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State Phytophthora Dieback Management and Investment Framework

VERSION 1 | JULY 2014

This project is supported by funding from the Western Australian Government's State NRM program, along with contributions made by the following partners:

ACRONYMS

CPSM	Murdoch University Centre for Phytophthora Science and Management
DCC	Dieback Consultative Council
DSC	Dieback Steering Committee
DWG	Dieback Working Group
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Authority
NRM	Natural Resource Management
Parks and Wildlife	Western Australian Government Department of Parks and Wildlife
PDMA	Plant Disease Management Areas
PPA	Priority Protection Area
PPAMS	Priority Protection Area Management System Logic
South Coast NRM	South Coast Natural Resource Management, Inc (NRM Regional Body)
The Framework	State Dieback Management and Investment Framework

Notes:

Glossary of terms is located in Section 8 of this document

Gaia Resources have produced a supporting technical document "Developing a State-Wide Dieback Management and Investment Framework" (2014). The Gaia Resources report can be used in conjunction with this report for further technical information on the development of the State Dieback Management and Investment Framework. This report is available through South Coast NRM.

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1. SUMMARY

Phytophthora Dieback is a plant disease caused by *Phytophthora cinnamomi*, an introduced soil borne plant pathogen that can devastate plant communities. It affects up to 40% of native species within the south-west of Western Australia (WA) see figure 2. The pathogen can irreversibly alter plant communities, killing susceptible species, many of which are both iconic and fundamental to the ecosystems they support.

With more than 1 million hectares of remnant vegetation in WA now infested with the pathogen, the epidemic has reached the stage where an urgent investment is required to conserve significant examples of vulnerable biodiverse ecosystems. New and well planned investment is necessary to ensure a uniform approach to Phytophthora Dieback management across industries and tenures. Prioritising the most important areas which offer the greatest chance of successful disease control or mitigation will maximise current and future Phytophthora Dieback investment.

The State Phytophthora Dieback Management and Investment Framework (Framework) identifies Priority Protection Areas (PPAs) representing the most significant examples of ecosystems supporting plant species and communities vulnerable to Phytophthora Dieback within the south-west of Western Australia.

The Framework provides a logical process and operational toolkit to develop area specific management actions including on ground activity, planning, engagement, communication and structured training to prevent the further spread of Phytophthora Dieback at a landscape scale. This facilitates a standardised approach for targeted management and investment across tenure enabling collaboration between key stakeholders providing optimum return for the preservation of the state's unique biodiversity assets.

The preservation of the state's unique biodiversity assets is not a short-term matter and requires on-going collaborative effort between all stakeholders. Whilst the maintenance and implementation of the Framework into the future will be dependent on future resourcing, the provision of targeted and prioritised management strategies and activities will enable available resources to be put to optimum use. Many of the management strategies and activities for Phytophthora Dieback provide multiple conservation benefits; advancing the conservation of multiple threatened (flora and fauna) species and ecological communities, and managing other biosecurity issues such as reducing the spread of weeds and feral animals. In this regard, Phytophthora Dieback management can be readily integrated into broader biosecurity management and provide effective use of limited resources.

The Framework is designed for adaptive management of Phytophthora Dieback in the PPAs. Adaptive management allows the capture of new developments in our understanding of Phytophthora Dieback as well encompasses any new data on the P. cinnamomi susceptible biodiversity values within each PPA. To ensure the process is adaptive, it is recommended that the Framework is reviewed at least every ten years. This will enable the PPAs and their management to remain current and effective.

1.1 Goal statement

To protect and conserve the most significant examples of the biodiverse ecosystems and communities of the South West of Australia that are vulnerable to, or threatened by, Phytophthora Dieback over the next 50 years.

1.2 Operational objectives

1. Identify 100 Priority Protection Areas (PPA) that represent significant biodiverse ecosystems and communities threatened by *P. cinnamomi* by 2014.

2. Prioritise targeted investment that provides the most effective protection and conservation of significant biodiversity values in identified PPAs over the next 50 years.

3. Implement, monitor and evaluate threat abatement investment into Phytophthora Dieback management within PPAs over the next 50 years.

2. CONTEXT

Phytophthora cinnamomi is an introduced soil borne plant pathogen that can devastate plant communities. Phytophthora Dieback caused by the root-rot pathogen is listed as a 'key threatening process' under the Federal Environment Protection and Biodiversity Conservation Act 1999 (the EPBC Act). It can affect up to 40 per cent of native species within the south-west of Western Australia.

The greatest threat of Phytophthora Dieback to WA's south west vegetation communities is caused by *P. cinnamomi*. This pathogen can irreversibly alter plant communities, killing susceptible species, many of which are both iconic and fundamental to the ecosystems they support. It can dramatically modify the structure and composition of susceptible native plant communities, significantly reducing primary productivity and resulting in habitat loss and degradation for dependant flora and fauna.

The Australian Government recently released the Department of Sustainability, Environment, Water, Population and Communities (2014) Threat Abatement Plan (TAP) for disease in natural ecosystems caused by *Phytophthora cinnamomi*. This Framework is consistent with key objectives of the TAP, providing strategic direction for current and future investment in Phytophthora Dieback management, in WA.

It is pertinent to recognise that other *Phytophthora* species e.g. *P. multivora,* can similarly impact native vegetation communities. While these *Phytophthora* species are not featured within this Framework they should not be discounted and also require management.

This Framework builds on considerable effort undertaken by community, industry and government to date providing structure to unify efforts and a strategic approach to management implementation. Although the Framework provides for state prioritisation, Phytophthora Dieback remains an issue within areas outside of the Top 100 PPAs. It is envisaged that the Framework tools for developing Phytophthora Dieback management strategies and activities can be applied to all areas of remnant vegetation as best practice.

3. STATE PHYTOPHTHORA DIEBACK MANAGEMENT AND INVESTMENT FRAMEWORK

The Framework provides a blueprint for identifying PPAs and collaborative Phytophthora Dieback management across tenure, providing a common set of tools and protocols. This is achieved through the implementation of a cohesive decision making approach that includes on ground activity, planning, engagement, communication and structured training.

The Framework can be divided into three main phases. The first phase is the initial prioritisation process for identifying the indicative top 100 PPAs and utilises state- data sets through an automated process. The second phase uses

standardised protocols in conjunction with an operational toolkit to refine the indicative Top 100 PPAs using local data sets and knowledge, ground truthing *P. cinnamomi* (if required) and then develops and implements area specific management strategies and activities. The operational toolkit contains six templates which provide the step by step process to achieve this. The final phase of the Framework is the implementation of prioritised projects and their monitoring and evaluation. Information gathered then feeds back into the top 100 PPAs.

The Framework utilises a collaborative approach with the objective of ensuring a unified system of dieback control resulting in landscape-scale management of dieback across all land tenures. The major partners of the Framework are:

- South Coast Natural Resource Management (South Coast NRM);
- Dieback Working Group (DWG);
- Murdoch University Centre for Phytophthora Science and Management (CPSM); and
- Department of Parks and Wildlife (Parks and Wildlife)

with the support and involvement of key stakeholders from all the NRM regions within the Phytophthora Dieback project risk area including Northern Agricultural, Swan, Avon, South West Catchment Council and South Coast NRM regions.

The success of this Framework will depend on a high level of cooperation between all key stakeholders, including:

- Western Australia environmental, conservation and natural resource management and planning agencies;
- Local governments;
- Research institutes;
- Industry and entrepreneurs, including the timber industry, horticulture, mining and utilities (e.g. road construction and fire suppression industries);
- Non-government environmental organisations and private conservation land management bodies, private landholders, Indigenous communities and natural resource management groups; and
- Recreational user group organisations (e.g. 4wd/off-road vehicle associations, mountain bike rider associations).

The management of Phytophthora Dieback and prioritisation of PPAs is an adaptive process. To incorporate new data and developments in understanding Phytophthora Dieback and its management it is proposed that the Framework be maintained through periodical review at least every 10 years.

3.1 Logic and Processes for the State Phytophthora Dieback Management and Investment Framework

The logic of the Framework is to provide a structure to:

1. Identify areas that are considered a priority for management (the PPAs).
2. Identify values, objectives, threats and management strategies and actions.
3. Assess the feasibility of management strategies and actions.
4. Develop risk reduction plans for identified PPAs.
5. Implement priority projects.
6. Monitor and evaluate implementation and if necessary adapt management objectives and goals.

The flow chart (Figure 1) outlines the hierarchal steps of the Framework. Further details are provided later in this document.

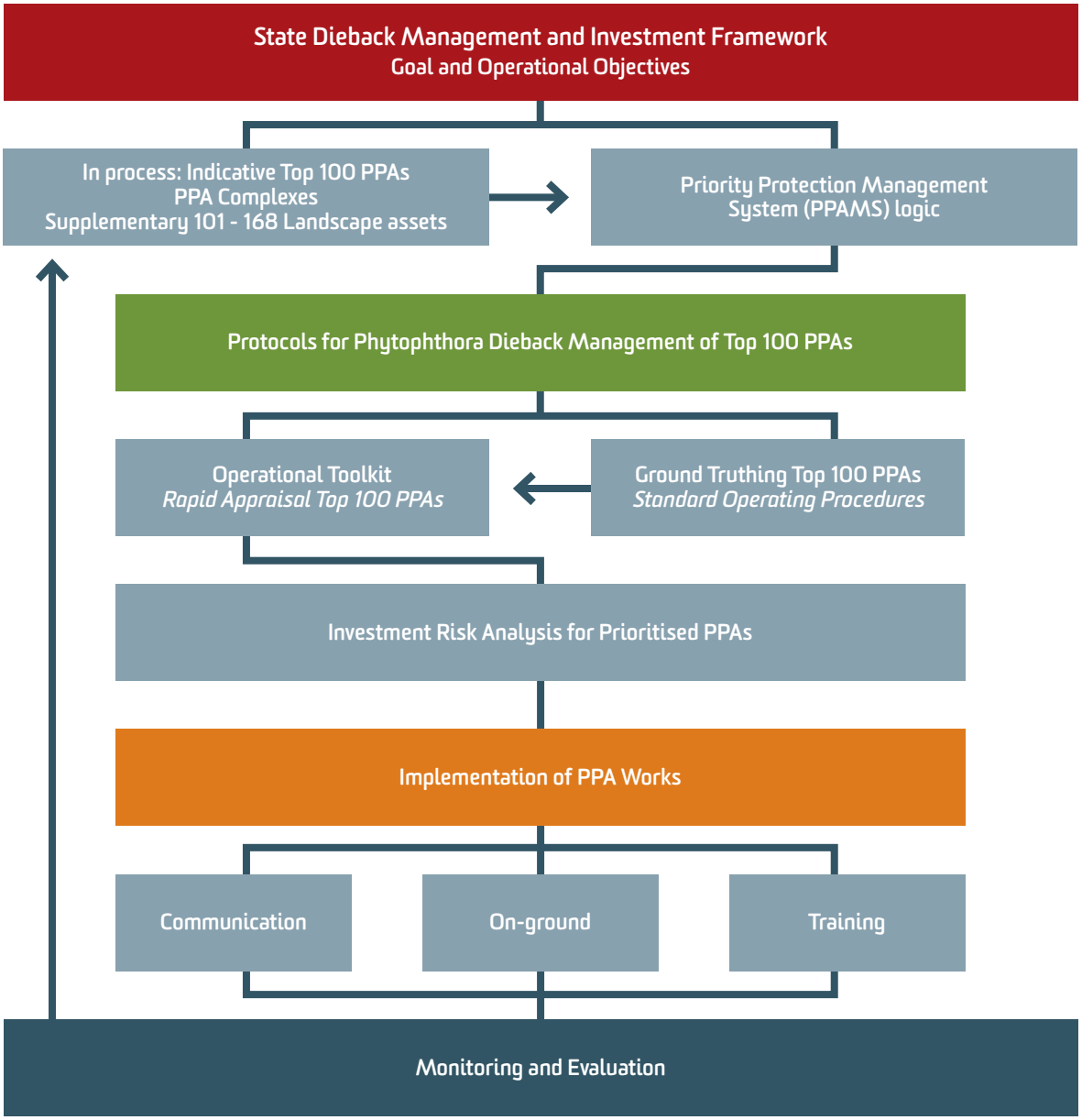

Figure 1: The State Phytophthora Dieback Management and Investment Framework

3.2 Application of the Framework for Phytophthora Dieback management in areas additional to the top 100 Priority Protection Areas

The Framework provides strategic direction for targeted management and investment that can also be used as a standardised tool for any parties wishing to prioritise Phytophthora Dieback management in their local area. Regionally and locally significant biodiversity values susceptible to *P. cinnamomi* can be managed using the Framework by a range of groups and organisations.

While the Framework provides for state wide prioritisation of investment areas this does not mean that Phytophthora Dieback is not an issue within areas outside the top 100 PPAs. It is envisaged that the Framework tools for developing Phytophthora Dieback management strategies and activities can be applied to all areas of remnant vegetation as best practice. For example, local government is encouraged to use the process to prioritise and implement Phytophthora Dieback management within their vested reserves.

4. IDENTIFICATION OF PRIORITY PROTECTION AREAS IN THE SOUTH WEST OF WESTERN AUSTRALIA

4.1 Defining the Phytophthora Dieback risk project area

Traditionally the area considered at risk from Phytophthora Dieback has been defined by the 400mm isohyet. However *P. cinnamomi* can occur outside this boundary rainfall incidence.

The pathogen is most active in warm, moist conditions. To incorporate this factor, regions within the 300mm and 400mm rainfall isohyets receiving high summer rainfall (above 50mm) have also been included in the analysis to identify the Top 100 PPAs (Figure 2).

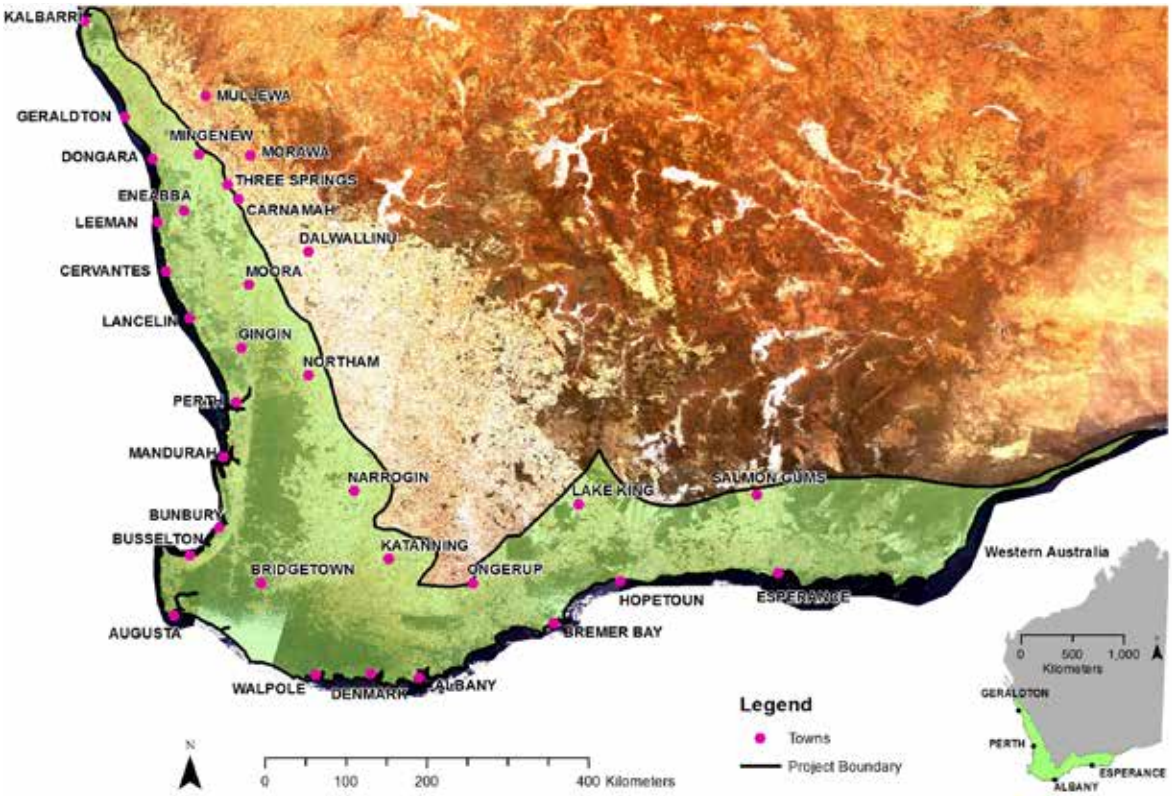

Figure 2: Area highlighted in green considered at risk to Phytophthora Dieback (including areas in the 300-400 mm rainfall isohyets receiving 50-80 mm of rainfall during December to January).

4.2 Prioritisation Process

Consistent with the goal and objectives of the Framework, a prioritisation process was developed to identify PPAs representative of significant biodiverse ecosystems and communities vulnerable to Phytophthora Dieback within the south-west of WA.

The PPA prioritisation process is an automated selection process based on rule sets which utilise state-wide datasets.

The PPAs were defined and prioritised using three key data processing stages:

1. Identification of the analysis boundary and the geographic extent of the initial selection.
2. Refinement of the initial selection to select areas to score and weight.
3. Identification of areas to establish the Top 100 PPAs.

This process is outlined graphically in Figure 3. For more comprehensive detail see Gaia Resources (2014).

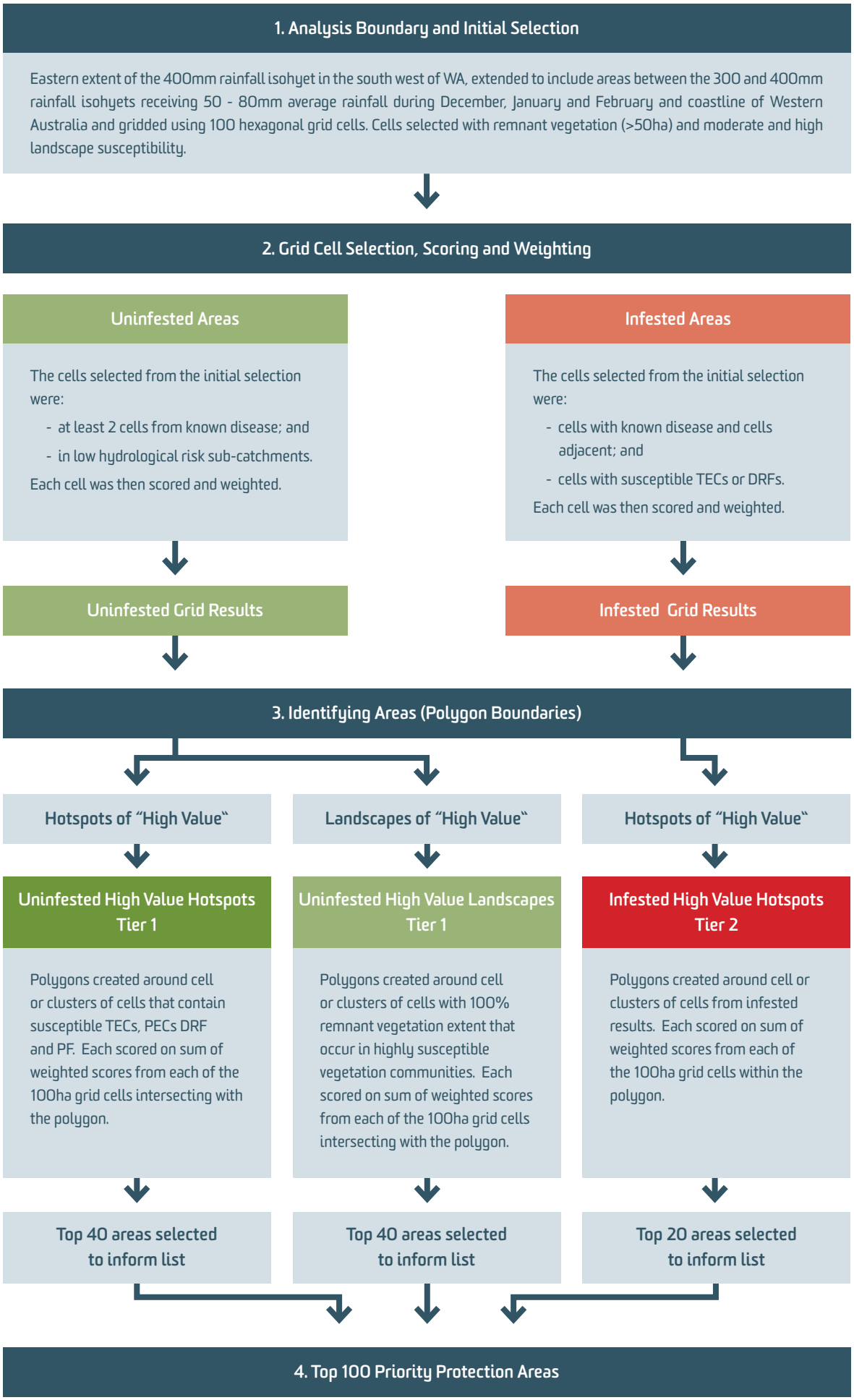

Figure 3: Priority Protection Area Prioritisation Process to identify the Indicative Top 100 Priority Areas for Phytophthora Dieback management over the next 50 years.

The development of the PPA prioritisation was highly iterative. The process to prioritise areas in the initial phase was developed in two themes, **infested** and **uninfested**, based on considerations of direct and indirect threat. Infested areas were considered likely to contain values that may be directly threatened by *P. cinnamomi*, whereas uninfested areas may contain values indirectly threatened from *P. cinnamomi*. It was noted that this rationale had the potential to create bias in the prioritisation analyses, a limitation overcome by prioritising uninfested and infested areas independently.

Because identified PPAs ranged in area as well as in concentration and type of biodiversity values, it was necessary to define criteria to assist prioritisation of investment and management:

- "**Landscape**" PPAs - areas with lower numbers of susceptible species values but with significant remnant vegetation in highly susceptible vegetation communities and landscapes. Considered landscapes of "high value", these require planning at the landscape scale.
- "**Hotspot**" PPAs - relatively smaller areas of high value with high concentrations of species and community values. These require more localised investment to optimise biodiversity outcomes.

During the development of the prioritisation process three types of PPA units were identified:

- **Uninfested High Value Hotspots** - uninfested areas with occurrences of Threatened Ecological Communities, Priority Ecological Communities, Declared Rare Flora and/or Priority Flora;
- **Uninfested High Value Landscapes** - uninfested areas with significant remnant vegetation in highly susceptible vegetation communities and landscapes; and
- **Infested High Value Hotspots** - areas with known infestations of *P. cinnamomi* but which also include occurrences of Threatened Ecological Communities, Priority Ecological Communities, Declared Rare Flora and/or Priority Flora.

The three PPA units were assigned Tier 1 and Tier 2 values. These differentiate between 'uninfested' and 'infested' units. Uninfested areas are considered in general of higher value and require relatively lower investment costs to manage than infested areas. 'Tier 1 hotspots' refer to the 'uninfested hotspot' areas and 'Tier 2 hotspots' refers to the 'infested hotspot' areas. There are only Tier 1 uninfested landscapes in the indicative Top 100 PPAs.

Following prioritisation processing, more than 1,288 potential PPAs were identified from which the Top 100 (indicative) were selected. These reflected the top scoring 40 uninfested high value hotspots, the top 40 uninfested high value landscapes, and the top 20 infested high value hotspots.

The prioritisation process highlights areas with the highest susceptible biodiversity values across the project area. This indicative top 100 selection require further refinement at a local scale with ground truthing for *P. cinnamomi* occurrence and inclusion of additional local and regional data. The methodology and protocols describing this process are outlined later in this report (see Section 5.1 Protocols for the Management of Phytophthora Dieback within the Top 100 Priority Protection Areas).

The prioritisation process was reviewed by the Project Dieback Steering Committee (DSC) and feedback provided by five local area reference groups engaged over the project area. Representatives included Parks and Wildlife, local government authorities (LGA), natural resource management (NRM) groups including South Coast NRM, CPSM, private consultants, key local community groups and community dieback experts as well as utilities including Main Roads WA. This broad-ranging consultation process provided Phytophthora Dieback knowledge at both the state and local scale. Appendix 1 lists the indicative Top 100 PPAs in relation to NRM regions.

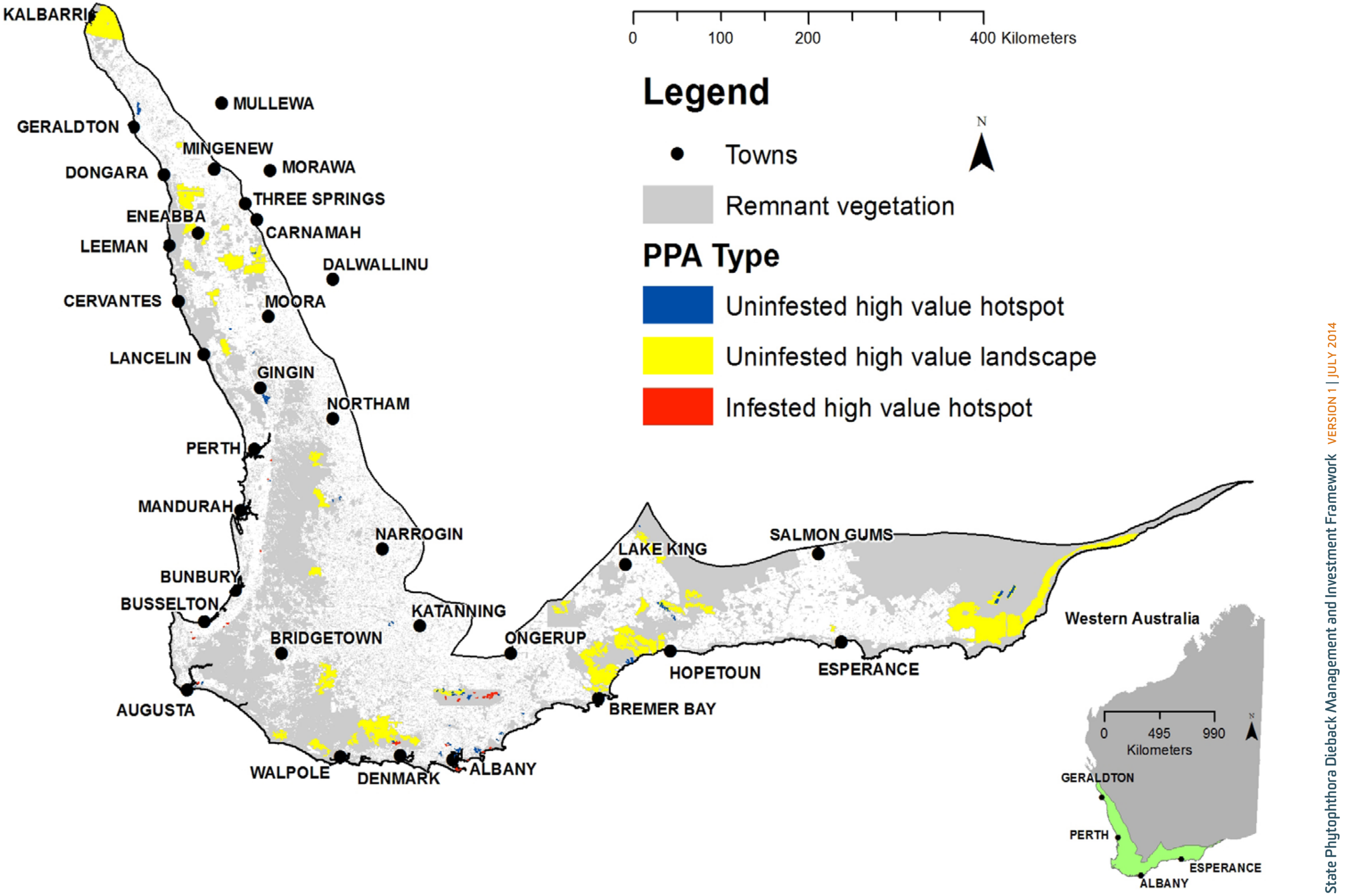

Figure 4: Indicative Top 100 Priority Protection Areas selected during the prioritisation process of Phytophthora Dieback management

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4.3 Vegetation Representation

To measure the extent to which the susceptible vegetation systems in WA were represented, duplicated or not represented in the indicative Top 100 PPAs, they were assessed against:

- Derived *P. cinnamomi* susceptible vegetation;
- IBRA regions;
- Sub-IBRA regions; and
- Beard's Vegetation Systems datasets;

This verification of the Top 100 PPAs identified in the prioritisation process was undertaken to ensure those selected met the overarching goal and operational objectives of the framework.

The Project Dieback study area includes eight IBRA regions, 14 sub-IBRA regions and 94 Beard's vegetation systems. The Top 100 PPAs represent seven IBRA regions, 12 Sub-IBRA regions, and 56 Beard vegetation systems. The Hampton IBRA and Sub-IBRA regions, and the Roe plains vegetation system are not represented and are not considered susceptible to *P. cinnamomi*.

A total of 38 Beard's vegetation systems were not represented. These systems either did not include *P. cinnamomi* susceptible vegetation types, were heavily cleared or occurred in high to medium *P. cinnamomi* risk hydrological landscapes.

The Swan Coastal Plain and Jarrah Forest IBRA sub-regions are not well represented in the prioritisation process. This may be due to extensive clearing of the Swan Coastal Plain and wide-spread *P. cinnamomi* infestations of both the Jarrah Forest and Swan Coastal Plain regions.

These results do not indicate the Swan Coastal Plain or Jarrah Forest does not contain areas of high biodiversity value, but illustrates areas experiencing high fragmentation, smaller area size and high levels of infestation may not meet criteria for inclusion in Top 100 PPA. These regions are acknowledged in other biodiversity management plans and integration of Phytophthora Dieback investment and management should be incorporated into these plans.

4.4 Priority Protection Area Groupings into Complexes

To facilitate a strategic approach to landscape management of Phytophthora Dieback, PPAs within the top 100 were grouped using local expert knowledge where there were:

1. common biodiversity and landscape features; and
2. feasible management/operational boundaries.

These groupings were called PPA **Complex's**. PPA Complexes allow for better integrated management of susceptible landscapes.

PPA Complexes group assets for strategic and holistic management, as illustrated by the Stirling Range Highland complex. This complex includes eight individual PPAs which are geographically close, contain similar vegetation types and are managed by the same management agency. Because the pressures, strategies and risk reduction activities for each PPA unit are similar, management of the complex rather than individual PPAs increases operational efficiency.

In total, the Top 100 PPAs were grouped into 63 complexes. Of these 27 complexes contain multiple PPA and 36 areas are a single PPA. Because of the dynamic nature of ecosystems, the *P. cinnamomi* susceptible biodiversity values within each PPA will require periodic review to confirm the viability of protecting or conserving these values.

The rapid appraisal process in Section 7.1 of this document outlines the protocols and processes to undertake review and develop risk reduction plans. Templates guiding the rapid appraisal can be found in Gaia Resources (2014). The rapid appraisal process has been designed to include stakeholder consultation at local and state level. The process takes into consideration technical and economic constraints, as well as land tenure, land-use and zoning factors that may enhance or constrain management. This process informs the refinement of the PPA Complex boundary into the final PPA Complex management area.

4.5 Supplementary Uninfested Landscapes

In addition to the Top 100 PPA list, an additional 68 supplementary uninfested landscape PPAs, identified in the prioritisation process but outside of the top 100 rankings, were recognized for consideration in the next phase (Operational Toolkit - rapid appraisal process) of the Framework. These were included to:

1. Buffer existing PPAs.
2. Provide greater representation of susceptible vegetation systems; and
3. Be included within the Top 100 PPA rankings should any currently listed PPAs be rejected following the rapid appraisal phase or during the on-going management of the Framework system.

The concept of 'supplementary uninfested landscape was introduced so that these additional areas could be differentiated from the uninfested landscapes in the Top 100 PPAs.

The supplementary uninfested landscapes are generally linked to a Top 100 PPA and can be included as part of a PPA Complex. Any investment in a supplementary uninfested landscape will need to benefit a Top 100 PPA, with the possible exception of 5 of the supplementary uninfested landscapes which do not have an associated top 100 PPA. These five were included based on connectivity values and representativeness gaps in Beard's vegetation mapping. A full list of supplementary uninfested landscapes can be found in Appendix 2.

Table 1 describes the Tiers and categories of the PPAs while Figure 5 illustrates the Top 100 PPAs and associated supplementary uninfested Landscape additions.

Table 1: Tiers and categories of Priority Protection Areas for Phytophthora Dieback management

PPA Type	Tier & Category	Description
Uninfested High Value Hotspot	Tier 1 uninfested hotspots	Uninfested high value areas with concentrations of high value species, community and landscapes). Generally smaller than Tier 1 uninfested landscapes.
Uninfested High Value Landscape	Tier 1 uninfested landscapes	Extensive uninfested high value areas with dispersed values (species, community and landscapes). Generally larger areas with landscape values.
Infested High Value Hotspot	Tier 2 infested hotspots	Infested high value areas and a concentration of high value species and communities within a small area.
Additional Uninfested PPA Landscape	Supplementary uninfested landscapes	Uninfested value areas identified through local area review processes and fewer dispersed values throughout. PPAs outside of initial top 100 PPAs. (Supplementary or reserve list for further consideration)

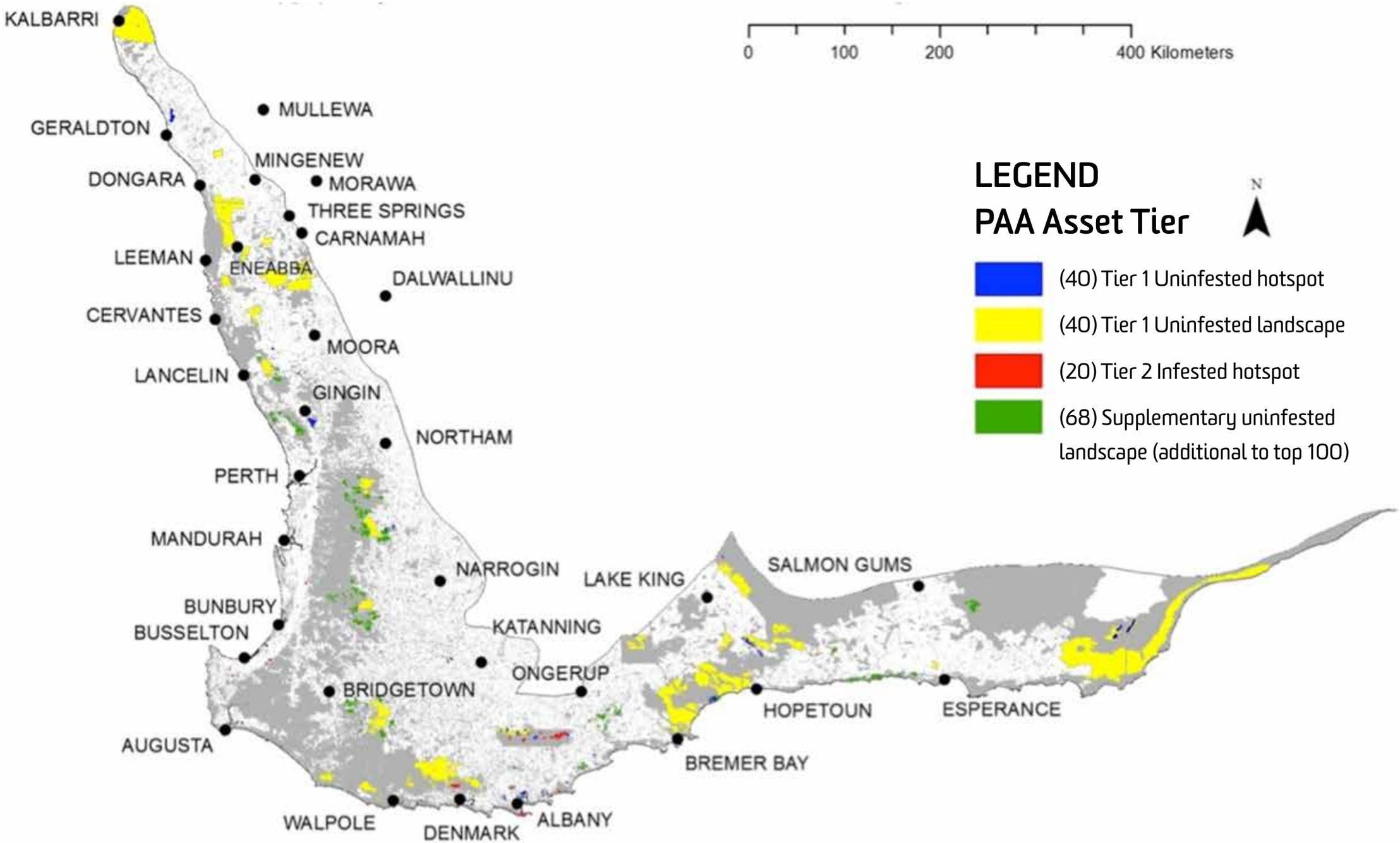

Figure 5. Map showing Top 100 Priority Protection Areas and associated supplementary uninfested landscapes in green.

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4.6 Adaptive management of the top 100 Priority Protection Areas

The prioritisation process is an adaptive process which will continue to evolve, incorporating new developments and data sets through periodical review. During the development of the process, areas of improvement have been recognised with recommendations as outlined below:

- The state wide datasets are generically broad. From the beginning of the PPA prioritisation process it was acknowledged that there was an information gap in the State datasets, e.g. the State *P. cinnamomi* occurrence data, vegetation/flora (Declared Rare and Priority flora).

  Recommendation: Improve the coverage, accuracy and standardisation of state wide datasets. The most current datasets including *P. cinnamomi* occurrence and biodiversity assets should be considered when undertaking periodic review/ reassessments of the Framework.

  Further measures undertaken to enhance dataset quality included:

  - To cover a gap in the state data sets available a susceptible vegetation dataset based on Beard's vegetation was developed in conjunction with local experts. This was a key data set utilised in the prioritisation process;
  - Ground truthing of *P. cinnamomi* occurrence within identified PPAs through the rapid appraisal process (see section 5.1). (NB: Ground truthing *P. cinnamomi* other than within the PPAs is outside the scope of this project and would require additional resourcing).
  - Incorporation of existing local and regional data sets, e.g. flora and dieback mapping relevant to identified PPAs, during the rapid appraisal process (see section 5.1).

- Expert opinion was utilised in weighting scores for values, however, limited timeframes prevented a sensitivity analysis of the weighting scores from being undertaken.

  Recommendation: When reviewing the Framework in early 2015, utilise a rigorous standardisation system to run the weighting scores through a sensitivity analysis. This will facilitate the systematic identification of objectives and prioritisations.

5. LOGIC OF THE PRIORITY PROTECTION AREA MANAGEMENT SYSTEM

The Priority Protection Area Management System (PPAMS) (SCNRM 2014) was developed during the development of the indicative top 100 PPAs. The PPAMS is designed to support a uniform and coordinated approach by stakeholders and land managers for planning Phytophthora Dieback management across PPAs/PPA Complexes. Appendix 4 contains a flow logic diagram of PPAMS.

The PPAMS was developed by integrating and adapting the:

- Australasian Inter service Incident Management System (AIIMS);
- Investment Framework for Environmental Resources (INFFER) (Pannell 2008); and
- Biorisk Decision Framework (Wallace 2008).

The principles underpinning the PPAMS are:

1. Management by objective - "a process of consultative management by which a Dieback Management Team determines the desired outcomes or objectives for a PPA/ PPA Complex threatened by *P. cinnamomi* ";

2. Span of Control - "the number of groups or individuals that one person can directly and successfully supervise"; and
3. Management by function - "divided into four sections, each with defined functions and responsibilities, categorised according to:
   - control
   - operations
   - planning; and
   - logistics.

A consistent approach to Phytophthora Dieback management will facilitate stakeholders and land managers to share necessary skills and knowledge to assist one another when required.

5.1 Protocols for the Management of Phytophthora Dieback within the top 100 Priority Protection Areas

Following the PPAMS logic, a hierarchical series of protocols was developed to assess the Phytophthora Dieback status and hazard elements and to develop risk reduction plans for the specific PPAs/complexes.

Figure 6 flow chart outlines the process for Phytophthora Dieback management within the Top 100 PPAs. Local technical groups are referred to as LTG and the State Dieback Steering Committee as SDSC. Protocols are then provided in further detail.

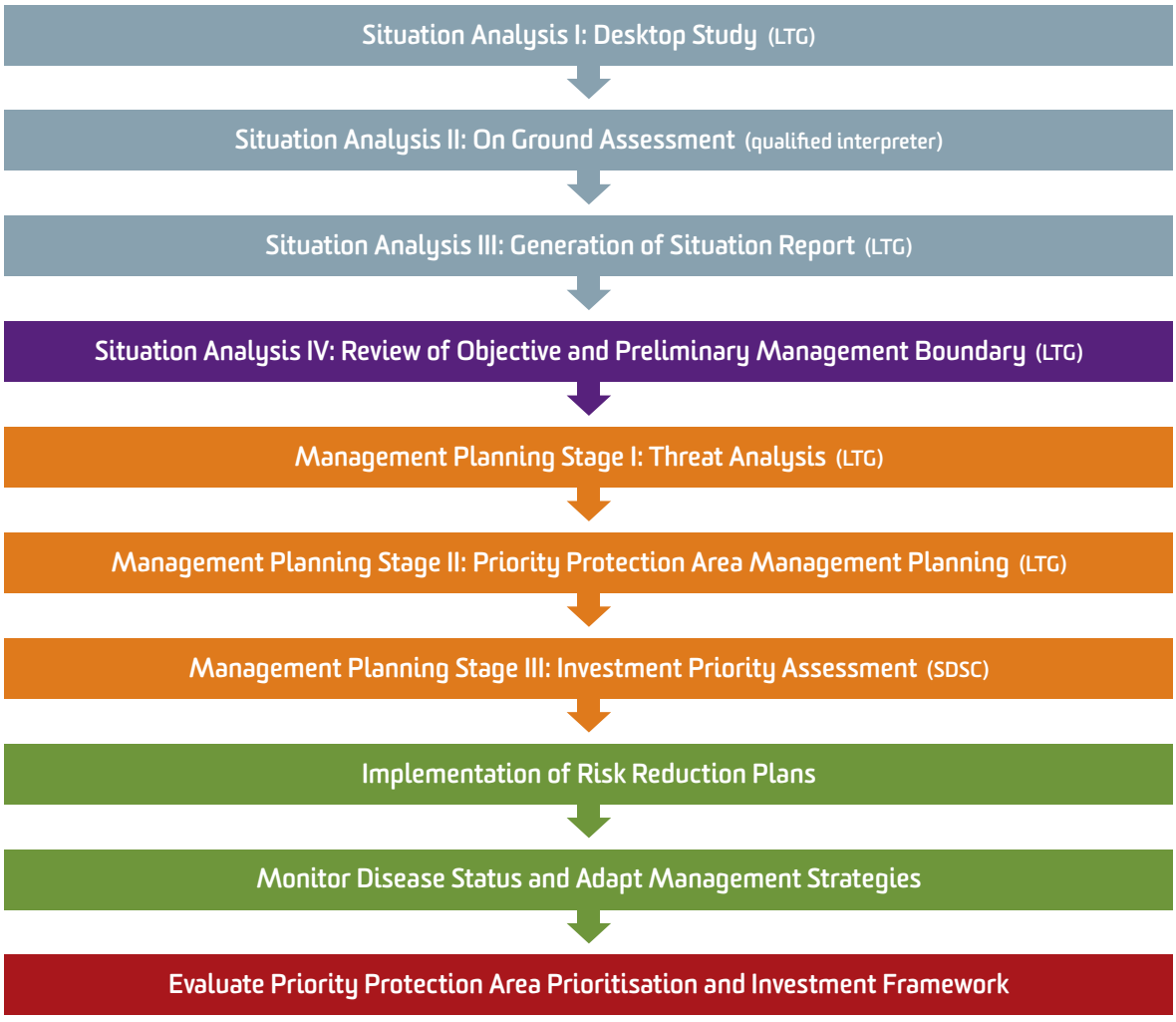

Figure 6: Flow Chart outlining the process for developing management plans for preventing further spread of Phytophthora Dieback within the top 100 Priority Protection Areas.

The protocols (Situation Analysis I to Management Planning Stage III) correlate with an operational, 'rapid appraisal' toolkit which is based on the existing Parks and Wildlife rapid appraisal management systems in place for fire management and adapted for Phytophthora Dieback management purposes. This provides a standardised decision support tool for operational use, consistent with existing methods. This approach promotes clear and consistent management prioritisation and allows for adaptive management of Phytophthora Dieback.

1. Situation Analysis I: Desktop Study

The desktop process using local expert knowledge refines the state datasets used in the prioritisation process and incorporates any additional datasets. The information used includes the known biodiversity values threatened by Phytophthora Dieback, existing *P. cinnamomi* occurrence information and hazard elements including identification of potential vectors and factors affecting the autonomous spread of the pathogen.

2. Situation Analysis II: On Ground Assessment

The on ground assessment allows for an evaluation of the biodiversity values threatened by Phytophthora Dieback such as the status of Declared Rare/Priority flora populations and condition of any Threatened/Priority ecological communities.

P. cinnamomi occurrence assessment may include:

- Potential disease vectors including roads and other service infrastructure, gravel pits and other areas where soil moving activities and human traffic provide a potential for the introduction of the disease;
- Soil and tissue sampling using traditional bait sampling method of analyses at areas with deaths of susceptible indicator species in a pattern consistent with Phytophthora Dieback; and
- Sampling within lower interpretability and/or susceptibility landscapes using next generation gene sequencing (NGS) testing for *P. cinnamomi*, particularly at high risk areas (i.e. moisture gaining sites). This method should be used where; susceptible species do not occur in locations influencing the sample point and; in areas where it is believed that an incursion may have occurred (e.g. illegal road access) but environmental conditions have not yet been conductive for disease to develop (e.g. adequate rainfall).

3. Situation Analysis III: Generation of Situation Report

Based on findings of the desktop and on ground assessments, the most up-to-date information is to be used to complete the situation analysis of the PPA. At this stage necessary information to commence the management planning process to protect and conserve the biodiversity values threatened by Phytophthora Dieback within a PPA/PPA Complex will have been determined.

4. Situation Analysis IV: Review of Objective and Preliminary Management Boundary

The adaptive management process allows the PPA values objectives set in situation analysis I to be reassessed based on the information determined in the situation analysis III. Results may indicate the objective is no longer achievable or requires refinement. At this stage the proposed management boundary is reviewed and finalised.

Further refinements in the situation analysis are captured through ongoing operational monitoring and evaluation, which may in turn initiate an adaptation in management strategy/activity and or management objective(s). The process is iterative and promotes regular evaluation of the management objective and effectiveness of management strategies.

5. Management Planning Stage I: Threat Analysis

The initial management planning stage consists of a Threat Analysis to identify the greatest threats of future introduction or spread of Phytophthora Dieback within and surrounding the PPA. This is undertaken in context to a PPA management objective, which considers the risk of *P. cinnamomi* introduction impact to PPA values and the achievement of management goals.

Current threat of vector hazards (e.g. human vectoring) and autonomous transmission pathways (e.g. natural pathways of spread) are evaluated to model the future spread of Phytophthora Dieback and to identify significant protectable areas, or management activities.

6. Management Planning Stage II: Priority Protection Area Management Planning

Following step 5, specific management strategies and activities are developed to:

1. Prevent the future introduction or spread of Phytophthora Dieback.
2. Contain and eradicate any high priority disease centres already present within the PPA boundary.
3. Develop targeted stakeholder engagement programs and associated communication plans to reduce the risk of any identified high risk activities.

Strategies and activities for each PPA or PPA complex should incorporate short to medium term targets, while encompassing the broader 50 year objectives outlined in Section 1.2.

Feasibility assessments of the strategies considering economic, cost, technical, socio-political factors should also be undertaken at this stage.

7. Management Planning Stage III: Investment Priority Assessment

Economic feasibility assessments for each PPA Risk Reduction Plan are to be developed at a local technical group level for evaluation and comparison through an investment risk assessment analysis. The Dieback Steering Committee and invited attendees will evaluate the proposed PPA Risk Reduction Plans in order to maximise successful investment in on-ground management activities and management goal success.

Investment will be based upon results of:

1. Situation analyses.
2. Management objective(s) set for the PPA.
3. Final feasibility assessment.

NB: This element of the process relates to situations where the management activity requires external (NRM or other State/National) funding investment. If implementation costs can be internally funded, referral to the Steering Committee is not necessary.

8. Implementation of Risk Reduction Plans

The Risk Reduction Plans and associated activity tasks are implemented for the nominated PPA management area. Activity tasks may include access controls, installation of signage and hygiene infrastructure, commencement of containment/eradication projects and impact reduction activities including phosphite treatment.

9. Monitor Disease Status and Adapt Management Strategies

The effectiveness of the management strategies, together with disease status and boundaries within the PPA, are to be monitored over time. Management strategies to be further refined as required through ongoing adaptive management within each PPA management area.

10. Evaluate Priority Protection Area Prioritisation and Investment Framework

Before the finalisation of the State NRM funded project, the PPA prioritisation process will be reviewed in the first half of 2015 and evaluated by the DSC. This evaluation will allow for further refinement of the processes developed in the Framework, together with the identification of future Phytophthora Dieback investment priorities and processes.

It is recommended that future reviews of the Framework occur periodically, at least every 10 years.

6. RECOMMENDATIONS AND FUTURE INVESTMENT

The unique biogeographic region of Southwest Australia covers over 300 000 square kms and is recognised as one of the top 35 global biodiversity hotspots. The introduction of invasive species including *Phytophthora cinnamomi* since European settlement of WA provide the greatest challenge to the future conservation of this rich, diverse flora and fauna. Phytophthora Dieback poses an immediate and significant threat to vulnerable plant species and high-value ecosystems within this region. Unless on-going, targeted investments are made directly, opportunities to prevent the permanent loss of conservation values will be gone.

The need for rigorous priority setting for investment in Phytophthora Dieback management across land tenure has been acknowledged and is the focus of this report. It builds on considerable effort undertaken by community, industry and government to date, however, unless partnerships continue and commitments are made to implement strategies and activities to mitigate impact and spread of Phytophthora Dieback, there is risk that past efforts may be lost.

Implementation of the rapid appraisal process and recommendations within this report aim to ensure targeted and strategic management of Phytophthora Dieback within WA for the co-ordinated protection and conservation of high value areas into the future. While every effort will be made to maintain and implement the Framework into the future the capability to do this is dependent on on-going resources and therefore subject to funding and competing priorities of governments and their agencies, together with their future responsibilities, roles and directions.

6.1 Planning and policy mechanisms

The Federal, State and Local Government's through their agencies and regulatory functions have key roles to play in addressing the threat of Phytophthora Dieback across all land tenures.

Effective and targeted use of legislation, policies and procedures along with awareness raising, community education and on ground works are essential to achieving the long term goals of the Framework.

State and federal legislation, policies and guidelines should be periodically reviewed to identify improvements that can be implemented to assist in addressing the management of Phytophthora Dieback, particularly the protection and conservation of PPAs.

6.2 Partnerships and communication

Achieving the Framework goal 'To protect and conserve the most significant examples of the biodiverse ecosystems and communities of the south west of Australia that are vulnerable to, or threatened by, Phytophthora Dieback over the next 50 years' requires continued partnerships between commonwealth, state and local governments, industry and local community groups.

Through the development of the Framework key partnerships have been strengthened. This has been achieved primarily through the Dieback Steering Committee and the Local Area Reference Groups. Currently the life of the Dieback Steering Committee is limited (at this stage) to the life of this project. However, it is proposed that there be a much longer timeframe for the PPAs and State Dieback Management and Investment Framework.

For partnerships in Phytophthora Dieback management to continue over the next 50 years it is recommended that a state Dieback Advisory Team be appointed. This advisory group would be made up of key stakeholder organisations to:

- Continue to foster partnerships,
- Provide governance
- Champion collaborative management and communication of Phytophthora Dieback across Western Australia

- Play a role in driving the communication of the Framework to the broader community.

The role of the Dieback Advisory Team and its activity would depend on the level of future resources available to maintain and implement the Framework.

At a local level where appropriate, 'action groups' for PPA management areas could be established. These groups could drive partnership opportunities and on-going management specific to PPA management areas. These can be formed during the rapid appraisal process where key stakeholders are identified. In some cases existing partnership mechanisms such as advisory groups or friends groups for conservation reserves could be used to achieve these objectives.

An important next step in the process is to facilitate public recognition of PPA's, their values and potential threats, together with specific actions required to ensure they are not infested as a result of human activities. Project Dieback will liaise with key agencies in raising awareness of Phytophthora Dieback and PPA's, with the aim of facilitating the development of specific and collaborative measures to enhance the recognition and protection of the biodiversity values of PPA's, and wider adoption of the Framework as a tool to enhance targeted Phytophthora Dieback management.

6.3 Collaborative investment

The impact of Phytophthora dieback upon valued ecosystems is recognised at local, state and federal levels. It is considered a major threatening process in federal legislation and is the focus of a recent Australian Government Threat Abatement Plan. Nevertheless, impediments to government funding exist and new opportunities to resource threat abatement actions are required.

This Framework through the operational toolkit – rapid appraisal process will develop management strategies and activities for PPAs for both short and long term application. It is envisaged that these will provide a platform for future funding opportunities at local, state and federal levels, government and non-government, to ensure land managers have the resources to implement risk reduction plans for critical PPAs.

For success, protection and conservation of biodiversity must be a community concern. Many industries including mining, tourism, horticulture and forest products have direct interest in protecting biodiversity from the impacts of *P. cinnamomi.* Joint delivery of projects and/or corporate sponsorship from a range of investment streams for research and management should be encouraged.

7. ACKNOWLEDGEMENTS

Funding for the State Dieback Management and Investment Framework 2014 was provided by the Western Australian State NRM Strategic Program. This document was developed by South Coast NRM with contributions from Elissa Stewart (South Coast NRM), Joanna Young (DSC), Tilo Massenbauer (South Coast NRM), Christopher Dunne (Parks and Wildlife) and direction from the Dieback Steering Committee.

Technical development and processing undertaken for the Top 100 prioritisation process and rapid appraisal process was achieved in collaboration with Gaia Resources, Tilo Massenbauer (South Coast NRM) and Christopher Dunne (Parks and Wildlife). Technical advice and review was provided by the Dieback Steering Committee [Joanna Young, Gary Whisson, Geoff Stoneman (Parks and Wildlife), Giles Hardy (CPSM), Carl Beck (South Coast NRM), Peter Elliot (DCC) and Ian Colquhoun (DWG)]. Five local area reference groups (Northern Agricultural Region to Esperance) also contributed to the review of the prioritisation protection areas process.

Many other agency and community members participated throughout the process and South Coast NRM gratefully acknowledges the contributions of all parties. Project Dieback is managed by Elissa Stewart with assistance from Karl Hansom of South Coast NRM.

Maps were produced by Gaia Resources and Tilo Massenbauer.

8. GLOSSARY

TERM	DEFINITION
Biodiversity	Biodiversity comprises all the millions of different species that live on our planet, as well as the genetic differences within species. It also refers to the multitude of different ecosystems in which species form unique communities, interacting with one another and the air, water and soil (Swingland, 2001)
Communities	Threatened and Priority Ecological Communities recognised by State and National legislation and/or as key environmental factors
DIDMS	The web based prototype Dieback Information Delivery and Management System (DIDMS). The system has been developed to: ▪ report on the status of Phytophthora dieback throughout WA; ▪ provide information to a broad range of interested stakeholders; ▪ manage Phytophthora dieback information; and ▪ support users to share information. DIDMS is a web based intelligence system designed to guide government, industry and community in their decision making and provide an effective tool to collate and store dieback information.
Feasibility	Reduce susceptibility and/or hazards to: ▪ reduce vulnerability of ecosystems to disease spread and/or impact ▪ reduce threat of Phytophthora dieback spread resulting in goal failure, e.g. reduction or loss of high value biodiversity assets.
Goal	The desired outcome of management constrained in both space and time. Under this framework, goals are expressed in terms of the desired end-states of existence (values). The outcome expressed in the goal identifies the primary values desired as the endpoint of management.
Hazards	Hazards are the autonomous and vectored spread activities (or situations) that increase the potential to mobilise and/or introduce *P. cinnamomi*
Landscapes	For this report, landscapes should be used in context as areas (considered to be uninfested) of conservation significant remnant vegetation in moderate to highly susceptible vegetation communities
Infested	Areas a certified interpreter determines to have plant disease symptoms consistent with the presence of *Phytophthora cinnamomi* .
Operational toolkit	The operational toolkit is based on existing Parks and Wildlife rapid appraisal management systems in place for fire management and adapted for Phytophthora Dieback management purposes. It has five templates which provide step by step the process to refine indicative PPA areas to developing area specific management strategies and activities.
Phytophthora cinnamomi	A soil-borne water mould that produces an infection which causes a condition in plants called root and collar rot or dieback. The plant pathogen is one of the world's most invasive species and impacts over 40% of south-west Western Australian native plant species

TERM	DEFINITION
Phytophthora Dieback	The root and root rot disease caused by *Phytophthora cinnamomi*.
Priority Protection Area (PPA)	An area that has been identified as representative of significant biodiverse ecosystems and communities threatened by P. cinnamomi.
PPA Complex	An amalgamation of PPAs with common biodiversity and landscape features
PPA multi Complex	A PPA complex that consists of multiple PPAs
PPA single Complex	A PPA complex that consists of a single PPA
PPA asset boundary	A defined geographical area that contains recognised significant biodiversity values susceptible to Pc impact and meet criteria* for determining an asset type: 1. Uninfested hotspot and/or 2. Infested hotspot and/or 3. Uninfested landscape. A PPA Asset boundary can contain multiple PPA types. * Criteria – Biodiversity values susceptible to Pc impact – Proximity to known and verified Pc infestations, (determines Infested Uninfested Asset status) – Values that are geographically concentrated with rare and priority species and communities (determines Hotspot status) , and – Values that are geographically dispersed rare and priority species, communities and landscapes, (Determines Landscape status)
PPA management boundary	A defined geographical area that contains hazards and stakeholders within and surrounding a PPA asset that will affect current and future management, in order to achieve a set objective/s.
PPA values	The various characteristics for which a PPA is assessed.
Risk	Risk (DEC policy Statement 3) The chance of an uninfested area becoming infested through the autonomous actions of the pathogen (*P. cinnamomi*) or the actions of people and/or animals or a combination of these factors, measured in terms of the magnitude of consequences of that event should it occur and the likelihood of the event and its consequences occurring and assessed in the context of existing controls.
Protectable area	Protectable areas are those within which the values are significant and the benefits of Phytophthora dieback hygiene are likely to be sustained for more than a few decades. Protectable areas prioritise and concentrate available resources on rigorous application of hygiene for their protection. Protectable areas are generally defined as disease free areas greater than four hectares with an axis greater than 100 meters, and being positioned in the landscape so as avoid autonomous infestation. They have controllable vectors and high conservation and/or socio-economic value (DPaW, 2013)

TERM	DEFINITION
Species	In this report "species" refers to those values used in the selection and prioritisation of PPAs process. These include Declared Rare and Priority (1, 2 and 3) flora species recognised by State and National legislation and/or as key environmental factors.
Susceptibility	Susceptibility refers to the impact *P. cinnamomi* may have on a value
Threat	Threat refers to the risk of *P. cinnamomi* impact/disturbance resulting in goal/objective failure (SCNRM, 2014)
Uninfested	Areas determined by a certified interpreter to be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.
Values	Values refer to the species, community and landscape criteria developed in the prioritisation process. These values underpin PPA objectives.
Vulnerability	The aggregation of the susceptibility of values and occurrence of hazards – Total Susceptibility x Total Hazard.

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Appendix – 1 Indicative Top 100 Priority Protection Area list

Note PPA Map ID column can be cross referenced with maps in Appendix 3.

PPA Map ID	NRM Region	PPA Name	Category	Remnant Vegetation (Ha) in PPA
33	Avon	Far West Greater Western Woodlands Complex	Uninfested high value hotspot	300
64	Avon	Far West Greater Western Woodlands Complex	Uninfested high value landscape	8600
53	Avon	Lake Magenta	Uninfested high value landscape	9700
32	Avon	NE Jarrah Complex	Uninfested high value hotspot	397
34	Avon	NE Jarrah Complex	Uninfested high value hotspot	464
63	Avon, South Coast	Far West Greater Western Woodlands Complex	Uninfested high value landscape	18200
36	Avon, Swan	Muchea east	Uninfested high value hotspot	2370
67	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	12500
65	Avon, SWCC	NE Jarrah Complex	Uninfested high value landscape	13600
37	NAR	39	Uninfested high value hotspot	258
38	NAR	Yandin	Uninfested high value hotspot	106
72	NAR	Alexander Morrison	Uninfested high value landscape	29800
76	NAR	Arrowsmith Complex	Uninfested high value landscape	21500
77	NAR	Arrowsmith Complex	Uninfested high value landscape	30594
78	NAR	Arrowsmith Complex	Uninfested high value landscape	10200
69	NAR	Badgingarra	Uninfested high value landscape	9300
79	NAR	Burma Road	Uninfested high value landscape	4500
40	NAR	Chapman Ranges	Uninfested high value hotspot	1883
74	NAR	Eneabba	Uninfested high value landscape	5600
80	NAR	Kalbarri	Uninfested high value landscape	84600
70	NAR	Lesueur	Uninfested high value landscape	6900
39	NAR	Pinjarrega Complex	Uninfested high value hotspot	800
71	NAR	Pinjarrega Complex	Uninfested high value landscape	20000
73	NAR	Pinjarrega Complex	Uninfested high value landscape	14800
75	NAR	Tathra	Uninfested high value landscape	4600
5	South Coast	Angove Water Reserve Complex	Uninfested high value hotspot	711
6	South Coast	Angove Water Reserve Complex	Uninfested high value hotspot	1154
60	South Coast	Arid Nuytsland Complex	Uninfested high value landscape	148600
3	South Coast	Bakers Junction	Uninfested high value hotspot	1329
83	South Coast	Betty's Beach	Infested high value hotspot	287
8	South Coast	Cheynes	Uninfested high value hotspot	143
2	South Coast	Down Road Nature Reserve	Uninfested high value hotspot	474
22	South Coast	Fitzgerald core Complex	Uninfested high value hotspot	1400
23	South Coast	Fitzgerald core Complex	Uninfested high value hotspot	1299

PPA Map ID	NRM Region	PPA Name	Category	Remnant Vegetation (Ha) in PPA
50	South Coast	Fitzgerald east Complex	Uninfested high value landscape	8800
51	South Coast	Fitzgerald east Complex	Uninfested high value landscape	67500
48	South Coast	Fitzgerald west Complex	Uninfested high value landscape	8900
49	South Coast	Fitzgerald west Complex	Uninfested high value landscape	78088
82	South Coast	Gull Rock	Infested high value hotspot	159
52	South Coast	Helms	Uninfested high value landscape	2000
13	South Coast	Mettlers	Uninfested high value hotspot	360
7	South Coast	Millbrook Nature Reserve Complex	Uninfested high value hotspot	500
85	South Coast	Millbrook Nature Reserve Complex	Infested high value hotspot	526
4	South Coast	Mount Lindesay Complex	Uninfested high value hotspot	500
44	South Coast	Mount Lindesay Complex	Uninfested high value landscape	10100
45	South Coast	Mount Lindesay Complex	Uninfested high value landscape	63968
84	South Coast	Mount Lindesay Complex	Infested high value hotspot	1991
86	South Coast	Mount Manypeaks	Infested high value hotspot	500
10	South Coast	Porongurup	Uninfested high value hotspot	200
26	South Coast	Ravensthorpe Range Complex	Uninfested high value hotspot	1090
27	South Coast	Ravensthorpe Range Complex	Uninfested high value hotspot	2371
28	South Coast	Ravensthorpe Range Complex	Uninfested high value hotspot	495
54	South Coast	Ravensthorpe Range Complex	Uninfested high value landscape	7600
57	South Coast	Ravensthorpe Range Complex	Uninfested high value landscape	5400
29	South Coast	Russell Ranges Complex	Uninfested high value hotspot	1600
30	South Coast	Russell Ranges Complex	Uninfested high value hotspot	1700
31	South Coast	Russell Ranges Complex	Uninfested high value hotspot	3200
61	South Coast	Russell Ranges Complex	Uninfested high value landscape	8300
62	South Coast	Russell Ranges Complex	Uninfested high value landscape	3100
15	South Coast	Stirlings high lands Complex	Uninfested high value hotspot	1700
19	South Coast	Stirlings high lands Complex	Uninfested high value hotspot	400
88	South Coast	Stirlings high lands Complex	Infested high value hotspot	800
89	South Coast	Stirlings high lands Complex	Infested high value hotspot	500
90	South Coast	Stirlings high lands Complex	Infested high value hotspot	400
91	South Coast	Stirlings high lands Complex	Infested high value hotspot	500
92	South Coast	Stirlings high lands Complex	Infested high value hotspot	300
93	South Coast	Stirlings high lands Complex	Infested high value hotspot	4000
14	South Coast	Stirlings low lands Complex	Uninfested high value hotspot	800
16	South Coast	Stirlings low lands Complex	Uninfested high value hotspot	400
17	South Coast	Stirlings low lands Complex	Uninfested high value hotspot	300
18	South Coast	Stirlings low lands Complex	Uninfested high value hotspot	800
20	South Coast	Stirlings low lands Complex	Uninfested high value hotspot	556

PPA Map ID	NRM Region	PPA Name	Category	Remnant Vegetation (Ha) in PPA
21	South Coast	Stirlings low lands Complex	Uninfested high value hotspot	250
46	South Coast	Stirlings low lands Complex	Uninfested high value landscape	9100
81	South Coast	Torndirrup	Infested high value hotspot	1237
55	South Coast	Upper Oldfield Complex	Uninfested high value landscape	14200
59	South Coast	Upper Oldfield Complex	Uninfested high value landscape	9900
58	South Coast	Upper Phillips	Uninfested high value landscape	9600
1	South Coast	Walmsey	Uninfested high value hotspot	262
43	South Coast	Walpole wilderness	Uninfested high value landscape	6600
9	South Coast	Wongerup Creek	Uninfested high value hotspot	396
66	South Coast, Rangelands	Arid Nuytsland Complex	Uninfested high value landscape	128500
68	Swan	Namming	Uninfested high value landscape	11300
100	Swan	Rushton Road	Infested high value hotspot	123
25	SWCC	19	Uninfested high value hotspot	297
24	SWCC	27	Uninfested high value hotspot	300
41	SWCC	Broke Inlet	Uninfested high value landscape	12700
56	SWCC	Central East Jarrah Complex	Uninfested high value landscape	8900
42	SWCC	D"Entrecasteaux	Uninfested high value landscape	8994
96	SWCC	East Whicher Scarp Complex	Infested high value hotspot	63
97	SWCC	East Whicher Scarp Complex	Infested high value hotspot	252
35	SWCC	Mundijong Complex	Uninfested high value hotspot	123
99	SWCC	Mundijong Complex	Infested high value hotspot	101
11	SWCC	Scott River Ironstone Complex	Uninfested high value hotspot	98
12	SWCC	Scott River Ironstone Complex	Uninfested high value hotspot	194
87	SWCC	Scott River Ironstone Complex	Infested high value hotspot	266
47	SWCC	Southern Jarrah Complex	Uninfested high value landscape	30896
94	SWCC	West Whicher Scarp Complex	Infested high value hotspot	151
95	SWCC	West Whicher Scarp Complex	Infested high value hotspot	83
98	SWCC	Yarloop	Infested high value hotspot	162

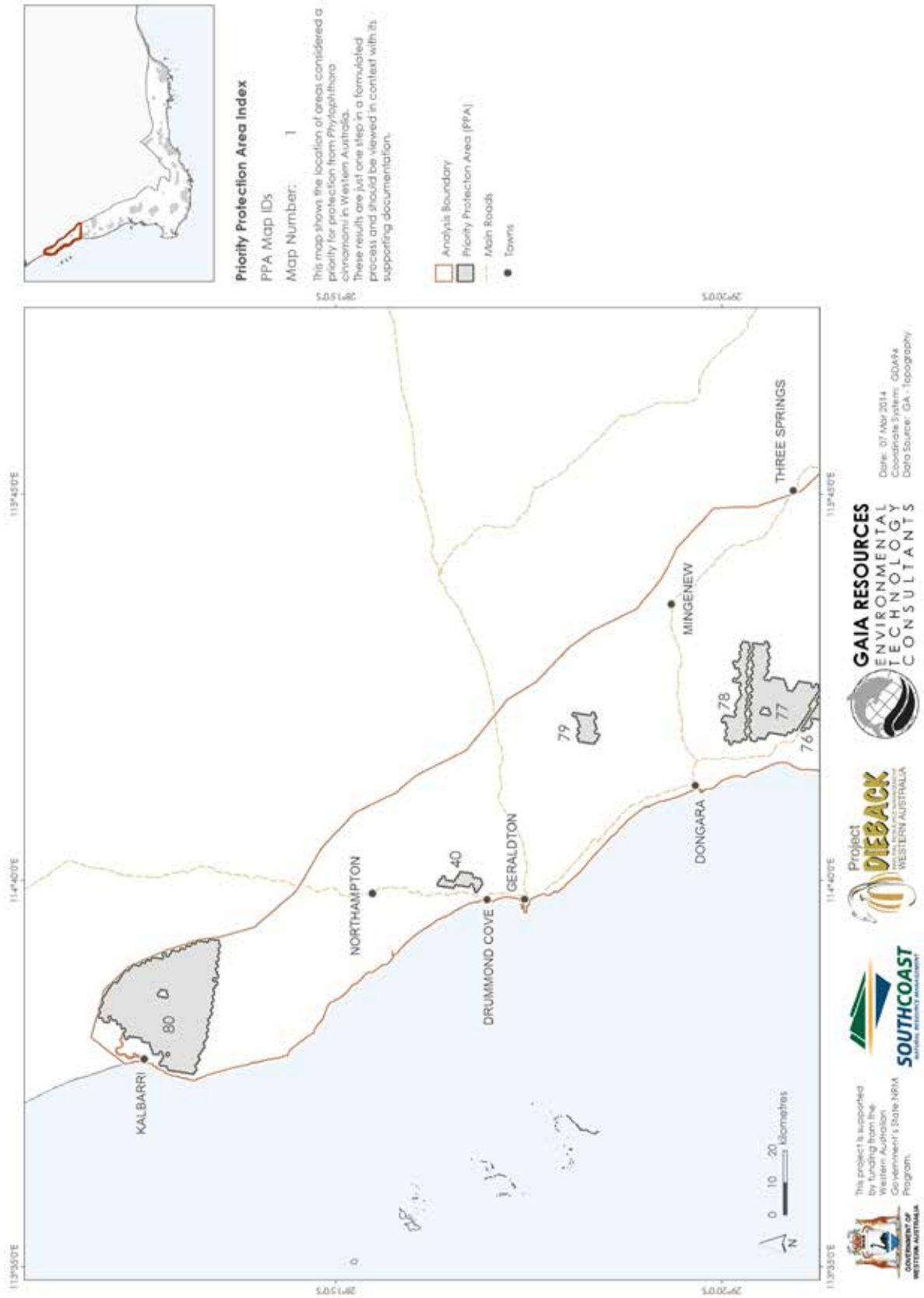
Appendix 2 – Supplementary uninfested landscapes

Map ID	NRM Region	PPA Name	Category	Remnant Vegetation (Ha) in PPA
Additional	Avon	NE Jarrah Complex	Uninfested high value landscape	2800
Additional	Avon, NAR, Swan	Muchea Complex	Uninfested high value landscape	5600
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	3100
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	2900
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	7900
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	7700
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	800
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	2900
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	5900
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	2600
Additional	Avon, Swan	NE Jarrah Complex	Uninfested high value landscape	1000
Additional	Avon, Swan, SWCC	NE Jarrah Complex	Uninfested high value landscape	6200
Additional	Avon, SWCC	NE Jarrah Complex	Uninfested high value landscape	4000
Additional	NAR	Moore River Complex	Uninfested high value landscape	3400
Additional	NAR	Moore River Complex	Uninfested high value landscape	400
Additional	NAR	Moore River Complex	Uninfested high value landscape	700
Additional	NAR	Moore River Complex	Uninfested high value landscape	1000
Additional	NAR	Muchea Complex	Uninfested high value landscape	800
Additional	NAR	Muchea Complex	Uninfested high value landscape	1498
Additional	NAR	Muchea Complex	Uninfested high value landscape	1200
Additional	NAR	Muchea Complex	Uninfested high value landscape	900
Additional	NAR, Swan	Muchea Complex	Uninfested high value landscape	2500
Additional	South Coast	Bluff Creek	Uninfested high value landscape	3500
Additional	South Coast	Crystal Lake	Uninfested high value landscape	7400
Additional	South Coast	Fitzgerald core Complex	Uninfested high value landscape	2200
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	300
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	1000
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	300
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	200
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	100
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	100
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	2600
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	100

Map ID	NRM Region	PPA Name	Category	Remnant Vegetation (Ha) in PPA
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	1500
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	300
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	500
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	300
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	100
Additional	South Coast	Fitzgerald Stirlings Link Complex	Uninfested high value landscape	100
Additional	South Coast	Stokes Complex	Uninfested high value landscape	2100
Additional	South Coast	Stokes Complex	Uninfested high value landscape	700
Additional	South Coast	Stokes Complex	Uninfested high value landscape	4700
Additional	South Coast	Stokes Complex	Uninfested high value landscape	800
Additional	South Coast	Stokes Complex	Uninfested high value landscape	1400
Additional	South Coast	Stokes Complex	Uninfested high value landscape	1400
Additional	South Coast	Upper Munglinup river	Uninfested high value landscape	1400
Additional	South Coast, SWCC	Southern Jarrah Complex	Uninfested high value landscape	1878
Additional	Swan	Muchea Complex	Uninfested high value landscape	1000
Additional	Swan	NE Jarrah Complex	Uninfested high value landscape	2900
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	3200
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	4200
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	4500
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	2300
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	5900
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	1800
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	4000
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	1500
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	3400
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	2000
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	3200
Additional	SWCC	Central East Jarrah Complex	Uninfested high value landscape	1600
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	4100
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	1200
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	1000
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	2600
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	800
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	6400
Additional	SWCC	Southern Jarrah Complex	Uninfested high value landscape	1600

Appendix 3 – Indicative Top 100 Priority Protection Area maps

(PPA Map ID numbers included for cross referencing)




114°40'0"E
115°45'0"E
116°50'0"E
29°20'0"S
30°25'0"S
31°30'0"S
DONGARA
78
77
76
75
74
THREE SPRINGS
CARNAMAH
ENEABBA
39
73
72
71
LEEMAN
GREEN HEAD
70
JURIEN BAY
69
CERVANTES
MOORA
38
68
LANCELIN
37
GOOMALLING
GINGIN
36
TWO ROCKS
YANCHEP
TOODYAY
NORTHAM
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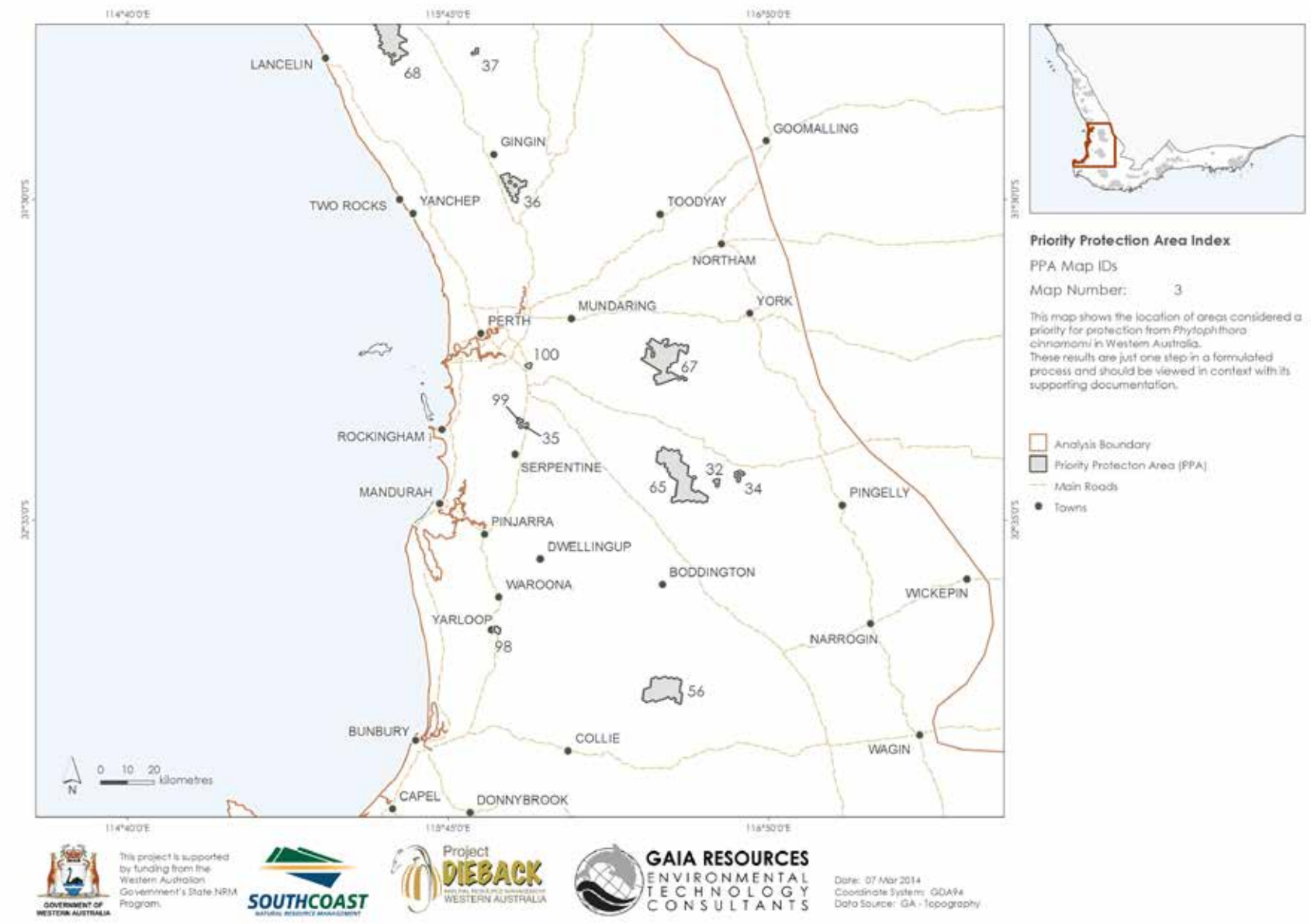
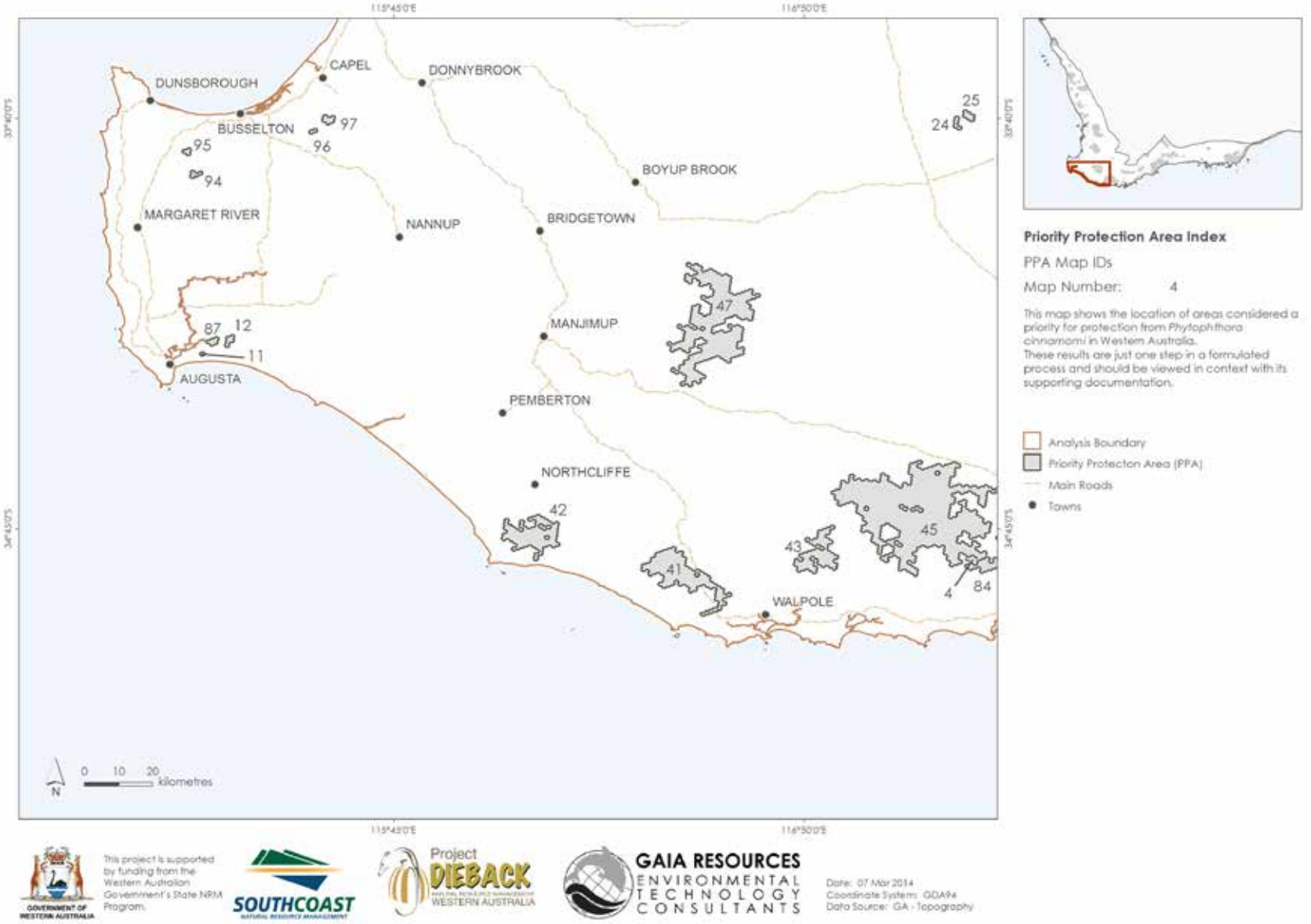
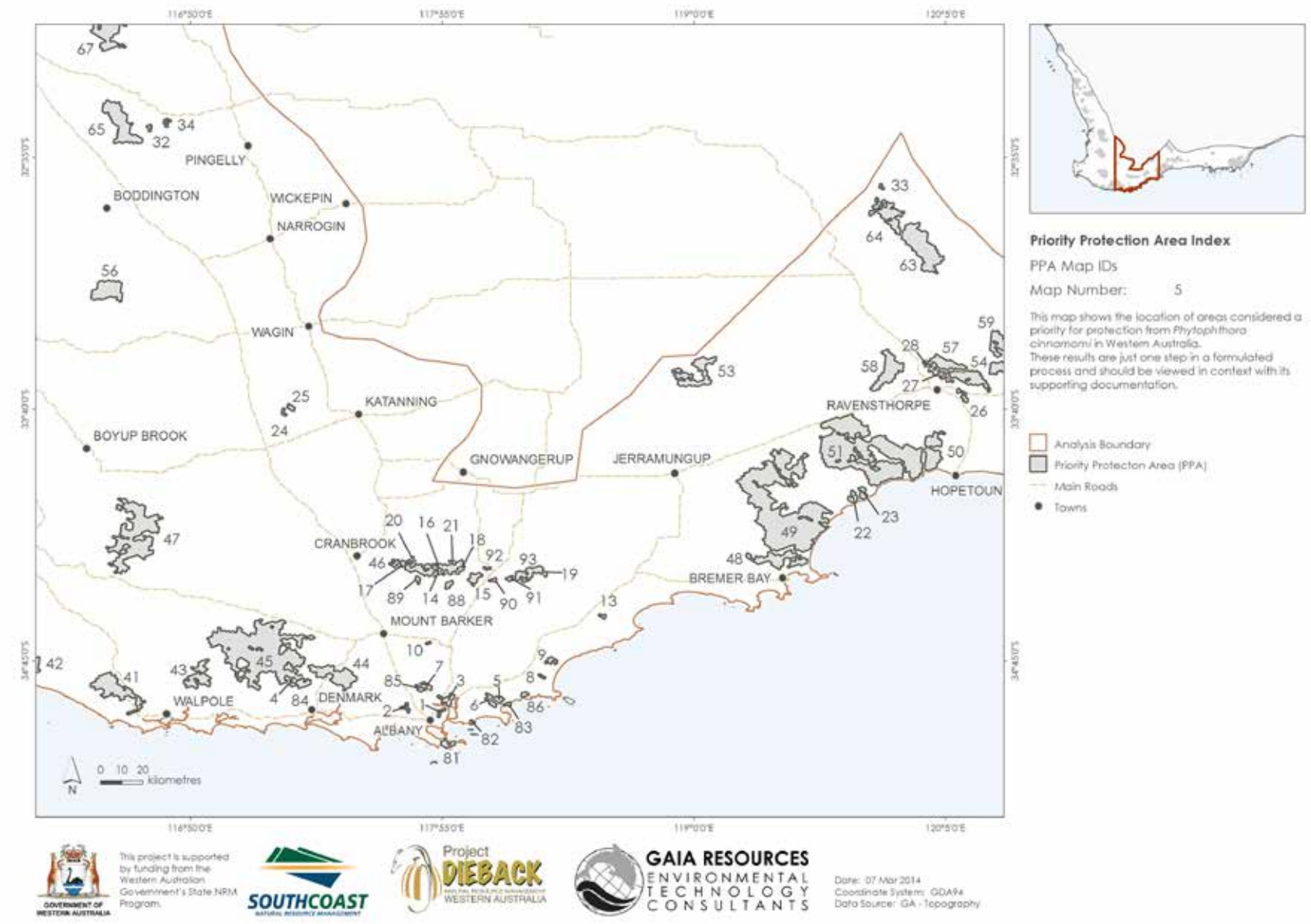
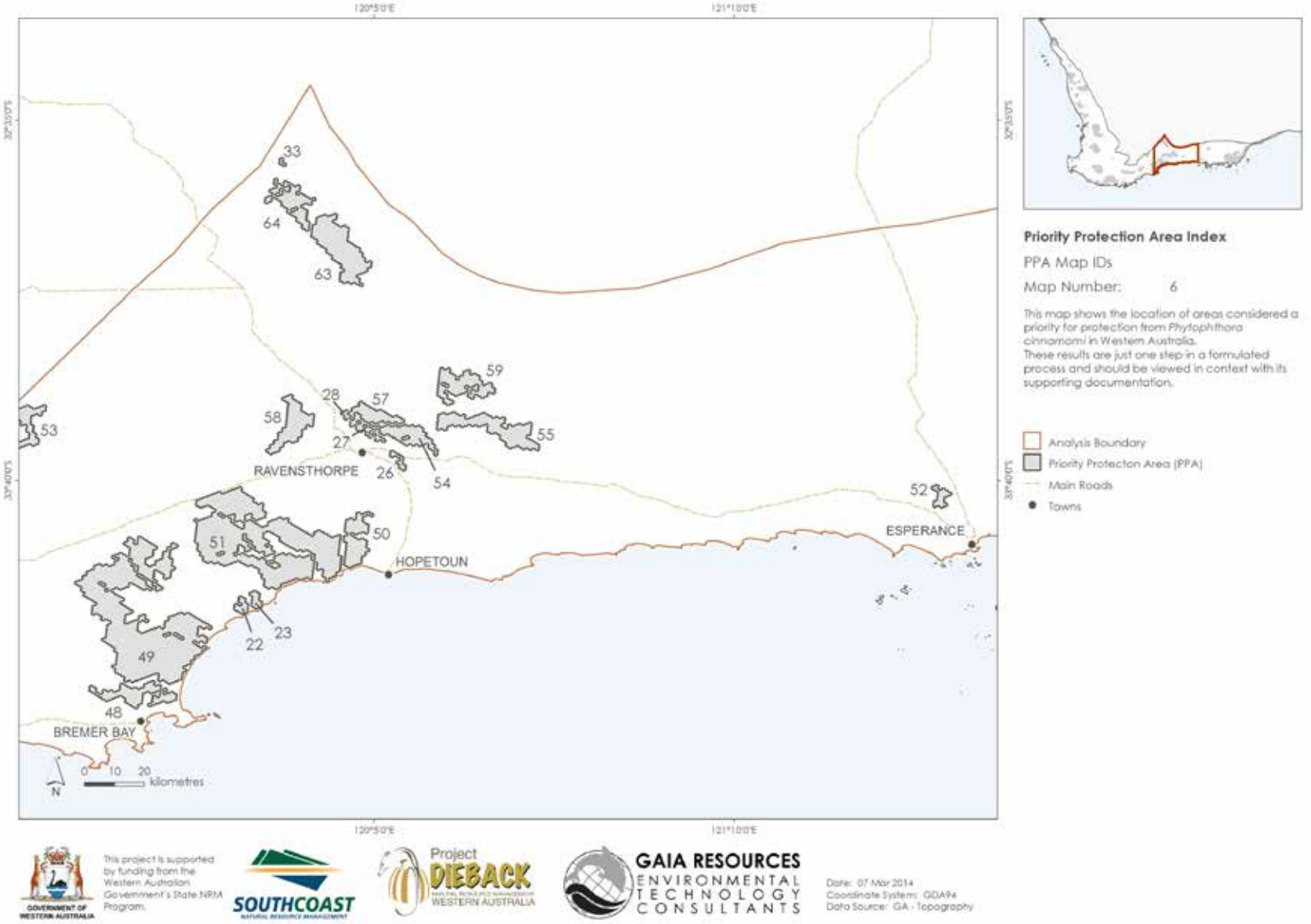
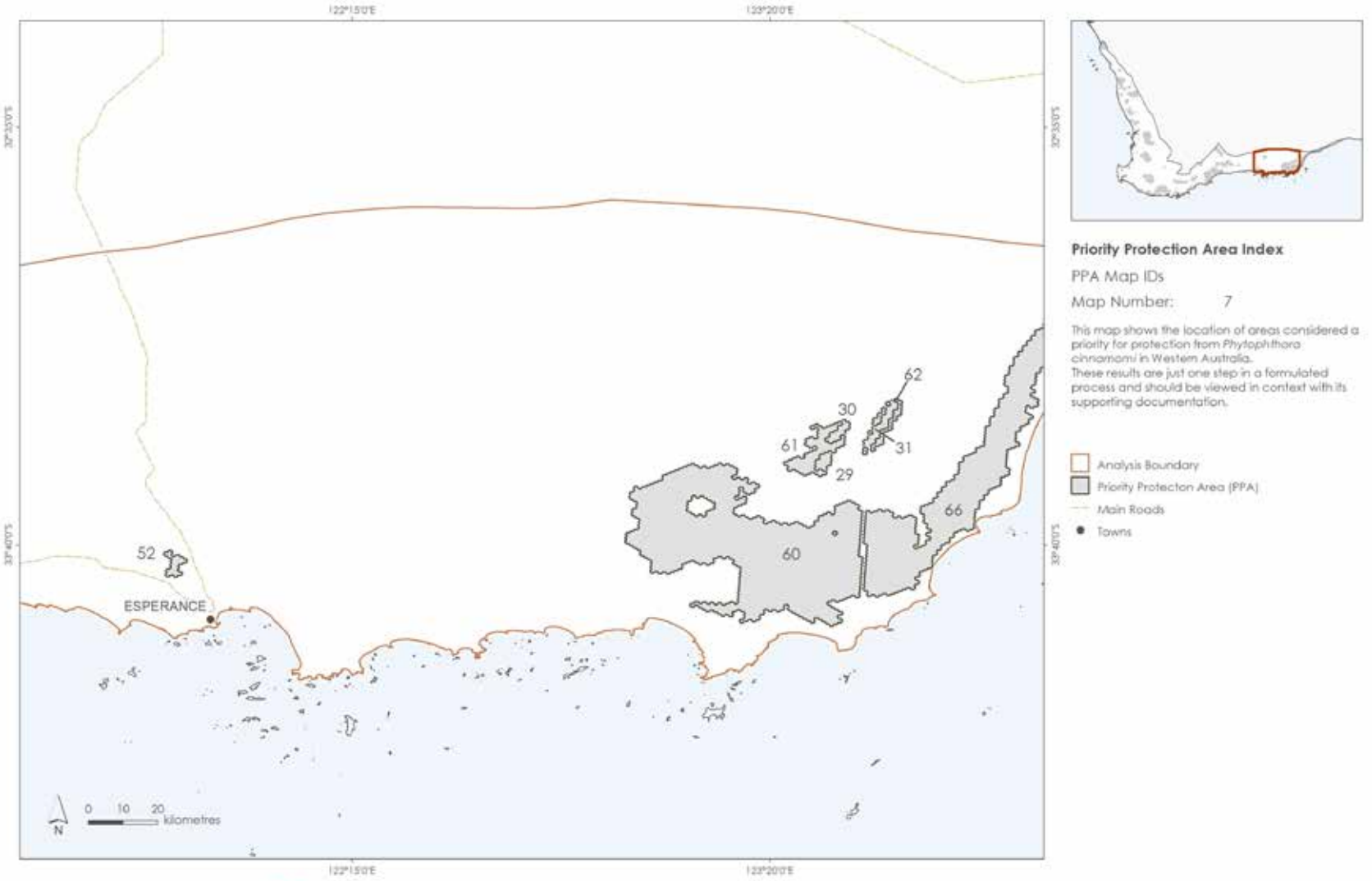
0 10 20
kilometres
Priority Protection Area Index
PPA Map IDs
Map Number: 2
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography

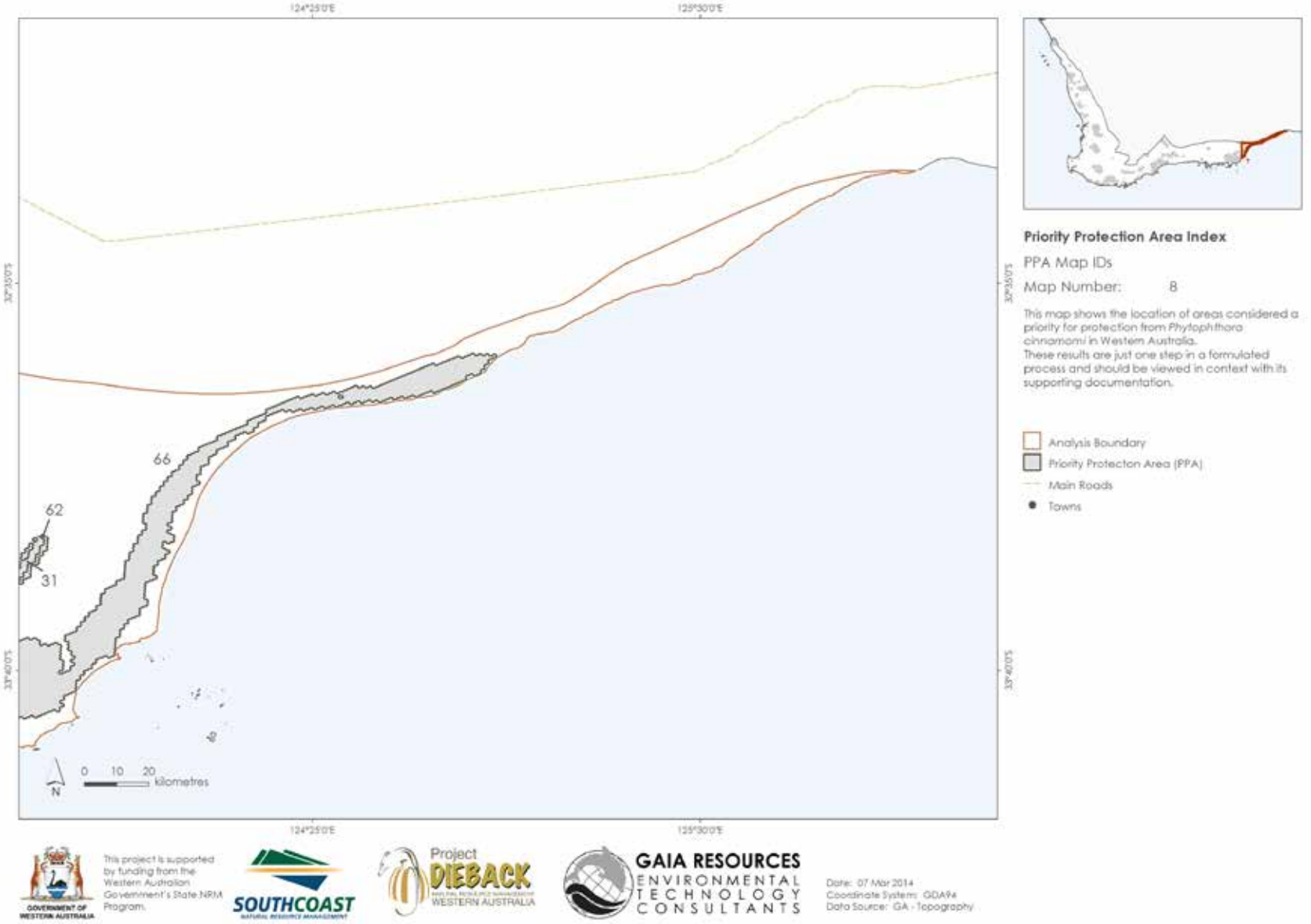

LANCELIN
68
37
GINGIN
GOOMALLING
TWO ROCKS
YANCHEP
36
TOODYAY
NORTHAM
MUNDARING
YORK
PERTH
100
67
99
35
ROCKINGHAM
SERPENTINE
32
65
34
MANDURAH
PINGELLY
PINJARRA
DWELLINGUP
BODDINGTON
WAROONA
WICKEPIN
YARLOOP
98
NARROGIN
56
BUNBURY
COLLIE
WAGIN
CAPEL
DONNYBROOK
0 10 20 kilometres
N
Priority Protection Area Index
PPA Map IDs
Map Number: 3
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography


115°45'0"E
116°50'0"E
33°40'0"S
34°45'0"S
DUNSBOROUGH
CAPEL
DONNYBROOK
BUSSELTON
97
96
95
94
25
24
BOYUP BROOK
MARGARET RIVER
NANNUP
BRIDGETOWN
47
MANJIMUP
87
12
11
AUGUSTA
PEMBERTON
NORTHCLIFFE
42
45
43
41
4
84
WALPOLE
0 10 20
kilometres
N
Priority Protection Area Index
PPA Map IDs
Map Number: 4
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography

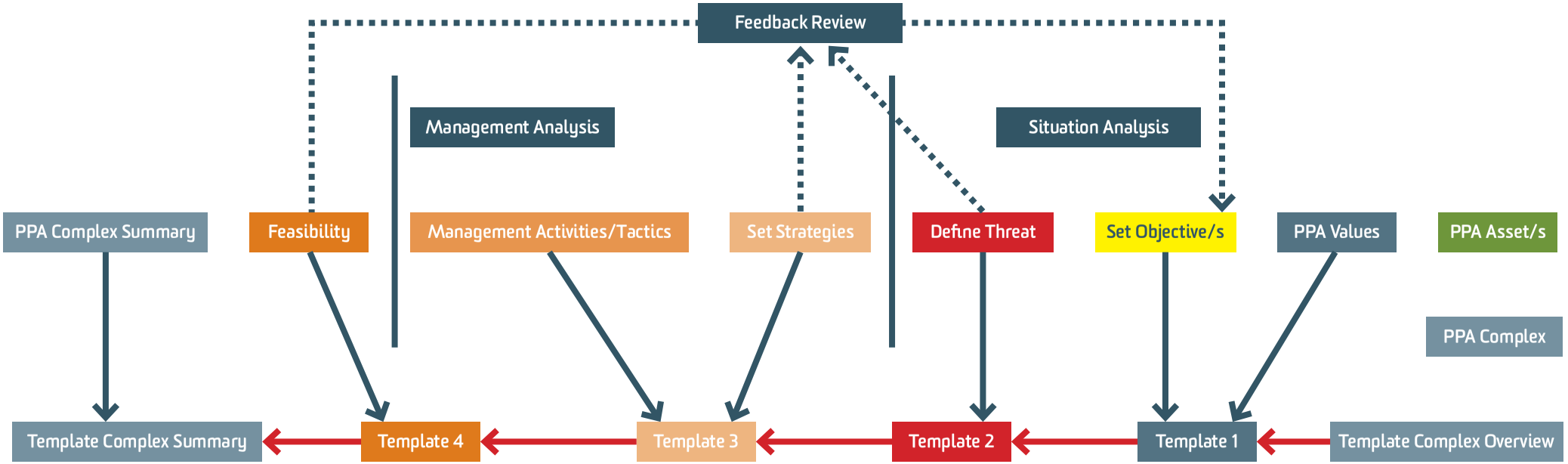

116°50'0"E
117°55'0"E
119°0'0"E
120°5'0"E
32°35'0"S
33°40'0"S
34°45'0"S
PINGELLY
BODDINGTON
WICKEPIN
NARROGIN
WAGIN
KATANNING
BOYUP BROOK
GNOWANGERUP
JERRAMUNGUP
RAVENSTHORPE
HOPETOUN
BREMER BAY
CRANBROOK
MOUNT BARKER
WALPOLE
DENMARK
ALBANY
0 10 20 kilometres
N
Priority Protection Area Index
PPA Map IDs
Map Number: 5
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography


120°5'0"E
121°1'0"E
33°3'0"S
33°4'0"S
33
64
63
59
28
57
58
27
55
53
RAVENSTHORPE
26
54
52
ESPERANCE
50
51
HOPETOUN
22
23
49
48
BREMER BAY
0 10 20
kilometres
N
Priority Protection Area Index
PPA Map IDs
Map Number: 6
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
GOVERNMENT OF WESTERN AUSTRALIA
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography


122°15'0"E
123°20'0"E
33°35'0"S
33°40'0"S
62
30
31
61
29
66
60
52
ESPERANCE
0 10 20
kilometres
N
Priority Protection Area Index
PPA Map IDs
Map Number: 7
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
GOVERNMENT OF WESTERN AUSTRALIA
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography


124°25'0"E
125°30'0"E
32°35'0"S
33°40'0"S
66
62
31
0 10 20
kilometres
N
Priority Protection Area Index
PPA Map IDs
Map Number: 8
This map shows the location of areas considered a priority for protection from Phytophthora cinnamomi in Western Australia.
These results are just one step in a formulated process and should be viewed in context with its supporting documentation.
Analysis Boundary
Priority Protecton Area (PPA)
Main Roads
Towns
GOVERNMENT OF WESTERN AUSTRALIA
This project is supported by funding from the Western Australian Government's State NRM Program.
SOUTHCOAST
Project DIEBACK
WESTERN AUSTRALIA
GAIA RESOURCES
ENVIRONMENTAL TECHNOLOGY CONSULTANTS
Date: 07 Mar 2014
Coordinate System: GDA94
Data Source: GA - Topography

Appendix 4 – PPAMS flow chart



Read right to left. Templates refer to operational toolkit templates for rapid appraisal process. Templates can be found in Gaia Resources (2014)

PHOTO: CLAUDIA MAGANA