

Phytophthora Dieback Occurrence Survey  
**Bunbury Water Resource Recovery Scheme**

12537061-00000-EN-RPT-007

19 October 2020





# Phytophthora Dieback Occurrence Survey

Bunbury Water Resources Recovery Scheme

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## Bunbury Water Resources Recovery Scheme

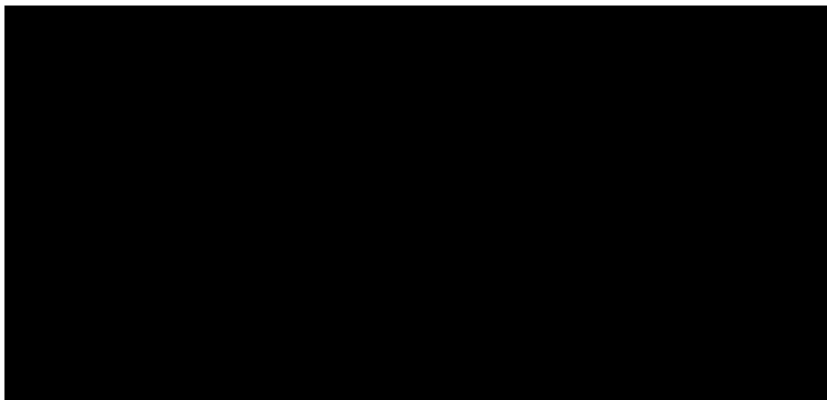
19 / 10 / 2020

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Project reference: GSBL419-Aqwest WRRS Pc-V1

Written and submitted by



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## EXECUTIVE SUMMARY

Aqwest is proposing to construct and operate a recycled water treatment plant and a pipeline to provide recycled water for the irrigation of the existing open spaces (Hay Park, Hands Oval and Forrest Park) and to provide the construction water requirements of the Bunbury Outer Ring Road (BORR) project. This proposed project comprises the following two stages:

- Stage 1: The irrigation of existing open spaces (Hay Park, Hands Oval and Forrest Park) with a direct supply of treated wastewater (TWW) from the Bunbury WWTP. This option provides the benefit of allowing reallocation of existing groundwater use for drinking water purposes.
- Stage 2: The Bunbury Outer Ring Road (BORR) project is being delivered by Main Roads Western Australia (MRWA) and consists of approximately 30 km of new freeway standard dual carriageway and associated infrastructure connecting the existing Forrest Highway to Bussell Highway. Road construction requires water for several key aspects including concrete production, earthworks and dust suppression. It is understood that construction will commence on the northern and central sections of BORR as early as January 2021 and likely to be completed by early 2024.

The project will engineer, construct and commission a water treatment plant receiving the currently treated waste stream from the Water Corporation (WC) as infeed to a new WWTP. It is proposed to build the new WWTP on the WC site adjacent to the existing WWTP. The new WWTP will feed either the Stage 1 or Stage 2 delivery points as required by their needs. The project is located entirely within the City of Bunbury

This project is referred herein as the Bunbury Water Resources Recovery Scheme (WRRS).

Disease occurrence surveys were undertaken in all areas of assessable vegetation within the WRRS Study Area. Three small areas of infested vegetation were identified, all located along the Centennial Road alignment, with a small area extending north from Centennial Rd, along Parade Rd. The majority of the Stage 1 Study Area was excluded from survey due to significant disturbance or clearing of remnant vegetation. A summary of Key statistics is presented below.

WRRS Study Area – Summary of Key Statistics	
Area of Assessable Vegetation	35.3 ha
Infested Vegetation	4.9 ha
Uninfested Vegetation	12.84 ha
Uninterpretable Vegetation	17.59 ha
Protectable Vegetation	29.98 ha
Unprotectable Vegetation	5.36 ha

Three soil and tissue samples were collected from assessable areas within the Study Area. The samples were collected to support visual disease assessment observed within infested areas. Only one sample returned a positive result for *P. cinnamomi* while the remaining two were negative, demonstrating that vegetation deaths in those areas are not attributable to Phytophthora Dieback.

Following the determination of disease hygiene categories, all uninterpretable or uninfested vegetation was assessed for protectability, using the Department of Biodiversity, Conservation and Attractions (DBCA) protectable areas criteria. It was determined that with the application of suitable hygiene during operational activities, approximately 30 ha of remnant vegetation within the Study Area can be protected from future introduction or spread of the disease.

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# 1 INTRODUCTION

## 1.1 Background

Aqwest is proposing to construct and operate a recycled water treatment plant and a pipeline to provide recycled water for the irrigation of the existing open spaces (Hay Park, Hands Oval and Forrest Park) and to provide the construction water requirements of the Bunbury Outer Ring Road (BORR) project. This proposed project comprises the following two stages:

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The project will engineer, construct and commission a water treatment plant receiving the currently treated waste stream from the Water Corporation (WC) as infeed to a new WWTP. It is proposed to build the new WWTP on the WC site adjacent to the existing WWTP. The new WWTP will feed either the Stage 1 or Stage 2 delivery points as required by their needs. The project is located entirely within the City of Bunbury.

This project is referred herein as the Bunbury Water Resources Recovery Scheme (WRRS).

As a part of the environmental surveys that will inform project planning there is a requirement to assess the distribution of Phytophthora Dieback within remnant native vegetation and identify areas within the Study Area that can be protected from the disease. Phytophthora Dieback is an introduced soil borne plant pathogen that affects up to 40% of native plant species within Western Australia. Most commonly the disease is caused by the species *Phytophthora cinnamomi*, however, other species such as *P. multivora* can also have significant impact under specific environmental conditions. Phytophthora Dieback is commonly introduced to an area through infested soils carried as basic raw materials or on vehicles, plant and machinery. In favourable conditions the pathogen can result in the collapse of entire vegetation communities. Once introduced to an area, Phytophthora Dieback will spread through further human vectoring and also via water movement and root to root contact, resulting in extensive infestations which may cause significant impact to native vegetation communities. There is currently no practical method of eradication of the pathogen.

## 1.2 Objectives

The objectives of the Phytophthora Dieback survey are to:

- Determine the presence/absence of the disease within areas of remnant native vegetation across the Study Area;
- Map the occurrence of the disease within areas of remnant native vegetation across the Study Area; and

- Apply relevant criteria to areas of disease free vegetation to determine the distribution of vegetation that can be protected from the future introduction and spread of the disease.

### 1.3 Scope of Works

In order to achieve the project objectives, the following scope of works was undertaken:

- Completion of a detailed desktop assessment of the Study Area involving an analysis of known infestations, topography, geology, land use and access;
- Completion of a comprehensive linear survey along each proposed pipeline alignment within the Study Area, in accordance with the relevant methodology defined in the *Phytophthora dieback interpreters manual for land managed by the department* (Department of Biodiversity, Conservation and Attractions (DBCA), 2015);
- Completion of a soil and tissue sampling program to verify field interpretation decisions. All samples were transported to the DBCA Vegetation Health Service (VHS) in Perth for analysis;
- Application of protectable area criteria to the Study Area to identify areas that can be considered protectable from future infestation by *Phytophthora* species; and
- Development of a disease occurrence report inclusive of disease occurrence figures and associated spatial data. The report shall also present an assessment of the disease occurrence data against criteria in the *Phytophthora Dieback Management Manual* (DBCA 2017) and provide recommendations for the requirement of a Dieback Management Plan.

### 1.4 Site Characteristics

#### 1.4.1 Study Area

The Study Area for the WRRS alignments is shown on Figure 1 and includes both Stage 1 and Stage 2 of the project. It covers approximately 16 linear kilometres, with a corridor 60 m wide, allowing for the required assessment area of 25 m either side of the proposed 10m wide disturbance area. The total area incorporating in the Study Area is approximately 83 ha.

The Stage 1 alignment runs north south from Forrest Park in the north to Centenary Road in the south following Blair Street, the Bussell Highway and Parade Road. The proposed disturbance corridor is situated mostly in the central median strip with a small exception at the southern end where it is located on the eastern verge.

Stage 2 runs east west originating at the existing Water Corporation water treatment facility on Ocean Drive. It traverses the Bunbury Regional Park and then follows the Centenary Road reserve, terminating at the junction of Centenary Road and the South Western Highway. The majority of the alignment is situated on areas of remnant vegetation with various levels of previous disturbance.

#### 1.4.2 Land Use

The proposed WRRS Study Area traverses a range of current land uses vested as both private and public lands. Only public land was accessed during the survey as no proposed disturbance will occur on private lands although these are incorporated in the Study Area due to the 60 m assessment corridor required by the survey method guidelines. Current land use of public lands within the Study Area includes existing or future road reserve for transport or conservation and/or recreation.

### 1.4.3 Climate

The Bureau of Meteorology (BoM) broadly classifies the climate across the south west region of Western Australia as warm summers with cold winters. The BoM maintains a network of weather stations across Australia to record weather data, with the nearest station to the project area being Bunbury. The long-term average annual rainfall data from Bunbury shows that annual average rainfall is 718.4mm/yr.

This is an important figure as the accepted distribution of *Phytophthora* is generally restricted by the 400 mm isohyet with distribution in the 400-600 mm/yr zone further restricted to sites with high summer rainfall averages or associated with water gaining sites. Based on the BoM climate classification and rainfall data the Study Area experiences suitable climatic conditions for *Phytophthora* to have a significant impact.

## 2 METHOD

In accordance with the agreed project scope of works, the field survey was undertaken using survey methodology referred to as linear surveys. The linear survey method is consistent with the DBCA guideline, *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). The information produced using this method of survey provides operational level disease hygiene information for application across all assessable vegetation within the Study Area.

Due to the mobility of the disease through autonomous spread and human vectoring, all operational scale disease occurrence data has a limited life of 12 months. A summary of key survey activities is provided below.

### 2.1 Desktop Interpretation

The proposed northern WRRS Study Area 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 extent of assessable remnant native vegetation occurring within the Study Area;
- The known occurrence of *Phytophthora Dieback* within or influential to the Study Area;
- The occurrence of site specific or influencing high risk vectors including but not limited to roads, creek lines and gravel pits; and
- Evidence of existing disease signatures such as areas of obvious vegetation decline.

### 2.2 Field Survey

The operational scale survey was undertaken by a DBCA registered disease interpreter and involved visual diagnosis of the disease which was then confirmed through the collection and analysis of representative soil and tissue samples collected from a sub-set of indicator species deaths. The extent of disease occurrence was then mapped using visual evidence consistent with expression associated with positive sample recoveries.

Once identified, the occurrence of the disease was mapped using a hand-held GPS unit and demarcation of disease hygiene boundaries was performed in the field using appropriately coloured flagging tape. All potentially uninfested areas upslope of infestations were traversed on foot to confirm the absence of the disease.

Demarcation of disease hygiene boundaries was performed in accordance with the requirements defined in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015). Flagging tape used for demarcation of hygiene boundaries is defined below:

- Infested vegetation – Dayglo Pink tape
- Uninterpretable – Pink and Black striped tape
- Uninfested – No demarcation

Demarcation tapes are tied on trees and other suitable bushes or shrubs, along the category boundary. Knots on the demarcation tapes face the category being demarcated. When demarcating infested or uninterpretable vegetation adjoining uninfested vegetation, the tapes are placed 20m into the uninfested

vegetation to allow a buffer between the hygiene categories. Adjoining uninfested and uninterpretable vegetation that are both classified as protectable are not demarcated.

Field data including disease presence and vegetation information was collected using a hand held GPS unit and converted to ArcGIS™ shapefiles. Collected field data included all sample locations, a point file of all identified individual plant deaths attributed to *Phytophthora*, disease hygiene boundaries 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 of *Phytophthora* expression. Where suspicious deaths were identified, soil and root tissue material was collected into heavy duty plastic bags and forwarded to the Vegetation Health Service (VHS) laboratory for analysis.

All sampling undertaken was performed in accordance with the methods described in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA, 2015).

Positive recoveries of *Phytophthora* confirm that the disease is present, and the positive result may be extrapolated across similar vegetation communities demonstrating a comparable nature of vegetation decline to that of the sample site. Conversely, however, and as defined in the *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (DBCA, 2015), a negative sample result does not confirm absence of the disease. This is because other factors may influence recovery of the pathogen through sampling and it is therefore necessary to interpret the site with consideration of a range of temporal and environmental factors.

### 3 ASSESSMENT CRITERIA

DBCA (2015) 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, e.g. 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:

1. **Infested** – Areas a registered interpreter determines to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi*.
2. **Uninfested** – Areas determined by a registered interpreter to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.
3. **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*.
4. **Temporarily uninterpretable** – 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, e.g. fire, rehabilitation.
5. **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 (400 mm to 600 mm rainfall range).
6. **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 *Phytophthora Dieback Interpreters Manual for lands managed by the Department* (2015) as areas that:

- have greater than 600 mm of annual rainfall or are water gaining sites in the 400 mm -600 mm rainfall zone;
- are determined to be free from *Phytophthora cinnamomi* by a DBCA registered disease interpreter. Uninterpretable areas may be classified as protectable;
- comprehensive transect survey areas that 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 3 ha with a minimum axis greater than 100 m, and not down slope of an infested area;
- linear assessment areas longer than 100 m after the application of appropriate disease category buffers;



- have controllable human vectors; and
- include high conservation and/or socio economic values.

## 4 RESULTS AND DISCUSSION

The WRRS South Study Area is shown in Figure 1. A summary of key statistics is presented in Table 1 below while the disease occurrence and location of soil and tissue samples across the WRRS Study Area is shown in Figures 2 and 3A – 3D. The location of protectable areas that will require the application of appropriate hygiene during operational soil movement activities area also presented in Figures 2a – 2c. Appendix A presents the VHS laboratory certificates for all samples collected during the assessment.

Table 1 – Summary of key statistics from the WRRS Study Area

WRRS Study Area – Summary of Key Statistics	
Area of Assessable Vegetation	35.3 ha
Infested Vegetation	4.9 ha
Uninfested Vegetation	12.84 ha
Uninterpretable Vegetation	17.59 ha
Protectable Vegetation	29.98 ha
Unprotectable Vegetation	5.36 ha

### 4.1 Desktop

#### 4.1.1 Previous interpretation data

No previous *Phytophthora Dieback* assessment reports were available for review, however, a review of the VHS sample database identifies multiple historic positive recoveries of the disease within the vicinity of the Study Area, as shown on Figures 2 and 3A-3D. – 2c. Historic positive recoveries are usually associated with previous assessment but only represent confirmed disease present at a specific location. They do not define the extent of disease occurrence within an area.

A single VHS positive recovery occurs in a wetland on the alignment, to the east of the Bussell Highway and several others are situated to the north of the Study Area around the Bunbury airstrip.

#### 4.1.2 Assessable remnant native vegetation

As defined in the assessment criteria presented in Section 3, only areas with suitable remnant native vegetation can be assessed. Areas that have been cleared or significantly altered are excluded from assessment (i.e. those classed as degraded or completely degraded under the Keighery (1994) condition scale). The extent of areas considered to be assessable due to the presence of remnant vegetation was initially determined during a review of available aerial imagery. Following this preliminary desktop assessment, it was determined that Stage 1, along Parade Rd was largely excluded from assessment and small sections of Stage 2 were also excluded where the alignment crosses major roads and cleared agricultural land.



## 4.2 Linear Assessment

The results of the linear assessment, including disease occurrence, soil and tissue sample sites and protectable areas are presented in Figures 2 and 3A-3D and the laboratory report for the soil and tissue samples is presented in Appendix A. The results of the linear survey for each stage are reported below.

### 4.2.1 Stage 1 – Centenary Rd to Forrest Park

The Stage 1 disturbance footprint is largely contained within existing infrastructure and there is limited remnant native vegetation that will be impacted or influenced. The interpretation of *Phytophthora* occurrence requires susceptible vegetation that can be assessed for evidence of disease impact and expression. Therefore, only areas with suitable remnant native vegetation can be assessed. As defined in Section 3, areas that have been cleared or significantly altered are excluded from survey. As shown on Figure 2, the majority of Stage 1 has been excluded from survey. A small section of Stage one did include remnant vegetation and is discussed below.

#### 4.2.1.1 Vegetation

The following vegetation description is presented to define the vegetation in terms of interpretability for *Phytophthora* Dieback assessment only. It is not intended to be used for detailed vegetation classification.

The assessable vegetation in Stage 1 consists of a mixed *Eucalyptus* and *Corymbia* forest over a mixed *Agonis flexuosa* (Peppermint) and *Banksia* woodland. There is a herbaceous understorey including *Xanthorrhoea* species and this vegetation transitions into a *Melaleuca* wetland where Stage 1 and Stage 2 intersect. The vegetation along the alignment is divided by Parade Road and the proposed disturbance area is located on the eastern verge of the road where it is also heavily weed infested.

#### 4.2.1.2 Disease Expression

*Phytophthora* Dieback disease expression in assessable vegetation was observed through fresh deaths of *Banksia* species and some deaths of *Xanthorrhoea gracilis* and *X. preissii* were noted on the western side of Parade Road.

#### 4.2.1.3 Disease Occurrence and Hygiene categories

A small area of uninfested vegetation was demarcated on the eastern side of Parade Road while the remainder of the assessable vegetation was either infested or uninterpretable. This area appears to be isolated from potentially infested drainage from the infested area on the western side of Parade Rd by the road itself which carries runoff to the wetland area to the south.

#### 4.2.1.4 Protectability Assessment

No protectable vegetation has been identified in Stage 1.

- The uninterpretable vegetation is situated downslope of infested vegetation and receives uncontrollable runoff from all areas.
- The uninfested area is too small to be protected from infestation into the future and is subject to uncontrolled access.

## 4.2.2 Stage 2 – Water Corporation treatment facility to SW Highway

Stage 2 consists of remnant native vegetation within the Centenary Road reserve and Bunbury Regional Park. Small sections have been excluded where the Study Area traverses cleared agricultural Land and roads.

### 4.2.2.1 Vegetation

The following vegetation descriptions are presented to define the vegetation in terms of interpretability for Phytophthora Dieback assessment only. They are not intended to be used for detailed vegetation classification.

The assessable vegetation in Stage 1 consists of several vegetation types;

At the western end there is a coastal heath with no disease indicator species. This transitions into a *Eucalyptus gomphocephala* (Tuart) forest over an *Agonis flexuosa* (Peppermint) midstory and then into a mixed *Eucalyptus* and *Corymbia* forest over a mixed Peppermint and *Banksia* woodland with a herbaceous understorey including *Xanthorrhoea* species. Along Centenary Road, west of the Bussell Highway, the vegetation consists of a *Melaleuca* wetland with no disease indicator species present.

To the east of the Bussell Highway the vegetation is dominated by a closed woodland of Peppermint and *Banksia* species including *B. grandis*, *B. attenuata* and *B. menzeisii*. Multiple *Xanthorrhoea preissii* and *X. gracilis* are also present. This vegetation is divided by a cleared wetland area that is naturally regenerating.

### 4.2.2.2 Disease Expression

Phytophthora Dieback disease expression in assessable vegetation was observed through fresh deaths of *Banksia* species and some deaths of *Xanthorrhoea gracilis* and *X. preissii* were noted on the western side of Parade Road. To the east of the Bussell Highway there were also several old deaths of *Banksia* species and were used to map the extent of disease occurrence.

### 4.2.2.3 Disease Occurrence and Hygiene categories

The same infested area in Stage 1 extends into Stage 2 and spreads west along the Stage 2 alignment for a short distance. The disease was also identified in the cleared wetland area to the east of the Bussell Highway and a third infested area was identified on Centennial Rd where it terminates outside the Bunbury Regional Prison.

All coastal heath vegetation and the Tuart Forest vegetation have been classified as uninterpretable due to the lack of disease indicator species and the majority of the Peppermint and *Banksia* woodlands have been classified as uninfested.

### 4.2.2.4 Protectability Assessment

All uninfested areas within the Stage 2 alignment Study Area have been classified as protectable as they:

- are of suitable size to remain uninfested and are associated with extensive areas of uninfested vegetation beyond the Study Area
- are not influenced by infested areas or associated drainage
- have controllable human vectors, limited by access restrictions to foot traffic.

The uninterpretable Coastal Heath and Tuart Forest vegetation types within the Stage 2 alignment Study Area have been classified as protectable as they:

- are of suitable size to remain uninfested and are associated with extensive areas of uninfested vegetation beyond the Study Area
- are not influenced by infested areas or associated drainage
- have controllable human vectors, limited by access restrictions to foot traffic.

The uninterpretable *Melaleuca* wetland along Centenary Road, west of the Bussell Highway has been classified as unprotectable as it:

- is situated downslope of infested vegetation and receives uncontrollable runoff from all areas.

### 4.3 Sample Program

Three soil and tissue samples were collected from assessable vegetation within the Study Area. The samples were collected to support visual disease assessment observed within infested areas. All sample locations and results are presented on Figures 2 and 3A-3D which also show the locations of historic VHS positive sample records. One sample returned a positive result for *P. cinnamomi* as shown in Table 2 below.

Table 2 – Sample data from the WRRS Study Area

Soil and Tissue Sample Data – WRRS South Study Area			
Sample label	Species sampled	Location	Sample result
Aqwest Pipe 1	<i>B. attenuata</i>	E 373928 N 6305110	Negative
Aqwest Pipe 2	<i>B. attenuata</i>	E 371591 N 6304905	Negative
Aqwest Pipe 3	<i>B. attenuata</i>	E 376062 N 6305136	<i>P. cinnamomi</i>

### 4.4 Limitation of results

Phytophthora Dieback is a soil borne plant pathogen that spreads autonomously via root to root transmission, independently through the soil and also with the movement of water. The disease is also widely spread by human activities involving the movement of infested soil and plant material. As a result, the edge of a disease infestation is considered to be an actively spreading disease front, and all uninfested areas of vegetation that are associated with human vectors such as tracks and access ways are considered to be at risk of future infestation unless appropriate management is applied.

The disease occurrence data presented in this report is representative of the distribution of Phytophthora Dieback within assessable vegetation in the WRRS Study Area at the time of assessment. In accordance with DBCA guidelines (2015, 2017) Phytophthora Dieback occurrence data is valid for a period of 12 months from the date of assessment. After 12 months a disease re-check assessment is required and after three years a full re-assessment of the survey area will be required.



## 5 RECOMMENDATIONS

As shown in Figures 2 and 3A-3D, protectable vegetation has been identified within road reserves and regional park in the WRRS Study Area.

The DBCA *Phytophthora dieback management manual* (2017) guides the development of Phytophthora Dieback Management Plans (PDMP) for specific projects and is designed for application across lands vested with the DBCA during all potential soil movement activities. While not directly applicable to the proposed WRRS Study Area, development of a PDMP is considered industry best practice. It is recommended that a PDMP consistent with the DBCA guidelines accepted by the Dieback management industry, other government authorities and regulatory agencies be developed.

The PDMP will need to address:

- hygiene requirements associated with mitigating risks of exporting disease from infested and potentially infested areas of the survey area to all other areas, including other sites external to the WRRS Study Area;
- protection of protectable areas within the WRRS Study Area;
- application of hygiene during all potential soil moving activities inclusive of preliminary site investigations, construction works and post construction revegetation and ongoing maintenance.

## 6 REFERENCES

**Bureau of Meteorology (BoM) (2020):** <http://www.bom.gov.au/climate/data/>

**Department of Biodiversity Conservation and Attractions (DBCA) (2015),** *Phytophthora Dieback Interpreters Manual for lands managed by the department*, Perth

**Department of Biodiversity Conservation and Attractions (DBCA) (2017),** *Phytophthora Dieback Management Manual*, Perth

**Keighery, B.J. (1994),** *Bushland plant survey. A guide to plant community survey for the community.* Wildflower Society of WA (Inc.), Nedlands, Western Australia.

## 7 REPORT DISCLAIMER

This report was prepared for GHD, 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.

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## Figures

*Phytophthora Dieback Occurrence Survey – Bunbury Water Resources Recovery*

*Scheme*



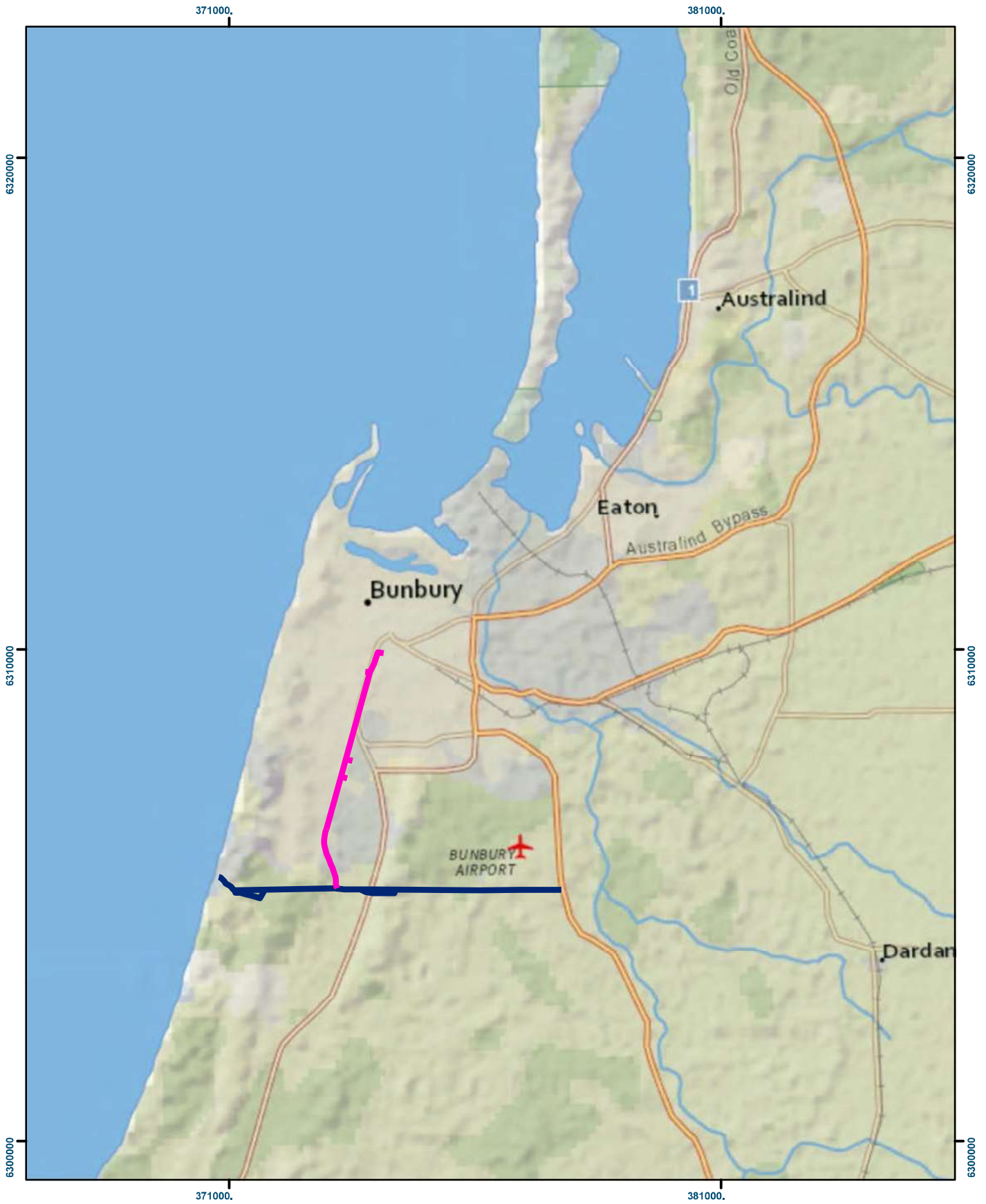


Figure 1: Regional Location and Study Area



Phytophthora Dieback Occurrence Survey -  
Bunbury Water Resources Recovery  
Scheme (WRRS) prepared for GHD, October 2020

**LEGEND**

- WRRS Stage 1\_20200624
- WRRS Stage 2\_20200701

0 1,000  
Meters  
GDA 1994 MGA Zone 50 1:100,000  
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: GSBL419 Date: 16-Oct-20

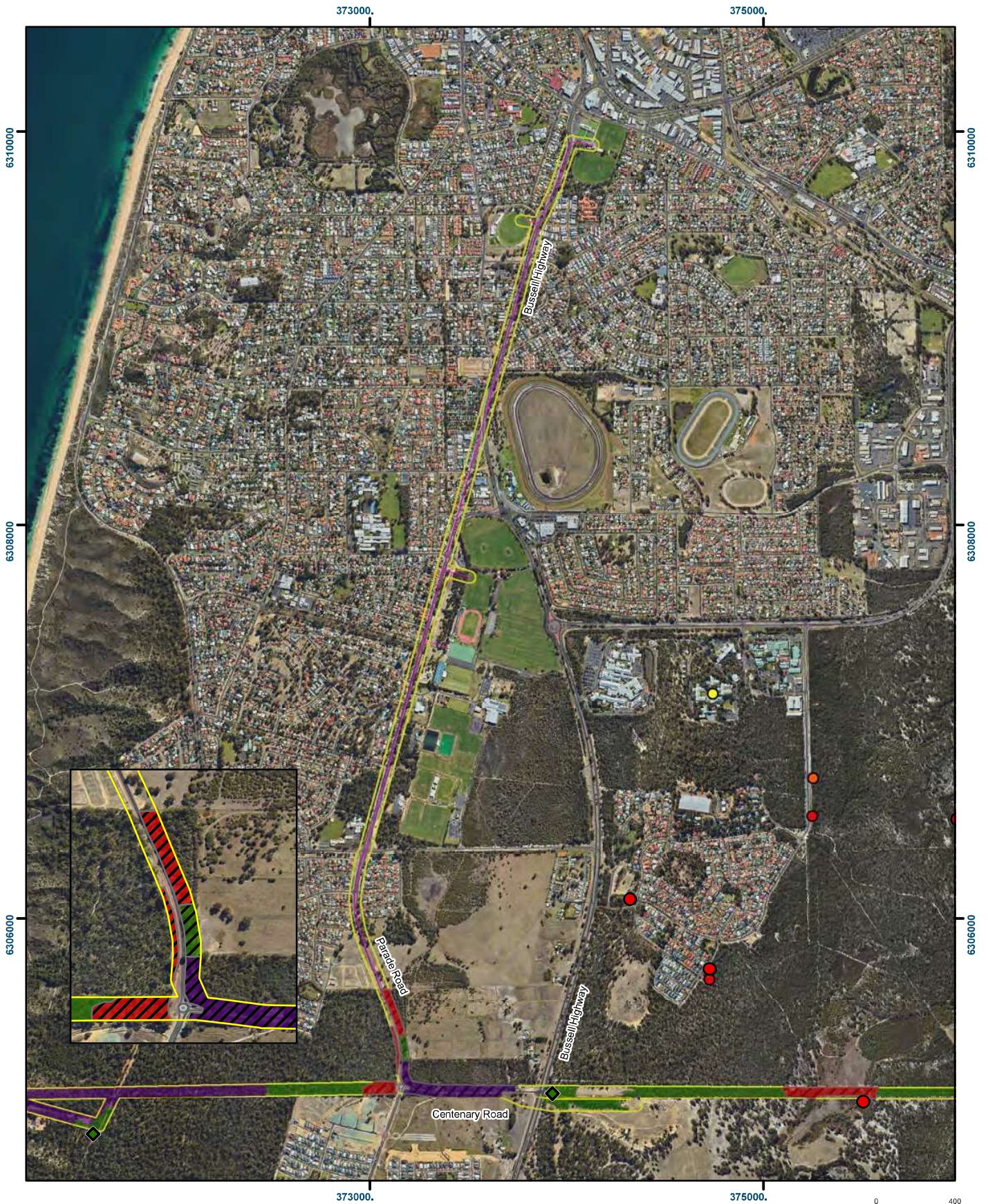


Figure 2: WRRS Stage 1 Phytophthora Dieback occurrence showing protectable vegetation and sample locations

0 400  
Meters  
GDA 1994 MGA Zone 50 1:25,000

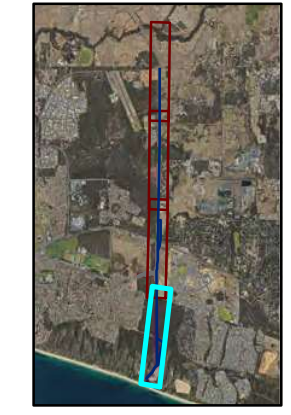
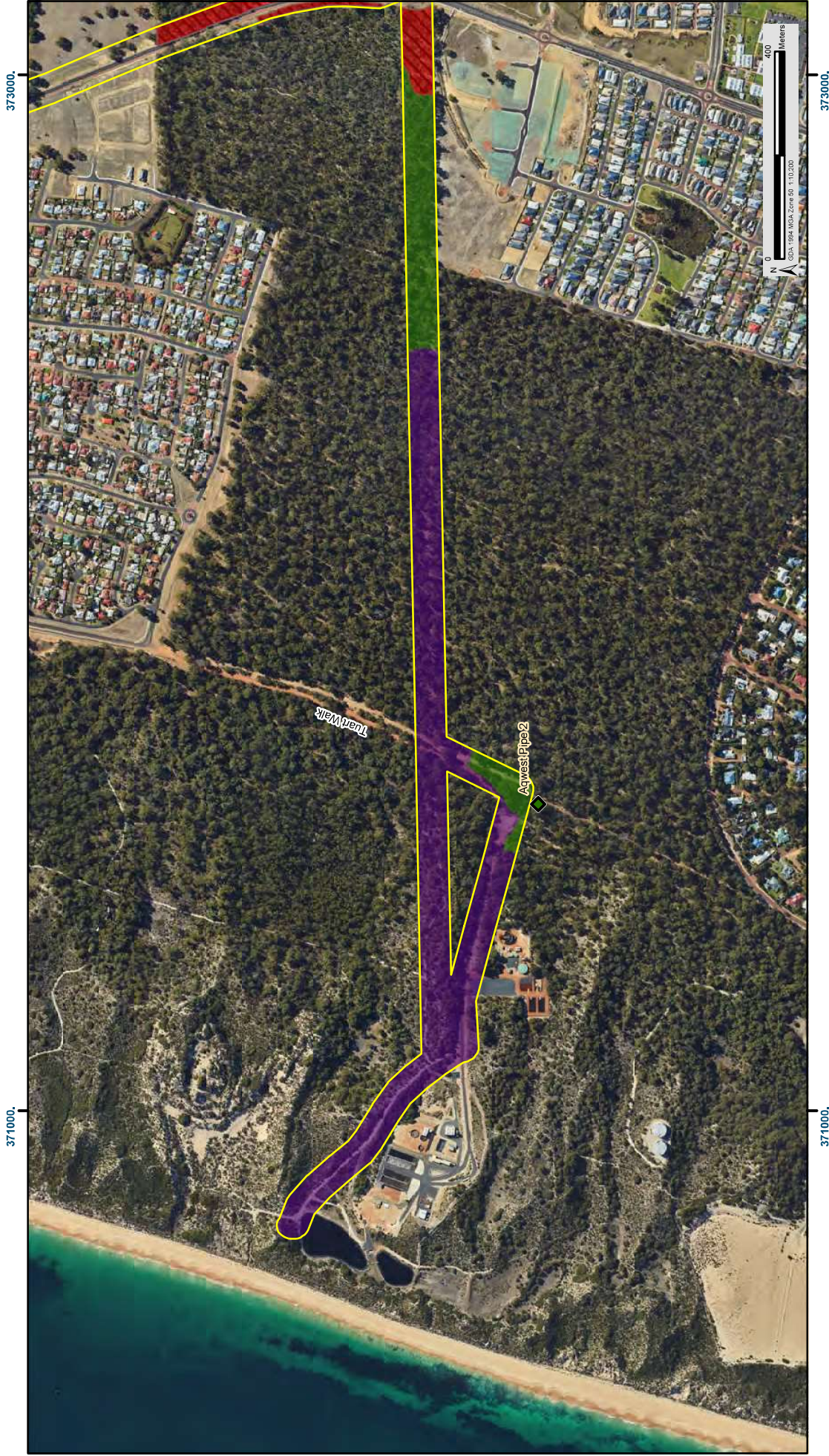


Figure 3A: WRRS Stage 2 Phytophthora Dieback occurrence showing protectable vegetation and sample locations

- |                                       |                               |
|---------------------------------------|-------------------------------|
| <span style="color: red;">●</span>    | Historic <i>P. cinnamomi</i>  |
| <span style="color: orange;">●</span> | Historic <i>P. nicotianae</i> |
| <span style="color: yellow;">●</span> | Historic <i>P. multivora</i>  |
- 
- |  |                 |  |                       |
|--|-----------------|--|-----------------------|
| <span style="color: red;">■</span>               | Infested        | <span style="color: green;">◆</span>                   | Positive              |
| <span style="color: green;">■</span>             | Uninfested      | <span style="color: purple;">◆</span>                  | Negative              |
| <span style="color: purple;">■</span>            | Uninterpretable | <span style="border: 1px solid yellow;">■</span>       | Study Area            |
| <span style="border: 1px solid black;">■</span>  | Excluded        | <span style="border-bottom: 1px solid black;">—</span> | WRRS Stage 2_20200701 |
| <span style="border: 1px dashed black;">■</span> | Unprotectable   |  |                       |

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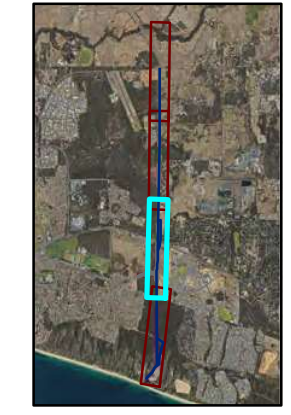
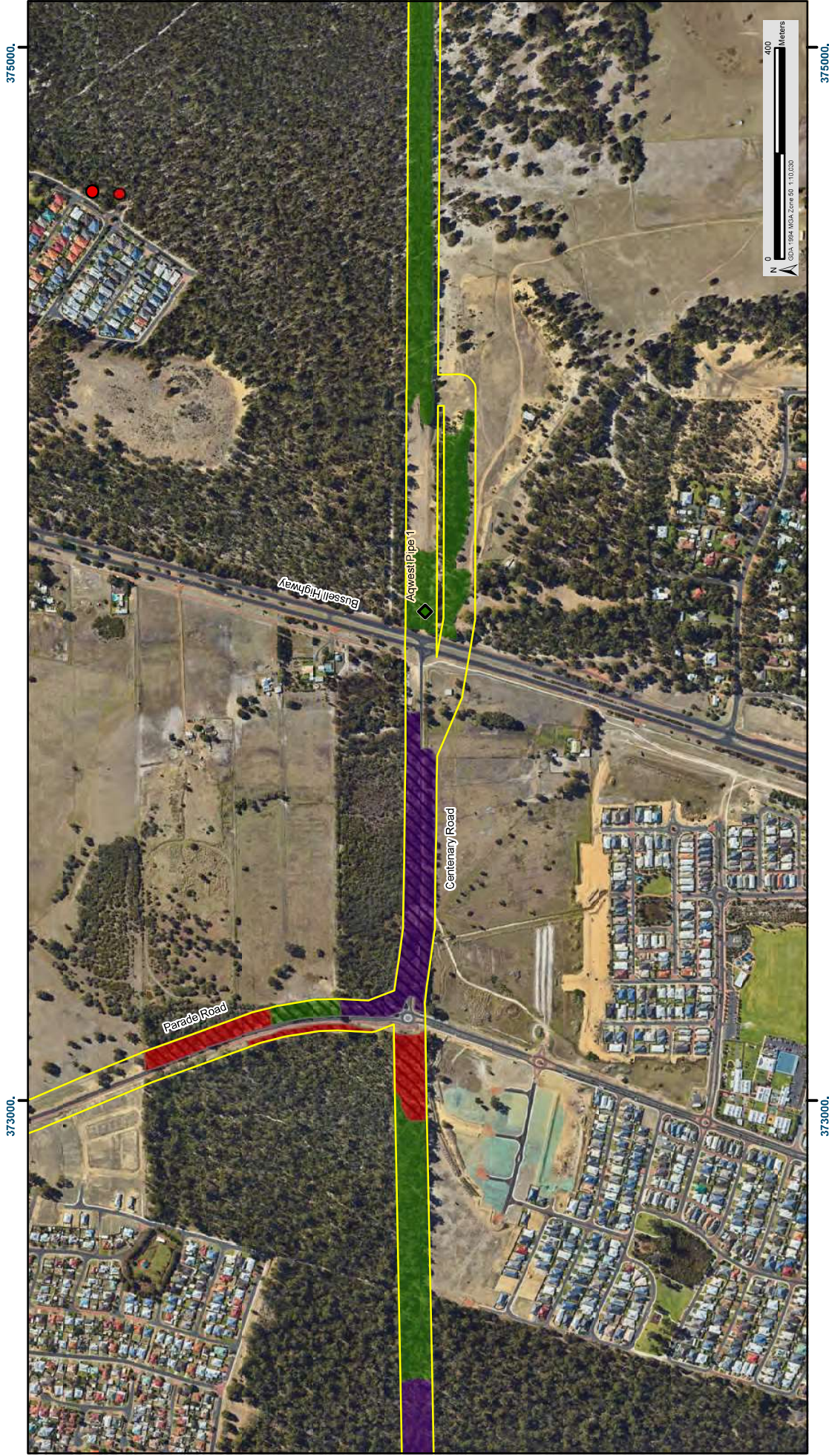


Figure 3B: WRRS Stage 2 Phytophthora Dieback occurrences showing protectable vegetation and sample locations

- |                                       |                               |
|---------------------------------------|-------------------------------|
| <span style="color: red;">●</span>    | Historic <i>P. cinnamomi</i>  |
| <span style="color: orange;">●</span> | Historic <i>P. nicotianae</i> |
| <span style="color: yellow;">●</span> | Historic <i>P. multivora</i>  |
- 
- |   |                 |   |                       |
|---|-----------------|---|-----------------------|
| <span style="color: red;">■</span>  | Infested        | <span style="color: green;">◆</span>  | Positive              |
| <span style="color: green;">■</span>  | Uninfested      | <span style="color: green;">◆</span>  | Negative              |
| <span style="color: purple;">■</span>   | Uninterpretable | <span style="border: 1px solid yellow; display: inline-block; width: 10px; height: 10px;"></span> | Study Area            |
| <span style="border: 1px solid white; display: inline-block; width: 10px; height: 10px;"></span>  | Excluded        | <span style="border-bottom: 1px solid black; width: 20px; display: inline-block;"></span>         | WRRS Stage 2_20200701 |
| <span style="background: repeating-linear-gradient(45deg, transparent, transparent 2px, black 2px, black 4px); display: inline-block; width: 10px; height: 10px;"></span> | Unprotectable   |   |                       |

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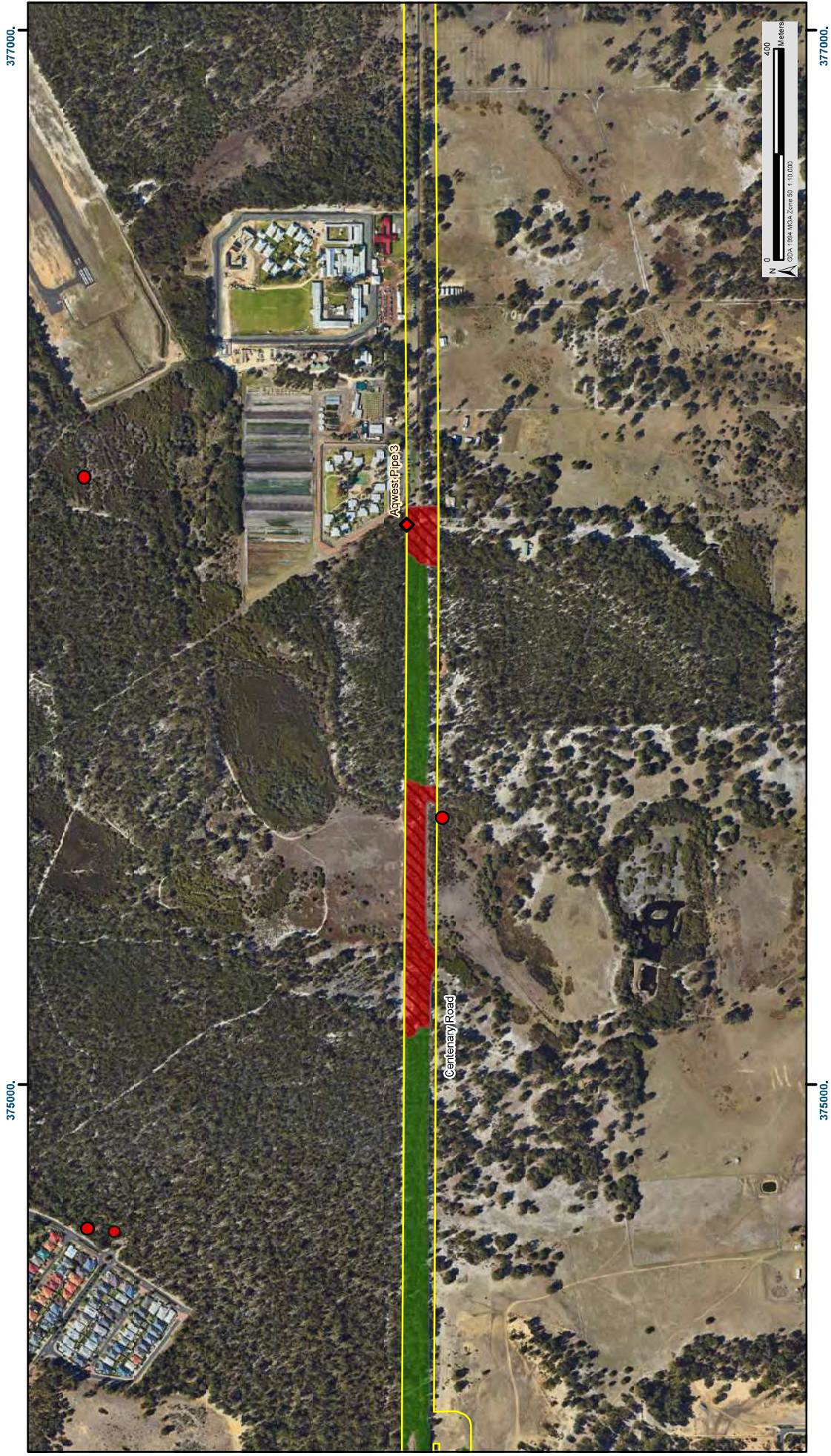
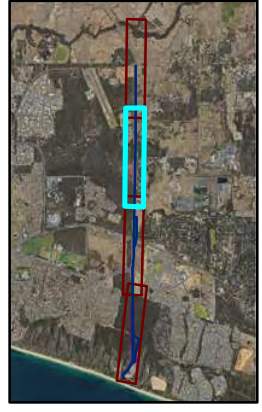


Figure 3C: WRRS Stage 2 Phytophthora Dieback occurrence showing protectable vegetation and sample locations

- | Status          | Sample Result         |
|-----------------|-----------------------|
| Infested        | Positive              |
| Uninfested      | Negative              |
| Uninterpretable | Study Area            |
| Excluded        | WRRS Stage 2_20200701 |
| Unprotectable   |                       |
- 
- Historic *P. cinnamomi*
  - Historic *P. nicotianae*
  - Historic *P. multivora*



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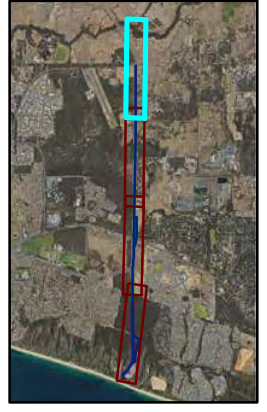


Figure 3D: WRRS Stage 2 Phytophthora Dieback occurrences showing protectable vegetation and sample locations

- |   |                               |   |                        |
|---|-------------------------------|---|------------------------|
| <span style="color: red;">●</span>  | Historic <i>P. cinnamomi</i>  | <span style="color: red;">◆</span>  | Sample Result Positive |
| <span style="color: orange;">●</span>   | Historic <i>P. nicotianae</i> | <span style="color: green;">◆</span>  | Sample Result Negative |
| <span style="color: yellow;">●</span>   | Historic <i>P. multivora</i>  | <span style="border: 1px solid yellow; display: inline-block; width: 10px; height: 10px;"></span> | Study Area             |
| <span style="border: 1px solid red; display: inline-block; width: 10px; height: 10px;"></span>    | Infested                      | <span style="border: 1px solid purple; display: inline-block; width: 10px; height: 10px;"></span> | Uninterpretable        |
| <span style="border: 1px solid green; display: inline-block; width: 10px; height: 10px;"></span>  | Uninfested                    | <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>  | Excluded               |
| <span style="border: 1px solid purple; display: inline-block; width: 10px; height: 10px;"></span> | Uninterpretable               | <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>  | Unprotectable          |
| <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>  | Excluded                      | <span style="border-bottom: 1px solid black; display: inline-block; width: 20px;"></span>         | WRRS Stage 2_20200701  |
| <span style="border: 1px solid black; display: inline-block; width: 10px; height: 10px;"></span>  | Unprotectable                 |   |                        |

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Revision	Author	Reviewer		Approved for Issue		
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0						

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