Mount Hallowell Reserve, Denmark and Reserve Hygiene Management Plan

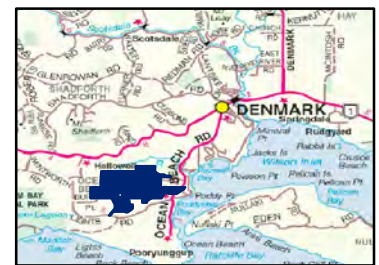
**Legend**

**Disease Status**

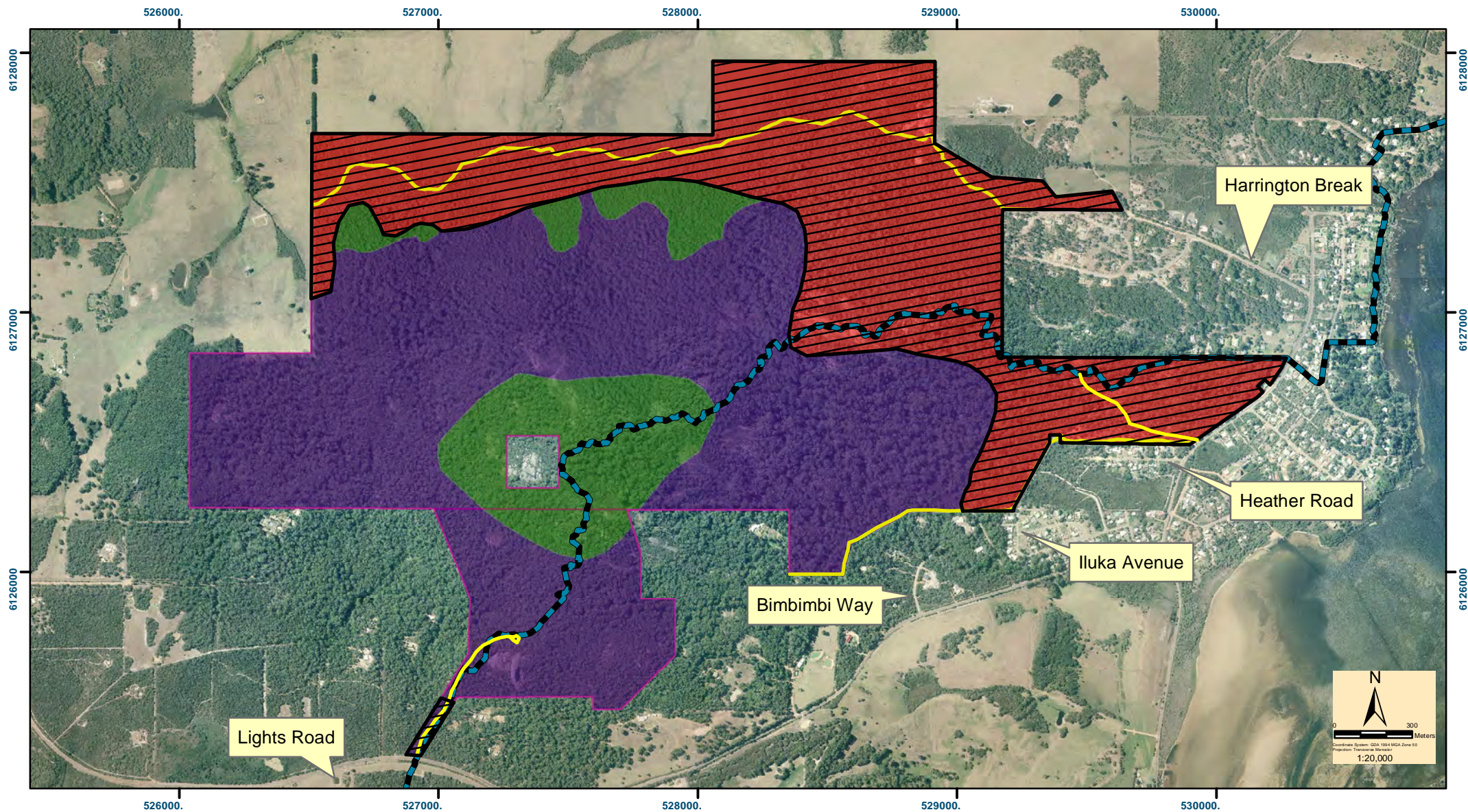
- Infested
- Uninfested
- Uninterpretable
- MtHallowellReserve
- Access tracks
- Bibbulmun Track (Sheila Hill Memorial Trail)

**Sample Locations Result**

- ◆ Negative
- ◆ Positive
- ◆ Unresolved at 16 June 2014
- ✕ Cleanup locations







**Figure 2: Phytophthora dieback disease distribution showing areas considered unprotectable from risk of disease spread**



Great Southern Bio Logic does not guarantee that this map is without flaw of any kind and disclaims all liability for any errors, loss or other consequence which may arise from relying on any information depicted.

Ref: GSBL133  
Date: 26/06/2014  
Image supplied by Shire of Denmark

Broadscale survey of Phytophthora Dieback Distribution across the Mount Hallowell Reserve, Denmark and Reserve Hygiene Management Plan

**Legend**

**Disease Status**

- Infested
- Uninfested
- Uninterpretable
- UNPROTECTABLE
- Bibbulmun Track (Sheila Hill Memorial Trail)

- Access tracks
- MtHallowellReserve





GSBL133-Mt Hallowell Pc survey and MP-V1



# Appendix A

## VHS Laboratory Certificate

# VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

**SEND TO:** Vegetation Health Service, Science Division – D.E.C., 17 Dick Perry Ave KENSINGTON 6151 **Phone:** (08) 9334 0317 **Fax:** (08) 9334 0114




**CONTACT DETAILS of sender**

Name Jeremy Spencer \_\_\_\_\_  
 Fax No. \_\_\_\_\_ Phone No. 0400113093 \_\_\_\_\_  
 DEC Office or Company Name - Great Southern Bio Logic \_\_\_\_\_

GDA  
(1)  
GDA 94 \_\_\_\_\_

Job Type (Please indicate)  
Private please see comment below

VHS USE ONLY  
Date received 7.5.14  
Date faxed 14.5.14, 18.5.14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS30627 	29-4-14	Mt Hallowell Res 1	X. gracillis	L	50	E 529173 N 6127202	R		CIN
VHS30628 	29-4-14	Mt Hallowell Res 2	L. verticillatis	L	50	E 529276 N 6126805	R		NEG
VHS30629 	29-4-14	Mt Hallowell Res 3	B. grandis	L	50	E 529499 N 6126720	R		CIN

- NOTES:**
1. Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
  2. Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
  3. An MGA map reference with prefixes **must** be supplied for all samples.
  4. Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
  5. Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*,  
 = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests
- Please Note:** a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

# VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLING INFORMATION SHEET

**SEND TO:** Vegetation Health Service, Science Division – D.E.C., 17 Dick Perry Ave KENSINGTON 6151 **Phone:** (08) 9334 0317 **Fax:** (08) 9334 0114


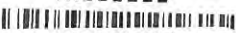

**CONTACT DETAILS of sender**

Name Jeremy Spencer  
 Fax No. \_\_\_\_\_ Phone No. 0400113093  
 DEC Office or Company Name - Great Southern Bio Logic

**GDA**  
(1)  
GDA 94 \_\_\_\_\_

**Job Type (Please indicate)**  
 Private please see comment below

**VHS USE ONLY**  
 Date received 9.5.14  
 Date faxed 14.5.14, 23/5/14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS30655 	1-5-14	Mt Hallowell Res 4	X. platyphylla	L	50	E 528490 N 6127014	R		CIN
VHS30656 	2-5-14	Mt Hallowell Res 5	B. grandis	L	50	E 527816 N 6127451	R		NEG
VHS30657 	2-5-14	Mt Hallowell Res 6	B. grandis	L	50	E 529094 N 6126237	R		CIN

- NOTES:**
- Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
  - Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
  - An MGA map reference with prefixes **must** be supplied for all samples.
  - Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
  - Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests
- Please Note:** a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

## VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

**SEND TO:** Vegetation Health Service, Science Division – D.E.C., 17 Dick Perry Ave KENSINGTON 6151 **Phone:** (08) 9334 0317 **Fax:** (08) 9334 0114

**CONTACT DETAILS of sender**



Name Jeremy Spencer  
 Fax No. \_\_\_\_\_ Phone No. 0400113093  
 DEC Office or Company Name - Great Southern Bio Logic

**GDA**  
(1)  
GDA 94 \_\_\_\_\_

**Job Type (Please indicate)**  
 Private please see comment below

**VHS USE ONLY**

Date received 20.5.14  
 Date faxed 3.6.14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS30685 	13-5-14	Mt Hallowell Res 7	B. grandis	L	50	E 529443 N 6126645	R		CIN
VHS30686 	13-5-14	Mt Hallowell Res 8	L. revolutus	L	50	E 527826 N 6126568	R		NEG

**NOTES:**

- Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
- Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
- An MGA map reference with prefixes **must** be supplied for all samples.
- Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
- Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

**Please Note:** a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.



## VEGETATION HEALTH SERVICE - PHYTOPHTHORA SAMPLE INFORMATION SHEET

**SEND TO:** Vegetation Health Service, Science Division – D.E.C., 17 Dick Perry Ave KENSINGTON 6151 **Phone:** (08) 9334 0317 **Fax:** (08) 9334 0114




**CONTACT DETAILS of sender**

Name Jeremy Spencer  
 Fax No. \_\_\_\_\_ Phone No. 0400113093  
 DEC Office or Company Name - Great Southern Bio Logic

GDA  
(1)  
GDA 94 \_\_\_\_\_

**Job Type (Please indicate)**  
 Private please see comment below

**VHS USE ONLY**  
 Date received 3.6.14  
 Date faxed 16.6.14

VHS Identification Number (VHS USE ONLY)	Sample Date	Sample label (Give location, eg. Forest Block or Shire, etc. and sample number)	Plant species sampled	Site Impact (2)	Zone 50 or 51	Map Reference (3)	Land Tenure (4)	RESULT s/s root (5)	RESULT bait (5)
VHS30748 	29-5-13	Mt Hallowell 9	L. revolutus	L	50	E 529017 N 6126984	R		SUB?
VHS30749 	29-5-13	Mt Hallowell 10	X. platyphylla	L	50	E 528431 N 6126904	R		CIN
VHS30750 	29-5-13	Mt Hallowell 11	X. priessii	L	50	E 527986 N 6126546	R		NEG

**NOTES:**

- Please tick this box if your map references are supplied in the **GDA 94** standard. If not, please specify the datum used.
- Site impact - Low, Moderate, or High (as in the Dieback Interpreter's Manual).
- An MGA map reference with prefixes **must** be supplied for all samples.
- Land Tenure - State Forest (SF), National Park (NP), Reserve (R), Westrail (W), Private (P), Gravel Pit (GP), or other. (Other - describe in comments below).
- Result codes used – CIN = *Phytophthora cinnamomi*, MUL = *P. multivora*, CRY = *P. cryptogea*, PI = *P. inundata*, ARE = *P. arenaria*, ELO = *P. elongata*, THE = *P. thermophila*, = *P. megasperma*, PN = *P. nicotianae*, CON = *P. constricta*, NEG = negative, SUB = subcultured for further tests

**Please Note:** a). NEG results cannot be used to represent a total absence of *Phytophthora* in the sampled area. b). Information from your samples will be incorporated into the VHS database.

**COMMENTS: SCNRM project on private estate for conservation works. Agreement with VHS to waive sample costs.**