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Floristic survey, management implications for planned environmental water allocation and comments on revegetation, Burke Road Billabong, Kew East



Prepared for: Vivian Amenta

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Summary

Background

Burke Road Billabong Reserve Kew is a c. 10 ha urban reserve some 8 km from Melbourne city centre. The Reserve contains a number of natural values that are now rare in inner urban areas including a billabong, *Eucalyptus camaldulensis* (River Red-gum) dominated woodland, records of flora and fauna of state to local significance and public access to native bushland close to the city. The Reserve is also part of the ecological corridor which runs for many kilometres along the Yarra River.

The site has a history of disturbance, including clearing and grazing in some parts, and altered hydrology due to the construction of the nearby freeway and the adjacent Kew Golf Course. This has resulted in the introduction of a number of weed species with up to as much as 50% cover dominating the understory. In addition, the natural filling of the billabong has been occurring with decreasing frequency due to the impacts from surrounding land use and upstream impacts on the river.

In 2010 the Reserve management committee developed and implemented a Reserve Management Plan. The work included consulting with Melbourne Water to have the billabong added to their environmental watering roster which will see it filled every 3-5 years. Extensive weed control and revegetation in the Reserve has been undertaken to address the declining understory condition.

Ecology Australia was commissioned in 2018 to undertake a floristic assessment and provide advice on the implications for the vegetation of environmental filling. In addition, there have been major weed control and revegetation works undertaken by the Burke Road Billabong Reserve management committee. The report will provide comment on the vegetation changes as a result of these works with reference to the Burke Road Billabong Reserve 2010 Management Plan.

Findings

A total of 215 plant species was recorded on site including 125 (58%) exotic species, 88 (41%) native plant species, which includes 2 (1%) native species with ambiguous status.

Two Ecological Vegetation Classes (EVCs) were recorded, Floodplain Riparian Woodland (EVC 56) and Floodplain Wetland Aggregate (EVC 172) both classified as Endangered in the Gippsland Plain bioregion.

Native Peppergrass (*Lepidium hyssopifolium*) classified as 'k' (poorly known) in Victoria has been recorded in the Reserve previously and was recorded in 2018. Swamp Flax-lily (*Dianella callicarpa*), classified as 'rare' in Victoria was also recorded. No plants listed under the Victorian *Flora and Fauna Guarantee Act 1988* or under the Federal *Environment Protection and Biodiversity Conservation Act 1999* were recorded.

Eight Australian native species that are weeds in this location were recorded in the Reserve in 2018.

Eleven weed species listed under the *Catchment and Land Protection Act 1994* (CaLP Act) were recorded.

Evidence of disturbance and negative impacts recorded in 2018 included:

- Soil disturbance and destroyed vegetation from informal BMX/mountain bike tracks
- Dumped rubbish

- Weed infestations (weed seed sources) on land adjacent to the reserve
- Off-target weed spraying of native plants
- Disused revegetation materials which may injure fauna
- Active fox dens
- Deer browsing

Billabong management implications

The planned environmental filling of the billabong will have positive implications for in situ native aquatic and riparian flora which will be enhanced by increased water availability, particularly given that no aquatic weed species were recorded.

Some terrestrial weed species were recorded in the billabong and filling may assist with control of these weeds depending on whether water is retained long enough to create anoxic conditions in the root zone which will kill them. Water was only retained for a few days with the first pumping as the river level dropped too low to continue pumping. Weed management in and around the billabong should only include herbicides deemed safe for use in and around waterways.

Retention of logs and organic detritus is recommended to habitat, food sources and niches for biota.

Increased filling should enhance habitat for biota including bacteria, algae and invertebrate fauna diversity and population size. In turn this would be a source of food for vertebrate fauna such as birds, reptiles and amphibians.

Comments on revegetation works undertaken since 2010

The revegetation works have greatly reduced the weed cover and increased the understory cover of native plants which in turn has improved the condition of the two EVCs on site. The number of native plant species has increased by 59 (from 30 to 89).

Except for Crack Willow (**Salix X fragilis*), all high and moderate priority weeds listed in the 2010 Reserve management plan were also recorded in 2018 but with much lower cover.

Tree Violet (*Melicytus dentatus*) cover is very high and it is recruiting prolifically. Thinning is recommended to increase amenity (it is a dense, very spiny shrub) and reduce competition for other in situ native plant populations.

Recommendations

A number of recommendations are made to continue working towards the objectives of the 2010 Reserve management plan:

- Thin the stands of Tree Violet
- Remove the native Australian plant species that are weeds in this location and replace with indigenous plants
- Prioritise the removal of weeds listed under the CaLP Act 1994
- Protect and restore populations of Native Peppergrass
- Monitor and control foxes as necessary

- Monitor and control deer as necessary
- Remove and revegetate informal bike tracks
- Remove dumped rubbish
- Liaise with adjacent land managers to control weeds on their land which may act as sources of propagules (mostly seeds) to enter the Reserve
- Ensure weed contractors are well trained in identifying native plants targeting the wrong species (e.g. *Rytidosperma* species) and to prevent off-target herbicide damage
- Remove disused tree guards and weed mats

1 Introduction

The Burke Road Billabong reserve is located in the inner Melbourne suburb of Kew East, 8 km north east of the city. The c. 10 ha reserve is located on the Yarra River flood-plain on the banks of the Yarra River and, as its name suggests, is centred around a billabong (Figure 1, Cover picture).

The reserve contains *Eucalyptus camaldulensis* (River Red-gum) dominated woodland or open forest which includes a number of large old River Red-gums. Victorian Rare or Threatened Flora Species (VROTS), and flora and fauna of local significance have been recorded there (DSE 2010, Lorimer 2006). The site is part of an important urban ecological corridor which extends many kilometres upstream and downstream of the site along the Yarra River. Lorimer (2006) states it is '*arguably Melbourne's foremost ecological corridor*'.

The reserve offers what is now a rare opportunity for the public to access native bushland this close to the city.

The billabong has been filling from overbank flows from the river with declining frequency over the past 40 years and last filled naturally in 2013 (Figure 2). It is understood that the opportunity has arisen for the billabong to be supplied with water pumped from the adjacent Yarra River as part of Melbourne Water environmental water allocation roster every three to five years (S. Barker pers. comm.). The proposed change to the hydrology of the billabong may have implications for the vegetation in and around the billabong.

In November 2017, Ecology Australia was commissioned by the Department of Environment, Land, Water and Planning (DELWP) to:

- conduct a flora assessment of Burke Road Billabong Reserve;
- report on the likely vegetation changes associated with the commencement of the environmental water pumping into the billabong; and
- provide comments on the vegetation changes resulting from management works with reference to the 2010 Burke Road Billabong Reserve Management Plan (DSE 2010).

The following report addresses the abovementioned objectives and includes a brief introduction to the study area, outline of methods, survey findings, implications of altered billabong hydrology for flora, and comments on vegetation management works.

1.1 Study area

Location

The Burke Road Billabong Reserve (study area) is located on the southern banks of the Yarra River (Figure 1). The reserve is bordered to the east by Burke Road, to the south by the Kew golf club and eastern freeway and to the west by the Kew Golf Club.

The study area is accessed by the bike track entry points on the southern and eastern boundaries and via the carpark at the garden and water feature retail premises on the eastern edge of the reserve just off Burke Road.

The site is reserved Crown Land located in the Gippsland Plain bioregion, Port Phillip and Western Port Catchment Management Authority and Boroondara City Council areas.

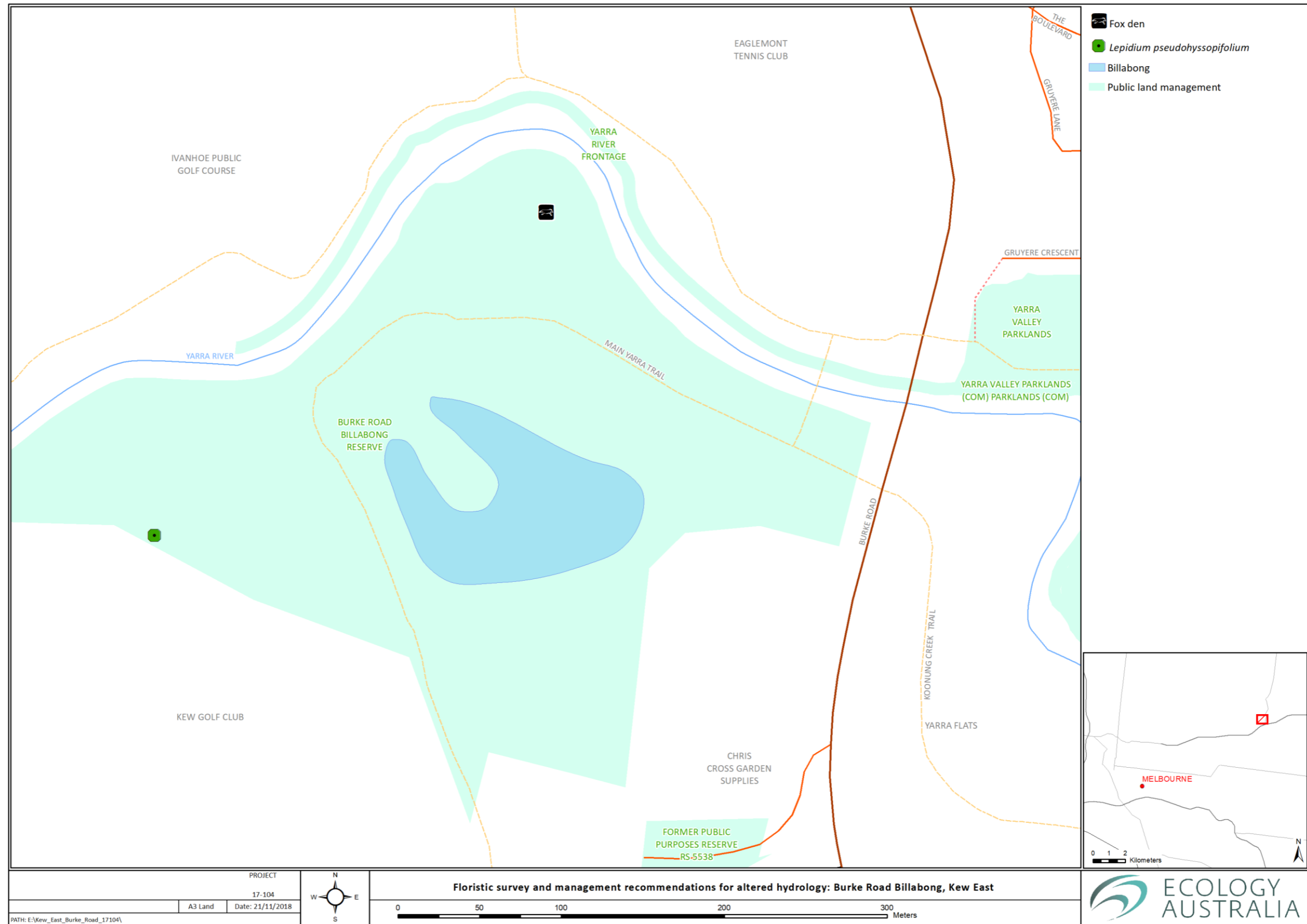


Figure 1 Burke Road Billabong Reserve, Kew, 2018

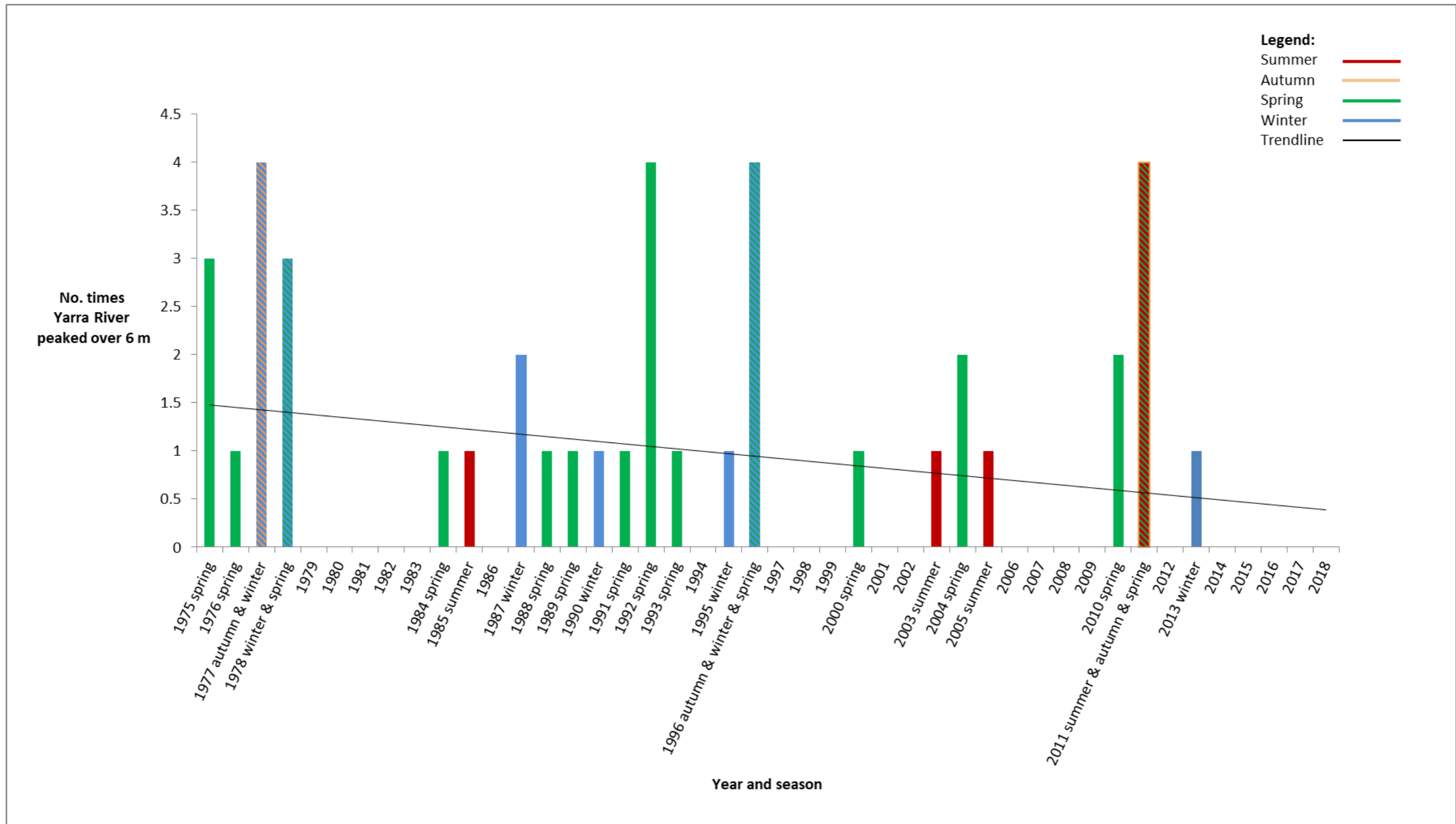


Figure 2 Dates and number of times Yarra River height peaked at over 6 m and overflowed into the billabong at Burke Road Billabong Reserve, Kew (source Melbourne Water data from S. Barker pers. comm.)

The reserve is zoned Public Park and Recreation Zone PPRZ and covered by a number of overlays including: Land Subject to Inundation Overlay (LSIO), Significant Landscape Overlay Schedule 1(SLO1) and Urban Floodway Zone (UFZ) (south east section only) (DELWP 2018a). Overlays specify land management objectives and permit requirements for works (such as vegetation management) in the reserve under the Boroondara Planning Scheme. In Victoria the *Guidelines for the removal, destruction or lopping of native vegetation* (Guidelines) (DELWP 2017) replaces the previous *Permitted Clearing of Native Vegetation - Biodiversity assessment guidelines* (DEPI 2013) which regulate vegetation removal. They are incorporated into all Victorian Planning Schemes and are applied under Clause 52.17 of the Boroondara Planning Scheme. Overlays and the Guidelines need to be considered when planning any vegetation removal works.

Management

Management information is sourced from the 2010 Burke Road Billabong Reserve Management Plan and 2013 draft Burke Road Billabong Reserve Management Plan (DSE 2010 & DSE 2013).

The study area was used for grazing in the 1800s with areas to the north east and south of the billabong cleared for agriculture in the early 1800s. Later that century the Kew Golf Club was constructed and the boundary extended close to the edge of the billabong. Part of the site near Burke Road was the site of the former Kew tip. A trunk sewer has been constructed running north west to south east across the western part of the study area. There is a sewer pump station overflow pipe running north-northeast/south-south west across the eastern part of the reserve. The construction of the eastern freeway in the 1970s diverted the drainage of the local area and reduced the catchment of the billabong.

Prior to 2008, DELWP (the responsible authority) managed a three hectare parcel of land to the east in the current reserve and in 2008 appointed the Burke Road Billabong Reserve Management Committee to undertake revegetation and maintenance works.

At that time the site had a high cover of weeds, pest animal populations and destructive recreational uses. The management committee began a program of weed management and revegetation. Following this, an additional seven hectare parcel of land owned by Vic Roads to the west was added to the crown land reserve. Weed-management works and revegetation has continue since then in the now c. 10 hectare reserve.

The Main Yarra Trail and Koonung Trail bike paths run through the reserve. The bike paths and land one metre either side are managed by DELWP. Melbourne Water manages the Yarra River and a zone 20 m wide either side of the river.

Geology

The underlying geology of the study area is Quaternary (Holocene) alluvial sediments (gravel, sand, silt) over lower Silurian marine sandstone and siltstone referred to as the Anderson Creek formation (Geoscience Portal 2018). The elevation of the reserve ranges from 9-14 metres above sea level (ASL) and the billabong sits at 7-8 m ASL (hand-held GPS).

Climate

The long term climate data used here includes combined records from three weather stations: Viewbank weather station 7 km from the study area (nearest open weather station – 1999 to 2018),

Burnley 5 km away–1855-2015 and Kew 3 km away – 1911 to 1973 (both stations now closed) (BOM 2018).

The mean annual maximum and minimum temperatures were 19°C and 9°C respectively and monthly minimum and maximum temperatures were lowest in July (5-13°C) and highest in February (14-26°C).

Rainfall was recorded throughout the year with a mean annual rainfall of 730 mm. The highest mean monthly rainfall (around 72 mm) was recorded in October. The lowest mean monthly rainfall (around 50 mm) was recorded in February.

Occasional frosts are reported to occur in the study area (DSE 2010 and DSE 2013).

Hydrology

Presently, the Burke Road Billabong fills when the Yarra River height reaches six metres (S. Barker pers. comm.) which most often occurs in spring (Figure 2) when the highest mean monthly rainfall occurs (see Climate above).

Surrounding land uses however are thought to be impacting the natural hydrological cycle of billabong filling due to altered flow regimes in the Yarra River resulting from dam building upstream, water extraction and construction of the Eastern freeway (DSE 2013). For example, the construction of the freeway included the redirection of water run-off which have reduced water recharge opportunities for the billabong (DSE 2013).

Water quality

Concern has been raised about contaminants from drums dumped near the billabong and the water quality in the Yarra which may affect the Billabong when filled from the river (DSE 2010). To address this, water sampling of the billabong commenced in 2008 (when the billabong contained water) and no water quality problems have been reported (DSE 2013). In addition, the Yarra River is reported to be gradually improving in water quality conditions according to monitoring between 2000 and 2017, metals have decreased, dissolved oxygen has gradually increased, and nutrient levels have decreased (EPA 2018).

2 Methods

The following methods were used for the study:

2.1 Desktop review

A desktop review of background information was undertaken, including:

- Plant species records within a 5 km Data Review Area (DRA) of the study area held in the Victorian Biodiversity Atlas (VBA) an online database maintained by DELWP which includes species listed under the *Victoria Flora and Fauna Guarantee Act 1988* (FFG), and/or classified as rare or threatened in Victoria (DELWP 2018b);
- Flora and Fauna species and communities within a 5 km DRA listed under the *Federal Environment Protection and Biodiversity Conservation Act 1999* (EPBC) through the EPBC protected matters search tool (DoE 2018);

- The DELWP interactive maps Ecological Vegetation Class mapping of the area (both extant and pre-1750) (DELWP 2018c);
- Review of GIS and aerial photo data;
- Legislation, government policy and strategies; and
- Review of the Burke Road Billabong Reserve Management Plan (DSE 2010).

2.2 Field assessment

Two field assessments were carried out, one in mid-summer on 31 January 2018, and one in mid spring on 29 and 31 October 2018. The following information was collected:

- A floristic species inventory of the study area (Figure 1) including indigenous and exotic plants;
- Mapping of Ecological Vegetation Classes (EVCs) in the reserve including communities within the billabong;
- Identification and mapping of significant rare or threatened plant populations;
- Identification and mapping of new and emerging, and existing high-threat weed populations; and
- Photographs to illustrate the findings.

2.3 Conservation status

Conservation significance of species was determined by reference to DELWP's advisory list (DEPI 2014) and listings under the FFG Act 1988 and the EPBC Act 1999.

2.4 Nomenclature and taxonomy

Plant taxonomy follows the online resource: Flora of Victoria–VicFlora–maintained by the National Herbarium of Victoria (RBG 2018). Common names follow the Victorian Biodiversity Atlas maintained by DELWP (DELWP 2018b).

An asterisk (*) denotes an exotic species and may include Australian plants species outside their natural distribution

A hash (#) indicates plants that may or may not be indigenous to this location; their status is ambiguous.

3 Findings

General site description

Previously cleared land to the south of the billabong has been planted out with native species over the last decade. As a result there are areas of open mown grassland between plantings a few scattered remnant River Red-gums. The rest of the Reserve surrounding the billabong and along the river consists of remnant native vegetation including a mature eucalypt canopy, dense understory shrub and ground layer and varying levels of litter cover. Areas of revegetation with native plantings are interspersed throughout. The billabong had a good cover of riparian species and did not have water in it during the

first survey in January 2018 but contained water from the first round of pumping during the second survey in spring 2018.

3.1 Vegetation

A total of 215 plant species was recorded on site including 125 (58%) exotic species, 88 (41%) native plant species, which includes 2 (1%) native species with ambiguous status (Appendix 1).

3.1.1 Native remnant vegetation

The study area is modelled as supporting Floodplain Riparian Woodland EVC 56 (DELWP 2018c) and this was confirmed on site through observations consistent with this EVC description and benchmark (DELWP 2018d) including plant species, vegetation structure (all life forms were recorded), vegetation and litter cover and the history of episodic flooding.

The vegetation in the study area is characterised by an open woodland/open forest dominated by a canopy of River Red-gums typical of this EVC. The understory is dominated by a very high cover and strong recruitment of Tree Violet (*Melicytus dentatus*) (Plate 1).



Plate 1 Very high cover and strong recruitment of Tree Violet (*Melicytus dentatus*), Burke Road Billabong Reserve, Kew, January 2018

Other understory trees and shrubs include Sweet Bursaria (*Bursaria spinosa* subsp. *spinosa*), Silver Wattle (*Acacia dealbata* subsp. *dealbata*), Black Wattle (*Acacia mearnsii*), Yarra Burgan (*Kunzea leptospermoides*), Large Kangaroo Apple (*Solanum laciniatum*), Kangaroo Apple (*Solanum aviculare*), Tree Everlasting (*Ozothamnus ferrugineus*) and Prickly Currant-bush (*Coprosma quadrifida*).

The ground story includes scattered herbs such as: Clustered Everlasting (*Chrysocephalum semipapposum*), Clammy Goosefoot (*Dysphania pumilio*), Scrub Nettle (*Urtica incisa*), Shrubby Fireweed (*Senecio minimus*) and Shade Wood-sorrel (*Oxalis exilis*); Grasses and graminoids include: Weeping Grass (*Microlaena stipoides* var. *stipoides*), Rough Spear-grass (*Austrostipa scabra* subsp. *scabra*), Kneed Wallaby-grass (*Rytidosperma geniculatum*) and *Juncus bufonius*; as well as scrambler climber Wonga Vine (*Pandorea pandorana* subsp. *pandorana*).

The study area was also modelled as containing Floodplain Wetland Aggregate EVC 172 (DELWP 2018c) which was confirmed onsite against the description in (DSE 2012). This EVC occurred in and around the billabong and was characterised by riparian rushes, sedges and dicot herbs including: Tall Sedge (*Carex appressa*), Poong'ort (*C. tereticaulis*), Toad Rush (*Juncus bufonius*), Green Rush (*J. gregiflorus*), Hairy Knotweed (*Persicaria subsessilis*), Creeping Knotweed (*P. prostrata*), Slender Knotweed (*P. decipiens*), Spotted Knotweed (*P. praetermissa*) and Water Pepper (*P. hydropiper*).

3.1.2 Revegetation

Fifty five planted species were recorded in the revegetation areas, 53 were indigenous and of local provenance (Appendix 1). Some species, although indigenous to Victoria, are not of local provenance (Appendix 1, Plate 2).



Plate 2 Spiny-headed Mat-rush (*Lomandra longifolia* subsp. *longifolia*), from New South Wales provenance, planted in Burke Road Billabong Reserve Kew, 2018.

Nine native Victorian plant species were recorded that are indigenous to the region but do not occur in floodplain environments (Appendix 1, Table 1).

Table 1 Native plant species recorded at Burke Road Billabong Reserve in 2018 that do not occur in floodplain environments

Species	Common Name
<i>Acacia verniciflua</i>	Varnish Wattle
<i>Austrostipa elegantissima</i>	Feather Spear-grass
<i>Brachyscome multifida</i> var. <i>multifida</i>	Cut-leaf Daisy
<i>Correa glabra</i> var. <i>glabra</i>	Rock Correa
<i>Correa reflexa</i> var. <i>reflexa</i>	Common Correa
<i>Dianella tasmanica</i>	Tasman Flax-lily
<i>Dianella</i> sp. aff. <i>longifolia</i> (Benambra)	Arching Flax-lily
<i>Grevillea rosmarinifolia</i>	Rosemary Grevillea

3.1.3 Weeds

There were 125 woody and herbaceous weed species recorded on site (Appendix 1). Eight of these species are Australian native species that are weeds in this region (Appendix 1, Table 2).

Table 2 Native plant species recorded in Burke Road Billabong Reserve in 2018 that are weeds in this region.

Species	Common Name
* <i>Corymbia maculata</i>	Spotted Gum
* <i>Callistemon viminalis</i>	Weeping Bottlebrush
* <i>Dianella callicarpa</i>	Swamp Flax-lily
* <i>Eucalyptus botryoides</i> X <i>Eucalyptus camaldulensis</i> subsp. <i>camaldulensis</i>	Southern Mahogany
* <i>Kunzea ericoides</i>	Burgan
* <i>Melaleuca armillaris</i> subsp. <i>armillaris</i>	Giant Honey-myrtle
* <i>Melaleuca parvistaminea</i>	Rough-barked Honey-myrtle
* <i>Pittosporum undulatum</i>	Sweet Pittosporum

Eleven weeds listed under the *Catchment and Land Protection Act 1994* (CaLP Act) were recorded. These included six regionally controlled weeds and five restricted weeds (Appendix 1).

The CaLP Act 1994 is intended to protect primary production, Crown land, the environment and community health from the effects of noxious weeds and pest animals (AV 2018). As such it is the land manager's responsibility to take all reasonable steps to prevent the growth and spread of regionally controlled weeds and it is an offence to sell or trade any restricted weeds and (AV 2018).

3.2 Rare or threatened plant species and threatened vegetation communities

There were no plant species or vegetation communities listed under the EPBC Act 1999 or the FFG Act 1988 recorded during the surveys.

Rare or threatened plants

Several plants of one species, Native Peppercress (*Lepidium pseudohyssopifolium*), classified as 'k' (poorly known) in Victoria (DEPI 2014) were recorded on site in the general vicinity of previous records (Lorimer 2006) (Plate 3). The 'k' classification means that the species is poorly known and suspected, but not definitely known, to belong to one of the rare or threatened categories within Victoria due to a lack of accurate distribution information (DEPI 2014). There is no question that this is a rare species in Victoria and it is most likely endangered (G. Carr pers. comm.).

Swamp Flax-lily (*Dianella callicarpa*), classified as 'rare' in Victoria (DEPI 2014) was also recorded but is naturalised from plantings and does not occur any further east beyond the west Otways (G. Carr pers. comm.).



Plate 3 Native Peppercress (*Lepidium pseudohyssopifolium*), classified as 'k' (poorly known) in Victoria (DEPI 2014), Burke Road Billabong Reserve, Kew, January 2018.

The locally threatened Hemp Bush (*Gynatrix pulchella*) and Mutton-wood (*Myrsine howittiana*) (Lorimer 2006) were recorded and Mutton-wood observed to be recruiting.

The 2010 Reserve Management Plan records a possible record of Studley Park Gum (*Eucalyptus X studleyensis*) classified as endangered in Victoria (DEPI 2014) however this plant was identified as Southern Mahogany 9**Eucalyptus botryoides* X *Eucalyptus camaldulensis* subsp. *camaldulensis* (*Eucalyptus X trabutii*).

Threatened vegetation communities

The vegetation communities recorded on site, Floodplain Riparian Woodland EVC 56 and Floodplain Wetland Aggregate EVC 172 are classified as endangered in the Gippsland Plain bioregion. This means that they considered to have:

- Contracted to less than 10% of former range; OR
- Less than 10% pre-European extent remains; OR
- A combination of depletion, degradation, current threats and rarity is comparable overall to the above including:
 - 10 to 30% pre-European extent remains and severely degraded over a majority of this area; or
 - naturally restricted EVC reduced to 30% or less of former range and moderately degraded over a majority of this area;
 - or
 - rare EVC cleared and/or moderately degraded over a majority of former area (DELWP 2018d).

3.3 Pest animals

Although fauna surveys were not part of the brief, opportunistic observations of pest animal evidence were recorded as this may be useful information for management.

Evidence of foxes were observed with one active fox (fresh diggings) den was seen in the northern section of the reserve near the river bank (Figure 1). Two other possible disused den sites were also observed nearby.

Evidence of deer including scats and vegetation browsing were observed along the river bank in the reserve. Deer browsing was evident on Hemp Bush (*Gynatrix pulchella*) and Mutton-wood (*Myrsine howittiana*) (Plate 4). There was reported siting of a Sambar deer (*Rusa unicolor*) in the Reserve on 27 October 2016 (BRBR website 2018).



Plate 4 Evidence of deer browsing on Mutton-wood (*Myrsine howittian*), Burke Road Billabong Reserve, Kew, 2018

Off-lead domestic dogs were observed running through the reserve during the survey and dog faeces were seen in native vegetation.

3.4 Disturbance

The area has a history of disturbance which has been outlined in Section 1.1 of this report and is detailed in the Burke Road Billabong Management Plan (DSE 2010) and Draft Management Plan 2013 (DSE 2013).

During the field assessments evidence of various activities in the reserve impacting flora and fauna were recorded, including:

- Informally constructed 'BMX' and mountain bike tracks causing damage and removal of vegetation, and soil disturbance (Plate 5 & 6)
- Rubbish dumping causing vegetation damage and providing fox harbour (Plate 7)
- Offsite weed populations providing sources for weeds spread into the reserve (Plate 8)
- Off-target herbicide spraying of weeds e.g. of *Rytidosperma* species (possibly targeting Bromes (**Bromus*) or Chilean Needle-grass (**Nassella neesiana*) nearby) (Plate 9)
- Disused materials from revegetation such as plastic tree guards and weed matting which may enter water ways and injure fauna (Plate 10 & 11)



Plate 5 Soil disturbance and vegetation damage from informal bike tracks, Burke Road Billabong Reserve Kew, 2018



Plate 6 Soil disturbance and vegetation damage from informal bike tracks, Burke Road Billabong Reserve, Kew, 2018



Plate 7 Rubbish dumping, Burke Road Billabong Reserve, Kew, 2018



Plate 8 Infestation of Wandering Jew (*Tradescantia fluminensis*) on land adjoining Burke Road Billabong Reserve, Kew, 2018



Plate 9 Off target weed spraying of *Rytidosperma* species sprayed on the left with *Galenia* (**Galenia pubescens* var. *pubescens*) not sprayed on the right, Burke Road Billabong Reserve, Kew, 2018



Plate 10 Disused plant guards from revegetation works, Burke Road Billabong Reserve, Kew, 2018



Plate 11 Disused weed matting from revegetation works, Burke Road Billabong Reserve, Kew, 2018

4 Implications of planned billabong filling program

4.1 Billabongs

There appears to be little available information in the literature about billabongs, their hydrology and response to drought or the effects of environmental water filling. A comprehensive article by Shiel (1993) on the billabongs of the Murray-Darling Rivers in South-east Australia provides some background information on billabong formation and function and the effects of human impacts and altered flooding regimes that is applicable to Burke Road Billabong is summarised below.

Life history a billabongs

The term billabong (also known as an ox-bow lake) is a colloquial term used in the southern Australian states for cut-off river meanders left behind by rivers moving back and forth across their floodplain.

Billabongs are ephemeral in a geological time sense as they fill up with a combination of vegetation growth, litter, surrounding soil surface erosion and deposition and sedimentation of dead biota (macroinvertebrates, zoo plankton). Studies on billabongs near Wodonga in northern Victoria estimated billabongs filled with sediments and organic matter at a rate of 1-2 mm per year.

Human impacts on billabongs

In addition to natural loss mentioned above, human activities are also a cause of billabong loss. Billabongs have been drained to provide arable land for agriculture, garbage dumps, to accommodate

fill etc. There are few estimates of how many have been lost but losses of wetlands in general are estimated to be between 30%-60% in Victoria.

Other impacts on billabongs include introduction of weeds and selective grazing by stock associated with farming promoting changes in species composition. This in turn reduces availability/diversity of leaf litter and wood for shelter/food for aquatic biota and eventual decomposition. Agriculture and recreational inputs have also degraded riparian vegetation through altered shading, litter-fall timing and litter nutrient content (Giling et al. 2016).

River regulation is another impact on billabongs. It is undertaken to alter river flow regimes to manage flooding effectively and it alienates the river from the floodplain. Cyanobacterial blooms are being observed increasingly in billabongs in heavily grazed catchments thought to be due to livestock faecal material and fertilizers, leading to high inflows of phosphorus and nitrates. With reduced wetland availability, bird concentrations increase, further contributing to the phosphorus load. More frequent flooding in an unregulated river would have flushed these nutrients out into the mainstream.

Increased herbicide and pesticide loads pollute billabongs but the effects on aquatic flora and fauna are undocumented.

Native fish have been severely impacted by introduced species (e.g. European carp, *Cyprinus carpio*) or eaten by them (e.g. Redfin, *Perca fluviatilis*) which may also have depleted indigenous micro/macroinvertebrates.

Recreational activities can also impact billabongs, such as damage by off-road recreational vehicles and overfishing. There may be health risks associated with chemical or faecal contamination for people using inland waters.

Altered flooding regimes effects on billabongs

Billabongs provide biological heterogeneity and flora and fauna have adapted accordingly with a range of survival strategies to cope with the dry times. Microbiota germinate and hatch rapidly during times of inundation and evidence suggest only part of the assemblage does so at any one time. However, if flooding frequency drops below a critical threshold for some species, they do not survive. In addition short floods may be inadequate for recruitment of species such as River Red-gums. Timing of inundation may influence water quality and provide different environmental cues for different species. The impacts of unnatural flood events need to be researched.

What is known is that there are two types of biota, those that have resting stages and 'wait it out in the sediments' to be cued by flooding. They have a desiccant-resistant life history (Bond et al. 2008). Others arrive as propagules via wind, water, or under their own steam. They have well-developed mechanisms for widespread and rapid dispersal (e.g. fish and water birds) (Bond et al. 2008). It has been suggested that some species of biota may be endemic to individual billabongs but this needs to be studied.

Studies also suggest that bacteria, algae, microfauna (e.g. *Protozoa*, *Rotifer*, *Cladocera*, *Copepoda*) and macroinvertebrate (e.g. crayfish) populations are larger and microfauna more diverse in billabongs compared to nearby rivers. Other studies report that species of biota in standing water are different to biota in flowing water (Bond et al. 2008). This highlights the range of niches and often abundant food supply in billabongs. However more research is required in this area. Research has shown that macroinvertebrate biomass was highest with annual flooding and reduced with less frequent flooding.

Declines in the range and abundance of many vertebrates (mammals, birds, reptiles, amphibians and fish) have been associated with reduced flooding of billabongs and the associated food source and nursery areas. In addition altered high flows may not correspond with their breeding cycles.

Climate change and drought impacts on billabongs

Bond et al. (2008) provide a detailed article on the impacts of drought on freshwater ecosystems in Australia and this is summarised below.

Drought can be defined as an extended period – a season, a year or several years of deficient rainfall relative to the statistical multi-year mean for the region. While droughts are a normal part of Australian climate, the frequency and severity of drought is predicted to increase with climate change.

Studies to date have reported some of the impacts of drought on riparian biota. A study of the Murray-Darling Basin showed that drought caused declines in fish and aquatic invertebrate abundance, greatly depleting the invertebrate egg bank on the floodplain. Vegetation such as River Red-gums died over the extensive areas during the millennium drought. Changes in biogeochemical processes occurred at that time but are poorly understood.

Drought may impact ground water due to a number of mechanisms. For example, changed land cover affects runoff and groundwater dynamics due to reduced percolation of surface water to below ground. With depleted surface waters, groundwater levels and volumes may reduce over time. Increased drought may lead to increased water extraction, exacerbate natural drought and hinder ecological recovery from drought.

Algal blooms may be exacerbated by drought. Drought is usually associated with high temperatures and evaporation and decreasing oxygen levels. With stagnant water conditions, nutrients may build up leading to an algal bloom particularly if unshaded.

Floodplains are a vital component of lowland rivers but the effects of drought on aquatic biota and processes are little understood. Waterholes, floodplain lagoons and riverine pools are extremely valuable refugia for biota to survive in times of drought. It is important to restore these water bodies.

Billabong revegetation

There is a lack of studies on billabong revegetation in the literature and only a few studies on stream revegetation that might apply to the Burke Road Billabong. A recent article by Giling et al. (2016) referred to a study that looked at streams in the Goulburn-Broken catchment in Victoria in areas of pasture with occasional River Red-gums that had been revegetated more than 22 years previously. Results showed that invertebrate assemblages had not recovered to reference-site levels. Giling says however that other reports indicate recovery after 5-10 years and suggested this was influenced by re-establishment of water quality and habitat characteristics. Catchment-scale land use effects were possibly the main influencing factor rather than local replanting which may not rectify water quality and habitat changes. Forest cover was found to effect macroinvertebrates with higher cover coinciding with invertebrate assemblages closer to reference sites, this decreased with increasing distance from continuous forest cover (Giling et al. 2016).

In the urban setting, the main restraints impacting water-way environmental restoration are highlighted in an article by Bush et al. (2003). They include pollution, small size of reserves with consequential high edge effects, overlapping recreational needs (e.g. cycling, walking, dog walking etc.) and conflicting use

and associated infrastructure e.g. stormwater drainage, sewage easements, freeways etc. Bush et al. (2003) say that ultimately, restoration in the urban setting involves the replacement of weedy landscapes with simpler versions of the original ecosystem that incorporate structure, wildlife habitats and some of the ecological processes of the original ecological communities.

The article discusses an example of a successful creation of an off-creek wetland system (three ephemeral pools) in the Merri Creek (less than 10 km downstream from the Burke Road billabong) with one of the highlights being the dispersal of two frog species not common into the area (Bush et al. 2003). Several mayfly larvae were also found (Bush et al. 2003). Mayfly are good indicators of low levels of water pollution (Bush et al. 2003). Plantings of shrubs, grasses and forbs were undertaken to link the off-creek constructed wetland to mature vegetation along the creek (Bush et al. 2003). This enhanced habitat for lizards, small birds and frogs at the junction of the Yarra River and Merri Creek in Hall Reserve Clifton Hill (Bush et al. 2003).

The key points in the article by Bush et al. (2003) for restoration were:

- Maintain riparian vegetation, retain fallen timbers, maintain habitat structure and refugia, protect from human disturbance, maintain hydrological connectivity of ephemeral streams and wetlands to permanently flowing with no permanent barriers;
- Modest volumes at the right time of year may tip the scales in favour of beneficial outcomes, e.g. seedling recruitment, water quality maintenance, fish spawning; and
- The need for monitoring of ecological responses to environmental watering to research recovery and inform future efforts to manage environmental flows and restoration.

4.2 Burke Road billabong

4.2.1 Vegetation

Native plants

A high cover of native aquatic and terrestrial plants is already in situ and plants are recruiting (Plates 12, 13) and there are a number of native aquatic species onsite (Appendix 1). Additional planting may not be necessary and existing vegetation will only be enhanced with increased filling.

While terrestrial plants may die of anoxic conditions in the root zone if water sits for long enough, no rare or threatened plant species were recorded in the billabong which might be threatened by increased filling. In addition, the water table is likely to be depleted from past droughts and surrounding land management, and the billabong may not remain full long enough to kill terrestrial plants. The first filling saw standing water last only a matter of days (S. Barker pers. comm.). However, this will be influenced by how many days the pumping lasts during each filling session in the future.

The recent pumping was ceased after a few days due to dropping water levels in the river. It is hoped there will be sufficient pumping for the billabong to hold standing water for 2-3 months (S. Barker pers. comm.).

Detritus from dead plants and logs need to be retained to provide habitat, food sources and niches for aquatic biota. Logs would also provide roosting places for water birds foraging in the water when the billabong is full.



Plate 12 Cover of largely native plants in the billabong during a dry period, Burke Road Billabong Reserve, Kew, January 2018



Plate 13 Cover of largely native plants in the billabong when containing water, Burke Road Billabong Reserve, Kew, January 2018

Weeds

While there were some terrestrial weeds recorded, no aquatic weed species were recorded. Billabong filling should assist weed control efforts by drowning terrestrial weeds if water is retained long enough. Management of weeds in the billabong should only include herbicides deemed safe for use in and around waterways.

Monitoring should be undertaken for new and emerging weeds as water is now being pumped from the river and weeds may spread from upstream sources. Weeds can also be introduced and spread by recreational users such as on walker's footwear and cyclist's bike tyres.

4.2.2 Fauna

In light of the literature, it is anticipated that increased frequency of flooding will be beneficial for the billabong leading to increased bacteria, algae, microfauna, macroinvertebrate and invertebrate diversity and population size. This is particularly promising given the indicators of Yarra River water quality indicated by the presence of mayfly larvae downstream and water quality monitoring near the study site. However Melbourne Water recognises that there is work to be done. They rate conditions for Platypus, birds, vegetation and macroinvertebrates as ranging from very low to low (MW 2019). Frogs population diversity however is rated as very high and native fish levels as moderate in the lower reaches of the Yarra River (MW 2019).

Increased filling may help to ward off the risk of losing species of biota from this billabong that may occur due to increased dry periods associated with climate change and surrounding land use.

The increase in invertebrate biota may support ecosystem processes by providing food sources for fauna such as birds (Plate 14), reptiles, amphibians. The timing of pumping is likely to be spring when river levels are high enough for pumping (Figure 2). This would match the timing of most of the natural filling episodes (Figure 2) and match and so provide a refuge and food resource for fauna during the breeding season.



Plate 14 Chestnut Teal (*Anas castanea*) at Burke Road Billabong Reserve Kew, October 2018

4.2.3 Other impacts

E. coli (*Escherichia coli*) are bacterium that come from warm blooded animals (Yarrawatch 2019). *E. coli* is measured regularly in the Yarra River as an indication of faecal contamination (Yarrawatch 2019). Levels can increase after rain events in the Yarra River, particularly in the lower reaches (Yarrawatch 2019). As filling occurs when the river levels are high (generally after rain) consideration may need to be given to *E.coli* levels in the billabong.

In addition, there may need to be monitoring for algal bloom events which have already occurred in the past (Lorimer 2006) as they can be toxic to fauna.

Carp were identified as a possible threat to the billabong and may be impacting species diversity due to substrate disturbance (DEPI 2010, Lorimer 2006). Future monitoring may be required to detect their presence in the billabong given that water will now be being pumped from the Yarra River where populations of European Carp occur.

5 Comments on vegetation changes in response to management works

A large amount of revegetation and weed control has been carried out by the Burke Road Billabong Reserve Management Committee since its appointment as the reserves managers by DELWP in 2008. This work has been undertaken as part of the implementation of the 2010 Burke Road Billabong Reserve Management Plan (DSE 2010). In 2010 the Reserves vegetation understory was dominated by a cover and number of weed species. The first aim of the plan was *'to ensure the Reserve has viable and robust ecosystems'* through the re-establishment of an indigenous understory. To achieve this, the plan's primary objective for vegetation management was *'to increase indigenous vegetation cover and reduce invasive species cover'*.

Ecological Vegetation Classes

The 2018 flora survey found that there are still two Endangered EVCs on site, Floodplain Riparian Woodland EVC 56 and Floodplain Wetland Aggregate EVC 172 and their condition has been improved through a reduction in weed cover and an increase in native species diversity.

Native plants

In 2005 Lorimer (2006) recorded 30 native plant species and the same number was recorded in the 2010 Burke Road Billabong Reserve management plan (DSE 2010). In 2018 the number of native species recorded has more than doubled with a total of 89 species.

Tree Violet was noted as common understory species in 2010 (DSE 2010) and a dominant species in 2018.

One of the expectations mentioned in the 2010 reserve plan is that in response to increased ecological health there will be an increase in rare or threatened species (DSE 2010). However, no EPBC classified or FFG listed plants were recorded in 2018. The one VROT recorded previously, Native Peppergrass (Lorimer 2006), was also recorded in 2018. It was located in one of the several locations it had been recorded in previously.

Weeds

While the number of weed species has increased from 58 in 2005 (Lorimer 2006) and 49 in 2010 (DSE 2010) to 118 in 2018, the cover of weeds has been greatly reduced.

In 2010 it was estimated that in some parts of the Reserve and riparian environs adjacent to the Reserve, weed cover was as high as 50%, now there are few areas in the Reserve that would have a cover this high. These areas include parts of the southern historically grazed area to the south which still have a high cover of grassy weeds and some areas near the garden centre have a high cover of herbaceous weeds. Weed cover is still high on adjacent land.

The billabong had a high cover of Spear Thistle (**Cirsium vulgare*) (DSE 2010) and the cover of this species was much lower in 2018.

The understory in the northern area between the billabong and the Yarra River was reported as being almost entirely composed of weeds, now it is dominated by revegetation plantings of native species.

High priority weeds in the 2010 Management Plan were:

- Boneseed (**Chrysanthemoides monilifera* subsp. *monilifera*)
- Boxthorn (**Lycium ferocissimum*)
- Chilean Needle-grass (**Nasella neesiana*)
- Gorse (**Ulex uropaeus*)

Of these weeds only *Chilean Needle-grass was recorded in 2018. It was listed as an emerging concern in 2010, and while it is still present it's cover is not high.

Moderate priority weeds in the 2010 Management Plan were:

- Crack Willow (**Salix fragilis*)
- Blackberry (**Rubus fruticosus*)
- Madeira Winter-cherry (**Solanum pseudocapsicum*)
- White Bladder-flower (**Araujia sericifera*)
- Plum (**Prunus* spp.)
- Wandering Jew (**Tradescantia fluminensis*)
- Pampas Lilly-of-the-Valley (**Salpichroa organifolia*)
- Hawthorn (**Crataegus monogyna*)
- Couch (**Cynodon dactylon* var. *dactylon*)
- Cleavers (**Galium aparine*)
- Box-elder Maple (**Acer negundo*)
- Black Bindweed (**Fallopia convolvulus*)
- Sweet Pittosporum (**Pittosporum undulatum*)

*Crack Willow was not recorded in 2018. The large stands of Blackberry (**Rubus fruticosus*) south and west of the billabong have been removed. Only scattered plants of Common Blackberry (**Rubus*

anglocandicans) were recorded in 2018. Previously there had been a high cover of * Blackberry reported around the Native Peppercreess (DSE 2010) and by 2018 this has been largely removed. *Madeira Winter-cherry, *White Bladder-flower and *Plum species were recorded in 2018 but in low numbers. One of the most dominant weeds in 2010 was *Wandering Jew. In 2018 it was largely confined to the Melbourne Water land on the river bank. The other moderate priority weeds were all recorded in low numbers and cover in 2018.

5.1 Vegetation management recommendations

The following recommendations are made to continue working towards meeting the objectives of the 2010 Burke Road Billabong Reserve Management Plan:

- There is a very high cover of Tree Violet and as it is one of the few woody species recruiting in high numbers. It is recommended that suitable densities are determined and thinning be undertaken to address reduced amenity from impenetrable spiny growth and high densities outcompeting in situ and planted native vegetation.
- Native plants which are weeds in this region or do not occur on floodplains have been planted and/or naturalised in the reserve. Further plantings of these species should not be undertaken. If possible, these species should be replaced. Retention of these plant species may wrongly convey to people that these plants are part of the natural flora and they may use them as seed sources for indigenous species.
- Eleven CaLP weed species were recorded and these should be a priority for weed control.
- Protection and restoration of populations of the locally threatened Native Peppercreess, Hemp Bush and Mutton-wood should continue, including hand weeding around adult plants and recruits (to avoid damage to seedlings), seed collection, propagation and replanting, and on-ground identification and protection of plants to avoid mowing/slashing.
- A fox den was recorded in the reserve and it is noted in the 2010 Reserve Management Plan that foxes can play a role in the spread of weed seeds such as Blackberries, one of their food sources (DSE 2010). The plan also points out that eradication of foxes is not possible as new animals readily replace any that are removed (DSE 2010). However, it is recommended that monitoring and control should be undertaken as necessary to determine and manage any impacts on fauna which would also assist with reducing the spread of weeds.
- Monitoring the impacts of deer (browsing of native plants was observed) is suggested and control may be required if impacts become severe.
- It is suggested that informal bike tracks be removed and revegetated. These open areas of soil disturbance provide space and conditions that favour weed infestations. Bikes can spread weed seeds picked up and carried on their tyres.
- Rubbish removal is recommended to decrease fox harbours and for aesthetic amenity and public safety
- Where possible, liaise with adjacent land managers to find a solution to control weeds on their land and reduce the spread of weeds into the reserve which will require ongoing resources to control.

- Ensure people carrying out weed control are adequately trained in weed identification to avoid off target impacts on native plants.
- It is recommended that disused materials from revegetation such as tree guards and weed matting be removed as they pose a threat to fauna which can become entangled and trapped or may be ingested by some animals. These materials can also be washed/blown into the river as rubbish and impact aquatic fauna as well as terrestrial fauna.

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Appendix 1 Plant species recorded at Burke Road Billabong Reserve, Kew, 2018

Key:

- * – Exotic species – may include Australian plant species outside their natural distribution
- # – Native plants which may or may not be indigenous species in this location; their status is ambiguous
- R – Noxious weed species listed as Restricted under the *Catchment and Land Protection Act 1994*
- C – Noxious weed species listed as Controlled under the *Catchment and Land Protection Act 1994*
- s.s.–from the latin *sensu stricto*, in the narrow sense
- s.l.–from the latin *sensu lato*, in the broad sense

FFG – Listed under the *Flora and Fauna Guarantee Act 1988*

EPBC – Listed under the *Environmental Protection Act and Biodiversity Conservation Act 1999*

VROTS – Victorian Rare or Threatened Species (2014)

k – poorly known but thought to be rare or threatened

r – rare in Victoria but not considered otherwise threatened – there are relatively few known populations or the taxon is restricted to a relatively small area

Family	Weed status	Scientific name	Common name	FFG_ACT_STATUS	EPBC_ACT_STATUS	VIC_ADVISORY_STATUS	Victorian indigenous planted (P)	Victorian indigenous species but provenance exotic (E)	Victorian indigenous in situ (I)	Victorian regionally indigenous species but not found in floodplain locations (A)	CaLP weeds
Aizoaceae	*	<i>Galenia pubescens</i> var. <i>pubescens</i>	Galenia								
Amaranthaceae		<i>Enchylaena tomentosa</i> var. <i>tomentosa</i> (prostrate form)	Ruby Saltbush (prostrate form)				P				
Amaryllidaceae	*	<i>Allium triquetrum</i>	Angled Onion								R
	*	<i>Narcissus tazetta</i>	Tazetta (Jonquil)								
Apiaceae	*	<i>Conium maculatum</i>	Hemlock								C
	*	<i>Foeniculum vulgare</i>	Fennel								R
Apocynaceae	*	<i>Araujia sericifera</i>	White Bladder-flower								
Araceae	*	<i>Zantedeschia aethiopica</i>	White Arum-lily								
Araliaceae	*	<i>Hedera helix</i>	English Ivy								
Asparagaceae		<i>Arthropodium milleflorum</i> s.l.	Pale Vanilla-lily				P				
		<i>Arthropodium strictum</i> s.s.	Chocolate Lily				P				
	*	<i>Asparagus aethiopicus</i>	Emerald fern								
		<i>Lomandra longifolia</i> subsp. <i>longifolia</i>	Spiny-headed Mat-rush				P	E			
Asteraceae	*	<i>Arctotheca calendula</i>	Cape weed								R
	*	<i>Aster subulatus</i>	Aster-weed								
		<i>Brachyscome multifida</i> var. <i>multifida</i>	Cut-leaf Daisy							A	
		<i>Cassinia longifolia</i>	Shiny Cassinia				P				
		<i>Cassinia sifton</i>	Sifton Bush				P		I		
		<i>Chrysocephalum semipapposum</i> s.l.	Clustered Everlasting				P				
	*	<i>Cirsium vulgare</i>	Spear Thistle								C
	*	<i>Cynara cardunculus</i> subsp. <i>flavescens</i>	Artichoke Thistle								C
	*	<i>Erigeron bonariense</i>	Flaxleaf Fleabane								

Family	Weed status	Scientific name	Common name	FFG_ACT_STATUS	EPBC_ACT_STATUS	VIC_ADVISORY_STATUS	Victorian indigenous planted (P)	Victorian indigenous species but provenance exotic (E)	Victorian indigenous in situ (I)	Victorian regionally indigenous species but not found in floodplain locations (A)	CaLP weeds
	*	<i>Erigeron sumatrensis</i>	Tall Fleabane								
	*	<i>Helminthotheca echioides</i>	Ox-tongue								
	*	<i>Hypochaeris radicata</i>	Flatweed								
	*	<i>Lactuca saligna</i>	Willow-leaf Lettuce								
	*	<i>Lactuca serriola</i>	Prickly Lettuce								
		<i>Olearia lirata</i>	Snowy Daisy-bush				P				
		<i>Olearia ramulosa</i> var. <i>ramulosa</i>	Twiggy Daisy-bush				P				
		<i>Ozothamnus ferrugineus</i>	Tree Everlasting				P				
		<i>Senecio minimus</i>	Shrubby Fireweed				P				
	*	<i>Solidago chilensis</i>	Goldenrod								
	*	<i>Sonchus asper</i> s.l.	Rough Sow-thistle								
	*	<i>Sonchus oleraceus</i>	Common Sow-thistle								
	*	<i>Taraxacum</i> spp.	Dandelion								
	*	<i>Tragopogon porrifolius</i> subsp. <i>porrifolius</i>	Salsify								
Bignoniaceae		<i>Pandorea pandorana</i> subsp. <i>pandorana</i>	Wonga Vine				P				
Brassicaceae	*	<i>Brassica fruticulosa</i>	Twiggy Turnip								
		<i>Lepidium pseudohyssopifolium</i>	Native Peppercross			k			I		
	*	<i>Raphanus raphanistrum</i>	Wild Radish								
	*	<i>Rorippa palustris</i>	Marsh Yellow-cress								
	*	<i>Sisymbrium</i> spp.	Mustard								
Campanulaceae		<i>Wahlenbergia communis</i> s.s.	Tufted Bluebell				P				
Caprifoliaceae	*	<i>Lonicera japonica</i>	Japanese Honeysuckle								
Caryophyllaceae	*	<i>Cerastium glomeratum</i> s.s.	Sticky Mouse-ear Chickweed								
	*	<i>Polycarpon tetraphyllum</i>	Four-leaved Allseed								
	*	<i>Stellaria media</i>	Chickweed								
Casuarinaceae		<i>Allocasuarina verticillata</i>	Drooping Sheoak				P				
Chenopodiaceae	*	<i>Atriplex prostrata</i>	Hastate Orache								
		<i>Atriplex semibaccata</i>	Berry Saltbush				P				
	*	<i>Chenopodium album</i>	Fat Hen								
	#	<i>Dysphania pumilio</i>	Clammy Goosefoot					E			
		<i>Einadia nutans</i> subsp. <i>nutans</i> (s.s.)	Nodding Saltbush				P				
		<i>Einadia trigonos</i> subsp. <i>trigonos</i>	Lax Goosefoot				P				
Commelinaceae	*	<i>Tradescantia fluminensis</i>	Wandering Jew								
Convolvulaceae	*	<i>Calystegia silvatica</i>	Greater Bindweed								
		<i>Dichondra repens</i>	Kidney-weed				P				
Cyperaceae		<i>Carex appressa</i>	Tall Sedge						I		

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		<i>Carex tereticaulis</i>	Poong'ort						I		
	*	<i>Cyperus eragrostis</i>	Drain Flat-sedge								
Euphorbiaceae	*	<i>Euphorbia peplus</i>	Petty Spurge								
	*	<i>Homalanthus populifolius</i>	Bleeding Heart								
Fabaceae		<i>Acacia acinacea</i> s.s.	Gold-dust Wattle				P				
		<i>Acacia dealbata</i> subsp. <i>dealbata</i>	Silver Wattle						I		
		<i>Acacia mearnsii</i>	Black Wattle						I		
		<i>Acacia melanoxylon</i>	Blackwood				P				
		<i>Acacia verniciflua</i>	Varnish Wattle							A	
		<i>Acacia verticillata</i> subsp. <i>verticillata</i>	Prickly Moses				P				
	*	<i>Chamaecytisus proliferus</i>	Tree Lucerne								
	*	<i>Dipogon lignosus</i>	Common Dipogon								
	*	<i>Genista X spachiana</i>	Madeira Broom								
		<i>Indigofera australis</i> subsp. <i>australis</i>	Austral Indigo				P				
	*	<i>Medicago minima</i>	Little Medic								
	*	<i>Medicago polymorpha</i>	Burr Medic								
	*	<i>Trifolium fragiferum</i> var. <i>fragiferum</i>	Strawberry Clover								
	*	<i>Trifolium glomeratum</i>	Cluster Clover								
	*	<i>Trifolium repens</i> var. <i>repens</i>	White Clover								
	*	<i>Trifolium subterraneum</i>	Subterranean Clover								
	*	<i>Vicia hirsuta</i>	Tiny Vetch								
	*	<i>Vicia sativa</i> subsp. <i>nigra</i>	Narrow-leaf Vetch								
	*	<i>Vicia sativa</i> subsp. <i>sativa</i>	Common Vetch								
Geraniaceae	*	<i>Erodium moschatum</i>	Musky Heron's-bill								
	*	<i>Geranium dissectum</i>	Cut-leaf Crane's-bill								
		<i>Geranium</i> sp.	Crane's Bill				P				
		<i>Pelargonium australe</i>	Austral Stork's-bill				P				
Goodeniaceae		<i>Goodenia ovata</i>	Hop Goodenia				P				
Iridaceae	*	<i>Dietes grandiflora</i>	Wild Iris								
	*	<i>Iris</i> spp.	Iris								
Juncaceae		<i>Juncus bufonius</i>	Toad Rush						I		
		<i>Juncus gregiflorus</i>	Green Rush						I		
		<i>Juncus sarophorus</i>	Broom Rush						I		
		<i>Juncus</i> spp.	Rush						I		
Lamiaceae		<i>Prostanthera lasianthos</i> var. <i>lasianthos</i>	Victorian Christmas-bush				P				
	*	<i>Prunella vulgaris</i>	Self-heal								

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		<i>Teucrium corymbosum</i>	Forest Germander				P				
Linaceae		<i>Linum marginale</i>	Native Flax				P				
Loranthaceae		<i>Amyema quandang</i> var. <i>quandang</i>	Grey Mistletoe						I		
		<i>Muellerina eucalyptoides</i>	Creeping Mistletoe						I		
Malvaceae		<i>Gynatrix pulchella</i>	Hemp Bush						I		
	*	<i>Malva parviflora</i>	Small-flower Mallow								
	*	<i>Modiola caroliniana</i>	Red-flower Mallow								
Moraceae	*	<i>Ficus carica</i>	Fig								
Myrsinaceae		<i>Myrsine howittiana</i>	Mutton-wood						I		
Myrtaceae		<i>Callistemon sieberi</i>	River Bottlebrush								
	*	<i>Callistemon viminalis</i>	Weeping Bottlebrush								
	*	<i>Corymbia maculata</i>	Spotted Gum								
	*	[^] <i>Eucalyptus botryoides</i> X <i>Eucalyptus camaldulensis</i> subsp. <i>camaldulensis</i> (<i>Eucalyptus</i> X <i>trabutii</i>)	Southern Mahogany								
		<i>Eucalyptus camaldulensis</i> subsp. <i>camaldulensis</i>	River Red-gum						I		
		<i>Eucalyptus viminalis</i> subsp. <i>viminalis</i>	Manna Gum				P				
	*	<i>Kunzea ericooides</i> s.l.	Burgan							A	
		<i>Kunzea leptospermoides</i>	Yarra Burgan				P				
		<i>Leptospermum obovatum</i>	River Tea-tree				P				
		<i>Leptospermum scoparium</i>	Manuka				P				
	*	<i>Melaleuca armillaris</i> subsp. <i>armillaris</i>	Giant Honey-myrtle								
	*	<i>Melaleuca parvistaminea</i>	Rough-barked Honey-myrtle								
Oleaceae	*	<i>Fraxinus angustifolia</i> subsp. <i>angustifolia</i>	Desert Ash								
	*	<i>Ligustrum lucidum</i>	Large-leaf Privet								
Oxalidaceae		<i>Oxalis</i> aff. <i>exilis</i> (glabrescent)	Small-flower Wood-sorrel						I		
		<i>Oxalis exilis</i>	Shade Wood-sorrel						I		
	*	<i>Oxalis incarnata</i>	Pale Wood-sorrel								
	*	<i>Oxalis pes-caprae</i>	Soursob								R
Papaveraceae	*	<i>Fumaria capreolata</i>	White Fumitory								
	*	<i>Fumaria muralis</i> subsp. <i>muralis</i>	Wall Fumitory								
Passifloraceae	*	<i>Passiflora caerulea</i>	Blue Passion-fruit								
Phytolaccaceae	*	<i>Phytolacca octandra</i>	Red-ink Weed								
Pittosporaceae		<i>Bursaria spinosa</i> subsp. <i>spinosa</i>	Sweet Bursaria				P				
	*	<i>Pittosporum undulatum</i>	Sweet Pittosporum								
Plantaginaceae	*	<i>Plantago lanceolata</i>	Ribwort								

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	*	<i>Plantago major</i>	Greater Plantain								
	*	<i>Veronica arvensis</i>	Wall Speedwell								
		<i>Veronica gracilis</i>	Slender Speedwell				P				
Poaceae	*	<i>Anthoxanthum odoratum</i>	Sweet Vernal-grass								
		<i>Austrostipa elegantissima</i>	Feather Spear-grass				P			A	
		<i>Austrostipa scabra</i> subsp. <i>scabra</i>	Rough Spear-grass				P				
		<i>Austrostipa</i> spp.	Spear Grass				P				
	*	<i>Avena barbata</i>	Bearded Oat								
	*	<i>Avena sterilis</i>	Sterile Oat								
	*	<i>Bromus catharticus</i> var. <i>catharticus</i>	Prairie Grass								
	*	<i>Bromus diandrus</i>	Great Brome								
	*	<i>Bromus hordeaceus</i>	Soft Brome								
	*	<i>Cenchrus clandestinus</i>	Kikuyu								
	*	<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch								
	*	<i>Dactylis glomerata</i>	Cocksfoot								
	*	<i>Digitaria sanguinalis</i>	Summer Grass								
	*	<i>Ehrharta erecta</i> var. <i>erecta</i>	Panic Veldt-grass								
	*	<i>Ehrharta longiflora</i>	Annual Veldt-grass								
	*	<i>Eragrostis mexicana</i> subsp. <i>virescens</i>	Mexican Love-grass								
	*	<i>Eragrostis</i> sp.	Love Grass								
	*	<i>Holcus lanatus</i>	Yorkshire Fog								
	*	<i>Hordeum glaucum</i>	Northern Barley-grass								
	*	<i>Lolium perenne</i>	Perennial Rye-grass								
		<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass				P		I		
	*	<i>Nassella neesiana</i>	Chilean Needle-grass								R
	*	<i>Paspalum dilatatum</i>	Paspalum								
	*	<i>Phalaris aquatica</i>	Toowoomba Canary-grass								
	*	<i>Piptatherum miliaceum</i>	Rice Millet								
	*	<i>Poa annua</i>	Annual Meadow-grass								
		<i>Poa ensiformis</i>	Sword Tussock-grass				P				
		<i>Poa labillardierei</i> var. <i>labillardierei</i>	Common Tussock-grass				P				
	*	<i>Poa pratensis</i>	Kentucky Blue-grass								
		<i>Rytidosperma fulvum</i>	Copper-awned Wallaby-grass				P				
		<i>Rytidosperma geniculatum</i>	Kneed Wallaby-grass				P				
		<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	Slender Wallaby-grass				P		I		
	*	<i>Vulpia muralis</i>	Wall Fescue								

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Polygonaceae	*	<i>Acetosa sagittata</i>	Rambling Dock								
		<i>Persicaria decipiens</i>	Slender Knotweed						I		
		<i>Persicaria hydropiper</i>	Water Pepper						I		
		<i>Persicaria praetermissa</i>	Spotted Knotweed						I		
		<i>Persicaria prostrata</i>	Creeping Knotweed						I		
		<i>Persicaria subsessilis</i>	Hairy Knotweed						I		
	*	<i>Polygonum aviculare</i>	Hogweed								
	*	<i>Rumex conglomeratus</i>	Clustered Dock								
	*	<i>Rumex crispus</i>	Curled Dock								
	*	<i>Rumex pulcher</i> subsp. <i>pulcher</i>	Fiddle Dock								
	*	<i>Rumex</i> sp.	Dock								
Portulacaceae	#	<i>Portulaca oleracea</i>	Common Purslane					E			
Primulaceae	*	<i>Lysimachia arvensis</i>	Pimpernel								
Proteaceae		<i>Grevillea rosmarinifolia</i>	Rosemary Grevillea							A	
Pteridaceae		<i>Pteris tremula</i>	Tender Brake						I		
Ranunculaceae		<i>Clematis microphylla</i> s.l.	Small-leaved Clematis				P				
	*	<i>Ranunculus muricatus</i>	Sharp Buttercup								
	*	<i>Ranunculus repens</i>	Creeping Buttercup								
Rhamnaceae		<i>Pomaderris aspera</i>	Hazel Pomaderris				P				
		<i>Pomaderris racemosa</i>	Cluster Pomaderris				P				
Rosaceae		<i>Acaena novae-zelandiae</i>	Bidgee-widgee				P				
	*	<i>Crataegus monogyna</i>	Hawthorn								C
	*	<i>Prunus cerasifera</i>	Cherry Plum								
	*	<i>Prunus persica</i>	Peach								
	*	<i>Rosa canina</i>	Dog Rose								
	*	<i>Rubus anglocandicans</i>	Common Blackberry								C
		<i>Rubus parvifolius</i>	Small-leaf Bramble				P				
Rubiaceae		<i>Coprosma quadrifida</i>	Prickly Currant-bush						I		
	*	<i>Galium aparine</i>	Cleavers								
Rutaceae		<i>Correa glabra</i> var. <i>glabra</i>	Rock Correa							A	
		<i>Correa reflexa</i> var. <i>reflexa</i>	Common Correa							A	
Sapindaceae	*	<i>Acer negundo</i>	Box-elder Maple								
		<i>Dodonaea viscosa</i> subsp. <i>spatulata</i>	Sticky Hop-bush				P				
Solanaceae	*	<i>Salpichroa origanifolia</i>	Pampas Lily-of-the-Valley								C
		<i>Solanum aviculare</i>	Kangaroo Apple				P				
		<i>Solanum laciniatum</i>	Large Kangaroo Apple				P				

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	*	<i>Solanum mauritianum</i>	Wild Tobacco Tree								
	*	<i>Solanum nigrum</i>	Black Nightshade								
	*	<i>Solanum pseudocapsicum</i>	Madeira Winter-cherry								
Thymelaeaceae		<i>Pimelea humilis</i>	Common Rice-flower				P				
Urticaceae	*	<i>Ulmus</i> spp.	Elm								
	*	<i>Ulmus X hollandica</i>	Dutch Elm								
		<i>Urtica incisa</i>	Scrub Nettle						I		
Verbenaceae	*	<i>Verbena bonariensis</i> var. <i>bonariensis</i> s.s.	Purple-top Verbena								
Violaceae		<i>Melicytus dentatus</i>	Tree Violet						I		
	*	<i>Viola odorata</i>	Common Violet								
Asphodelaceae		<i>Dianella admixta</i>	Black-anther Flax-lily				P				
		<i>Dianella callicarpa</i>	Swamp Flax-lily			r	P				
		<i>Dianella laevis</i>	Smooth Flax-lily				P				
		<i>Dianella</i> sp. aff. <i>longifolia</i> (Benambra)	Arching Flax-lily							A	
		<i>Dianella tasmanica</i>	Tasman Flax-lily							A	

