Main Roads W.A

Tonkin Highway Corridor Upgrade Hale Road to Kelvin Road

Phytophthora Dieback occurrence assessment – Version 2.0

GLEVAN
CONSULTING

Client	*Main Roads W.A*
Report name	*Tonkin Highway Corridor Upgrade Hale Road to Kelvin Road*

This report has been prepared in accordance with the scope of work agreed between Main Roads W.A and Glevan Consulting and contains results and recommendations specific to the agreement. Results and recommendations in this report should not be referenced for other projects without the written consent of Glevan Consulting.

Procedures and guidelines stipulated in various manuals, particularly Phytophthora Dieback Interpreters Manual for lands managed by the Department (DBCA), are applied as the base methodology used by Glevan Consulting in the delivery of the services and products required by this scope of work. These guidelines, along with overarching peer review and quality standards ensure that all results are presented to the highest standard.

Glevan Consulting has assessed areas based on existing evidence presented at the time of assessment. The Phytophthora pathogen may exist in the soil as incipient disease. Methods have been devised and utilised that compensate for this phenomenon; however, very new centres of infestation, that do not present any visible evidence, may remain undetected during the assessment.

Executive Summary

Glevan Consulting conducted an assessment of the development envelope associated with the Tonkin Highway Corridor Upgrade, Hale Road to Kelvin Road, to determine the presence of Phytophthora Dieback. The development envelope is located on both sides of the Tonkin Highway and incorporates Hale Road, Welshpool Road and Kelvin Road intersections.

Three infestations caused by *P. cinnamomi* were observed during the assessment. The infestations were observed on the western side of the Tonkin Highway, on the southern side of Hale Road, with a total area of 2.5 ha. Two disturbed areas comprising 0.6 ha exhibited signs of recovery and were mapped as temporarily uninterpretable. An area comprising 1.1 ha was observed to be uninterpretable due an insufficient coverage of reliable indicator species. An additional 1.8 ha of uninterpretable vegetation was mapped as unprotectable due to being in or immediately adjacent to a water-gaining site that is almost certainly infested. A total of 4.0 ha of uninfested vegetation was observed within the development envelope.

The remaining 86.5 ha of the development envelope was excluded from the assessment due to having a vegetation condition scale rating of 5 (degraded) or 6 (completely degraded) or being completely void of vegetation. No infestations caused by other *Phytophthora* species were observed during the assessment.

Three soil and tissue samples were taken during the assessment, one of which produced a positive result for the presence of *P. cinnamomi*. The Phytophthora Dieback occurrence mapping contained in this report is valid for 12 months and will expire in December 2020.

Table of Contents

List of Figures

List of Tables

1 Introduction

Glevan Consulting was commissioned by Woodman Environmental Consulting on behalf of Main Roads Western Australia (Main Roads) to conduct an assessment of the development envelope associated with the Tonkin Highway Corridor Upgrade, Hale Road to Kelvin Road, for the presence of Phytophthora Dieback. Main Roads is proposing to construct grade separate interchanges along Tonkin Highway at the three following intersections:

- Hale Road
- Welshpool Road
- Kelvin Road

The assessment is required to determine the Dieback status of the vegetation within the development envelope (Figure 1) prior to the commencement of construction activities. The assessment was conducted between 27-09-2019 and 29-06-2020.

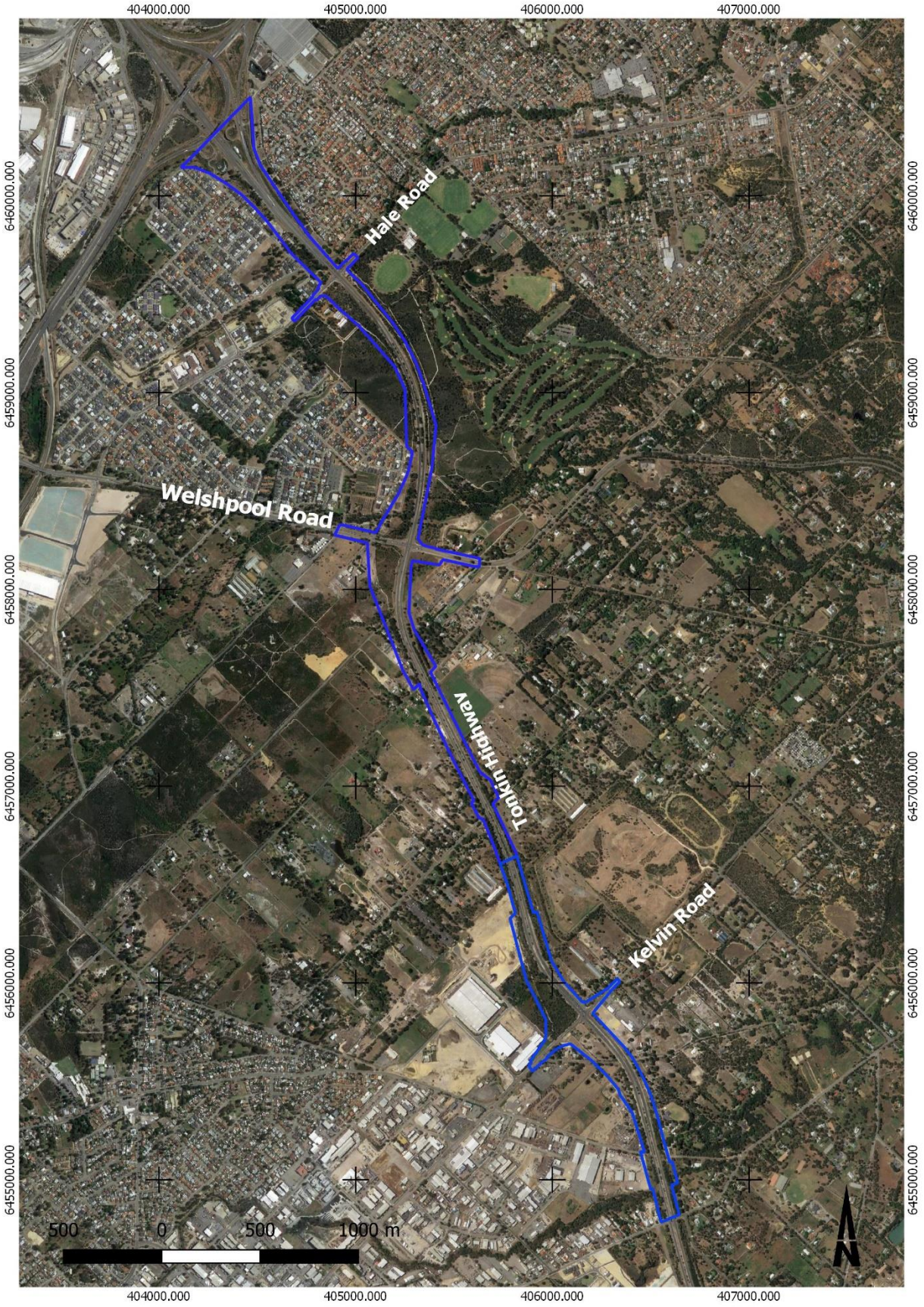


Figure 1 - Assessment area location (development envelope)

2 Background

Thousands of Australian native plant species are susceptible to Phytophthora dieback—a destructive disease caused by the pathogen *Phytophthora cinnamomi* and other Phytophthora species. This disease is a major threat to Australia's biodiversity, placing important plant species at risk of death, local extirpation or even extinction. Its dramatic impact on plant communities can also result in major declines in some insect, bird and animal species due to the loss of shelter, nesting sites and food sources. Phytophthora dieback can cause permanent damage to ecosystems. Once an area is infested with the pathogen, eradication is usually impossible. Awareness that human activity can easily spread the pathogen will help prevent an increase in the extent of this disease (Commonwealth of Australia, 2018).

Phytophthoras are a group of microscopic water moulds that belong to the class Oomycetes. Oomycetes organisms are filamentous and absorptive and reproduce both sexually and asexually. *Phytophthoras* are considered parasitic. It behaves largely as a necrotrophic pathogen causing damage to the host plant's root tissues because of infection and invasion (Department of Parks and Wildlife, 2015). The pathogen infects a host when it enters at a cellular level and damages the cell structure.

Phytophthora Dieback is the result of interaction between three physical components forming a 'disease triangle': the pathogen (*Phytophthora species*), the environment and the host. All three components are needed for the disease to develop over time. The relationship between the presence of *Phytophthora* and the development of Phytophthora Dieback disease is variable and based on the susceptibility of native plant species and the different environmental characteristics, landform types and rainfall zones across bioregions.

Armillaria Rot Disease (ARD) is a pathogen frequently encountered during Phytophthora Dieback assessments. It is caused by an indigenous fungus which is endemic to the south-west of Western Australia, occasionally presenting symptoms consistent with Phytophthora Dieback presence. The impact of the fungus on the vegetation may range from single dead plants to complete devastation of understorey and overstorey species.

3 Materials and methods

3.1 The assessment area

Areas within the development envelope will be excluded from assessment if the vegetation is suffering from significant disturbance. This disturbance (Table 1Error! Reference source not found.) is based on Vegetation Condition Scales (Keighery, 1994). The remaining area, including areas outside of the development envelope if necessary, will be categorised post-assessment into Phytophthora Dieback occurrence categories (Table 2).

Table 1 - Keighery Vegetation Condition Scale

Scale		Vegetation condition
1	Pristine	Pristine or nearly so; no obvious signs of disturbance.
2	Excellent	Vegetation structure intact; disturbance affecting individual species and weeds are non-aggressive species.
3	Very good	Vegetation structure altered; obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	Completely degraded	The structure of the vegetation is no longer intact, and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Table 2 - Phytophthora Dieback assessment for vegetation condition

Vegetation Condition	Phytophthora occurrence category
Naturally vegetated areas. Keighery disturbance rating of 3 or less Phytophthora occurrence categorisation is possible.	Infested - Determined to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi.*
	Uninfested - Determined to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*
	Uninterpretable - Undisturbed areas where susceptible plants are absent, or too few to make a determination of the presence or absence of *P. cinnamomi.*
	Not yet resolved.
Vegetation structure temporarily altered.	Temporarily Uninterpretable - Areas of disturbance where natural vegetation is likely to recover.
Vegetation structure severely altered. Keighery disturbance rating 4 or greater. Phytophthora occurrence assessment is not possible	Excluded.

3.2 The assessment method

All Phytophthora Dieback detection, diagnosis and mapping will be performed to standards and procedures defined in FEM047 Chapter 6 (DPAW 2015). These procedures are grounded on the presence in the vegetation of Indicator Species, and the observance of deaths in these plants. An indicator species is a plant species that is reliably susceptible to *Phytophthora cinnamomi*. Indicator species deaths (ISDs) alone do not necessarily indicate disease presence and it is necessary to consider all environmental and ecological factors that may be present. These other factors (as listed in FEM047) include:

- Chronology of deaths;
- Pattern of deaths;
- Topographical position;
- Vectoring – causal agencies, and;
- Biomass and biological diversity reduction.

Other causes of plant deaths need to be considered when determining the presence of Phytophthora Dieback, including (from FEM047):

- *Armillaria luteobubalina*;
- various cankers;
- insects;
- drought, wind scorch and frost;
- salinity and waterlogging;
- fire and lightning;
- senescence and competition;
- physical damage, and;
- herbicides and chemical spills.

For the majority of the assessment, the assessment type used was the linear type (when a proposed activity is linear in nature, such as along a utility easement or road) using standards defined by Chapter 8, FEM047. Prior to assessment, all information relevant to the project was assembled to assist the interpretation process (as defined in Chapter 7, FEM047). This information included previous assessments of the area, history of burning and possible other disturbances.

3.3 Other *Phytophthora* species

Phytophthora species other than *P. cinnamomi* are identified using DNA analysis by the Centre for Phytophthora Science and Management (CPSM) at Murdoch University following the identification of the presence of a *Phytophthora* species in baiting analysis performed by Vegetation Health Service (VHS) at the Department of Biodiversity, Conservation and Attractions (DBCA).

3.4 Collection of evidence of Phytophthora Dieback

During the assessment process, the collection of evidence to support the field diagnosis is recorded using a tablet running the ESRI Collector application. Waypoints are recorded at locations to show evidence of:

- where field diagnosis is certain or almost certain of Phytophthora Dieback infestation;

- healthy indicator species where field diagnosis is almost certain of the site being uninfested;
- sites with too few or devoid of indicator species, thus supporting uninterpretable classification, or
- areas of disturbance, which are temporarily uninterpretable or excluded from assessment.

Additional waypoints recorded include:

- Points located at soil and tissue sample sites with *Phytophthora cinnamomi* result;
- Points located at sites known to be infested by Phytophthora species other than *Phytophthora cinnamomi*;
- Points located where field diagnosis is certain or almost certain of Armillaria;
- points requiring soil and tissue sampling;
- points located where samples have been taken, results pending;
- points located at ISDs, and
- points that need to be revisited for further examination.

3.5 Soil and Tissue Samples

Any soil and tissue samples taken during the assessment will be to standards and prescriptions defined in Chapter 11 of FEM047. All samples are analysed in the Vegetation Health Services (DBCA) laboratory using best-practice techniques.

Taking a soil and tissue sample from dead and dying plants is an integral part of assessment – although in some cases sampling is not essential. Sample results provide evidence to support field diagnostic decisions. The following table (Table 3) shows the need for sampling to assist the disease diagnosis process (Department of Parks and Wildlife, 2015).

Table 3 - Determination of requirement for sampling

Observable factors indicating likelihood of *Phytophthora cinnamomi* presence				
ISD type	Multiple	Cluster	Scattered	Isolated
Species	Some or most indicator species	Any indicator plant	Any indicator plant	Any indicator plant
Pattern development	Obvious			Not obvious
Chronology	Obvious			Not obvious
Topographic situation	Gully/flat	Lower to mid slope	Mid slope to upper slope	Ridge
Causal agent	Obvious			Not obvious
Requirement for soil and tissue sample	Low	High	High	Low

Samples may also be taken for the following strategic reasons:

- Supporting infested field diagnosis;
- Incipient, subtle or cryptic disease in apparent uninfested sites, or
- Altering mapped infested area boundaries.

4 Results

4.1 Phytophthora Dieback Occurrence

Three infestations caused by *P. cinnamomi* were observed during the assessment. The infestations were observed on the western side of the Tonkin Highway, on the southern side of Hale Road, with a total area of 2.5 ha. Two disturbed areas comprising 0.6 ha exhibited signs of recovery and were mapped as temporarily uninterpretable. An area comprising 1.1 ha was observed to be uninterpretable due an insufficient coverage of reliable indicator species (Map 2 of Section 7). An additional 1.8 ha of uninterpretable vegetation was mapped as unprotectable due to being in or immediately adjacent to a water-gaining site that is almost certainly infested. A total of 4.0 ha of uninfested vegetation was observed within the development envelope (Table 4) (Maps 1-2 of Section 7).

The remaining 86.5 ha of the development envelope was excluded from the assessment due to having a vegetation condition scale rating of 5 (degraded) or 6 (completely degraded) or being completely void of vegetation (Maps 1-2 of Section 7). No infestations caused by other *Phytophthora* species were observed during the assessment.

Table 4 - Area Summary

Category	Area (ha)	% of total area
Infested (with *Phytophthora)*	2.5	2.6
Uninfested	4.0	4.1
Uninterpretable	1.1	1.1
Uninterpretable (unprotectable)	1.8	1.9
Temporarily uninterpretable	0.6	0.6
Excluded	86.5	86.7
TOTAL AREA	96.5	

4.2 Disease symptoms and expression

There was perceptible or obvious disease expression evident at both of the infested sites. *Banksia attenuata*, *Banksia menziesii* and *Xanthorrhoea preissii* were the species most commonly observed to be deceased in the infested areas.

4.3 Ecosystem health

The uninfested and uninterpretable sections of vegetation were observed to be in good health. There was some evidence of drought stress, however in general, the plants exhibited excellent health. The other sections however, were observed to be highly degraded, with a complete loss of structure, significantly reduced species richness and high levels of weed infestation. Such areas were excluded from assessment.

4.4 Armillaria luteobubalina (ARD)

No infestations associated with ARD were observed during the assessment.

4.5 Sample results

Three soil and tissue samples were taken during the assessment, one of which produced a positive result for the presence of *P. cinnamomi* (Table 5).

5 Discussion

The larger of the two infestations near Hale Road had been identified during a previous assessment, while the smaller infestation immediately south of Hale Road had not previously been identified. Only minor changes were made to the boundaries of the previously mapped infestations. The means by which the disease was introduced to these areas is not entirely clear, however, there is evidence of vehicles accessing the areas and also dumping of waste. There is also evidence of historical excavation activity associated with the larger of the two infestations. The pattern of infestation in this area is largely consistent with the disease having been introduced through the excavation activity.

The infestation on the western side of the Tonkin Highway, opposite Hartfield Golf Course is associated with a large water-gaining area. While there was no obvious disease expression in this area, there are three historical recoveries (through sampling) of *P. cinnamomi* in the area, including one within the development envelope. Much of the vegetation in this high-moisture site is uninterpretable, meaning there is little or no disease expression present. In addition, it is likely that the disease has been present for a considerable length of time (many decades) and has reached an endemic state whereby there is currently no discernible disease activity.

The section of the development envelope associated with Hartfield Golf Course is also almost certainly infested. This is also a water-gaining site that may have been connected to the infested site on the western side of the highway prior to the construction of Tonkin Hwy. There are no historical sample results however and the vegetation is uninterpretable, with no reliable indicator species deaths to sample. As such, the area has been mapped as uninterpretable and unprotectable.

The temporarily uninterpretable areas that occur near the Hale Road intersection are currently too sparsely vegetated (due to disturbance) to confidently detect or map disease presence. There are signs of recovery in these areas however, with several young plants observed, many of which are reliable indicators. Should these reliable indicator species continue to successfully re-establish in the area, it is possible that these areas will become interpretable in three to five years time.

The uninterpretable areas were largely associated with low lying, high moisture sites featuring non-susceptible species or species with low susceptibility, such as *Kunzea ericifolia* and various *Melaleuca* species. As a result, it is not possible to confidently detect or map the presence of the disease in these areas.

6 Bibliography

Commonwealth of Australia. (2018). *Threat abatement plan for disease in natural ecosystems caused by Phytophthora cinnamomi.*

Department of Parks and Wildlife. (2015). *FEM047 Phytophthora Dieback Interpreter's Manual for lands managed by the department.* Unpublished.

Keighery, B. (1994). *Bushland Plant Survey: a Guide to Plant Community Survey for the Community.* Wildflower Society of WA (Inc.).

7 Appendices

7.1 Sample summary

Three soil and tissue samples were taken during the assessment (Table 5).

Table 5 Sample Results

Sample no	Plant Sampled	Easting	Northing	Result
01	*Banksia attenuata*	406085	6455811	*Negative*
02	*Xanthorrhoea preissii*	404860	6459526	*P. cinnamomi*
03	*Xanthorrhoea preissii*	404863	6459494	*Negative*

7.2 Phytophthora Dieback Occurrence map

The provided maps are the Phytophthora Dieback occurrence maps.

The project area is displayed as a blue boundary line. The following categories are also shown (if present in the project area):

- Excluded (shown as uncoloured). Areas of high disturbance where natural vegetation has been cleared and is unlikely to recover to a level that is interpretable.
- Infested (shown as red). Determined from the assessment to have the plant disease caused by *Phytophthora cinnamomi*. Phytophthora Dieback caused by other *Phytophthora* species will be displayed as other colours, typically shades of orange and yellow.
- Uninfested (shown as green). Determined from the assessment to be free of plant disease Phytophthora Dieback.
- Uninterpretable (shown as purple). Undisturbed areas where susceptible plants are absent, or too few to decide the presence or absence of Phytophthora Dieback.
- Uninterpretable Unprotectable (shown as orange). Uninterpretable area that either does not meet minimum size requirements or is positioned in the landscape such that it will become infested in the near future. Areas exhibiting signs of significant disturbance activity likely to have introduced the pathogen may also be classified as unprotectable. Also includes areas where the values at risk are not significant and the benefits of hygiene are not likely to be sustained for more than a few decades.
- Temporarily Uninterpretable (shown as grey). Areas of disturbance where natural vegetation is likely to recover.

Additional spatial data that may be shown include:

- Sample location with result

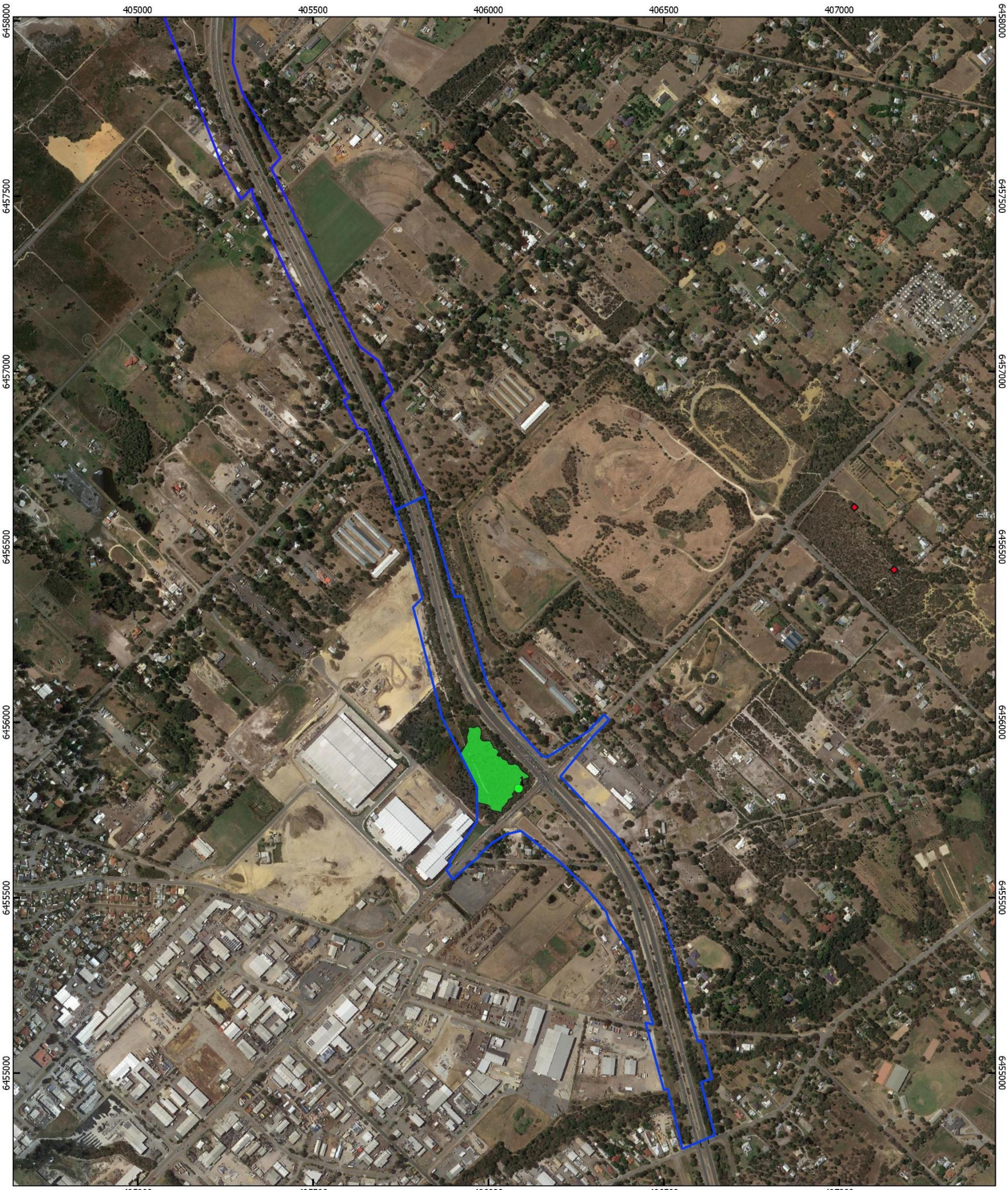
Phytophthora Dieback is a dynamic disease with autonomous spread of the pathogen not expected to be more than three metres a year upslope in average conditions. In unusual circumstances, such as heavy spring, summer or autumn rainfall, the spread of the disease may be rapid and breach the buffers. These buffers however provide the best chance of hygienic operating conditions within protectable areas over a set twelve-month period. The information on Phytophthora occurrence maps then becomes obsolete.

7.3 Mapping Metadata

DATASET DESCRIPTION	
Title	TGSI
Data Created	26-09-2019
Date Last Updated	30-06-2020
Abstract	Phytophthora Dieback Occurrence shapefiles for Tonkin Grade Separated Interchanges project area.
Purpose	Dieback category boundary mapping
Document Number	19-0679
Contact Organisation	Glevan Consulting
Contact Name	Simon Robinson
Contact Position	Phytophthora Dieback Interpreter
Contact Phone	0427 113 336
Contact Email	simon.robinson@glevan.com.au
Lineage	All field data recorded using ESRI Collector on a GPS enabled tablet.
Datum / Coordinate System	GDA94 Zone 50
Geographic Description	Tonkin Hwy between Maddington Road and Roe Hwy.
Restrictions	None

7.4 Shapefile spatial data

Spatial data is contained in the attached file named Tonkin_Hwy_Corridor_Upgrade_shapefiles.zip.



Map 1
Phytophthora Dieback
Occurrence Map

Tonkin Highway Corridor Upgrade
Hale Road to Kelvin Road
Main Roads W.A.

Development Envelope

Occurrence
- Uninfested
- Excluded

Sample sites
- Negative
- P. cinnamomi all years

Author: Simon Robinson
Date: 30-06-2020

Datum: GDA94 Zone 50
Mapping expiry: 29-06-2021

100 0 100 200 m

N

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Map 2
Phytophthora Dieback
Occurrence Map

Tonkin Highway Corridor Upgrade
Hale Road to Kelvin Road
Main Roads W.A.

Development Envelope

Occurrence

- Excluded
- Uninfested
- Uninterpretable
- Infested

- Temporarily Uninterpretable
- UI unprotectable

Sample sites

- Negative
- Positive
- P. cinnamomi all years

Author: Simon Robinson
Date: 30-06-2020

Datum: GDA94 Zone 50
Mapping expiry: 29-06-2021

100 0 100 200 m

N

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