Appendix 3: Aquatic Assessment undertaken by John McGuckin (Streamline Research Pty. Ltd.)

Melbourne Airport Link to OMR/Bulla Bypass - aquatic fauna assessment

Deep Creek habitat to the north of Bulla

John McGuckin

Streamline Research Pty. Ltd.

Updated report prepared for

VicRoads

November 2012

EXECUTIVE SUMMARY

This report provides an updated field assessment of the aquatic fauna in the vicinity of the Melbourne Airport Link to OMR and various alignment options for the Bulla Bypass.

No threatened fish species were found in the study area.

Deep Creek is considered of moderate conservation value for aquatic fauna.

Melbourne Airport Link to OMR will most likely have no impact on Deep Creek aquatic fauna or habitat.

Bulla Bypass options BB1 North, BB2 and BB3 will most likely have no impact on aquatic fauna or habitat.

Bulla Bypass Option BB1 South is likely to have a greater impact on aquatic fauna and instream habitat as it passes along 250 metres of Deep Creek, increasing the likelihood that piers would be needed to be placed instream.

CONTENTS

1.0 INTRODUCTION

The purpose of this report is to provide an updated field assessment of the aquatic fauna in the vicinity of the Melbourne Airport Link to the Outer Metropolitan Ring (OMR)/Bulla Bypass.

A field investigation was made to determine whether any threatened fish species exist within the proposed works area. Two nationally threatened fish species, the Australian grayling (*Prototroctes maraena*) and the Yarra pygmy perch (*Nannoperca obscura*) could potentially be found within the study area. Australian grayling are known to occur downstream in the Maribrynong River, and Yarra pygmy perch are known from upstream reaches of Deep Creek near Romsey and Lancefield. Although there is no known record of either species within the Melbourne Airport Link to the OMR/Bulla Bypass study area, floodwaters in 2010/11 could have potentially moved these species into the study area.

A third nationally threatened fish species, the dwarf galaxias (*Galaxiella pusilla*) was listed for a targeted survey in this investigation, but as the species has never been recorded in the Maribrynong River drainage basin, it was not expected to be found in the field survey.

This study summarises the aquatic fauna in the Melbourne Airport Link to the OMR/Bulla Bypass study area and assesses the potential impact for each of the Bulla Bypass Options.

1.2 Project objectives.

The objectives of this study are to:

- identify aquatic fauna (particularly threatened species) that could occur within the study area
- identify valued aquatic habitat on proposed Bulla Bypass Options
- determine the potential impacts that each of the Bulla Bypass Options has on aquatic ecological values
- provide recommendations that will minimise/avoid interference to aquatic ecological values

1.3 Study area

The Melbourne Airport Link to OMR/Bulla Bypass is located to the north-east of Melbourne and is close to Melbourne Airport (Figure 1).

This alignment begins at the end of Tullamarine Freeway (east of Melbourne Airport), travelling north towards Somerton Road. After Somerton Road, this alignment then heads north to north west and connects into the future proposed OMR. The ultimate form is a 6 lane freeway.

The Bulla Bypass Options (BB1 North, BB1 South, BB2 and BB3) are shown in Figure 1.

Bulla Bypass consists of four options. All options begin at vicinity of the junction of Somerton and Oaklands Road and travels west along Somerton Road. The options all end on Sunbury Road, south of the OMR/E6 Reservation. The ultimate form is a six lane arterial.

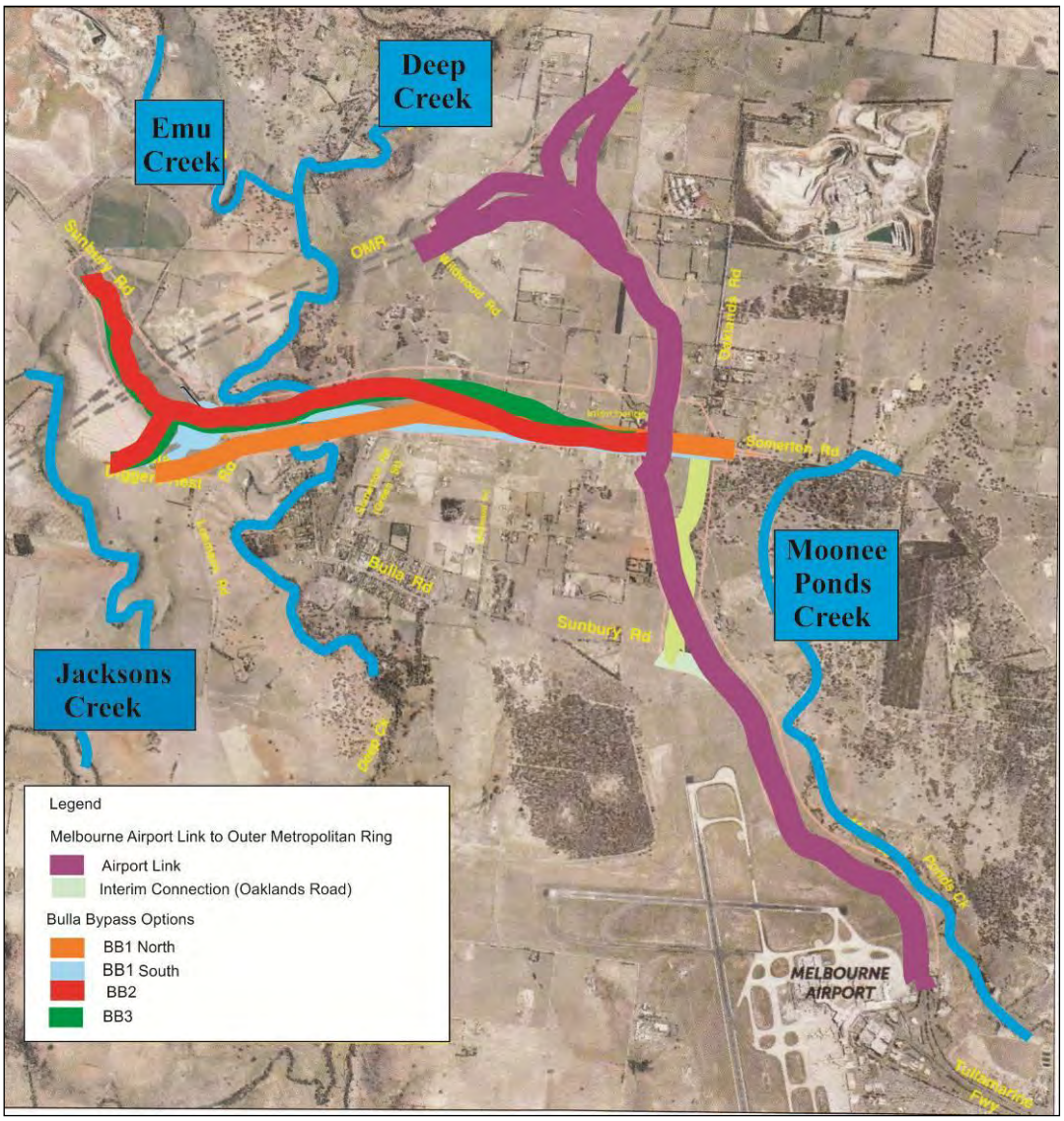

Figure 1. The Melbourne Airport Link to OMR and the Bulla Bypass Options.

BB1 North – orange alignment

BB1 (north) presents the most southerly crossing of Deep Creek and links in at the existing roundabout. Bulla Diggers Rest Road is proposed to be linked via a roundabout or T- intersection subject to grade considerations.

BB1 South – light blue alignment

BB1 (south) links into the existing Sunbury Road. This route traverses for 250 m along Deep Creek. Bulla Diggers Rest Road is proposed to be linked via a roundabout or T- intersection subject to grade considerations.

BB2 – red alignment

BB2 deviates from Somerton Road just before Wildwood Road towards the north. It then loops back southwards and in the process crosses Deep Creek before curving back towards the northern direction connecting into the OMR/Bulla Bypass interchange.

BB3 - green alignment

BB3 deviates northwards along Somerton Road, between Oaklands Road and Wildwood Road to avoid vegetation. It then loops back southwards where it bridges across Deep Creek. Similar to BB2, it connects into the OMR/Bulla Bypass interchange.

Interim Bulla Bypass - Oaklands Road Duplication (light green alignment)

VicRoads is investigating potential staging of this project. This may include duplicating Oaklands Road to a 4 lane divided road. This would connect Sunbury and Somerton Roads.

1.4 Waterways

Deep Creek is the main waterway that could be affected by the proposed road works. Other waterways in near vicinity to the study area include Emu Creek, a tributary of Deep Creek to the north of Bulla and Jacksons Creek, a tributary to the south of Bulla. One additional waterway, Moonee Ponds Creek, is located to the east of the study area.

1.5 River health

Under the Victorian Index of Stream Condition (DSE, 2005), hydrology, physical form, streamside zone, water quality and aquatic life is used for rating river health.

Based of these ratings Deep Creek, Emu Creek and Jacksons Creek are all considered in moderate environmental condition for river health (DSE, 2005). Under the Port Phillip and Westernport Regional River Health Strategy the creeks are also considered in moderate condition for river health (Melbourne Water, 2007).

1.6 Aquatic fauna

Table 1 lists the aquatic fauna that has been recorded within the Melbourne Airport Link to the OMR/Bulla Bypass study area. Data is sourced from the Victorian Aquatic Fauna Database (Department of Sustainability and Environment (DSE), 2010) and from reports conducted by Streamline Research for Melbourne Water (McGuckin, 2005, 2012a and 2012b).

For Deep Creek, the data only includes information for Sunbury Bulla Road and Wildwood Road. Data for Emu Creek is for Gellies Road, data for Jacksons Creek is for Bulla Diggers Rest Road and for Moonee Ponds Creek data is from close proximity to Oaklands Road.

Threatened fish species known for Deep Creek include the Australian grayling, which has only been recorded downstream, in the Maribrynong River and the Yarra pygmy perch which has a restricted upstream population near Lancefield. There is no known record of either species within the study area for this project.

In total six native fish species and seven exotic fish species have been recorded within the study area.

The native fish include the short finned eel (*Anguilla australis*), the common galaxias (*Galaxias maculatus*) which are migratory species and have lifestages in both freshwater and saltwater environments. There are four non migratory native fish species, all of which have their entire lifecycles in freshwater. The species are the mountain galaxias (*Galaxias olidus*), the southern pygmy perch (*Nannoperca australis*), the flat headed gudgeon (*Philypnodon grandiceps*) and Australian smelt (*Retropinna semoni*).

Exotic fish include goldfish (*Carassius auratus*), carp (*Cyprinus carpio*), eastern gambusia (*Gambusia holbrooki*), oriental weatherloach (*Misgurnus anguillicaudatus*), redfin (*Perca fluviatilis*), brown trout (*Salmo trutta*) and tench (*Tinca tinca*).

No fish species have been captured in the upper reaches of Moonee Ponds Creek to the north of Melbourne Airport.

Platypus (*Ornithorhynchus anatinus*) and the water rat (*Hydromys chryogaster*) are known to occur in Deep Creek (Atlas of Victorian Wildlife Database, DSE, 2005). Although platypus have historically been recorded throughout the Melbourne Airport Link to OMR study area, there is no record of the species at Bulla from surveys in 2006, 2008 or 2011 (Edward Tsyrlin, Melbourne Water, pers. comm., 2011).

Emu Creek and Jacksons Creek have known platypus populations (Edward Tsyrlin Melbourne Water, pers. comm., 2011).

The long necked tortoise (*Chelodina longicollis*) has been recorded in Emu Creek (Victorian Aquatic Fauna Database, DSE, 2010).

Freshwater shrimp (*Paratya australiensis*) and the yabby (*Cherax destructor*) are crustacea found in the Melbourne Airport Link to the OMR/Bulla Bypass study area

Table 1. Aquatic fauna that have been recorded for the waterways which are in or near the Melbourne Airport Link to OMR/Bulla Bypass study area.

	Common name	Scientific name	Deep Creek	Emu Creek	Jacksons Creek	Moonee Ponds Creek
Native fish	short-finned eel **m**	*Anguilla australis*	X	X	X	
	common galaxias **m**	*Galaxias maculatus*	X	X	X	
	mountain galaxias	*Galaxias olidus*	X	X	X	
	southern pygmy perch	*Nannoperca australis*	X			
	flat headed gudgeon	*Philypnodon grandiceps*	X	X	X	
	Australian smelt	*Retropinna semoni*	X		X	
Exotic fish	goldfish	*Carassius auratus*	X			
	carp	*Cyprinus carpio*	X		X	
	eastern gambusia	*Gambusia holbrooki*	X	X	X	
	oriental weatherloach	*Misgurnus anguillicaudatus*	X			
	redfin	*Perca fluviatilis*	X		X	
	brown trout	*Salmo trutta*	X		X	
	tench	*Tinca tinca*	X	X	X	
Aquatic mammals	water rat	*Hydromys chryogaster*	X	X		
	platypus	*Ornithorhynchus anatinus*	X	X	X	
Tortoises	long necked tortoise	*Chelodina longicollis*	X	X		
Crustacea	yabbie	*Cherax destructor*				X
	freshwater shrimp	*Paratya australiensis*	X	X	X	X

2.0 FIELD INVESTIGATION

The field investigation for this study was conducted on 5-6 December 2011.

2.1 Fish survey

A total of seven locations were surveyed in this investigation (Figure 2).

Four locations were surveyed on Deep Creek between Bulla Sunbury Road and Wildwood Road (sites 1-4). Additional sites were surveyed at Emu Creek on Gellies Road (site 5), Jacksons Creek at Bulla Diggers Rest Road (site 6) and Moonee Ponds Creek at Woodlands Historic Park (site 7).

With the exception of the two survey locations on the 'Lochton' property (sites 2 and 3), all of the other selected survey locations have previously been surveyed and have historical data available.

Table 2 lists the topographical map reference for each survey site and Figure 2 shows the survey locations.

Table 2. Fish survey sites.

Site Number	Date surveyed	Waterway	Location	Map No.	East	North
1	5-6/12/2011	Deep Creek	Quartz Street, Bulla	7822	306055	5832909
2	5-6/12/2011	Deep Creek	Lochton property site A	7822	305992	5833488
3	5-6/12/2011	Deep Creek	Lochton property site A	7822	305328	5833570
4	5/12/2011	Deep Creek	Wildwood Road, Bulla	7822	305930	5835085
5	5/12/2011	Emu Creek	Gellies Road, Sunbury	7823	302855	5837778
6	6/12/2011	Jacksons Creek	Bulla Diggers Rest Road, Bulla	7822	303865	5833264
7	6/12/2011	Moonee Ponds Creek	Woodlands Historic Park, near Oaklands Road	7822	309027	5832440

2.2 Sampling techniques

Aquatic fauna sampling was made with a number of gear types, backpack electrofishing, fyke nets and light traps. Electrofishing was conducted at one location in Deep Creek (site 4), Emu Creek (site 5), Jacksons Creek (site 6) and Moonee Ponds Creek (site 7). Fyke nets and light traps were set overnight at the three remaining survey locations on Deep Creek (sites 1-3).

Electrofishing is an effective fish capture technique in waters that have good water clarity and moderately low conductivity (less than 1800 EC). Fish sampling was made with a Smith Root 12B backpacker electrofisher. For sites where electrofishing was ineffective due to the presence of deep pools, the use of fyke nets and light traps was employed. One of the advantages in using fyke nets is that along with fish capture, the nets are effective in the capture of bycatch like platypus, water rats, tortoise and crustacea.

(Google base map)

Figure 2. Survey locations in Deep Creek and nearby waterways.

All fish captured were identified and counted. The smallest and largest of each species was measured and weighed.

The fish study was conducted under permit approvals from the Department of Primary Industries and the Department of Sustainability and Environment.

In situ water quality measurements were made in conjunction with each of the fish survey sites. A TPS model 90-FLT water quality logger was used to measure temperature, pH, dissolved oxygen, conductivity and turbidity. The instrument was calibrated in accordance with NATA protocols.

3.0 RESULTS

3.1 Fish survey

Four fish species were captured in Deep Creek, three of which were native fish species and one which is an exotic fish species. The native fish species included the short finned eel, the common galaxias and the mountain galaxias. The one exotic species recorded was tench. Bycatch in Deep Creek included platypus (site 1) the presence of a water rat (site 2) and freshwater shrimp (sites 1-4).

Two native fish species were captured in Emu Creek, the short finned eel and the mountain galaxias. Freshwater shrimp were also recorded.

In Jacksons Creek, the fish fauna was a little more diverse than at the other survey locations with five fish species being captured. The three native fish species were the short finned eel, the mountain galaxias and the flat headed gudgeon. Exotic fish included redfin and tench. Freshwater shrimp were also present in Jacksons Creek.

No fish were captured in Moonee Ponds Creek. Bycatch included the yabbies and freshwater shrimp.

Table 3. Aquatic fauna captured in this investigation.

Waterway	Site	Technique	Fish captures (common name)	No. of fish	Length (mm)	Weight (g)	Bycatch
Deep Creek	1	4 fyke nets	short finned eel	7	420-950		3 platypus
			common galaxias	6	43-46	0.2-0.3	31 freshwater shrimp
	2	4 fyke nets	short finned eel	6	370-850		14 freshwater shrimp
			common galaxias	54	34-134	0.1-15.3	water rat
		4 light traps	no fish				13 freshwater shrimp
	3	4 fyke nets	short finned eel	7	450-830		14 freshwater shrimp
			common galaxias	10	35-48	0.2-0.5	
			*tench	5	180-450	99-1194	
		4 light traps	no fish				8 freshwater shrimp
	4	Electrofished	short finned eel	18	400-700		15 freshwater shrimp
		(100 m)	common galaxias	5	110-119	9.3-9.8	
			mountain galaxias	5	41-79	0.5-3.9	
			*tench	1	296	518	
Emu Creek	5	Electrofished	short finned eel	6	500-900		8 freshwater shrimp
		(100 m)	mountain galaxias	27	47-99	0.4-6.4	
	6	Electrofished	short finned eel	8	180-810		450 freshwater shrimp

Waterway	Site	Technique	Fish captures (common name)	No. of fish	Length (mm)	Weight (g)	Bycatch
Jacksons Creek		(80 m)	mountain galaxias	5	44-78	0.4-2.8	
			flat headed gudgeon	1	50	1.1	
			*redfin	1	225	159	
			*tench	2	350-355	629-644	
Moonee Ponds Creek	**7**	Electrofished (140 m)	no fish				7 freshwater shrimp 4 yabbies

*exotic species

3.2 Water quality

Table 4 provides basic water quality data for the locations where fish sampling was conducted.

In most instances, the water quality parameters of pH, temperature, dissolved oxygen and conductivity meet the SEPP guidelines for the Waters of Victoria (EPA, 1988).

The water quality measurements made in Deep, Emu, Jacksons and Moonee Ponds Creek are all considered acceptable to supporting a variety of aquatic fauna.

Table 4. Basic water quality parameters at the fish survey sites.

Waterway	Site Number	pH	Temperature (°C)	Dissolved oxygen (mg/L)	Electrical conductivity (µS/cm)	Turbidity (NTU)
Deep Creek	**1**	7.7	22.0	8.4	1107	21
	2	7.4	23.9	10.0	1133	16
	3	7.7	23.1	9.8	1094	20
	4	7.0	24.6	12.4	1033	22
Emu Creek	**5**	7.7	26.8	9.8	1180	6.6
Jacksons Creek	**6**	7.5	22.7	7.4	453	61
Moonee Ponds Creek	**7**	6.9	26.4	4.0	779	41

4.0 DISCUSSION

4.1 Aquatic fauna and the study area

The field survey conducted in this study confirms presence of some aquatic fauna species, but it still only provides a snap-shot of the species present at a single point in time. This is why it is important to consider historical data in the overall assessment of the aquatic fauna that may occur in the Melbourne Airport Link to the OMR/Bulla Bypass study area.

There is no state or federally listed threatened fish species that have been recorded within the study area in either this study or past investigations.

This study has confirmed that the nationally and state listed Australian grayling and the Yarra pygmy perch do not currently have populations in close proximity to Bulla. The Australian grayling has not been recorded upstream of the Jacksons Creek junction, which is approximately five kilometres to the south of Bulla. The Yarra pygmy perch has only been recorded in Deep Creek about 20 kilometres north of Bulla. As expected, the dwarf galaxias was not recorded in the Melbourne Airport Link to the OMR/Bulla Bypass study area.

The confirmed presence of platypus in Deep Creek at Quartz Road, Bulla is the first record of the species in the creek in recent times. Platypus surveys conducted for Melbourne Water in 2006, 2008 and in early 2011 have not caught platypus in the vicinity of the Bulla Sunbury Road (Edward Tsyrlin, Melbourne Water, pers. comm., 2011).

Throughout the Melbourne Airport Link to the OMR/Bulla Bypass study area Deep Creek was reduced to a series of pools when streamflow ceased during the drought of 1996-2010. Few pools remained on the 'Lochton' property prior to the recommencement of streamflow in September 2010 (Michael Dentry pers. com., 2011). The current fish fauna is predominantly comprised of freshwater species, species which took refuge in the pools that remained during the drought. The presence of two migratory species, the short finned eels and common galaxias, does, however, show that some connectivity with downstream habitats has occurred since the breaking of the drought.

The fish fauna recorded in Emu and Jacksons Creeks was similar to that recorded in a recent surveys of these waters (McGuckin, 2012a). None of the fish found in these waters is considered threatened.

4.2 Assessment of the Bulla Bypass Options

Bulla Bypass Option BB1 South is likely to have a greater impact on aquatic fauna and instream habitat than the other Options as it passes along 250 metres of Deep Creek, increasing the likelihood that piers would be needed to be placed instream.

Bulla Bypass Options (BB1 North, BB2 and BB3) are all essentially similar and require a single point crossing of Deep Creek. Table 5 shows aquatic value, potential impact and priority ranking. These alignments will have low aquatic impact if a suitable bridge crossing of Deep Creek is made.

Bridge spanning offers minimal interference to aquatic habitat and floodplain hydrology. Ideally the bridge should span Deep Creek and pier placement should be predominately on the creek banks and on the floodplain. This process would ensure that the natural flow regime of Deep Creek is maintained. It would also provide unrestricted aquatic fauna passage.

Where possible, riparian vegetation should be retained at the crossing of Deep Creek. Lopping is preferable to removal. If woody debris is present at the crossing point the material should be moved on the substrate (but not removed). Sediment and toxic substances could have an impact on the surrounding aquatic habitat and as such, have strict guidelines imposed through appropriate mitigation measures (Section 4.4).

Table 5. Aquatic issues with Bulla Bypass Options.

BULLA BYPASS OPTIONS	**BB1 SOUTH Option**	**BB1 NORTH, BB2 and BB3 Options**
Aquatic environments and value	-Deep Creek (**moderate**)	-Deep Creek (**moderate**)
Issues	-incomplete spanning of creek -poor positioning of bridge supports (most likely)	-incomplete spanning of creek -poor positioning of bridge supports (unlikely)
Other aquatic impacts	-road water runoff and sediment to creek -contamination from oil and chemical road spills	-road water runoff and sediment to creek -contamination from oil and chemical road spills
Overall aquatic impact	moderate	low
Priority ranking (to minimise aquatic impacts)	lowest priority of all options	no difference between Options (all are preferable to BB1 South)

4.3 Victorian legislation

The Flora and Fauna Guarantee Act (FFG Act) 1988 is conservation legislation for the protection of flora and fauna in Victoria. The legislation is a public process for identifying and protecting threatened species and ecological communities. In the Melbourne Airport Link to the OMR/Bulla Bypass study area, there is a number of potentially threatening processes that could affect aquatic fauna with road construction.

The potentially threatening processes are:

- Alteration to the natural flow regimes of rivers and streams
- Prevention of passage of aquatic biota as a result of the presence of instream structures
- Alteration to the natural temperature regimes of rivers and streams
- Habitat fragmentation as a threatening process for fauna in Victoria
- Removal of wood debris from Victorian streams.
- Increase in sediment input into Victorian rivers and streams due to human activities
- Input of toxic substances into Victorian rivers and streams

The first five listed threatening processes have only a low risk of occurring if bridge construction is made over Deep Creek as part of the Bulla Bypass Options. Sediment and toxic substance input (threats 6 and 7) would be of low risk but could be mitigated.

The Water Act, 1989 (Government of Victoria, 1989) provides a formal means for the protection and enhancement of the environmental qualities of waterways and their instream uses. The Conservation Strategy for Victoria (Government of Victoria, 1987) mentions that within rivers, flows should be maintained at an adequate level for the survival of aquatic ecosystems.

Under the Victorian Strategy for conserving and maintaining biodiversity (Department of Natural Resources and Environment (DNRE), 1997):

- Ecological processes and biodiversity dependent upon freshwater environments should be maintained and, where necessary, restored
- There should be no further preventable decline in the viability of any rare species or of any rare ecological community
- There should be an increase in the viability of threatened species and in the extent and quality of threatened ecological communities

The Victorian River Health Strategy (DNRE, 2002) provides a framework for the management of river health using Statewide targets for river restoration and integrates the management of activities impacting on rivers.

Mitigation measures (Section 4.4) address the requirements of the above legislation on the Bulla Bypass Options for the crossing of Deep Creek.

4.4 Mitigation measures

The recommended mitigation measures outlined in this section should ensure that aquatic habitat remains intact, and that water and pollutant runoff to waterways is prevented, it assumes that one of BB1 North, BB2 and BB3 is the chosen Bulla Bypass Option and that the BB1 South Option is discarded.

- All stream crossings need to be constructed in a manner which does not impede water movement and to ensure that no obstruction to fish passage occurs.
- Best practice environmental protection measures need to be in accordance with the VicRoads Environment Strategy 2005-2015 (VicRoads, 2005), VicRoads Environmental Management Guidelines (2006).
- A minimal footprint should be used for construction activities. No-go zones could be applied both during construction and after completion of the works. Temporary barriers must be erected around the perimeter of construction areas, and around sites of native vegetation adjacent to the construction zone, prior to construction activities commencing and for the duration of construction works. The barriers will prevent access by construction personnel to Deep Creek and the floodplain habitat.
- Sediment and hazardous wastes should be prevented from entering Deep Creek. As a precaution against flooding, the storage of fill, excavated material, fuels and oils should not be stockpiled near Deep Creek. Sedimentation and erosion controls must be implemented during construction in accordance with Victorian Environment Protection Authority (EPA) guidelines including Environmental Guidelines for Major Construction Sites (1996) and Construction Techniques for Sediment Pollution Control (1991).
- Sedimentation control measures must remain in place until the completion of the works. Sediment fences should be installed to prevent unnecessary erosion and sedimentation to the creek. Sediment and erosion control plans should be developed.
- The adoption of best practise drainage management and incorporation of water sensitive road design (VicRoads, 2012) should be incorporated into the works. VicRoads should ensure that there is no drainage/runoff from the new road directly into Deep Creek.
- The movement of construction vehicles in the vicinity of Deep Creek should be minimised. Passage of vehicles should occur within the smallest amount of easement possible.
- Monitoring following an incident that may impact on aquatic fauna will comprise appropriate sampling to confirm the extent of the disturbance to aquatic habitat. For spillages, post incident monitoring (water quality) will be repeated at daily intervals until the contaminant is no longer considered to be a threat. Monitoring should be performed by a suitably qualified aquatic biologist.

5.0 SUMMARY OF FINDINGS

Deep Creek is considered of moderate conservation value for aquatic fauna.

The nationally threatened Yarra pygmy perch is known to occur in the upper stream reaches of Deep Creek and the nationally threatened Australian grayling is known to occur in the Maribrynong River which has connectivity with Deep Creek. Both species could, in the future, utilise Deep Creek habitat in and around Bulla, even though neither species is currently present in the area. Dwarf galaxias are not expected to exist in the Melbourne Airport Link to the OMR/Bulla Bypass study area, or, anywhere else in the Maribrynong Basin.

Option BB1 South is the least preferred Bulla Bypass Option, as the route traverses 250 metres of Deep Creek. The adoption of any of the remaining Bulla Bypass Options (BB1 North, BB2, or BB3) would be preferable. A bridge crossing of Deep Creek is desirable as it would ensure that the natural flow regime of Deep Creek can be maintained and that unrestricted aquatic fauna passage can occur.

If no pier structures are built within the Deep Creek channel hydrological characteristics are expected to be maintained, resulting in the chosen Bulla Bypass Option being of minimal impact to the aquatic environment of Deep Creek.

Table 6 summarises the remedial actions needed to prevent degradation of aquatic fauna and habitat.

Table 6. Aquatic fauna mitigation measures required for adopted Bulla Bypass Option.

Waterway	Conservation Value	Possible Impacts	Specific Mitigation Measures
Deep Creek	High	-hydrological changes to streamflows -poor water quality inflows -loss of riparian vegetation	-span bridge over creek, where possible positioning-piers on creek banks - lopping of overhanging vegetation rather than removal - prevent sediment and pollution/ to rivers/floodplain - works to be conducted during low flow periods - replant riparian zones with endemic native species

6.0 RECOMMENDATIONS

- Option BB1 South is the least preferred Bulla Bypass Option, as the route traverses 250 metres of Deep Creek. The Option should be discarded.
- For the selected Bulla Bypass BB1 North, BB2, or BB3 (all are similar in aquatic fauna considerations) appropriate bridge design is needed to avoid any alteration in water movement in Deep Creek. It is also necessary to prevent hydrological changes to water movement on the floodplain. Trees that are to removed along the alignment could be placed into Deep Creek to provide instream aquatic fauna habitat.
- Water quality should be monitored during the construction phase to ensure that poor water quality is not entering Deep Creek and therefore, not adversely impacting on aquatic fauna or habitat.

7.0 ACKNOWLEDGEMENTS

VicRoads is thanked for allowing Streamline Research to undertake this study. Brett Lane and Associates are thanked for considering Streamline Research as part of their team in the Flora and Fauna assessment for this study. Edward Tsyrlin from Melbourne Water is thanked for providing up-to-date information on platypus occurrences within the study area. Michael and Julie Dentry are thanked for allowing access to their 'Lochton' property. Dave Lucas (Feral Industries) was an excellent assistant with the field study.

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Appendix 4: Detailed habitat hectare assessment results

Habitat Zone			A	B	C	D	E	F	G	H	I	J	K	L	M	N
EVC Name (Initials)			CGW	CGW	CGW	CGW	CGW	CGW	CGW	CGW	SBS	HHrW	HHrW	HHrW	HHrW	HHrW
EVC Number			68	68	68	68	68	68	68	68	851	71	71	71	71	71
Total area of Habitat Zone (ha)			0.13	7.11	0.15	0.31	2	0.26	0.55	0.49	1.4	4.12	1.03	0.09	0.45	1.66
Site Condition	Large Old Trees	/10	9	3	10	3	0	0	5	5	7	2	0	8	5	3
	Canopy Cover	/5	4	4	5	4	0	0	4	2	2	3	0	0	2	4
	Lack of Weeds	/15	0	4	4	6	4	4	2	2	4	4	4	7	0	0
	Understorey	/25	5	10	10	5	5	5	5	0	10	20	15	5	5	5
	Recruitment	/10	0	0	0	0	0	0	0	0	3	3	0	0	0	0
	Organic Matter	/5	3	3	5	5	5	5	2	3	3	5	0	3	3	5
	Logs	/5	0	0	4	0	0	0	0	0	5	5	0	0	4	4
	Total site condition score		21	24	38	23	14	14	18	12	34	42	19	23	19	21
	Possible site condition score		75	75	75	75	75	75	75	75	75	75	75	75	75	75
	*Adjusted site condition score**		*21*	*24*	*38*	*23*	*14*	*14*	*18*	*12*	*34*	*42*	*19*	*23*	*19*	*21*
Landscape Context	Patch Size	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Neighbourhood	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Distance to Core	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	*Landscape context subtotal***		*4*	*6*	*6*	*6*	*6*	*6*	*6*	*6*	*10*	*10*	*10*	*6*	*6*	*6*
Total Habitat Score		**/100**	**25**	**30**	**44**	**29**	**20**	**20**	**24**	**18**	**44**	**52**	**29**	**29**	**25**	**27**
Habitat score out of 1			0.25	0.30	0.44	0.29	0.20	0.20	0.24	0.18	0.44	0.52	0.29	0.29	0.25	0.27
Habitat Hectares in Habitat Zone#			**0.03**	**2.13**	**0.07**	**0.09**	**0.40**	**0.05**	**0.13**	**0.09**	**0.62**	**2.14**	**0.30**	**0.03**	**0.11**	**0.45**
Bioregion			CVU	CVU	CVU	CVU	CVU	CVU	CVU	CVU	VVP	CVU	CVU	CVU	CVU	CVU
EVC Conservation Status			Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Vulnerable	Vulnerable	Vulnerable	Vulnerable	Vulnerable
Conservation Significance	Conservation Status x Habitat Score		High	High	High	High	High	High	High	High	Very High	Very High	Medium	Medium	Medium	Medium
	Threatened Species Rating		NA	High	High	High	NA	NA	NA	NA	NA	High	NA	Very High	Very High	Very High
	Other Site Attribute Rating		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Overall Conservation Significance (highest)		**High**	**High**	**High**	**High**	**High**	**High**	**High**	**High**	**Very High**	**Very High**	**Medium**	**Very High**	**Very High**	**Very High**
No. Large Old Trees^ in Habitat Zone			**7**	**41**	**3**	**1**	**0**	**0**	**5**	**3**	**11**	**8**	**0**	**1**	**3**	**7**

Habitat Zone			O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
EVC Name (Initials)			HHrW	SBS	HHrW	PW	PW	PW	PW	PW	PW	CGW	SBS	SBS	SBS
EVC Number			71	851	71	803	803	803	803	803	803	68	851	851	851
Total area of Habitat Zone (ha)			0.5	0.73	1.3	1.27	0.76	0.22	1.35	5.25	1.09	0.65	1.65	3.71	1.53
Site Condition	Large Old Trees	/10	7	7	5	2	2	0	3	0	1	3	3	5	0
	Canopy Cover	/5	4	2	2	2	2	2	4	0	2	4	2	2	0
	Lack of Weeds	/15	0	0	0	0	2	0	2	0	4	0	0	4	2
	Understorey	/25	5	10	5	5	5	5	5	5	5	5	5	5	5
	Recruitment	/10	0	3	0	0	0	0	0	0	3	3	3	0	0
	Organic Matter	/5	5	5	5	5	3	3	5	3	3	3	3	5	3
	Logs	/5	5	5	5	2	2	0	4	0	4	2	2	4	0
	Total site condition score		26	32	22	16	16	10	23	8	22	20	18	25	10
	Possible site condition score		75	75	75	75	75	75	75	75	75	75	75	75	75
	*Adjusted site condition score**		*26*	*32*	*22*	*16*	*16*	*10*	*23*	*8*	*22*	*20*	*18*	*25*	*10*
Landscape Context	Patch Size	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Neighbourhood	/10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Distance to Core	/5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	*Landscape context subtotal***		*6*	*10*	*10*	*6*	*4*	*4*	*6*	*4*	*4*	*4*	*6*	*10*	*6*
Total Habitat Score		**/100**	**32**	**42**	**32**	**22**	**20**	**14**	**29**	**12**	**26**	**24**	**24**	**35**	**16**
Habitat score out of 1			0.32	0.42	0.32	0.22	0.20	0.14	0.29	0.12	0.26	0.24	0.24	0.35	0.16
Habitat Hectares in Habitat Zone#			**0.16**	**0.31**	**0.42**	**0.28**	**0.15**	**0.03**	**0.39**	**0.63**	**0.28**	**0.16**	**0.40**	**1.30**	**0.24**
Bioregion			CVU	VVP	VVP	VVP	VVP	VVP	VVP	VVP	VVP	CVU	VVP	VVP	VVP
EVC Conservation Status			Vulnerable	Endangered	Vulnerable	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered	Endangered
Conservation Significance	Conservation Status x Habitat Score		High	Very High	Medium	High	High	High	High	High	High	High	Very High	High	High
	Threatened Species Rating		NA	NA	Very High	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Other Site Attribute Rating		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Overall Conservation Significance (highest)		**High**	**Very High**	**Very High**	**High**	**High**	**High**	**High**	**High**	**High**	**High**	**Very High**	**High**	**High**
No. Large Old Trees^ in Habitat Zone			**6**	**6**	**9**	**3**	**2**	**0**	**8**	**0**	**3**	**3**	**5**	**24**	**0**

* = Modified approach to habitat scoring - refer to Table 14 of DSE's Vegetation Quality Assessment Manual (DSE, 2004); ** = The landscape context score as modelled on DSE's Biodiversity Interactive Maps were used for this result; # = Habitat hectares (habitat score/100 X area [ha]); ^ = Large and very large trees

Appendix 5: Scattered trees in the study area

Tree no.	Common Name	DBH (cm)	Bioregion	EVC No.	BCS	Benchmark	Size Class	Conservation Significance
5	River Red-gum	49	CVU	68	E	80	Small	Low
6	River Red-gum	32	CVU	68	E	80	Small	Low
7	River Red-gum	21	CVU	68	E	80	Small	Low
8	River Red-gum	37	CVU	68	E	80	Small	Low
12	River Red-gum	62	CVU	68	E	80	Medium	High
13	River Red-gum	55	CVU	68	E	80	Small	Low
14	River Red-gum	52	CVU	68	E	80	Small	Low
15	River Red-gum	54	CVU	68	E	80	Small	Low
16	River Red-gum	121	CVU	68	E	80	Very Large	High
17	River Red-gum	67	CVU	68	E	80	Medium	High
18	River Red-gum	72	CVU	68	E	80	Medium	High
19	River Red-gum	99	CVU	68	E	80	Large	High
20	River Red-gum	70	CVU	68	E	80	Medium	High
62	River Red-gum	87	CVU	71	V	70	Large	Medium
63	Grey Box	68	CVU	71	V	70	Medium	Medium
88	Yellow Gum (v)	71	CVU	71	V	70	Large	Very High*
89	Yellow Box	98	CVU	71	V	70	Large	Medium
90	Yellow Box	98	CVU	71	V	70	Large	Medium
96	Yellow Gum (v)	22	CVU	71	V	70	Small	Very High*
97	Yellow Box	19	CVU	71	V	70	Small	Low
104	Yellow Gum (v)	19	CVU	71	V	70	Small	Very High*
106	Yellow Gum (v)	17	CVU	71	V	70	Small	Very High*
110	Grey Box	88	CVU	71	V	70	Large	Medium
140	Grey Box	52	CVU	71	V	70	Medium	Medium
141	Grey Box	84	CVU	71	V	70	Large	Medium
142	Grey Box	60	CVU	71	V	70	Medium	Medium
143	Grey Box	43	CVU	71	V	70	Medium	Medium
149	Grey Box	84	VVP	803	E	70	Large	High

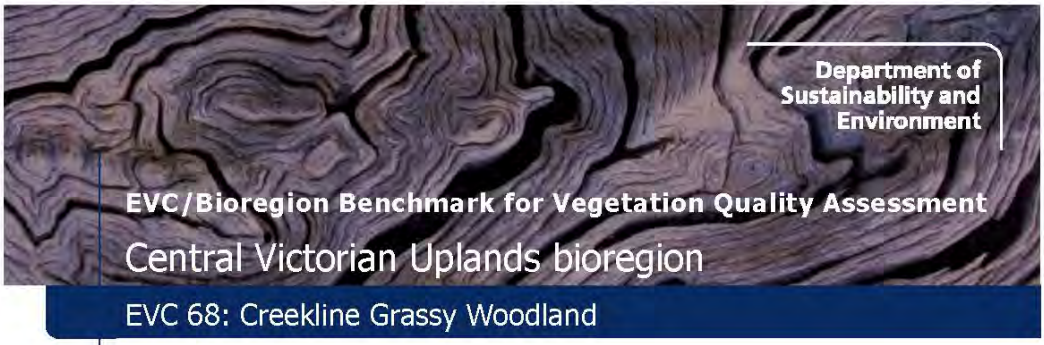
Tree no.	Common Name	DBH (cm)	Bioregion	EVC No.	BCS	Benchmark	Size Class	Conservation
150	Grey Box	75	VVP	803	E	70	Large	High
151	Grey Box	82	VVP	803	E	70	Large	High
152	Grey Box	87	VVP	803	E	70	Large	High
161	Grey Box	71	VVP	803	E	70	Large	High
162	Grey Box	66	VVP	803	E	70	Medium	High
163	Grey Box	75	VVP	803	E	70	Large	High
164	Grey Box	59	VVP	803	E	70	Medium	High
165	Grey Box	56	VVP	803	E	70	Medium	High
166	Grey Box	59	VVP	803	E	70	Medium	High
167	Grey Box	66	VVP	803	E	70	Medium	High
168	Grey Box	45	VVP	803	E	70	Small	Low
200	River Red-gum	131	CVU	68	E	80	Very Large	High
201	River Red-gum	128	CVU	68	E	80	Very Large	High
202	River Red-gum	50	CVU	68	E	80	Small	Low
203	River Red-gum	114	CVU	68	E	80	Large	High
210	Dead Tree	110	CVU	68	E	80	Large	High
211	River Red-gum	31	CVU	68	E	80	Small	Low
212	River Red-gum	95	CVU	68	E	80	Large	High
213	River Red-gum	27	CVU	68	E	80	Small	Low
214	River Red-gum	29	CVU	68	E	80	Small	Low
216	River Red-gum	27	CVU	68	E	80	Small	Low
217	River Red-gum	69	CVU	68	E	80	Medium	High
218	River Red-gum	94	CVU	68	E	80	Large	High
219	River Red-gum	32	CVU	68	E	80	Small	Low
220	River Red-gum	30	CVU	68	E	80	Small	Low
221	River Red-gum	43	CVU	68	E	80	Small	Low
222	River Red-gum	53	CVU	68	E	80	Small	Low
223	River Red-gum	72	VVP	71	V	70	Large	Medium
224	River Red-gum	52	VVP	71	V	70	Small	Low
225	River Red-gum	57	VVP	71	V	70	Medium	Medium
226	River Red-gum	69	VVP	71	V	70	Medium	Medium
227	River Red-gum	64	VVP	71	V	70	Medium	Medium
228	River Red-gum	67	VVP	71	V	70	Medium	Medium
229	River Red-gum	59	VVP	71	V	70	Medium	Medium

Tree no.	Common Name	DBH (cm)	Bioregion	EVC No.	BCS	Benchmark	Size Class	Conservation
230	River Red-gum	37	VVP	71	V	70	Small	Low
231	River Red-gum	105	VVP	71	V	70	Very Large	Medium
232	River Red-gum	112	VVP	71	V	70	Very Large	Medium
233	River Red-gum	51	VVP	71	V	70	Small	Low
234	River Red-gum	23	VVP	71	V	70	Small	Low
235	River Red-gum	138	VVP	71	V	70	Very Large	Medium
236	River Red-gum	28	VVP	71	V	70	Small	Low
237	River Red-gum	69	VVP	71	V	70	Medium	Medium
238	River Red-gum	68	VVP	71	V	70	Medium	Medium
239	River Red-gum	83	VVP	71	V	70	Large	Medium
240	River Red-gum	60	VVP	71	V	70	Medium	Medium
241	River Red-gum	42	VVP	71	V	70	Small	Low
242	River Red-gum	42	VVP	71	V	70	Small	Low
267	River Red-gum	55	VVP	55	E	80	Small	Low
268	River Red-gum	70	VVP	55	E	80	Medium	High
273	River Red-gum	51	VVP	851	E	70	Small	Low
274	River Red-gum	104	VVP	851	E	70	Large	High
275	River Red-gum	123	VVP	851	E	70	Very Large	High

DBH = Diameter at breast height (130 cm from the ground); Note**:** Offsets for the removal of small scattered trees are calculated based on the specific DBH of the tree. Tree replacement numbers are sourced from Section 3.4.4 (Figure 7) of the Port Phillip and Western Port CMA Native Vegetation Plan (2006); *** =** Conservation significance raised as this species is DSE-listed, see Appendix 7 for more information; **v =** vulnerable.

Appendix 6: EVC Benchmarks

- Creekline Grassy Woodland (EVC 68) – **Central Victorian Uplands**
- Hills Herb-rich Woodland (EVC 71) – **Central Victorian Uplands**
- Hills Herb-rich Woodland (EVC 71) – **Victorian Volcanic Plains**
- Plains Woodland (EVC 803) – **Victorian Volcanic Plains**
- Stream Bank Shrubland (EVC 851) – **Victorian Volcanic Plains**



Description:
Eucalypt-dominated woodland to 15 m tall with occasional scattered shrub layer over a mostly grassy/sedgy to herbaceous ground-layer. Occurs on low-gradient ephemeral to intermittent drainage lines, typically on fertile colluvial/alluvial soils, on a wide range of suitably fertile geological substrates. These minor drainage lines can include a range of graminoid and herbaceous species tolerant of waterlogged soils, and are presumed to have sometimes resembled a linear wetland or system of interconnected small ponds.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	80 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
15%	*Eucalyptus camaldulensis*	River Red-gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understroey Tree or Large Shrub	1	5%	T
Medium Shrub	4	10%	MS
Small Shrub	3	5%	SS
Large Herb	2	5%	LH
Medium Herb	9	15%	MH
Small Herb	3	5%	SH
Large Tufted Graminoid	3	15%	LTG
Large Non-tufted Graminoid	1	5%	LNG
Medium to Small Tufted Graminoid	15	30%	MTG
Medium to Tiny Non-tufted Graminoid	3	5%	MNG
Bryophytes/Lichens	na	10%	BL

Ecological Vegetation Class bioregion benchmark

Victoria The Place To Be

EVC 68: Creekline Grassy Woodland - Central Victorian Uplands bioregion

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia dealbata*	Silver Wattle
T	*Acacia melanoxylon*	Blackwood
MS	*Acacia pycnantha*	Golden Wattle
MS	*Melaleuca parvistaminea*	Rough-barked Haoney-myrtle
MS	*Acacia retinodes var. retinodes*	Wilrilda
SS	*Pimelea humilis*	Common Rice-flower
PS	*Astroloma humifusum*	Cranberry Heath
LH	*Senecio tenuiflorus*	Slender Fireweed
LH	*Senecio quadridentatus*	Cottony Fireweed
MH	*Centipeda cunninghamii*	Common Sneezeweed
MH	*Hypericum gramineum*	Small St John's Wort
SH	*Dichondra repens*	Kidneyweed
LTG	*Poa labillardierei*	Common Tussock-grass
LTG	*Carex appressa*	Tall Sedge
LNG	*Phragmites australis*	Common Reed
MTG	*Elymus scaber var. scaber*	Common Wheat-grass
MTG	*Juncus* spp.	Rush
MTG	*Cyperus* spp.	Flat-sedge
MNG	*Microlaena stipoides var. stipoides*	Weeping Grass

Recruitment:
Continuous

Organic Litter:
40 % cover

Logs:
30 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Cirsium vulgare*	Spear Thistle	high	high
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Anagallis arvensis*	Pimpernel	high	low
MH	*Hypochoeris glabra*	Smooth Cat's-ear	high	low
MH	*Galium murale*	Small Goosegrass	high	low
MH	*Oxalis pes-caprae*	Soursob	high	high
LTG	*Juncus acutus*	Spiny Rush	high	high
LTG	*Phalaris aquatica*	Toowoomba Canary-grass	high	high
MTG	*Briza maxima*	Large Quaking-grass	high	low
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MTG	*Romulea rosea*	Onion Grass	high	low
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Bromus hordeaceus ssp. hordeaceus*	Soft Brome	high	low
MNG	*Aira elegantissima*	Delicate Hair-grass	high	low
MNG	*Vulpia muralis*	Wall Fescue	high	low
MNG	*Bromus madritensis*	Madrid Brome	high	low

Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Central Victorian Uplands bioregion

EVC 71: Hills Herb-rich Woodland

Description:
A dry, open eucalypt woodland to 15 m tall often with a sparse shrub layer. The understorey is dominated by a carpet of herbs and grasses. Soils are generally shallow but fertile, and outcropping rock is not uncommon. This seasonally dry environment is favourable for annual herbs, with the fertile nature of the various geologies also supporting perennial herbs. Landform can vary from relatively flat ground to ridge tops on sedimentary sandstones (along seams of mineral-rich sandstone) to undulating, rounded, granite hill landforms.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
15%	*Eucalyptus microcarpa*	Grey Box
	Eucalyptus melliodora	Yellow Box
	Eucalyptus camaldulensis	River Red-gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	5%	T
Medium Shrub	4	10%	MS
Small Shrub	2	1%	SS
Prostrate Shrub	1	1%	PS
Large Herb	1	5%	LH
Medium Herb	4	5%	MH
Large Tufted Graminoid	1	1%	LTG
Medium to Small Tufted Graminoid	8	25%	MTG
Medium to Tiny Non-tufted Graminoid	3	5%	MNG
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	10%	S/C
Total understorey projective foliage cover		**75%**	

Ecological Vegetation Class bioregion benchmark

Victoria The Place To Be

EVC 71: Hills Herb-rich Woodland - Central Victorian Uplands bioregion

LF Code	Species typical of at least part of EVC range	Common Name
T	*Allocasuarina verticillata*	Drooping Sheoak
MS	*Acacia pycnantha*	Golden Wattle
MS	*Acacia paradoxa*	Hedge Wattle
MS	*Ozothamnus obcordatus*	Grey Everlasting
PS	*Bossiaea prostrata*	Creeping Bossiaea
MH	*Hypericum gramineum*	Small St John's Wort
MH	*Gonocarpus tetragynus*	Common Raspwort
MTG	*Poa sieberiana*	Grey Tussock-grass
MTG	*Lomandra filiformis*	Wattle Mat-rush
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Tricoryne elatior*	Yellow Rush-lily
MNG	*Microlaena stipoides var. stipoides*	Weeping Grass

Recruitment:
Continuous

Organic Litter:
20 % cover

Logs:
15 m/0.1 ha.

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 71: Hills Herb-rich Woodland

Description:
A dry, open eucalypt woodland to 15 m tall often with a sparse shrub layer. The understorey is dominated by a carpet of herbs and grasses. Soils are generally shallow but fertile, and outcropping rock is not uncommon. This seasonally dry environment is favourable for annual herbs, with the fertile nature of the various geologies also supporting perennial herbs. Landform can vary from relatively flat ground to ridge tops on sedimentary sandstones (along seams of mineral-rich sandstone) to undulating, rounded, granite hill landforms.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha

Tree Canopy Cover:

%cover	Character Species	Common Name
15%	*Eucalyptus microcarpa*	Grey Box
	Eucalyptus melliodora	Yellow Box
	Eucalyptus camaldulensis	River Red-gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Understorey Tree or Large Shrub	1	5%	T
Medium Shrub	4	10%	MS
Small Shrub	2	1%	SS
Prostrate Shrub	1	1%	PS
Large Herb	1	5%	LH
Medium Herb	4	5%	MH
Large Tufted Graminoid	1	1%	LTG
Medium to Small Tufted Graminoid	8	25%	MTG
Medium to Tiny Non-tufted Graminoid	3	5%	MNG
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	10%	S/C
Total understorey projective foliage cover		**75%**	

Ecological Vegetation Class bioregion benchmark

Victoria The Place To Be

EVC 71: Hills Herb-rich Woodland – Victorian Volcanic Plain bioregion

LF Code	Species typical of at least part of EVC range	Common Name
T	*Allocasuarina verticillata*	Drooping Sheoak
MS	*Acacia pycnantha*	Golden Wattle
MS	*Acacia paradoxa*	Hedge Wattle
MS	*Ozothamnus obcordatus*	Grey Everlasting
PS	*Bossiaea prostrata*	Creeping Bossiaea
MH	*Hypericum gramineum*	Small St John's Wort
MH	*Gonocarpus tetragynus*	Common Raspwort
MTG	*Poa sieberiana*	Grey Tussock-grass
MTG	*Lomandra filiformis*	Wattle Mat-rush
MTG	*Themeda triandra*	Kangaroo Grass
MTG	*Tricoryne elatior*	Yellow Rush-lily
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass

Recruitment:
Continuous

Organic Litter:
20 % cover

Logs:
15 m/0.1 ha.

Department of Sustainability and Environment

EVC/Bioregion Benchmark for Vegetation Quality Assessment

Victorian Volcanic Plain bioregion

EVC 803: Plains Woodland (*syn.* EVC 55 *Riverina* Plains Grassy Woodland)

Description:
Grassy or sedgy woodland to 15 m tall with large inter-tussock spaces potentially supporting a range of annual or geophytic herbs adapted to low summer rainfall, with low overall biomass. Mostly occurs on terrain of low relief in areas receiving <600 mm rainfall per annum. Fertile, sometimes seasonally waterlogged, mostly silty, loamy or clay topsoils, with heavy subsoils, derived largely from former Quaternary swamp deposits.

Large trees:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	15 / ha
Allocasuarina luehmannii	40 cm	

Tree Canopy Cover:

%cover	Character Species	Common Name
15%	*Eucalyptus microcarpa*	Grey Box
	Allocasuarina luehmannii	Buloke
	Eucalyptus melliodora	Yellow Box
	Eucalyptus leucoxylon	Yellow Gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree		5%	IT
Medium Shrub	2	5%	MS
Small Shrub	2	5%	SS
Prostrate Shrub	1	1%	PS
Large Herb	1	1%	LH
Medium Herb	20	20%	MH
Small or Prostrate Herb	4	10%	SH
Large Tufted Graminoid	1	1%	LTG
Large Non-tufted Graminoid	1	1%	LNG
Medium to Small Tufted Graminoid	16	45%	MTG
Medium to Tiny Non-tufted Graminoid	3	5%	MNG
Bryophytes/Lichens	na	10%	BL
Soil Crust	na	10%	S/C

Recruitment:
Continuous

Organic Litter:
10 % cover

Logs:
10 m/0.1 ha.

Ecological Vegetation Class bioregion benchmark

Victoria The Place To Be

EVC 803: Plains Woodland (*syn.* EVC 55 *Riverina* Plains Grassy Woodland) - Victorian Volcanic Plain bioregion

LF Code	Species typical of at least part of EVC range	Common Name
MS	*Acacia pycnantha*	Golden Wattle
MS	*Acacia acinacea s.l.*	Gold-dust Wattle
SS	*Eutaxia microphylla* var. *microphylla*	Common Eutaxia
PS	*Astroloma humifusum*	Cranberry Heath
LH	*Senecio quadridentatus*	Cotton Fireweed
MH	*Acaena echinata*	Sheep's Burr
MH	*Plantago gaudichaudii*	Narrow Plantain
MH	*Maireana enchylaenoides*	Wingless Bluebush
MH	*Calocephalus citreus*	Lemon Beauty-heads
SH	*Solenogyne dominii*	Smooth Solenogyne
SH	*Oxalis perennans*	Grassland Wood-sorrel
SH	*Daucus glochidiatus*	Austral Carrot
SH	*Goodenia pinnatifida*	Cut-leaf Goodenia
LTG	*Austrostipa bigeniculata*	Kneed Spear-grass
MTG	*Austrostipa scabra*	Rough Spear-grass
MTG	*Austrodanthonia setacea*	Bristly Wallaby-grass
MTG	*Dianella revoluta* s.s.	Black-anther Flax-lily
MTG	*Austrodanthonia caespitosa*	Common Wallaby-grass
MNG	*Wurmbea dioica*	Common Early Nancy
TTG	*Centrolepis strigosa* ssp. *strigosa*	Hairy Centrolepis
TTG	*Centrolepis aristata*	Pointed Centrolepis
EP	*Amyema miquelii*	Box Mistletoe
SC	*Thysanotus patersonii*	Twining Fringe-lily
SC	*Convolvulus erubescens* spp. agg.	Pink Bindweed

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Trifolium angustifolium* var. *angustifolium*	Narrow-leaf Clover	high	low
MH	*Hypochoeris glabra*	Smooth Cat's-ear	high	low
MH	*Arctotheca calendula*	Cape Weed	high	low
MH	*Petrorhagia velutina*	Velvety Pink	high	low
MH	*Trifolium dubium*	Suckling Clover	high	low
MH	*Anagallis arvensis*	Pimpernel	high	low
SH	*Trifolium glomeratum*	Cluster Clover	high	low
LNG	*Avena fatua*	Wild Oat	high	low
MTG	*Romulea rosea*	Onion Grass	high	low
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MTG	*Briza maxima*	Large Quaking-grass	high	low
MTG	*Lolium rigidum*	Wimmera Rye-grass	high	low
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MNG	*Vulpia myuros*	Rat's-tail Fescue	high	low
MNG	*Juncus capitatus*	Capitate Rush	high	low
MNG	*Bromus rubens*	Red Brome	high	low

Description:
Tall shrubland to 8 m tall above a ground layer of sedges and herbs. A sparse eucalypt overstorey to 15 m tall may sometimes be present. Occurs along rivers and major streams where the watercourse consists of either rocky banks, a flat rocky stream bed or broad gravel banks which are often dry but are also regularly flooded by fast flowing waters.

[+] eucalypt woodland only components (ignore when assessing shrublands and standardise site condition score as required)

Large trees[+]:

Species	DBH(cm)	#/ha
Eucalyptus spp.	70 cm	10 / ha

Tree Canopy Cover[+]:

%cover	Character Species	Common Name
10%	*Eucalyptus camaldulensis*	River Red-gum

Understorey:

Life form	#Spp	%Cover	LF code
Immature Canopy Tree[+]		5%	IT
Understorey Tree or Large Shrub	2	10%	T
Medium Shrub	4	20%	MS
Large Herb	3	5%	LH
Medium Herb	12	20%	MH
Small or Prostrate Herb	4	10%	SH
Large Tufted Graminoid	3	10%	LTG
Large Non-tufted Graminoid	3	10%	LNG
Medium to Small Tufted Graminoid	10	15%	MTG
Medium to Tiny Non-tufted Graminoid	5	10%	MNG
Scrambler or Climber	2	5%	SC

LF Code	Species typical of at least part of EVC range	Common Name
T	*Acacia mearnsii*	Black Wattle
T	*Acacia melanoxylon*	Blackwood
MS	*Leptospermum lanigerum*	Woolly Tea-tree
MS	*Hymenanthera dentata* s.l.	Tree Violet
MS	*Bursaria spinosa* ssp. *spinosa*	Sweet Bursaria
MS	*Callistemon sieberi*	River Bottlebrush
LH	*Persicaria decipiens*	Slender Knotweed
LH	*Epilobium billardierianum*	Variable Willow-herb
MH	*Acaena novae-zelandiae*	Bidgee-widgee
MH	*Hydrocotyle verticillata*	Shield Pennywort
MH	*Oxalis perennans*	Grassland Wood-sorrel
SH	*Crassula helmsii*	Swamp Crassula
SH	*Dichondra repens*	Kidney-weed
SH	*Apium prostratum* ssp. *prostratum*	Sea Celery
SH	*Hydrocotyle verticillata*	Shield Pennywort
LTG	*Poa labillardierei*	Common Tussock-grass
LTG	*Lomandra longifolia*	Spiny-headed Mat-rush
LNG	*Phragmites australis*	Common Reed
LNG	*Schoenoplectus tabernaemontani*	River Club-sedge
MTG	*Triglochin procerum* s.l.	Water Ribbons
MNG	*Microlaena stipoides* var. *stipoides*	Weeping Grass
MNG	*Ficinia nodosa*	Knobby Club-sedge
SC	*Calystegia sepium*	Large Bindweed

Ecological Vegetation Class bioregion benchmark

Victoria The Place To Be

EVC 851: Stream Bank Shrubland - Victorian Volcanic Plain bioregion

Recruitment:
Continuous

Organic Litter:
40 % cover

Logs:
10 m/0.1 ha.

Weediness:

LF Code	Typical Weed Species	Common Name	Invasive	Impact
T	*Crataegus monogyna*	Hawthorn	high	high
MS	*Rosa rubiginosa*	Sweet Briar	high	high
MS	*Ulex europaeus*	Gorse	high	high
LH	*Plantago lanceolata*	Ribwort	high	low
LH	*Rumex crispus*	Curled Dock	high	low
LH	*Sonchus oleraceus*	Common Sow-thistle	high	low
LH	*Rumex conglomeratus*	Clustered Dock	high	low
LH	*Sonchus asper* s.l.	Rough Sow-thistle	high	low
LH	*Helminthotheca echioides*	Ox-tongue	high	low
LH	*Aster subulatus*	Aster-weed	high	low
MH	*Hypochoeris radicata*	Cat's Ear	high	low
MH	*Trifolium angustifolium* var. *angustifolium*	Narrow-leaf Clover	high	low
MH	*Trifolium dubium*	Suckling Clover	high	low
MH	*Plantago major*	Greater Plantain	high	low
SH	*Trifolium repens* var. *repens*	White Clover	high	low
LTG	*Phalaris aquatica*	Toowoomba Canary-grass	high	high
LNG	*Holcus lanatus*	Yorkshire Fog	high	high
MTG	*Vulpia bromoides*	Squirrel-tail Fescue	high	low
MTG	*Bromus hordeaceus* ssp. *hordeaceus*	Soft Brome	high	low
MTG	*Nassella neesiana*	Chilean Needle-grass	high	high
MTG	*Bromus diandrus*	Great Brome	high	low
MTG	*Lolium perenne*	Perennial Rye-grass	high	low
MTG	*Romulea rosea*	Onion Grass	high	low
MTG	*Bromus catharticus*	Prairie Grass	high	low
MTG	*Briza maxima*	Large Quaking-grass	high	low
MTG	*Briza minor*	Lesser Quaking-grass	high	low
MNG	*Cynosurus echinatus*	Rough Dog's-tail	high	low
MNG	*Dactylis glomerata*	Cocksfoot	high	high
MNG	*Avena barbata*	Bearded Oat	high	low
MNG	*Paspalum distichum*	Water Couch	high	high
SC	*Galium aparine*	Cleavers	high	low
SC	*Vicia sativa* ssp. *sativa*	Common Vetch	high	low

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Appendix 7: Best / Remaining 50% habitat assessment for rare and threatened species

Species and DSE Conservation Status	Habitat Zones	Assessment Process	Outcome	Conservation Significance	Justification
Arching Flax-lily (v)	B, C and D	A, D, F, No	Remaining 50% Habitat	High	The quality of the understorey in these Habitat Zones is not considered to be significant.
Austral Tobacco (r)	J	A, B, E, F, Yes	Best 50% Habitat	High	The large size of the population recorded in Habitat Zone J suggests that it provides above-average habitat for the species.
Branching Groundsel (r)	I, P and Q	A, D, No	No further consideration	N/A	The quality of the understorey in these Habitat Zones is not considered to be significant.
Fragrant Saltbush (r)	J and Q	A, B, E, F, Yes	Best 50% Habitat	Very High	The large size of the population recorded in Habitat Zones suggests that it provides above-average habitat for the species.
Melbourne Yellow-gum (v)	J, L, M and N	A, B, E, F, Yes	Best 50% Habitat	Very High	The large size of the population recorded in Habitat Zones suggests that it provides above-average habitat for the species.
Melbourne Yellow-gum (v) (Scattered trees)	Tree Nos. 88, 96, 104 and 106	N/A	Best 50% Habitat	Very High	The large size of the population recorded in Habitat Zones and as scattered trees suggests that it provides above-average habitat for the species.
Yellow Star (k)	B, C and D	A, D, F, No	Remaining 50% Habitat	High	The quality of the understorey in these Habitat Zones is not considered to be significant.
Black Falcon (vu)	R, S, T, U, V, W	A, D, No	No further consideration	High	Although habitat is suitable at the study area it is unlikely that the Black Falcon would make significant use of the area.
Diamond Firetail (vu)	K, L, M, N	A, D, F, No	Remaining 50% of habitat	Medium	Although there is suitable habitat for this species at the study area, it is considered to be below average habitat quality.
	A, B, C, D, E, F, G, H, O		Remaining 50% of habitat	High	
	J, Q		Remaining 50% of habitat	Very High	
Swift Parrot (en)	K, L, M, N	A, D, F, No	Remaining 50% of habitat	Medium	Although there is suitable habitat for this species at the study area, it is considered to be below average habitat

Species and DSE Conservation Status	Habitat Zones	Assessment Process	Outcome	Conservation Significance	Justification
	A, B, C, D, E, F, G, H, O		Remaining 50% of habitat	High	quality and is not considered to be core habitat, the bird may just pass through.
	J, Q		Remaining 50% of habitat	Very High	
Grey-headed Flying-Fox (vu)	K, L, M, N	A, D, F, No	Remaining 50% of habitat	Medium	Although there is suitable habitat for this species at the study area, it is considered to be below average habitat quality.
	A, B, C, D, E, F, G, H, O		Remaining 50% of habitat	High	
	J, Q		Remaining 50% of habitat	Very High	
Brown Toadlet (en)	K, L, M, N	A, D, F, No	Remaining 50% of habitat	Medium	Although there is suitable habitat for this species at the study area, it is considered to be below average habitat quality.
	A, B, C, D, E, F, G, H, O		Remaining 50% of habitat	High	
	J, Q		Remaining 50% of habitat	Very High	
Growling Grass Frog (en)	A, B, F, Y, Z, AA	A, D, F, Yes	Best 50% of habitat	Very High	The creeks in the study area are considered to be of high habitat quality.
	I, P		Best 50% of habitat	Very High	

Notes: For habitat zones refer to Figures 1, 2 & 3; Assessment process refers to Table 2 in the Guide for Assessment of referred planning permit applications (DSE 2007a)

Appendix 8: AVW Records of Brown Toadlet

Common Name	Scientific Name	FFG	DSE	Date	Latitude	Longitude	Location
Brown Toadlet	*Pseudophryne bibronii*	L	EN	15-Apr-61	37°37'59"	144°49'00"	1.6 km. E. of Bulla
				15-Apr-61	37°37'54"	144°45'04"	4 km. E. of Diggers Rest
				15-Apr-61	37°37'00"	144°55'00"	5.6 km. N. of Broadmeadows
				25-Apr-61	37°37'00"	144°55'00"	5.6 km. N. of Broadmeadows
				6-May-62	37°34'59"	144°52'59"	1.6 km. N. of Yuroke
				11-May-62	37°37'54"	144°55'04"	4.8 km. N. of Broadmeadows
				1-Apr-72	37°34'59"	144°43'59"	Sunbury
				28-Sep-72	37°34'59"	144°43'59"	Sunbury
				3-Oct-72	37°34'59"	144°43'59"	Sunbury
				2-May-89	37°35'26"	144°48'23"	Roughly 4 km NNW of bulla
				2-May-89	37°38'09"	144°47'40"	Bulla
				30-Mar-90	37°38'53"	144°49'13"	Oaklands Junction
				4-May-90	37°37'02"	144°44'14"	Roughly 2 km W of Redstone
				29-May-90	37°38'02"	144°50'58"	Roughly 2 km NE of Oaklands Junction

Appendix 9: Objective Based Evaluation Matrix (OBEM) for Bulla Bypass – Biodiversity

Objective Based Evaluation Matrix (OBEM) for Bulla Bypass - Biodiversity				
Project Objective	Sub-objectives			Alignment Option
				BB5
To minimise impacts on biodiversity, including catchment values / waterways	**Minimise impacts on listed threatened flora species**	Austral Tobacco (1), Fragrant Saltbush (2) and Melbourne Yellow-gum (3) (recorded in study area)- DSE listed flora species	*Without the proposed mitigation measures*	No impacts on these species **Very Well**
			With the proposed mitigation measures	No impacts on these species **Very Well**
	Minimise impacts on listed threatened fauna species	Growling Grass Frog (habitat in Deep Creek)-EPBC Act, FFG Act & DSE listed	*Without the proposed mitigation measures*	An oblique crossing of Deep Creek minimises impacts to Growling Grass Frog habitat however supporting piers may still be placed in suitable habitat **Poor**
			With the proposed mitigation measures	If the piers supporting the bridge are not placed in Growling Grass Frog habitat in Deep Creek, the impacts to this species are minimised. **Moderately Well**
		Australian Grayling and Yarra Pygmy Perch (habitat in Deep Creek) - EPBC Act, FFG Act & DSE listed	*Without the proposed mitigation measures*	A creek crossing over Deep Creek may impact on the habitat and life cycle of these fish **Poor**
			With the proposed mitigation measures	The Deep Creek crossing must be a bridge and construction and usage of the bridge must not impede water movement, cause no obstruction to fish passage and ensure that the hydrological regime of the creek is retained **Moderately Well**

Objective Based Evaluation Matrix (OBEM) for Bulla Bypass - Biodiversity				
Project Objective	**Sub-objectives**			**Alignment Option**
				BB5
To minimise impacts on biodiversity, including catchment values / waterways	**Minimise impacts on vegetation communities**	Grey Box Grassy Woodlands - EPBC Act listed-and Derived Native Grasslands of South-eastern Australia - EPBC Act listed -Grey Box – Buloke Grassy Woodland (Habitat Zone W) - FFG Act listed	*Without the proposed mitigation measures*	No impacts **Very Well**
			With the proposed mitigation measures	No impacts so no mitigation required **Very Well**
		Remnant patch vegetation removal	*Without the proposed mitigation measures*	2.66 ha (0.76 Hha) High and Very High Conservation Significance **Poor**
			With the proposed mitigation measures	None of the proposed mitigation measures lessens this impact **Poor**
	Minimise impacts on Large Old Trees, Very Large Old trees and scattered trees	%of total Large and Very Large Old Trees in affected habitat zones proposed to be removed	*Without the proposed mitigation measures*	11.3% **Very Poor**
			With the proposed mitigation measures	None of the proposed mitigation measures lessens this impact **Very Poor**
		Scattered tree removal	*Without the proposed mitigation measures*	1 x Very large 2 x Large 5 x Medium 4 x Small **Moderately Well**
			With the proposed mitigation measures	None of the proposed mitigation measures lessens this impact **Moderately Well**
	Mininise isolating and/or fragmenting habitat in a landscape context	Habitat Isolated and/or fragmented	*Without the proposed mitigation measures*	Moderate impacts **Moderately Well**
			With the proposed mitigation measures	None of the proposed mitigation measures lessens this impact **Moderately Well**