

Dieback and Invasive Weed Management Plan CPS 9341/1



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1 Introduction:

The Shire of Esperance is renowned for its high biodiversity, it contains over 3000 known flora species, and is part of the one of the world's 34 biodiversity hotspots. It contains many endemic and rare and priority flora species, as well as threatened ecological communities (TECs) including large areas of the Proteaceae dominated Kwonkgan Shrublands TEC. Two of the biggest threatening processes to the biodiversity and native vegetation within the Shire of Esperance include invasive weeds and dieback.

The Shire of Esperance is made up of two interim biogeographic regions; The Esperance Sandplain and the Esperance Mallee. The Esperance Sandplain biogeographic region consists of sandy and sandy-duplex soils, experiences annual yearly rainfall in the range of 400mm in the north to 600mm in the south and vegetation is dominated by mostly mallee-heath interspersed with granite and wetlands. The Esperance Mallee biogeographic region consists of heavier soils on a level to very gently inclined internally drained landscape, it experiences annual yearly rainfall in the range of 400mm in the south to 300mm in the north and vegetation is dominated by mostly eucalypt-mallee with some Eucalypt woodlands and *Banksia media* heath and well as samphire dominated salt-lake communities. The location of project areas within these two biogeographic regions affects dieback susceptibility and the types of weeds that are also a threat.

The Shire of Esperance manages over 380 reserves and maintains over 4,800km of sealed and unsealed roads and roadside reserves. In 2009, The Shire of Esperance published its Environmental Weeds Strategy. This strategic document was undertaken to assist in the management and control of environmental weeds across the Shire of Esperance. The strategy focused on four main components which were:

- Identification of priority environmental weeds and their management;
- Identification of priority bushland reserves and road reserves and their management;
- Strategic approaches for improved weed management; and
- Financial and human resourcing.

The priority invasive weeds identified through this process were: Spiny Rush, *Juncus acutus*; Geraldton Carnation Weed, *Euphorbia terracina*; Pyp Grass, *Erharta villosa*; Victorian Teatree, *Leptospermum laevigatum*; African Boxthorn, *Lycium ferocissimum*; Watsonia species; African Lovegrass, *Eragrostis curvula*; Cumbungi, *Typha sp.*; Caltrop, *Tribulus terrestris*; Golden Wattle, *Acacia pycnantha* and other eastern states Acacia species.

In 2006 a survey of Roadside Conservation Value in the Shire of Esperance, was completed by the Esperance Wildflower Society funded by the Shire of Esperance. This report covered the surveying (from 1999 to 2002) of the weed infestation level and other attributes of vegetation conservation values for all Shire of Esperance roadside reserves in the rural zone (townsite areas excluded, both sides of every road in the Shire). This data was also mapped into a GIS system and is held by DBCA and the Shire of Esperance, and has been recently incorporated into the 2020 updated Esperance Weeds database used by a variety of land managers and not for profit organisations. In the 2006 report the occurrence of specific weeds along roadsides in the Shire of Esperance was found to be:

- African Lovegrass - 4990km
- Veldt Grass - 1 605km
- Victorian Tea Tree - 751 km
- Bridal Creeper - 420km

- African Boxthorn - 91 km
- Other Weeds - 2821km

This report (although the data is now 20 years old) shows the high extent of infestation of some weeds. The only priority invasive weeds that have reduced in extent over the 20 year period is African Boxthorn, *Lycium ferocissimum* and Caltrop, *Tribulus terrestris* as well as Watsonia and Cactus. This is due to targeted control programs undertaken by the Shire of Esperance, Esperance Weeds Action Group and South Coast NRM.

Bridal creeper rust fungus *Puccinia myrsiphylli* was introduced to Australia in 2000. The Shire of Esperance Environmental Officers distribute the rust to uninfested areas during the winter months. Most infested areas now have the rust fungus present and the rate of spread of this weed and the vigour in which it competes with native vegetation has been dramatically improved throughout the shire through this program.

The extent of Victorian Teatree, *Leptospermum laevigatum* and some of the grass weeds has increased substantially over the last 20 years. The Shire of Esperance rural slasher that slashes road verges has only had an air compressor on the slasher ute since around 2009 (approx. 12 years). This clean down device has since reduced the rate of spread of these weed seeds being spread by slashing operations which was one of the main spread vectors.

The weedy eastern states Acacia species, have substantially increased in distribution in the Esperance Shire over the last 20 years, mostly due to distribution of seeds by birds and farmer roadside vegetation burning. The Shire of Esperance is a key project member on the Esperance Weeds Action Group 2021 State NRM Weedy Wattles project, currently mapping extent and prioritising control of these woody weeds.

All of the project areas under CPS 9341/1 are adjacent to farmland in road reserves ranging from 20m to 100m wide. As a result agricultural weeds in adjacent paddocks occur in these project areas spread from rural machinery and agricultural operations.

Gravel and limestone most of the Shire of Esperance Projects is also sourced from on-farm supplies. Apart from Site X Fisheries Rd SLK 77.3 - 82.8, (which gravel is planned to be extracted from CPS 8884/1, Site B) all projects under CPS 9341/1 will have gravel or limestone sources from nearby on farm pits. To reduce the spread of agricultural weeds from these pits to the project areas the Shire of Esperance follows the following protocols; topsoil (containing the majority of weeds) is removed first and placed in a separate pile, gravel or limestone is then pushed up onto clear ground and is used within a few months (maximum) of being pushed. This reduces the amount of weed seed in the gravel to almost zero. In the rare case that gravel piles exist on farm land that have been pushed up longer than 4 months prior, and wind blown weeds have blown into the stockpile, the Shire of Esperance will spray the stockpile with herbicide prior to transporting to the project area.

Phytophthora dieback is one of the biggest threats to biodiversity in Western Australia and has now spread throughout the south-west from Eneabba to Esperance. Phytophthora have likely been established in the Shire of Esperance since the 1960's (Massenbauer, 2017). Phytophthora dieback is a deadly, introduced plant pathogen and is unusual as it has animal, fungal and plant characteristics. Scientifically known as the group of *Phytophthora* species, it is classified as a water mould belonging to the new ancestral kingdom Chromista. Strict hygiene and effective management are essential to minimise the risk of dieback spread. In most cases, removing all mud and soil from footwear, vehicles,

machinery and equipment minimises the risk of spreading the plant pathogen. Road maintenance, and construction carries a high risk of spreading *Phytophthora dieback* and the Shire of Esperance, reduces this risk by adhering to the following hygiene guidelines recommended by Project dieback:

Where possible, the Shire of Esperance will during road maintenance and construction activities:

- Schedule activities in high dieback risk areas for low rainfall months and avoid wet or muddy conditions.
- Be aware of Dieback Free and Infested areas prior to activities commencing.
- Clean all vehicles and equipment prior to starting works at a new location
- Regularly clean all vehicles and equipment, to keep in a clean condition
- Stay on established roads and tracks.

The Shire of Esperance uses a combination of dry clean and wash-down methods. Dry clean is where compressed air or a spade/brush is used to blow weeds and dirt from machinery. Wash-down is where pressurised water spray unit to remove any remaining soil, mud and plant material. Wash-downs need to be done on a hard, well drained surface in low lying areas (e.g. road, ramp or grate). Shire of Esperance Environmental Services staff and Operations Supervisors have completed Dieback Green Card Training.



Figure 1: Shire of Esperance Depot vehicle washdown bay



Figure 2: One of the Shire of Esperance's fleet of mobile washdown facilities

All project sites are checked for the most up to date disease status using Project Dieback's Dieback Information and Delivery Management System (DIDMS). DIDMS is a user registered web based platform for storage, viewing, basic mapping and sharing of spatial Phytophthora dieback information. Environmental Officers also inspect for visual signs of Dieback during flora surveys.



Figure 3: DIDMS map of known dieback occurrences within the Shire of Esperance

In 2017, South Coast NRM carried out the 'South Coast Coastal Corridors' Project. Amongst other threatening processes to remnant vegetation within the

15km buffer from the southern coast line, the project developed a Phytophthora Hazard Dispersion Model as part of Project Dieback. This GIS soil borne Phytophthora Hazard Dispersion tool was developed to help quantitatively and qualitatively link hazard spread pathways of a known plant disease occurrence to a susceptible biodiversity value. The model is not a biological disease occurrence model, but a scenario hazard assessment tool. The hazard dispersion tool estimates areas geographically linked to a known soil-borne disease point via spread pathways over time using a cost distance method.

The 15 km buffer Coastal Corridor study area is susceptible to the spread of various species of soil-borne Phytophthora. About 20 per cent of the study area is a Phytophthora dispersion hazard and 88 per cent of the existing road, track, and trail network are linked to a known disease point. Of these roads, tracks and trails 82 per cent are unsealed which poses a major hygiene risk to susceptible vegetation types. The Phytophthora dispersion hazard roads are mapped in DIDMS and this provides a useful reference tool to plan operation risk reduction measures.

Table 1 - CPS 9341/1 project areas assessed against the Phytophthora dispersion hazard model

Site	PC infested within 50 years as per model	Dieback susceptible vegetation
Site B – Henkes Road Resheet and Howick Henkes Intersection upgrade	Yes – Moderate to no risk	yes
Site C - Scaddan road	Yes - Moderate to no risk	yes
Site E - Grass Patch Materials Store	Outside PC dispersion model boundaries	no
Site O - Holt road	Outside PC dispersion model boundaries	no
Site P - Merivale road	Extreme	yes
Site S - Coramup road	Yes – very high to high	yes
Site V - Scaddan road	No risk	yes
Site W - Plowman road	Yes – extreme to very high	yes
Site X - Fisheries road	Yes – High-moderate to no risk	yes

Based on these risk ratings, if there is dieback susceptible vegetation types within a project area and only moderate to no risk of dieback getting there, extreme caution should be taken not to introduce dieback into the site.

Sites with extreme risk, may already have dieback within them and extreme caution regarding moving vehicles and equipment out of that site needs to be implemented.

Regular training is carried out by Environmental Officers to rural maintenance and construction teams on invasive weed and dieback management and risk reduction.

Specific site weed and dieback management at each CPS 9341/1 site is detailed below.

Site B - Howick road and Henke road - (SLK) 2.95 to 11.05

There was varying levels of weed invasion across the entirety of the proposed ‘Site B – Henkes Road Resheet and Howick Henkes Intersection upgrade’ area. Invasive plant species were found across the majority of the survey area, however the burden of these species on the natural vegetation varied from moderate to high between sections. Overall, 35 invasive species were identified within the project area (Table 1). Of these, the most extensive and of serious concern were Golden Wattle (*Acacia pycnantha*) and African Love Grass (*Eragrostis curvula*). High weed burden was most notable at the start of the project area (east from the Henkes and Howick Rd intersection) and in the immediate road reserves adjacent to property driveways. However, because these driveways are already cleared areas, the weed burden here is not of high concern in relation to the broader landscape.

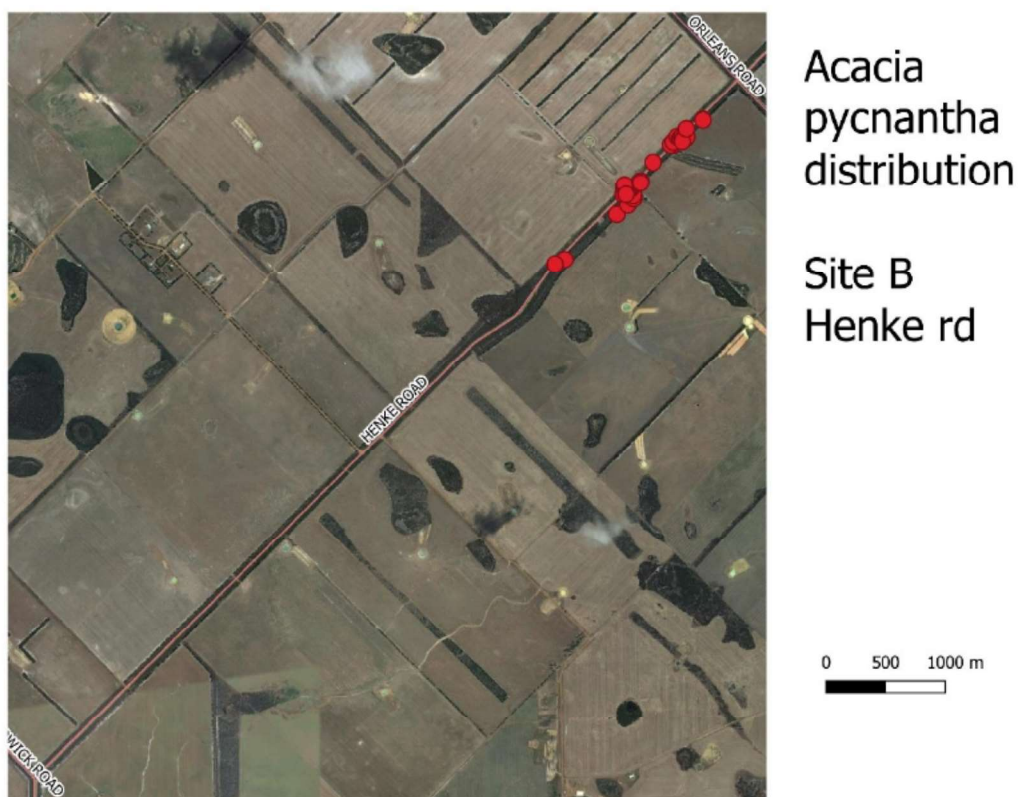


Figure 4 – Acacia pycnantha distribution Henke Road.

Table 2 - Invasive weeds present in Site B Howick road and Henke road pre-clearing

Family	Genus	Species
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>
Asteraceae	<i>Conzya</i>	<i>sp.</i>
Asteraceae	<i>Gamochaeta</i>	<i>calviceps</i>
Asteraceae	<i>Hypochaeris</i>	<i>sp.</i>
Asteraceae	<i>Taraxacum</i>	<i>officinale</i>
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>
Brassicaceae	<i>Raphanus</i>	<i>nigra</i>
Brassicaceae	<i>Raphanus</i>	<i>raphanistrum</i>

Campanulaceae	<i>Monopsis</i>	<i>debilis var depressa</i>
Caryophyllaceae	<i>Polycarpon</i>	<i>tetraphyllum</i>
Cyperaceae	<i>Cyperus</i>	<i>tenellus</i>
Euphorbiaceae	<i>Euphorbia</i>	<i>terraccina</i>
Fabaceae	<i>Acacia</i>	<i>pyncnatha</i>
Fabaceae	<i>Lupinus</i>	<i>albus</i>
Fabaceae	<i>Ornithopus</i>	<i>sativus</i>
Fabaceae	<i>Trifolium</i>	<i>sp.</i>
Geraniaceae	<i>Erodium</i>	<i>cicutarium</i>
Iridaceae	<i>Romulea</i>	<i>rosea</i>
Juncaceae	<i>Juncus</i>	<i>bufonius</i>
Myrtaceae	<i>Eucalyptus</i>	<i>gomphocephala</i>
Myrtaceae	<i>Leptospermum</i>	<i>laevigatum</i>
Orchidaceae	<i>Disa</i>	<i>bracteata</i>
Pinaceae	<i>Pinus</i>	<i>pinaster</i>
Poaceae	<i>Avena</i>	<i>fatua</i>
Poaceae	<i>Briza</i>	<i>maxima</i>
Poaceae	<i>Briza</i>	<i>minor</i>
Poaceae	<i>Ehrharta</i>	<i>calycina</i>
Poaceae	<i>Eragrostis</i>	<i>curvula</i>
Poaceae	<i>Paspalum</i>	<i>vaginatum</i>
Poaceae	<i>Pentaschistis</i>	<i>airoides</i>
Poaceae	<i>Triticum</i>	<i>aestivum</i>
Polygonaceae	<i>Polygonum</i>	<i>aviculare</i>
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>
Solanaceae	<i>Solanum</i>	<i>nigrum</i>
Junceaeae	<i>Juncus</i>	<i>capitatus</i>

Vegetation types B, E, G, and J contain large amounts of vegetation susceptible to *Phytophthora cinnamomi* dieback, most notably Proteaceae and Ericaceae species.

Table 3 - Vegetation types present in Site B Howick road and Henke road pre-clearing

Veg type	Description	Area (ha)
A	Scattered <i>Nuytsia floribunda</i> with dense <i>Allocasuarina</i> and <i>Melaleuca</i> shrubland.	3.733
B	Semi-open to dense <i>Eucalyptus angulosa</i> with mixed and diverse low shrubland of Proteaceous sp., dominated by <i>Hakea</i> species, with scattered <i>Allocasuarina</i> sp..	2.866
C	Open tall <i>Eucalyptus</i> / <i>Mallee</i> Woodland with scattered <i>Banksia media</i> , and diverse low shrubland and dense sedgeland under-story.	5.782
D	Yates woodland with <i>Melaleuca calycina</i> .	0.28
E	Dense <i>Eucalyptus angulosa</i> with dominant <i>Banksia armata</i> and <i>Hakea cormybose</i> and mixed low shrubland.	0.211

F	Disturbed gravel pits forming a mix of regenerating <i>Banksia armata</i> (possibly vegetation type E) and Tall Mallee (possibly vegetation type C), with dense <i>Cyathostemon</i> sp..	3.858
G	Mixed tall and low Eucalyptus woodland with dense and highly mixed mid-story, dominated by <i>Hakea cinerea</i> and <i>Cyathostemon ambiguus</i> .	2.426
H	Dense/closed tall Eucalyptus and <i>Hakea laurina</i> woodland with semi-open shrubland of <i>Exocarpus sparteus</i> and <i>Hakea</i> sp, with dense Cyperaceae sedgeland under-story.	0.552
I	Mixed dense <i>Acacia cyclops</i> , <i>Eucalyptus angulosa</i> and <i>Allocasuarina</i> shrubland with Cyperaceae sedgeland and no Proteaceae species.	0.577
J	Closed Mallee woodland with dense <i>Hakea corymbosa</i> mid-story and dense sedge under-story.	0.576
K	<i>Allocasuarina</i> shrubland with <i>Nuytsia</i> and <i>Anarthria</i> sedgeland.	0.628

DIDMS data shows no records of *P. cinnamomi* or other *Phytophthora* sp. sample results in the immediate area. However, the presence of dead *Banksia media*, *Hakea laurina* and other Proteaceous plants was noted during the survey in vegetation types B, C, E, and H is likely an indicator of *P. cinnamomi* presence. This was not comprehensively mapped or sampled, but was visually observed to only occur in clustered locations scattered throughout the site. Proposed works will be conducted using appropriate hygiene measures to reduce risk and limit spreading of the disease, including clearing in dry conditions and clean down of vehicles and machinery before entering the site to complete proposed works.



Figure 5 - Potential signs of dieback, including dead *Banksia* sp., observed in vegetation type B at 'Site B – Henkes Road Resheet and Howick Henkes Intersection upgrade'.

Site C - Scaddan road - (SLK) 48.0 to 53.0

The vegetation condition varies dramatically across 'Site C – Scaddan Road Construction, West of Backmans Rd', ranging from completely degraded to excellent condition (Figure 3). This is primarily due to the extensive weed infestation of particularly African Lovegrass (*Eragrostis curvula*), on the periphery of the road footprint. As well as some impacts of *Phytophthora* dieback (Section 5.3). Additionally, the

road reserve bordering the farmland has all been historically cleared, with only scattered native hardy shrubs remaining, consisting almost entirely of dense Tuart, *Eucalyptus gomphocephala* and Pine, *Pinus pinaster* trees. During the targeted flora survey, the adjacent property owner on the southern road reserve was clearing and removing the large invasive trees. Where possible it was evident they were leaving the occasional *Nuytsia floribunda* present.

DIDMS data shows no positive or negative *Phytophthora cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area, likely due to the lack of sampling on road reserves in general. However, there were several positive *Phytophthora cinnamomi* sample results in the surrounding area, including on Wittenoom Road, a road which intersects with Scaddan Road approximately 10 km west of the survey area. Many dead Proteaceae species were observed during the survey, including *Banksia speciosa*, *B. media*, *B. armata* and Chittick, *Lambertia inermis*. There was no distinct cluster of dead species, and dead plants were sporadically scattered throughout the site. Vegetation types A and D are most susceptible to *P. cinnamomi* dieback due to the high prevalence of Proteaceae species in these vegetation communities, some limited signs of *P. cinnamomi* were present in the site (Figure 5). Proposed works will be conducted using appropriate hygiene measures to limit spreading of the disease, including clearing in dry conditions and clean down of vehicles and machinery before entering the site to complete proposed works.



Figure 6 - Dead *Banksia media* observed in vegetation type A at 'Site C – Scaddan Road Construction, West of Backmans Rd'.

There was high levels of weed invasion across the entirety of the proposed 'Site C - Scaddan Road Construction, West of Backmans Rd' area. Overall, 33 invasive species were identified within the project area (Appendix 2, Table 8). Of these, the most extensive and of serious concern were African Love Grass, *Eragrostis curvula*, and Golden Wattle, *Acacia pycnantha*. African Love Grass and agricultural weeds were observed across the survey area, and *Acacia pycnantha* was observed to be scattered throughout vegetation type A. *Pinus pinaster* trees lined the fence lines of the adjacent agricultural properties. The weed burden was so high in some sections that it led to the complete breakdown of community structure (Figure 4). Control of *Acacia pycnantha* is recommended prior to commencing road works, as can rapidly become a serious environmental weed. There is the potential

that proposed works will increase the distribution of weeds and degrade vegetation along the entire road reserve where works occur. To manage this risk it is recommended that the road reconstruction occur from the north-west area and head south-east, from the better condition to the poorer condition area. This will hopefully limit and minimise the weed spread into the areas in better condition. Ideally, regular air cleaning or wash downs during the course of works to remove weed seeds or follow up herbicide control of invasive species needs to occur.

Table 4 - Weeds present in Site C pre clearing

Family	Genus	Species	Common Name
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape Weed
Asteraceae	<i>Centaurea</i>	<i>melitensis</i>	Maltese Cockspur
Asteraceae	<i>Hypochaeris</i>	<i>radicata</i>	Flat weed
Asteraceae	<i>Psuedophagnalium</i>	<i>luteoalbum</i>	Jersey Cudweed
Asteraceae	<i>Sonchus</i>	<i>oleraceus</i>	
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Ursinia Daisy
Brassicaceae	<i>Sinapis</i>	<i>arvensis</i>	Wild Mustard
Campanulaceae	<i>Monopsis</i>	<i>debilis var depressa</i>	
Campanulaceae	<i>Wahlenbergia</i>	<i>capensis</i>	Cape bluebell
Cucurbitaceae	<i>Cucumis</i>	<i>myriocarpus</i>	prickly paddy melon
Fabaceae	<i>Acacia</i>	<i>pycnantha</i>	Golden Wattle
Fabaceae	<i>Ornithopus</i>	<i>compressus</i>	Yellow Serradella
Fabaceae	<i>Ornithopus</i>	<i>sativus</i>	french (pink) serradella
Fabaceae	<i>Trifolium</i>	<i>arvense</i>	Hare's Foot Clover
Geraniaceae	<i>Erodium</i>	<i>Sp.</i>	Storksbill Pelargonium
Junaceae	<i>Juncus</i>	<i>microcephalus</i>	
Myrtaceae	<i>Eucalyptus</i>	<i>globulus</i>	
Myrtaceae	<i>Eucalyptus</i>	<i>gomphocephala</i>	Tuart
Onagraceae	<i>Oenothera</i>	<i>biennus</i>	Evening Primrose
Oxalidaceae	<i>Oxalis</i>	<i>glabra</i>	Oxalis
Pinaceae	<i>Pinus</i>	<i>pinaster</i>	Pinaster pine
Poaceae	<i>Avena</i>	<i>fatua</i>	Wheat
Poaceae	<i>Briza</i>	<i>maxima</i>	Blow Fly Grass
Poaceae	<i>Briza</i>	<i>minor</i>	Little Blowfly Grass
Poaceae	<i>Bromus</i>	<i>catharticus</i>	Prairie grass
Poaceae	<i>Ehrharta</i>	<i>calycina</i>	
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	African Lovegrass
Poaceae	<i>Erharta</i>	<i>calycina</i>	
Poaceae	<i>Lolium</i>	<i>rigidum</i>	Wimmera ryegrass
Poaceae	<i>Romulea</i>	<i>rosea</i>	Guildford Grass
Poaceae	<i>Triticum</i>	<i>sp.</i>	Wild oats
Polygonaceae	<i>Rumex</i>	<i>crispus</i>	Dock
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>	Pimpernell
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Deadly Nightshade

Site E – Grass Patch Materials Storage

The vast majority of vegetation within this site is not susceptible to *Phytophthora cinnamomi* Dieback, and is unlikely to be recorded in this area due to the persisting dry nature of the soil. Dieback Information Delivery and Management System (DIDMS; GAIA Resources, SCNRM & State NRM 2020) data shows no *P. cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area. Proposed works will be conducted using appropriate hygiene measures to limit spreading of other plant pathogens or diseases, including clearing in dry conditions and clean down of vehicles and machinery before entering the site to commence proposed works.

There was low weed invasion across the entirety of the proposed 'Site E – Grass Patch Material Storage' area. Overall, six invasive species were identified within the project area (Appendix 7.1). Of these, the most extensive and of serious concern were annual veldt grass (*Ehrharta longiflora*) and Prairie grass (*Bromus catharticus*). However, both are unlikely to outcompete the natural bush and will not invade the surrounding bushland. The minimal degree of weed invasion has a low impact on the sites overall condition. Given the final end use of the site is as a machinery storage area, it is unlikely that weeds will persist as an issue during the future operations at the site.

The boxthorn plants (approximately 5 individuals) on the site have already been controlled by grubbing and herbicide by SOE Environmental Officers in June 2021.

Table 5 - Weeds present in Site O pre clearing

Family	Genus	Species	Common Name
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape weed
Asteraceae	<i>Gazania</i>	<i>linearis</i>	Treasure Flower
Brassicaceae	<i>Rhaphanus</i>	<i>raphniastrum</i>	Wild radish
Iridaceae	<i>Freesia</i>	<i>freesia alba x leichtlinii</i>	Freesia
Poaceae	<i>Austrostipa</i>	<i>hemipogon</i>	annual veldt grass
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	prairie grass
Solanaceae	<i>Lycium</i>	<i>ferocissimum</i>	African Boxthorn

Site 0 - Holt road– (SLK) 4 to 6.37

Dieback Information Delivery and Management System (DIDMS) data shows no records *Phytophthora cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area. It is unlikely *P. cinnamomi* is active within the area, due to the extremely arid nature of the environment.

There was minimal weed invasion across the entirety of the proposed 'Site O – Holt Road' area. Overall, five invasive species were identified within the project area (Appendix 8.1). Of these, the most extensive and of serious concern were Wild Radish (*Raphnus raphanistrum*) and Cape Weed (*Arctotheca calendula*). Due to the arid nature of the climate, it is unlikely that these will continue to persist in the landscape or be spread by the road widening activities.

Table 6 - Weeds present in Site O pre clearing

Family	Genus	Species	Common Name
Asphodelaceae	<i>Asphodelus</i>	<i>fistulosus</i>	Onion Weed
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape Weed, Cape Dandelion

Asteraceae	<i>Sonchus</i>	<i>oleraceus</i>	Sour Thistle, Tall Daisy
Brassicaceae	<i>Carrichtera</i>	<i>annua</i>	Wards weed
Brassicaceae	<i>Raphnus</i>	<i>raphanistrum</i>	Wild Raddish
Poaceae	<i>Triticum</i>	<i>aestivum</i>	Wheat

Site P - Merivale road - (SLK) 14.96 to 19.77

There was extensive weed invasion across the entirety of the proposed 'Site P - Merivale Road Widening' area. Overall, 30 invasive species were identified within the project area (Appendix 8.2). The most concerning of these was a previously unrecorded population *Asparagus declinatus* (Bridal veil) Weed of National Significance. Until 2020, *Asparagus declinatus* was not known to occur within the Shire of Esperance, however in 2020 two populations were located, this one (located in shady areas under the tuarts on the south side of the road at -33.823488S, 121.111528E) and one discovered around the same time within the Esperance townsite, near the Esperance Port by Esperance Wildflower Society. The area of occupation of *Asparagus declinatus* has been mapped on 2/6/2021

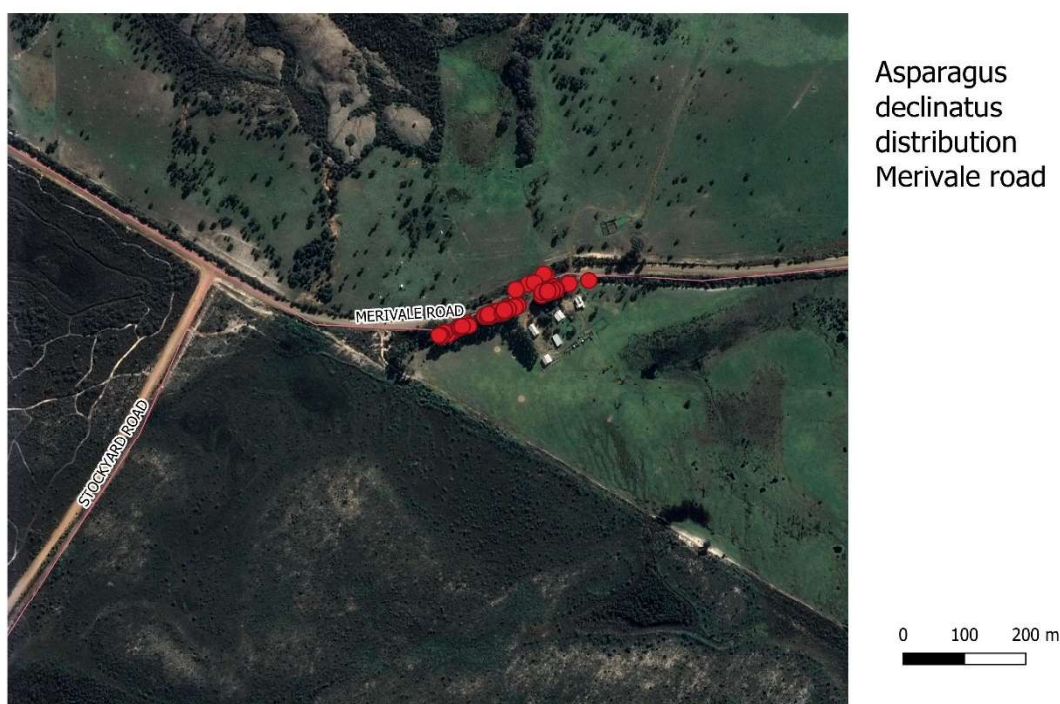


Figure 7 – *Asparagus declinatus* distribution Merivale Rd

Since the clearing permit application has been submitted, the Shire of Esperance have sprayed the *Asparagus declinatus* twice. Shire Environmental officers have also met adjoining landowners at the site and educated them about the weed and the landowner is also actively controlling *A. declinatus* via spraying.

Of the other weeds, the most extensive and of serious concern were Victorian Tea Tree (*Leptospermum laevigatum*) and African Love Grass (*Eragrostis curvula*). African Love Grass was present throughout the entire proposed permit area, aside from vegetation type G, and had become the dominant understory species in many areas, degrading the native vegetation and reducing biodiversity. Victorian Tea Tree was present in every vegetation type within the proposed clearing permit area, with

dense stands, with significantly reduced biodiversity, being present in several areas of the site. Given the vast majority of the area is so degraded, it's likely that proposed works will have a minimal impact in the landscape. The single *Acacia dealbata* has been ringbarked and sprayed by Shire Environmental Officers in 2021 and is now dead.

Table 7 - Weeds present in Site P pre clearing

Family	Genus	Species	Common Name
Asparagaceae	<i>Asparagus</i>	<i>declinatus</i>	Bridal veil
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape Weed, Cape Dandelion
Asteraceae	<i>Conyza</i>	<i>sumatrensis</i>	Fleabane
Asteraceae	<i>Hypochaeris</i>	<i>radicata</i>	Flatweed Daisy
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Ursinia Daisy
Asteraceae	<i>Vellereophyton</i>	<i>dealbatum</i>	White cudweed
Brassicaceae	<i>Raphnus</i>	<i>raphanistrum</i>	Wild Radish
Campanulaceae	<i>Wahlenbergia</i>	<i>campensis</i>	Cape Bluebell
Caryophyllaceae	<i>Silene</i>	<i>gallica</i>	
Euphorbiaceae	<i>Euphorbia</i>	<i>terraccina</i>	
Fabaceae	<i>Acacia</i>	<i>dealbata</i>	
Fabaceae	<i>Cytisus</i>	<i>proliferus</i>	Tagasaste, Tree Lucerne
Fabaceae	<i>Ornithopus</i>	<i>compressus</i>	Yellow serradella/vetch
Fabaceae	<i>Ornithopus</i>	<i>sativus</i>	Common Bird's Foot
Geraniaceae	<i>Erodium</i>	<i>cicutarium</i>	Storksbill Pelargonium
Geraniaceae	<i>Pelargonium</i>	<i>capitatum</i>	Rose Pelargonium
Iridaceae	<i>Freesia</i>	<i>alba × leichtlinii</i>	
Iridiaceae	<i>Romulea</i>	<i>rosea</i>	Guildford grass
Juncaceae	<i>Juncus</i>	<i>acutus</i>	
Lythraceae	<i>Lythrum</i>	<i>hyssopifolia</i>	Lesser loosestrife
Myrtaceae	<i>Eucalyptus</i>	<i>globulus</i>	Southern Blue Gum
Myrtaceae	<i>Eucalyptus</i>	<i>gomphocephala</i>	Tuart
Myrtaceae	<i>Leptospermum</i>	<i>laevigatum</i>	Victorian Tea Tree
Onagraceae	<i>Oenothera</i>	<i>stricta</i>	Evening Primrose
Orchidaceae	<i>Disa</i>	<i>bracteata</i>	South African Weed Orchid
Pinaceae	<i>Pinus</i>	<i>pinaster</i>	Pinaster Pine Tree
Poaceae	<i>Avena</i>	<i>fatua</i>	Wild oats
Poaceae	<i>Briza</i>	<i>maxima</i>	Blowfly grass
Poaceae	<i>Bromus</i>	<i>diandrus</i>	
Poaceae	<i>Cenchrus</i>	<i>clandestinus</i>	Kikuyu
Poaceae	<i>Ehrharta</i>	<i>calycina</i>	
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	Annual Veldt Grass
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	African Love Grass
Polygonaceae	<i>Rumex</i>	<i>acetosella</i>	Sheeps Sorrell
Polygonaceae	<i>Rumex</i>	<i>vesicarius</i>	Ruby dock
Polygonaceae	<i>Rumex</i>	<i>acetosella</i>	Sheeps sorrel
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>	Scarlet Pimpernel

Site S - Coramup road - (SLK) 3.58 to 7.29

There was high weed invasion across the entirety of the proposed 'Site S – Coramup Road' area. Overall, 31 invasive species were identified within the project area (Appendix 8.1), which is significantly high and indicates the extent of degradation caused by invasive species within the site. Of these, the most extensive and of serious concern were African Lovegrass (*Ergrostis curvula*) and Victorian Tea Tree (*Leptospermum laevigatum*), which are a significant environmental weeds. It is highly likely that proposed works will increase the distribution of weeds and degrade vegetation along the entire road reserve where works occur. Ideally, regular air cleaning or wash downs during the course of works to remove weed seeds or follow up herbicide control of invasive species needs to occur.

Dieback Information Delivery and Management System (DIDMS; GAIA Resources, SCNRM & State NRM 2020) data shows no *Phytophthora cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area, which is likely due to the lack of sampling that has occurred on road reserve. Despite this, in field surveys saw likely evidence of Dieback effected Banksia sp. and other Proteaceous species, with scattered deaths present (Figure 4). This may be due to natural senescence from old age. The indicator signs for a plant pathogen were mostly restricted from from SLK 4.01 to 4.45 of Coramup road. This area should be treated with extra precaution to limit the spread of the disease, and suggested to complete these works last or wash down prior to continuing with the road resheet. Proposed works will be conducted using appropriate hygiene measures to limit spreading of the disease, including clearing in dry conditions and clean down of vehicles and machinery before entering the site and commencing proposed works.



Figure 8 - Dying *Banksia speciosa* within SLK 4.01 to 4.45 of Coramup Rd and the 'Site S – Coramup Rd' area, this may indicate the presence of dieback, or may be natural senescence.

Table 8 - Weeds present in Site S pre clearing

Family	Genus	Species	Common Name
Asparagaceae	<i>Myrsiphyllum</i>	<i>asparagoides</i>	Bridal Creeper
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape weed
Asteraceae	<i>Hypochaeris</i>	<i>radicata</i>	Flat Weed daisy
Asteraceae	<i>Sonchus</i>	<i>oleraceus</i>	
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Ursinia Daisy
Brassicaceae	<i>Raphanus</i>	<i>raphanistrum</i>	Wild Radish
Brassicaceae	<i>Raphnus</i>	<i>rugosum</i>	Wild Mustard
Fabaceae	<i>Lupinus</i>	<i>cosentinii</i>	
Fabaceae	<i>Ornithopus</i>	<i>sativus</i>	
Geraniaceae	<i>Erodium</i>	<i>cicutarium</i>	Storksbill Pelargonium
Geraniaceae	<i>Pelargonium</i>	<i>capitatum</i>	Rose Pelargonium
Iridaceae	<i>Romulea</i>	<i>rosea</i>	Guildford Grass
Iridaceae	<i>Romulea</i>	<i>rosea var. communis</i>	Morning Star
Juncaceae	<i>Juncus</i>	<i>acutus</i>	spiny rush
Myrtaceae	<i>Eucalyptus</i>	<i>gomphocephala</i>	Tuart
Myrtaceae	<i>Leptospermum</i>	<i>laevigatum</i>	Victorian Tea Tree
Orchidaceae	<i>Disa</i>	<i>bracteata</i>	
Papaveraceae	<i>Fumaria</i>	<i>muralis</i>	
Pinaceae	<i>Pinus</i>	<i>pinaster</i>	Pinaster Pine
Pinaceae	<i>Pinus</i>	<i>radiata</i>	Pine
Poaceae	<i>Avena</i>	<i>Fatua</i>	Wild oats
Poaceae	<i>Briza</i>	<i>maxima</i>	Blowfly Grass
Poaceae	<i>Bromus</i>	<i>sp.</i>	Brome grass
Poaceae	<i>Ehrharta</i>	<i>calycina</i>	
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	African Lovegrass
Poaceae	<i>Holcus</i>	<i>lanatus</i>	Yorkshire Fog
Poaceae	<i>Pennisetum</i>	<i>clandestinum</i>	Kikuyu
Poaceae	<i>Triticum</i>	<i>aestivum</i>	Wheat
Polygonaceae	<i>Rumex</i>	<i>vesicarius</i>	Ruby dock
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>	Scarlet Pimpernel
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Black Berry Nightshade

Site V - Scaddan road - (SLK) 14.68 to 18.94

There was a significant amount of weed invasion across the entirety of the proposed 'Site V - Scaddan Road Resheet, Yates Rd to Styles Rd' area. Overall, 18 invasive species were identified within the project area (Appendix 8.1). Of these, the most extensive and of serious concern were African Love Grass (*Eragrostis curvula*) and Bridal Creeper (*Asparagus asparagoides*), with African Love Grass being present in all sections and Bridal Creeper present in all but one.

Table 9 - Weeds present in Site V pre clearing

Family	Genus	Species	Common Name
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Aizoaceae	<i>Mesembryanthemum</i>	<i>nodiflorum</i>	
Asparagaceae	<i>Asparagus</i>	<i>asparagoides</i>	Bridal Creeper
Asphodelaceae	<i>Asphodelus</i>	<i>fistulosus</i>	Onion weed
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape Weed, Cape Dandelion
Asteraceae	<i>Osteospermum</i>	<i>ecklonis</i>	Veldt Daisy
Asteraceae	<i>Sonchus</i>	<i>asper</i>	Prickly sowthistle
Asteraceae	<i>Ursinia</i>	<i>anethemoides</i>	
Asteraceae	<i>Sonchus</i>	<i>sp.</i>	Sow thistle
Brassicaceae	<i>Raphnus</i>	<i>raphanistrum</i>	Wild Radish
Fabaceae	<i>Chamaecytisus</i>	<i>palmensis</i>	
Fabaceae	<i>Vicia</i>	<i>benghalensis</i>	Purple vetch
Geraniaceae	<i>Erodium</i>	<i>cicutarium</i>	Storksbill Pelargonium
Iridaceae	<i>Romulea</i>	<i>rosea</i>	Guildford Grass
Malvaceae	<i>Malva</i>	<i>parviflora</i>	Marshmallow
Onagraceae	<i>Oenothera</i>	<i>stricta</i>	Evening Primrose
Poaceae	<i>Avena</i>	<i>sativa</i>	Oat grass
Poaceae	<i>Briza</i>	<i>maxima</i>	Blowfly grass
Poaceae	<i>Bromus</i>	<i>catharticus</i>	Prairie Grass
Poaceae	<i>Bromus</i>	<i>diandrus</i>	Great Brome
Poaceae	<i>Bromus</i>	<i>hordaceus</i>	
Poaceae	<i>Ehrharta</i>	<i>calyina</i>	
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	Love grass
Poaceae	<i>Hordeum</i>	<i>leporinum</i>	
Poaceae	<i>Lolium</i>	<i>perenne</i>	
Poaceae	<i>Vulpia</i>	<i>myuros</i>	
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>	Scarlet Pimpernel

Dieback Information Delivery and Management System (DIDMS; GAIA Resources, SCNRM & State NRM 2020) data shows no positive or negative *Phytophthora cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area. However, there were several positive *Phytophthora cinnamomi* Dieback samples nearby on Wittenoom Rd, approximately 20 km south-west of the survey area. Proposed works will be conducted using appropriate hygiene measures to limit spreading of the disease, including clearing in dry conditions and clean down of vehicles and machinery before entering the site. Due to the fire it was difficult to detect any signs of *Phytophthora cinnamomi* dieback disease within the clearing permit area. It is known to take at least five years for visual markers of Dieback to become apparent due to the tolerance of juveniles to the adverse effects of *P. cinnamomi*, a qualified dieback interpreter also cannot determine dieback presence for at least five years after a bushfire.

Site W - Plowman road - (SLK) 8.5 to 12.62

There was high weed invasion across the entirety of the proposed 'Site W – Plowman road'. Overall, 36 invasive species were identified within the project area (Appendix 8.1). Of these, the most extensive and of serious concern were Victorian Tea Tree (*Leptospermum laevigatum*) and invasive grasses such

as African lovegrass (*Eragrostis curvula*) and Annual veldt Grass (*Ehrharta longiflora*). As the vast majority of the project area is already experiencing degradation, this is not of a large conservation consequence in the broader landscape.

Table 10 - Weeds present in Site W pre clearing

Family	Genus	Species	Common Name
Asphodelaceae	<i>Asphodelus</i>	<i>fistulosus</i>	Onion Weed
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Cape Weed, Cape Dandelion
Asteraceae	<i>Cirsium</i>	<i>vulgare</i>	Spear Thistle
Asteraceae	<i>Cotula</i>	<i>coronopifolia</i>	Waterbuttons
Asteraceae	<i>Hypochaeris</i>	<i>radicata</i>	Flatweed
Asteraceae	<i>Lactuca</i>	<i>serriola</i>	Prickley Lettuce,
Asteraceae	<i>Sonchus</i>	<i>oleraceus</i>	Common Sowthistle
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Solar Daisy
Asteraceae	<i>Vellereophyton</i>	<i>dealbatum</i>	hairy pompom head
Brassicaceae	<i>Brassica</i>	<i>napus</i>	Canola
Brassicaceae	<i>Brassica</i>	<i>tournefortii</i>	Turnip
Brassicaceae	<i>Raphnus</i>	<i>raphanistrum</i>	Wild Radish
Campanulaceae	<i>Wahlenbergia</i>	<i>capensis</i>	cape bluebell
Cucurbitaceae	<i>Cucumis</i>	<i>myriocarpus</i>	Paddy melon
Fabaceae	<i>Acacia</i>	<i>pycnantha</i>	Golden Wattle
Fabaceae	<i>Chamaecytisus</i>	<i>palmensis</i>	Tagasaste
Fabaceae	<i>Ornithopus</i>	<i>compressus</i>	yellow serradella
Fabaceae	<i>Ornithopus</i>	<i>sativus</i>	Pink serradella
Geraniaceae	<i>Erodium</i>	<i>cicutarium</i>	Storksbill Pelargonium
Iridaceae	<i>Freesia</i>	<i>sp.</i>	Freesia
Iridaceae	<i>Romulea</i>	<i>rosea</i>	Guildford grass
Myrtaceae	<i>Eucalyptus</i>	<i>leucoxydon</i>	Red Flowering Gum
Myrtaceae	<i>Leptospermum</i>	<i>laevigatum</i>	Victoria Tea Tree
Onagraceae	<i>Oenothera</i>	<i>stricta</i>	Evening Primrose
Orobanchaceae	<i>Orobanche</i>	<i>minor</i>	Lesser Broomrape
Pinaceae	<i>Pinus</i>	<i>pinaster</i>	Pine tree
Poaceae	<i>Avena</i>	<i>fatua</i>	Wild oats
Poaceae	<i>Briza</i>	<i>maxima</i>	Blowfly grass
Poaceae	<i>Bromus</i>	<i>diandrus</i>	Ripgut Brome
Poaceae	<i>Ehrharta</i>	<i>calycina</i>	Perennial Veldt Grass
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	Love Grass
Poaceae	<i>Erharta</i>	<i>longiflora</i>	annual veldt grass
Poaceae	<i>Lolium</i>	<i>perenne</i>	perennial rye grass

Polygonaceae	<i>Rumex</i>	<i>crispus</i>	Curled Dock
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>	Scarlet Pimpernel
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Nightshade

Dieback Information Delivery and Management System (DIDMS) data shows positive *Phytophthora cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area. In 2018 positive records of *P. cinnamomi* were observed in *Lambertia inermis* plants on Wittenoom Road (~300 m south of Plowman Rd). There are more than ten further locations within a 20 km radius of the project site with positive *Phytophthora* results. Due to the fire it was difficult to detect any signs of *P. cinnamomi* dieback disease within the clearing permit area. It is known to take at least five years after fire for visual markers of Dieback to become apparent due to the tolerance of juveniles to the adverse effects of *P. cinnamomi*. Clear signs of dieback were present in vegetation type A, with many large dead *Banksia speciosa* plants. It therefore could be inferred that *P. cinnamomi* infestations are present within the project area and the site will be treated as such. Vegetation types A and C are the most susceptible to dieback with Proteaceae species having a strong presence in the vegetation community. Proposed works will be conducted using appropriate hygiene measures to limit spreading of the disease, including clearing in dry conditions and clean down of vehicles and machinery before entering the site and commencing proposed works. All machinery will be washed down after leaving the site, to prevent spreading it in the wider Esperance landscape.

Site X - Fisheries road - (SLK) 77.3 to 82.8

There was a high load of weed invasion across the entirety of the proposed 'Site X - Fisheries Road, East of Daniels Road' area. Overall, 19 invasive species were identified within the project area (Appendix 8.1). Of these, the most extensive and of serious concern were Victorian Tea Tree (*Leptospermum laevigatum*), African lovegrass (*Eragrostis curvula*) and Curled Dock (*Rumex crispus*). There was only one 4m tall *Acacia pycnantha* at the site located at 473204mE 6260544mS which will be removed prior to works starting at the site. Given that almost the entire site consists of good to completely degraded vegetation, this is not considered of great concern. However, more importantly wash downs will occur following the completion of the project to ensure that weeds and disease aren't further spread in the wider Esperance landscape.

Table 11 - Weeds present in Site X pre clearing

Family	Genus	Species	Common Name
Asteraceae	<i>Hypochaeris</i>	<i>radicata</i>	flat weed
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Solar Fire
Fabaceae	<i>Acacia</i>	<i>pycnantha</i>	Golden Wattle
Fabaceae	<i>Vicia</i>	<i>sp. 1</i>	Vetch
Iridaceae	<i>Romulea</i>	<i>rosea</i>	Guilford grass
Juncaceae	<i>Juncus</i>	<i>microcephalus</i>	
Myrtaceae	<i>Eucalyptus</i>	<i>globulosus</i>	Southern Blue Gum
Myrtaceae	<i>Eucalyptus</i>	<i>gomphocephala</i>	Tuart
Myrtaceae	<i>Leptospermum</i>	<i>laevigatum</i>	Victorian Tea Tree
Onagraceae	<i>Oenothera</i>	<i>stricta</i>	Common evening primrose
Pinaceae	<i>Pinus</i>	<i>pinaster</i>	Pine Tree
Poaceae	<i>Avena</i>	<i>fatua</i>	Wild Oats
Poaceae	<i>Briza</i>	<i>maxima</i>	Blowfly grass
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	Annual Veldt Grass
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	African Lovegrass
Poaceae	<i>Lolium</i>	<i>perenne</i>	Perennial Ryegrass
Polygonaceae	<i>Rumex</i>	<i>crispus</i>	Curled dock
Primulaceae	<i>Lysimachia</i>	<i>arvensis</i>	Pimpernel

Dieback Information Delivery and Management System (DIDMS; GAIA Resources, SCNRM & State NRM 2020) data shows no records *Phytophthora cinnamomi* or other *Phytophthora* sp. Dieback sample results in the immediate area, likely due to the lack of sampling that has occurred in the wider Esperance landscape. Despite no records found on the desktop survey, evidence of a plant pathogen, most likely *Phytophthora cinnamomi*, was found in the field survey, in the form of dying Proteaceae species, such as large *Banksia speciosa* plants. From this evidence, it is believed that dieback is present across almost the full extent of Site X – Fisheries Road Reconstruction. Appropriate hygiene measures will be employed prior to leaving the site to ensure the disease isn't spread elsewhere.



Figure 9 - Evidence of disease *Phytophthora cinnamomi* in vegetation type C, a *Banksia speciosa* specimen can be seen dead, while other flora persists 'Site X – Fisheries road, East of Daniels Road'.