Denmark Roadside Vegetation Survey

Report prepared for the

Shire of Denmark

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1 SUMMARY

The Denmark Roadside Vegetation Survey (DRVS) aims to provide a spatial resource to identify roadside of high quality conservation and areas requiring protection, revegetation and weed control. A total of 329 km of road (including both roadsides along 87 Shire roads) was assessed using a rapid assessment method adapted from the Roadside Conservation Committee and other regional weed mapping projects.

Remnant vegetation was present across the majority of the roadsides (total of 89.4%), occurring in five condition categories. Vegetation in Excellent (30.8%) and Very Good (18.5%) condition accounted for a higher collective proportion than Degraded (23.2%) and Completely Degraded (8.6%). The vegetation was mapped and classified into 22 types, comprised of Woodlands and Forest, Shrublands and Heath or Wetlands and Damplands. The most common vegetation types were upland lateritic or granitic woodlands or forest dominated by *Corymbia calophylla*, *Eucalyptus marginata* or *E. diversicolor* (3, 5 and 7).

A total of 595 infestations of 57 individual weed species were recorded. The most frequently encountered significant weeds were Watsonia, Blackberry, Arum lily and Bridal creeper, respectively. Several other weeds were frequently recorded that currently have no significant status. Two novel weeds include *Rubus alceifolius* (not previously recorded in Western Australia) and *Kunzea ambigua* (not previously recorded in the Warren region).

Roadside Conservation Value (RCV) was calculated using six vegetation attributes, which determined the majority of roads (73%) scored 'high' for conservation value. Analysis revealed RCV to over-estimated roadside vegetation 'value' compared to Vegetation Condition, which is recommended to be used in preference.

2 INTRODUCTION

2.1 Project Background

The Shire of Denmark is situated in one of 36 global biodiversity hotspots that are noted as areas of high conservation value due to their level of species richness and endemism. The Denmark community has emphasised in the Shire's Community Strategic Plan Our Future 2033 that the natural environment was 'our most valuable asset'. The conservation of roadside remnant native vegetation has implications for sustaining biodiversity, tourism and ecological values. Remnant vegetation along roadsides provides linkages and refuges among a fragmented landscape and often contains conservation significant flora or fauna, combined with providing wind shelter, assisting with stabilisation, erosion and salinity control, and aesthetic appeal for local tourism. Identification of existing remnant vegetation and areas of high conservation value by undertaking roadside vegetation mapping can enable protection and management of values and linkages from threats.

The Denmark Roadside Vegetation Survey (DRVS) aims to provide a spatial resource to help identify roadside of high quality conservation and areas requiring protection, revegetation and weed control activity.

2.2 Scope and Objectives

The objective of the survey is to determine the baseline biological attributes of rural road reserves in the local government area that may contain conservation values. The key attributes to capture, include:

- type and condition of native and rehabilitated vegetation;
- location and abundance of significant weeds;
- land use on adjacent tenure
- occurrence of conservation significant flora and communities.

The results of the survey will be provided for incorporation into a multi-criteria assessment to determine roadside conservation value and will be used inform the strategic planning of the Shire of Denmark.

2.3 State and Commonwealth Conservation and Pest Categories

Commonwealth, State and Local government authorities maintain lists of plant species that are assigned into categories of pest or weeds status. An overview of the codes and categories used for pest status in Western Australia are provided in Table 1.

Table 1. Species that are 'introduced' or 'weeds' can potentially be listed under the state Biosecurity Management Act (DPIRD 2019) or under the commonwealth Weeds of National Significance (WoNS) (DotEE 2019b) or recognised by local government authorities.

Category	Description
Weeds of National Significance (WoNS)	Weeds of National Significance – this is nationally recognised list of weeds agreed by Australian governments based on an assessment process that prioritised weeds based on their invasiveness, potential for spread and environmental, social and economic impacts. Consideration was also given to their ability to be successfully managed.
Declared Pest (DP) Prohibited - s12	Prohibited organism and may only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Declared Pest (DP) s22(2)	Declared pests must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia.
Permitted, Requires Permit - r73	Regulation 73 permitted organisms may only be imported subject to an import permit. These organisms may be subject to restriction under legislation other than the Biosecurity and Agriculture Management Act 2007. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions.
Permitted - s11	Permitted organisms must satisfy any applicable import requirements when imported. They may be subject to an import permit if they are potential carriers of high-risk organisms.
Locally Significant (LS)	Recognised by local government authorities as an additional weed of concern that may be locally invasive.

3 METHODS

3.1 Personnel

The vegetation assessment was conducted by Damien Rathbone (senior ecologist, BScHons Plant Science, Scientific License FB2000229). Various personnel were employed as vehicle driving assistants. Damien has over 16 years of experience conducting biological surveys in southern Western Australia. Within the South Coast region, he has previously conducted regional flora and vegetation surveys for the Department of Biodiversity, Conservation and Attractions (DBCA) and has undertaken threatened species survey and recovery implementation. Damien is also an accredited interpreter for dieback assessments on DBCA estate (Accreditation PDI-032).

3.2 Desktop Review

A desktop review was undertaken of comparative projects and spatial data in the Shire of Denmark, including the following sources:

- Denmark Environment Centre [DEC] (2002) Denmark Shire Rural Road Reserve Vegetation Survey Report.
- Ecotones (2017) Spatial Modelling for the Main Roads WA Revegetation Strategy.
- GHD (2016) Revegetation Strategy: Great Southern Region Weed survey methodology Main Roads Western Australia.
- Green Skills & Southcoast Bushcare Services [GS&SBS] (2024) Shire of Denmark Weeds Strategy & Action Plan (2024- 2034).
- Jackson (2002) Assessing Roadsides: A Guide for Rating Conservation Value.
- Protected Matters Search Tool (Department of Climate Change, Energy, Environment and Water [DCCEEW] (2024).
- Roadside Conservation Committee [RCC] (2011) Roadside Vegetation and Conservation Values in the Shire of Denmark.
- Roadside Conservation Committee [RCC] (2012a) Roadside Conservation Committee Declared Flora Roads Management Plan.
- Roadside Conservation Committee [RCC] (2012b) Shire of Denmark Code of Practice for Roadside Conservation and Road Maintenance.
- Threatened and Priority flora records from DBCA and/or the Western Australian Herbarium.
- Western Australian Herbarium [WAH] (1998–) *Florabase – the Western Australian Flora.* Department of Parks and Wildlife.

3.3 Survey Area

The Shire of Denmark contains 433 local roads (total of 935 km) and two state managed roads, Denbarker Road (M014, 24.3 km) and South Coast Highway (M009, 67.7 km) (Figure 1). Approximately 680 km of these roads are considered 'rural' and may contain important roadside conservation values (RCC 2011).

The survey area for the DRVS was initially defined by the extent of road that was previously assessed in the Roadside Conservation Committee survey: "*Roadside Vegetation and Conservation Values in the Shire of Denmark*" (RCC 2011). This included 119 shire roads that comprised a total of 387 km (several additional roads were excluded during the survey due to an absence of native vegetation). Due to survey priorities, time constraints and changes in road use, the survey area for the DRVS included 87 roads that comprised a total of 329 km (Table 2).

3.4 Field Survey Schedule

Field surveys were undertaken over twelve days during spring in 2024 (September 6, 9, 10, 11, 12 and 13; October 8 and 9; November 1, 2, 6 and 7).

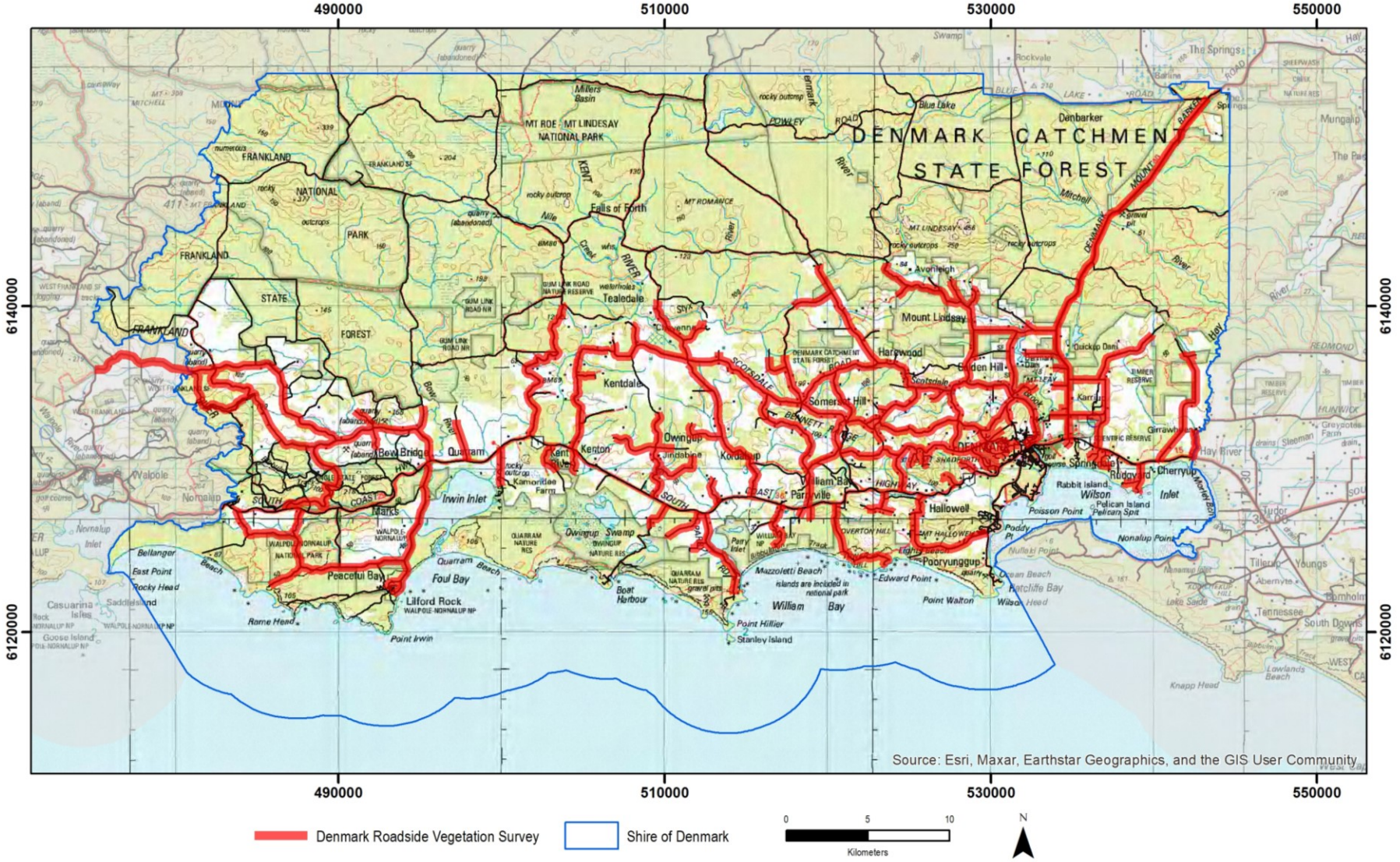

Figure 1. Survey area location.

Table 2. Local and state managed* roads included in the Denmark Roadside Vegetation Survey.

Name	Length (km)	Name	Length (km)
Barnes Rd (North)	2.6	Middleton Cl	1.1
Barnes Rd (South)	3.2	Mohr Rd	0.7
Bastiani Rd	1.8	Mt Lindesay Rd	11.5
Board Rd	6.3	Nekel Rd	1.0
Boat Harbour Rd	2.0	Nunn Rd	5.5
Brenton Rd	0.9	Nutcracker Rd	1.4
Chauncy Pl	0.1	Osborne Rd	2.0
Church Rd	1.1	Parker Rd	8.2
Churchill Rd	5.2	Parry Beach Rd	5.9
Collins Pl	0.5	Pates Rd	3.8
Conspicuous Beach Rd	6.2	Peace St W	2.8
Crusoe Beach Rd	2.0	Pitt Rd	2.7
Cussons Rd	2.3	Plozza Rd	1.3
Denmark Mt Barker Rd*	24.4	Point Hillier Vsta	2.1
Dingo Flats Rd	9.9	Powleys Rd	1.0
East River Rd (East)	2.3	Pratt Rd	1.9
East River Rd (West)	1.1	Randall Rd	0.9
Edwards St	0.2	Rice Rd	0.6
Fernlea Rd	4.5	Richmond Rd	1.0
Ficifolia Rd	6.5	Roberts Rd	5.2
Flower Wy	0.3	Rugyard Rd	1.1
Freds Rd	3.7	Scotsdale Rd	33.4
Glenrowan Rd	5.4	Settlers Rd	2.1
Greatorex Rd	0.5	Skipping Rd	2.7
Hamilton Rd	4.0	Springdale Heights	1.6
Happy Valley Rd	9.3	Stan Rd	0.7
Harewood Rd	7.2	Station Rd	4.6
Hazelvale Rd	18.7	Styx River Rd	2.0
Hicks Rd	0.5	Sunny Glen	8.1
Hodgsons Rd	0.6	Sunrise Rd	2.5
Honey Possum Ct	0.4	Tame Cl	0.1
Illsley Dr	0.9	Tealdale Rd	1.4
Jamieson Hts	0.3	Tearle Ct	0.1
Jasper Pl	0.2	Tindale Rd	11.6
Kenton Dr	1.6	Tomkin Dr	0.2
Kernutts Rd	6.6	Tulley Cl	0.6
Kerr Cl	0.4	Turner Rd	1.9
Knowles Ct	0.7	Valley Of Giants Rd	17.1
Kordabup Rd	10.4	Vigus Rd	1.7
Lights Rd	8.3	Walnut Gr	0.2
Limbourne Rd	2.3	Walter Rd	2.2
Love Cr	0.7	Williams Rd	1.5
Mcintosh Rd	4.8	Woodward Hts (E)	0.8
Mcness Rd	0.2		

3.5 Field Assessment Method

Field assessment was undertaken by vehicle (with driving assistant) or e-bike traverse of each road in both directions. Field data for each side (true left and right) was recorded independently and entered directly into an Android tablet with a customised database developed for the DRVS survey using the Fulcrum platform (Fulcrum 2024). Additional weed location point data was also recorded using a handheld GPS (Garmin Montana 700).

The survey focused on the roadside as defined by the strip of land between the road formation (beyond the drainage area or “back slope”) and the approximate cadastral boundary. Differentiation of property boundary offsets was often indistinct, therefore the survey typically recorded values easily visible within a 10-20 m corridor adjacent to the backslope.

Discrete sections of the roadside reserve were defined into Roadside Mapping Units (RMUs) that represent areas of uniform vegetation attributes. Attribute data was assigned to the start point of each RMU and ‘boundaries’ were signified by the start of a new RMU when significant changes occurred over a distance greater than 50m (i.e., changes for less than 50 m was generally not considered large enough to map as a separate RMU). The attributes were recorded for each RMU are described in Table 3 and 5. Weed infestations were mapped independently of RMUs by recording weed attributes from point locations (Table 4) (i.e., one RMU may contain multiple weed species and infestation locations).

Table 3. Roadside vegetation attributes recorded in each Roadside Mapping Unit (RMU) in the Denmark Roadside Vegetation Survey. *Six attributes contribute to the Roadside Conservation Value (Jackson 2002).

Attribute	Description
General Information	Road name, date, location and comments etc.
Road Side	True left or right side relevant to the Stright Line Kilometres (SLK) from the road origin.
Vegetation Extent*	Categorical description of vegetation overall cover (>70%, 30-70%, <30% or 0%), relating to native remnant vegetation only. If no vegetation is present, no further vegetation attributes are recorded.
Vegetation Type	Description of remnant native vegetation type. Field codes were used to define preliminary vegetation types. Floristic comparison with published vegetation assemblages was later undertaken (i.e., Albany Regional Vegetation Survey Sandiford and Barret 2010).
Vegetation Condition	Vegetation condition according to the EPA (2016) vegetation condition classification (Table 5).
Vegetation Structure*	Categorical description of vegetation layers (0 layers,1 layer or 2-3 layers). Contributes to RCV value.
Species Diversity*	Categorical description of species diversity (0-5 taxa, 6-19 taxa or >20 taxa), estimated to occur over 100m^2. RCC (2002) recorded this value as total over entire mapping unit, however this was deemed inappropriate. Contributes to RCV value.
Weed Cover*	Categorical description of overall annual weed cover within vegetated area (>70%, 30-70%, <30% or 0%). Areas with no native vegetation were not scored for this attribute, but may have had up to 100% cover of agricultural grasses. Weed infestation were primarily mapped independently from RMU (see table 4). Contributes to RCV value.
Habitat Values*	Cumulative number of values presents: (i) connects to other bushland areas (ii) hollow logs, (iii) tree hollows (iv) flowering shrubs, (v) environmentally sensitive areas. Contributes to RCV value.
Width*	Categorical description of approximate width of roadside vegetation corridor (<5m, 5-20m and >20m). Contributes to RCV value.
Adjacent Land Use	Description of land use beyond road reserve (i.e., agricultural/cleared, high condition vegetation or low condition vegetation).

Table 4. Attributes of weed infestations recorded in the Denmark Roadside Vegetation Survey.

General Information	Road name, date, location and comments etc.
Taxon	Weed species considered to be significant were primarily recorded (WoNS, Declared Pests (DP) and Locally Significant (LS) within the Shire of Denmark). Other weeds listed in the Shire of Denmark Weed Strategy (GS&BCS 2024) or that are novel within the region were opportunistically recorded.
Abundance	Number of plants or m^2 covered by infestation.
Density Category	Density category was applied for mapping continuity with the Shire of Denmark Weed Strategy (GS&BCS 2024). Categories Very Dense, Dense, Scattered and Isolated were applied post-hoc.

Table 5. Vegetation condition scale (EPA 2016).

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement. This category was not used in the assessment as roadside vegetation is unlikely to meet this value and is impractical to confirm through a rapid assessment.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.

3.6 GIS Mapping

The field data within the RMU attribute database was converted from points to a polyline feature (i.e., road centreline) with segments for each RMU assigned to either true left or right (Figure 2). The points were used to split the polyline road feature, then RMU attributes were transferred using a spatial join. Polylines for either side (left/right) were initially processed separately then merged. The output polyline feature contains segments with RMU attributes for left and right roadsides that are symbolised using a cartographic line offset (left = +2, right =-2). All field mapping was undertaken using hand-held GPS accuracy (+/- 5-10m) and all features were mapped in an ARCGIS environment.

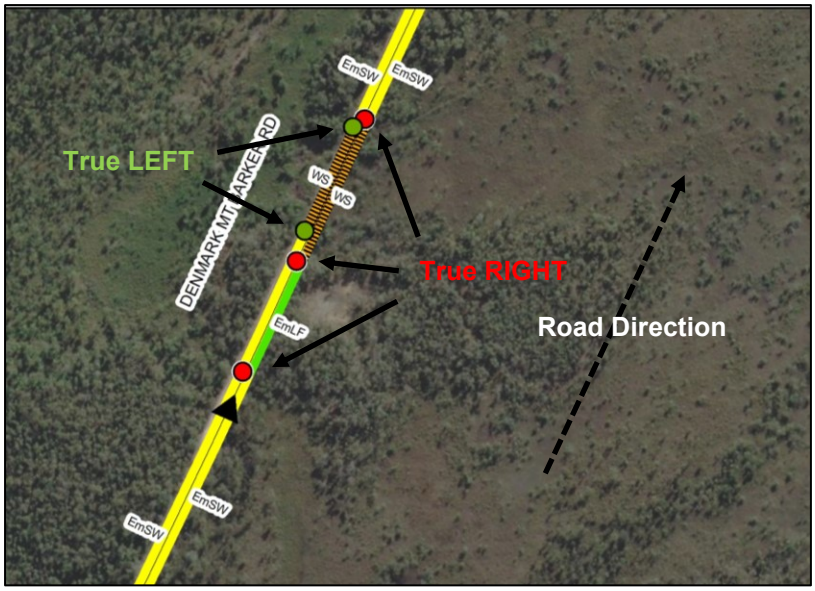

Figure 2. Field RMU points for either true left (green) or right (red) where used to split boundaries and transfer attributes to output a final polyline feature with all RMUs. Vegetation type (labelled by VegID) shown here using a cartographic line offset symbology.

3.7 Roadside Conservation Value

In accordance with methods for determining the Roadside Conservation Value (RCV) (Jackson 2002), six RMU vegetation attributes were aligned in the DRVS to determine the RCV for each road section (Table 6 and 7).

Table 6. Vegetation attributes and categorical score use to calculate a total RCV (out of 12). *In the DRVS weed cover categories were modified by shifting the scale (i.e, 0% weed cover = maximum score(2)).

Attribute	Score	Description
Vegetation Structure	0	No layers
	1	1 layer
	2	2-3 layers
Vegetation Extent	0	<30%
	1	30-70%
	2	>70%
Species Diversity	0	0-5 taxa
	1	6-19 taxa
	2	>20 taxa
Weed Cover*	0	>70% or 30-70%
	1	<30%
	2	0
Habitat Values	0	Cumulative number of values presents: (i) connects to other bushland areas (ii) hollow logs, (iii) tree hollows, (iv) flowering shrubs, (v) environmentally sensitive areas
	1	
	2	
	3	
Width	0	0-5m
	1	>5m

Table 7. Roadside Conservation Value (RCV) Scale (total score out of 12) developed by the Roadside Conservation Committee.

RCV Category	Description
High (9-12)	- Intact Structure Various Layers - Minimal Disturbance - High Diversity Of Native Flora - Few Weeds - Connectivity
Medium High (7-8)	- Generally Intact Structure – One Layer Disturbed Or Missing - Medium To High Diversity - Few To Half Weed - Medium To High Connectivity
Medium Low (5-6)	- Structure Disturbed, I.E. One Or More Vegetation Layers Absent; - Extent Of Native Vegetation Between 30 And 70%; - Medium To Low Diversity Of Native Flora Between 0 And 5 Species; - Half To Mostly Weeds; Medium To Low Value As A Biological Corridor And Few Habitat Features
Low (0-4)	- Narrow Roadside No Structure - Low Native Species Diversity - Mostly Weeds - Low Connectivity And Habitat Value

3.8 Survey Limitations

A review of potential limitations encountered during the project was undertaken (Table 8). The information provided within this report is accurate and correct to the best of the author's knowledge. However, no liability is accepted for loss, damage or injury arising from its use. Weed populations can fluctuate over time, particularly after disturbance events such as fire. Consequently, all mapping within this report should not be considered accurate indefinitely.

Table 8. Assessment of potential survey limitations for flora.

Potential for limitation	Assessment
Availability of contextual information	Regional vegetation mapping in the Shire of Demark is restricted to broad-scale pre-European vegetation formations (i.e., Beard mapping). The Albany Regional Vegetation Survey (Sandiford and Barret 2010) was primarily used to align or describe vegetation types in the DRVS. Many ARVS Units are likely to extend into the Shire, but require confirmation through empirical vegetation assessments. In this assessment vegetation types are aligned with ARVS, but should be considered preliminary only.
Personnel experience	The senior ecologist conducting the assessments is competent with sufficient experience (>10 years) in surveying south coast vegetation and flora.
Spatial accuracy and mapping resolution	Mapping data is for planning use only. It is not suitable for Environmental Impact Assessment for disturbance operations. Mapping data was captured with handheld GPS units from the road edge or within a stationary or slowly moving vehicle and a forest canopy was often present. Consequently, the spatial accuracy of the data points and boundaries may have a degree of error. Vegetation mapping resolution was 'meso-scale'. i.e., changes for less than 50 m were generally not considered large enough to map as a separate RMU. Wetland vegetation often inherently occurred in small sections, therefore may have sometimes been amalgamated. Weed points were recorded from the road to represent the occurrence of weeds in the adjacent roadside.
Method limitations	Observations were primarily made from the road (on a bike/or within a vehicle) therefore the visible proportion of the roadside vegetation was biased towards the edge. Sections with dense vegetation or steep embankments were also difficult to observe. Due to road safety, busy sections of road or those with sharp corners had to be surveyed rapidly and some values may have been overlooked. Identification of the legal road reserve (i.e., cadastral boundary) was not possible and many fence-lines were misplaced or absent. Consequently, attributes were generally recorded for closest 20m of vegetation and may include areas of private property. Two of the RCC attributes were ambiguous or problematic to record: vegetation structure and species diversity was confounded as some vegetation types naturally have layers absent (i.e., trees may be absent from wetlands) or have low species richness (i.e., Karri forest). The required plant density to constitute a 'layer' is not specified by Jackson (2002) and species diversity should preferentially be measured at a consistent spatial scale (i.e., 6-20 plants per 100m^2).
Proportion/intensity of data recorded, identification issues or sampling biases	The intensity of data collection used in the DRVS survey method was higher than in the previous assessment (i.e., DRVS recorded 5 RMUs / km, RCC2011 recorded 2.7 RMUs / km). Field observation was also conducted on each roadside separately in the DRVS, rather than concurrently in the RCC2011. The DRVS also recorded detailed weed locations independent of the RMU mapping. Hence, the survey data was considered higher resolution then the previous assessment and may not be directly comparable.
Extent of survey	The survey area was very large and not all roads could be assessed using the proposed method within the allocated time frame (approximately 85% was achieved relative to the RCC2011). No major access restrictions were present, however several road sections were not surveyed as they are not currently trafficable (i.e., servicing Munda Biddi or Nornalup Rail Trail).

Timing/weather/season	The survey was conducted in spring, which is the most suitable period for flora and vegetation survey. Most, but not weeds were flowering during this period so could easily be observed from inside a vehicle. Smaller annual weeds or those not flowering may have been overlooked.
Disturbances (e.g. fire, flood, accidental human intervention etc.)	Multiple sections of road reserve were recently burnt, therefore vegetation attributes (condition and cover) required estimation. Weed infestation may also change more rapidly following disturbance.

4 RESULTS

4.1 Vegetation Type and Condition

Remnant vegetation was present across the majority of the roadsides (total of 89.4%), occurring in five condition categories (Table 9). Vegetation in Excellent (30.8%) and Very Good (18.5%) condition accounted for a higher collective proportion than Degraded (23.2%) and Completely Degraded (8.6%).

The vegetation was classified into 22 types, comprised of Woodlands and Forest, Shrublands and Heath or Wetlands and Damplands (Table 9). The most common vegetation types were upland lateritic or granitic woodlands or forest dominated by *Corymbia calophylla*, *Eucalyptus marginata* or *E. diversicolor* (3, 5 and 7). Floristic descriptions vegetation types and condition categories are described in Appendix B.

Table 9. Extent (length (km) and % of total) of roadside vegetation type and condition category.

	Vegetation Condition					
Vegetation Type	**Completely Degraded**	**Degraded**	**Good**	**Very Good**	**Excellent**	**Total Distance (%)**
Woodlands and Forest						
1. Agonis Woodland (Ago)	1.3	3.5	6.5	0.5	5.5	17.5 (2.7)
2. Coastal Hills Forest (CHF)		0.1	1.0	2.5	2.0	5.7 (0.9)
3. *Corymbia calophylla* Forest (CcF)	19.3	48.4	36.3	27.0	19.5	150.6 (22.9)
4. *Eucalyptus cornuta* Forest (EcF)	0.2	0.1				0.3 (<0.0)
5. *Eucalyptus diversicolor* Forest (EdF)	12.9	38.3	36.0	27.4	31.4	146 (22.2)
6. *Eucalyptus marginata* Laterite Forest (EmLF)	0.4	1.5	0.8	1.2	15.0	19 (2.9)
7. *Eucalyptus marginata*/Sheoak Woodland (EmSW)	9.2	22.3	17.7	32.5	58.4	140 (21.3)
8. *Eucalyptus patens* Woodland (EpW)	2.0	4.0	2.1	1.1	2.3	11.5 (1.7)
9. *Eucalyptus staeri* Woodland (EsW)	0.4	0.6	2.5	3.3	13.1	20 (3)
Shrublands and Heath						
10. *Banksia attenuata* Heath (BaH)					1.3	1.3 (0.2)
11. Coastal Heath (CH)					1.4	1.4 (0.2)
12. *Corymbia ficifolia* Heath (CcH)		0.6			5.0	5.5 (0.8)
Wetlands and Damplands						
13. *Empodisma* Peatland (EmP)		0.8	0.0	1.0	3.4	5.2 (0.8)
14. *Melaleuca cuticularis* Woodland (McW)				1.1	0.4	1.5 (0.2)
15. *Melaleuca densa* Shrubland (MdS)		1.3	1.4	1.1	4.0	7.8 (1.2)
16. *Melaleuca preissiana* Woodland (MpW)	1.6	4.0	2.2	3.3	0.8	12 (1.8)
17. *Melaleuca rhaphiophylla* Woodland (MrW)		0.8	0.6		0.1	1.5 (0.2)
18. *Taxandria juniperina* Forest (TjF)	2.7	3.7	0.8	2.1	4.8	14.1 (2.2)
19. *Taxandria linearifolia* Thicket (TlT)	0.1	4.7	1.3	0.8	1.4	8.3 (1.3)
20. *Taxandria parvifolia* Thicket (TpT)		1.4	1.9	3.0	2.8	9.1 (1.4)
21. Wetland Suite (WS)				0.2	6.7	6.9 (1.1)
22. *Xanthorrhoea* Damp Heath (XDH)					1.3	1.3 (0.2)
Total Distance (%)	50.2 (8.6)	136.2 (23.2)	111.1 (18.9)	108.3 (18.5)	180.6 (30.8)	
Cleared areas or non-remnant vegetation						70.2 (10.6%)
					Total km:	656.6

4.2 Weeds

A total of 595 infestations of 57 individual weed species or groups (i.e., *Rubus* species) were recorded (Table 10). The most frequently encountered significant weeds were Watsonia (*Watsonia* sp.), Blackberry (*Rubus* sp.), Arum lily (*Zantedeschia aethiopica*) and Bridal creeper (*Asparagus asparagoides*), respectively (Figure 3). Several other weeds were frequently recorded that currently have no significant status (Figure 4).

The frequency of infestations of all weeds species recorded on individuals roads (Table 11), indicates weed occurrence is particularly high on several roads (Table 11). In particular, Scotsdale Road, Mt Lindesay Road and Tindale Road are “Declared Flora Roads” that rated amongst the highest.

A comprehensive list of weeds known from the Shire of Denmark and those recorded in the DRVS is presented in Appendix B. Thirteen weed species recorded during the survey are additions to the inventory. Two novel weeds include *Rubus alceifolius* (not previously recorded in Western Australia, WAH1998-) and *Kunzea ambigua* (not previously recorded in the Warren region).

Table 10. Frequency weed infestations recorded in the DRVS (highest 40 taxa shown). *Distribution in the survey area is mapped in Figures 3 and 4.

	Status			
Taxon/group	**WoNS/DP**	**LS**	**Other**	**Total**
Watsonia species*		168		168
Rubus species*	55			55
*Zantedeschia aethiopica**	37			37
*Asparagus asparagoides**	24			24
*Vinca major**			20	20
*Leptospermum laevigatum**	*	19		19
Pinus species			19	19
*Acacia decurrens**			18	18
*Melaleuca armillaris**			18	18
Schinus molle			16	16
*Polygala myrtifolia**			14	14
Acacia longifolia		13		13
Eucalyptus species (planted)			13	13
Agapanthus praecox			11	11
Psoralea pinnata		10		10
*Allium triquetrum**			9	9
Chamaecytisus palmensis			9	9
Eucalyptus globulus			9	9
Acacia dealbata			8	8
Arctotheca calendula			8	8
Asparagus scandens	8			8
Acacia baileyana			6	6
Acacia melanoxylon			6	6
Dipogon lignosus		6		6
Acacia iteaphylla			5	5
Cotoneaster species		4		4
Cyathea cooperi			4	4
Genista monspessulana	4			4
Kunzea baxteri			4	4
Pandorea pandorana			4	4
Phytolacca octandra			4	4
Bamboo			3	3
Coprosma repens			3	3
Lonicera japonica			3	3
Pittosporum undulatum		3		3
Agave americana			2	2
Callistemon species	0		2	2
Cirsium vulgare	0		2	2
Hedera helix	0		2	2

Table 11. Frequency of weed infestations (all species) for individual roads (highest 40 shown here). *Denotes Declared Flora Road (RCC 2012b).

	Density Category			
Road Name	**Isolated**	**Scattered**	**Dense**	**Very Dense**
Scotsdale Rd*	68	48	45	2
Mt Lindesay Rd*	17	16	9	
Board Rd	8	10	3	1
Mcintosh Rd	14	8		
Tindale Rd*	14	5	1	
Happy Valley Rd	6	5	4	1
Denmark Mt Barker Rd	4	5	5	1
Lights Rd	10	3	1	1
Parry Beach Rd	8	6	1	
Hazelvale Rd	11	1		1
Fernlea Rd	4	6	2	
Pates Rd	8	4		
Hamilton Rd	5	1	2	2
Kernutts Rd	6	4		
Springdale Heights	8	1	1	
Pitt Rd	6	3		
Valley Of Giants Rd	5	1	3	
Cussons Rd	4	3	1	
Freds Rd	4	3		
Harewood Rd	4	3		
Kordabup Rd	4	3		
Settlers Rd	4	1	2	
Barnes Rd (South)	2	4		
Plozza Rd	4	2		
Roberts Rd	3	3		
Station Rd	2	4		
Sunny Glen	4	2		
Limbourne Rd	3		1	1
Osborne Rd	1	4		
Point Hillier Vsta	4		1	
Rice Rd	4	1		
Tealdale Rd	3	1	1	
Turner Rd	1	2	2	
Church Rd	3		1	
Crusoe Beach Rd	3	1		
East River Rd (East)	4			
Ficifolia Rd*	2	2		
Glenrowan Rd		3	1	
Illsley Dr	3	1		
Peace St W	1	2	1	

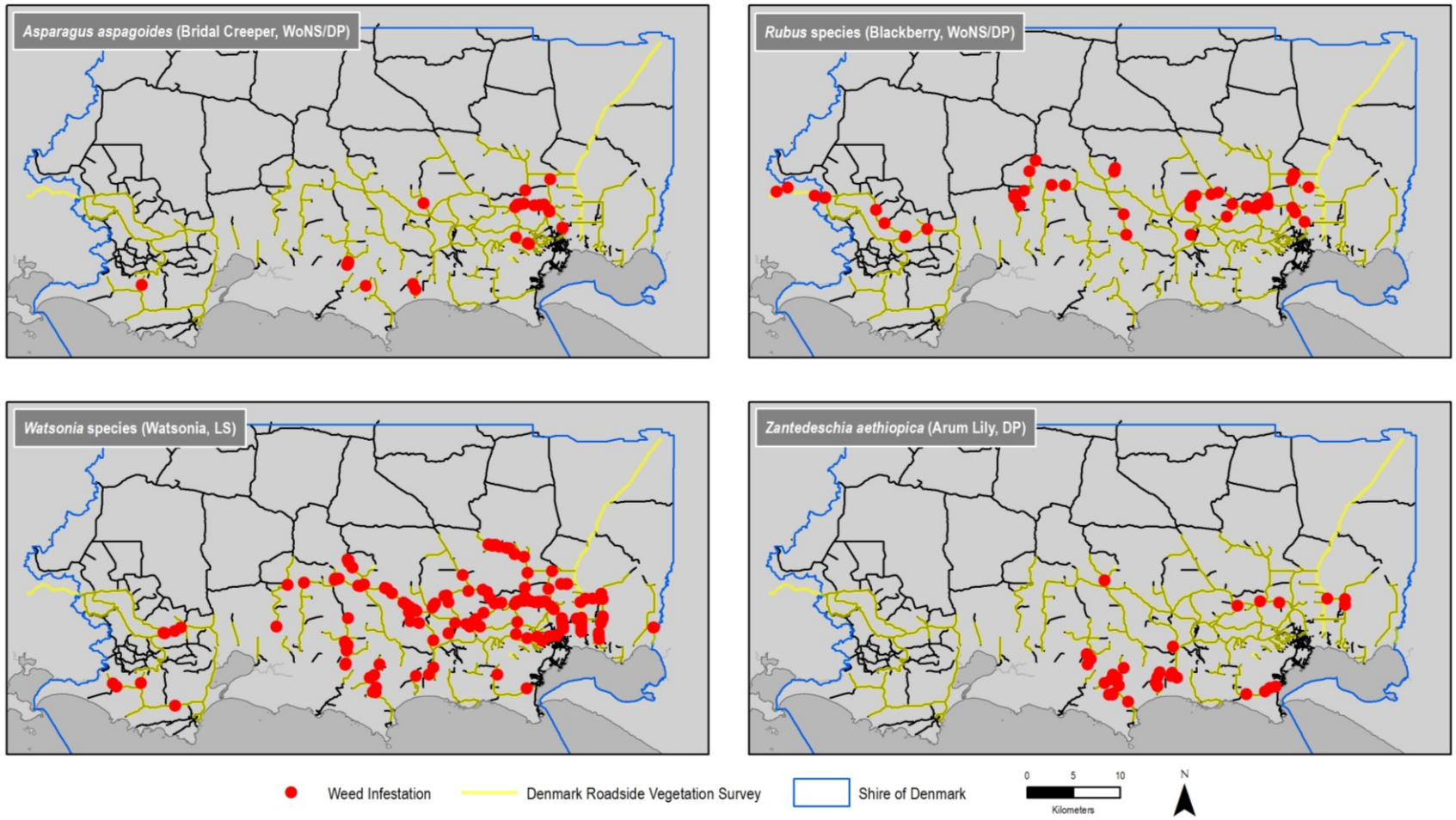

Figure 3. Distribution of the four most common significant weed species recorded in the survey area.

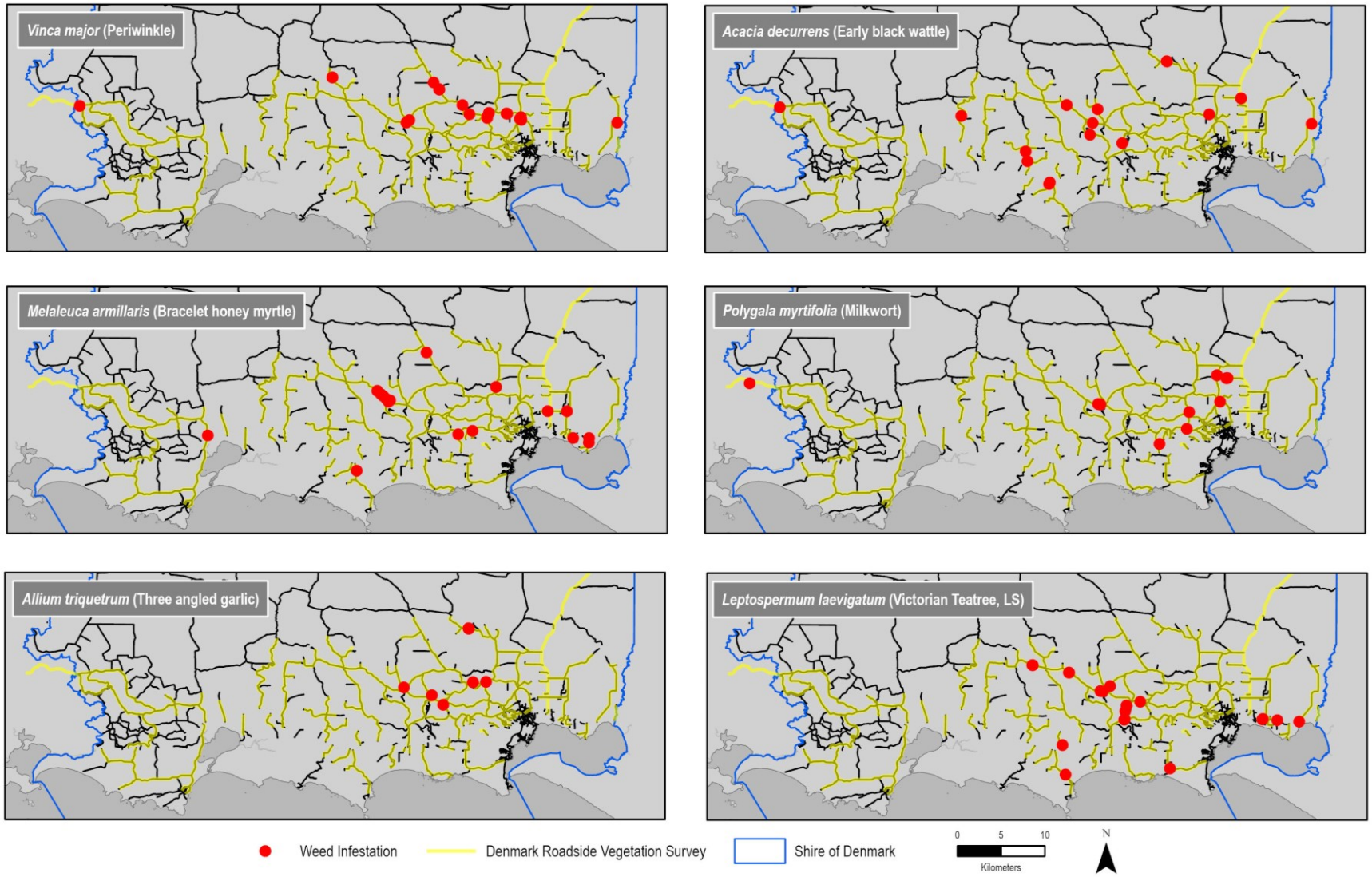

Figure 4. Distribution of six weed species that were recorded frequently in the survey area. Only *Leptospermum laevigatum* is recognised as Locally Significant (LS).

4.3 Roadside Conservation Value

The RCV was calculated using six vegetation attributes (Table 12), which determined the majority of roads within the survey area scored high for conservation value (Table 13; i.e., 73% of roads scored above 6 in the High and Medium High categories).

Table 12. Roadside length (% of total) of vegetation attributes contributing to the Roadside Conservation Value (RCV).

Attribute	Score	Description	% of total
Vegetation Extent	0	<30% (includes 0%)	14.6%
	1	30-70%	15.6%
	2	>70%	69.8%
Vegetation Structure	0	No layers	10.49%
	1	1 layer	5.82%
	2	2-3 layers	83.69%
Species Diversity	0	0-5 taxa	43.23%
	1	6-19 taxa	2.29%
	2	>20 taxa	44.01%
Weed Cover	0	>70% or 30-70%	31.3%
	1	<30%	54.5%
	2	0	21.2%
Habitat Values	0	Cumulative number of values presents: (i) connects to other bushland areas (ii) hollow logs, (iii) tree hollows, (iv) flowering shrubs, (v) environmentally sensitive areas	14.31%
	1		17.26%
	2		39.51%
	3		28.92%
Width	0	0-5m	71.6%
	1	>5m	28.4%

Table 13. Roadside length (% of total) of Roadside Conservation Value (RCV) categories derived from vegetation attributes.

RCV Category	% of total
High (9-12)	46.8%
Medium High (7-8)	26.2%
Medium Low (5-6)	12.2%
Low (0-4)	14.8%

5 CONCLUSIONS

The Denmark Roadside Vegetation Survey, spring 2024 produced a spatial dataset of vegetation attributes (type, condition, RCV value) and weed mapping for approximately 329 km of roads within the Shire. The following recommendations indicate the intended use of these data and additional work required:

- Seek further funding to extend mapping to outstanding roads within the Shire.
- Lobby other agencies and private landholders (i.e., Main Roads Western Australia, Water Corporation) to undertake weed mapping on their estate to inform a regional, cross-agency approach to managing significant weeds in the Shire.
- Manage emerging threats rapidly, where current extent is low and can be eradicated efficiently (i.e., giant bramble, *Kunzea ambigua*). Followed, by a strategic approach to manage more widely distributed significant weeds.
- Extend the Shire Weed Management Strategy (GS&SBS 2024) to incorporate roadside weed mapping and apply management based on weed significance/extent, control technique and level of threat to high Condition or Conservation Significant vegetation.
- Revegetation planning within the Shire should identify priority roadside areas, where the establishment of revegetation may offset long term weed eradication costs through competition and suppression.
- Collate available vegetation and weed mapping data within the Shire and establish methods to capture and assess eradication effort over time (i.e., maintain spatial database(s) of weed location, abundance and eradication effort).
- Plan to repeat the DRVS every ten years, or as funding permits.
- Vegetation types within the Shire of Denmark have not been described using empirical investigation. In this assessment, the ARVS Units where used to compared with the observed vegetation by field observation. Many vegetation types showed a high affinity to ARVS Units, while others were novel. More detailed regional vegetation assessments would greatly improve the baseline understanding vegetation assemblages and their extent within the Shire.
- RCV value was measured in the assessment. However, several attributes were ambiguous to record and resulted in over-estimation of roadside vegetation ‘value’ compared to Vegetation Condition (EPA 2016). It is recommended to use RCV values as indicative only; Vegetation Condition should be used in preference.

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APPENDIX A - Vegetation Descriptions

The vegetation descriptions as follows are based on both field observations and adaptation of Sandiford and Barret (2010). Equivalent or related Albany Regional Vegetation (ARVS) Units are indicated. Vegetation Type names and codes aim to be indicative of dominant taxon in upper-most stratum and typical structural formation. Cover values in floristic tables are as follows: E = emergent, D = > 70%, M= 30-70%, S = 10-30%, V = <10%.

1. *Agonis* Woodland (Ago)

Agonis Woodland occurs mainly in the coastal dune system where it commonly occurs in swales and flats. A dense canopy of *Agonis flexuosa* (Peppermint) is characteristic of this unit with the structure varying from a closed to open (ARVS Unit: Peppermint Low Forest).

Floristic Summary

Lifeform	%cover	Species
Mallee/Tree <8m	M-D	*Agonis flexuosa, +/-Eucalyptus megacarpa, +/-Hakea oleifolia*
Shrubs 1m to >2m	S	*Spyridium globulosum, Adenanthos sericeus, Bossiaea linophylla, Leucopogon obovatus, Hibbertia cuneiformis, Hibbertia furfuracea*
Sedges/rushes	V-D	*Lepidosperma effusum, Lepidosperma gladiatum, Desmocladus flexuosus, Lepidosperma densiflora, Gahnia scleroides* (P4)
Herbs	V	*Hardenbergia comptoniana, Clematis pubescens, Opercularia hispidula*

2. Coastal Hills Forest (CHF)

Coastal Hills Forest is a floristically variable unit associated with the granitic coastal hills. It occurs on a variety of soils from gravelly loam, gravelly sand to sandy loam and sand, with granite and lateritic exposures frequently present. The structure of this unit is highly variable with both Marri and Jarrah occurring as shrubs or low mallees on the windswept exposed coastal slopes and occurring as an open forest on the deeper soil of more protected slopes and gullies. High floristic diversity, dense tall shrub layers and a sedgeland frequently dominated by *Lepidosperma gracile* and *Cyathochaeta avenacea* are typical of this unit as is the dominance or co-dominance of *Corymbia calophylla* in the overstorey (ARVS Unit: Marri/Jarrah Coastal Hills Forest).

Floristic Summary

Lifeform	%cover	Species
Trees<10mto 10-30	V-M	*Corymbia calophylla, Eucalyptus marginata, Allocasuarina fraseriana, Agonis flexuosa*
Shrubs >2m	V-D	*Banksia grandis, Hakea trifurcata, Beaufortia decussata, Hibbertia furfuracea, Hakea florida, Bossiaea linophylla, Taxandria parviceps, Petrophile diversifolia*
Shrubs 0.5-2m	V-M	*Hovea elliptica, Agonis theiformis, Crowea angustifolia* subsp. *angustifolia, Eutaxia parvifolia, Leucopogon obovatus, Acacia myrtifolia, Xanthorrhoea preissii, Leucopogon verticillatus, Macrozamia riedlei, Grevillea pulchella, Xanthosia rotundifolia*
Sedges/rushes/herbs	S	*Lepidosperma gracile, Cyathochaeta avenacea, Tetraria octandra, Anarthria prolifera, Mesomelaena gracilipes, Tetraria capillaris, Anarthria prolifera, Desmocladus fasciculatus, Patersonia umbrosa, Lomandra pauciflora, Scaevola striata.*

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3. *Corymbia calophylla* Forest (CcF)

Corymbia calophylla Forest occurs in well drained sand or loam on hill slopes and adjacent to larger creeks and rivers. The structure varies from a low open forest on exposed coastal slopes to open forest in protected gullies. *Eucalyptus marginata* may be a sub-dominant canopy species with *Agonis flexuosa* usually forming a sparse secondary tree stratum. The understorey is often dominated by *Acacia pentadenia* and or *Bossiaea linophylla*.

Floristic Summary

Lifeform	%cover	Species
Trees <10-<30m	M	*Corymbia calophylla, Eucalyptus marginata, Agonis flexuosa*
Shrubs 0.5-2m	V-	*Acacia pentadenia, Bossiaea linophylla, Hibbertia cuneiformis, Lasiopetalum floribundum, Trymalium odoratissimum, Leucopogon obovatus, Hibbertia amplexicaulis, Hovea elliptica, Tremandra stelligera, Crowea angustifolia* subsp. *angustifolia*
Sedges/rushes/grasses	V-M	*Cyathochaeta avenacea, Tetrandra octandra, Tetraria capillaris, Lepidosperma* aff *angustatum, Desmocladus flexuosus, Anarthria prolifera. Patersonia umbrosa, Tetrarrhena laevis, Microlaena stipoides*

4. *Eucalyptus cornuta* Forest (EcF)

Eucalyptus cornuta Forest is found along the coastal fringe in protected swales, slopes, crests and flats on grey sand. It is dominated by an upper canopy of *Eucalyptus cornuta* over a sparse secondary tree stratum of *Agonis flexuosa.* There is usually one shrub layer, a tall open scrub or open heath and common dominant shrubs include *Hibbertia furfuracea, Bossiaea linophylla* and *Spyridium globulosum.* Ground cover is frequently sparse and there is a high degree of variability in sedge dominance with *Desmocladus flexuosus* most common. (ARVS Unit: Coastal Yate Woodland).

Floristic Summary

Lifeform	%cover	Species
Trees 10-30m	S-M	*Eucalyptus cornuta, Agonis flexuosa*
Trees <10m	V	
Shrubs >2m	M	*Hibbertia furfuracea, Bossiaea linophylla, Spyridium globulosum Leucopogon obovatus, Hibbertia cuneiformis, Pimelea clavata*
Sedges/rushes	Nil -V	*Desmocladus flexuosus, Lepidosperma densiflora, Lepidosperma densiflora* forma proliferous*, Lepidosperma effusum, Lepidosperma effusum* forma small*, Lepidosperma gladiatum, Ficinia nodosa*
Herbs		*Billardiera fusiformis, Clematis pubescens, Stylidium adnatum, Opercularia hispidula, Hardenbergia comptoniana*
Grasses		*Tetrarrhena laevis*

5. *Eucalyptus diversicolor* Forest (EdF)

Eucalyptus diversicolor Forest is distinguished by the presence *Eucalyptus diversicolor* (Karri) trees in the canopy. However, is a floristically variable across the Shire and include sub-assemblages co-dominance of Corymbia calophylla and other Eucalypts (i.e., Eucalyptus jacksonii, Eucalyptus guilfoylei, Eucalyptus brevistylis, Eucalyptus megacarpa). (ARVS Unit: Karri Forest).

Floristic Summary

Lifeform	%cover	Species
Trees 10-30m	M	*Eucalyptus diversicolor*
Trees <10 m	V	*Agonis flexuosa, Allocasuarina decussata, Hakea oleifolia*
Shrubs >2m	S-M	*Trymalium odoratissimum, Chorilaena quercifolia, Hibbertia furfuracea, Bossiaea linophylla, Acacia pentadenia,*
Shrubs <2m	V	*Acacia alata, Tremandra stelligera*
Sedges/rushes	V	*Lepidosperma effusum, Ficinia nodosa, Desmocladus flexuosus, Lepidosperma squamatum, Lepidosperma densiflora*
Herbs	V	*Opercularia hispidula, Hardenbergia comptoniana, Clematis pubescens, Billardiera variifolia, Lagenophora huegelii, Pteridium esculentum*
Grasses		*Tetrarrhena laevis, Poa porphyroclados, Microlaena stipoides*

6. *Eucalyptus marginata* Laterite Forest (EmLF)

Eucalyptus marginata Laterite Forest is found on well drained shallow loamy/sandy soil, with outcropping laterite, usually occurring on the crests and middle slopes of low relief hills and plateaus with occasional occurrences on lower slopes. Canopy structure varies from a low woodland to an open forest and both *Eucalyptus marginata* and *Allocasuarina fraseriana* may be present as sole canopy species. *Banksia grandis* is often present as a secondary tree strata or a tall shrub layer. The understorey is often relatively open though structurally diverse with shrub, sedge and herb layers well developed. The sedge layer is dominated by four sedge species *Anarthria prolifera, Tetraria octandra, Tetraria capillaris* and *Desmocladus fasciculatus.* (ARVS Unit: Jarrah/Marri/Sheoak Laterite Forest).

Floristic Summary

Lifeform	%cover	Species
Trees	S-M	*Eucalyptus marginata, Corymbia calophylla, Allocasuarina fraseriana*
Shrubs >2m	S	*Banksia grandis, Bossiaea linophylla, Beaufortia decussata, Hakea amplexicaulis, Persoonia longifolia, Taxandria parviceps, Petrophile diversifolia, Banksia serra Agonis theiformis, Leucopogon verticillatus, Grevillea occidentalis, Isopogon longifolius, Hakea ruscifolia, Sphaerolobium alatum, Xanthosia rotundifolia, Bossiaea ornata, Hovea chorizemifolia*
Sedges/rushes/herbs	V-S	*Anarthria prolifera, Tetraria octandra, Tetraria capillaris, Desmocladus fasciculatus,+/- Lepidosperma densiflora, Lepidosperma gracile, Cyathochaeta avenacea, Mesomelaena gracilipes, Stylidium amoenum, Conostylis setigera*

7. *Eucalyptus marginata*/Sheoak Woodland (EmSW)

Eucalyptus marginata/Sheoak Woodland is usually found on gentle middle to lower slopes on sandy soil overlying laterite. A low open woodland of *Banksia attenuata* and less frequently *Banksia ilicifolia* can be present as a secondary tree strata over a tall open scrub, open heath, low shrubland, sedgeland and herbland. Characteristic shrubs include *Melaleuca thymoides*, *Adenanthos cuneatus, Isopogon longifolius*. Characteristic sedges include *Anarthria scabra* and *Dasypogon bromeliifolius.* (ARVS Unit: Jarrah/Sheoak/*Eucalyptus staeri* Sandy Woodland).

Floristic Summary

Lifeform	%cover	Species
Trees<10m	S	*Allocasuarina fraseriana. Eucalyptus marginata, Eucalyptus staeri, Banksia attenuata, Banksia ilicifolia, Banksia grandis*
Shrubs 0.5-1m	V-M	*Taxandria parviceps, Hakea ruscifolia, Persoonia longifolia, Isopogon longifolia, Melaleuca thymoides, Agonis theiformis, Gompholobium scabrum, Beaufortia decussata, Adenanthos cuneatus, Xanthosia rotundifolia, Leucopogon glabellus, Allocasuarina humilis, Daviesia flexuosa, Daviesia incrassata, Tetratheca setigera, Conospermum caeruleum*
Sedges/rushes/herbs	M	*Anarthria scabra, Cyathochaeta equitans, Tricostularia neesii* var *elatior, Dasypogon bromeliifolius*

8. *Eucalyptus patens* Woodland (EpW)

Eucalyptus patens Woodland in grey to dark grey sand and sandy loams low in the landscape where moisture retention is high. This unit forms narrow bands along valley edges and drainage lines between upland and wetland units. (ARVS Unit: *Eucalyptus patens* Low Woodland).

Floristic Summary

Lifeform	%cover	Species
Trees	S-M	*Eucalyptus patens*
Shrubs >2m	S	*Taxandria parviceps, Taxandria juniperina, Astartea pulchella, Pultenaea reticulata, Callistachys lanceolata, Aotus intermedia*
Sedges/rushes	S	*Leptocarpus tenax, Anarthria scabra, Hypolaena exsulca, Anarthria prolifera, Lepidosperma* aff *squamatum*

9. *Eucalyptus staeri* Woodland (EsW)

Eucalyptus staeri Woodland occurs on deep white/light grey sand on the lower slopes and valleys, usually occurring just upslope of seasonally wet drainage lines. This unit is floristically very diverse and structurally variable. *Allocasuarina fraseriana* and *Banksia attenuata* and are often present. Characteristic shrubs include *Jacksonia spinosa, Melaleuca thymoides, Adenanthos cuneatus* and *Leucopogon rubricaulis.* (Affinities to ARVS Unit: *Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland).

Floristic Summary

Lifeform	%cover	Species
Trees<10m	V	*Eucalyptus staeri, Allocasuarina fraseriana, Banksia attenuata, Banksia ilicifolia, +/- Eucalyptus marginata, Nuytsia floribunda*
Shrubs 1-2m	M	*Taxandria parviceps, Jacksonia spinosa, Melaleuca thymoides, Adenanthos cuneatus, Adenanthos obovatus, Daviesia incrassata, Daviesia flexuosa, Gompholobium scabrum, Leucopogon rubricaulis, Kingia australis Andersonia caerulea*
Ground	S-M	*Cyathochaeta equitans, Lyginia barbata, Anarthria scabra, Anarthria prolifera, Hypolaena exsulca, Hypolaena fastigiata, Schoenus caespititius, Mesomelaena gracilipes, Anarthria gracilis, Dasypogon bromeliifolius, Phlebocarya ciliata, Johnsonia teretifolia, Stylidium scandens*

10. *Banksia attenuata* Heath (BaH)

Banksia attenuata Heath occurs on deep white sand on the lower slopes and valleys, usually occurring just upslope of seasonally wet drainage lines. This unit has strong floristic affinities with *Eucalyptus staeri* Woodland, but is distinguished by an absence of a Eucalypt canopy. (Affinities to ARVS Unit: *Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland).

Floristic Summary

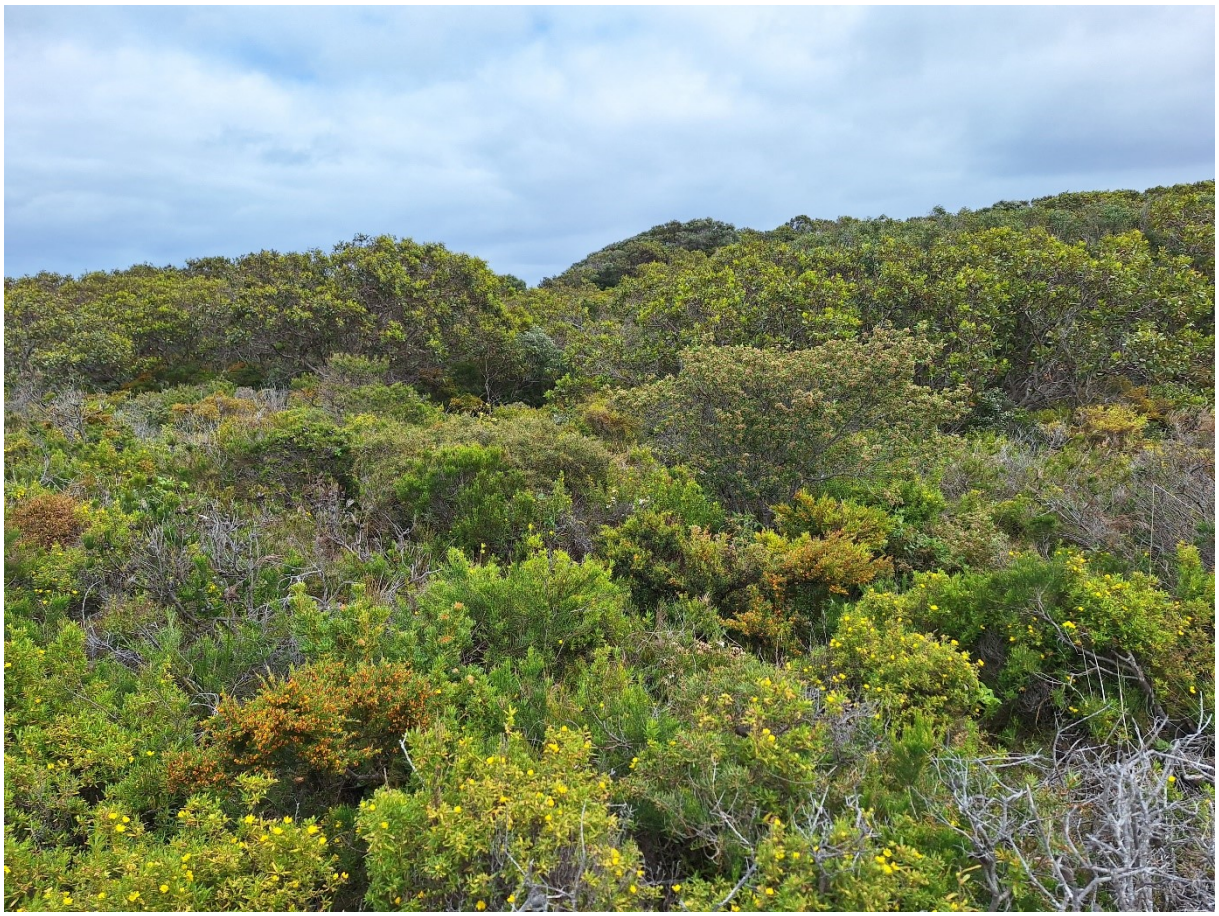
Lifeform	%cover	Species
Trees<10m	V	*Allocasuarina fraseriana, Banksia attenuata, Nuytsia floribunda*
Shrubs 1-2m	M	*Jacksonia horrida, Melaleuca thymoides, Adenanthos cuneatus, Adenanthos obovatus, Leucopogon rubricaulis*
Sedges/rushes	S-M	*Anarthria scabra, Hypolaena fastigiata, Anarthria gracilis, Cyathochaeta equitans*

11. Coastal Heath (CH)

Coastal Heath is restricted to light grey alkaline sand on the coastal dunes system. (ARVS Unit: Coastal Heath).

Floristic Summary

Lifeform	%cover	Species
Trees<10m	E-V	*Agonis flexuosa*
Shrubs 1-2m	M	*Bossiaea linophylla, Banksia grandis, Hakea florida, Hakea ruscifolia, Hibbertia furfuracea, Jacksonia horrida, Adenanthos cuneatus, Spyridium globulosum, Leucopogon obovatus, Isopogon formosus, Acacia littorea, Melaleuca thymoides, Olax phyllanthi, Olearia axillaris, Gyrostemon sheathii, Hibbertia racemosa, Platysace compressa, Amperea ericoides*
Sedges/rushes	S-M	*Cyathochaeta equitans, Desmocladus flexuosus, Anarthria prolifera, Schoenus caespititius, Lepidosperma densiflora, Lyginia imberbis, Lyginia barbata, Loxocarya cinerea Conostylis aculeata* subsp. *aculeata*



12. *Corymbia ficifolia* Heath (CfH)

Corymbia ficifolia Heath is restricted to coastal areas near Peaceful Bay where it is found in deep acidic sands on low dunes. (Affinities to ARVS Unit: Coastal *Banksia ilicifolia*/Peppermint Low Woodland).

Floristic Summary

Lifeform	%cover	Species
Trees<10m	V-S	*Corymbia ficifolia, Allocasuarina fraseriana*
Shrubs 1-2m	S-M	*Jacksonia horrida, Taxandria parviceps, Pultenaea reticulata, Melaleuca thymoides, Leucopogon obovatus, Adenanthos cuneatus, Leucopogon obovatus, Leucopogon rubricaulis, Andersonia caerulea, Acacia myrtifolia*
Sedges/rushes	V-M	*Anarthria scabra, Anarthria prolifera, Cyathochaeta equitans*

13. *Empodisma* Peatland (EP) (Threatened Ecological Community - TEC)

Empodisma Peatland occurs in drainage depressions below the seepage zone on dark brown peat or sandy peat that is waterlogged in winter and moist in summer. This unit has a distinctive dense sedgeland characterized by the presence and dominance of *Empodisma gracillimum*. Other co- or sub-dominant sedges include Lepido*sperma striatum, Leptocarpus tenax, Schoenus multiglumis, Gymnoschoenus anceps, Gahnia decomposita* and *Baumea rubiginosa*. The upper stratum is dominated by tall shrubs and varies from a closed tall scrub or closed heathland to a shrubland, a lower secondary shrub stratum may be present. Common shrub species include *Callistemon glaucus, Homalospermum firmum, Hakea linearis, Aotus intermedia, Acacia hastulata, Sphaerolobium fornicatum* and *Dampiera leptoclada.* (ARVS Unit: *Homalospermum firmum/Callistemon glaucus* Peat Thicket). This vegetation type is concordant with the *Empodisma* peatlands of southwestern Australia TEC (DCCEEW 2023).

Floristic Summary

Lifeform	%cover	Species
Shrubs >2m	S-D	*Homalospermum firmum, Callistemon glaucus, Hakea linearis, Taxandria linearifolia, Taxandria parviceps +/- Callistachys lanceolata, Rhadinothamnus anceps*
Shrubs 1-2m	S-M	*Acacia hastulata, Hypocalymma cordatum, Boronia crassipes, Sphaerolobium rosulatum, Boronia stricta, Sphaerolobium fornicatum*
Sedges/rushes	D	*Empodisma gracillimum, Gymnoschoenus anceps, Schoenus multiglumis, Leptocarpus tenax, Gahnia decomposita, Lepidosperma striatum, Baumea rubiginosa, Schoenus sublaxus, Baumea acuta*

14. *Melaleuca cuticularis* Woodland (McW)

Melaleuca cuticularis Woodland is restricted to the coastal fringe along low energy estuarine and inlet shores. (ARVS Unit: Coastal *Melaleuca cuticularis* Low Forest).

Floristic Summary

Lifeform	%cover	Species
Trees	S-D	*Melaleuca cuticularis, Melaleuca preissii*
Shrubs >2m	M	*Melaleuca densa, Rhadinothamnus anceps*
Sedges/rushes	V-D	*Juncus kraussii, Gahnia trifida, Baumea vaginalis, Baumea juncea, Baumea arthrophylla*

15. *Melaleuca densa* Shrubland (MdS)

Melaleuca densa Shrubland occurs on the fringe of estuaries or seasonally inundated damplands on a variety of sand to loam soils, often with some clay content. *Melaleuca densa* Swamp Heath

Floristic Summary

Lifeform	%C	Species
Trees	E	*Melaleuca preissiana, Melaleuca cuticularis, Banksia littoralis*
Shrubs >2m	V	*Hakea tuberculata, Hakea ceratophylla*
Shrubs 1-2	M	*Melaleuca densa*
Sedges/rushes	V-D	*Juncus kraussii, Gahnia trifida, Baumea vaginalis, Baumea juncea, Baumea arthrophylla*

16. *Melaleuca preissiana* Woodland (MpW)

Melaleuca preissiana Woodland along drainage lines on dark grey sandy loam and occasionally on sandy peat soil. (ARVS Unit: *Melaleuca preissiana* Low Woodland).

Floristic Summary

Lifeform	%cover	Species
Trees	E-S	*Melaleuca preissiana +/- Banksia littoralis*
Shrubs 1-2m	M	*Aotus intermedia, Homalospermum firmum, Callistemon glaucus, Hakea ceratophylla, Taxandria linearifolia, Taxandria parviceps, Sphenotoma gracilis,*
Sedges/rushes	M	*Leptocarpus tenax, Schoenus efoliatus, Evandra aristata, Anarthria prolifera, Cyathochaeta avenacea, Lepidosperma striatum, Baumea juncea, Xyris lanata*

17. *Melaleuca rhaphiophylla* Woodland (MrW)

Melaleuca rhaphiophylla Woodland/Low Forest Complex is characterized by a canopy of *Melaleuca rhaphiophylla* and is low in species diversity. It is restricted to low-lying freshwater areas including creek lines, flats and lake margins. (ARVS Unit: *Melaleuca rhaphiophylla* Woodland/Low Forest Complex).

Floristic Summary

Lifeform	%cover	Species
Trees	MD	*Melaleuca rhaphiophylla*
Shrubs >2m	V	*Rhadinothamnus anceps, Taxandria linearifolia, Callistachys lanceolata*
Sedges/rushes	V-D	*Baumea vaginalis, Lepidosperma effusum, Baumea juncea, Gahnia decomposita, Ficinia nodosa, Baumea articulata.*

18. *Taxandria juniperina* Forest (TjF)

Taxandria juniperina Forest occurs in swamps and adjacent to freshwater lakes and drainage lines. A dense canopy of *Taxandria juniperina* and a depauperate shrub and sedge layer is characteristic of this unit. (ARVS Unit: *Taxandria juniperina* Closed Forest).

Floristic Summary

Lifeform	%cover	Species
Trees	M-D	*Taxandria juniperina*, *Callistachys lanceolata, +/- Banksia littoralis, Melaleuca preissiana*
Shrubs >2m	Nil-V	*Rhadinothamnus anceps*
Sedges/rushes	V-D	*Baumea vaginalis, Leptocarpus tenax, Empodisma gracillimum, Baumea rubiginosa, Meeboldina scariosus, Lepidosperma striatum, Lepidosperma effusum*

19. *Taxandria linearifolia* Thicket (TIT)

Taxandria linearifolia Thicket represents a modified assemblage of Empodisma Peatlands, where disturbance (i.e., browsing, fire or weeds) has removed the sedge and peat layer and *Homalospermum firmum* is often absent. (ARVS Unit: *Homalospermum firmum/Callistemon glaucus* Swamp Thicket).

Floristic Summary

Lifeform	%cover	Species
Shrubs >2m	S-D	*Taxandria linearifolia, Taxandria parviceps, Callistachys lanceolata, Rhadinothamnus anceps*
Sedges/rushes	D	*Leptocarpus tenax, Gahnia decomposita, Lepidosperma striatum, Baumea rubiginosa*

20. *Taxandria parvifolia* Thicket (TpT)

Taxandria parviceps Transitional Shrubland is found throughout the survey area on grey sand along the edge of drainage depressions, or in pockets of poorly drained sand over laterite. This unit often exists as narrow bands along valleys between the uplands and wetlands and shares species with units typical of these areas. The upper stratum is a *Taxandria parviceps* tall open or closed tall scrub with understorey strata decreasing in both structural and floristic diversity with increasing canopy cover. *Banksia quercifolia* may be co-dominant in the upper stratum. Emergent trees are occasionally present. Common species include *Melaleuca thymoides, Adenanthos obovatus, Leucopogon glabellus, Boronia spathulata, Dampiera leptoclada, Conospermum caeruleum, Anarthria scabra, Anarthria prolifera, Mesomelaena gracilipes, Hypolaena exsulca, Schoenus efoliatus, Evandra aristata* and *Dasypogon bromeliifolius*. (ARVS Unit: *Taxandria parviceps* Transitional Shrubland).

Floristic Summary

Lifeform	%cover	Species
Trees	V	*Eucalyptus marginata, Allocasuarina fraseriana, Eucalyptus staeri, Melaleuca preissiana*
Shrubs <1m	V	*Taxandria parviceps, Banksia quercifolia, Beaufortia sparsa, Sphaerolobium grandiflorum, Beaufortia decussata, Adenanthos obovatus, Leucopogon glabellus, Sphenotoma gracilis, Boronia crenulata, Xanthosia rotundifolia*
Sedges/rushes	M	*Anarthria scabra, Anarthria prolifera, Mesomelaena gracilipes, Hypolaena exsulca, Schoenus efoliatus, Schoenus acuminatus, Evandra aristata, Lyginia barbatus, Lepidosperma striatum, Leptocarpus tenax, Chordifex laxus Dasypogon bromeliifolius*

21. Wetland Suite (WS)

Wetland Suite is broad wetland mapping unit that is floristically diverse, especially in the sedge stratum that varies with soil, hydrology, landscape and fire history. It occurs on the upper margins of drainage depressions, often forming bands on gentle slopes above the seepage zone. (ARVS Unit: *Evandra aristata* Sedgeland)

Floristic Summary

Lifeform	%cover	Species
Shrubs >2m	S-D	*Kunzea ericifolia*
Shrubs 1-2m	M	*Beaufortia sparsa, Homalospermum firmum, Taxandria fragrans, Taxandria parviceps, Banksia quercifolia, Sphaerolobium grandifolium, Banksia littoralis*
Shrubs <1m	S	*Sphenotoma gracilis*, *Pericalymma spongiocaule, Boronia spathulata, Adenanthos obovatus, Calothamnus schaueri, Pimelea longifolia, Hypocalymma strictum, Leucopogon distans*
Sedges/rushes	M-D	*Evandra aristata, Leptocarpus tenax, Schoenus efoliatus, Schoenus multiglumis, Anarthria prolifera, Anarthria scabra, Mesomelaena gracilipes, Gymnoschoenus anceps*

22. *Xanthorrhoea* Damp Heath (XDH)

Xanthorrhoea Damp Heath occurs in low-lying, seasonally damp/wet areas, on clay loams/sands. (ARVS Unit: *Xanthorrhoea* Lowland Sedgeland).

Floristic Summary

Lifeform	%cover	Species
Mallees <10m	E	*Eucalyptus marginata, Melaleuca preissiana*
Shrubs >2m	E	*Hakea tuberculata, Hakea falcata, Hakea ceratophylla, Hakea trifurcata, Taxandria parviceps*
Shrubs 0.5-1m	S-M	*Hakea sulcata, Xanthorrhoea preissii, Pericalymma spongiocaule, Allocasuarina humilis, Petrophile squamata, Hakea ceratophylla, Melaleuca densa, Melaleuca violacea, Leucopogon pendulus, Melaleuca suberosa*
Sedges/rushes	V-S	*Mesomelaena tetragona, Cyathochaeta avenacea, Desmocladus fasciculatus, Schoenus obtusifolius, Anarthria gracilis*

APPENDIX B - Inventory of Weed Species

Table B1. Inventory of weed species in the Shire of Denmark. Combined data from DRVS and GS&SCB (2024).

Scientific Name	Common Name	Status	Code
Acacia baileyana	Cootamundra wattle		Abai
Acacia dealbata	Silver wattle		Adea
Acacia decurrens	Early black wattle		Adec
Acacia elata	Mountain cedar wattle		Aela
Acacia floribunda	Catkin wattle		Aflo
Acacia iteaphylla	Flinders Ranges wattle		Aite
Acacia longifolia	Sydney golden wattle	LS	Alon
Acacia melanoxylon	Tasmanian blackwood		Amel
Acacia podalyriifolia	Queensland silver wattle		Apod
Acacia pycnantha	Golden wattle		Apyc
Acacia saligna	Acacia saligna		Asal
Agapanthus praecox	Agapanthus		Apra
Agave americana	Century plant		Aame
Allium triquetrum	Three-cornered garlic		Atri
Amaryllis belladonna	Easter lily		Abel
Anredera cordifolia	Madeira vine	WoNS	Acor
Arctotheca calendula	Capeweed		Acal
Asparagus aethiopicus	Garden/basket asparagus	WoNS	Aaet
Asparagus asparagoides	Bridal creeper	WoNS, DP, LS	Aasp
Asparagus scandens	Asparagus fern	WoNS	Asca
Asphodelus fistulosus	Onion weed		Afis
Atriplex prostrata	Goosefoot		Apro
Avena spp	Wild oats		Aspp
Bamboo	Bamboo		Bamb
Brizia spp	Blowfly grass		Bspp
Callistemon species	Bottlebrush		Caspp
Cenchrus clandestinum	Kikuyu		Ccla
Centranthus ruber	Red valerian		Crub
Centranthus ruber	Red valerian		Crub
Chamaecytisus palmensis	Tagasaste/Tree lucerne		Cpal
Chasmanthe floribunda	African cornflag		Cflo
Cirsium vulgare	Spear thistle		Cvul
Conyza spp	Fleabane	LS	Cbon
Coprosma repens	Mirror bush		Crep
Cortaderia selloana	Pampas grass	LS	Csel
Cotoneaster species	Cotoneaster	LS	Cspp
Crocosmia crocosmiiflora	Montbretia		Ccro
Cyathea cooperi	Tree fern		Ccoo
Cynodon dactylon	Couch grass		Cdac
Cyperus eragostis	Umbrella sedge		Cera

Scientific Name	Common Name	Status	Code
Delairea odorata	German/False ivy		Dodo
Dimorphotheca ecklonis	Daisy		Deck
Dipogon lignosus	Dolichos pea	LS	Dlig
Dittrichia viscosa	Dittrichia		Dvis
Dodonaea viscosa	Hop tree		Dvis
Ehrharta longiflora	Veldt grass		Elon
Eragrostis curvula	African lovegrass	LS	Ecur
Eriobotrya japonica	Loquat		Ejap
Erythrina x sykesii	Coral tree		Esyk
Eucalyptus globulus	Tasmanian bluegum		Eglo
Eucalyptus species (planted)	Eucalyptus species (planted)		Eucspp
Euphorbia terracina	Geraldton carnation weed		Eter
Foeniculum vulgare	Fennel		Fvul
Freesia alba	Freesia		Falb
Garden escapees			Gesc
Gazania linearis	Gazania		Glin
Genista monspessulana	Genista/Broom	WoNS	Gmon
Gladiolus undulatus	Wavy gladiolus		Gund
Hedera helix	Ivy		Hhel
Histiopteris incisa	Bat's wing fern		Hinc
Holcus lanatus	Yorkshire fog		Hlan
Homalanthus novo-guineensis	Bleeding heart tree		Hnov
Hypochaeris radicata	Flatweed		Hrad
Ipomoea indica	Morning glory		Iind
Ixia species	Ixia		Ispp
Juncus microcephalus	Smallhead rush		Jmic
Kunzea ambigua	White Kunzea		Kamb
Kunzea baxteri	Scarlet Kunzea		Kbax
Lantana camara	Lantana	WoNS, DP	Lcam
Lathyrus tingitanus	Tangier pea		Ltin
Lavandula stoechas	Lavanda		Lsto
Leptospermum laevigatum	Victorian tea tree	LS	Llae
Lonicera japonica	Honeysuckle		Ljap
Lupinus species	Lupin		Lspp
Melaleuca armillaris	Bracelet honey myrtle		Marm
Melaleuca diosmifolia	Green Honey Myrtle		Mdio
Melaleuca hypericifolia	Hillock bush		Mhyp
Moraea flaccida	One leaf Cape tulip	DP	Mfla
Myosotis sylvatica	Forget me not		Msyl
Nephrolepis cordifolia	Fishbone fern		Ncor
Oenothera glazioviana	Tall evening primrose		Ogla
Olea europaea	Olive		Oeur
Oxalis species	Wood sorrel family		Ospp

Scientific Name	Common Name	Status	Code
Palm	Palm		Palm
Pandorea pandorana	Wonga vine		Ppan
Parthenocissus quinquefolia	Virginia creeper		Pqui
Paspalum dilatatum	Paspalum		Pdil
Passiflora filamentosa	Passion flower		Pfil
Pelargonium capitatum	Rose pelargonium		Pcap
Physalis peruviana	Cape gooseberry		Pper
Phytolacca octandra	Inkweed		Poct
Pinus species	Pine Trees		Pspp
Pittosporum undulatum	Sweet pittosporum	LS	Pund
Polygala myrtifolia	Milkwort		Pmyr
Psoralea pinnata	Taylorina	LS	Ppin
Robinia pseudoacacia	Robinia		Rpse
Rosa climbing species	Climbing Rose		Rcli
Rubus alceifolius	Giant Bramble		Ralc
Rubus species	Blackberry	WoNS, DP	Rspp
Rumex crispus	Dock		Rcri
Salix species	Willow		Sspe
Schinus molle	Pepper Tree		Smol
Senecio elegans	Senecio/Purple groundsel		Sele
Silybum marianum	Variegated thistle		Smar
Solanum laciniatum	Kangaroo apple		Slac
Solanum nigrum	Blackberry nightshade		Snig
Sonchus oleraceus	Sowthistle		Sole
Sparaxis tricolor	Harlequin flower		Stri
Stenotaphrum secundatum	Buffalo grass		Ssec
Syzygium smithii	Lilly pilly		Ssmi
Thunbergia alata	Black-eyed susan		Tala
Trachyandra divaricata	Dune onion weed		Tdiv
Tradescantia albiflora	Spiderwort		Talb
Trifolium species	Clover		Tspp
Tropaeolum majus	Nasturtium		Tmaj
Typha orientalis	Bulrush		Tori
Ulex europaeus	Gorse	WoNS, DP	Ueur
Vinca major	Periwinkle		Vmaj
Viola odorata	Violet (English)		Vado
Watsonia species	Watsonia	LS	Wspp
Yucca aloifolia	Yucca		Yalo
Zantedeschia aethiopica	Arum lily	DP	Zaet

APPENDIX C - Map Series (See Attached)