FINAL REPORT:

Weed Management Plan, Western Highway Project – Section 2 Beaufort to Ararat, Victoria

ON BEHALF OF:

VicRoads

June 2013VicRoads June 201 3

Ecology and Heritage Partners Pty Ltd

HEAD OFFICE: 420 Victoria Street, Brunswick VIC 3056 MELBOURNE: PO Box 298, Brunswick VIC 3056 GEELONG: PO Box 8048, Newtown VIC 3220

Table of Contents

Acknowledgments

Ecology and Heritage Partners thank the following people for their contribution in the project:

- Grant Deeble (VicRoads) for project information.
- Landowners for site access.
- Department of Sustainability and Environment for access to ecological databases.

DOCUMENT CONTROL

Project Details	Document Details
Project Name	Weed Management Plan, Western Highway Duplication Project – Section 2, Beaufort to Ararat, Victoria
Project Number	4308
Project Manager	Robyn Giles, Consultant Botanist
Report author(s)	Robyn Giles, Consultant Botanist Andrew Warnock, Botanist
Report Reviewer	Mark Stockdale, Senior Ecologist
Other EHP Staff	NA
File Name	4308_EHP_Weed_Management Plan_Western_Hwy_Section2_Final_27062013

Report Version	Comments	Comments Updated by:	Date Submitted
Draft	Draft Report	-	19/12/12
Final	-	-	27/06/13

SUMMARY

Introduction

Ecology and Heritage Partners Pty Ltd was engaged by VicRoads to undertake a Weed Assessment for the Western Highway Duplication project – Section 2, between Beaufort and Ararat, Victoria.

The weed assessment was required to identify the extent of environmental and noxious weed species, identify measures for control and outline mitigation measures to be implemented during each phase of the project.

This investigation will also assist VicRoads to ensure that the project is undertaken in a manner consistent with the principles of Ecologically Sustainable Development, and meets relevant Commonwealth and State environmental legislation requirements.

Study Area

The study area consists primarily of road reserve and private properties on either side of the Western Highway, between Beaufort and Ararat, situated approximately 170 kilometres west of Melbourne, Victoria. According to the Department of Sustainability and Environments Biodiversity Interactive Map the study area is located within the Central Victorian Uplands and Victorian Volcanic Plains bioregions.

The study area is characterised by native and exotic grassland vegetation, with scattered areas of remnant indigenous vegetation consisting of forest, grassland and wetland communities. The existing highway intersects Cemetery Creek, Green Hill Creek, Hopkins River, Billy Billy Creek, Middle Creek, Fiery Creek and several smaller drainage lines along its length.

Methods

A weed survey was undertaken throughout the study area between the 3 and 5 December

2012, to identify the type of weeds present, distribution, cover and abundance, and likelihood of threat to values within private property and surrounding areas (i.e. road reserves). All landholders were contacted prior to entering areas of private property.

The study area was traversed by vehicle and by foot where vehicle access was not possible. Locations of weed infestations were recorded in the study area using hand-held Geographic Positioning System (accuracy ± 5 m). In order to identify the cover and abundance of each weed infestation, a visual assessment of density was undertaken.

Results

Eighty six exotic species were recorded within the study area during the field assessment, including 15 species listed as noxious under the *Catchment and Land Protection Act 1994* (five of which are listed as Weeds of National Significance).

In general, the study area has been subject to historical land uses (land clearing, grazing and cropping) and consists of predominantly introduced vegetation dominated by exotic species. The majority of native vegetation within the study area is restricted to patches within roadside reserves, and less frequently within adjoining land. The history of disturbance and surrounding agricultural land use, are key factors in facilitating weed invasion within the study area.

The survey identified 8 noxious weed species with a high predicted threat level, based on the level of impact, invasiveness, distribution and rate of dispersal within the study area. The control and management of key weed species is considered a high priority.

Conclusion

Specific issues and mitigation measures relating to weed management have been detailed for each project phase (pre-construction, construction and post-construction). A regular monitoring program will be undertaken for key noxious and environmental weed species throughout the construction area for two years post-construction as part of an integrated weed management approach within the locality.

INTRODUCTION

1.1 Background

Ecology and Heritage Partners Pty Ltd was engaged by VicRoads to undertake a Weed Assessment for the Western Highway Duplication project – Section 2, between Beaufort and Ararat, Victoria.

The weed assessment was required to identify the extent of environmental and noxious weed species, identify measures for control and outline mitigation measures to be implemented during each phase of the project.

This investigation will also assist VicRoads to ensure that the project is undertaken in a manner consistent with the principles of Ecologically Sustainable Development, and meets relevant Commonwealth and State environmental legislation requirements.

1.2 Objectives

The objectives of the weed assessment are to:

- Identify and quantify the extent of environmental and noxious weed species within the study area;
- Ensure that the activities of the project do not exacerbate existing weed impacts so as to cause economic or environmental impacts to surrounding landholders;
- Prepare a weed control strategy aimed at reducing/eliminating weeds; and,
- Outline mitigation measures to be implemented throughout each phase (pre- construction, construction and post-construction) of the project to prevent the increase of weed populations.

1.3 Western Highway Project

The Western Highway is being progressively upgraded as a four-lane divided highway for approximately 110 km between Ballarat and Stawell. As the principal road link between Melbourne and Adelaide, the Western Highway serves interstate trade between Victoria and South Australia and is the key transport corridor through Victoria's west, supporting farming, grain production, regional tourism and a range of manufacturing and service activities. Currently, more than 5500 vehicles travel the highway west of Ballarat each day, including

1500 trucks. This traffic expected to double by 2025.

The Western Highway Duplication Project consists of three stages:

- Section 1: Ballarat to Beaufort
- Section 2: Beaufort to Ararat
- Section 3: Ararat to Stawell

Construction works on an initial eight kilometre section between Ballarat and Burrumbeet (Section 1A) commenced in April 2010 and will be completed in 2012. Construction for Section 1B (Burrumbeet to Beaufort) is expected to start by late 2011 and be completed by

2014. Separate Environment Effects Statements (EES) and Planning Scheme Amendments (PSA) must be prepared for both Sections 2 and 3. It is expected that Sections 2 and 3 will be completed and opened in stages through to 2016.

Section 2 of the Project commences at the railway crossing (Old Shirley Road) west of the Beaufort township and extends for a distance of approximately 38 km to Heath Street, Ararat. Section 3 commences at Pollards Lane, Ararat and extends for approximately 24 km to Gilchrist Road, Stawell.

1.4 Study Area

The study area (Figure 1) consists primarily of road reserve and private properties on either side of the Western Highway, between Beaufort and Ararat, situated approximately 170 kilometres west of Melbourne, Victoria. According to the Biodiversity Interactive Map (DSE

2012) the study area is located within the Central Victorian Uplands (CVU) and Victorian Volcanic Plains (VVP) bioregions. The western section of the study area is located within the City of Ararat municipality and the eastern section within the Shire of Pyrenees municipality. The study area is located within the Glenelg Hopkins Catchment Management Authority.

The study area is characterised by native and exotic grassland vegetation, with scattered areas of remnant indigenous vegetation consisting of forest, grassland and wetland communities. The existing highway intersects Cemetery Creek, Green Hill Creek, Hopkins River, Billy Billy Creek, Middle Creek, Fiery Creek and several smaller drainage lines along its extent.

Legislation and Guidelines

2.1 Commonwealth and State Legislation

Relevant Commonwealth and State government legislation and policy regarding the control and spread of listed noxious weeds include:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
- Flora and Fauna Guarantee Act 1988 (FFG Act).
- Catchment and Land Protection Act 1994 (CaLP Act).
- Weeds of National Significance (WONS).

2.1.1 Environment Protection and Biodiversity Conservation Act

The Commonwealth EPBC Act deals with actions that have, or are likely to have, a significant impact on a matter of national environmental significance. There are currently no key threatening processes relevant to pest plants listed under the EPBC Act.

2.1.2 Flora and Fauna Guarantee Act

The Victorian FFG Act provides the listing of taxa and communities of flora and fauna which are threatened, and potentially threatening processes. The listed potentially threatening processes under the FFG Act that consider weed species and are relevant to the study area are:

- Invasion of native vegetation by Blackberry (*Rubus fruticosus* L. agg.);
- Spread of *Pittosporum undulatum* in areas outside its natural distribution; and,
- Invasion of native vegetation by environmental weeds (DPI 2009).

2.1.3 Catchment and Land Protection Act 1994

The key legislation relating to the management of weeds in Victoria is the CaLP Act which is administered by DSE. The CaLP Act provides for the declaration of plants as noxious weeds if they have or have the potential to become a threat to primary production, the environment or community health in Victoria. This legislation places responsibility on land managers to control and prevent the spread of noxious weeds from their properties (NRE 2002b).

Under the CaLP Act, certain plants are declared as noxious weeds in Victoria. These are considered to either: cause environmental or economic harm; or have the potential to cause such harm. They can also present risks to human health. Current legislation requires that these species must be controlled or eradicated (DPI 2008).

There are four categories of noxious weeds defined under the CaLP Act, including:

- State Prohibited (S).
- Regionally Prohibited (P).
- Regionally Controlled (C).
- Restricted (R) (DPI 2008).

State Prohibited Weeds: These weeds either do not occur in Victoria but pose a significant threat if they invade, or are present, pose a serious threat or can reasonably be expected to be eradicated. Under the CaLP Act landowners may be directed to prevent their growth and spread (DPI 2008).

Regionally Prohibited Weeds: In general, Regionally Prohibited Weeds are not widely distributed in a region, but are capable of spreading further and they must be managed to eradicate them from the region. Land owners and managers, including public authorities responsible for the management of Crown lands, are responsible for control of these weeds on their lands (DPI 2008).

Regionally Controlled Weeds: These weeds are usually widespread and are considered critical in a particular region. Continuing control measures are required to prevent their spread. Land owners have the responsibility to take all reasonable steps to control and prevent the spread of these weeds on their land and the roadsides that adjoin their land (DPI, 2008).

Restricted Weeds: This includes plants that pose an unacceptable risk of spreading in this State or to other parts of Australia, and are a serious threat to another State or Territory of Australia (DPI 2008).

VicRoads has responsibilities to control Regionally Prohibited Weeds and Regionally Controlled Weeds on freeways, highways, tourist roads, and some main roads under the CaLP Act. This covers both declared noxious and serious undeclared weeds.

It should be noted that all land managers/persons are required under the CaLP Act to prevent the growth and spread of a Regionally Controlled weed for which they are responsible. Land managers that do not control Regionally Controlled weeds may be issued with a Land Management Notice or Directions notice that requires specific control work to be undertaken. Failure to comply with the conditions of a Notice may result in court action and fines or the issuing of an infringement notice and fine (DPI 2008).

There are no legal requirements to eradicate or control Restricted Weeds growing on land; however, Restricted Weeds cannot be traded, transported or spread in Victoria. Sections 70, 70A and 71 of the CaLP Act for all declared noxious weeds, irrespective of category or region, prohibits the:

- Movement from land on to a road of:
    - Vehicles and trailers used for carrying, moving or transporting hay, grain, fodder or livestock.
    - Vehicles used for carrying, moving or transporting machinery or equipment for road and utility building or maintenance.
    - Machinery, implements or other equipment without first taking precautions to ensure the vehicle and equipment is free from noxious weed seeds and any other part of a noxious weed that is capable of growing (weed propagules).

- Removal or sale of soil, sand, gravel or stone which comes from land on which a noxious weed grows, or contains or is likely to contain any part of a noxious weed. Transport of a noxious weed or its propagules within Victoria.
- Deposition on land of a noxious weed or its seeds (DPI 2008).

2.1.4 Weeds of National Significance (WONS)

The National Weeds Strategy Executive Committee was established in 1997, which concluded that the greatest impact from weed problems within Australia was related to the effect and spread of specific individual species. On this basis, they developed a list of Weeds of National Significance (WONS). The determination of WONS is the first attempt to prioritise weeds over a range of land uses at the national level. WONS are those weeds, which have been identified as already causing significant environmental damage and must be eradicated (DPIF 2008; DEWHA 2009).

Four major criteria were used in determining WONS:

- the invasiveness of a weed species;
- a weed's impacts;
- the potential for spread of a weed; and
- socio-economic and environmental values (DEWHA 2009).

Individual landowners and managers are ultimately responsible for managing Weeds of National Significance (WONS), while the State government is responsible for overall legislation and administration (AWC 2008; DEWHA 2009).

2.2 Literature Review

The following documents were reviewed:

- Australian Weed Strategy – a National Strategy for Weed Management in Australia. (DEWR 2007);
- Victorian Pest Management – A Framework for Action (NRE 2002a);
- Victorian Pest Management – A Framework for Action: Weed Management Strategy (NRE 2002b);
- Weed management in riparian zones: A guide for grazing properties in southwest Victoria (DPI 2004);
- Guidelines and Procedures for Managing the Environmental Impact of Weeds on Public Land in Victoria (DSE 2007); and,
- Invasive Plant and Animals Policy Framework (DPI 2010).

2.3 Definition of a Pest Plant

Under the CaLP Act the definition of a pest plant or weed is (DSE 2008):

"Pest" means exotic plants (excluding any that cannot be declared under the CaLP Act) that threatens or has the potential to threaten the existence or well being of valued environmental, agricultural, social or personal resources or assets.

For the purposes of this assessment weed species have been categorised in two broad classes: noxious weeds (regionally controlled and prohibited, and state prohibited weeds) and environmental weeds (overlap often occurs between these classes), which includes all other weeds and introduced pasture species. Note: during the assessment sown pasture species have not been referred to as environmental weeds.

Species listed as WONS or as defined under the CaLP Act will be referred to throughout as 'noxious' weeds.

Environmental weeds are usually plants of garden, horticultural or agricultural origin and many are not recognised under environmental legislation. However, management of these species is still important, as they can out compete and displace indigenous plant species and alter fauna habitats. In some instances, plants that are of value in agricultural production systems can become major weed problems in native ecosystems. Environmental weeds may also represent a threat to agricultural production (also known as agricultural weeds). They can reduce the available area for agricultural use, interfere with agricultural practices and affect the quality of produce (NSW DPI 2005).

METHODOLOGY

3.1 Survey Method

A weed survey was undertaken throughout the study area between the 3 and 5 December, 2012 to identify the weed species present, distribution, cover and abundance; and likelihood of threat to values within private property and surrounding areas (i.e. road reserves).

The study area was traversed by vehicle and by foot where vehicle access was not possible. The location of weed infestations were recorded in the study area using hand-held mapping device (Trimble GeoExplorer XT - accuracy ± 1 m).

In order to determine the cover and abundance of each weed infestation, a visual assessment of density was undertaken. A visual assessment is the simplest way to determine weed density, and although this method can be subjective, it is considered appropriate for the requirements of this report. Weed density, as a percentage of ground cover, is the proportion of the area covered by each weed species (Plate 1). This approach was applied to all observed noxious and environmental weeds within the study area.

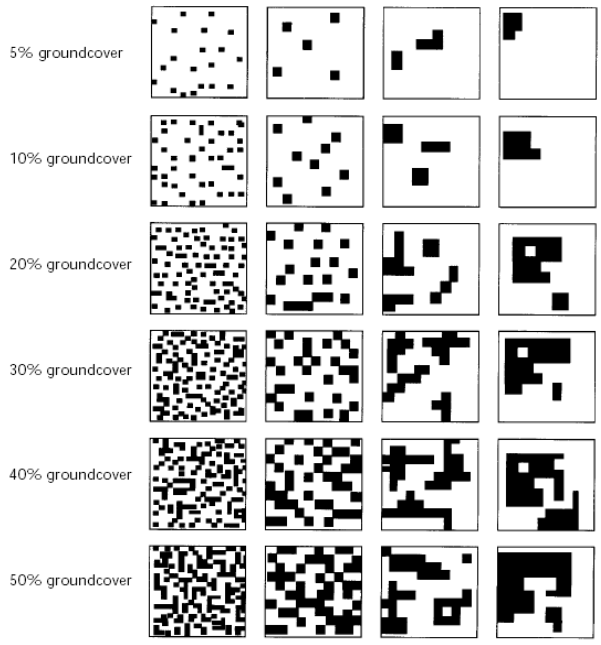


Plate 1: Weed Densities Expressed as a Percentage of Ground Cover (Source: Weeds CRC 2004)

3.2 Assessment Qualifications and Limitations

The purpose of this assessment was to identify noxious and environmental weed species and document their distribution and abundance within the study area. The assessment was carried out at a time of year (mid spring) which is considered sub-optimal to identify many plant species, i.e. grasses.

Notwithstanding the above, data collected during the field survey and information obtained from relevant sources was considered sufficient to provide an accurate assessment of weed infestations within the study area, and to determine the potential impacts of the proposed works.

Weed Assessment

4.1 Desktop Review

A review of the Flora Information System (2011) identified 181 exotic plant species that have previously been recorded within 5 km of study area (Appendix 1). An additional 15 exotic species have also been recorded during the detailed and targeted flora assessments (EHP 2011)

4.2 Field Assessment

Eighty six exotic species were recorded within the study area during the field assessment, including 14 species listed as noxious under the CaLP Act (five of which are listed as WONS) (Table 1; Appendix 1). The predicted threat level in Table 1 is based on the level of impact, invasiveness, distribution and rate of dispersal within the study area (DSE 2008).

In general, the study area has been subject to historical land uses (land clearing, grazing and cropping) and consists of predominantly introduced vegetation dominated by exotic species. The majority of native vegetation within the study area is restricted to patches within roadside reserves, and less frequently within adjoining land. The history of disturbance and surrounding agricultural land use, are key factors in facilitating weed invasion within the study area.

The roadside reserve generally consisted of remnant vegetation with intact tree canopy and occasional indigenous shrub species and an understorey dominated by exotic grass and herb species. Common environmental weed species included Large Quaking-grass *Briza maxima*, Panic Veldt-grass *Ehrharta erecta* and Rough Dog's-tail *Cynosurus echinatus*, Sweet Vernal-grass *Anthoxanthum odoratum*, Cocksfoot *Dactylis glomerata*, Toowoomba Canary-grass *Phalaris aquatica* and Wild Oat *Avena fatua*. Woody weeds including Apple *Malus pumila*, White Poplar *Populus alba* and Radiata Pine *Pinus radiata* were also common within road reserves throughout the study area.

The areas of open pasture on private property adjacent to the road reserve generally consisted of pasture grasses such as Perennial Ryegrass *Lolium perenne*, Cocksfoot, Yorkshire Fog *Holcus lanatus* and occasional crops and plantations. Several environmental weeds were also present, including, Toowoomba Canary-grass, Ribwort *Plantago lanceolata*, Buck's-horn Plantain *Plantago coronopus* and Cat's Ear *Hypochoeris radicata*.

Numerous noxious weed species were present within the roadside reserve and in adjoining land (Figures 2). Spear Thistle *Cirsium vulgare*, Perennial Thistle *Cirsium arvense*, Paterson's Curse *Echium plantagineum*, Gorse *Ulex europaeus*, Montpellier Broom *Genista monspessulana*, Sweet Briar *Rosa rubiginosa*, Hawthorn *Crataegus monogyna* and St John's Wort *Hypericum perforatum subsp. veronense* were found scattered throughout the study area, with low cover and abundance. Whereas Boneseed *Chrysanthemoides monilifera*, African Boxthorn *Lycium ferocissimum*, Soursob *Oxalis pes-caprae*, Flax-leaf Broom *Genista linifolia*, Spiny Rush *Juncus acutus* and Horehound *Marrubium vulgare*, were confined to isolated patches often with a higher level of cover. Crack Willow *Salix fragilis* was also found

beside some dams and creeks.

Table 1: Weed Species Recorded during the Field Assessment

Scientific Name	Common Name	Classification	Threat Level	Density	Location
Acacia baileyana	Cootamundra Wattle	Environmental Weed	Moderate	Medium	Scattered along roadside
Acetosella vulgaris	Sheep Sorrel	Environmental Weed	Low	Low	Roadside/Pasture
Agapanthus praecox[1]	Agapanthus	Environmental Weed	Low	Low	Around dwellings
Agave americana var.americana	Century Plant	Environmental Weed	Low	Low	Hillside Road extension
Agrostis capillaris	Brown-top Bent	Environmental Weed	High	Medium	Roadside/Pasture
Aira elegantissima	Delicate Hair-grass	Environmental Weed	Low	Low	Roadside/Pasture
Anthoxanthum odoratum	Sweet Vernal-grass	Environmental Weed	High	Medium	Roadside/Pasture
Arctotheca calendula	Cape Weed	Environmental Weed	Moderate	Medium	Roadside/Pasture
Avena barbata	Bearded Oat	Environmental Weed	High	Medium	Roadside/Pasture
Avena fatua	Wild Oat	Environmental Weed	High	Medium	Roadside/Pasture
Billardiera heterophylla[1]	Bluebell Creeper	Environmental Weed	Moderate	Medium	Hillside Road extension
Brassica fruticulosa	Twiggy Turnip	Environmental Weed	Moderate	Low	Roadside/Pasture
Briza maxima	Large Quaking-grass	Environmental Weed	High	High	Dominant in roadside
Briza minor	Lesser Quaking-grass	Environmental Weed	Moderate	Medium	Roadside
Bromus hordeaceus subsp. hordeaceus	Soft Brome	Environmental Weed	High	Low	Roadside
Centaurium erythraea	Common Centaury	Environmental Weed	Low	Low	Roadside
Chamaecytisus palmensis	Tree Lucerne	Environmental Weed	Low	Low	Scattered
Chrysanthemoides monilifera[23]	Boneseed	Regionally Controlled	Moderate	Low	Hillside Road extension
Cirsium arvense[2]	Perennial Thistle	Regionally Controlled	High	Medium	Roadside
Cirsium vulgare[2]	Spear Thistle	Restricted	High	High	Scattered along roadside and within paddocks
Cortaderia selloana[1]	Pampas Grass	Environmental Weed	Low	Low	Roadside
Cotoneaster glaucophyllus	Large-leaf Cotoneaster	Environmental Weed	Low	Low	Roadside
Crataegus monogyna[2]	Hawthorn	Restricted	Moderate	Medium	Roadside
Cupressus macrocarpa	Monterey Cypress	Environmental Weed	Low	Low	Roadside/around dwellings
Cynodon dactylon	Couch	Environmental Weed	Low	Low	Roadside/Pasture
Cynosurus echinatus	Rough Dog's-tail	Environmental Weed	High	Medium	Dominant in roadside
Cyperus eragrostis	Drain Flat-sedge	Environmental Weed	Low	Low	Drainage lines
Dactylis glomerata	Cocksfoot	Environmental Weed	High	Medium	Dominant in roadside
Echium plantagineum[2]	Paterson's Curse	Regionally Controlled	High	Medium	Scattered along roadside
Ehrharta erecta	Panic Veldt Grass	Environmental Weed	High	Medium	Dominant in roadside
Ehrharta longifolia	Annual Veldt-	Environmental Weed	Moderate	Low	Roadside/Pasture

Scientific Name	Common Name	Classification	Threat Level	Density	Location
Erica lusitanica[1]	Spanish Heath	Environmental Weed	Moderate	Medium	Eurambeen -Streetham Rd
Fraxinus spp.	Ash	Environmental Weed	Low	Low	Along waterways
Fumaria muralis subsp. muralis	Wall Fumitory	Environmental Weed	Low	Low	Scattered along roadside
Galium aparine	Cleavers	Environmental Weed	Low	Low	Scattered along roadside
Genista linifolia[2]	Flax-leaf Broom	Restricted	High	Medium	Scattered along roadside
Genista monspessulana [23]	Montpellier Broom	Restricted	High	Medium	Anderson Road
Geranium dissectum	Cut-leaf Crane's-bill	Environmental Weed	Low	Low	Roadside
Helminthotheca echioides	Ox-tongue	Environmental Weed	Moderate	Low	Roadside/Pasture
Holcus lanatus	Yorkshire Fog	Environmental Weed	High	Low	Roadside/Pasture
Hypericum perforatum subsp. veronense[2]	St John's Wort	Regionally Controlled	High	Medium	Scattered along roadside
Hypochoeris radicata	Flatweed	Environmental Weed	Low	Medium	Scattered along roadside and within paddocks
Juncus acutus[2]	Spiny Rush	Regionally Controlled	High	Medium	Along drainage lines and waterways
Juncus capitatus	Capitate Rush	Environmental Weed	Low	Low	Along drainage lines and paddocks
Juncus microcephalus	Tiny-headed Rush	Environmental Weed	Low	Low	Along drainage lines and paddocks
Lactuca serriola	Prickly Lettuce	Environmental Weed	Low	Low	Roadside/Pasture
Leontodon taraxacoides subsp. taraxacoides	Hairy Hawkbit	Environmental Weed	Low	Low	Roadside/Pasture
Lepidium africanum	Common Peppercress	Environmental Weed	Low	Low	Roadside/Pasture
Lolium perenne	Perennial Rye-grass	Environmental Weed	Moderate	Low	Roadside/Pasture
Lycium ferocissimum[23]	African Box-thorn	Regionally Controlled	High	Low	Scattered plants
Malus pumila	Apple	Environmental Weed	Low	Medium	Scattered along roadside
Marrubium vulgare[2]	Horehound	Regionally Controlled	High	Medium	Beneath scattered trees
Medicago sativa subsp. sativa	Lucerne	Environmental Weed	Low	Low	Scattered along roadside
Oenothera stricta subsp. stricta	Common Evening primrose	Environmental Weed	Low	Low	Scattered along roadside
Oxalis pes-caprae[2]	Soursob	Restricted	Moderate	Low	One isolated occurrence although likely to be widespread in winter/spring
Paspalum dilatatum	Paspalum	Environmental Weed	Low	Low	Roadside
Phalaris aquatica	Toowoomba Canary-grass	Environmental Weed	High	Medium	Roadside/Pasture
Pinus radiata	Radiata Pine	Environmental Weed	Low	Medium	Planted around dwellings
Plantago coronopus subsp. coronopus	Buck's-horn Plantain	Environmental Weed	Moderate	Low	Roadside/Pasture
Plantago lanceolata	Ribwort	Environmental Weed	Moderate	Low	Roadside/Pasture

Scientific Name	Common Name	Classification	Threat Level	Density	Location
Poa annua	Annual Meadow-grass	Environmental Weed	Low	Low	Roadside/Pasture
Populus alba[1]	White Poplar	Environmental Weed	Moderate	Medium	Planted around dwellings, scattered along waterways
Prunus spp. [1]	Prunus	Environmental Weed	Moderate	Low	Scattered along roadside
Romulea rosea	Onion Grass	Environmental Weed	High	Low	Roadside/Pasture
Rosa rubiginosa [2]	Sweet Briar	Regionally Controlled	High	Medium	Scattered along roadside
Rumex conglomeratus	Clustered Dock	Environmental Weed	Low	Low	Roadside
Rumex crispus	Curled Dock	Environmental Weed	Low	Low	Roadside
Salix babylonica s.l.[1]	Weeping Willow	Environmental Weed	Low	Low	Around dams
Salix fragilis[23]	Crack Willow	Restricted	Moderate	Medium	Scattered around waterways
Salix X reichardtii[1]	Pussy Willow	Environmental Weed	Low		Around dams
Scabiosa atropurpurea	Pincushion	Environmental Weed	Low	Low	Roadside
Schinus molle	Pepper Tree	Environmental Weed	Low	Low	Scattered in paddocks and around dwellings
Silybum marianum[2]	Variegated Thistle	Restricted	Moderate	Low	Martins Lane
Solanum nigrum	Black Nightshade	Environmental Weed	Low	Low	Roadside
Sonchus asper s.l.	Rough Sow-thistle	Environmental Weed	Moderate	Low	Roadside/Pasture
Sonchus oleracea	Common Sow-thistle	Environmental Weed	Moderate	Low	Roadside/Pasture
Sporobolus africanus	Rat-tail Grass	Environmental Weed	Moderate	Low	Roadside/Pasture
Stellaria media	Chickweed	Environmental Weed	Low	Low	Roadside
Tragopogon	Salsify	Environmental Weed	Low	Low	Roadside
Trifolium arvense var.arvense	Hare's-foot Clover	Environmental Weed	Low	Low	Roadside/Pasture
Trifolium subterraneum	Subterranean Clover	Environmental Weed	Low	Low	Roadside/Pasture
Ulex europaeus[23]	Gorse	Regionally Controlled	High	High	Scattered along roadside and within paddocks
Ulmus spp.	Elm	Environmental Weed	Low	Low	Hopkins River and around dwellings
Vicia sativa	Common Vetch	Environmental Weed	Moderate	Low	Roadside/Pasture
Vinca major[1]	Blue Periwinkle	Environmental Weed	High	Low	Within GDF at Eastern end
Vulpia muralis	Wall Fescue	Environmental Weed	High	Medium	Roadside/Pasture
Vulpia myuros	Rat's-tail Fescue	Environmental Weed	High	Medium	Roadside/Pasture

Notes: CaLP Act Classification - State Prohibited, Regionally Prohibited, Regionally Controlled, Restricted, (all Noxious Weeds) (DPI 2008); [2] = Weed of National Significance, [2] = Declared Noxious Weeds (DSE 2008), [1] = Weeds identified by DPI 2004 as Environmental Weeds within the GHCMA, Environmental Weed.

Predicted threat level; High, Moderate, Low; Predicted threat level determined by current abundance and distribution within the study area. Threat classification defined by DPI (2008). Low density - contains few or many individual scattered plants that cover less than 10% of the area. Medium density - covers 10–30% of total ground cover. High density -covers more than 30% of total ground cover.

WEED MANAGEMENT

5.1 Noxious Weed Species

A number of noxious weed species recorded during the field survey were identified as comprising a high predicted threat level based on the level of impact, invasiveness, distribution and rate of dispersal within the study area. Based on this, the control and management of the following noxious weed species is considered a high priority:

- African Boxthorn (C; WONS);
- Flax-leaved Broom (R; WONS);
- Gorse (C; WONS);
- Hawthorn (R);
- Horehound (C);
- Montpellier Broom (R; WONS);
- Paterson's Curse (C);
- Perennial Thistle (C);
- Soursob (R);
- Spear Thistle (R);
- Spiny Rush (C);
- St John's Wort (C);
- Sweet Briar (C);
- Variegated Thistle (R);
- Willows (R; WONS).

The approximate location of noxious weed species within the study area is shown in Figure 2. The Action Plan for management of high priority noxious weed species recorded within the study area is outlined in Table 4.

5.2 Environmental Weeds

Many of the environmental weeds recorded during the survey are common in unimproved pasture or degraded areas. Roadsides for example commonly included grassy weeds such as Sweet Vernal Grass, Great Brome, Yorkshire Fog, Toowoomba Canary Grass, Wild Oat and Cocksfoot (Table 2) and woody weeds including Apple, White Poplar, Radiata Pine and Cotoneaster. Herbaceous weeds included Cape Weed, Ribwort, Common Sow-thistle and Cats Ear. While many of these species are prolific, control through mechanical (i.e. slashing) and chemical control (herbicide spraying) is often effective.

The study area contains the following features with common environmental weed assemblages:

- Roadsides dominated by environmental weeds;
- Improved pasture with scattered environmental weeds; and
- Unimproved pasture dominated by environmental weeds.

Table 2: Environmental Weed Assemblages

Vegetation Type	Environmental Weeds
Roadsides	Grassy weeds: Sweet Vernal Grass, Yorkshire Fog, Perennial Rye-grass, Great Brome, Paspalum, Toowoomba Canary Grass, Wild Oat Herbaceous weeds: Lucerne, Common Vetch, Cape Weed, Ribwort. Woody weeds: Apple, Radiata Pine, Cotoneaster, White Poplar, Monterey Cypress
Improved pasture	Grassy weeds: Sweet Vernal Grass, Yorkshire Fog, Perennial Rye-grass, Great Brome, Toowoomba Canary Grass, Wild Oat Herbaceous weeds: Sheep Sorrel, Common Sow-thistle, Onion Grass, Prickly Ox-tongue
Unimproved pasture	Grassy weeds: Sweet Vernal Grass, Yorkshire Fog, Perennial Rye-grass, Great Brome, Toowoomba Canary Grass, Wild Oat Herbaceous weeds: Sheep Sorrel, Onion Grass, Common Sow-thistle, Prickly Ox-tongue

General control measures for environmental weeds are detailed in Table 4 and Appendix 2.

5.3 Environmental Values

The study area contains a number of environmental values, which need to be protected from the direct (i.e. loss of biodiversity) or indirect impacts (i.e. loss of fauna habitat) of weeds.

While much of the study area has been modified (extensively cleared and grazed), there are large areas of remnant vegetation containing important environmental values (Ecology and Heritage Partners 2011). These values include;

- Presence of the endangered Plains Grassland, Plains Grassy Wetland, Alluvial Terraces Herb-rich Woodland, Plains Grassy Woodland and Creekline Grassy Woodland EVC in the VVP bioregion;
- Presence of the endangered Grassy Woodland, Creekline Grassy Woodland and Alluvial Terraces Herb-rich Woodland EVC in the CVU bioregion;
- Presence of the vulnerable Hills Herb-rich Woodland in the CVU bioregions;
- Presence of at least two flora species considered to be nationally significant (Spiny Rice-flower, Button Wrinklewort);
- Presence of at least three flora species considered to be significant within the state of Victoria (Emerald-lip Greenhood, Yarra Gum, Golden Cowslips);
- Presence of two vegetation communities considered to be nationally significant (Grassy

Eucalypt Woodland of the Victorian Volcanic Plain and Natural Temperate Grassland of the Victorian Volcanic Plain;

- Suitable habitat for the nationally significant Growling Grass Frog, Dwarf Galaxias and Golden Sun Moth;
- Suitable habitat for the state significant Brown Toadlet, Powerful Owl, Barking Owl and Brush-tailed Phascogale as well as several woodland-dependent birds; and,
- Presence of regionally significant reserve areas including Langi Ghiran State Park and Woodnaggerak Reserve.

Potential impacts from weeds to environmental values include:

- Alteration of ecological processes and prevention of regeneration of native species;
- Modification of native fauna habitat; and,
- Loss of threatened flora species through competition.

MITIGATION MEASURES

6.1 Overview

Specific issues and mitigation measures relating to weed management have been detailed for each project phase (pre-construction, construction and post-construction). Mitigation measures should be incorporated into a site Construction Environment Management Plan.

Mitigation measures have been developed to comply with regulations outlined in the CaLP Act for noxious weeds; and the FFG Act for environmental weeds. Specific control measures are outlined in the Action Plan in Table 4. Proper implementation of mitigation measures for weed control will enable compliance with responsibilities under the CaLP Act.

6.2 Pre-Construction

6.2.1 Threats

One of the main concerns associated with pre-construction activities is the further spread of existing weeds or the introduction of new weed species into the area. Weeds can potentially be spread between sites via contaminated machinery, vehicles, equipment, clothing, footwear and other sources. The implementation of personnel, vehicle and equipment hygiene procedures are critical to minimising the spread and/or introduction of noxious and environmental weeds onto the construction area.

Appropriate weed hygiene measures will need to be implemented to minimise the risk of the further spread and introduction of weeds. Where appropriate, weed hygiene measures must be followed by all construction personnel, vehicles and equipment entering the construction area during the pre-construction phase.

6.2.2 Mitigation Measures

Mitigation measures identified during the pre-construction phase include:

- Any noxious weeds within the construction area will be controlled by a licensed contractor, and as directed by a site environmental officer, any environmental weeds, within the construction area will also be controlled by a licensed contractor,
- Vehicle access points will be established at entry points to the construction zone, and all vehicles accessing the construction site will enter and exit only through the recognised access points,
- Prior to entering the construction area all personnel will complete weed management inductions,
- A wash down area will be established on site for vehicles entering the site for the first time or that requires periodic cleaning, and will be maintained to prevent the further spread of noxious and environmental weeds.
- Key weed species (outlined in Table 1) within the construction area will be controlled by a suitably qualified and licensed contractor.
- Prior to exiting the properties, all vehicles and/or machinery must be adequately cleaned

down to prevent the spread of weeds in accordance with the CaLP Act.

- The cleaning process may include physical removal of soil and organic matter from underneath vehicles and/or load trays. Where required, removal of excess material by high pressure air or water spray jets may be necessary.
- The wash down bays are to include:
    - Equipment for: a rumble/shaker grid; vehicle cleaning with compressed air; a pressure pump for cleaning with hot water and detergent; brush down facilities; designated area for workers to dislodge soil or vegetative material from clothing and boots; and
    - A collection system to capture soil, seeds and other material washed away from vehicles and equipment.
- Signage must be established at clean and wash-down points, directing machinery/vehicle operators to utilise these facilities prior to exiting the sites.

6.3 Construction

6.3.1 Threats

During construction, weeds have the potential to germinate within the study area such as around infrastructure, fencing, soil stockpiles, disturbed areas, etc. In order to minimise the germination of weeds (particularly noxious weeds) within the study area during construction, on-going weed control works will be maintained to control any further spread.

A dedicated clean down area must be constructed at the designated entry and exit points within the study area and must include a rumble grid. Rumble grids are an effective and cost efficient way of removing soil and other contaminants off machinery and/or vehicles. Any topsoil excavated during construction must be carefully managed and replaced after construction.

Further, any topsoil that is stockpiled or transported must be covered to minimise the risk of weed establishment. Removal of topsoil off-site may require planning approval as this material is usually required to be retained and reused on development sites. Therefore the movement of topsoil and machinery between different properties within the precinct must be avoided wherever possible. However in the event that excess soil/fill cannot be utilised on-site, it must be disposed of at a licensed receiving facility or other property with an approved planning permit to receive such material.

The above information needs to be clearly communicated to all soil carting contractors working on site during the induction process. Furthermore, the induction must explain that anybody who dumps this material elsewhere other than in accordance with the above soil movement requirement, may be in contravention of the local Planning Scheme and will face fines and/or prosecution.

To help minimise the possibility of non-compliance with these soil movement requirements, it is strongly recommended that these requirements be included within any contracts/tenders documents for the transport/ movement of soil off-site.

Finally any imported topsoil or bedding material must be certified free of weeds.

6.3.2 Mitigation Measures

Mitigation measures identified during the construction phase include:

- The construction and adjacent areas (including access points) will be monitored for noxious and environmental weeds at least two times per year (spring and summer), and these species, as appropriate, will be controlled/eradicated.
- Disturbed areas will be sown as soon as practicable to minimise the area of exposed soil as potential for weed establishment and spread.
- Imported topsoil and bedding material will be certified free of weeds (where practicable).
- Vehicles will enter and leave the site via defined entry points and use constructed roads to minimise on site damage and the potential for weed spread.
- A wash down area will be established on site for vehicles entering the site for the first time or that requires periodic cleaning, and will be maintained to prevent the further spread of noxious and environmental weeds.
- The cleaning process will include physical removal of soil and organic matter from underneath vehicles, in the cabin and/or load trays. Where required, removal of excess material by high pressure air or water spray jets may be necessary.
- Prior to entering the construction area all personnel will complete weed management inductions and will check personnel clothing and footwear daily;
- All machinery, vehicles and equipment will only enter and leave the site via defined access points and use constructed roads to minimise the potential for weed spread.
- Where machinery, vehicles and equipment are required to leave the construction area they must go through the wash down area/bays, and remove excess soil and organic matter by high pressure air or water spray jets (as required).
- Soil and vegetative matter from the clean down area is to be removed regularly and stockpiled and/or disposed of to an appropriate area as agreed with the local council. The clean down area should not:
    - Have excessive run-off from wash-down procedures; and
    - Contribute to further machinery contamination. Prevention measures may include gravel to collect seeds and minimise contact with mud and aid drainage.
- Prior to exiting the properties, all vehicles and/or machinery must be adequately cleaned down to prevent the spread of weeds in accordance with the CaLP Act.
- Key weed species must be controlled by a suitably qualified and licensed contractor.
- Imported topsoil and bedding material will be certified free of weeds (where possible) and must be stockpiled separately to any excavated topsoil which may contain weed seeds or vegetative material.
- Excess soil/fill which is to be transferred off-site must be disposed of at a licensed receiving facility or other property with an approved planning permit to receive such material.
- Weed-infested stockpiles as well as topsoil which are to be transported away must be

covered to protect against further spread and contamination.

- Disturbed areas must be re-sown as soon as practicable to minimise the area of exposed soil for weed establishment and spread.

6.4 Post Construction

6.4.1 Threats

The threat of weeds being introduced and/or spread within the construction area remains into the post-construction phase. This threat is particularly evident in the first year following reinstatement, when weeds have a greater likelihood of colonising or emerging from disturbed areas.

Actions will be undertaken after the construction phase to minimise the risk of noxious and environmental weeds spreading from an existing site or being introduced to the construction area.

6.4.2 Mitigation Measures

Mitigation measures identified during the post-construction phase include:

- The construction and adjacent areas (including access points) will be monitored four times in the first year (early spring, late spring, summer, autumn), and bi-annually (mid-late spring, mid-late summer) the following two years to identify any new outbreaks of noxious and environmental weeds.
- Vegetative cover within disturbed areas will be reinstated as soon as practicable to minimise areas of exposed soil as potential for weed spread and establishment.
- Access points, clean down areas and each property within the development will be monitored by a licensed contractor four times in the first year post-construction (or until the property is sold) in early spring, late spring, summer and autumn to identify and control any new outbreaks of noxious and environmental weeds.
- Information notes on key noxious weed species should be passed onto new landowners so that they can continue best practice land management.
- Monitoring will be undertaken by a licensed weed contractor, but during spring in the first and second years, the licensed weed contractor will be accompanied by an ecologist/botanist,
- A weed monitoring proforma will be completed following each monitoring assessment, and summarised at the end of each year in a progress report. The proforma will include categories such as weed species; location; weed distribution and cover; and recommended control measures.
- At the completion of the two year post-construction period, a weed audit will be undertaken comparing the results of the current assessment, with the results after the two year post-construction period, with references made to the weed control/eradication techniques employed during that period.

6.5 Summary of Mitigation Measures

Mitigation measures to be implemented throughout the site are summarised in Table 3.

Table 3: Summary of Mitigation Measures

Phase	Mitigation Measure	Action	Location	Responsibility
Pre-construction	Control of significant weed infestations	Any noxious weeds and at the direction of the site environmental officer, environmental weeds within the construction area will be controlled by a licensed contractor	Areas impacted by construction activities	Site/Project Environmental Officer
Pre-construction	Vehicle and equipment hygiene	Vehicle access points will be established at entry points to the construction zone, and all vehicles accessing the construction site will enter and exit only through the recognised access points	Vehicle access points	Site/Project Environmental Officer
Pre-construction	Personnel equipment hygiene	Prior to entering the construction area all personnel will complete weed management inductions	Access Points	Site/Project Environmental Officer
Pre-construction	Vehicle and equipment hygiene	A vehicle wash down area will be established on site for vehicles entering the site for the first time and for periodic cleaning, and will be maintained to prevent the further spread of noxious and environmental weeds	On site, away from water points	Site/Project Environmental Officer
Pre-Construction	Vehicle and equipment hygiene	The cleaning process will include physical removal of soil and organic matter from underneath vehicles, in the cabin and/or load trays. Where required, removal of excess material by high pressure air or water spray jets may be necessary	Designated vehicle wash down area	Site/Project Environmental Officer

Phase	Mitigation Measure	Action	Location	Responsibility
Construction	Control of significant weed infestations	Any noxious weeds and at the direction of the site environmental officer, environmental weeds within the construction area will be controlled by a licensed contractor.	Areas impacted by construction activities	Site/Project Environmental Officer
Construction	Monitoring of significant weed infestations	The construction area will also be monitored at least twice a year and during any weed control works for the germination of noxious and environmental weeds	Areas impacted by constructionactivities	Site/Project Environmental Officer
Construction	Weed monitoring	A weed monitoring proforma will be completed following each monitoring assessment	Areas impacted by construction	Weed contractor
Construction	Topsoil management	Disturbed areas will be revegetated as soon as practicable to minimise the area of exposed soil as potential for weed establishment and spread	All areas directly impacted by construction activities	Site/Project Environmental Officer
Construction	Topsoil management	Imported topsoil and bedding material will be certified free of weeds (where possible)	All areas directly impacted by construction activities	Site/Project Environmental Officer
Construction	Weed management	Vehicles will enter and leave the site via defined entry points and use constructed roads to minimise on site damage and the potential for weed spread	Defined entry points	Site/Project Environmental Officer
Construction	Personnel equipment hygiene	Prior to entering the construction area all personnel will complete weed management inductions	Access Points	Site/Project Environmental Officer

Phase	Mitigation Measure	Action	Location	Responsibility
Construction	Vehicle and equipment hygiene	A vehicle wash down area will be established on site for vehicles entering the site for the first time and for periodic cleaning, and will be maintained to prevent the further spread of noxious and environmental weeds	On study area, away from water points	Site/Project Environmental Officer
Construction	Vehicle and equipment hygiene	The cleaning process will include physical removal of soil and organic matter from underneath vehicles, in the cabin and/or load trays. Where required, removal of excess material by high pressure air or water spray jets may be necessary	Designated vehicle wash down area	Site/Project Environmental Officer
Post-construction	Periodic weed monitoring	Construction areas and access points will be monitored four times annually (early spring, late spring, summer, autumn) for two years	Defined entry points and areas directly impacted by construction activities	Weed contractor
Post-construction	General weed management	Monitoring and control will be undertaken by a licensed weed contractor but during spring in the first and second years, the licensed weed contractor will be accompanied by an ecologist/botanist,	Areas impacted by construction activities	Botanist/Ecologist/ Weed contractor
Post-construction	Weed monitoring	A weed monitoring proforma will be completed following each monitoring assessment	Areas impacted by construction activities	Weed contractor
Post-construction	Weed monitoring	At the completion of the two year post-construction period, a weed audit will be undertaken comparing the results of the current assessment, with the results after the two year post-construction period, with references made to the weed control/eradication techniques employed during that period.	Defined entry points and areas directly impacted by construction activities	Botanist/Ecologist

6.6 Performance Indicators

Key performance indicators for weed management include:

- Meeting the requirements of the CaLP Act in relation to control of listed noxious weeds within the study area;
- Achieving control and eradication of key (noxious) weed species within the construction phases (for the duration of the project); and
- No net increase in the cover of environmental weeds.

6.7 Monitoring and Reporting

A regular monitoring program should also be undertaken for weeds throughout the construction area for two years post-construction. Monitoring of the area for the presence of existing key weeds as well as any new outbreaks of other weeds will be undertaken four times annually (early spring, late spring, summer, autumn) for two years, as part of an integrated weed management approach within the study area. During spring in the first and second years, the licensed weed contractor undertaking the monitoring will be accompanied by an ecologist/botanist, in order to provide specialist advice.

Monitoring across the study area should include:

- Photographs taken from the same place during each monitoring period;
  A record of the distribution and abundance of key weeds species using GIS mapping; and,
- Details on the effectiveness of weed control.

Monitoring and reporting of weed management should follow established processes such as bioregional planning to ensure that relevant information is recorded on appropriate monitoring systems, including the Integrated Pest Management System and the Environmental Information System of Parks Victoria (DPI 2008).

The results of the weed monitoring should be recorded in a progress report after the first and second years, in order to compare different approaches to weed management, increase efficiency and maximise the removal and control of infestations.

At the completion of the two year post-construction period, a weed audit will be undertaken by an ecologist/botanist, comparing the results of the current assessment, with the results after the two year post-construction period, with references made to the weed control/eradication techniques employed during that period.

ACTION PLAN

7.1 Objectives

The action plan is designed to:

- Prevent the spread of noxious weeds and environmental weeds;
- Eradicate or control any noxious weeds and environmental weeds that may establish during or after the soil disturbance associated with construction activities; and,
- To ensure that the study area is returned to a similar or better state in regards to weeds, after the two year post construction period.

7.2 Action Plan for Weed Control

7.2.1 Pre Construction

Any noxious weeds within the construction area will be controlled by a licensed contractor, and as directed by a site environmental officer, any environmental weeds, within the construction area will also be controlled by a licensed contractor.

7.2.2 Construction

During construction weeds have the potential to germinate within the study area, such as around infrastructure, fencing, soil stockpiles, open areas, disturbed areas, etc. In order to minimise the germination of weeds, particularly noxious weeds, within the study area during construction, on-going weed control works will be maintained. Weed control works will be undertaken at least two times annually (early spring and summer).

7.2.3 Post Construction

Weed control works will be undertaken four times annually (early spring, late spring, summer, autumn) for two years at the same time as the weed monitoring to identify any additional outbreaks of weeds.

7.3 Management Approaches

Depending on the type of weed being controlled on the site, the main approach to management will either be eradication or containment (Weeds CRC 2004).

Eradication of certain weeds may not be realistic due to the nature of the weed itself (i.e. highly dispersive) or the level of infestation (predominant throughout the landscape). Eradication may be achieved where:

- The weed occupies only a small area and will not reinvade from adjoining areas;
- The infested area is known and at low density;
- The control method used kills all plants before maturity (i.e. before seed set); and,
- The weed seed does not remain dormant in the soil, or the infestation is detected before seeds are released (Weeds CRC 2004).

Containment or control of weed species is likely to be a more realistic management approach when dealing with widespread, well established species (such as the key weed species identified on the study area). Containment is aimed at reducing new weed infestations and the need for future control by limiting the extent and intensity of infestations. The key to containment is to focus on treating isolated infestations, rather than core infestations, with the objective of preventing weed populations extending beyond the perimeter of the core infestation (Weeds CRC 2004).

7.4 General Weed Control Information

Weed control will primarily target key noxious weeds and focus on areas of high weed abundance by commencing weed control from the edge of the population, converging towards the centre of the population. Spring and summer are appropriate seasons to target many weeds as they are actively growing in this period and herbicide application is more effective, but autumn is also considered an appropriate time to control some weeds (Muyt 2001).

It is important that realistic timeframes for weed control works are implemented in order to apply a definite structure to weed management within the study area. It is advised that timeframes are set on a location-by-location basis, based on the priority for management. An action plan for control of key weed species is shown in Table 4.

Weed control contractors will make appropriate decisions on which technique to use based on individual situations. Contractors will also need to be aware of the potential for new outbreaks of weed species not recorded in this survey and implement necessary weed control techniques. It is likely that several control methods will be needed to be employed, including: spraying, physical removal, hand pulling, and cutting and painting. Different weed control techniques are outlined in Appendix 2.

Table 4: Action Plan for Key Weed Species

Common Name	Aim	Work Plan	Timing	Control	Comments
African Boxthorn *Lycium ferocissimum*	Control existing population by removing existing plants	Remove small and scattered plants first and then target outer edges of larger infestations. Mulch sites, where feasible, to reduce seedling regrowth. Monitor sites regularly for regrowth or new seedlings	Best removed before main fruiting time (March-May)	Mechanical Removal; Cut & Paint & Spot Spray	• Small Plants: dig out whole crown. • Large plants: cut and paint. • Larger-scale: basal bark or foliar herbicide treatment. • Boxthorn should be physically destroyed (burnt) or removed off site (only if seed/ berries are not present), as the spines can pose a significant threat to vehicle tyres. • Grooming (which shears off and mulches weeds) is a technique to consider
Gorse *Ulex europaeus*	Contain existing population by removing all existing plants	Where possible prevent flowering or at least reduce the ability to set seed.	All Year	Mechanical Removal; Cut & Paint & Spot Spray	• Do not apply sprays when plants are in full flower or when bees are active. • Small-scale: dig out plants or slash frequently to weaken them. • Larger scale: slash or groom. Herbicide can be used as an effective follow-up control. • Cut-paint herbicide is an alternative for larger plants.
Hawthorn *Crateagus monogyna*	Eradicate from study area	Plants can be treated using Cut-Paint or Drill-Fill methods and applied during growing season. Plants can also be Sprayed in late spring so that follow up treatment can be applied in autumn before dormancy.	Late Spring – Early Autumn	Drill & Fill; Spot Spray & Cut & Paint	• Drill and Fill the base of medium to large trees • Ringbarking can be used if Drill and Fill not possible • Seedlings & plants under 2m can be sprayed /dug out/hand pulled • Grooming (which shears off and mulches weeds) is a technique to consider
Willows *Salix spp.*	Eradicate from study area	Plants can be treated using Cut-Paint or Drill-Fill methods and applied during growing season.	Late Winter – Early Spring	Drill & Fill; Spot Spray & Cut &	• Drill and Fill the base of medium to large trees • Ringbarking can be used if Drill and Fill not possible

Common Name	Aim	Work Plan	Timing	Control	Comments
Horehound *Marrubium vulgare*	Contain by removing all existing plants within the study area	Lightly infested areas should be treated as a priority to minimise further spread. Maintain good ground cover at all times, and prevent seed set to minimise seedling establishment	Spring	Spot Spray & Chip Out or Hand Pull	• Hand weed small infestations • Spray large infestations • Burning can be used to destroy large infestations and encourage seed germination.
Broom species *Genista spp.*	Contain by removing all existing plants within the study area	Prevent seed set and ensure machinery hygiene is followed to minimise spread.	Autumn – early winter	Cut & Paint & Spot Spray	• Small plants: can be pulled out by hand or using selective herbicides • Larger plants: can be controlled by cut and paint techniques or using selective herbicides. • Grooming (which shears off and mulches weeds) is a technique to consider
Paterson's Curse *Echium plantagineum*	Control existing population and contain all new outbreaks prior to seed set	Most effective control is achieved at the rosette stage. Maintain good ground cover at all times, especially in spring to prevent seedling establishment.	Autumn – Winter	Chip Out or Hand Pull; Spot Spray	• Hand-hoeing: individual plants and small patches. Ensure the growing point and top 20-40mm of taproot is removed. • Spot Spraying: after a flush of germination following early or late rain. • Ensure machinery hygiene is followed to minimise spread. • Ploughing can be used as a management technique, but must be undertaken prior to plants flowering and seeding
Spear Thistle *Cirsium vulgare*, Perennial Thistle *Cirsium arvense* and Variegated Thistle *Silybum marianum*	Control existing population by removing all existing plants	Lightly infested areas should be treated as a priority to minimise further spread and heavily infested areas should be tackled progressively	Early Spring	Chip Out or Hand Pull; Spot Spray	• Very small infestations: Hand- hoeing: individual plants and small patches. Ensure the growing point and top 20-40mm of taproot is removed. • Heavy infestations: chemical control and/ or slashing. • Ploughing can be used as a management technique, but must be undertaken prior to plants flowering and seeding

Common Name	Aim	Work Plan	Timing	Control	Comments
Sweet Briar *Rosa rubiginosa*	Control existing population by removing all existing plants	Lightly infested areas should be treated as a priority to minimise further spread and heavily infested areas should be tackled progressively	Late Spring – Early Autumn	Cut & Paint & Spot Spray	• Dig out whole crown of small plants. • Large plants: cut and paint • Larger-scale: basal bark or foliar herbicide treatment
Blue Periwinkle *Vinca major*	Control existing population and contain all new outbreaks	Stems reproduce from fragmentation. Ensure whole plant is removed and disposed of appropriately.	Spring	Spot Spray; Chip Out or Hand Pull;	• Remove seedlings by hand, ensure all stem and root material is completely removed. • Large infestations: spot spray. • Large infestations may require slashing prior to herbicide treatment to reduce large biomass, remove all stem and root material.
Grassy Weeds: Brown-top Bent, Bearded Oat, Briza spp., Cocksfoot, Fescue spp., Great Brome, Onion Grass, Panic Veldt-grass, Rough Dog's-tail, Sweet Vernal Grass, Soft Brome, Toowoomba Canary Grass, Wild Oat, Yorkshire Fog.	Contain by suppressing growth and spread	Regularly slash larger infestations with machinery along roadsides; spot spray smaller areas with Glyphosate;	All year	Spot Spray, Frequent Mowing	• Slashing roadsides can reduce infestation into adjoining properties
Herbaceous Weeds: Sour-sob, Ribwort, Common Sow-thistle, St John's Wort, Spiny Rush, Cape Weed	Contain by suppressing growth and spread	Regularly slash larger infestations with machinery along roadsides; spot spray smaller areas with Glyphosate;	All year	Chip Out or Hand Pull; Spot Spray; Frequent Mowing	• Slashing roadsides can reduce infestation into adjoining properties

FIGURES

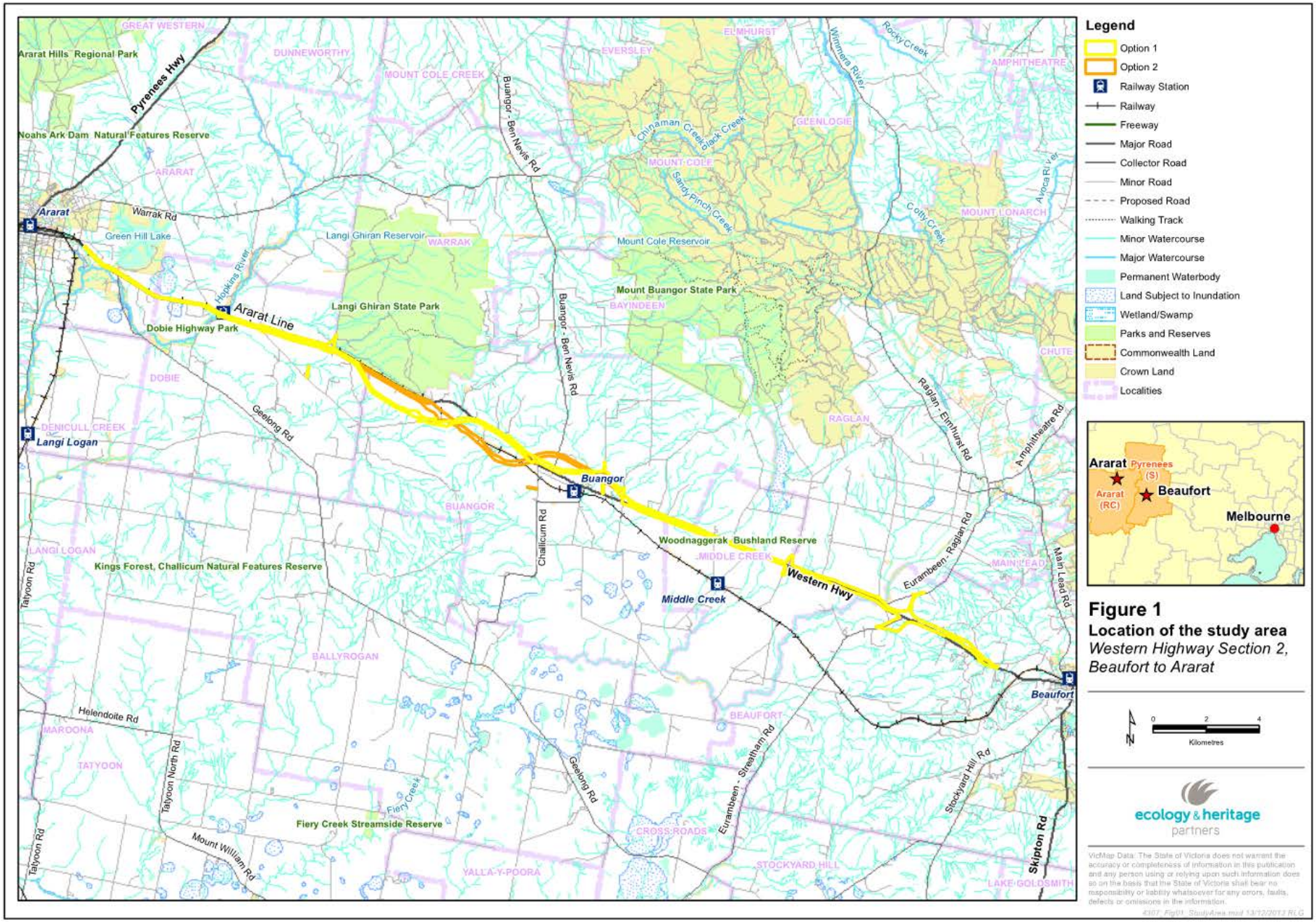


Figure 1
Location of the study area
Western Highway Section 2, Beaufort to Ararat

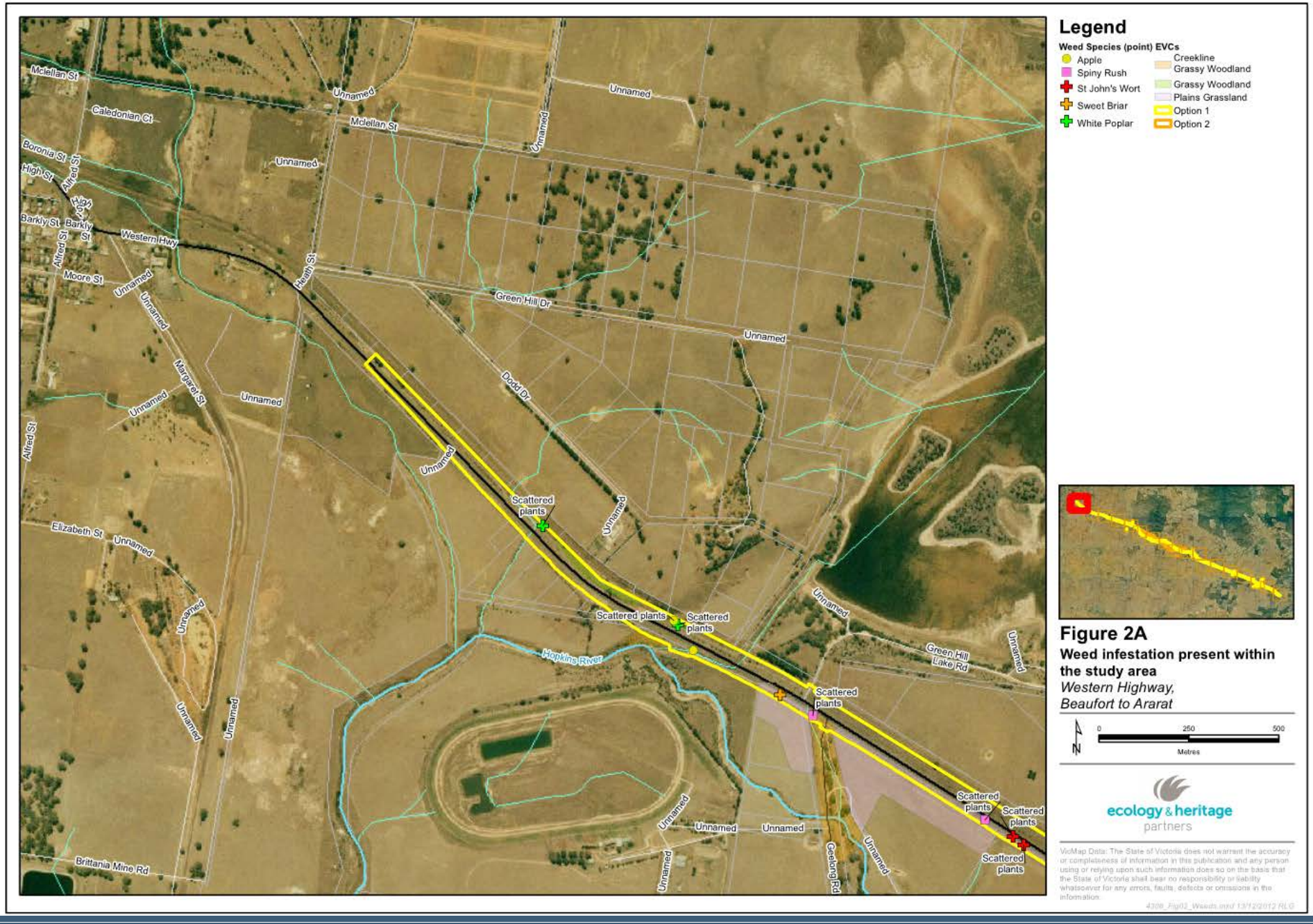


Figure 2A

Weed infestation present within the study area

Western Highway, Beaufort to Ararat

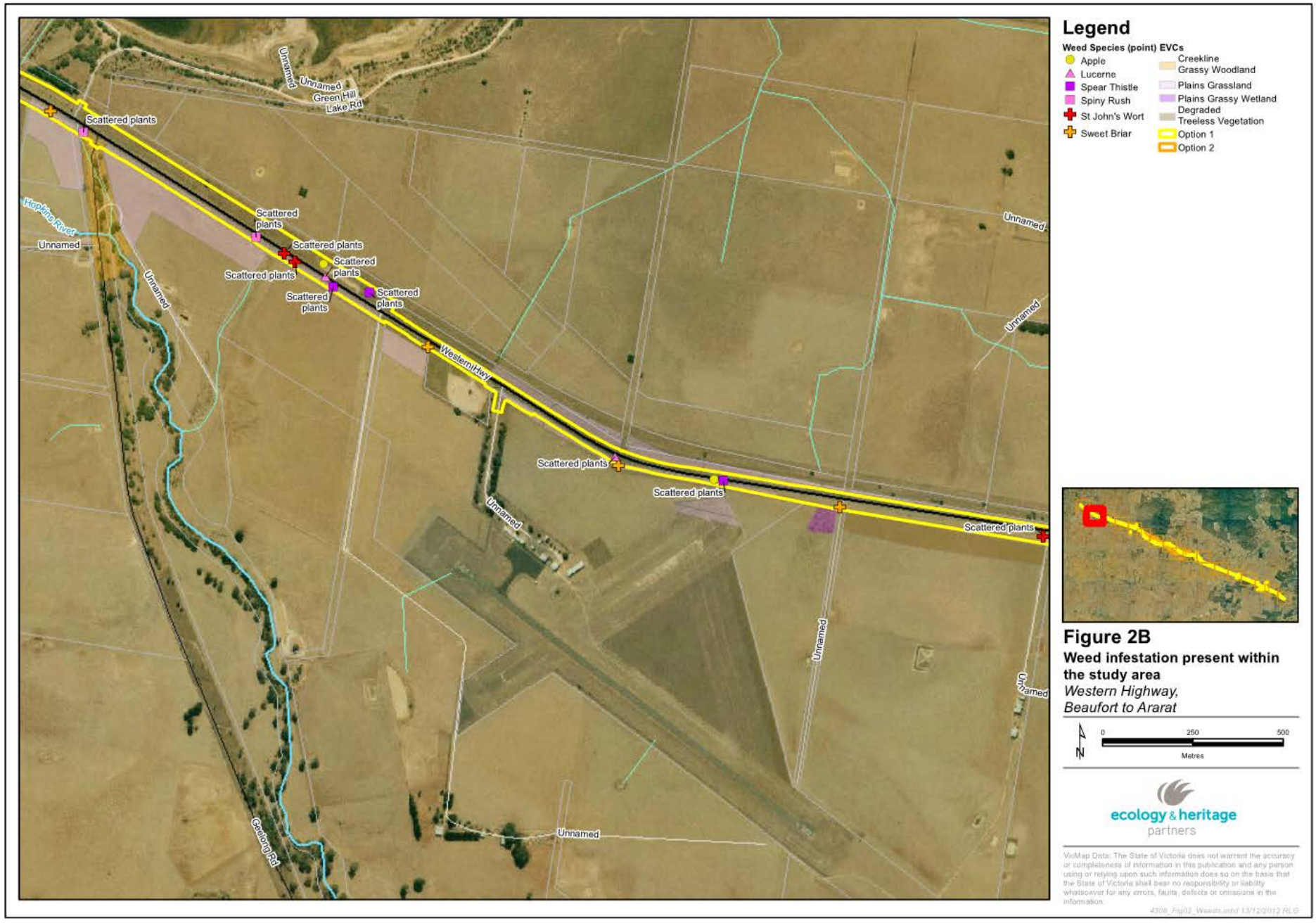


Figure 2B
Weed infestation present within the study area
Western Highway, Beaufort to Ararat

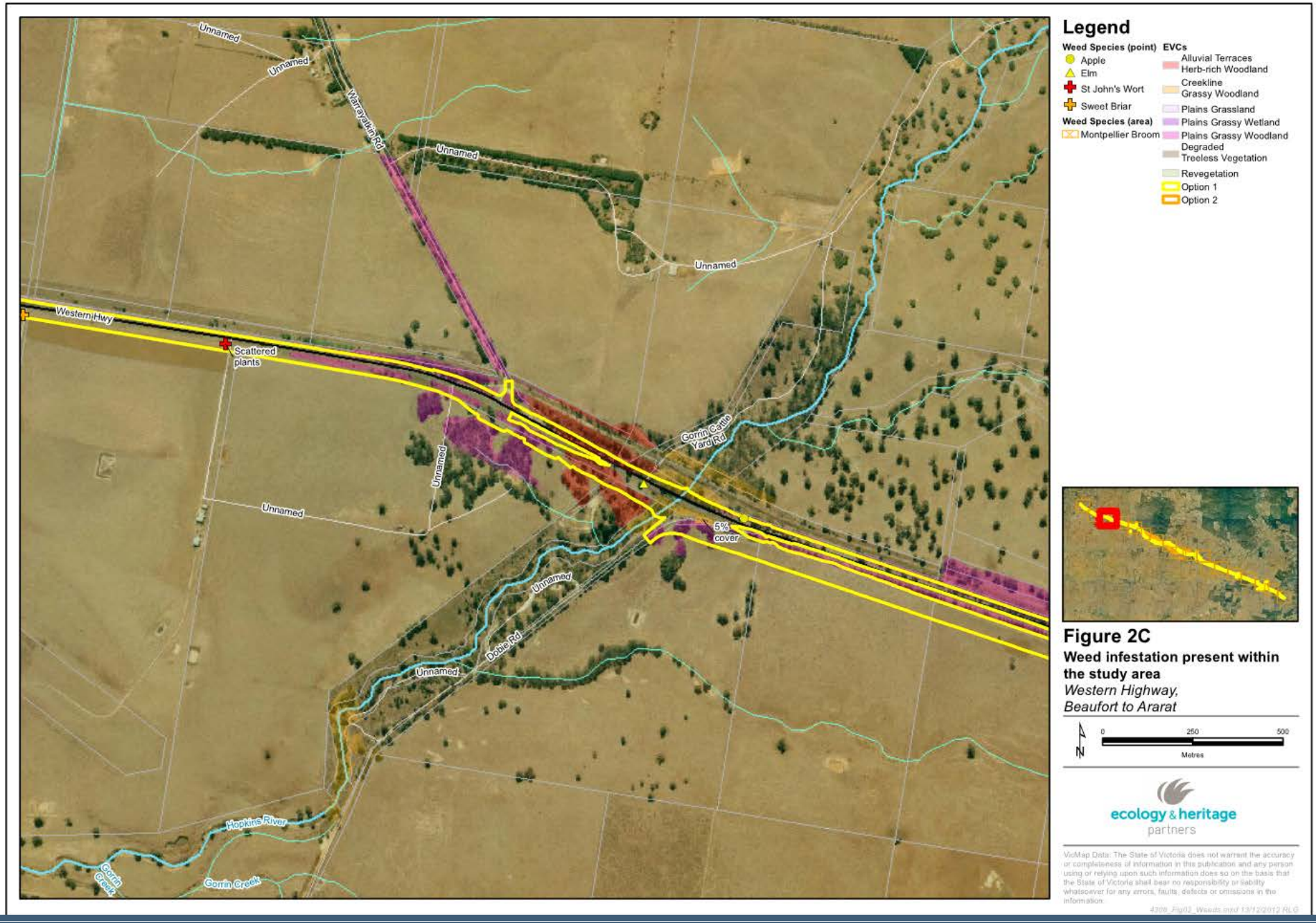


Figure 2C
Weed infestation present within the study area
Western Highway, Beaufort to Ararat

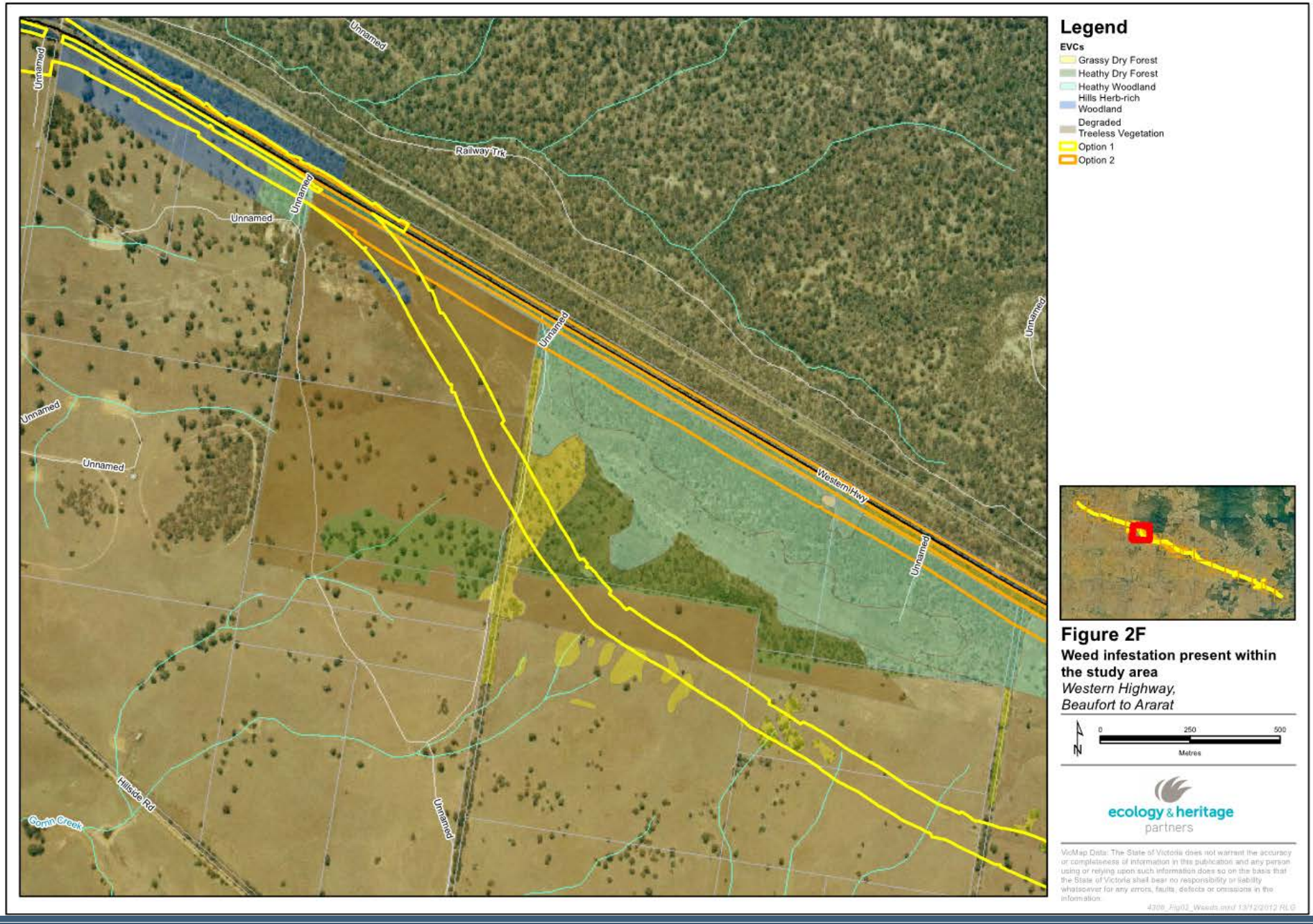


Figure 2F
Weed infestation present within the study area
Western Highway, Beaufort to Ararat

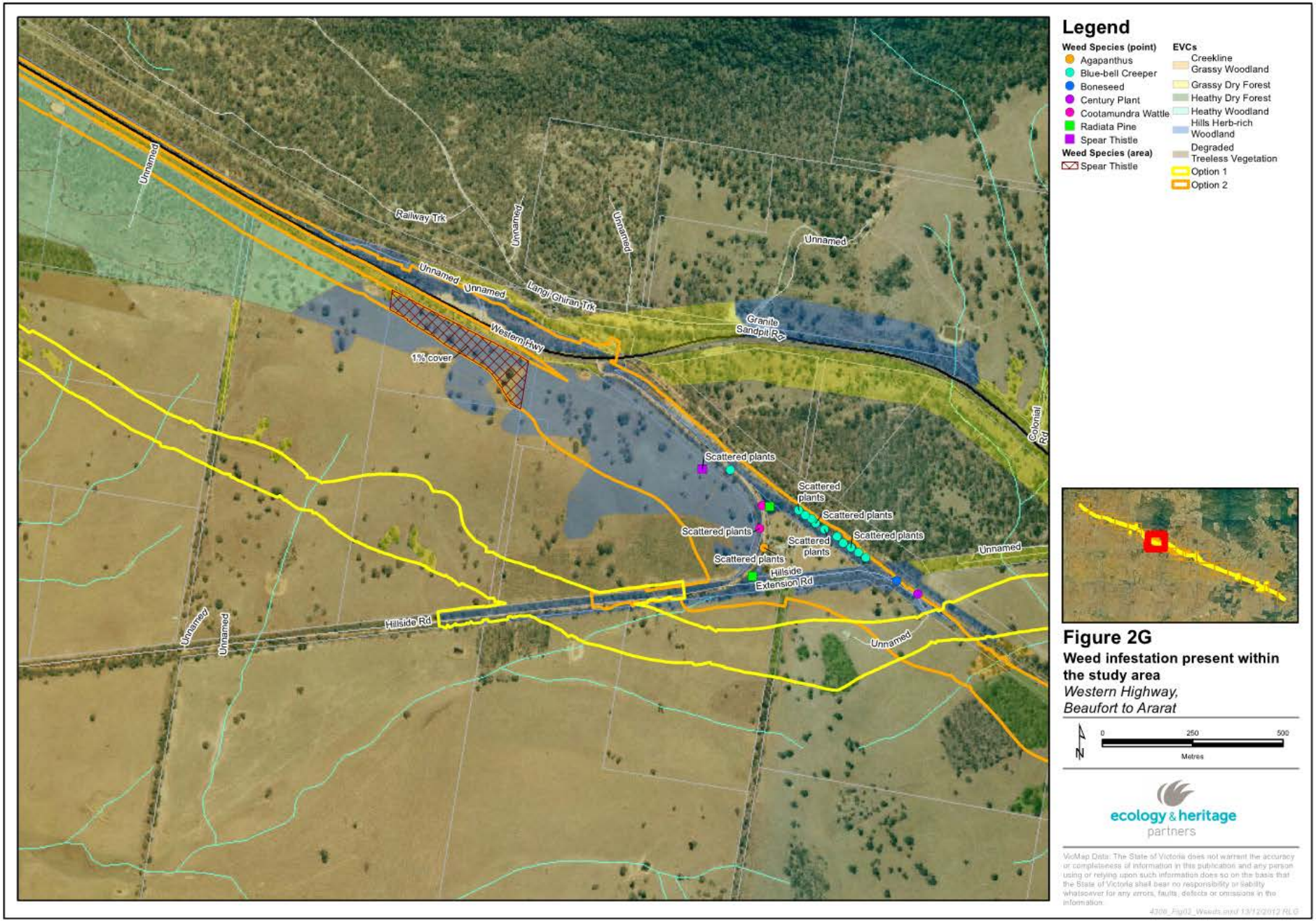


Figure 2G
Weed infestation present within the study area
Western Highway, Beaufort to Ararat

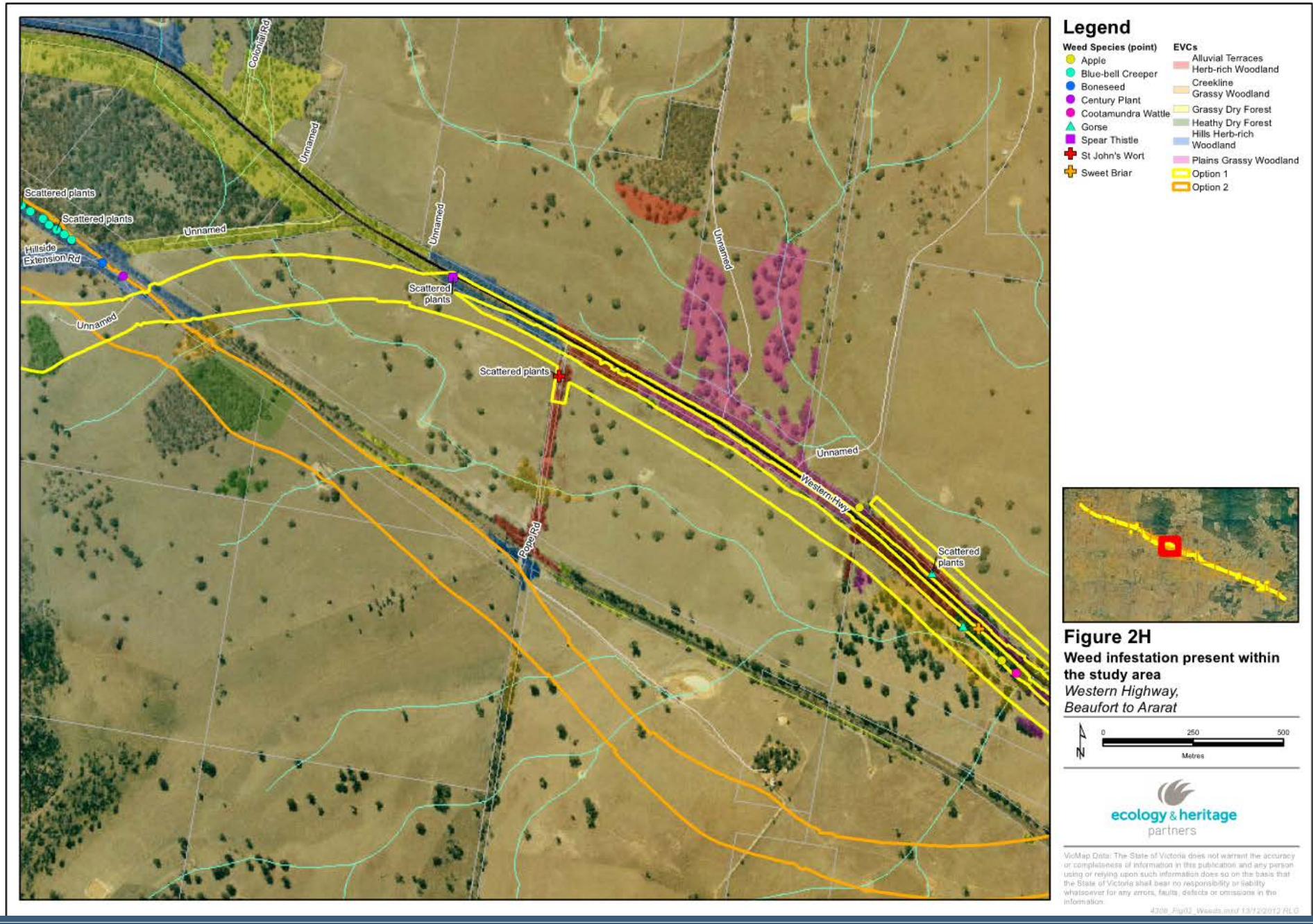
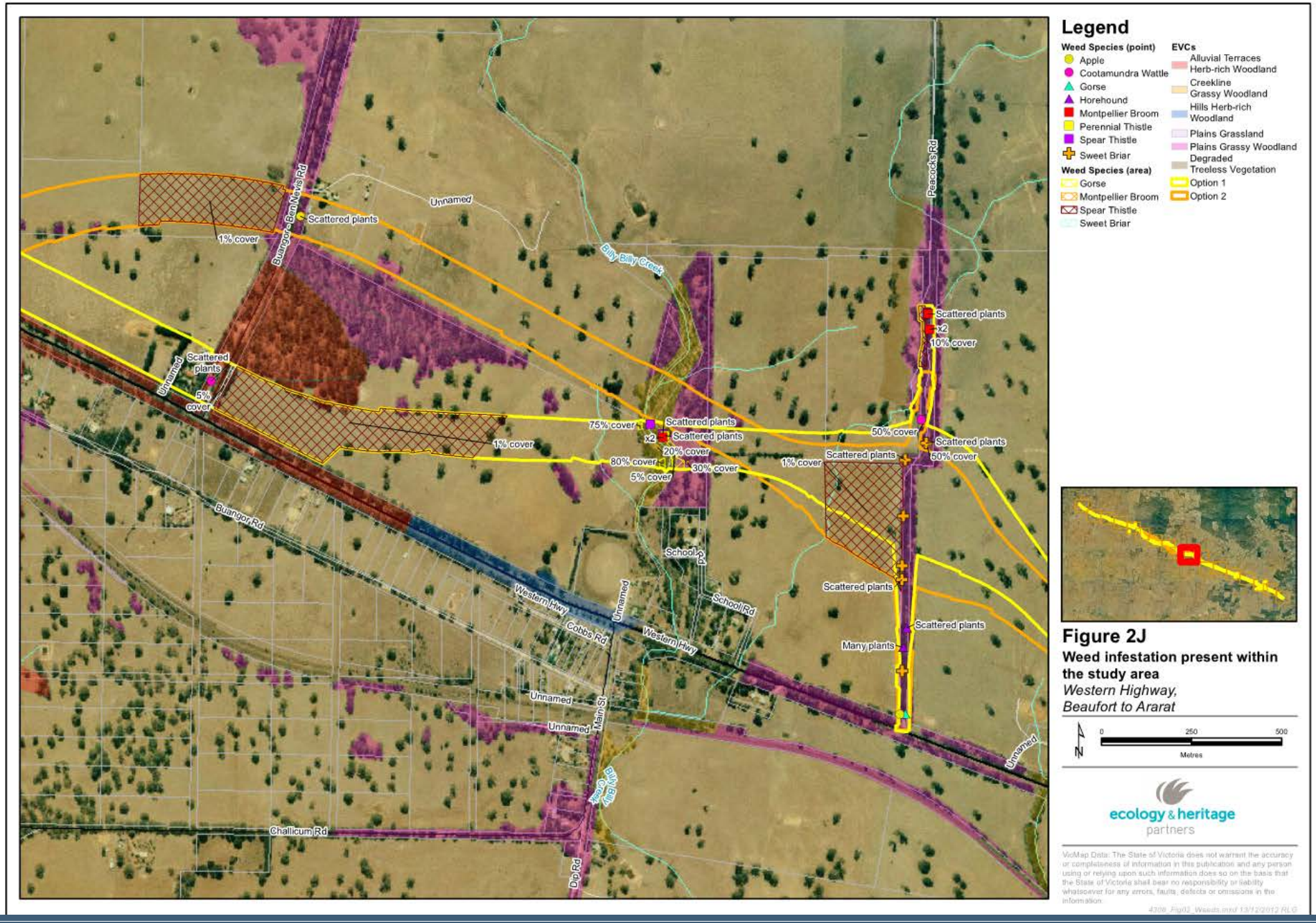
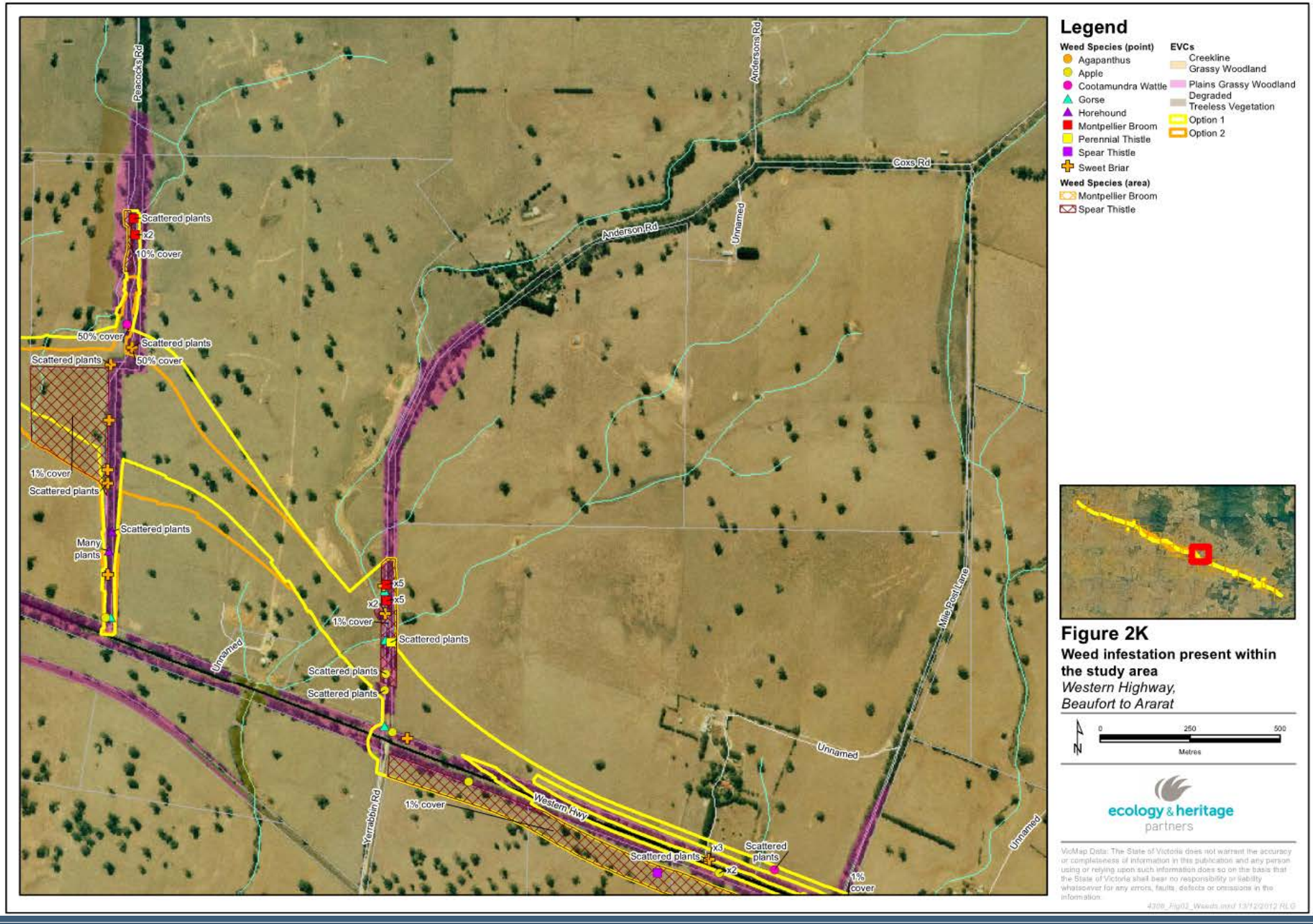


Figure 2H
Weed infestation present within the study area
Western Highway, Beaufort to Ararat


Legend
Weed Species (point)
Apple
Cootamundra Wattle
Gorse
Horehound
Montpellier Broom
Perennial Thistle
Spear Thistle
Sweet Briar
Weed Species (area)
Gorse
Montpellier Broom
Spear Thistle
Sweet Briar
EVCs
Alluvial Terraces Herb-rich Woodland
Creekline Grassy Woodland
Hills Herb-rich Woodland
Plains Grassland
Plains Grassy Woodland
Degraded Treeless Vegetation
Option 1
Option 2
Buangor-Ben Nevis Rd
Unnamed
Billy Billy Creek
Peacocks Rd
Scattered plants
1% cover
Scattered plants
x2
10% cover
Scattered plants
5% cover
75% cover
Scattered plants
x2
Scattered plants
20% cover
80% cover
30% cover
5% cover
1% cover
50% cover
Scattered plants
1% cover
Scattered plants
50% cover
Buangor Rd
School St
Western Hwy
Cobbs Rd
Unnamed
School Rd
Western Hwy
Scattered plants
Scattered plants
Many plants
Unnamed
Unnamed
Main St
Unnamed
Billy Billy Creek
Challicum Rd
Dip Rd
Figure 2J
Weed infestation present within the study area
Western Highway,
Beaufort to Ararat
0
250
500
Metres
ecology & heritage partners
VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.
4308_Fig02_Weeds.mxd 13/12/2012 RLG


Legend
Weed Species (point)
Agapanthus
Apple
Cootamundra Wattle
Gorse
Horehound
Montpellier Broom
Perennial Thistle
Spear Thistle
Sweet Briar
Weed Species (area)
Montpellier Broom
Spear Thistle
EVCs
Creekline Grassy Woodland
Plains Grassy Woodland
Degraded Treeless Vegetation
Option 1
Option 2
Peacocks Rd
Andersons Rd
Coxs Rd
Anderson Rd
Unnamed
Mile Post Lane
Yerrabbin Rd
Western Hwy
Scattered plants
x2
10% cover
50% cover
1% cover
Many plants
x5
Figure 2K
Weed infestation present within the study area
Western Highway, Beaufort to Ararat
0
250
500
Metres
N
ecology & heritage partners
VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.
4306_Fig02_Weeds.mxd 13/12/2012 RLG

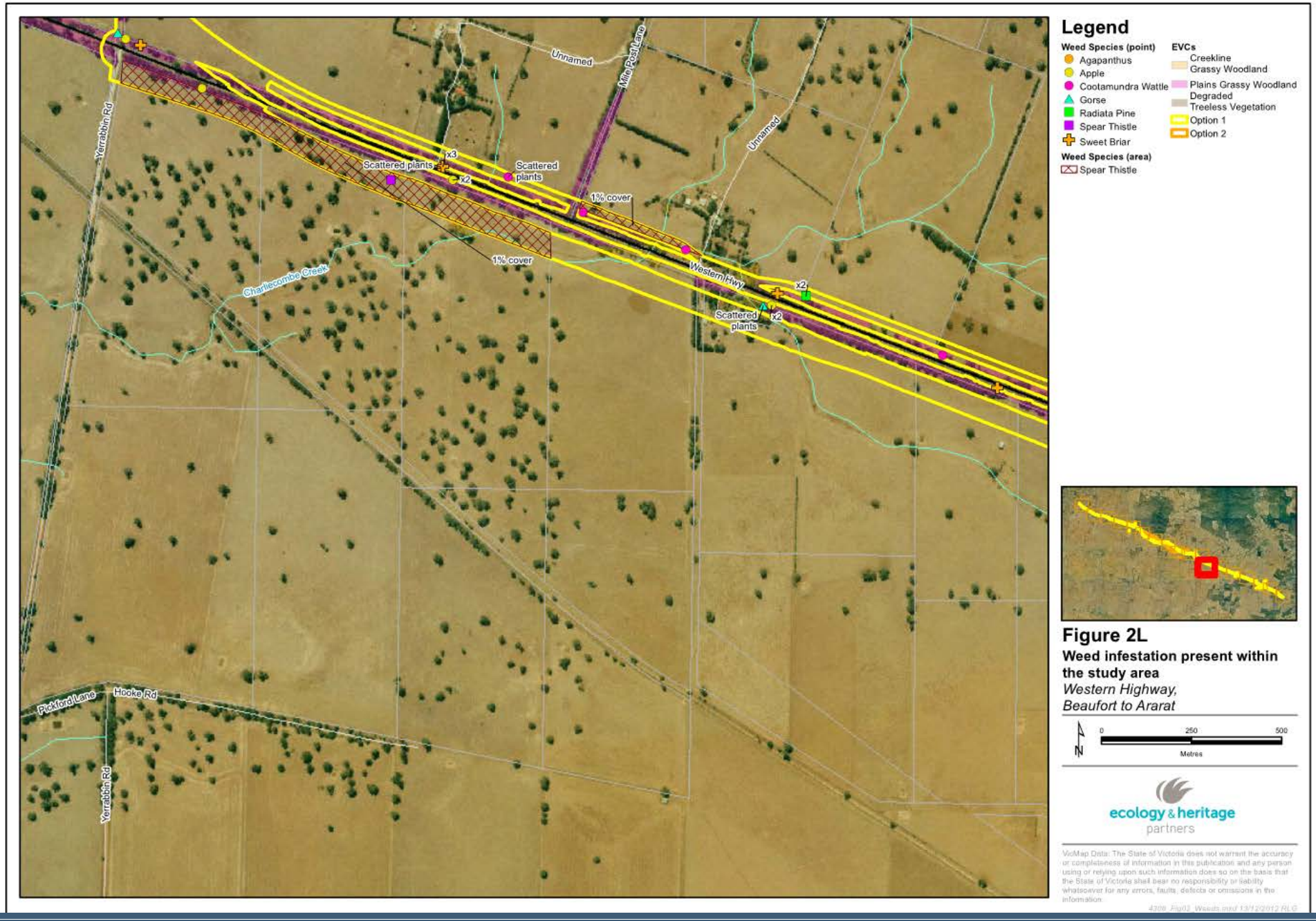


Figure 2L

Weed infestation present within the study area

Western Highway, Beaufort to Ararat

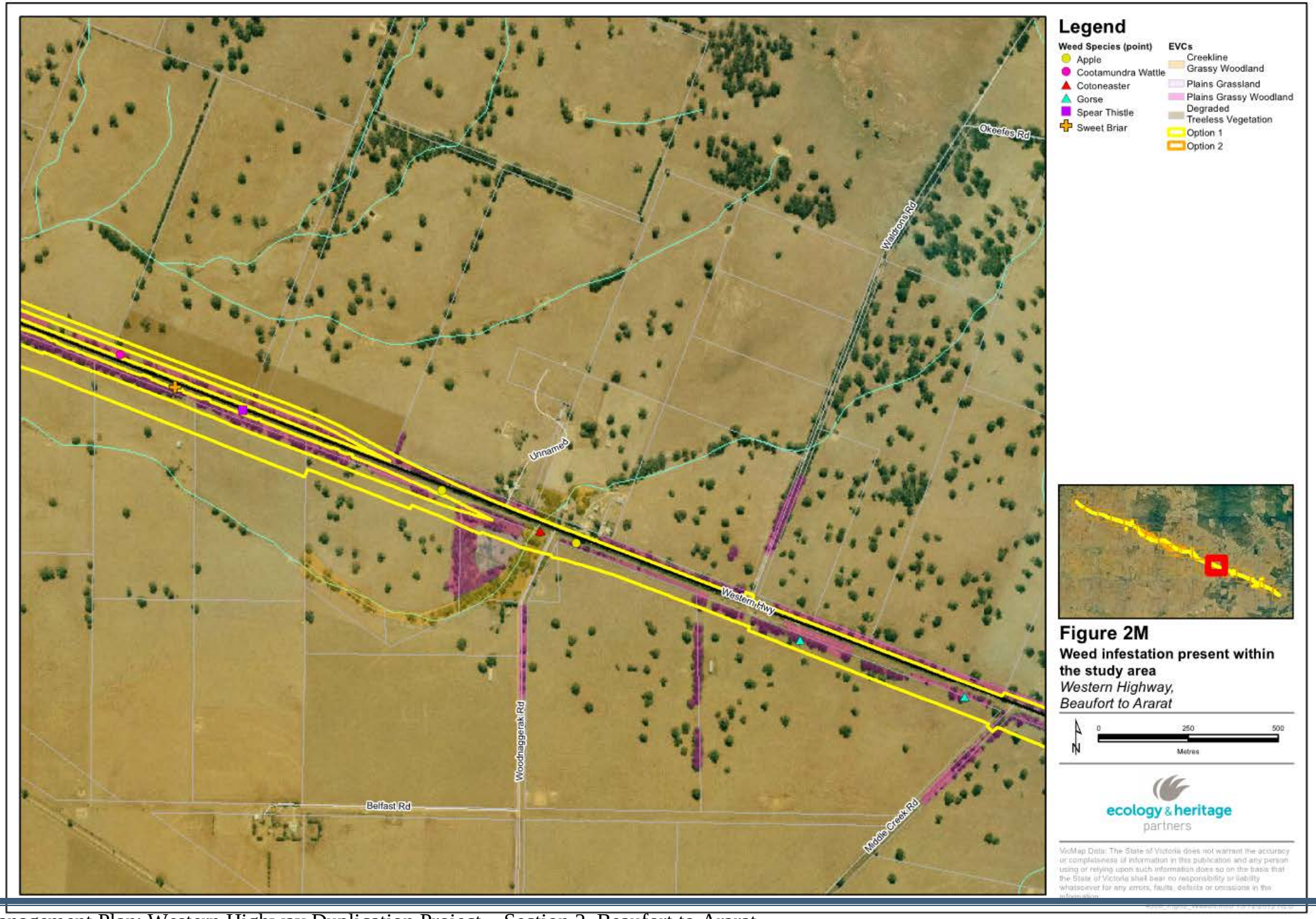


Figure 2M
Weed infestation present within the study area
Western Highway, Beaufort to Ararat

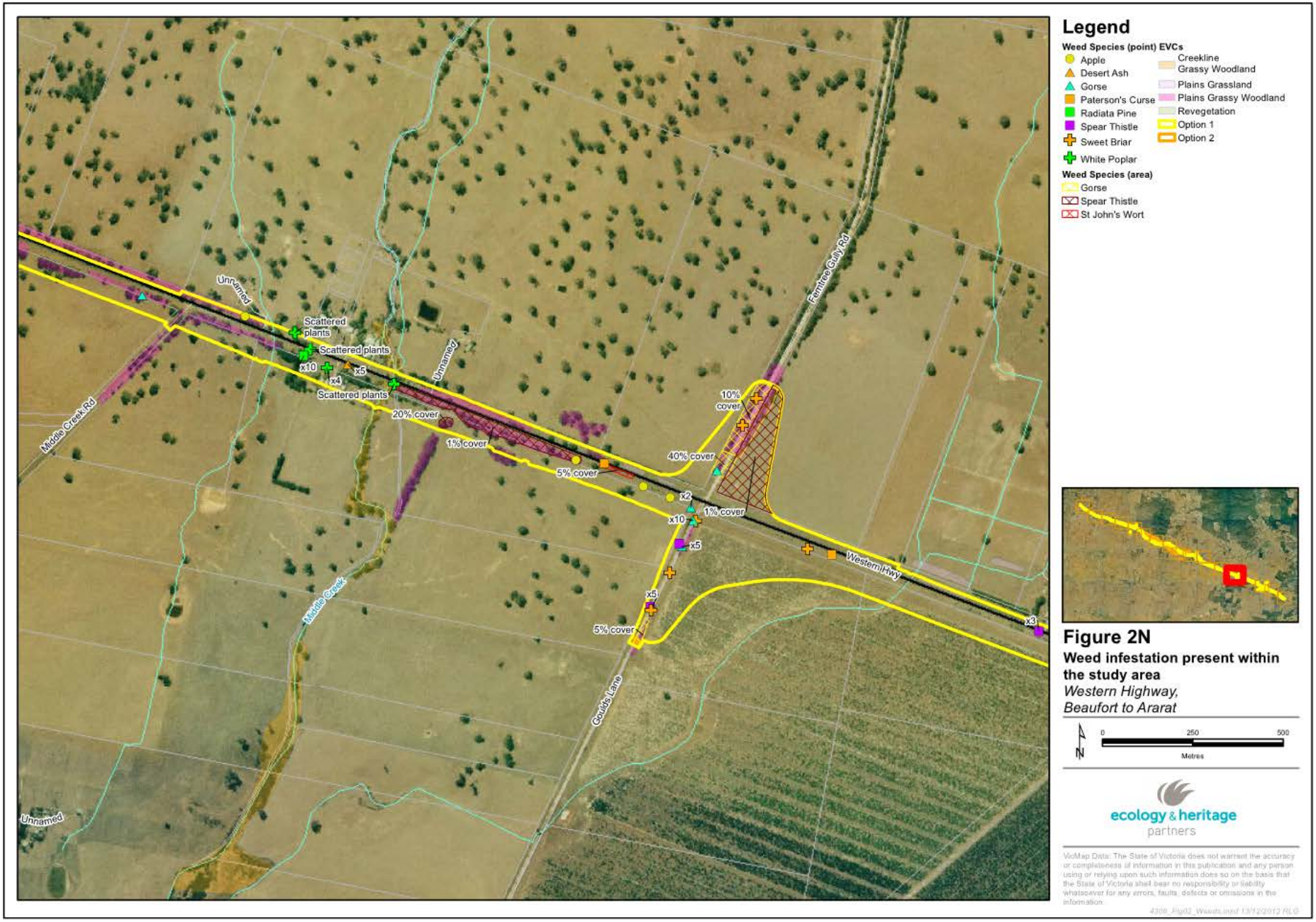


Figure 2N

Weed infestation present within the study area

Western Highway, Beaufort to Ararat

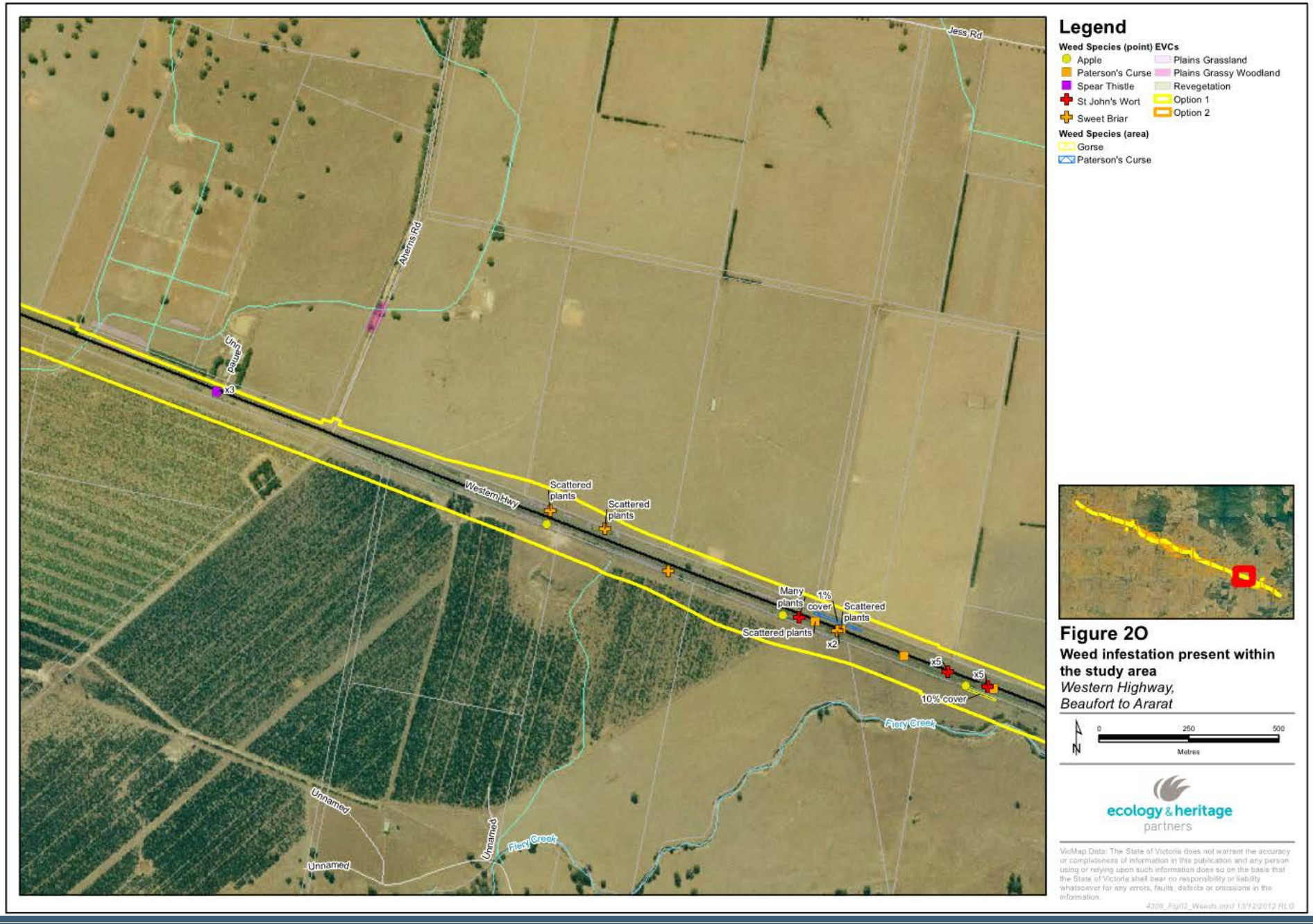
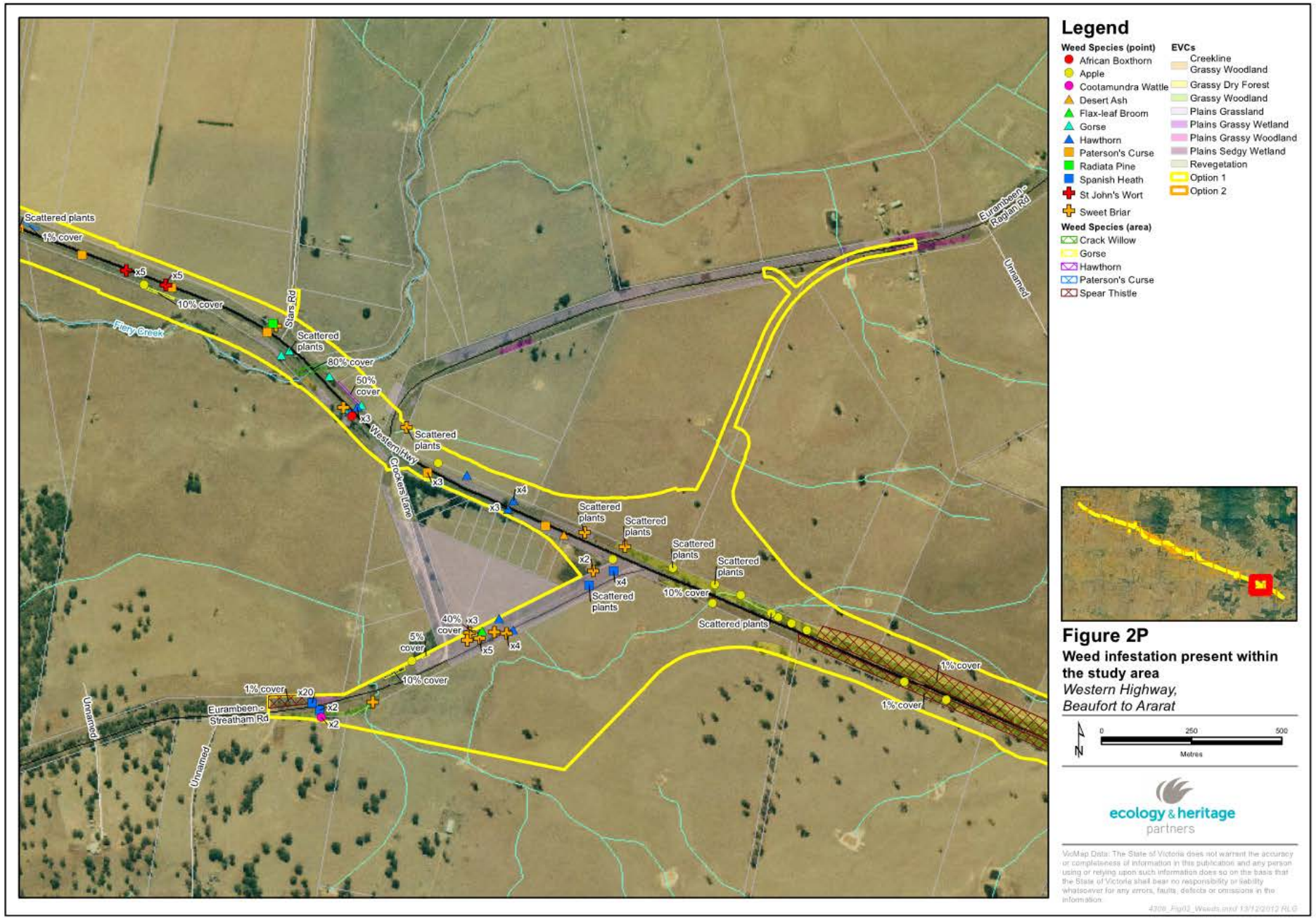


Figure 2O
Weed infestation present within the study area
Western Highway, Beaufort to Ararat


Legend
Weed Species (point)
African Boxthorn
Apple
Cootamundra Wattle
Desert Ash
Flax-leaf Broom
Gorse
Hawthorn
Paterson's Curse
Radiata Pine
Spanish Heath
St John's Wort
Sweet Briar
Weed Species (area)
Crack Willow
Gorse
Hawthorn
Paterson's Curse
Spear Thistle
EVCs
Creekline Grassy Woodland
Grassy Dry Forest
Grassy Woodland
Plains Grassland
Plains Grassy Wetland
Plains Grassy Woodland
Plains Sedgy Wetland
Revegetation
Option 1
Option 2
Scattered plants
1% cover
x5
10% cover
Stars Rd
Fiery Creek
80% cover
50% cover
x3
Western Hwy
Crockers Lane
x4
40% cover
5% cover
x20
x2
Eurambeen - Streatham Rd
Unnamed
Eurambeen - Reglan Rd
Figure 2P
Weed infestation present within the study area
Western Highway, Beaufort to Ararat
0
250
500
Metres
N
ecology & heritage partners

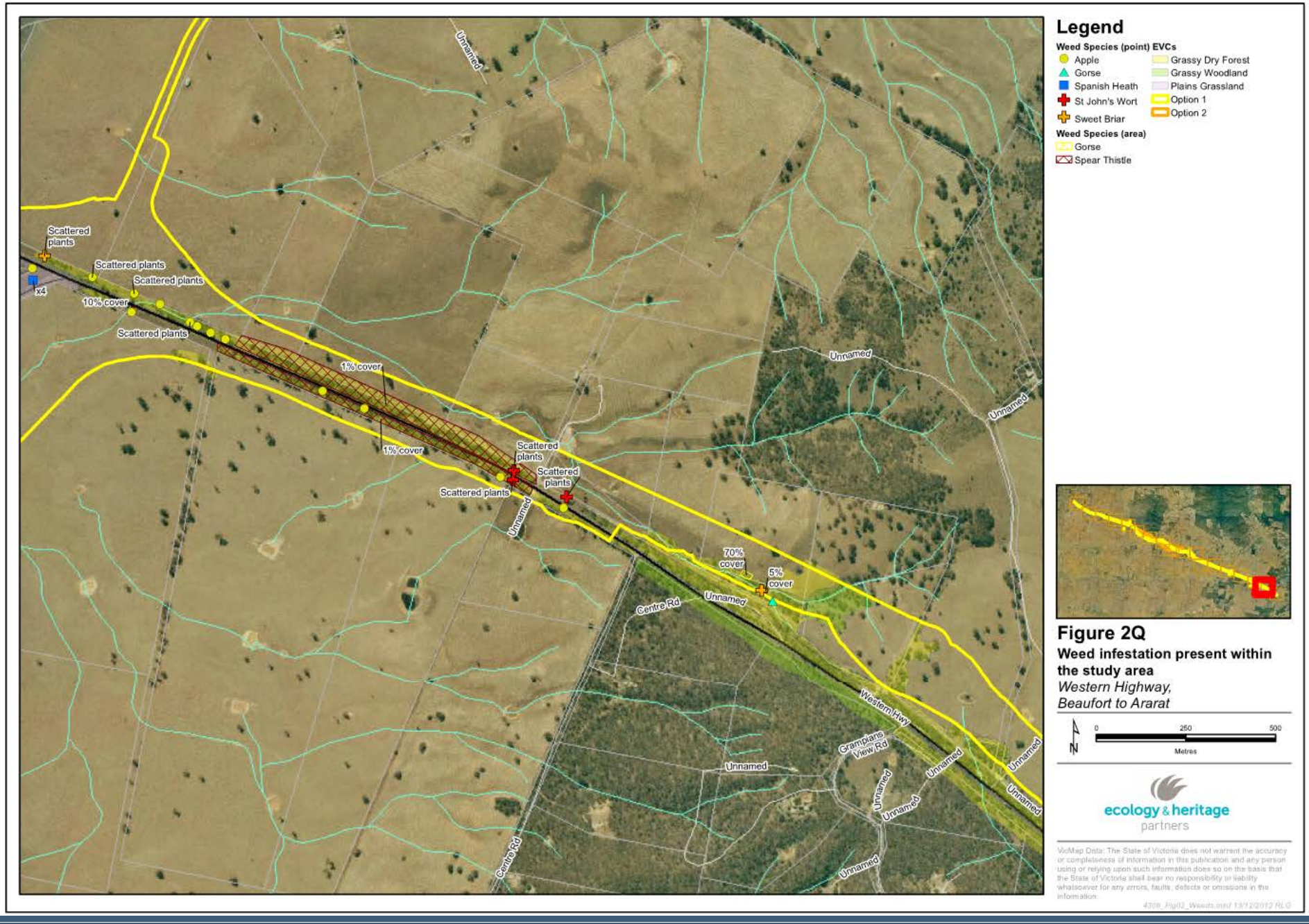
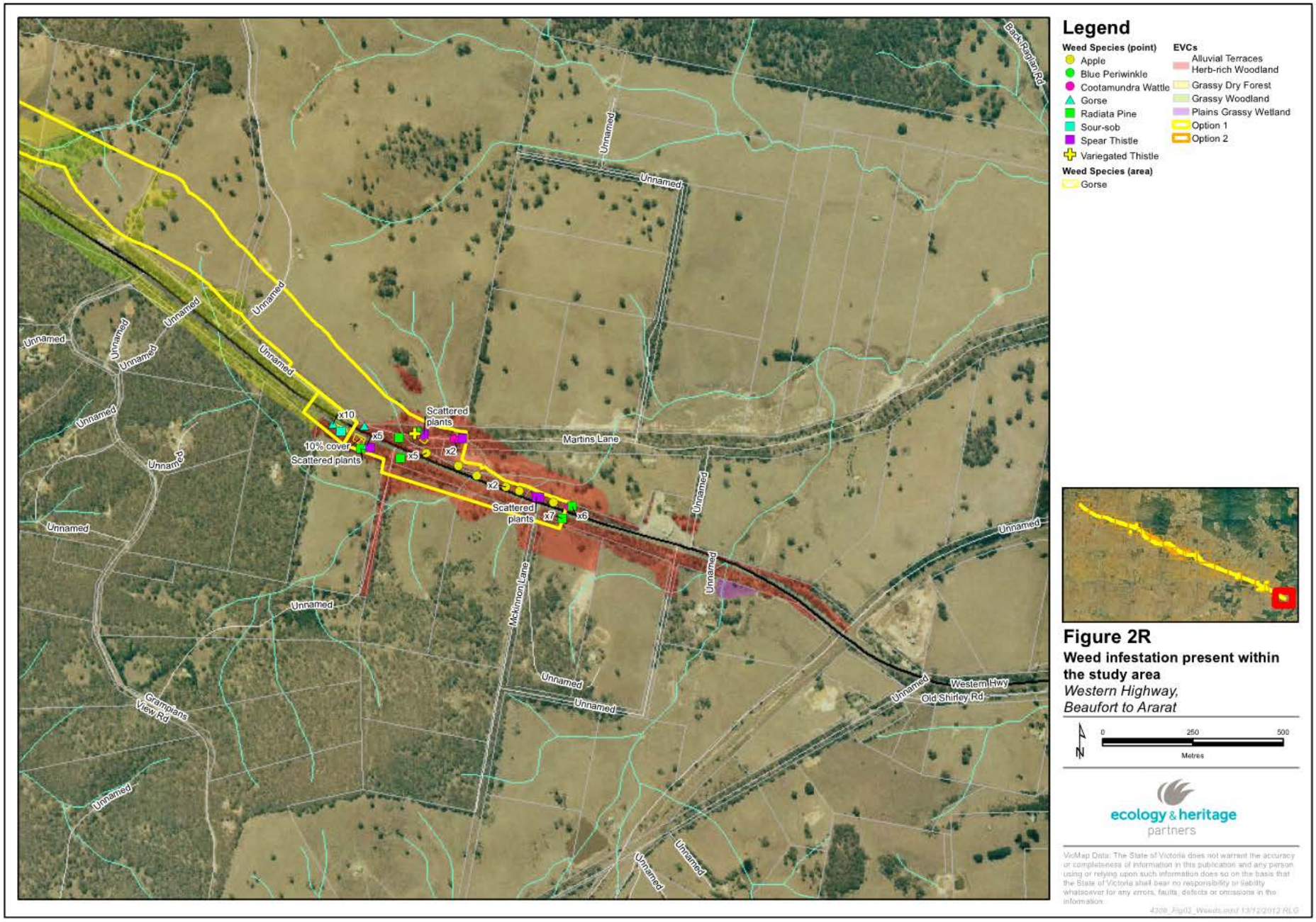


Figure 2Q
Weed infestation present within the study area
Western Highway, Beaufort to Ararat


Legend
Weed Species (point)
Apple
Blue Periwinkle
Cootamundra Wattle
Gorse
Radiata Pine
Sour-sob
Spear Thistle
Variegated Thistle
Weed Species (area)
Gorse
EVCs
Alluvial Terraces Herb-rich Woodland
Grassy Dry Forest
Grassy Woodland
Plains Grassy Wetland
Option 1
Option 2
Figure 2R
Weed infestation present within the study area
Western Highway, Beaufort to Ararat
0
250
500
Metres
N
ecology & heritage partners
VicMap Data: The State of Victoria does not warrant the accuracy or completeness of information in this publication and any person using or relying upon such information does so on the basis that the State of Victoria shall bear no responsibility or liability whatsoever for any errors, faults, defects or omissions in the information.
4308_Fig02_Weeds.mxd 13/12/2012 RLG
Martins Lane
McKinnon Lane
Western Hwy
Old Shirley Rd
Back Raglan Rd
Grampians View Rd
Unnamed
Scattered plants
10% cover
x10
x5
x2
x7
x6

REFERENCES

AWC 2008. *Summary of State and Territory Noxious Weeds Legislation*. Australian Weeds Committee.

DEWHA. 2009. *Weeds in Australia*. Department of the Environment, Water, Heritage and the Arts http://www.weeds.gov.au/weeds/lists/wons.html

DEWR. 2007. *Australian Weed Strategy – a national strategy for weed management in Australia*. Department of Environment and Water Resources.

DPI. 2004. *Weed management in riparian zones - A guide for grazing properties in southwest Victoria*. Department of Primary Industries East Melbourne, Victoria.

DPI. 2008. *Declared Noxious Weeds – Listed by Common Name*. Landcare Notes. Department of Primary Industries, East Melbourne, Victoria.

DPI. 2009. *Flora and Fauna Guarantee Act 1988*. Department of Primary Industries. http://www.dpi.vic.gov.au/DSE/

DPI. 2010. *Invasive Plants and Animals Policy Framework*. Department of Primary Industries East Melbourne, Victoria.

DPIF. 2008. *Weeds of National Significance (WONS) Strategies*. Department of Primary Industries and Fisheries, Queensland Government.

DSE. 2007. *Guidelines and Procedures for Managing the Environmental Impacts of Weeds on Public Land in Victoria 2007*. Department of Sustainability and Environment, East Melbourne, Victoria.

DSE. 2008. *Advisory list of environmental weeds of coastal plains and heathy forests bioregions of Victoria*. Department of Sustainability and Environment, East Melbourne, Victoria.

DSE 2012. Biodiversity Interactive Map http://www.dse.vic.gov.au

Ecology and Heritage Partners 2011. *Western Highway Project: Section 2, Beaufort to Ararat, Victoria. Existing Conditions Report – Flora, Fauna and Ecological Communities*. Unpublished report prepared for VicRoads.

Muyt, A. 2001. *Bush Invaders of South-East Australia – A guide to the identification and control of environmental weeds found in south-east Australia*. R.G. and F.J. Richardson, Meredith, Victoria.

NRE. 2002a. *Victorian Pest Management – A Framework for Action*. Department of Natural Resources and Environment, Victoria.

NRE. 2002b. *Victorian Pest Management – A Framework for Action: Weed Management Strategy*. Department of Natural Resources and Environment, Victoria. NSW DPI. 2005. Weeds. http://www.dpi.nsw.gov.au/

Richardson, F.J., Richardson, R.G. and Shepherd, R.C.H. 2006. *Weeds of the South-east. An identification guide for Australia*. R.G. and F.J. Richardson, Meredith, Victoria.

Weeds CRC. 2004. *Developing and implementing a weed management plan*. CRC for Australian Weed Management and Commonwealth Department of the Environment and Heritage.

APPENDICES

Appendix 1 – Database Searches and Survey Results

Table A1: Exotic species recorded during database searches and field investigations.

Scientific name	Common Name	Classification	Present within wider study area	Present during weed assessment
Acacia baileyana	Cootamundra Wattle	Environmental Weed	Yes	Yes
Acacia decurrens	Early Black-wattle	Environmental Weed		
Acetosella vulgaris	Sheep Sorrel	Environmental Weed	Yes	Yes
*Agapanthus praecox**	Agapanthus	Environmental Weed	Yes	Yes
Agave americana var. Americana	Century Plant	Environmental Weed		Yes
Agrostis capillaris	Brown-top Bent	Environmental Weed	¥	Yes
Agrostis stolonifera	Creeping Bent	Environmental Weed		
Aira caryophyllea subsp. caryophyllea	Silvery Hair-grass	Environmental Weed		
Aira cupaniana	Quicksilver Grass	Environmental Weed		
Aira elegantissima	Delicate Hair-grass	Environmental Weed	Yes	Yes
*Allium triquetrum***	Angled Onion	Restricted	Yes	
Allium vineale	Crow Garlic	Environmental Weed		
Amaryllis belladonna	Belladonna Lily	Environmental Weed		
Anthoxanthum odoratum	Sweet Vernal-grass	Environmental Weed	Yes	Yes
Arctotheca calendula	Cape Weed	Environmental Weed	Yes	Yes
Arctotheca prostrata	Creeping Bear's-ear	Environmental Weed		
*Asparagus asparagoides***^	Bridal Creeper	Restricted	Yes	
Asparagus officinalis	Asparagus	Environmental Weed		
Atriplex prostrata	Hastate Orache	Environmental Weed		
Avellinia michelii	Avellinia	Environmental Weed		
Avena barbata	Bearded Oat	Environmental Weed	Yes	Yes
Avena fatua	Wild Oat	Environmental Weed		Yes
Avena sativa	Oat	Environmental Weed		
*Billardiera heterophylla**	Bluebell Creeper	Environmental Weed		Yes
Brassica fruticulosa	Twiggy Turnip	Environmental Weed		Yes
Briza maxima	Large Quaking-grass	Environmental Weed	Yes	Yes
Briza minor	Lesser Quaking-grass	Environmental Weed	Yes	Yes
Bromus alopecuros	Mediterranean Brome	Environmental Weed		
Bromus catharticus	Prairie Grass	Environmental Weed		
Bromus diandrus	Great Brome	Environmental Weed		
Bromus hordeaceus subsp. hordeaceus	Soft Brome	Environmental Weed	Yes	Yes
Bromus madritensis	Madrid Brome	Environmental Weed		
Bromus rubens	Red Brome	Environmental Weed		
Calicotome spinosa	Spiny Broom	Environmental Weed		
Carduus pycnocephalus	Slender Thistle	Environmental Weed		
Carduus tenuiflorus	Winged Slender-thistle	Environmental Weed		

Scientific name	Common Name	Classification	Present within wider study area	Present during weed assessment
Carpobrotus edulis	Hottentot Fig	Environmental Weed		
Carthamus dentatus	Toothed Thistle	Environmental Weed		
Cenchrus macrourus	African Feather-grass	Environmental Weed		
Centaurium erythraea	Common Centaury	Environmental Weed	Yes	Yes
Centaurium tenuiflorum	Slender Centaury	Environmental Weed		
Cerastium glomeratum s.l.	Common Mouse-ear Chickweed	Environmental Weed		
Cerastium glomeratum s.s.	Sticky Mouse-ear Chickweed	Environmental Weed		
Chamaecytisus palmensis	Tree Lucerne	Environmental Weed	Yes	Yes
Chenopodium album	Fat Hen	Environmental Weed		
Chondrilla juncea	Skeleton Weed	Environmental Weed		
Chrysanthemoides monilifera^**	Boneseed	Regionally Controlled	Yes	Yes
Cicendia filiformis	Slender Cicendia	Environmental Weed		
Cicendia quadrangularis	Square Cicendia	Environmental Weed		
*Cirsium arvense***	Perennial Thistle	Regionally Controlled		Yes
*Cirsium vulgare***	Spear Thistle	Restricted	Yes	Yes
*Conium maculatum***	Hemlock	Restricted	Yes	
*Cortaderia selloana**	Pampas Grass	Environmental Weed		Yes
Cotoneaster glaucophyllus	Large-leaf Cotoneaster	Environmental Weed	Yes	Yes
Cotula coronopifolia	Water Buttons	Environmental Weed	Yes	
*Crataegus monogyna***	Hawthorn	Restricted	Yes	Yes
Cupressus macrocarpa	Monterey Cypress	Environmental Weed	Yes	Yes
Cynodon dactylon	Couch	Environmental Weed	Yes	Yes
Cynosurus echinatus	Rough Dog's-tail	Environmental Weed	Yes	Yes
Cyperus eragrostis	Drain Flat-sedge	Environmental Weed	Yes	Yes
*Cytisus scoparius**^	English Broom	Restricted		
Dactylis glomerata	Cocksfoot	Environmental Weed	Yes	Yes
Digitaria sanguinalis	Summer Grass	Environmental Weed		
Diplotaxis tenuifolia	Sand Rocket	Environmental Weed		
Dittrichia graveolens	Stinkwort	Environmental Weed		
*Echium plantagineum***	Paterson's Curse	Regionally Controlled		Yes
Ehrharta erecta	Panic Veldt Grass	Environmental Weed	Yes	Yes
Ehrharta longifolia	Annual Veldt-grass	Environmental Weed	Yes	Yes
Elytrigia repens	English Couch	Environmental Weed		
*Eragrostis curvula***	African Love-grass	Restricted		
*Erica lusitanica**	Spanish Heath	Environmental Weed	Yes	Yes
Erodium botrys	Big Heron's-bill	Environmental Weed		
Erodium cicutarium	Common Heron's-bill	Environmental Weed		
Festuca arundinacea	Tall Fescue	Environmental Weed	Yes	
*Foeniculum vulgare***	Fennel	Restricted		
Fraxinus spp.	Ash	Environmental Weed		Yes
Freesia alba x Freesia leichtlinii	Freesia	Environmental Weed		

Scientific name	Common Name	Classification	Present within wider study area	Present during weed assessment
Fumaria muralis subsp. muralis	Wall Fumitory	Environmental Weed	Yes	Yes
Galinsoga parviflora	Gallant Soldier	Environmental Weed		
Galium aparine	Cleavers	Environmental Weed	Yes	Yes
Galium divaricatum	Slender Bedstraw	Environmental Weed		
Galium murale	Small Goosegrass	Environmental Weed		
Gazania linearis	Gazania	Environmental Weed	Yes	
*Genista linifolia***	Flax-leaf Broom	Restricted		Yes
Genista monspessulana **^	Montpellier Broom	Restricted	Yes	Yes
Geranium dissectum	Cut-leaf Crane's-bill	Environmental Weed	Yes	Yes
Gladiolus tristis	Evening-flower Gladiolus	Environmental Weed		
*Hedera helix**	English Ivy	Environmental Weed		
Hedypnois rhagadioloides	Hedypnois	Environmental Weed		
Helminthotheca echioides	Ox-tongue	Environmental Weed	Yes	Yes
Holcus lanatus	Yorkshire Fog	Environmental Weed	Yes	Yes
Hordeum leporinum	Barley-grass	Environmental Weed		
Hordeum murinum s.l.	Barley-grass	Environmental Weed	Yes	
Hordeum spp.	Barley Grass	Environmental Weed		
*Hypericum perforatum subsp. veronense***	St John's Wort	Regionally Controlled		Yes
Hypochoeris glabra	Smooth Cat's-ear	Environmental Weed		
Hypochoeris radicata	Flatweed	Environmental Weed	Yes	Yes
Isolepis hystrix	Awned Club-sedge	Environmental Weed		
Isolepis levynsiana	Tiny Flat-sedge	Environmental Weed		
Ixia maculata	Yellow Ixia	Environmental Weed		
*Juncus acutus***	Spiny Rush	Regionally Controlled	Yes	Yes
Juncus capitatus	Capitate Rush	Environmental Weed		Yes
Juncus microcephalus	Tiny-headed Rush	Environmental Weed		Yes
Kickxia elatine	Hairy Toadflax	Environmental Weed		
Kickxia elatine subsp. elatine	Woolly Toadflax	Environmental Weed		
Lactuca serriola	Prickly Lettuce	Environmental Weed		Yes
Lavandula spp.	Lavender	Environmental Weed		
Leontodon taraxacoides subsp. taraxacoides	Hairy Hawkbit	Environmental Weed	Yes	Yes
Lepidium africanum	Common Peppercress	Environmental Weed	Yes	Yes
Lolium perenne	Perennial Rye-grass	Environmental Weed	Yes	Yes
Lolium rigidum	Wimmera Rye-grass	Environmental Weed		
Lycium ferocissimum **^	African Box-thorn	Regionally Controlled	Yes	Yes
Lysimachia arvensis	Pimpernel	Environmental Weed	Yes	
Lysimachia arvensis (Red-flowered variant)	Scarlet Pimpernel	Environmental Weed		
Lysimachia minima	Chaffweed	Environmental Weed		
Malus pumila	Apple	Environmental Weed		Yes

Scientific name	Common Name	Classification	Present within wider study area	Present during weed assessment
Malva parviflora	Small-flower Mallow	Environmental Weed	Yes	
*Marrubium vulgare***	Horehound	Regionally Controlled		Yes
Medicago polymorpha	Burr Medic	Environmental Weed		
Medicago sativa subsp. sativa	Lucerne	Environmental Weed		Yes
Melilotus albus	Bokhara Clover	Environmental Weed		
Moenchia erecta	Erect Chickweed	Environmental Weed		
Moraea flaccida	One-leaf Cape-tulip	Environmental Weed		
Myriophyllum aquaticum	Parrot's Feather	Environmental Weed		
*Nassella trichotoma**^	Serrated Tussock	Regionally prohibited		
Oenothera stricta subsp. stricta	Common Evening-primrose	Environmental Weed		Yes
*Opuntia spp.**	Prickly Pear	Restricted		
*Oxalis pes-caprae**	Soursob	Restricted	Yes	Yes
Oxalis purpurea	Large-flower Wood-sorrel	Environmental Weed	Yes	
Parapholis incurva	Coast Barb-grass	Environmental Weed		
Parentucellia latifolia	Red Bartsia	Environmental Weed		
Parietaria judaica	Wall Pellitory	Environmental Weed		
Paspalum dilatatum	Paspalum	Environmental Weed	Yes	Yes
Paspalum distichum	Water Couch	Environmental Weed	Yes	
Phalaris aquatica	Toowoomba Canary-grass	Environmental Weed	Yes	Yes
Pinus radiata	Radiata Pine	Environmental Weed	Yes	Yes
Pittosporum undulatum	Sweet Pittosporum	Environmental Weed	Yes	
Plantago coronopus subsp. coronopus	Buck's-horn Plantain	Environmental Weed		Yes
Plantago lanceolata	Ribwort	Environmental Weed	Yes	Yes
Poa annua	Annual Meadow-grass	Environmental Weed	Yes	Yes
Poa bulbosa var.bulbosa	Bulbous Meadow-grass	Environmental Weed		
Polypogon monspeliensis	Annual Beard-grass	Environmental Weed		
*Populus alba**	White Poplar	Environmental Weed	Yes	Yes
*Prunus spp.**	Prunus	Environmental Weed	Yes	Yes
Ranunculus ophioglossifolius	Snake-tongue Buttercup	Environmental Weed		
Romulea minutiflora	Small-flower Onion-grass	Environmental Weed		
Romulea rosea	Onion Grass	Environmental Weed	Yes	Yes
*Rosa rubiginosa **	Sweet Briar	Regionally Controlled	Yes	Yes
*Rubus fruticosus spp. agg.**^	Blackberry	Regionally Controlled	Yes	
Rumex conglomeratus	Clustered Dock	Environmental Weed		Yes
Rumex crispus	Curled Dock	Environmental Weed		Yes
*Salix babylonica s.l.**	Weeping Willow	Environmental Weed		Yes
*Salix cinerea** ^	Grey Sallow	Restricted		
*Salix fragilis**^	Crack Willow	Restricted	Yes	Yes
*Salix X reichardtii**	Pussy Willow	Environmental Weed		Yes
Scabiosa atropurpurea	Pincushion	Environmental Weed		Yes
Schinus molle	Pepper Tree	Environmental Weed	Yes	Yes
Silene gallica	French Catchfly	Environmental Weed		

Scientific name	Common Name	Classification	Present within wider study area	Present during weed assessment
*Silybum marianum***	Variegated Thistle	Restricted		Yes
Sisymbrium orientale	Indian Hedge- mustard	Environmental Weed		
Solanum nigrum	Black Nightshade	Environmental Weed	Yes	Yes
Sonchus asper s.l.	Rough Sow-thistle	Environmental Weed		Yes
Sonchus oleracea	Common Sow-thistle	Environmental Weed	Yes	Yes
Sparaxis bulbifera	Harlequin Flower	Environmental Weed		
Sporobolus africanus	Rat-tail Grass	Environmental Weed	Yes	Yes
Stellaria media	Chickweed	Environmental Weed	Yes	Yes
Stellaria pallida	Lesser Chickweed	Environmental Weed		
Tragopogon porrifolius	Salsify	Environmental Weed		Yes
Tribolium acutiflorum s.l.	Desmazeria	Environmental Weed		
Tribolium acutiflorum s.s.	Crested Desmazeria	Environmental Weed		
Trifolium angustifolium var. angustifolium	Narrow-leaf Clover	Environmental Weed	Yes	
Trifolium arvense var. arvense	Hare's-foot Clover	Environmental Weed		Yes
Trifolium campestre var. campestre	Hop Clover	Environmental Weed		
Trifolium dubium	Suckling Clover	Environmental Weed		
Trifolium glomeratum	Cluster Clover	Environmental Weed		
Trifolium repens var. repens	White Clover	Environmental Weed		
Trifolium striatum	Knotted Clover	Environmental Weed		
Trifolium subterraneum	Subterranean Clover	Environmental Weed		Yes
Trifolium tomentosum var. tomentosum	Woolly Clover	Environmental Weed		
Tritonia gladiolaris	Lined Tritonia	Environmental Weed		
*Ulex europaeus***^*	Gorse	Regionally Controlled	Yes	Yes
Ulmus spp.	Elm	Environmental Weed		Yes
Vellereophyton dealbatum	White Cudweed	Environmental Weed		
*Verbascum thapsus subsp. Thapsus***	Great Mullein	Restricted		
Veronica arvensis	Wall Speedwell	Environmental Weed		
Veronica persica	Persian Speedwell	Environmental Weed		
Vicia hirsuta	Tiny Vetch	Environmental Weed		
Vicia sativa	Common Vetch	Environmental Weed	Yes	Yes
*Vinca major**	Blue Periwinkle	Environmental Weed	Yes	Yes
Viola odorata	Common Violet	Environmental Weed		
Vulpia bromoides	Squirrel-tail Fescue	Environmental Weed		
Vulpia ciliata	Fringed Fescue	Environmental Weed		
Vulpia muralis	Wall Fescue	Environmental Weed		Yes
Vulpia myuros	Rat's-tail Fescue	Environmental Weed	Yes	Yes
*Watsonia bulbillifera***	Bulbil Watsonia	Environmental Weed	Yes	
Watsonia meriana	Bugle Lily	Environmental Weed		

Notes: Flora Information System (2011); ^ WONS listed weed (DEWHA 2009);** Listed noxious weed (DSE 2008); * Identified in DPI 2004 as Environmental Weed in GHCMA

Appendix 2 – Weed Control Methods

Herbicides

Spot spraying and Rig-spraying

The application of herbicides is an effective and efficient control technique for a range of woody, herbaceous and grass weeds. The correct use and application of herbicides can provide targeted control of a range of species, however it must be stressed all use of herbicides must be used in accordance with the manufacturer's specifications and occupational health and safety policies.

Application methods for herbicides include spot spraying with a knapsack for small or sensitive areas, or for targeted species. Rig spraying is best used in larger areas which are not sensitive to high volume application of herbicide and there is limited potential for off-target damage. Dabbing of species with foam tipped application device, with the herbicide applied from an attached bottle, should be used in sensitive areas or in areas where weed control is targeted to a small number of plants, especially bulbs or tuberous plants.

Timing of intervals, plant age and growth seasons, plant stress levels and climatic factors all need to be considered when develop methodologies for the application of herbicides to ensure successful outcomes. Problems exist with ongoing unsuccessful herbicide treatments, which may result in weeds developing herbicide resistance, or the build up of chemicals in the soil. Surrounding plants' susceptibility to herbicides and ongoing uses of the treated areas should also be considered when choosing the right herbicide to be used in a weed control program, as some herbicides are residual and may persist within the soil for varying durations.

Drill and Fill

Drill and fill, also known as direct injection, is a method where the selected herbicide (usually Glyphosate) is injected though a device into a hole that has been made into the targeted plant (i.e. woody species). The hole is usually made through the use of a drill but sometimes a tomahawk or saw may be used to put small nicks into the targeted plant. It is essential that the hole or nick must always be lower than the first branch containing foliage (i.e. ideally, the lowest possible point on the plant) and also the herbicide is applied into the hole as quick as possible. The general rule of thumb is that the herbicide must be applied within 30 seconds. Holes are scattered around the main trunk at 50 millimetre intervals, depending on the diameter of the trunk and also branches or angle of the trunk. It is essential that a complete ring around the trunk of the plant be made of this herbicide filled holes to ensure plant death, as large gaps may allow sections of the target tree to survive. Generally, the holes or nicks do not need to be deeper than 20 millimetres, but do need to be deep enough to penetrate the outer cambium layer of the tree. This allows the phloem to carry the herbicide into the roots, which will kill the plant over a number of weeks, depending on conditions.

The benefits of this method include: the retention of standing material for habitat, no costs for the removal of the plant from the site; no dragging of material across sensitive areas; and, speed, as the method is fast to execute (i.e. drill and fill, and move on).

The drawbacks of this method are that if it is not executed correctly, trees may re-grow, particularly as accessing the base of the trunk of spiny plants such as Hawthorn and African Box-thorn can be difficult. However if the application is successful, dead standing vegetation can become a fire hazard and look aesthetically displeasing to the community.

Cut and Paint

The cut and paint method of control requires the cutting of the target species at the very base, under any foliage, and the immediate application of herbicide (usually a glyphosate, dependent on the target species). The application can be done through a 'dabber' bottle or paint brush. Care should be undertaken during application, to avoid splash of herbicide causing non-target damage. Once cut down, the biomass of the target species may sometimes be left on the ground, but usually requires removal. This is particularly necessary if it bears fertile seeds or has the potential to re-shoot from contact with moist ground (i.e. *Salix* sp.), or covers native vegetation.

Many herbicides are available that are very effective in the control of woody weed species. Typically these herbicides are applied to the stem, trunk or roots of the target plant by 'drill and fill', 'cut and paint' or 'frilling' methods of application. These herbicides can be more effective than manual removal alone, as the chance of the plant re-sprouting is significantly reduced.

Mechanical Removal

Mechanical removal by machine may include grooming of woody weed infestations by a tractor-mounted groomer (slasher/mulcher), which is quite effective on Gorse, African Box-thorn infestations.

Manual Removal

Some weed species are resilient against other methods of eradication, such as herbicides, and should be targeted by manual removal. Infestations of species such as African Box-thorn, Fennel, Serrated Tussock and Toowoomba Canary-grass should be combated by manual removal techniques.

Additionally, manual removal is a crucial technique when used in conjunction with herbicides for the control of both woody and herbaceous weed species. This combination of weed eradication is advised for almost all weed species.

Ring-barking

Ring-barking is a viable technique for use when eradicating large woody shrubs and trees. The technique involves the use of a large knife, tomahawk or axe to make a continuous cut around the trunk of the plant. The cut should be 5-10 centimetres wide and deep enough to penetrate the heart-wood (Muyt 2001). This technique should not be used when removing species which can reproduce by suckering.

Mowing / Slashing

While it has been found that mowing may enhance the survival of many weed species, in some instances mowing can be used to control their spread. This method of weed control is only effective against species which are prevalent within mown areas. It will prove most effective in controlling the spread of noxious species such as Chilean Needle-grass, Serrated Tussock and environmental weeds such as Sweet Vernal Grass, Great Brome, Yorkshire Fog, Rough Dog's-tail, Toowoomba Canary Grass, Wild Oat and Cocksfoot.

Mulching

It is advised that mulching be used in areas of revegetation which were previously dominated by exotic vegetation. Mulching can be a very effective technique in suppressing species which may invade, particularly from mown areas.

In areas of remnant vegetation, mulch should be used very carefully. Only people who have an in-depth knowledge and long history of the specific site should advise the use of mulch in these areas to ensure native species (particularly rare and threatened species) are not affected by the use of mulch.

Soil Scalping

Soil scalping involves the removal of a thin layer of topsoil in areas of extremely high weed cover abundance. Care must be taken in order to ensure that enough soil is removed to eliminate the possibility of re-colonisation from the soil seedbank. It is important that this process is directly followed by high density revegetation and mulching in order to reduce the migration of other weeds into these areas. This process is only favoured in areas that are considered a major source population for weed species of high threat to agriculture, or areas of conservational significance.

Appendix 2 – Noxious Weed Species Identification

Image 2.1 Spiny Rush *Juncus acuta*

Image 2.2 Horehound *Marrubium vulgare* (Photo DPI 2007)

Image 2.3 Soursob *Oxalis pes-caprae* (DPI 2010)

Image 2.4 St John's Wort *Hypericum perforatum subsp. Veronense* (DPI 2007)

Image 2.5 African Boxthorn *Lycium ferocissimum*

Image 2.6 Sweet Briar *Rosa rubiginosa* (Photo DPI 2010)

Image 2.7 Hawthorn *Crateagus monogyna* (Photo: DPI 2010)

Image 2.8 Spear Thistle *Cirsium vulgare*

Image 2.9 Perennial Thistle *Cirsium arvense* (Photo DPI 2010)

Image 2.10 Gorse *Ulex europaeus* (DPI 2010)

Image 2.11 Paterson's Curse *Echium plantagineum* (Photo DPI 2010)

Image 2.12 Montpellier Broom *Genista monspessulana* (Photo DPI 2010)

Image 2.13 Flax-leaf Broom *Genista linifolia* (Photo DPI 2010)

Image 2.14 Crack Willow *Salix fragilis* (Photo DPI 2010)