Assessment and Mapping of Hoddles Creek Riparian Vegetation, 2012

by

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Contents

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- The Department of Sustainability & Environment for permitting use of the state botanical database (to which the author is a contributor) to determine the distribution of certain plant species, Data source: 'VBA_FLORA25', August 2010. © The State of Victoria, Department of Sustainability & Environment. The contribution of the Royal Botanic Gardens, Melbourne to the database is acknowledged.

Executive Summary

This report and associated computer files are the result of a botanical survey along 6 km of forested stream reserve along Hoddles Ck, through the postcode areas of Hoddles Creek and Gladysdale. The study area and its surroundings are mapped on Figure 1.

The main outputs of the study are:

- Classification of the types of vegetation, with reference to Ecological Vegetation Classes where possible;
- Mapping of vegetation communities, large trees, rare plants and significant environmental weeds. The maps are on p. 12 and are available on a geographic information system (GIS);
- Compilation of plant species lists for each of forty zones within the study area, including the abundance of each species and a rating of environmental threat level for introduced species (see the Appendix);
- Assessment of environmental issues such as rare plant populations, environmental weeds, feral deer and clearing of public land for private gain.

Highlights of Newly Discovered Natural Assets

- Tracts of Cool Temperate Rainforest (albeit atypical due to a thin tree canopy, possibly as a result of past clearing) and two other, even rarer, vegetation communities;
- An apparently undescribed vegetation type dominated by an apparently undescribed species of tea-tree that is more than twice the height of the next-tallest species in Victoria (p. 23);
- Large old trees, particularly scattered old growth Mountain Ash (up to 2·9 m trunk diameter) that have survived past selective logging and clearing for mining and agriculture;
- An unexpected abundance of plant species that are listed as rare throughout Victoria, particularly Jungle Bristle-fern (*Cephalomanes caudatum*), Oval Fork-fern (*Tmesipteris ovata*) and Small Fork-fern (*Tmesipteris parva*) – all of which grow on tree-fern trunks.

There is a strong tendency for the significance of the vegetation to increase from downstream to upstream.

Environmental Threats

Parts of the stream reserve have been subject to clearing for private gain within the past decade or so. The largest instance is 1·6 hectares that are now used for commercial tree growing and from which prolific environmental weeds are spreading.

Elsewhere in the study area, environmental weeds are less serious than is normal for riparian vegetation. The greatest (but still modest) threats are from Blackberry and Holly, although the latter has been reduced by a recent control program. Both Blackberry and Holly can be readily and effectively controlled with herbicide.

Feral deer are having a significant adverse effect on the native vegetation, particularly some of the most significant aspects of the native vegetation. Southern Sassafras trees that dominate the rainforest are being ringbarked and very few seedlings of any species are able to survive where deer have been wallowing. Such impacts could significantly change the structure, composition and ecological functions

of the rainforest and some of the other vegetation types in the study area. There is no known method to achieve effective and lasting control of feral deer.

Two vegetation types along Hoddles Ck (namely Cool Temperate Rainforest and Wet Forest) are particularly vulnerable to fire, as are some of the rarest plant species (namely, Jungle Bristle-fern, Oval Fork-fern and Small Fork-fern). It is therefore important to protect these natural assets from fire.

The increased incidence of extreme droughts and bushfires that are predicted to result from climate change pose significant threats to fire-prone and drought-prone vegetation, including rainforest dominants and the rare fern species mentioned above.

Implications for Management

Because of the high sensitivity of some parts of the surveyed vegetation, it is very important to exclude fire from the Cool Temperate Rainforest, Fern Swamp, paperbark & tea-tree forest, Wet Forest and areas occupied by the aforementioned rare ferns. These areas should not be subject to prescribed burning and should be a focus of protection in the event of a bushfire.

Melbourne Water is responsible for the bed and banks of Hoddles Ck while the Department of Sustainability & Environment has responsibility for other aspects of the stream reserve, including licences for private use of the public land. The many significant natural assets discovered by this study point to the need for those two organisations to review the stream reserve's management, the associated allocation of resources and the impact of licenses. This should be done with attention to the Victorian Environmental Assessment Council's draft (2012) and final (imminent) proposals for its 'Yellingbo Investigation'. One of the proposals is that key stream frontages along Hoddles Ck become part of a 'State Emblems Conservation Area'.

It would also be desirable to disseminate the information in this report widely within the local community so that the natural assets are better known, appreciated and respected.

It is recommended that the area of stream reserve that is presently being used for commercial tree growing should be returned to a more natural state, consistent with the land's status and intended purpose. This would involve revegetation and weed control.

Elsewhere, the need for weed control is quite modest. The recommended measures are control of two patches of blackberry, one patch of Japanese Honeysuckle and follow-up of the recent program to control Holly.

It may help the recovery of Cool Temperate Rainforest to plant more Southern Sassafras and potentially Myrtle Beech. The rare fern species mentioned above are probably not amenable to propagation.

Further Work

Rather than pursuing further investigations in the study area, it is recommended to explore other riparian strips that have not been botanically studied. Based on the experience of this study and another recent study by the same author in the Hoddles Creek Education Area, there are likely to be additional highly significant natural assets yet to be discovered. Most of these are likely to be on private land.

There is also more fundamental botanical research needed to scientifically describe and name the giant tea-tree species found on Hoddles Ck and to improve the state-wide classification system for riparian Ecological Vegetation Classes.

1. Introduction

This document and the accompanying Geographic Information System files and photographs represent the findings of what appears to be the first botanical survey along the stream reserve of Hoddles Ck, through the postcode areas of Hoddles Creek and Gladysdale to the southern tip of Launching Place. The study area and its surroundings are mapped on Figure 1.

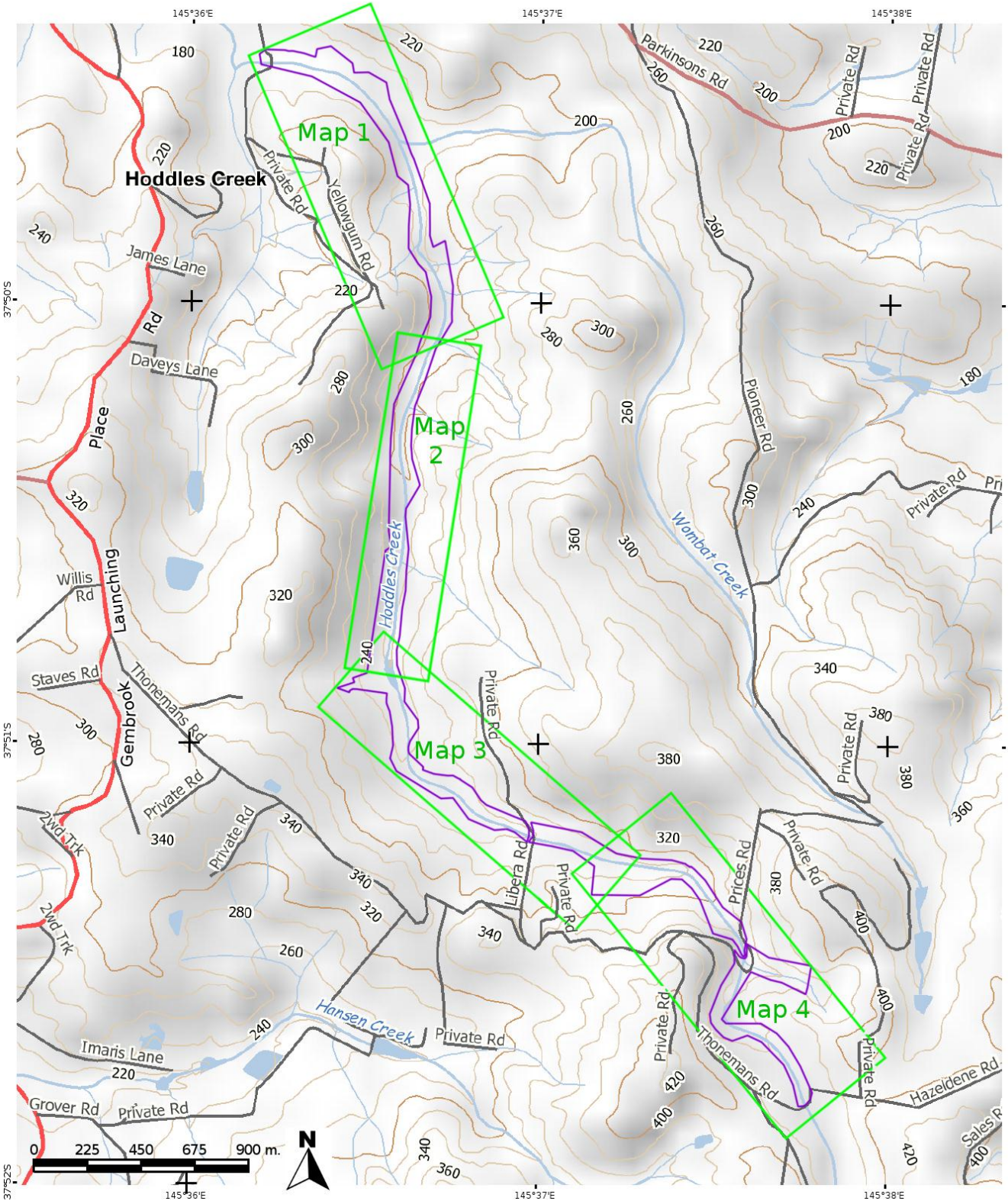

Figure 1. A context map showing the study area in purple and green rectangles outlining the areas covered by the four vegetation maps in Figure 4 (p. 12).

The survey was devised and initially funded by the Friends of Hoddles Creek, who could see that important natural assets along the creek were likely to be awaiting detection and potentially deteriorating for want of recognition. On the first day of fieldwork (15th May 2011), it was already evident that quite rare and unexpected plants grow along the stream and that sympathetic management would be required to conserve them. For example, we discovered three rainforest fern species that are listed as rare throughout Victoria, even though none of these species had been previously recorded anywhere in the Hoddles Ck catchment.

Consequently, as the fieldwork proceeded, the Friends of Hoddles Creek approached Melbourne Water for funds to extend the scope of work. Melbourne Water agreed, allowing the survey to cover the whole length of the stream corridor from the upstream end of the stream reserve at Hazeldene Rd to Blackleather Creek Rd, just over 6 km away. The stream reserve is mostly 60-80 m wide but much wider in places, particularly around stream confluences. The survey also included native vegetation that could be seen on abutting private land. One landowner (Mr Steven Moore) generously granted permission to survey a 265 m-long reach of a particularly significant tributary on his land.

The contract for conducting the survey was given to Biosphere Pty Ltd, whose principal scientist, Dr Graeme Lorimer, had responsibility for the project. However, many people outside Biosphere Pty Ltd were involved in various ways. The Friends of Hoddles Creek organised a field day on 15th May 2011 for Dr Lorimer to show the group's members how the survey was done and for the members to help find anything notable, such as particularly large trees. The group's project manager – Laurence Gaffney – attended every day of fieldwork and became adept at spotting and identifying rare plants such as the Jungle Bristle-fern, which most botanists find difficult. Several other members joined in for a day or a few hours.

Several Melbourne Water staff joined in the fieldwork for one or more days each.

A summary of this report's contents and the associated mapping was presented to a public meeting at Hoddles Creek Primary School on 20th February 2012. The meetings was organised by the Friends of Hoddles Creek and the overflowing classroom included group members, Melbourne Water staff and local residents.

The involvement of so many local people and Melbourne Water staff represents a substantial and unusual benefit of the project. A number of people who live or work in the area are now better able to recognise rare plants and vegetation communities and know how to go about finding them. This has already led directly to important botanical discoveries along nearby streams. The dissemination of knowledge and skills into the local community represents significant leverage of the benefits from this project.

2. Methods

The project began by seeking relevant prior information in literature, maps, local knowledge and the state botanical database. This process and its outcomes are described in Chapter 3.

On 29th March 2011, Dr Graeme Lorimer (project leader), Mr Laurence Gaffney (Friends of Hoddles Creek) and Mr Rob Dabal (Melbourne Water) undertook the first of nine days of fieldwork. Throughout the fieldwork the intention was to walk along the creek in gumboots, zigzagging from one side of the stream reserve to the other (Figure 2) while recording or mapping:

- Boundaries between different vegetation types;
- The abundance of every plant species (native and introduced) found in each vegetation type and each distinct reach of the creek, totalling 1,569 entries;
- The locations and population sizes of rare plant species;
- Assessments of the apparent or expected adverse environmental impact of any introduced plants;
- Locations and trunk girths of trees that are particularly large examples of their species;
- Locations of non-botanical natural assets such as cascades or wildlife habitat features;
- Environmental threats or ongoing damage (e.g. illegal clearing) that may warrant corrective action.

Dr Lorimer did all the recording and mapping, the latter with the aid of a 'Garmin Oregon' hand-held Global Positioning System (GPS) unit and geo-referenced aerial photographs.

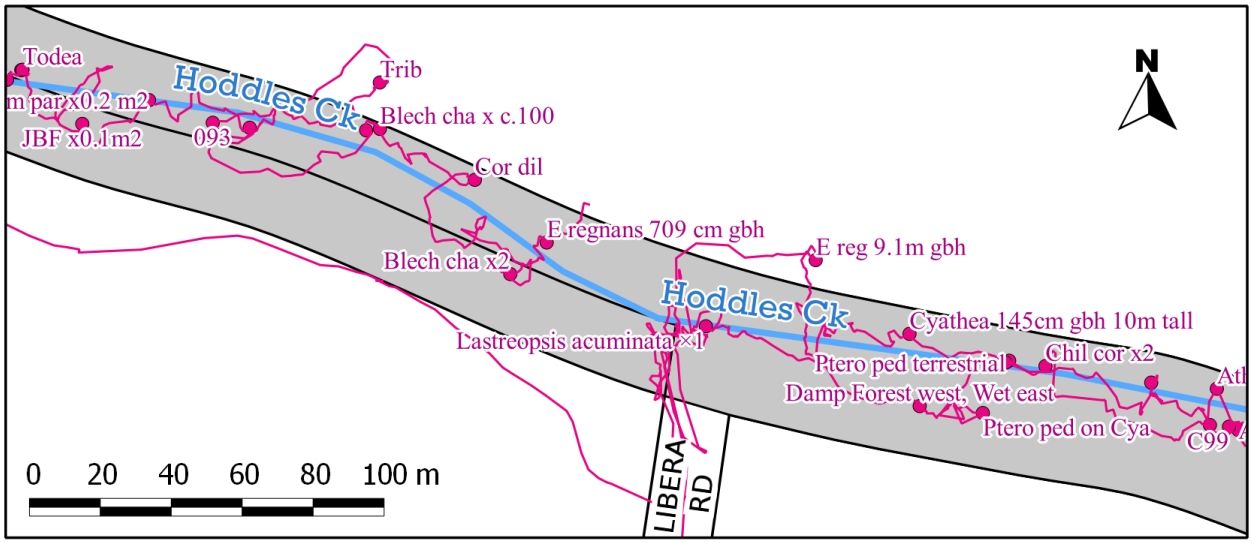

Figure 2. Example of information recorded by GPS, including the author's path and waypoints (some of which are unlabelled due to clutter at this scale). The shaded area is the stream reserve. The author's assistants covered areas away from the author's path.

Whenever Dr Lorimer encountered a rare plant, he showed the helpers how to recognise and detect it. He also provided similar information about rare species that might be encountered ahead. This allowed the helpers to assist in detecting rare plants and drawing them to Dr Lorimer's attention. It also steadily increased the helpers' botanical skills, to the ongoing benefit for the local community. The helpers also contributed to thorough searching for large trees and other features such as wildlife signs and habitat.

Figure 3. Helpers Laurence Gaffney (left) and Rob Dabal, and between them, a tree-fern trunk covered with the rare Jungle Bristle-fern, near Hazeldene Rd.

It took approximately 75 hours of fieldwork to survey the study area, ending on 12th September 2011. The survey work was slow, arduous, wet, muddy and slippery. There were plentiful leeches, prickles, sharp-edged sedge leaves, welt-inducing wiregrass and obstacles such as large logs, impenetrable thickets and unmarked mineshafts. These hardships were well rewarded with discoveries of rare plants and special places.

Some of the fieldwork was done as part of a field day for the Friends of Hoddles Creek on 15th May 2011, hosted kindly by Mr and Mrs Packer at their property abutting the creek. Dr Lorimer conducted training in fern identification and detection of significant natural assets that were likely to be encountered. In return, the participants provided local knowledge of features they knew about along the creek. Dr Lorimer engaged the participants as helpers to survey a section of the creek, including the discovery of some rare ferns and very large Mountain Ash trees.

The field data and mapping were transferred to a database and a Geographic Information System (GIS), both of which accompany this report. The data for the abundance of each species within each of forty mapped areas were used to classify the areas into recognised vegetation types (Chapter 4).

3. Prior Information

The Department of Sustainability & Environment's vegetation mapping is only intended to be a guide to broad-scale patterns of vegetation types and even a casual check reveals it to be unreliable in the local area. This is partly due to the lack of previous fieldwork in the area.

The state flora database, whose curator is the Department of Sustainability & Environment, was searched for plant records in or near the survey area. There are several records of the common introduced species, Ragwort and Blackberry, which are of no importance here. The other relevant entries are two herbarium specimens of the rare Lacy Wedge-fern, *Lindsaea microphylla*. An investigation at the National Herbarium of Victoria revealed that the specimens were both collected by Betty Duncan in 1976 beside Prices Rd 'near Gladysdale'. Suitable habitat for the Lacy Wedge-fern occurs just outside the strip of land surveyed in this project, where members of the Friends of Hoddles Creek have searched in vain.

The only other relevant source of prior botanical information is a draft report on weed mapping by Australian Ecosystems Pty Ltd for Melbourne Water (Bennetts & Osler 2008). The mapping was based on observations of weeds along transects across the creek. Although the focus was strongly on weeds, the notes for some of the transects reported 'Good bush', which was initially presumed to indicate the most promising locations to target in the search for significant vegetation and plant species. However, it turned out that many of the most significant sections of stream were only annotated according to whether any non-indigenous plants were found there, without any comment about the rest of the vegetation. This did not matter in the end because funding became available to survey the whole corridor rather than target specific areas.

No fires in the study area since 1939 could be found in fire history maps from the Department of Sustainability & Environment, despite blackened trunks that clearly indicate that several such fires have occurred during that time.

Members of the Friends of Hoddles Creek were asked for information about the history of the valley as it affected vegetation. The responses concentrated on the area's history of gold mining, which continued in a small way until quite recently. In addition to the mining itself, there must have been extensive clearing and excavation for tramways, water diversions, timber, firewood, buildings and food production. Unfortunately, only sketchy information was gleaned about the timing, extent and nature of the impact of gold mining on vegetation. However, there are many mineshafts in the study area near Blackleather Creek.

Clearing of the stream corridor for agriculture, horticulture, water abstraction and dam construction appears to have occurred in a piecemeal manner over the past century. During the fieldwork for this study, recent excavations into forest were found, even within the stream reserve.

A 1952 aerial photograph of the Gembrook district, available from the Victorian government's 'Land Channel' website, shows the study area with a sparse canopy of predominantly young trees and a thin scattering of mature trees.

Overall, an impression is created of a valley that has been subject to extensive, continual clearing for more than a century, often repeatedly for different purposes and sometimes illegally. The survival of botanical treasures that were discovered in the present study (see below) suggests that other treasures have been destroyed forever in ignorance of their presence.

4. Vegetation Types and Extent

4.1. Classification System

The Department of Sustainability & Environment has adopted a system of classifying vegetation types into groups called Ecological Vegetation Classes, or EVCs (Woodgate *et al*. 1994). An EVC represents vegetation associated with a particular combination of environmental influences (e.g. climate, soil fertility, hydrology) and associated ecological adaptations (e.g. reproductive strategies and defences against fire or flooding). While these parameters are paramount in defining an EVC, one can often classify vegetation into an EVC based on a combination of the following secondary characteristics:

- Topographic position (e.g. sheltered valleys or rocky ridges);
- Vegetation structure;
- The relative abundance of different life forms (e.g. trees, shrubs, climbers, creepers); and
- The families and genera of plants present.

Use of some of these characteristics relies on the vegetation being mature, not still developing or recovering from major disruptions such as fire, flood or clearing. In most (but not all) cases, EVCs are deemed to encompass all stages of development (called seral stages). For example, Wet Forest is deemed to include the earliest stages of regeneration following logging or fire and continue until it is fully developed, after which there may be a transition to Cool Temperate Rainforest more than a century later. Some wetlands can change between various wetland EVCs over a drought cycle.

Across the range of a widely distributed EVC there can be considerable variation in species even though the families and genera remain fairly consistent. Even within a small area, an EVC may be represented by two or more mixtures of species (called 'floristic communities') as a result of environmental or historical differences that are deemed too small to warrant recognition of separate EVCs.

There is no defined limit on the amount of variability that can be accommodated within a single EVC. As a result, some EVCs listed by the Department of Sustainability & Environment are much more narrowly defined than others. For example, Floodplain Riparian Woodland (EVC 56) includes part of Wetland Formation (EVC 74) which includes part of Shallow Freshwater Marsh (EVC 200) which includes parts of numerous more narrowly-defined EVCs such as Aquatic Herbland (EVC 653).

Part of the reason for so many nested and overlapping EVCs is differences in the spatial scale under consideration. This is a matter of particular importance for riparian vegetation. If one's aim is to characterise or map riparian vegetation at scale of (say) 50 m or more, the distinctive flora of finer-scale structures such as small backwaters or gravel shoals become consolidated and obscured, and broader EVCs are likely to be applied.

Another aspect of the EVC classification system that is particularly relevant in this study is that it is not well developed for riparian habitats. Confusion has arisen largely because botanical studies rarely focus on streams or take into account stream processes. When vegetation on a stream is included in a study, it is usually by way of standard sample plots ('quadrats') measuring 30 m across that encompass land both inside and outside the strictly riparian vegetation. The data from these plots forms the basis for the department's species lists for riparian EVCs, thereby obfuscating the features that make riparian EVCs distinct from non-riparian EVCs.

A good example is the list in the 'EVC benchmark' for Riparian Thicket, which the Department of Sustainability & Environment describes as occurring on stream beds and stream terraces that are frequently inundated. The 'typical species' listed in the corresponding EVC benchmark are largely species of dry land that cannot survive frequent inundation or waterlogged conditions.

Other problems with riparian EVCs include the following:

- Some riparian EVCs (including some relevant here) were only described after the state-wide mapping of EVCs was completed, and consequently do not appear on maps, have no EVC benchmarks and the only descriptions of them are sketchy ones on the Department of Sustainability & Environment's website;
- Some riparian EVCs that the department once used in its higher-resolution (1:25,000) mapping have disappeared from more recent mapping, apparently to provide conformity with coarse-scale mapping of pre-1750 vegetation. It is not that EVCs such as Shrubby Gully Forest no longer exist, simply that the department has substituted similar EVCs from the subset used in the coarse-scale mapping.
- Within tracts of Damp Forest or Wet Forest (e.g. upper Hoddles Ck), the department's mapping of vegetation along streams is typically not differentiated from the flanking vegetation, despite profound differences in environmental influences and ecological adaptations (e.g. flooding, soil type and adaptation to continuously wet conditions).

With these problems and the lack of prior botanical surveys in Hoddles Creek, it is not surprising that the EVCs detected during this project's fieldwork do not match the Department of Sustainability & Environment's mapping. Some of the vegetation encountered does not comfortably fit any previously mapped EVC, although it does fit sketchy descriptions that the department provides for EVCs that it has not mapped and for which there is no EVC benchmark.

4.2. Vegetation Types Found

A map of the vegetation types found during this project appears in Figure 4, using four panels corresponding to the green rectangles mapped on Figure 1 (p. 5). Figure 4 also shows other aspects of the vegetation discussed in later chapters. The Geographic Information System files that accompany this report allow much more flexible and detailed inspection of the mapping than is possible with Figure 4, such as zooming, overlaying information and using 'search' tools.

An A3-sized version of Figure 4 is available separately.

There is a strong distinction between riparian and non-riparian types of vegetation (particularly in ecological functions), so they are discussed in separate sections below.

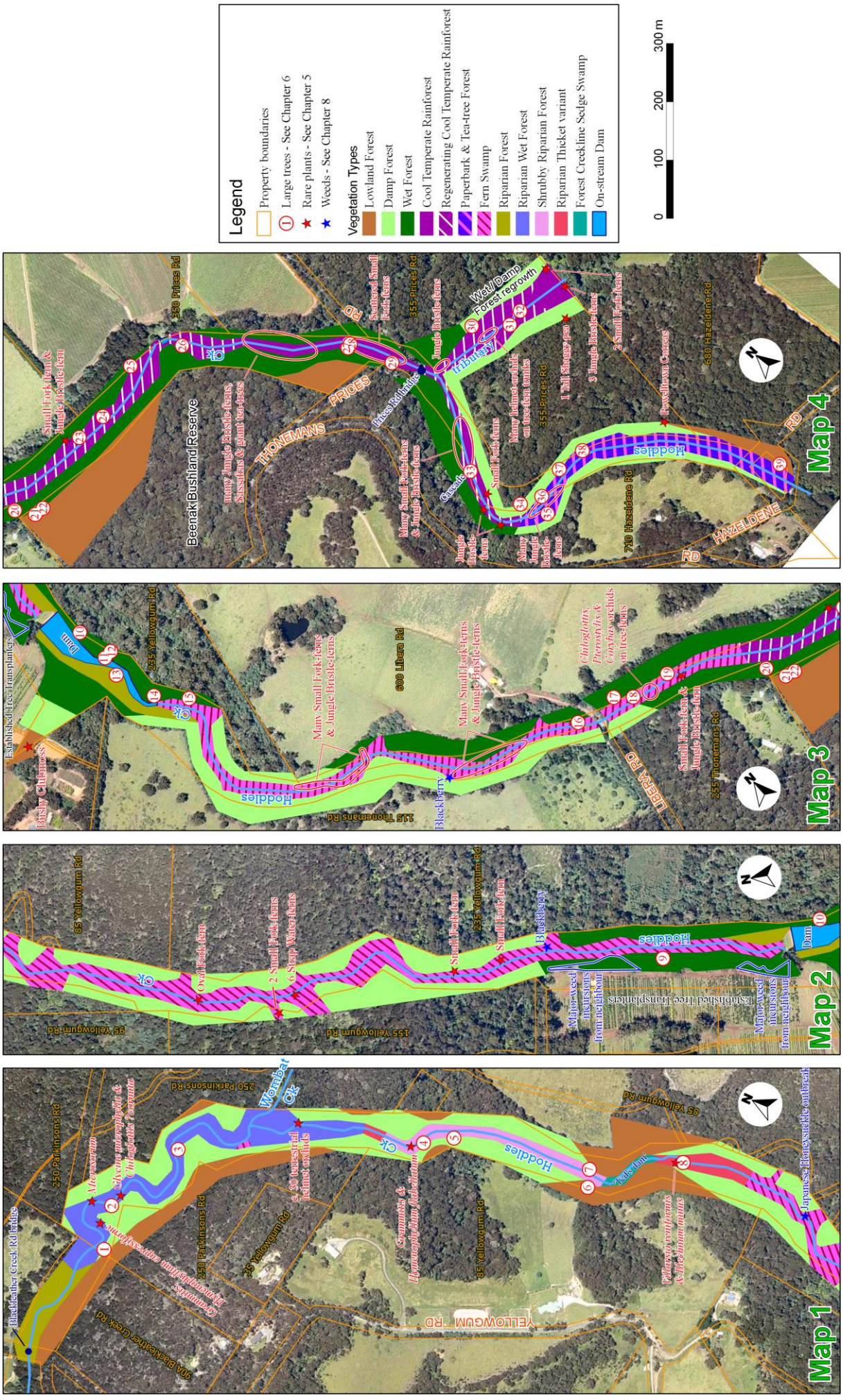

Figure 4. Vegetation map, in four panels corresponding to the differently oriented segments marked with green rectangles on Figure 1 (p. 5). The bottom of each of the first three panels overlaps the top of the next. The marked large trees, rare plants and weeds are discussed in Chapters 5, 5.2 and 8.

4.2.1. Riparian Types

Riparian vegetation types occur on the banks and beds of streams, in strips whose width varies in the study area from 10 m to 60 m. Collectively, riparian vegetation is distinguished by its adaptations to flooding and waterlogging and its reliance on continuously plentiful soil moisture. Riparian vegetation grows in alluvial soil or slightly beyond the alluvial soil if there is moisture seepage and the valley is sufficiently steep and sheltered to keep the soil and air moist during periods of dry weather.

Plentiful moisture makes riparian vegetation particularly productive and hence important for wildlife. Faunal groups such as frogs, yabbies and numerous invertebrates are strongly associated with riparian habitat.

The riparian vegetation of the Hoddles Creek - Gladysdale area differs from that of much of Victoria due to the district's high rainfall (over 1,200 mm annually), cool-temperate climate and soil of moderately low fertility.

Within the study area, different riparian floristic communities (i.e. mixtures of plant species) were found to correlate with:

- The speed of stream flow, which affects the amount of alluvium deposited, the duration of waterlogging and the stresses that floods place on plants (e.g. through soil erosion and pushing plants over). The speed of stream flow depends on the breadth of the valley, the stream's longitudinal gradient (i.e. vertical fall per distance along the stream) and the stream's volume flow. These factors, in turn, depend on geology, topography and runoff rates from the catchment;
- The amount of topographic protection, which relates mainly to the steepness and narrowness of the valley. These factors affect the amount of light and humidity in the valley and hence which plants can thrive best. For example, vines and epiphytic ferns are concentrated in areas of maximum topographic protection.

The different riparian floristic communities found in this study are classified here as:

- Forest Creekline Sedge Swamp (EVC 728) in a former on-stream dam;
- An on-stream dam whose habitat most closely approximates Riparian Wetland (EVC 962);
- Cool Temperate Rainforest (EVC 31), both in fully developed form and in stages of regrowth following clearing;
- In the uppermost reach of the study area, a dense forest with an understorey like Cool Temperate Rainforest but a canopy dominated by a mixture of very large Scented Paperbark (*Melaleuca squarrosa*) and an undescribed large forest tea-tree;
- Fern Swamp (EVC 721) in the remainder of the upper three-quarters of the study area;
- A previously undocumented EVC allied to Riparian Thicket (EVC 59), from which it differs in its higher rainfall, much taller structure, greater abundance of ferns and lower abundance of large tussocks;
- Vegetation that best fits Shrubby Riparian Forest (EVC 936), being intermediate between Riparian Thicket (EVC 59) and Riparian Forest (EVC 18);
- Riparian Forest (EVC 18) in two small areas; and
- Riparian Wet Forest (EVC 972) on the broad floodplain at and below the confluence of Hoddles Ck and Wombat Ck;

The Department of Sustainability & Environment's vegetation mapping shows Riparian Forest in place of all of the above EVCs, except that it shows Riparian Thicket at the downstream end where there is actually Riparian Forest.

The department's vegetation mapping differs from Figure 4 due to its coarse scale and (more importantly) because it is based on modelling and assumptions with very little observational basis.

Figure 5 provides a schematic representation of the author's concept of the relationship between the riparian EVCs (excluding wetlands), simplified to two dimensions. The horizontal axis relates to topographic protection and speed of stream flow, with steep-sided mountain valleys to the right and broad floodplains to the left. Alternatively, the horizontal axis can be thought of as varying from forests with well-spaced Manna Gums (*Eucalyptus viminalis*) to the left, grading to closed forests with abundant Soft Tree-ferns (*Dicksonia antarctica*) covered with epiphytes on the right. The vertical axis represents soil fertility, reflected in the abundance of Scented Paperbark (*Melaleuca squarrosa*) and an apparently undescribed tea-tree (*Leptospermum* aff. *lanigerum* – see Section 5.1).

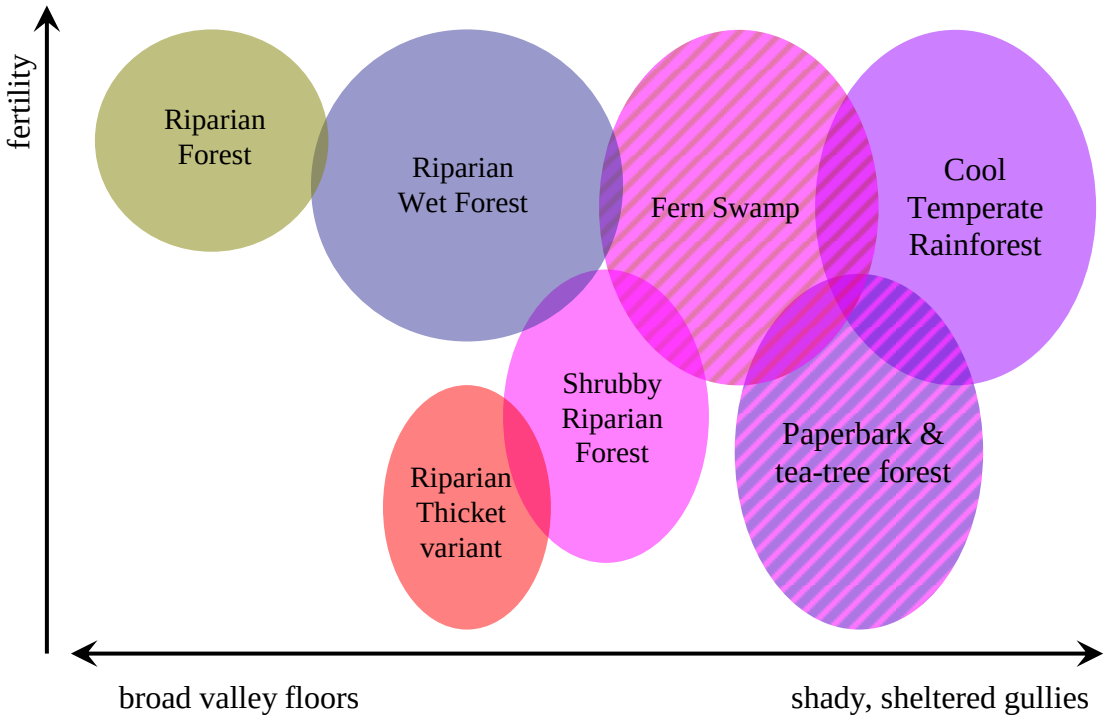

Figure 5. Schematic representation of the relationship between riparian EVCs (excluding wetlands). The colour scheme approximates that of Figure 4.

Non-riparian EVCs are also dependent on fertility and topographic protection, so there is a tendency for each riparian EVC to be flanked by one (or very few) specific types of non-riparian vegetation. For example, Wet Forest (Section 4.2.2.1, p. 31) would occupy the top right of a non-riparian equivalent of Figure 5 and so Wet Forest tends to flank Cool Temperate Rainforest and Fern Swamp.

While Figure 5 should be applicable to other streams in the district, it will not apply to areas with significantly different climate or soils. For example, if the rainfall is substantially higher and less seasonally variable, Cool Temperate Rainforest may extend well beyond shady, sheltered gullies. As the amount and reliability of rainfall increases, the distinction between riparian and non-riparian EVCs diminishes; e.g Cool Temperate Rainforest becomes less reliant on stream water and can intergrade with Wet Forest.

Table 1 provides a summary of the relative abundance of each riparian EVC along Hoddles Ck, as well as the conservation status of the three EVCs where the Department of Sustainability & Environment has made assessments.

The detailed characteristics of the riparian EVCs are discussed in detail in the following sections.

Table 1. Summary of the rarity of each riparian EVC in the study area and more widely. The bioregional conservation status ratings are those published by the Department of Sustainability & Environment for the Highlands Southern Fall biogeographic region.

EVC	Area found		Bioregional Conservation Status (where published)
	hectares	% of study area	
18 - Riparian Forest	1.6	3.4%	Least Concern
31 - Cool Temperate Rainforest	4.3	9.4%	Endangered
59 - Riparian Thicket	0.5	1.2%	Vulnerable
721 - Fern Swamp	7.5	16.5%	
728 - Forest Creekline Sedge Swamp	0.2	0.4%	
936 - Shrubby Riparian Forest	0.9	2.0%	
972 - Riparian Wet Forest	2.6	5.7%	
Paperbark & Tea-tree Forest	1.7	3.7%	

4.2.1.1. Forest Creekline Sedge Swamp (EVC 728)

'Ted's dam' is a former dam on Hoddles Ck next to 85 Yellowgum Rd, Hoddles Creek. It has been left to completely fill with alluvium and it now contains the swampy flat seen in Figure 6, 20 m wide, 100 m long and level with the top of the dam wall. Hoddles Ck now makes its way though the swamp via small, anastomosing channels (i.e. channels that diverge and converge).

Figure 6. 'Ted's dam', showing the dominance of its sedges and the presence of scattered ferns. The few woody plants within the wetland are mostly dead.

The breadth and flatness of the swamp means that floodwaters passing over it must flow slower and shallower than along the stream channel. Consequently, the vegetation is protected from erosion and low foliage is prone to heavy deposition of sediment.

The vegetation that can grow in the former dam is governed by the deep layer of waterlogged sediment and its moderately low fertility. Such conditions favour sedges and creeping plants and are hostile to woody plants. The moisture favours ferns but the exposure to sunlight does not.

Consequently, the vegetation in 'Ted's dam' is almost free of woody plants and is dominated by the large tussock-forming sedge, *Carex appressa*, with scattered water-ferns (*Blechnum* species) and a sub-stratum dominated by *Triglochin striatum*. A summary of the vegetation composition follows:

Trees and shrubs: Extremely sparse, best regarded as outliers from the adjacent forest (excluding a single, introduced *Salix*). There are a few stunted *Acacia dealbata* and *Kunzea ericoides* and one each of *Bursaria spinosa* and *Hedycarya angustifolia*.

Grassy species: The wetland is dominated by *Carex appressa* and there is a sub-stratum dominated by *Triglochin striatum*. *Isolepis inundata* and *Typha domingensis* are scattered quite liberally. There are moderate numbers of *Carex fascicularis, Gahnia sieberiana, Juncus procerus* and *Juncus planifolius*. *Juncus prismatocarpus* and the introduced *Juncus articulatus* are less common.

Ferns: The water-ferns *Blechnum cartilagineum, Blechnum nudum* and (notably) *Blechnum minus* are scattered fairly abundantly. *Blechnum wattsii*, *Cyathea australis* and *Gleichenia microphylla* are scarce.

Climbers: The introduced Blackberry, *Rubus anglocandicans*, is scattered through the wetland, representing a moderate threat of displacing indigenous flora and fauna.

Creepers: Abundant and rich in species. *Callitriche muelleri, Gratiola peruviana* and the introduced *Lotus corniculatus* are numerous but their cover is not large. *Acaena novae-zelandiae, Geranium* ?*homeanum, Hydrocotyle hirta* and *Hypericum japonicum* are present in moderate numbers. *Centella cordifolia, Lobelia anceps, Oxalis perennans* and ?*Schoenus maschalinus* are scarce.

Large herbs: *Senecio minimus* is abundant.

Other herbs: *Epilobium billardierianum* subspecies *cinereum* and *Euchiton* ?*involucratus* are present in moderate numbers.

This wetland probably provides good habitat for frogs, snakes and a range of invertebrate species.

The vegetation described above is a good match for Forest Creekline Sedge Swamp (EVC 728), which The Department of Sustainability & Environment (2009) describes thus:

> 'Defining characteristics: Sedge-dominated wetlands of drainage line terraces within moist to wet forest areas. Very restricted occurrences, eastern highlands. Indicator species: *Carex appressa, Carex fascicularis, Cyperus lucidus* and *Phragmites australis*, with herbs such as *Epilobium pallidiflorum, Gratiola* spp., *Lythrum salicaria*, and other associated species variously including *Acacia melanoxylon, Kunzea ericoides* spp. agg., *Rubus parviflorus* [sic.], *Stellaria flaccida, Gleichenia microphylla, Hypolepis rugosula, Blechnum minus, Juncus gregiflorus* and *Persicaria decipiens*. *Lepidosperma elatius* can be dominant on the drier verges.'

Like most other types of wetland, the Department of Sustainability & Environment has not yet mapped the current or pre-settlement extent or distribution of this EVC and is therefore unable to formally rate its conservation status. However, note the department's description above of 'very restricted occurrences'. There are varying views about the degree to which the conservation significance of vegetation is diminished by occurring on substantially altered topography (as in this case).

4.2.1.2. The Established Tree Transplanters Dam

Established Tree Transplanters Pty Ltd maintains a dam on the Hoddles Ck stream (seen in Figure 7) for extraction of water to irrigate their adjacent crops at 65 Thonemans Rd, Hoddles Creek. It is up to 40 m wide at the downstream end and 250 m long, with a long tail at the upstream end.

Figure 7. The Established Tree Transplanters dam, showing its open water and fringing vegetation on the dam embankment in the foreground.

The dam was full on the two days that the dam was surveyed, so some plant species almost certainly escaped detection because they were submerged. It is quite possible that the bed of the water body is vegetated with aquatic plants such as pondweeds.

Despite the high water, a range of indigenous plant species was observed growing on the dam embankment and in the upstream tail of the water body. The most abundant species found were the grassy species, *Isolepis inundata, Juncus prismatocarpus* and *Lachnagrostis filiformis*, as well as the small herb, *Hypericum gramineum*. The other characteristic species are *Persicaria decipiens* and *Persicaria praetermissa*.

A dam such as this is missing some important ecological processes that occur in similar-looking natural on-stream bodies of still water. This is largely because few native fish are able to survive there, which is in turn because dams like this prevent fish migration. (Most native fish must migrate to and from the sea during their lifecycle.) Consequently, it could reasonably be argued that a dam such as this should not be classified as an EVC in the same way as natural wetlands. To the extent that an EVC classification can be allocated, the most appropriate is probably Riparian Wetland (EVC 962), which the Department of Sustainability & Environment's website describes as:

> 'Aquatic herbaceous vegetation with medium to tall sedges and rushes on the verges of larger watercourses and their ponds and backwaters. In-stream wetland, extending to lower flood-prone banks on relatively quiet stretches of stream verge on various forms of alluvial soil.'

There is also a small (100 m²) on-stream dam servicing a vineyard at 350 Prices Rd, providing a tiny amount of unnatural wetland habitat and promoting ingress of introduced plants into the native vegetation along the creek.

4.2.1.3. Cool Temperate Rainforest (EVC 31)

The study area contains vegetation that is well-developed Cool Temperate Rainforest as well as vegetation that appears to be regenerating Cool Temperate Rainforest with an as-yet diminished overstorey.

Figure 8. Cool Temperate Rainforest, 30 m downstream from the Prices Rd bridge, showing the shady conditions created by Southern Sassafras and tree-ferns. Note also the abundance of epiphytes.

The most typical example of Cool Temperate Rainforest is at the eastern edge of 355 Prices Rd, Gladysdale, on a tributary of Hoddles Ck, followed by an area just downstream from Prices Rd. The composition of the vegetation in these areas can be summarised as follows:

Tree canopy: *Atherosperma moschatum* (Southern Sassafras) forms a dense canopy and is a strong indicator species for Cool Temperate Rainforest. Scattered *Acacia melanoxylon* and *Pomaderris aspera* further add to the dense shade produced by the canopy. One dense patch of *Atherosperma* also contains an apparently undescribed species of *Leptospermum* (see Section 5.1) whose lowest branches are almost 10 m above ground. There are also a few similarly tall *Melaleuca squarrosa*. There are no eucalypts. As in the nearby Dandenong Ranges, *Nothofagus cunninghamii* is absent but it may have

been present prior to settlement, as it is confirmed to be approximately 2 km away and there are uncorroborated reports of it even closer at 565 Thonemans Rd.

Small trees/Large Shrubs: There are small numbers of *Olearia argophylla* and *Pittosporum bicolor*.

Smaller shrubs: *Coprosma quadrifida* and *Hedycarya angustifolia* are the main smaller shrub species. *Prostanthera lasianthos* is scarce and *Cassinia trinerva* occurs where the canopy is thinnest.

Ferns: Abundant ferns strongly dominate the understorey. The dominant fern is *Dicksonia antarctica*, whose trunks are heavily clothed in epiphytic ferns including *Asplenium bulbiferum*, *Crepidomanes venosum*, *Grammitis billardierei*, *Hymenophyllum australe*, *Hymenophyllum cupressiforme*, *Hymenophyllum flabellatum*, *Microsorum pustulatum*, *Rumohra adiantiformis*, *Tmesipteris obliqua* and *Tmesipteris parva*. *Cyathea australis* is less abundant and more peripheral, and its trunks support the epiphytic ferns *Cephalomanes caudata* and *Tmesipteris parva*. The trunks of both species of tree-fern support abundant liverworts (e.g. *Hymenophyton flabellatum*) and mosses. *Todea barbara* is scattered among the tree-ferns. The ground flora is strongly dominated by *Blechnum wattsii*, which is accompanied by scattered *Blechnum cartilagineum*, *Blechnum chambersii*, *Blechnum fluviatile* and *Blechnum nudum*. *Histiopteris incisa* and *Sticherus urceolatus* grow where the canopy is thinnest. *Calochlaena dubia* is notably absent.

Vines: *Parsonsia brownii* and *Pandorea pandorana* are abundant, *Clematis aristata* less so. The climbing grass, *Tetrarrhena juncea*, occurs where the canopy is thinnest. An abundance of tall vines is characteristic of rainforests as an adaptation to the low light penetration through the tree canopy.

Creepers: *Australina pusilla* is scattered thinly.

Other species: The orchids *Corybas diemenicus* and, to a lesser extent, *Pterostylis pedunculata* grow as epiphytes on some of the *Dicksonia* trunks. *Carex appressa* and *Lepidosperma elatius* are consistently present where sunlight penetrates, though not in large numbers.

Figure 9. An upward view through a canopy of young Southern Sassafras, 200 m downstream from the Prices Rd bridge.

Cool Temperate Rainforest is listed by the Department of Sustainability & Environment as an Endangered EVC.

Judging from the number of sawn stumps and the ages of trees, clearing has occurred at least once in history along practically all of the streams in this study. Some trees were spared, as evidenced by the presence of very large trees such as a Southern Sassafras with a trunk diameter of 76 cm on 355 Prices Rd (presumed to pre-date settlement). There are areas of vegetation which match the rainforest description above fairly well except that Southern Sassafras is represented mostly or wholly by immature trees, too young (and sometimes too sparse) to provide a normal, dense rainforest canopy. The question arises whether such vegetation should be regarded as regenerating Cool Temperate Rainforest.

Rainforest is characteristically very slow to recover following fire or clearing. This is particularly so for the epiphytes and the tree canopy, while most fern species are fairly resilient. The patch of well-developed rainforest on 355 Prices Rd terminates abruptly in a straight line along the property boundary, beyond which there is a tall, dense canopy of *Acacia dealbata* as regrowth from clearing. The size of the *Acacias* suggests that the clearing occurred several decades ago. An aerial photograph from 1952 suggests that this area had been cleared at least once prior. Despite the passage of time, very few elements of rainforest have recovered except for ferns. It appears that species associated with the adjacent slopes have encroached into the cleared gully.

This is understandable because of major changes that clearing (or fire) cause to soil type, soil fertility and availability of sunlight to seedlings. Rainforests occur on soils whose fertility and organic content is moderate or high as a result of nutrient cycling and decomposition that occurs in the permanently moist forest floor. Clearing or fire, followed by the inevitable soil erosion, remove the organic layer and expose the underlying earth, which in Hoddles Creek and Gladysdale is of substantially lower fertility. The reduced fertility and the loss of the tree canopy may allow certain surrounding species like *Melaleuca squarrosa* and *Pomaderris aspera* to thrive where previously they would have been out-competed.

This depiction of regenerating Cool Temperate Rainforest fits some of the vegetation along Hoddles Ck and the tributary on 355 Prices Rd. Within these areas, the immature Southern Sassafras trees reach densities up to one tree per two lineal metres of gully, including a wide range of ages all intermixed. The fact that they have been germinating continuously, even through the worst drought on record, suggests that the species is an intrinsic part of the vegetation's natural state, not just a chance occurrence. The accompanying presence of abundant epiphytic ferns and liverworts in these areas lends further credibility to the hypothesis that these areas should be regarded as regenerating Cool Temperate Rainforest whose tree canopy is slowly recovering.

Some other reaches of Hoddles Ck have a very similar understorey but Southern Sassafras is scarce and there is little sign of a recovering tree canopy. Such areas fit the description of the EVC, Fern Swamp (discussed in Section 4.2.1.4) but in some cases may be the result of failed regeneration of Cool Temperate Rainforest.

There are also reaches whose understorey is similar to Cool Temperate Rainforest but Southern Sassafras is scarce and the 15 m tall canopy is dominated by a mixture of *Melaleuca squarrosa* and the apparently undescribed *Leptospermum* mentioned above. While this vegetation might be the result of historical clearing or burning of Cool Temperate Rainforest, its occurrence next to Damp Forest and Lowland Forest makes this less likely than a separate, undescribed EVC that is here given the title 'Paperbark and Tea-tree Forest' (Section 4.2.1.5).

To deal with the foregoing complexities related to the regeneration of Cool Temperate Rainforest, a decision has been made here to map vegetation as:

- Well-developed Cool Temperate Rainforest where it matches the description at the start of this section, including a dense (or at least patchily dense) canopy of Southern Sassafras and abundant epiphytic ferns of many species;
- Regenerating Cool Temperate Rainforest where:

- The understorey matches that of rainforest;
- Southern Sassafras is present but sparse;
- Scented Paperbark is absent or scarce; and
- Wet Forest lies adjacent;

- Fern Swamp where there is a dense tree-fern stratum and a sparse cover of woody plants (with or without Southern Sassafras); and
- Paperbark and Tea-tree Forest where the understorey resembles rainforest but the overstorey comprises dense *Melaleuca* and *Leptospermum* trees.

There are locations where it was not possible to be confident about the boundaries between these intergrading categories, but further fieldwork with the benefit of the analysis in this report may allow refinement and greater confidence.

4.2.1.4. Fern Swamp (EVC 721)

Figure 10. Fern Swamp, 270 m downstream from Libera Rd, showing the shady, swampy conditions beneath its tree-fern canopy and a *Cyathea* trunk bearing the rare epiphytic fern, *Tmesipteris parva* (Small Fork-fern).

The Department of Sustainability & Environment (2009) describe Fern Swamp as follows:

> 'Defining characteristics: Ferny (to sedgy-ferny) swampy drainage line vegetation of high-rainfall areas (mostly occurring along drainage systems which support Riparian Thicket or Cool Temperate Rainforest in more free-draining areas). Woody species are generally confined to sparse emergent

> tall shrubs /small trees, but sparse emergent *Eucalyptus ovata* are sometimes present. Rare, higher rainfall areas (Central Highlands, South Gippsland, Otways).
>
> 'Indicator species: Sparse *Melaleuca squarrosa, Leptospermum lanigerum/Leptospermum grandifolium, Atherosperma moschatum* and/or *Acacia melanoxylon*; variously with *Todea barbara, Blechnum nudum, Blechnum minus, Blechnum wattsii, Dicksonia antarctica, Gleichenia microphylla, Carex appressa, Isolepis inundata, Persicaria hydropiper, Parsonsia brownii* and *Coprosma quadrifida*. On the drier edges, conspicuous species variously include *Tetrarrhena juncea, Austrocynoglossum latifolium, Lepidosperma elatius, Cyathea australis, Hydrocotyle hirta, Histiopteris incisa* and *Stellaria flaccida*. *Astelia australiana* can be an extremely localised component species (near Powelltown).'

This EVC does not appear in the Department of Sustainability & Environment's publicly available EVC maps of anywhere in Victoria.

A fairly clear but tiny example of Fern Swamp occurs on the broad floodplain at the confluence of Hoddles Ck and Wombat Ck. It includes 17 of the 23 listed indicator species (despite measuring only 200 m²) and the landscape context matches the description above very well.

Further upstream, there are substantial areas that have similar vegetation, including almost all the indicator species listed above, but with some tendencies toward rainforest, such as frequent epiphytes (as in Figure 10). The composition of this vegetation is as follows:

Tree canopy: Above the dominant tree-ferns, there is a patchy, thin canopy typically 15-20 m tall of various mixtures of *Acacia melanoxylon, Pomaderris aspera*, *Leptospermum* aff. *lanigerum* and *Melaleuca squarrosa*. There are also scattered *Acacia dealbata*, *Atherosperma moschatum*, *Myrsine howittiana*, *Olearia argophylla*, *Pittosporum bicolor* and *Zieria arborescens*.

Ferns: Ferns strongly dominate the vegetation. The only differences that the composition and structure of ferns in Fern Swamp show compared with the rainforest are that *Asplenium bulbiferum* and *Rumohra adiantiformis* are absent, *Blechnum nudum* and *Polystichum proliferum* are more prevalent and there is one colony of each of *Blechnum patersonii* and *Pteris tremula*.

Shrubs: As for the rainforest, *Coprosma quadrifida* and *Hedycarya angustifolia* are the main shrub species, but *Prostanthera lasianthos* is not as scarce as in the rainforest. The only other shrubs recorded were isolated, scarce *Cassinia trinerva* and *Cassinia aculeata*, which can be regarded as outliers of adjacent vegetation.

Vines: Abundant. The only difference compared with rainforest is that *Pandorea pandorana* is less abundant.

Creepers: Scarce except for *Australina pusilla*, the main difference from rainforest being that *Callitriche muelleri* and *Schoenus maschalinus* were commonly present on sandy shoals created by a recent flood.

Other species: As in the rainforest, *Carex appressa* and *Lepidosperma elatius* are consistently present where sunlight penetrates (though not in large numbers) and the orchids *Corybas diemenicus* and *Pterostylis pedunculata* grow as epiphytes on some of the *Dicksonia* trunks. *Chiloglottis cornuta* was also found growing on *Dicksonia* in Fern Swamp but not in rainforest (though it may well be found in rainforest in future).

It is possible that some of the areas classified here as Fern Swamp supported Cool Temperate Rainforest prior to historical clearing. It is not clear whether to treat such vegetation as regenerating rainforest or as Fern Swamp that has the potential to become rainforest in decades to come. The choice makes a practical difference because conservation of rainforests is given much greater attention than Fern Swamp, which is because rainforests are more common and better known than Fern Swamp. The approach taken here is to map Fern Swamp rather than regenerating rainforest if trees and large shrubs are sparse, although there are inevitably intermediate cases.

Similarly, there are intermediate cases between Fern Swamp and the Paperbark and Tea-tree Forest described below. It is possible that the latter may transform into Fern Swamp if its tree canopy senesces and thins.

4.2.1.5. Paperbark and Tea-tree Forest

For a distance of 600 m downstream from Hazeldene Rd, the gully differs in topography from reaches further downstream in that it has a particularly shallow longitudinal gradient (less than 1:50) and a wider alluvial floodplain (typically 30-40 m across). The vegetation is also distinctive: It has an understorey similar to Cool Temperate Rainforest but *Atherosperma moschatum* (Southern Sassafras) is scarce and the 15 m tall canopy is dominated by a mixture of *Melaleuca squarrosa* (Scented Paperbark) and an apparently undescribed species of *Leptospermum* (tea-tree) in the *lanigerum* group – therefore called 'paperbark and tea-tree forest' in this report.

Photographs of the vegetation appear in Figure 3 (p. 8) and Figure 11 (below). The composition of the vegetation is summarised following Figure 11.

Figure 11. The paperbark and tea-tree forest near Hazeldene Rd, showing the tall canopy of immature paperbarks and tea-trees. The foreground is near the edge of this vegetation type and does not display the full density of tree-ferns found closer to the creek.

Tree canopy: Dense *Melaleuca squarrosa* and *Leptospermum* approximately 15 m tall, with moderately abundant *Acacia melanoxylon* and *Pomaderris aspera* and occasional *Atherosperma moschatum* and *Acacia dealbata*. Eucalypts are absent.

Sub-canopy trees: There are scattered *Zieria arborescens*.

Shrubs: Sparse, similar to Cool Temperate Rainforest. The most abundant shrubs are *Hedycarya angustifolia* and *Pittosporum bicolor*. *Coprosma quadrifida* and *Prostanthera lasianthos* are scattered.

Climbers: *Parsonsia brownii* is abundant and *Tetrarrhena juncea* is scattered. *Rubus anglocandicans* (an introduced blackberry) is scarce.

Ferns: Abundant ferns strongly dominate the understorey. The dominant fern species are *Blechnum wattsii* and *Todea barbara* (with trunk diameters to 75 cm), followed by *Dicksonia antarctica* and *Cyathea australis*. There are also substantial numbers of *Sticherus urceolatus* and *Gleichenia microphylla*. The *Dicksonia* trunks support many epiphytic ferns, including *Grammitis billardierei* (which is abundant), *Crepidomanes venosum*, *Hymenophyllum australe*, *Hymenophyllum cupressiforme*, *Hymenophyllum flabellatum*, *Rumohra adiantiformis* and *Tmesipteris obliqua*. The *Cyathea* trunks also support epiphytic ferns, mainly *Cephalomanes caudata* and *Tmesipteris parva*. The trunks of both species of tree-fern support abundant liverworts and mosses. In addition to the abundant *Blechnum wattsii*, ground ferns are represented by *Blechnum cartilagineum*, *Blechnum nudum* and *Histiopteris incisa*. *Pteridium esculentum* is present as sparse outliers from adjacent Lowland Forest. *Calochlaena dubia* is notably absent.

Creepers: Scarce, comprising *Hydrocotyle hirta* and *Viola hederacea*.

Other Ground flora: *Lepidosperma elatius* is scattered. *Carex appressa*, *Carex* ?*fascicularis* and *Isolepis* ?*inundata* are scarce.

Investigation of the state flora database uncovered only three locations in Victoria with a good match to the above description:

- 3 km further south, on a tributary of Tomahawk Ck (southeast of the corner of Beenak Rd and Soldiers Rd) – Quadrat N0201100;
- 19 km to the east-southeast on a tributary of Tarago River in Gentle Annie, 800 m east of Sisters Ck – Quadrat C0065600;
- Another tributary of Tarago River, 3 km further east-southeast of the last, near North Hell's Gate – Quadrats F2701600 and F2702400.

A comparison of the vegetation composition at these sites is provided in Table 2. Note that two of the four quadrats have the important distinction that instead of the tea-tree, *Nothofagus cunninghamii* (Myrtle Beech) is co-dominant with the paperbark. The presence of Myrtle Beech provides a compelling case for classifying those two quadrats as Cool Temperate Rainforest. The first column, which is for the paperbark and tea-tree forest near Hazeldene Rd, is very similar apart from the Myrtle Beech.

The trees in the paperbark and tea-tree forest near Hazeldene Rd are mostly no older than middle-aged, with the notable exceptions of an *Atherosperma moschatum* and a tea-tree whose trunk diameters are both 39 cm. The lack of mature trees appears more likely to result from historical clearing than fire because the understorey includes a substantial number of *Cephalomanes caudatum* (Jungle Bristle-fern) and *Tmesipteris parva* (Small Fork-fern), which are very sensitive to fire and take a very long time to return after fire. Myrtle Beech occurs approximately 2 km away, so it is possible that it also occurred around Hazeldene Rd prior to clearing. Myrtle Beech has been favoured for logging and it regenerates poorly.

Despite the links between Cool Temperate Rainforest and the paperbark and tea-tree forest, the latter is flanked by Damp Forest (Section 4.2.2.2) and (to a lesser extent) Lowland Forest (Section 4.2.2.3), which would be abnormal for rainforest.

Table 2. Comparison of the composition of paperbark and tea-tree forest ('PTF') to four quadrats with similar vegetation. Species are grouped by life form, then in decreasing order of similarity among the sites. The symbols to the right of the common names indicate abundance using the Department of Sustainability & Environment's modification of the Braun-Blanquet system, with '4' meaning 50-75% cover, '3' meaning 25-50% cover, '2' meaning 5-25% cover, '1' meaning below 5% cover but numerous and '+' meaning scarce. The data from Hoddles Ck have been converted from the raw data in the Appendix, taking into account that the other data in this table come from quadrats much smaller than the area surveyed in this study.

Species are not shown if they occur only in one or two columns and they only rate '+'.

		Data Sources				
Scientific Name	**Common Name**	PTF	F2702400	F2701600	N0201100	C0065600
Overstorey trees						
Melaleuca squarrosa	Scented Paperbark	3	3	3	3	3
Acacia melanoxylon	Blackwood	2	2	2	2	1
Acacia dealbata	Silver Wattle	1	2	2		2
Atherosperma moschatum	Southern Sassafras	+	+		+	2
Pomaderris aspera	Hazel Pomaderris	2	2	2		
Nothofagus cunninghamii	Myrtle Beech		3			3
Leptospermum aff. *lanigerum*	Woolly Tea-tree	2				
Eucalyptus regnans (overhanging?)	Mountain Ash					2
Sub-canopy trees						
Pittosporum bicolor	Banyalla	1	+		+	1
Shrubs						
Coprosma quadrifida	Prickly Currant-bush	1	+		+	1
Hedycarya angustifolia	Austral Mulberry	1	+	1		
Acacia verticillata	Prickly Moses			+		1
Ferns						
Dicksonia antarctica	Soft Tree-fern	3	3	4	3	4
Blechnum wattsii	Hard Water-fern	3	3	2	2	3
Todea barbara	Austral King-fern	2	2	2	2	2
Blechnum nudum	Fishbone Water-fern	3	1	+	+	3
Grammitis billardierei	Common Finger-fern	1	+	+	+	+
Cyathea australis	Rough Tree-fern	2	2	2	1	
Crepidomanes venosum	Veined Bristle-fern	1	+	+	+	
Hymenophyllum australe	Austral Filmy Fern	+	1		+	+
Hymenophyllum cupressiforme	Common Filmy Fern	+	1	+		+
Gleichenia microphylla	Scrambling Coral-fern	1			1	1
Tmesipteris parva	Small Fork-fern	+	+		+	
Rumohra adiantiformis	Leathery Shield-fern	+	1	1		
Tmesipteris obliqua	Long Fork-fern	+	+			
Polystichum proliferum	Mother Shield-fern		+	1		
Asplenium bulbiferum	Mother Spleenwort			1		
Blechnum cartilagineum	Gristle Fern	1				
Climbers						
Tetrarrhena juncea	Forest Wire-grass	1	1	1	+	1
Parsonsia brownii	Twining Silkpod	+	+		+	+
Clematis aristata	Mountain Clematis			1	+	
Fieldia australis	Fieldia		1	+		

An alternative explanation of the paperbark and tea-tree forest is that it may have derived from Fern Swamp (Section 4.2.1.4) if the dense trees are an artifice of clearing. If that is the case, the trees will ultimately senesce and become sparse over a period of scores of years.

The recognised riparian EVCs dominated by *Melaleuca squarrosa* and/or the *Leptospermum lanigerum* group of tea-trees are Riparian Scrub (EVC 191), Riparian Thicket (EVC 59) and Shrubby Gully Forest (EVC 938), although the last of these has a stratum of eucalypts above the paperbarks and tea-trees. These EVCs are characteristic of lower elevations (0-250 m), they lack rainforest elements (particularly dense *Dicksonia* and epiphytes) and their *Melaleuca* and *Leptospermum* do not grow taller than 6 m.

4.2.1.6. Riparian Thicket Variant

Along Hoddles Ck at elevations of 175-185 m (beside 85 Yellowgum Rd) the vegetation is similar to the paperbark and tea-tree forest of Section 4.2.1.5 but is less allied to rainforest. The eucalypts of the adjoining Damp Forest extend into the riparian vegetation for part of this stretch. The part with the eucalypts is treated in Section 4.2.1.7 as Shrubby Riparian Forest and the part without eucalypts is treated in this section as a variant of Riparian Thicket (EVC 59).

Figure 12. The variant of Riparian Thicket.

The stream's longitudinal gradient is low in this reach, leading to perennially boggy conditions. The composition of the vegetation allied to Riparian Thicket is summarised as follows:

Eucalypts: Represented by a single, long-dead stag with a trunk diameter of 133 cm.

Canopy: Very patchy in density, with patches of dense *Melaleuca squarrosa* and the apparently undescribed *Leptospermum* reaching over 10 m tall (unlike Riparian Thicket). These are accompanied by scattered *Pomaderris aspera, Acacia melanoxylon* and *Acacia dealbata*.

Small trees/Large Shrubs: *Hedycarya angustifolia* is abundant and *Kunzea ericoides* is scarce.

Smaller shrubs: *Coprosma quadrifida* and the shrubby herb *Senecio minimus* are fairly abundant but the cover of medium shrubs is much less than in Riparian Thicket. There are small numbers of *Olearia lirata* and *Prostanthera lasianthos* and a single *Goodenia ovata*.

Climbers: The climbing grass, *Tetrarrhena juncea* is moderately abundant and there are scattered plants of *Clematis aristata* and the blackberry, *Rubus anglocandicans*.

Ferns: Unlike Riparian Thicket, the understorey is dominated by ferns. The dominant fern species are *Dicksonia antarctica, Cyathea australis* and *Blechnum nudum*. *Blechnum cartilagineum* and *Histiopteris incisa* are fairly abundant. *Blechnum minus* and *Calochlaena dubia* are scattered in moderate numbers and *Gleichenia microphylla* is scarce. There is a single *Blechnum wattsii* plant. Importantly, there are no epiphytic species.

Creepers: *Australina pusilla* is fairly abundant. *Acaena novae-zelandiae, Geranium* ?*homeanum, Hydrocotyle hirta and Stellaria flaccida* have moderate numbers. *Viola hederacea* is scarce. The introduced *Potentilla indica* is fairly well established.

Grassy species: Not very abundant. Those with the largest populations are *Carex appressa, Gahnia sieberiana, Isolepis inundata, Lepidosperma elatius* and *Triglochin striatum*.

Other Ground flora: In the more open patches, *Callitriche muelleri* is abundant (though this would be seasonal).

Riparian Thicket is listed by the Department of Sustainability & Environment as a Vulnerable EVC.

4.2.1.7. Shrubby Riparian Forest (EVC 936)

Figure 13. Shrubby Riparian Forest, photographed immediately downstream of 'Ted's dam'.

Embraced by the two patches of the Riparian Thicket variant just described, there is vegetation that is intermediate between Riparian Thicket and Riparian Forest (Section 4.2.1.9), depicted in Figure 13. It is categorised here as Shrubby Riparian Forest (EVC 936) on the basis of the Department of Sustainability & Environment's description: *'Open forest to woodland with dense ferny - shrubby understorey, ecologically intermediate between Riparian Scrub and Riparian Forest. Occurs on alluvial terraces of streams towards the fringes of high rainfall areas on frequently water-logged soils that are typically sandy/silty, with a high organic content'*.

The Department of Sustainability & Environment has not yet mapped this EVC or published a more detailed description or EVC benchmark. It appears to be a rare EVC but further research is required.

The composition of the vegetation, as observed on Hoddles Ck, is as follows:

Eucalypts: Like Riparian Forest, this vegetation is dominated by tall eucalypts – in this case, *Eucalyptus cypellocarpa* (Mountain Grey Gum) and a few *Eucalyptus obliqua* (Messmate Stringybark). These eucalypts have the same density as in the flanking Damp Forest. This is the only part of the study area where the riparian vegetation's overstorey is the same as the adjoining vegetation.

Sub-canopy trees: There is a moderately dense stratum at least 10 m tall dominated by *Melaleuca squarrosa*, with smaller numbers of *Acacia melanoxylon*, *Acacia dealbata* and *Pomaderris aspera*. There is a single *Pittosporum bicolor*. The *Leptospermum* of the previous two vegetation types is absent.

Shrubs: Very similar to the Riparian Thicket variant. *Hedycarya angustifolia* and *Coprosma quadrifida* are again dominant but the shrubby herb *Senecio minimus* is absent. There are small numbers of *Prostanthera lasianthos*.

Climbers: *Clematis aristata* and the climbing grass *Tetrarrhena juncea* are moderately abundant.

Ferns: The vegetation below a height of 5 m is again dominated by ferns, and again the tree-fern species *Dicksonia antarctica* and *Cyathea australis* dominate the ferns. Among the ground ferns, *Blechnum nudum* and *Blechnum cartilagineum* are abundant while *Blechnum minus* and *Blechnum wattsii* are scarce and there is a single *Blechnum wattsii* plant. *Histiopteris incisa* and *Calochlaena dubia* are scattered in moderate numbers. The presence of small numbers of *Sticherus urceolatus* and *Todea barbara* and a single *Gleichenia microphylla* plant are consistent with the presence of *Melaleuca squarrosa*. Importantly, there are small numbers of the epiphytic species *Grammitis billardierei*, *Hymenophyllum flabellatum* and *Tmesipteris obliqua* on *Dicksonia* trunks. Unlike further upstream, *Cyatheas* have no epiphytic ferns.

Creepers: Scarcer and less diverse than the Riparian Thicket variant above, represented by small numbers of *Poa tenera* and *Oxalis perennans*.

Grassy species: Scarce, represented by scattered plants of *Isolepis inundata* and *Lepidosperma elatius*.

Other Ground flora: In the more open patches, there are moderate numbers of *Callitriche muelleri* and small numbers of a few other herb species.

4.2.1.8. Riparian Wet Forest (EVC 972)

As Hoddles Ck approaches its confluence with Wombat Ck, its longitudinal gradient declines to roughly 1:100, which results in a much more meandering watercourse and a broader alluvial plain. The hydrology also changes due to the flows of Wombat Ck and Hoddles Ck combining. Floodwaters must slow down greatly upon reaching the broad floodplain, causing deposition of silt that creates boggy conditions. These influences are most evident in the section of the valley between 150 m upstream of the confluence and 400 m downstream of the confluence. In this section, the watercourse takes broad meanders and conditions are particularly boggy, giving rise to ferny, swampy vegetation (Figure 14) categorised here as Riparian Wet Forest. Further downstream, there is a transition to Riparian Forest (Section 4.2.1.9), with its narrower floodplain, straighter stream and more tussocky (not ferny) ground flora.

The categorisation of Riparian Wet Forest (EVC 972) is applied here on the basis of the Department of Sustainability & Environment's description: *'Tall, open forest with broad-leaved shrubs, ferns and tree-*

ferns indicative of Wet Forest and riparian species. Ground-layer is usually sparse, typically ferny to grassy/sedgy-ferny, sometimes with herbaceous patches. Occurs on riparian terraces of streams in higher rainfall areas from near sea-level to montane elevations'.

Figure 14. Riparian Wet Forest,
photographed on Hoddles Ck, 120 m downstream from the confluence with Wombat Ck.

The Department of Sustainability & Environment has not yet mapped this EVC or published a more detailed description or EVC benchmark, so it is unclear whether the high density of ferns seen in Figure 14 is within the intended range for Riparian Wet Forest. The closest EVC prior to the advent of Riparian Wet Forest was Riparian Forest, which has fewer ferns and more tussock-forming species.

The composition of the vegetation categorised here as Riparian Wet Forest is as follows:

Eucalypts: Dominated by *Eucalyptus cypellocarpa* with somewhat fewer *Eucalyptus viminalis* and *Eucalyptus obliqua*. (Riparian Forest has few *Eucalyptus cypellocarpa*.)

Sub-canopy trees: *Acacia dealbata*, *Acacia melanoxylon* and *Pomaderris aspera* are patchy.

Shrubs: The shrub cover is moderate. *Hedycarya angustifolia* and *Coprosma quadrifida* dominate. *Prostanthera lasianthos* and *Olearia lirata* are present in moderate numbers. *Olearia argophylla* is scarce (but more abundant further up Wombat Ck) and so is *Goodia lotifolia*.

Climbers: The climbing grass, *Tetrarrhena juncea*, is abundant and the vine, *Clematis aristata*, less so. There are also small numbers of *Glycine clandestina*, *Rubus parvifolius* and *Parsonsia brownii*.

Tree Ferns: Dense in patches (mainly beside the stream) but not dense overall. *Cyathea australis* strongly outnumbers *Dicksonia antarctica*.

Epiphytic ferns: *Hymenophyllum cupressiforme* is found on a small proportion of the tree-fern trunks. Five *Grammitis billardierei* plants and a single *Microsorum pustulatum* plant were found.

Other Ferns: Ground ferns dominate the ground flora, particularly *Blechnum nudum* followed by *Calochlaena dubia*. There are smaller numbers of *Blechnum cartilagineum*, *Histiopteris incisa* and *Polystichum proliferum*.

Creepers: *Viola hederacea* is moderately abundant and *Hydrocotyle hirta* is scarce.

Grassy species: Well out-competed by ferns. As in Riparian Forest, the most abundant species are *Poa ensiformis* and *Lepidosperma elatius*. There are occasional *Carex appressa*, *Gahnia sieberiana* and *Isolepis*.

Aquatic/amphibious: *Callitriche muelleri* is scattered and *Gratiola peruviana* is scarce.

In the absence of more research on this EVC, its conservation status is uncertain.

4.2.1.9. Riparian Forest (EVC 18)

Riparian Forest occurs downstream of the Riparian Wet Forest and around the Established Tree Transplanters dam. It is most easily detected from its tall canopy of Manna Gums (*Eucalyptus viminalis*) and its ground flora having many tussocks (as opposed to the more ferny ground flora of Riparian Wet Forest). A photograph appears in Figure 15.

Figure 15. Riparian Forest,
photographed immediately downstream of the Established Tree Transplanters dam.

The composition of the vegetation categorised here as Riparian Wet Forest is as follows:

Eucalypts: Dominated by *Eucalyptus viminalis*, sometimes accompanied by scattered outliers of the flanking vegetation.

Sub-canopy trees: *Acacia dealbata*, *Acacia melanoxylon* and *Pomaderris aspera* are fairly abundant.

Shrubs: The shrub cover is dense in patches. *Prostanthera lasianthos* and *Olearia lirata* dominate in cover but *Coprosma quadrifida* is similarly abundant in numbers. *Goodenia ovata* and *Cassinia aculeata* are scattered. *Hedycarya angustifolia* and *Olearia argophylla* are scarce.

Climbers: The climbing grass, *Tetrarrhena juncea* and the vine, *Clematis aristata*, are moderately abundant. There are also small numbers of *Glycine clandestina* and *Rubus parvifolius*.

Tree Ferns: *Cyathea australis* is scattered, mainly beside the stream.

Epiphytic ferns: Absent.

Other Ferns: Fairly abundant but no more so than grassy plants. The most abundant species are *Calochlaena dubia*, *Blechnum cartilagineum*, *Blechnum nudum* and *Polystichum proliferum*. ferns dominate the ground flora, particularly followed by. *Adiantum aethiopicum* is scarce.

Creepers: Moderately abundant. *Poa tenera* is the most abundant species. Others include *Acaena novae-zelandiae*, *Geranium* ?*homeanum*, *Hydrocotyle hirta*, *Oxalis perennans* and *Viola hederacea*.

Grassy species: Abundant. The most abundant species are *Poa ensiformis* and *Lepidosperma elatius*.

The conservation status of Riparian Forest is listed by the Department of Sustainability & Environment as 'Least Concern'.

4.2.2. Non-Riparian Types

As seen in the vegetation map of Figure 4 (p. 12), the following EVCs were found flanking the riparian vegetation types discussed in Section 4.2.1:

- Lowland Forest (EVC 16) on less fertile soil;
- Damp Forest (EVC 29) on more fertile soil; and
- Wet Forest (EVC 30) on the deeper soils in the upper reaches, where rainfall is highest.

The Department of Sustainability & Environment's vegetation mapping differs greatly from Figure 4 in that it:

- Shows no Wet Forest anywhere in the Hoddles Ck catchment;
- Shows a quite different division of the slopes and ridges into Damp Forest and Lowland Forest.

4.2.2.1. Wet Forest (EVC 30)

Wet Forest is usually easily identified by its very tall overstorey of Mountain Ash (*Eucalyptus regnans*), but *Eucalyptus viminalis* has taken over a patch beside the Established Tree Transplanters land (probably due to the manner of past logging). Wet Forest occurs on the most sheltered slopes of the southern half of the study area, with Damp Forest or Lowland Forest further up the slope or sometimes on the opposite, more exposed side of the valley. Wet Forest responds quite differently to fire than Damp Forest or Lowland Forest.

The composition of the Wet Forest is summarised below:

Eucalypts: Dominated by *Eucalyptus regnans*, sometimes accompanied by scattered outliers of the flanking vegetation.

Sub-canopy trees: *Zieria arborescens* is abundant. *Acacia dealbata*, *Acacia melanoxylon*, *Pittosporum bicolor* and *Pomaderris aspera* are fairly abundant. *Bedfordia arborescens* is nearly always scattered through the vegetation. *Kunzea ericoides* is present rarely, only as a result of past clearing.

Large shrubs: *Hedycarya angustifolia* and *Olearia argophylla* are very variable in their abundance.

Shrubs: Abundant, dominated by *Prostanthera lasianthos* followed by *Coprosma quadrifida*, then *Olearia lirata*, *Goodenia ovata*, *Pimelea axiflora* and *Cassinia trinerva*.

Climbers: There is an abundance of *Clematis aristata*, *Pandorea pandorana*, *Parsonsia brownii* and the climbing grass, *Tetrarrhena juncea*. The blackberry, *Rubus anglocandicans* is common.

Figure 16. Wet Forest,
photographed slightly upstream of the Established Tree Transplanters dam.

Tree Ferns: *Cyathea australis* is abundant and *Dicksonia antarctica* is usually present.

Epiphytic ferns: Confined to very occasional *Grammitis billardierei*, *Hymenophyllum cupressiforme* or *Hymenophyllum flabellatum* in gullies or close to riparian vegetation.

Other Ferns: Ferns dominate the ground flora, dominated by *Blechnum wattsii* followed by *Polystichum proliferum* and *Blechnum cartilagineum*. *Histiopteris incisa* is commonly present and so is *Calochlaena dubia* near Damp Forest.

Creepers: *Viola hederacea* is consistently present in moderate to high density. *Hydrocotyle geraniifolia* is often conspicuous seasonally. Other creeping species are sporadically present, the most common being *Australina pusilla*, *Acaena novae-zelandiae*, *Hydrocotyle hirta* and *Oxalis perennans*.

Grassy species: Although not usually outnumbering ferns, *Lepidosperma elatius* is consistently abundant or co-dominant. The only other grassy species that was found consistently in the Wet Forest is the climbing *Tetrarrhena juncea* (in common with Damp Forest). *Dryopoa dives* is seasonally abundant in openings, e.g. where a eucalypt has fallen.

Other species: *Gonocarpus humilis* is usually present but not abundant. The very large moss, *Dawsonia superba*, is a good indicator of Wet Forest.

The conservation status of Wet Forest is listed by the Department of Sustainability & Environment as 'Least Concern'.

4.2.2.2. Damp Forest

Damp Forest and Lowland Forest are the two predominant non-riparian vegetation types in the Hoddles Creek - Gladysdale district. Their absence of Mountain Ash distinguishes them immediately from Wet

Forest. A quick way to distinguish them from each other is by the ferny ground flora of Damp Forest and the more grassy ground flora of Lowland Forest. Another good identifying feature of some stands of Damp Forest is that they contain substantial numbers of Mountain Grey Gum (*Eucalyptus cypellocarpa*), but other stands of Damp Forest do not. Lowland Forest tends to occur on less fertile soil than Damp Forest.

Figure 17. Tall tree-ferns on the edge of Damp Forest where it meets riparian vegetation, 100 m downstream from where the unused Yellowgum Rd reservation meets Hoddles Ck.

The composition of the Damp Forest in the study area is summarised below:

Eucalypts: *Eucalyptus obliqua* is always present and usually abundant. Sometimes it is co-dominant with *Eucalyptus radiata* and sometimes *Eucalyptus cypellocarpa* is dominant.

Sub-canopy trees: As in Wet Forest, *Acacia dealbata*, *Acacia melanoxylon* and *Pomaderris aspera* are fairly abundant. *Kunzea ericoides* can be abundant to absent. As distinct from Wet Forest, *Zieria arborescens* is absent or scattered. *Bedfordia arborescens* and *Pittosporum bicolor* are less commonly present than in Wet Forest. A single plant of *Acacia obliquinervia* was found.

Large shrubs: The density of *Hedycarya angustifolia* and *Olearia argophylla* can vary from absent to moderate. *Lomatia fraseri* is occasionally present and only a single plant of *Oxylobium arborescens* was found.

Smaller shrubs: Scattered with occasional denser patches, dominated by *Prostanthera lasianthos* and *Coprosma quadrifida*. Most stands include moderate numbers of *Goodenia ovata*, *Olearia lirata*, *Pimelea axiflora*, *Polyscias sambucifolia* and either *Cassinia aculeata* or *Cassinia trinerva*. There is quite a range of other shrub species that occur in some stands but not others.

Climbers: Abundant, particularly *Clematis aristata* and the climbing grass, *Tetrarrhena juncea*. Other climbers include, in decreasing frequency, *Parsonsia brownii*, *Rubus parvifolius* and *Pandorea pandorana*.

Tree Ferns: *Cyathea australis* is moderately abundant on the slopes, becoming dense in gullies and toward the interface with riparian vegetation (as in Figure 17). Importantly, *Dicksonia antarctica* is rarely present.

Epiphytic ferns: Confined to very occasional *Hymenophyllum cupressiforme* or *Hymenophyllum flabellatum* in gullies or at the interface with riparian vegetation.

Other Ferns: Ferns dominate the ground flora, particularly *Calochlaena dubia* and *Blechnum cartilagineum*. Other fern species tend to reflect whatever other EVC is closest; e.g. *Blechnum wattsii* and *Polystichum proliferum* near Wet Forest and *Blechnum nudum* near riparian EVCs.

Creepers: *Viola hederacea* is consistently present in moderate to high density. Many other species are sporadically present, the most common being *Poa tenera*, *Acaena novae-zelandiae*, *Geranium* ?*homeanum*, *Hydrocotyle hirta* and *Oxalis perennans*.

Grassy species: While ferns mostly outnumber grassy species in Damp Forest, there can be dense patches of the large sedge, *Lepidosperma elatius*. The only other grassy species that was found consistently in the Damp Forest is the climbing *Tetrarrhena juncea*. Other species that were encountered include *Poa ensiformis*, *Gahnia sieberiana* and *Microlaena stipoides*.

Other species: *Gonocarpus humilis* is consistently present but not abundant.

The conservation status of Damp Forest is listed by the Department of Sustainability & Environment as 'Least Concern'.

4.2.2.3. Lowland Forest

Lowland Forest is the widespread 'dry' forest around Hoddles Creek and Gladysdale. Its low fertility is attested by its wiry, heathy ground flora and an abundance of members of the protea family such as banksias, hakeas, lomatias and geebungs.

The composition of the Lowland Forest in the study area is summarised below:

Eucalypts: *Eucalyptus obliqua* is always present and either dominates or co-dominates with *Eucalyptus radiata*.

Sub-canopy trees: *Kunzea ericoides* is abundant in patches. *Acacia dealbata* and/or *Acacia melanoxylon* are scattered. *Exocarpos cupressiformis* is occasionally present, unlike any other vegetation in this study.

Shrubs: The shrub layer is patchy and variable in density and rich in species. *Spyridium parvifolium* is the most consistent species encountered in Lowland Forest in the study area, followed (in order) by *Olearia lirata*, *Cassinia aculeata*, *Coprosma quadrifida* and *Polyscias sambucifolia*. Although less abundant and less consistently present in the study area, the following species are good indicators of Lowland Forest *Acacia mucronata, Bauera rubioides, Banksia spinulosa, Bursaria spinosa, Hakea decurrens*, *Leptospermum continentale*, *Leucopogon virgatus* and *Olearia myrsinoides*. Other members of the protea family are also good indicators but absent from the study area.

Climbers: The scrambling grass *Tetrarrhena juncea* is abundant but does not act as a true climber in Lowland Forest. True climbers are thinly scattered and include *Billardiera mutabilis*, *Clematis aristata* and *Comesperma volubile*.

Tree Ferns: *Cyathea australis* is scattered on lower slopes and gullies. *Dicksonia antarctica* is absent.

Epiphytic ferns: Absent.

Figure 18. Lowland Forest on the eastern bank adjacent to 'Ted's dam'.

Other Ferns: There are ferny patches but overall, grassy plants exceed ferns. *Pteridium esculentum* is the most abundant and consistent fern, followed by *Calochlaena dubia*. The following species are not consistently present but are good indicators of Lowland Forest: *Gleichenia dicarpa*, *Lindsaea linearis* and *Lycopodium deuterodensum*. *Blechnum* species, which are so abundant in the other vegetation types considered in this report, were not recorded at all in Lowland Forest during this study.

Creepers: Scattered, with low cover overall. In common with Wet Forest and Damp Forest, *Viola hederacea* is consistently present in moderate to high density. *Acrotriche prostrata* and *Goodenia lanata* are often present and serve as good indicators of Lowland Forest.

Grassy species: Grasses generally dominate the ground flora, particularly the scrambling species *Tetrarrhena juncea*. Another scrambler, *Austrostipa muelleri*, is scarce in the study area but serves as a good indicator of Lowland Forest. *Xanthorrhoea minor* is another indicator species and is frequently present. *Gahnia radula* and *Lomandra filiformis* are usually present and often abundant.

Other species: Lowland Forest is fairly rich in non-grassy herbs ('forbs'). *Amperea xiphoclada* and *Dampiera stricta* are commonly present and serve as very good indicators of Lowland Forest. The same could also be said in the local context for the *Tetratheca ciliata* and the sundews *Drosera whittakeri* and *Drosera peltata* subspecies *auriculata*. Whereas Damp Forest and Wet Forest contain *Gonocarpus humilis*, Lowland Forest includes *Gonocarpus tetragynus* as well.

The conservation status of Lowland Forest is listed by the Department of Sustainability & Environment as 'Least Concern'.

5. Plant Species Detected

The Appendix (p. 52) contains a table of the plant species detected in each of forty separate zones of the study area. In most cases, a zone contains a single EVC. There are 1,569 entries in the table spanning 192 indigenous species and 40 introduced species. (Records of moss and liverwort were so incomplete as to be omitted from the table.)

The state botanical database was checked for all species recorded within 5 km of the study area. The database does not include 106 of the indigenous species recorded either in this study or in the study of the Hoddles Creek Education Area by Lorimer (2009, 2012). The present study recorded the following thirty-four indigenous species that had not been previously recorded either in the state database or in the Hoddles Creek Education Area:

Acacia ?*mearnsii*	*Dryopoa dives*	*Lomatia fraseri*
Acacia obliquinervia	*Epilobium billardierianum* ssp. *cinereum*	*Luzula meridionalis*
Atherosperma moschatum	*Euchiton involucratus*	*Pelargonium inodorum*
Blechnum fluviatile	*Geranium homeanum*	*Pterostylis pedunculata*
Blechnum patersonii	*Glycine microphylla*	*Pultenaea forsythiana*
Callitriche muelleri	*Goodia lotifolia*	*Solanum aviculare*
Calystegia marginata	*Hymenophyllum australe*	*Tmesipteris ovata*
Carex breviculmis	*Hymenophyllum flabellatum*	*Typha domingensis*
Cassinia trinerva	*Hymenophyton flabellatum*	*Villarsia reniformis*
Coprosma hirtella	*Leptospermum* aff. *lanigerum*	*Wahlenbergia stricta*
Daviesia ulicifolia	*Leucopogon virgatus*	
Dawsonia superba	*Lomandra longifolia* subsp. *exilis*	

The two young plants that were identified (with 90% confidence) as *Acacia mearnsii* could have grown from seeds inadvertently brought to the site where they were observed, so they may not be indigenous to the study area. All but three of the species listed above can be readily found elsewhere in the region but have not been previously recorded locally due to lack of botanical surveys.

5.1. Significant Species

Four species found in this study are classified by Walsh and Stajsic (2007) and the Department of Sustainability & Environment (2005) as rare throughout Victoria. In each case, the author collected and pressed small 'voucher' specimens for lodgement at the National Herbarium of Victoria. The details of the four species are given in the following paragraphs and their locations are mapped on Figure 4 (p. 12). The precision of the mapping was often better than 10 m but deteriorated to as much as 25 m at times where topography and tall trees obstructed satellite reception.

***Correa reflexa* var. *lobata* (Powelltown Correa)**: This shrub was seen in substantial numbers in Lowland Forest near Hazeldene Rd, but only a few extend into the study area. Although very localised in its distribution, this variety of *Correa reflexa* is abundant in suitable local habitat but not in riparian habitat. The common variety, 'var. *reflexa*', was not found in this study.

***Cephalomanes caudatum* (Jungle Bristle-fern)**: A small, translucent filmy-fern with fronds one cell thick (Figure 19), living on the trunks of old Rough Tree-ferns (*Cyathea australis*) or rarely on Soft Tree-fern (*Dicksonia antarctica*). The population that occurs between the study area and the Beenak area is a remarkable outlier of this predominantly tropical or subtropical jungle species. Well over one hundred plants were found on scores of tree-fern trunks. The precise number is impossible to say because plants sometimes intermingle and cannot be counted. Most plants are on weathered, old tree-fern trunks close to the edge of the riparian zone, or sometimes slightly into adjacent forest. Figure 4 shows them to be distributed upstream from the bend in Hoddles Ck on Map 3.

Figure 19. A cluster of intermingled *Cephalomanes caudatum* growing on *Cyathea* beside Hoddles Ck, midway from Hazeldene Rd to Prices Rd. The brown foliage has died from drought.

Figure 20. *Tmesipteris ovata* (left) and *Tmesipteris parva* (right) growing on *Cyathea*.

***Tmesipteris ovata* (Oval Fork-fern)**: A small epiphytic fern with leaves rather than fronds (Figure 20). In this study, *Tmesipteris ovata* was found growing on two *Cyathea* trunks: One on the steep, northern bank of Hoddles Ck opposite the Beenak Bushland Reserve 430 m east of Libera Rd; and the other in a gully emanating from 155 Yellowgum Rd. A small specimen was taken from each for lodgement at the National Herbarium of Victoria.

***Tmesipteris parva* (Small Fork-fern)**: A very similar species to *Tmesipteris ovata* (Figure 20), differing outwardly in the leaf tips tapering more gradually. Over 100 plants were seen on scores of tree-fern trunks (e.g. Figure 10 on p. 21) within paperbark and tea-tree forest, Wet Forest, Cool Temperate Rainforest and (particularly) Fern Swamp. They often occur alongside *Cephalomanes caudatum*, more commonly on *Cyathea* than *Dicksonia*. Figure 4 shows that these species have a very similar distribution in the study area. A few grow in a neighbouring catchment, within the Hoddles Creek Education Area in the gully beside Prices Rd (Lorimer 2012). The district around Hoddles Creek and Beenak is a stronghold for *Tmesipteris ovata* and *Tmesipteris parva*.

Undescribed tea-tree: The tea-tree or *Leptospermum* that is the dominant species along some reaches of Hoddles Ck is potentially more significant than any of the species just discussed because it seems to be very rare and undescribed. The closest recognised species in Victoria is the Woolly Tea-tree *Leptospermum lanigerum*, which the definitive reference on Victorian Flora, *Flora of Victoria* (Walsh & Entwisle 1996) describes as a 'shrub or tree to 4 m high'. By contrast, the fully-grown tea-trees in the study area are 15-20 m tall and have their lowest branch as much as 10 m above ground. The largest trunk diameter measured was 39 cm but no attempt was made to look for larger ones. The tallest tea-tree species recognised in *Flora of Victoria* is the clearly different *Leptospermum grandifolium*, which is said to grow to 10 m tall.

The author aims to collect a flowering and fruiting specimen of the tea-tree to lodge at the National Herbarium with detailed notes, to assist future research that may lead to a new species name.

The absence of an accepted name for these tea-trees means that there are no searchable botanical records of its distribution or abundance. Botanist Neville Walsh of the National Herbarium of Victoria has seen tea-trees of the kind and size found in this study to the southeast of Hoddles Creek and it seems likely that most or all records of *Leptospermum lanigerum* in the tall forests and rainforests in the upper Bunyip and Tarago catchments are the same species as the Hoddles Ck tea-trees. Even then, if the tea-tree's extinction risk were to be assessed under the international standard ('Red List') criteria, it would almost certainly qualify as threatened with extinction because its known range and population are small and it has a specialised habitat.

In addition to the rare species just discussed, the following species found in this study can be deemed regionally rare:

***Hibbertia empetrifolia* (Tangled Guinea-flower)**: A low, tangled, wiry, suckering species with bright yellow flowers. A single, small plant that is thought to be this species (with 80% confidence) was found on a north-facing slope in Damp Forest approximately 350 m northwest of the Hazeldene Rd bridge. This species occurs nearby on 155 Yellowgum Rd. It was also recorded at several nearby locations in 1979 and 1980 but otherwise, the closest records since 1980 are 10 km east (in 1990), 13 km east (in 1989), 20 km south (in 2005), 21 km southeast (in 2005) and 30 km west (in 2000).

***Glycine microphylla* (Small-leaf Glycine)**: A creeper that puts down roots at intervals along its fine, sprawling stems. Several were found scattered through the Riparian Forest near Blackleather Creek Rd. The number of historical records of this species is artificially diminished because it was widely mistaken for the climber, *Glycine clandestina* until the past decade or two. The closest records are two herbarium specimens dated 1907 and 1977 from approximately 15 km away, followed by a record 23 km west (2009), 23 km northwest (1989), 25 km south (1989) and 27 km southwest (in 1903, 1988, 1989 and 2003).

***Lycopodium deuterodensum* (Bushy Clubmoss)**: A fern ally that looks like an overgrown moss. In this study, A few plants were found in Lowland Forest approximately 200 m uphill from Hoddles Ck on the triangle of public land that projects into the Established Tree Transplanters land. The author also found many in 2009 in the Hoddles Creek Education Area, uphill from Parkinsons Rd near the eastern boundary. Otherwise, the nearest records since 1980 are 5 km north (1990), 16 km south (1982) and 41 km northwest (1982).

***Villarsia reniformis* (Running Marsh-flower)**: A semi-aquatic plant to shin-high with shiny, almost heart-shaped leaves. One or two plants were found in mud just upstream of 'Ted's dam'. The closest prior record of this species was 9 km to the west-southwest in 1990, followed by several records more than 25 km away in Melbourne's outer suburbs. However, the author suspects that its apparent rarity may be exaggerated by the paucity of riparian botanical surveys.

***Callitriche muelleri* (Round Water-starwort)**: An annual creeper that appears on drying mud after floodwater recedes. Many colonies were recorded in this study, mostly measuring a fraction of a square metre in extent and growing in silty deposits on the edge of the stream where sunlight penetrates to the

ground. There were nine prior records within 20 km up to 1980, but since 1980 the closest records have been 24 km to the west (in 1995 and 2004) and 31 km to the west (in 1992 and 1994). The author suspects that the data understates the true abundance of the species because of the paucity of riparian botanical surveys.

5.2. Species for Revegetation

As discussed in Chapter 9, revegetation is recommended for a section of stream reserve adjacent to the Established Tree Transplanters property. For this purpose, and for revegetation along other local streams, it is useful to know which species are best suited to the conditions.

It is Melbourne Water's practice and the author's recommendation that revegetation of a site beside a stream should be done using species that occur naturally in the site's EVC (or the EVC that occurred prior to clearing, if applicable) and only using plants raised from local stock.

While the Appendix provides information about which plant species grow naturally within each EVC in the study area, it says nothing about how readily each species can be propagated, how well they establish when planted or what roles they might play as colonising species. Some of the EVCs are represented by such small areas within the study area that the lists in the Appendix are not very comprehensive. For these reasons, Table 3 is provided to indicate the author's views about which species are best suited to local revegetation for each riparian EVC. The relative numbers of plants of each species used in a revegetation project should take into account the structure of the EVC's vegetation as described in Section 4.2.1, the species' roles as colonising species and the site conditions, e.g. prevalence of weeds.

Table 3. Plant species selection guide for revegetation within each riparian EVC.

Within the columns for the various EVCs, the suitability of each species for planting has been classified according to the following codes:

1: A species that should be present in any occurrence of the EVC, and planted if not already present;

2: A suitable species for routine planting, with no special considerations; and

3: A species only for special applications, e.g. if it is locally threatened and an opportunity arises to plant a viable population. Selection of such a species should be on the basis of expert consideration of the conditions in which the planting is to occur and whether the project represents a good use of the available stock.

		Ecological Vegetation Class								
Scientific Name	Common Name	Wet Forest	Rainforest	Paperbark/tea-tree forest	Fern Swamp	Riparian Thicket variant	Shrubby Riparian Forest	Riparian Wet Forest	Riparian Forest	Forest C'line Sedge Swamp
Trees										
Acacia dealbata	Silver Wattle	1	2	2	2	1	1	1	1	
Acacia melanoxylon	Blackwood	1	1	1	1	1	1	1	1	
Acacia obliquinervia	Mountain Hickory Wattle	3								
Atherosperma moschatum	Southern Sassafras		1	2	2					
Bedfordia arborescens	Blanket-leaf	1								
Eucalyptus cypellocarpa	Mountain Grey Gum						1	1		
Eucalyptus obliqua	Messmate Stringybark						2	1	2	

		Ecological Vegetation Class								
Scientific Name	Common Name	Wet Forest	Rainforest	Paperbark/tea-tree forest	Fern Swamp	Riparian Thicket variant	Shrubby Riparian Forest	Riparian Wet Forest	Riparian Forest	Forest C'line Sedge Swamp
Eucalyptus regnans	Mountain Ash	1								
Eucalyptus viminalis subsp. *viminalis*	Manna Gum	3						2	1	
Leptospermum aff. *lanigerum*	an undescribed tea-tree			1	1	1	3			
Melaleuca squarrosa	Scented Paperbark			1	2	1	1			
Nothofagus cunninghamii	Myrtle Beech		3							
Pomaderris aspera	Hazel Pomaderris	1	2	1	1	1	1	1	2	
Zieria arborescens	Stinkwood	1	2	2	3					
Large Shrubs										
Hedycarya angustifolia	Austral Mulberry	1	1	2	1	1	1	1	2	
Lomatia fraseri	Tree Lomatia	2								
Myrsine howittiana	Muttonwood	2			2					
Olearia argophylla	Musk Daisy-bush	1	1		2			2	2	
Pittosporum bicolor	Banyalla	1	1	1	2					
Prostanthera lasianthos	Victorian Christmas-bush	1	2	2	1	1		1	1	
Smaller Shrubs										
Acacia verticillata	Prickly Moses					2	2		2	
Cassinia aculeata	Common Cassinia	2					2	2	2	
Cassinia trinerva	Three-nerved Cassinia	1	1	2	2		2	2		
Coprosma quadrifida	Prickly Currant-bush	1	1	1	1	1	1	1	1	
Goodenia ovata	Hop Goodenia	1	3	3	3	2	2	1	1	
Goodia lotifolia	Golden-tip	2						2	2	
Kunzea ericoides species aggregate	Burgan	2						2	2	
Olearia lirata	Snowy Daisy-bush	1				2	2	2	1	
Ozothamnus ferrugineus	Tree Everlasting	2		2	2	2	2	2	1	
Pimelea axiflora	Bootlace Bush	1						2		
Pultenaea gunnii	Golden Bush-pea								2	
Solanum aviculare	Kangaroo Apple						2	2	2	
Tree-ferns										
Cyathea australis	Rough Tree-fern	2	2	2	2	2	2	2	2	
Dicksonia antarctica	Soft Tree-fern	1	1	1	1	2	2	2	2	
Todea barbara	Austral King-fern	2		1	2					
Ground Ferns										
Adiantum aethiopicum	Common Maidenhair								2	
Asplenium bulbiferum	Mother Spleenwort	2	2							
Blechnum cartilagineum	Gristle Fern	1	2	2	2					2
Blechnum minus	Soft Water-fern					2				2
Blechnum nudum	Fishbone Water-fern			2	1	1	2	1	2	2
Blechnum wattsii	Hard Water-fern	1	1	1	1					
Gleichenia microphylla	Scrambling Coral-fern			2	2	2				
Histiopteris incisa	Bat's Wing Fern	2	2	2	2	2	2	2		
Hypolepis rugosula	Ruddy Ground-fern						2	2	2	2
Polystichum proliferum	Mother Shield-fern	1	2		2					
Climbers										
Calystegia marginata	Forest Bindweed	1	2	2	2	2	2	2	2	
Clematis aristata	Mountain Clematis	1	1	2	2	2	2	2	2	

		Ecological Vegetation Class								
Scientific Name	Common Name	Wet Forest	Rainforest	Paperbark/tea-tree forest	Fern Swamp	Riparian Thicket variant	Shrubby Riparian Forest	Riparian Wet Forest	Riparian Forest	Forest C'line Sedge Swamp
Glycine clandestina	Twining Glycine							3	2	
Pandorea pandorana	Wonga Vine	1	1	1	2	2	2	2	2	
Parsonsia brownii	Twining Silkpod	1	1	1	1	2	2	2		
Rubus parvifolius	Small-leaf Bramble							2	1	
Creepers										
Acaena novae-zelandiae	Bidgee-widgee	1	2	2	2	1	2	2	2	2
Australina pusilla	Shade Nettle	1	1	2	2	2				
Centella cordifolia	Centella									1
Dichondra repens	Kidney-weed	2						2	2	
Gratiola peruviana	Austral Brooklime							3	3	1
Hydrocotyle hirta	Hairy Pennywort	2				2	2	2	2	
Lobelia anceps	Angled Lobelia			2	2	2	2	2	2	2
Viola hederacea	Ivy-leaf Violet	1	2	2	2	2	2	2	2	
Forbs (non-grassy, soft-stemmed species)										
Dianella tasmanica	Tasman Flax-lily	1						2	2	
Gonocarpus humilis	Shade Raspwort	2						2	2	
Persicaria decipiens	Slender Knotweed					2		2	2	1
Persicaria praetermissa	Spotted Knotweed							2	2	1
Senecio minimus	Shrubby Fireweed	2	2	2	2	1	2	2	1	1
Senecio velleioides	Forest Groundsel	2								
Stellaria flaccida	Forest Starwort					2	2	2	2	2
Grass-like Species										
Carex appressa	Tall Sedge		3	2	2	1	2	2	2	1
Carex fascicularis	Tassel Sedge		3	2	2	2	2	2	2	1
Echinopogon ovatus	Common Hedgehog-grass	2						2	2	
Gahnia sieberiana	Red-fruit Saw-sedge				3	1	2	2		1
Juncus amabilis	Hollow Rush									2
Juncus gregiflorus	Green Rush									2
Juncus procerus	Tall Rush									1
Juncus sarophorus	Broom Rush									2
Lepidosperma elatius	Tall Sword-sedge	1	2	2	2	2	2	2	1	
Microlaena stipoides	Weeping Grass								2	
Poa ensiformis	Purple-sheathed Tussock-grass	1					2	2	1	
Poa tenera	Slender Tussock-grass						2	2	1	
Tetrarrhena juncea	Forest Wire-grass	1	2	2	2	2	2	2		
Triglochin striata	Streaked Arrow-grass								3	1

It is quite uncommon in Victoria for revegetation to include ferns as a major component, as proposed for many of the riparian EVCs above. Most plant nurseries that service revegetation needs do not offer many ferns. Specialist fern nurseries propagate the fern species listed above but can rarely provide stock of known provenance (lineage). These problems may be overcome by allowing enough lead time for ferns to be specially propagated for a project, which may require two years or more. It would be undesirable to try recreating the affected EVCs without planting the ferns that dominate their ground flora.

Lepidosperma elatius poses a related problem. Availability is low because propagation by division is very laborious and propagation from seed (which requires tissue culture) only began commercially in

2012. As in the case of ferns, it is important to allow adequate lead time and not leave the species out of Wet Forest and Riparian Forest revegetation.

The Myrtle Beech, *Nothofagus cunninghamii*, is included in the list above on the basis that it is known to occur about 2 km south of the study area in similar rainforest and there is a high likelihood that it played a major ecological role in the Hoddles Ck rainforest prior to the extensive, repeated clearing of the past century or more.

6. Large Trees

As noted in previous chapters, there has been extensive logging in the Hoddles Creek valley throughout its period of settlement. However, a small proportion of trees have survived. The ones detected in this study are listed in Table 4 with individual identifying numbers. They are mapped with those numbers on Figure 4 (page 12) using red ink. The precision of the mapping was often better than 10 m but deteriorated to as much as 25 m at times where topography and tall trees obstructed satellite reception.

Table 4. Description of the numbered large trees mapped on Figure 4 (page 12).
The abbreviation, 'dbh' stands for 'diameter at breast height' (1.3m) and refers to the trees' trunks.
The largest specimen for each species is in bold.

Tree No.	Description
1	Mountain Grey Gum, 1·17 m dbh
2	Mountain Grey Gum, 1·50 m dbh
3	large Mountain Grey Gum
4	**Mountain Grey Gum, 2·31 m dbh**
5	Mountain Grey Gum, 2·16 m dbh
6	Messmate, 1·16 m dbh
7	Mountain Grey Gum, 1·72 m dbh
8	Dead eucalypt, 1·33 m dbh
9	Mountain Ash, 1·89 m dbh
10	Messmate, 1·51 m dbh
11	Blackwood, 71 cm dbh
12	**Blackwood, 76 cm dbh**
13	Manna Gum, 1·71 m dbh
14	Mountain Ash, 2·44 m dbh
15	**Manna Gum, 2·2 m dbh**
16	Mountain Ash, 2·3 m dbh
17	**Mountain Ash, 2·9 m dbh**
18	**Rough Tree-fern,** 10 m tall, **46 cm dbh**
19	Mountain Ash, 2 m dbh
20	Mountain Ash, 1·55 m dbh
21	Mountain Ash, 2·53 m dbh (position approx)
22	Mountain Ash, 2·0 m dbh (position approx)
23	Sassafras, large but not measured
24	Sassafras, large but not measured
25	Blackwood, 36 cm dbh
26	Tea-tree, 36 cm dbh
27	Mountain Ash, 1·5 m dbh
28	Sassafras, 50 cm dbh
29	Sassafras, 32 cm dbh
30	Messmate, 1·88 m dbh
31	Rough Tree-fern, 11 m tall
32	**Sassafras, 76 cm dbh**
33	**Austral King-fern, 1 m dbh**
34	Messmate, 1·83 m dbh
35	Austral King-fern, 75 cm dbh
36	**Dead Messmate, 2·20 m dbh** (position approx)
37	Messmate, 1·62 m dbh (position approx)
38	Sassafras & Tea-tree trunks 39 cm dbh
39	Blackwood, 75 cm dbh

The dimensions in Table 4 are impressive and many of the trees predate European arrival in Australia, but some stumps and fallen trunks are probably even larger. Sadly, we observed several extremely large eucalypts that had fallen in the past year or so due to apparently natural causes. In the absence of a statistical sample of trunk diameters of the whole population of each eucalypt species, we can only speculate that there is probably a steady decline in particularly large trees that is not being balanced by younger (generally post-settlement) trees reaching similar dimensions.

An example of some tall Rough Tree-ferns (but not the largest) appears in Figure 17 (p. 33). It is likely that some Rough Tree-ferns exceed 12 m tall but were not measured due to time limitations. The Department of Natural Resources & Environment (2001) states that the average growth rate of Rough Tree-ferns is about 7 cm per year, so an 11-metre specimen would be approximately 160 years old. The same reference indicates that Soft Tree-ferns grow much slower at '0.4 up to, but less commonly, 4 cm/year', so that the many specimens in the study area exceeding 2 m tall could be several centuries old.

The same reference also states that the growth rate of Austral King-ferns may be as low as 6 mm per year. This would make the largest specimens in the study area approximately 200 years old.

7. Wildlife and Habitat

Wildlife was not actively sought in this study but the following observations were made incidentally:

- There are many wombat burrows on the lower slopes next to Hoddles Ck and its side-gullies.
- There are extensive signs of deer beside the streams, particularly wallows, slides, hoof prints and tree trunks damaged by antlers. Some trees are dying as a result of antler rubbing.
- There are many large eucalypts with hollows adjacent to the strictly riparian zone, providing good opportunities for hollow-using wildlife such as possums, bats, owls and parrots.
- Yabbies and leeches are abundant.
- There can be very few native fish species in Hoddles Ck upstream from the lowest on-stream dam because they nearly all have to go to sea at some stage of their lifecycle.
- Streams are known to be the preeminent corridors for movement of mobile wildlife such as birds and flying insects, but the dense tree-fern canopy prevented meaningful observations of such movements along Hoddles Ck.
- Frogs were not calling during most of the fieldwork because of the time of year (winter).

8. Environmental Threats

8.1. Clearing

Recent clearing was observed within the Hoddles Ck stream reserve at several locations during the fieldwork for this study. Continuation of such clearing would represent significant environmental damage.

Although the stream reserve is public land, some of it is subject to licences owned by neighbours for various uses such as for on-stream dams and water abstractions. These licences are issued by the Department of Sustainability & Environment. They do not allow any significant amount of clearing.

The instance of clearing that has caused by far the greatest environmental damage in recent years has been adjacent to the Established Tree Transplanters property. As demonstrated by Map 2 on Figure 4 (page 12), a strip 510 m long by 35 m wide (on average) has been cleared for tree crops, an access road and associated road batter. In one place, the clearing reaches within 10 m of the waters of Hoddles Ck at low flow. The clearing has resulted in major incursions of environmental weeds into previously quite natural forest, including the rare Fern Swamp EVC (Section 4.2.1.4). Very little native vegetation is re-establishing in the cleared and excavated areas because the land is being used for cultivation of ornamental trees.

There has also been a small amount of removal of vegetation (particularly understorey) near the tip of the triangular projection of the stream reserve abutting the Established Tree Transplanters property, at the top left of Map 3 on Figure 4, some of which relates to a new dam constructed adjacent.

Map 3 on Figure 4 shows a corner of a paddock extending 50 m into the stream reserve, which may have predated the creation of the stream reserve.

Figure 21. A section of the stream reserve that has been cleared next to the Established Tree Transplanters property, with the introduced groundcover, Blue Periwinkle, suppressing native regrowth and spreading into forest beside Hoddles Ck to the left.

Other instances of clearing within the stream reserve that were observed during fieldwork are minor, mostly as collateral damage associated with accessing or using facilities for water abstraction.

8.2. Environmental Weeds

The Appendix (p. 52) includes forty introduced species that were found during this project. Most of them are of no concern but some (marked in red in the Appendix) are actively displacing indigenous flora and changing the vegetation's structure and ecological functions. Such plants are termed 'environmental weeds'. The main occurrences of environmental weeds are marked in blue on Figure 4 (page 12).

The most profound case of ongoing displacement of indigenous flora is beside the Established Tree Transplanters property as a result of the clearing discussed above. Figure 21 depicts the spread of **Blue Periwinkle** (*Vinca major*) into the forest. Blue Periwinkle is rather resistant to herbicide, requiring chemicals that would require considerable care to avoid damage to the adjacent forest and contamination of the aquatic environment. Beyond and to the left of the scene in Figure 21, **Blackberry** (*Rubus anglocandicans*) is substantially modifying the forest understorey. **Ivy** (*Hedera helix*) is only fairly scarce presently but it has the capacity to have as much effect as the Blue Periwinkle in the long term. Ivy is similarly difficult to control as Blue Periwinkle.

In this and several smaller patches in the study area, Blackberry has established where the canopy of native vegetation is thin and there has been soil disturbance. Once established, Blackberry is able to slowly spread into adjacent undisturbed vegetation, except in deep shade. Densely shady EVCs such as Cool Temperate Rainforest and Fern Swamp have shown themselves able to resist the spread of Blackberry. Blackberry is relatively easy to control with a herbicide that has little effect on the surrounding ferns and sedges, and this is recommended for each of the blackberry patches marked on Figure 4. Alternatively, the patch marked with a blue star on Map 2 of Figure 4 could be left untreated and used as an experiment to determine the propensity for blackberry to get out of control and cause ecological disruption along Hoddles Ck. That patch is already under monitoring by adjacent landowners (Laurence Gaffney and Meredith Bryce), who have so far observed it to be stable.

Holly (*Ilex aquifolium*) is scattered along Hoddles Creek from the Wombat Ck confluence upstream to about the middle of Map 2 on Figure 4. Although not dense, it became so numerous overall prior to a recent control program that it threatened to set in train a cascading process of ecological change that would result in a much less natural environment over at least a kilometre of Hoddles Creek's length. While many Hollies were killed in the control program, others were missed and follow-up will be critical for ultimate success.

There is a single patch of **Japanese Honeysuckle** (*Lonicera japonica*) at the location marked on the bottom of Map 1 of Figure 4. Although not a large patch, the author is concerned that it has the potential to proliferate and cause significant alteration to the native vegetation, its structure and the associated ecological processes and wildlife habitat. Japanese Honeysuckle is moderately difficult to control.

It goes without saying that care needs to be taken with herbicide use, particularly in proximity to rare species, rare vegetation types or water. High standards should be adopted in an area as significant as the study area. This includes (among other things) a high level of knowledge of the chemicals, methods and plants involved, and application of the Weeds CRC's riparian habitat management guide (Ede & Hunt 2008) and its guideline for herbicide use in and around water.

8.3. Deer

The population of feral deer in Victoria's Central Highlands has expanded considerably over the past decade, now becoming common as close to Melbourne as Warrandyte. Sambar is the largest and most common of the species. Sambar and Rusa Deer are the species whose habits are most consistent with signs seen during this study, and of these, Sambar are much more likely.

During the fieldwork, many trees were observed to be partly ringbarked by stags, which scrape their antlers on bark and rub their bodies against trees and tree-ferns. A trunk damaged by antlers can be seen on the left of Figure 3 on page 8. Stags favour trees with fragrant bark because the scent helps to mark their territory. Unfortunately, Southern Sassafras (which has only recently been discovered in the district) has strongly aromatic bark and has therefore suffered more damage than other species.

Deer wallows were seen at several locations in the mud of Hoddles Ck, particularly in the upper reaches. Wallowing damages the ground flora and seedlings are particularly vulnerable, thereby inhibiting reproduction of most riparian plant species.

Collectively, the impacts of deer are having a significant impact on rare plant species and endangered EVCs. The increasing population of deer in the region generally is of considerable concern, particularly as no effective, lasting control measures have been found.

8.4. Bushfire and Prescribed Fire

Rainforest is particularly vulnerable to bushfire and takes over a century to recover, if at all (Cheal 2010). The Cool Temperate Rainforest in the study area might transform into Fern Swamp if it burns, as the terrestrial fern species are mostly resistant to fire but the overstorey is not. Even a prescribed fire would pose a threat to the Cool Temperate Rainforest.

Within the Cool Temperate Rainforest and Fern Swamp vegetation, the rare epiphytic ferns, Jungle Bristle-fern (*Cephalomanes caudatum*), Small Fork-fern (*Tmesipteris parva*) and Oval Fork-fern (*Tmesipteris ovata*) are particularly vulnerable to fire. This can be inferred from the very poor response of their populations to a bushfire in early 2009 near Tomahawk Gap, 7 km to the southeast of the study area. The author (among others) checked those populations in spring 2011 and intends to publish the results elsewhere.

The high conservation significance of these species and of Cool Temperate Rainforest and Fern Swamp vegetation makes it important to protect these natural assets from fire. In particular, prescribed fire should be excluded from the affected areas. Cheal (2010, p. 114) proposes a ‘minimum tolerable fire interval’ for rainforests of eighty years, even for fire of low intensity, with the warning that ‘this does not suggest that fire is an appropriate management tool’. Burning of Cool Temperate Rainforest or Fern Swamp is unlikely to achieve any material benefit for fire safety.

Wet Forest can also be sensitive to fire, if the frequency or intensity are too great. Cheal (2010, p. 106) includes Wet Forest within the broader Ecological Vegetation Division called ‘Tall Mist Forest’ and proposes a minimum tolerable fire interval of eighty years, as for rainforests. On this basis, prescribed burns in Wet Forest should be avoided.

The Department of Sustainability & Environment’s vegetation mapping omits all of the aforementioned fire-sensitive vegetation types in the study area. This creates a risk that fire will be inappropriately prescribed in the mistaken belief that there is no fire-sensitive vegetation to be concerned about. However, as Cheal (2010, p. 217) comments, *‘As there will always be some inaccuracies and errors in data sets, map products should not replace the need for continued on-ground assessment’*.

8.5. Climate Change

The CSIRO and the Bureau of Meteorology predict increasing incidence of droughts, extremely high temperatures and bushfires. While increasing atmospheric carbon dioxide is advantageous for plants whose moisture needs are satisfied (as is generally true of riparian vegetation), extreme drought and bushfire pose significant threats to some of the study area’s greatest natural assets.

The rare Jungle Bristle-fern appears to be particularly vulnerable to extreme drought, as might be expected of a species whose foliage is one cell thick. Lorimer (2009, 2012) observed that most plants in the Hoddles Creek Education Area had died back substantially or completely by the time the recent drought broke in summer 2009-10, and most plants observed in the present study displayed fronds that appear to have died back during the drought (e.g. Figure 19, p. 37).

9. Implications for Management

1. It is very important that fire is excluded from the Cool Temperate Rainforest, Fern Swamp, paperbark & tea-tree forest, Wet Forest and areas occupied by Jungle Bristle-ferns or fork-ferns – all of which are very sensitive to fire. These areas should not be subject to prescribed burning and should be a focus of protection in the event of a bushfire.

2. Melbourne Water is responsible for the bed and banks of Hoddles Ck while the Department of Sustainability & Environment has responsibility for other aspects of the stream reserve, including licences for private use of the public land. The many significant natural assets discovered by this study point to the need for those two organisations to review the stream reserve's management, the associated allocation of resources and the impact of licenses. This should be done with attention to the Victorian Environmental Assessment Council's draft (2012) and final (imminent) proposals for its 'Yellingbo Investigation'. One of the proposals is that key stream frontages along Hoddles Ck become part of a 'State Emblems Conservation Area'.

3. It would also be desirable to disseminate the information in this report widely within the local community so that the natural assets are better known, appreciated and respected.

4. The cleared area of stream reserve beside the Established Tree Transplanters property that is presently being used for horticulture and a road should be returned to a more natural state, consistent with the land's status and intended purpose. This would require revegetation and weed control. It would also be prudent for Melbourne Water to check on recovery of native vegetation following recent vegetation removal in the triangular projection of the stream reserve seen at the top left of Map 3 on Figure 4 (page 12).

5. Elsewhere, the need for weed control is quite modest. The recommended measures are control of the Japanese Honeysuckle and Blackberry patches marked on Figure 4 and follow-up of the recent program to control Holly. The thinly scattered Cherry Laurels should be killed while following up the Holly program.

6. It may help the recovery of Cool Temperate Rainforest to plant Southern Sassafras and Myrtle Beech, which should be propagated from local stock. This may compensate for past clearing and ongoing damage by deer. If this option is adopted, it would be desirable to tag every plant and record GPS coordinates so that the progress of wild and planted populations can be separately monitored and the success of the planting tested. The number of plants is rather arbitrary. As a rough guide, it would be reasonable to plant fifty Southern Sassafras and twenty-five Myrtle Beech in the 300 m upstream of Prices Rd, and fifty Southern Sassafras beside Beenak Bushland Reserve (see Map 4 of Figure 4).

7. A specialist in propagation of ferns could be consulted about the prospects of propagating the rare epiphytic ferns discussed in Section 5.1. These species are not presently in cultivation and would present a significant challenge to raise them and return them to the wild.

10. Further Work

The natural assets discovered in this study differ greatly from what one would have expected from the sketchy pre-existing information. For example, no Cool Temperate Rainforest, Wet Forest or Oval Fork-ferns had been recorded previously in Hoddles Creek. In ignorance, these assets have not been given the protection they deserve and other natural assets have probably been lost forever.

The same is likely to apply in nearby riparian vegetation. It would therefore be desirable to conduct similar surveys of the more naturally vegetated reaches of local streams. Obvious examples include Hoddles Ck upstream of Hazeldene Rd (on private land) and parts of Blackleather Ck.

A serious historical study of the valley could shed more light on the pre-settlement nature of the vegetation and what might be done to restore lost environmental values. For example, nineteenth century maps at the Department of Sustainability & Environment's Land Information Centre may be annotated to note the presence of Myrtle Beech on upper Hoddles Ck. Old aerial photographs may be useful and information about the history of fires would considerably assist ecological interpretation of the current vegetation.

From a scientific viewpoint, it would be very useful to know how close Myrtle Beech grows to Hoddles Ck (which is almost certainly in a gully on private land). This might provide an indication that Myrtle Beech occurred within the study area at the time of settlement, in which case reintroduction should be considered. The most promising prospect is on Hoddles Ck at 565 Thonemans Rd, where Myrtle Beech was mentioned as an aside in a report by Gary Moran and Ian Sebire in support of a planning permit application on 10th October 2005.

A repeat of the botanical survey conducted in this study in years to come would probably uncover additional highlights and allow refinement of the mapping and plant lists presented here. However, the benefits of the additional information seem low compared with the likely benefits of exploring unsurveyed vegetation in the district.

Members of the Friends of Hoddles Creek can help with this exploration by keeping an eye out for the rare Lacy Wedge-fern (*Lindsaea microphylla*), which was collected beside Prices Rd in 1979 and could turn up sporadically in local Lowland Forest. It is a tufted fern, roughly shin-high, with fronds like a very slender version of Common Maidenhair. Photographs and a description can be found on the Shire of Yarra Ranges website.

There is also more fundamental botanical research needed to scientifically describe and name the giant tea-tree species found on Hoddles Ck and to improve the state-wide classification system for riparian Ecological Vegetation Classes.

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Appendix – Inventory of Plant Species

A separate list of plant species was compiled for each of the forty numbered zones mapped on Figure 22.

The table on the pages following Figure 22 indicates which species of flowering plants and ferns were observed in each zone, and with what abundance. Within each category of life form (e.g. shrubs), species are ordered alphabetically by their scientific names, using the same nomenclature as the *Census of Vascular Plants of Victoria* (Walsh and Stajsic 2007). Species whose names are written in **bold** text are rare in Victoria and those preceded by an asterisk are introduced. A question mark within a scientific name indicates that the parts of the name to the right of the question mark are uncertain.

The columns in the grid correspond to the different zones, grouped according to EVC using similar colour-coding to Figure 4 on page 12. Zone 8 is included with Wet Forest but it is immature regrowth and contains elements of Damp Forest as well. Zone 38 contains both Riparian Forest and Riparian Wet Forest.

The symbols used for the entries within the narrow columns have the following meanings:

- D Dominant (or sharing dominance) within the relevant vegetation stratum, at least in part of the zone;
- M Many individuals occur within the zone but with too little foliage cover to be dominant;
- ✓ Present in moderate numbers, not dominant within a vegetation stratum;
- - Scarce.

Where these symbols appear in blue type, the identity of the species is uncertain. Where they appear in red and encircled, the species is introduced and represents a serious threat to indigenous flora or fauna in the zone indicated (Chapter 8).

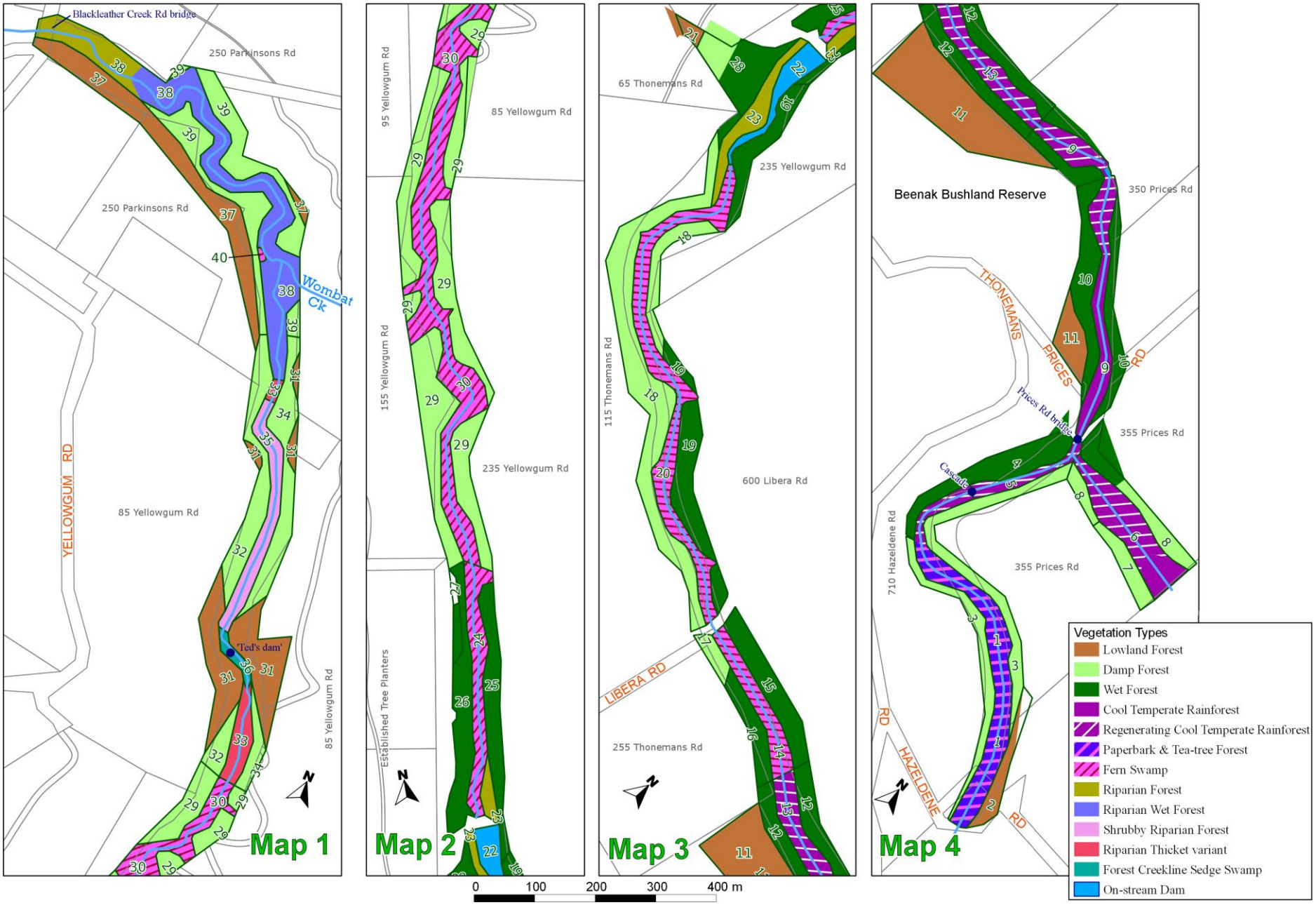

Figure 22. A map of the zones within which separate lists of species were compiled, which are outlined and numbered in green.
The four panels correspond to the green rectangles on Figure 1 (p. 5).

	Vegetation Types →	Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
	Zones from the map →	2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Mistletoe																																									
Amyema pendula	Drooping Mistletoe																				-																				
Trees																																									
Acacia dealbata	Silver Wattle			D		✓	-			✓	-	D	D	✓	-	✓	✓	✓	D				D	D	-	-		✓	-	-	✓	-			✓	✓	✓			-	
Acacia ?mearnsii	Black Wattle																	-																							
Acacia melanoxylon	Blackwood	✓	✓		✓	-	✓	-	D		D	✓	✓	-			✓	D		✓	-	D	-		✓	✓		D	M	D	D	D	D	✓	✓	✓	✓				
Acacia obliquinervia	Mountain Hickory Wattle							-																																	
Atherosperma moschatum	Southern Sassafras																								✓	D	D	✓	-	-			-								
Bedfordia arborescens	Blanket-leaf						✓			-	M		-		✓	✓	✓	-	-		✓	✓	✓	-				-													
Eucalyptus baxteri	Brown Stringybark									-																															
Eucalyptus cephalocarpa	Mealy Stringybark				-																																				
Eucalyptus cypellocarpa	Mountain Grey Gum			-		✓				✓	D	D	D	D									✓	✓												✓	D				
Eucalyptus obliqua	Messmate Stringybark	D	D	D	D	D	D	-	M	D	D	D	D	D	-	D						✓	-													-	✓				
Eucalyptus radiata	Narrow-leaf Peppermint	-	D		D	D	-		D	D	D	D	D	✓																											
Eucalyptus regnans	Mountain Ash									-					D	D	D	D	D	D	D	D	✓	D																	
Eucalyptus sieberi	Silver-top		✓																																						
Eucalyptus viminalis subsp. *viminalis*	Manna Gum									✓	D	-										D	D														✓	D			
Exocarpos cupressiformis	Cherry Ballart					✓																																			
**Ilex aquifolium*	Holly				-	✓						(✓)																					(✓)	(✓)		-					
Leptospermum aff. *lanigerum*	an undescribed tea-tree									-															-		✓		D	D	D	-	-		D						
Melaleuca squarrosa	Scented Paperbark																										✓	✓	D	D	✓		✓	D	D	D					
**Pittosporum undulatum*	Sweet Pittosporum																						-																		
Pomaderris aspera	Hazel Pomaderris						D	✓	D	D	D	✓	✓	✓	D	D	D	D	-	-	D		D	D	M	M	D	D	✓	-	D	D	D	D	✓	✓	✓	D			
Zieria arborescens	Stinkwood						✓		✓	-					M	D	M	M	D	D	✓				✓	-			✓	✓											

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Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Large Shrubs																																									
Acacia mucronata	Narrow-leaf Wattle				-	-																																			
Bursaria spinosa	Sweet Bursaria			-	✓	✓					-																										✓			-	
Hedycarya angustifolia	Austral Mulberry							-			M	✓	✓	D		✓	✓	✓	M		✓	-	✓		✓	✓	M	✓	-	D	✓	D	✓	✓	D	D	D	-		-	
Lomatia fraseri	Tree Lomatia						✓	-		-	-				✓	-	✓	-	-	-		-	-			-															
Myrsine howittiana	Muttonwood								-									✓				-	-			-		-					✓								
Olearia argophylla	Musk Daisy-bush						-		-	-	✓	-	-	-		✓		✓	M			✓	D			-	-			-	-		✓				-	-			
Pittosporum bicolor	Banyalla						✓			-	✓				✓	✓	✓	✓	M	D	M	-	-		✓	✓	✓	✓	M	✓			-			-					
Prostanthera lasianthos	Victorian Christmas-bush	✓				✓	✓	✓	D	M	M		✓	✓	✓	M	✓	D	D	D	D	✓	M	D	-	-			-	✓	✓	✓	✓	✓	-	-	✓	D			
**Prunus laurocerasus*	Cherry Laurel																					-	-																		-
**Salix* sp.	an unidentified willow																																							-	
Smaller Shrubs																																									
Acacia myrtifolia	Myrtle Wattle	-																																							
Acacia stricta	Hop Wattle						-																																		
Acacia verticillata	Prickly Moses	M	-				-																																		
Banksia spinulosa	Hairpin Banksia		D		-	-																																			
Bauera rubioides	Wiry Bauera	D	✓																																						
Cassinia aculeata	Common Cassinia	-		✓	✓	✓				-	-	✓	✓			✓					-	-	-									-				-	✓	✓			
Cassinia trinerva	Three-nerved Cassinia							✓	✓	-	-					✓	M	✓	✓	✓		D	✓	✓			D						-					✓			
Coprosma hirtella	Rough Coprosma							-																																	
Coprosma quadrifida	Prickly Current-bush		✓	-	✓	✓	✓		M	✓	✓	D	D	D	✓	✓	M	M	M	M	D	M	M	D	✓	✓	M	M	✓	D	✓	✓	-	✓	D	D	D	M			
Correa reflexa* var. *lobata	**Powelltown Correa**	✓																																							
Daviesia ulicifolia	Gorse Bitter-pea				-																																				
Epacris impressa	Common Heath			✓	✓	-							-																												
Goodenia ovata	Hop Goodenia	✓	-	✓			✓	✓	✓	✓	✓		-		✓	✓	✓	-	✓	✓		✓	-	D		-									-		✓	✓			
Goodia lotifolia	Golden-tip													-																							-				
Hakea decurrens	Bushy Needlewood		-			-																																			
Kunzea ericoides species aggregate	Burgan	✓	D	D	D	D		-		-	-	D	D			-			-				-	D											-					-	
Leptospermum continentale	Prickly Tea-tree				✓	✓																																			

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Leucopogon virgatus	Common Beard-heath				-																																				
Olearia lirata	Snowy Daisy-bush	✓	M	✓		D	✓		✓	✓		✓	✓	✓	✓		M	M	✓	✓		M	M	D											-		✓	D			
Olearia rugosa	Wrinkled Daisy-bush	✓															-	-																							
Oxylobium arborescens	Tall Shaggy Pea							-																																	
Ozothamnus ferrugineus	Tree Everlasting										-																														
Pimelea axiflora	Bootlace Bush						M		✓	✓	✓		-		M	✓	✓	✓	✓	✓	M	-	-	-																	
Platylobium formosum s.l.	Handsome Flat-pea	M		-	✓	M	-			-	-		-	-			✓																								
Polyscias sambucifolia	Elderberry Panax	✓	✓	-		-	✓	✓		✓		-	-	-	✓	✓	✓	✓																							
Pultenaea forsythiana	Eastern Prickly Bush-pea				✓	✓																																			
Pultenaea gunnii	Golden Bush-pea				M	-					-																														
Solanum ?aviculare	Kangaroo Apple										-																										-				
Spyridium parvifolium	Australian Dusty Miller	M	✓	-	-	-																																			
Tree-ferns																																									
Cyathea australis	Rough Tree-fern	-	✓		-	✓	-	✓	D	-	M	✓	✓	D	-	M	M	M	M	M	M	M	D	M	M	D	D	M	M	D	M	M	-	✓	D	D	✓	✓	✓	-	
Dicksonia antarctica	Soft Tree-fern										-					-	✓	✓	-		M		-		D	D	D	D	M	D	D	D	D	D	D	D	-				
Todea barbara	Austral King-fern												-												-	-	M	M	D	✓	✓	-	-	✓		-					
Epiphytic Ferns																																									
Cephalomanes caudatum	**Jungle Bristle-fern**																								✓	-	-	-	-	-	✓										
Crepidomanes venosum	Veined Bristle-fern																								✓	M	M	M	✓	✓	✓	✓	✓								
Grammitis billardierei	Common Finger-fern																					-			M	M	M	✓	M	-	✓	✓	✓			-	-				
Hymenophyllum australe	Austral Filmy Fern																								-	-		-	-		-		-								
Hymenophyllum cupressiforme	Common Filmy Fern													-							-	-					✓	✓	-	-	-	-	✓				-				
Hymenophyllum flabellatum	Shiny Filmy Fern						-																			✓	✓	✓	-				✓			-					
Microsorum pustulatum	Kangaroo Fern																									-						-					-				
Rumohra adiantiformis	Leathery Shield-fern																									-	✓	-	-	-	-	-	-								
Tmesipteris obliqua	Long Fork-fern														-				-	-					M	M	✓	✓	✓	✓	✓	-	-			-					
Tmesipteris ovata	**Oval Fork-fern**																											-					-								
Tmesipteris parva	**Small Fork-fern**														-						-				-	-	-		-	-	✓		-								

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Ground Ferns																																									
Adiantum aethiopicum	Common Maidenhair					✓						-		-																							-				
Asplenium bulbiferum	Mother Spleenwort																										-					-	-								
Blechnum cartilagineum	Gristle Fern						✓	M	D	M	✓	M	M	D	✓	D	M	M	✓		M	M	M	✓	✓	M	-	M	✓		✓	M			M	M	-	✓		✓	
Blechnum chambersii	Lance Water-fern																									✓	-				✓	✓									
Blechnum fluviatile	Ray Water-fern																										-						✓								
Blechnum minus	Soft Water-fern																																		✓	-				✓	
Blechnum nudum	Fishbone Water-fern													D		✓										✓	-	D	✓	M	✓	D	D	D	D	M	D	✓		✓	
Blechnum patersonii	Strap Water-fern																																-								
Blechnum wattsii	Hard Water-fern						D			✓	M				D	D	D	M	D	✓	D	D	✓		D	D	D	D	D	D	D	D	✓		-	-				-	
Calochlaena dubia	Common Ground-fern		D	✓	✓	✓	✓	D	M	D	M	D	D	D		D	✓	D		✓		-	-	D											M	✓	M	✓			
Gleichenia dicarpa	Pouched Coral-fern		✓																																						
Gleichenia microphylla	Scrambling Coral-fern	M					-																					-	M	✓	-	-	-		-	-				-	
Histiopteris incisa	Bat's Wing Fern										-			-	✓	✓		✓	✓		-				✓	-	-		✓	-	-	-	-		✓	✓	-				
Hypolepis rugosula	Ruddy Ground-fern																							-												-					
Lindsaea linearis	Screw Fern					-																																			
Lycopodium deuterodensum	Bushy Clubmoss			-																																					
Polystichum proliferum	Mother Shield-fern								-	M	-			✓	-	-	✓	M	M		✓	D	D	-						-		-	✓				-	✓			
Pteridium esculentum	Austral Bracken	M	M		D	D	-	✓	-				M	✓	-	-	-			-	-	-	-	-					-								✓				
Pteris tremula	Tender Brake																															-									
Sticherus urceolatus	Silky Fan-fern												-	✓		✓									✓		✓		M	-	✓	-	✓			-					
Climbers																																									
Billardiera mutabilis	Common Apple-berry	-			-	-																	-																		
Calystegia marginata	Forest Bindweed																						-																		
Clematis aristata	Mountain Clematis		✓		✓	✓	✓		M	✓	M	✓	✓	M	✓	✓	M	M	M	✓	M	M	M	M		✓	✓	M		✓	✓	M		✓	-	✓	✓	✓			
Comesperma volubile	Love Creeper				✓																																				
Glycine clandestina	Twining Glycine																																				-				
Pandorea pandorana	Wonga Vine						✓						-		✓	✓	M	✓	✓	-	-	-				✓	M	✓		-	-	-	-								

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Parsonsia brownii	Twining Silkpod						M		✓	✓	M	-			M	✓	✓	✓	✓	M	M		M	M	M	✓	M	M	M	✓	M	M	✓	-			-				
**Rubus anglocandicans*	Blackberry					✓	-		(✓)	(✓)				✓					(✓)	(✓)	(✓)		(M)	(✓)	-	-	(✓)	(✓)	-	(✓)	-	(✓)	-		-		(✓)	(✓)		(✓)	(M)
Rubus parvifolius	Small-leaf Bramble										✓		-	-				✓																-			-				
Creepers																																									
Acaena novae-zelandiae	Bidgee-widgee									✓	-	✓				-	-				-		✓	✓		-				-					✓		✓		✓	✓	
Acrotriche prostrata	Trailing Ground-berry				✓	-																																			
Asperula conferta	Common Woodruff										-																														
Australina pusilla	Shade Nettle																	✓	M			✓	✓			-	-	M		D	✓	✓	✓		M						
Callitriche muelleri	Round Water-starwort																										-	-				✓	✓	✓	M	✓	✓			M	
**Callitriche stagnalis*	Pond (or Common) Water-starwort																									-	-	-		-	-	-			-				✓		
Centella cordifolia	Centella																																							-	
Dichondra repens	Kidney-weed																																	-							
Galium gaudichaudii	Rough Bedstraw				-								-	✓				-			-		-													-	✓				
Galium ?propinquum	Maori Bedstraw																																				-				
Geranium homeanum	Northern Crane's-bill			✓						✓		✓									✓		✓							-	-				✓			-		✓	
Geranium ?potentilloides	Cinquefoil Crane's-bill																	-																							
Geranium sp.	an unidentified crane's-bill										-			✓		-																		-			✓				
Glycine microphylla	Small-leaf Glycine			✓																																					
Gonocarpus micranthus	Creeping Raspwort																																				✓				
Goodenia lanata	Trailing Goodenia				-	✓																																			
Gratiola peruviana	Austral Brooklime																									-								-		-	-			M	
**Hedera helix*	Ivy																						(-)																		
Hydrocotyle geraniifolia	Forest Pennywort															✓	M	✓	✓		✓					✓				-		-									
Hydrocotyle hirta	Hairy Pennywort								✓		-							✓	-			✓	-			-			-	-		-		-	✓		-			✓	
Hypericum japonicum	Matted St John's Wort																																							✓	
Lobelia anceps	Angled Lobelia																																							-	
Oxalis exilis/perennans	Wood-sorrel										✓	✓	✓			-				-	-	-										-				-	✓			-	
**Trifolium repens*	White Clover																																								-
**Vinca major*	Blue Periwinkle																						(✓)																		(D)

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Viola hederacea	Ivy-leaf Violet	M	✓	✓	✓	M	M		✓	✓	✓	✓	✓	✓	M	M	M	M	✓	✓	M	M	✓		-	-			-	✓	-	✓	-	✓	-		✓				
Forbs (non-grassy, soft-stemmed species)																																									
Amperea xiphoclada	Broom Spurge				✓	✓																																			
**Aster subulatus*	Aster-weed			-																																					
*Brassicaceæ species	an unidentified crucifer																																								M
Burchardia umbellata	Milkmaids				-																																				
**Cardamine flexuosa*	Wood Bitter-cress																											-		-	-	-			-		-				✓
Chiloglottis cornuta	Green Bird-orchid									-				-																-	-		✓				-				
Chiloglottis valida	Common Bird-orchid			-		✓																																			
**Cirsium vulgare*	Spear Thistle					-															-	-	-							-	-		-		-		-			-	✓
**Conyza sumatrensis*	Fleabane																											-													
Corybas diemenicus	Veined Helmet-orchid													-											-	M				✓	-										
**Crepis capillaris*	Smooth Hawksbeard																																								-
Dampiera stricta	Blue Dampiera				-																																				
Dianella caerulea	Paroo Lily				✓																																				
**Digitalis purpurea*	Foxglove																						✓																		✓
Drosera peltata subsp. *auriculata*	Tall Sundew				✓	M																																			
Drosera whittakeri	Scented Sundew				✓	✓																																			
Epilobium billardierianum subsp. *cinereum*	Variable Willow-herb																																		-				-	✓	
Euchiton involucratus	Common Cudweed																									-	-				-	-			✓					✓	
**Galium aparine*	Cleavers																																								✓
**Gamochaeta purpurea*	Spiked Cudweed																																						-		
Gonocarpus humilis	Shade Raspwort	✓	✓		-		✓			✓	✓	-	-		✓	✓	✓	✓		-		-	-			✓		✓								-					
Gonocarpus tetragynus	Common Raspwort			✓	✓	✓																																			
?*Hibbertia empetrifolia*	Tangled Guinea-flower						-																																		
Hypericum gramineum	Small St John's Wort									-																													M		
**Hypochoeris radicata*	Cat's Ear			✓	-				-	-								-					-	✓												-	-			-	✓

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Lagenophora stipitata	Common Lagenophora				✓									✓																											
**Leontodon taraxacoides*	Hairy Hawkbit																													-										-	-
**Lonicera japonica*	Japanese Honeysuckle																																-								
**Lotus corniculatus*	Bird's-foot Trefoil																																							M	
**Lotus* sp.	an unidentified trefoil																															-									
**Myosotis ?sylvatica*	Wood Forget-me-not																													-											
Olearia myrsinoides	Silky Daisy-bush				✓	-																																			
Pelargonium inodorum	Kopata			-																																					
Persicaria decipiens	Slender Knotweed																															-			-				✓	-	
Persicaria praetermissa	Spotted Knotweed																																						✓		
Plantago debilis	Shade Plantain																	-																							
**Plantago lanceolata*	Ribwort																																								✓
**Plantago major*	Greater Plantain																																						-		
Poranthera microphylla	Small Poranthera					-																																			
**Potentilla indica*	Indian Strawberry																													-	✓				✓					-	✓
**Prunella vulgaris*	Self-heal																										-	-		-	-	-	-	-	-	-			✓	✓	
Pterostylis nutans	Nodding Greenhood			-																																					
Pterostylis pedunculata	Maroon-hood													-								-								-	-						✓				
**Ranunculus repens*	Creeping Buttercup																										✓	-													
**Rumex* sp.	an unidentified dock																				-						-	-			-	-			-						
Sambucus gaudichaudiana	White Elderberry																				-		✓										-								
**Senecio jacobaea*	Ragwort																																								✓
Senecio minimus	Shrubby Fireweed								-					✓							-		✓	-		-	-	-			✓	✓	-		M		✓	-		M	
Senecio velleioides	Forest Groundsel						-								-																										
Sigesbeckia orientalis	Indian Weed										-											✓	✓				-	-		-											
**Solanum americanum*	Glossy Nightshade									-							-		-	-			-				-	✓		-	-	-	-								
Solanum prinophyllum	Forest Nightshade			✓			-		✓	-	-				-	-	✓	-				-	-			-							-								
**Sonchus asper*	Rough Sow-thistle																																								-
**Sonchus oleraceus*	Sow-thistle																											-													✓

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest									
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28
Scientific Name	**Common Name**																							
Stellaria flaccida	Forest Starwort										-												-	
**Stellaria media*	Chickweed																							
Stylidium armeria	Grass Trigger-plant				-																			
**Taraxacum officinale* spp. agg.	Garden Dandelion																							
Tetratheca ciliata	Pink-bells		✓							-														
Urtica incisa	Scrub Nettle																				-			
Villarsia reniformis	Running Marsh-flower																							
Wahlenbergia ?stricta	Tall Bluebell				-																			
Grass-like Species																								
**Anthoxanthum odoratum*	Sweet Vernal-grass																							
Austrostipa muelleri	Wiry Spear-grass					-																		
Carex appressa	Tall Sedge																							
Carex breviculmis	Short-stem Sedge				-																			
Carex fascicularis	Tassel Sedge																							
Carex sp.	an unidentified sedge																							
Dryopoa dives	Giant Mountain Grass			-				-							-	-	-	-						
Echinopogon ovatus	Common Hedgehog-grass																	-						
Gahnia radula	Thatch Saw-sedge				✓	M								-										
Gahnia sieberiana	Red-fruit Saw-sedge				-						✓		-	-										
**Holcus lanatus*	Yorkshire Fog															-								
Isolepis inundata	Swamp Club-rush			✓																				
Isolepis sp.	an unidentified club-rush																							
Joycea pallida – see *Rytidosperma pallidum*																								
Juncus amabilis	Hollow Rush																							
**Juncus articulatus*	Jointed Rush																							
Juncus gregiflorus	Green Rush			-																				
Juncus planifolius	Broad-leaf Rush																							
Juncus prismatocarpus	Branching Rush																							
Juncus procerus	Tall Rush			-																				

Vegetation Types →		Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																	
Stellaria flaccida	Forest Starwort											✓						
**Stellaria media*	Chickweed						-	-										
Stylidium armeria	Grass Trigger-plant																	
**Taraxacum officinale* spp. agg.	Garden Dandelion											-					-	
Tetratheca ciliata	Pink-bells																	
Urtica incisa	Scrub Nettle				-													
Villarsia reniformis	Running Marsh-flower											-						
Wahlenbergia ?stricta	Tall Bluebell																	
Grass-like Species																		
**Anthoxanthum odoratum*	Sweet Vernal-grass															✓ (circled)		
Austrostipa muelleri	Wiry Spear-grass																	
Carex appressa	Tall Sedge	-	✓	-	-	-	-	-	-	✓	✓	✓	-	✓			D	
Carex breviculmis	Short-stem Sedge																	
Carex fascicularis	Tassel Sedge	-	-			-						-					✓	
Carex sp.	an unidentified sedge															✓		
Dryopoa dives	Giant Mountain Grass		-															
Echinopogon ovatus	Common Hedgehog-grass													-				
Gahnia radula	Thatch Saw-sedge													✓				
Gahnia sieberiana	Red-fruit Saw-sedge										-	✓		-		-	✓	
**Holcus lanatus*	Yorkshire Fog																	✓
Isolepis inundata	Swamp Club-rush	-	✓						-	-		M				M	M	
Isolepis sp.	an unidentified club-rush	-				-	-	✓	-		✓	✓	✓	✓				
Joycea pallida – see *Rytidosperma pallidum*																		
Juncus amabilis	Hollow Rush															-		
**Juncus articulatus*	Jointed Rush																-	
Juncus gregiflorus	Green Rush																	
Juncus planifolius	Broad-leaf Rush								-				-			✓	✓	
Juncus prismatocarpus	Branching Rush															M	-	
Juncus procerus	Tall Rush											-				-	✓	

Vegetation Types →		Lowland Forest					Damp Forest								Wet Forest										Rainforest				Paperbark & tea-tree forest	Fern Swamp					Riparian Thicket variant	Shrubby Riparian Forest	Riparian (Wet) Forest	Riparian Forest	On-stream dam	'Ted's dam'	Cleared land
Zones from the map →		2	11	21	31	37	3	7	17	18	29	32	34	39	4	8	10	12	15	16	19	25	26	28	5	6	9	13	1	14	20	24	30	40	33	35	38	23	22	36	27
Scientific Name	**Common Name**																																								
Juncus sarophorus	Broom Rush																																						-		
Lachnagrostis filiformis	Common Blown Grass																																				-		M		
Lepidosperma elatius	Tall Sword-sedge	✓	✓		-		M	-	D	✓	D	✓	✓	D	M	M	D	D	M	D	D	M	M		✓		-	✓	✓	-	✓		-	✓	✓	✓	✓	D			
Lepidosperma laterale	Variable Sword-sedge			-																																					
Lomandra filiformis subsp. *coriacea*	Wattle Mat-rush				✓	✓																																			
Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush					-																																			
Lomandra longifolia subsp. *exilis*	Cluster-headed Mat-rush				-	-								-																							-				
Luzula meridionalis	Common Woodrush			✓																																	-				
Microlaena stipoides	Weeping Grass					-			-				-						-				-												-	-	-				
**Phyllostachys aurea*	Fishing Pole Bamboo													-																											
Poa ensiformis	Purple-sheathed Tussock-grass										-		-	-									-														M				
Poa ?sieberiana var. *sieberiana*	Grey Tussock-grass				-																																				
Poa tenera	Slender Tussock-grass											-		✓																						-	M		✓		
Rytidosperma ?penicillatum	Slender Wallaby-grass																																		-					-	
Rytidosperma pallidum	Silvertop Wallaby-grass				✓																																				
Schoenus apogon	Common Bog-rush				-																						✓														
Schoenus maschalinus	Leafy Bog-rush			-												-										-					-		✓	-	-			-		-	
Tetrarrhena juncea	Forest Wire-grass	M	M		✓	M	D	M	M	M	M	✓	✓	M	D	M	M	M	✓	M	M	M	M	-	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	M	✓			
Triglochin striata	Streaked Arrow-grass																																		✓					D	
Typha ?domingensis	Cumbungi																																							M	
Xanthorrhoea minor	Small Grass-tree				✓	✓																																			