VicRoads

Echuca Bridge Planning Study - Mid West 2 Option

Aquatic Flora and Fauna Assessment

Final

29 November 2012

Executive summary

VicRoads is undertaking a planning study in partnership with New South Wales Road and Maritime Services (RMS) for a crossing of the Campaspe and Murray Rivers at Echuca.

This assessment investigates the aquatic habitat and fauna present within the Campaspe and Murray Rivers at Echuca within the vicinity of the Mid West 2 alignment options. An initial desktop review was completed to provide baseline information on species likely to be present in the river at or near to the project area. A field survey was conducted on 10th, 11th and 12th of April 2012 in order to provide an assessment of the current condition of the aquatic habitat values and aquatic fauna (namely fish) of the project area. The field survey included a fish survey and habitat and water quality assessment. The field survey was undertaken within approximately 300 metres of the proposed bridge crossing on both the Campaspe and Murray Rivers.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.4 and the assumptions and qualifications contained throughout the report.

The Murray and Campaspe Rivers have a range of instream habitat for aquatic fauna including instream woody habitat (i.e. fallen trees, tree roots and snags) and bank undercuts. The banks were a muddy clay substrate and, as with similar reaches of the Murray River, a muddy silt substrate with snags and organic debris was present. The banks along the reaches assessed were mostly fine grained clay and this should be considered when developing the CEMP as bank disturbance could lead to the deposition of silt into the waterway which could potentially create blockages to fish passage and lead to increases in turbidity of the water and impacts to aquatic fauna.

Water quality data exhibited high turbidity, nutrient and algae levels, which was likely due to high sediment loads caused by rainfall events in the upstream catchments of the rivers through early to mid-March 2012. Despite this, the risk of eutrophication within both rivers is relatively low with low levels of non-toxigenic blue green algae present. All other water quality parameters measured were within both Victorian and NSW objectives for this segment Murray River and its tributaries.

The fish survey used passive sampling techniques including fyke nets and bait traps. Six common fish species (including three exotic) and two macroinvertebrates were recorded during the survey. Species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Victorian Flora & Fauna Guarantee Act 1988* (FFG Act), NSW *Fisheries Management Act, 1994* (FM Act) or Victorian Department of Sustainability and Environment's (DSE) Advisory Lists were not recorded during the fish survey.

The desktop review returned a number of listed threatened species as possibly inhabiting the project and assessment area including Golden Perch (DSE), Murray Cod (EPBC, FFG and DSE), Trout Cod (EPBC, FFG, NSW FM and DSE), Silver Perch (FFG, NSW FM and DSE), Eel-tailed Catfish (FFG and DSE), Macquarie Perch (EPBC, FFG, NSW FM and DSE), Murray River Rainbowfish (FFG and DSE), Southern Pygmy Perch (NSW FM) and Murray River Turtle (DSE). The absence of these species in the nets and traps during the fish survey should be not considered as evidence of absence. All of the 43 species (including 36 fish, four invertebrates, two mammals and one reptile) listed as previously identified with the Campaspe and Murray Rivers assessment area (see Appendix A) should be assumed to be present when developing mitigation controls for the construction of the bridge project.

No Commonwealth or State listed threatened aquatic flora species were returned in the desktop assessment and no aquatic flora species were recorded during the field survey. The aquatic habitat present in the project area is considered unlikely to support any listed threatened flora species. However, the desktop assessment identified a number of EPBC Act listed terrestrial flora species, some of which may occur in the riparian zone of the project area and will require assessment by a suitably qualified botanist.

Potential impacts from this project on the aquatic fauna of the Murray and Campaspe Rivers at the proposed crossing location are expected to be minor and short-term if the proposed mitigation measures are adhered to during and post construction. VicRoads advised GHD that a balanced cantilever construction method will be used to build the two bridges and there will be no pylon or pier structures required within the river bed.

Associated risks posed by the proposed project include bank works within the riparian zone leading to river sedimentation through disturbance of soils and vegetation. Sediment washed into the river can affect fish species through altered water quality. However, with a rigorous Construction and Environmental Management Plan (CEMP) in place, as recommended by this report, impacts should be negligible. Other potential sources of impact to aquatic fauna to be considered in the CEMP include potential spills of paints, concrete, fuels and lubricants. These impacts are also likely to be negligible with appropriate CEMP measures in place.

The 7-Part test (the test) under the NSW Threatened Species Assessment Guidelines was applied to the Lower Murray River endangered ecological community (EEC) and to four individual fish species including Murray Hardyhead (EPBC Act, FFG Act, FM Act and DSE), Silver Perch (FFG Act, FM Act and DSE), Eel-tailed Catfish (FFG and DSE) and Murray Jollytail (FM Act)). Three of the species (Eel-tailed Catfish, Silver Perch and Murray Jollytail) are considered likely to be present in the project area and are listed as part of an endangered population in the lower Murray. In addition, under the NSW FM Act, Silver Perch are listed as Endangered and Murray Jollytail as Critically Endangered. The Murray Hardyhead is considered unlikely to be present, however, as it is listed as Critically Endangered, the test was also applied. None of the tests indicated significant impacts on the EEC or fish species due to the small project footprint, short project duration and likely minimal impact to fish passage and aquatic habitat.

Under the EPBC Act, Trout Cod (Endangered), Macquarie Perch (Endangered) and Murray Cod, (Vulnerable) were assessed as being likely to occur in the assessment area. An EPBC Act Significance Assessment (see Appendix B) was completed for these species and indicated that significant impacts to the species are unlikely to arise from this project due to the small footprint, lack of instream works and short duration.

Mitigation recommendations include the use of sealed haul roads and access tracks, bunded chemical storage areas above the 1:20 year flood recurrence interval and avoidance of pile driving works when threatened fish are spawning. Further, it is recommended that an erosion and sediment control plan and a flood management plan to be included in the CEMP to provide guidance and measures to reduce the impacts that could arise through flooding.

Recommendations for further work

No further surveys of aquatic fauna at this location are recommended. The species inhabiting the Murray River and its associated tributaries are well documented as shown in the desktop survey component of this report. A number of the species found or predicted to occur in the project area and its immediate vicinity are migratory (i.e. Murray Cod and Macquarie Perch migrate upstream in spring to mid-summer to spawn), or are difficult to survey for. These species should be assumed to pass through the project area at particular stages of their life cycle and therefore are easily missed in one-off surveys. Whether or not these species are detected in short-term surveys they must be assumed to be present from time to time.

Given the minimal short and long-term impacts on fish species predicted from the bridge construction in this report, it is anticipated that the impacts on the identified species would be relatively minor.

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1. Introduction

1.1 Project Overview

VicRoads and New South Wales Road and Maritime Services (RMS) are planning for a new Murray River crossing at Echuca-Moama. GHD was commissioned by VicRoads to undertake an aquatic flora, fauna and habitat assessment (the assessment) at reaches of the Murray and Campaspe Rivers that occur within 300 metres of the proposed bridge crossing (see Figure 1). The assessment included a desktop review to determine the potential aquatic values in the vicinity of the project area and a field survey including a habitat assessment, to assess the extent and quality of aquatic habitat, and a survey of local fish populations. The field survey was conducted between the 10th and 12th of April 2012 by GHD aquatic ecologists and was undertaken in accordance with GHD's NSW and Victorian Fisheries research permits.

1.2 Objectives

The key objectives of the assessment were to:

- Conduct a review of relevant legislation and policies;
- Complete database searches for the NSW, Victorian and Federally listed threatened species;
- Provide a clear description of aquatic habitat;
- Conduct a fish survey of the Murray and Campaspe Rivers;
- Conduct a visual survey within the project footprint of the Campaspe and Murray Rivers;
- Assess potential impacts of the proposed activity on aquatic ecological values; and
- Identify opportunities to avoid or mitigate potential impacts through design or management.

1.3 The Project and Assessment Area

The project area in this report is the area (within 300 metres) of the proposed bridge alignment options. Observations were made of flora and fauna and a habitat assessment was completed in the project area. The assessment area refers to the project area plus a 5 km search buffer. The assessment area was used for searching database records for the desktop review. The 5 km buffer was included to capture data that informs the assessment of the potential for species and communities to occur within the project area.

The project area is located on the Murray and Campaspe Rivers in the townships of Echuca, Victoria and Moama, NSW. It lies on the Victoria/NSW border approximately 200 km north of Melbourne, 400 km east of Canberra and 640 km south south-east of Sydney, within the jurisdiction of the Campaspe (Victoria) and Murray (NSW) Shires.

The project area includes four potential bridge alignment options (alignments 2A, 2B, 2C and 2D) each crossing the Murray and Campaspe Rivers near Echuca and Moama (see Figure 1). All four options cross the Murray River at the same point, but there are three potential crossing options over the Campaspe River. Option 2A is the most downstream and Options 2C and 2D the most upstream. The Campaspe River options are within a 350 metre section of the river (see Figure 1).

In Victoria, the study area is within the jurisdiction of the North Central Catchment Management Authority (NCCMA) and is within the Victorian Riverina Bioregion (Department of Sustainability and Environment (DSE), 2012). In NSW the study area is within the jurisdiction of the Murray Catchment Management Authority (MCMA) and is within the Riverina Bioregion (Office of Environment and Heritage (OEH), 2011).

1.4 Scope and limitations

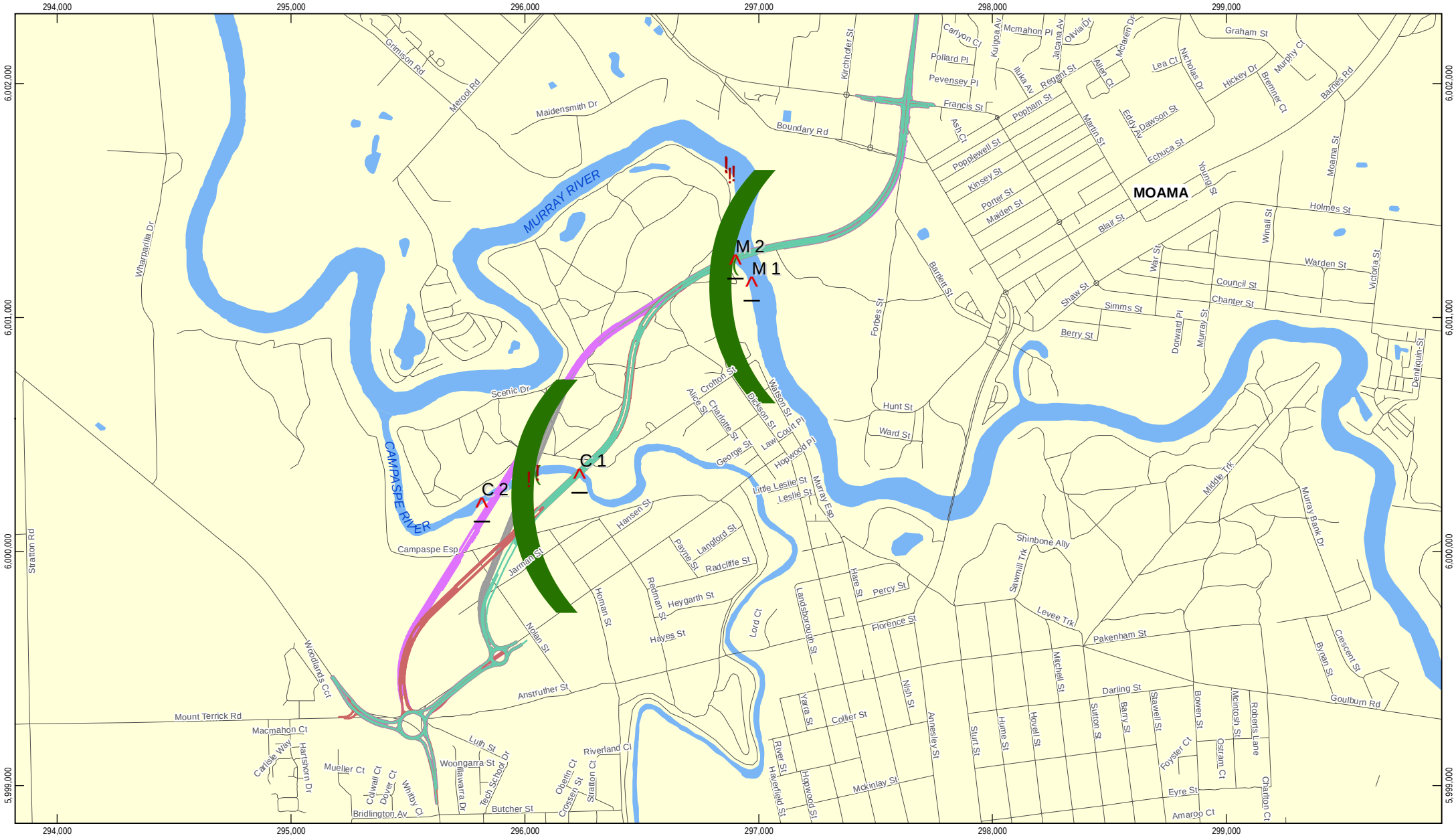
This report has been prepared by GHD for VicRoads and may only be used and relied on by VicRoads for the purpose agreed between GHD and the VicRoads as set out in Section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than VicRoads arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section 2.3). GHD disclaims liability arising from any of the assumptions being incorrect.



1:21,632 (at A4)

0 100 200 300 400 500

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

LEGEND

- Water Quality Monitoring Point
- Aquatic Fauna Sampling Area
- Project Area
- Alignment 2A
- Alignment 2B
- Alignment 2C
- Alignment 2D

M1 - Murray River Upstream Monitoring Point

M2 - Murray River Downstream Monitoring Point

C1 - Campaspe River Upstream Monitoring Point

C2 - Campaspe River Downstream Monitoring Point

GHD CLIENTS|PEOPLE|PERFORMANCE

VicRoads
Echuca Aquatic Flora and Fauna Study

Job Number	31-28726
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Sampling Locations

Figure 1

G:\31\28726\GIS\Maps\Deliverables\3128726_001_revB.mxd

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Data source: VicMap - Bridge Alignments, Roads, Watercourse (2012); GHD - GPS Points (2012). Created by:porogers

2. Methods

2.1 Desktop Review

The database search and literature review examined information on the assessment area (project area plus a 5 km search buffer). When interrogating databases, the search buffer of 5 km was selected to ensure that mobile fauna were adequately captured in the desktop assessment.

Databases

The following databases were searched as part of the desktop review:

- Department of Sustainability, Environment, Water, Populations and Community (SEWPaC) Protected Matters Database (SEWPaC, 2012);
- Victorian Atlas of Victorian Wildlife and Aquatic Fauna Databases, administered by the Department of Sustainability and Environment (DSE) (DSE, 2010);
- Victorian Rare or Threatened Species lists (vertebrates and invertebrates) (DSE, 2007; 2009);
- Atlas NSW Wildlife (OEH, 2012); and
- NSW Threated and protected Records Viewer (DPI, 2012).

Literature Review

The following documents were reviewed for information on aquatic ecology values relevant to the assessment area and project:

- Echuca-Moama Second Murray bridge crossing – aquatic fauna assessment (McGuckin, 2010); and
- Interim Environmental Watering Plan (NCCMA, 2009).

2.2 Field Survey

2.2.1 Water Quality

Physical water quality parameters were measured *in-situ* at each site using a calibrated Aquaread water quality meter. The Aquaread's probe was attached to a sampling pole and the probe placed in the water approximately 30 cm below the water surface and above the streambed.

The following parameters were recorded during the field survey:

- Temperature;
- pH;
- Electrical conductivity (EC);
- Percentage saturation of dissolved oxygen (DO);
- Turbidity; and
- Total dissolved solids (TDS).

Water samples were collected and later analysed for the following parameters:

- Total nitrogen (TN);
- Total phosphorus (TP);
- Chlorophyll *a*; and
- Total algae.

2.2.2 Habitat Assessment

At each site, a habitat assessment was undertaken considering broadly the entire reach (i.e. within 300 metres of the proposed alignments).

Included in the habitat assessment were:

- General landscape characteristics including land use and river water levels;
- Site specific parameters including:
  - channel width;
  - vegetative cover;
  - composition of the streambed substrate;
  - relative abundance of streambed cover including large woody debris (logs, branches), organic debris (leaves, bark) and tree roots;
  - bank stability;
  - riparian condition; and
- Any other relevant observations.

As part of the habitat assessment reference photographs were taken at each site. See Section 3.2 for the habitat descriptions and site reference photographs.

2.2.3 Fish Survey

GHD conducted a fish survey at two sites in the project area (see Figure 1). The survey was conducted over 10th and 12th of April in accordance with GHD's NSW and Victorian research permits.

The surveys involved the use of the following techniques for fish capture:

- **Bait Traps**: At least 12 bait traps were placed at each of the two survey sites (22 x 22 x 40 cm, 2 mm stretched mesh and 50 mm openings) with different bait in each trap. The traps were set in the afternoon submerged in water and left overnight, then inspected the next morning. The baiting regime included:
  - Non baited;
  - Dried cat food; and
  - Glow sticks.
- **Fyke nets**: Three fyke nets were deployed at each of the two sites, left overnight and inspected the following morning.

Freshwater fish captured were identified by reference to Freshwater Fishes of Australia (Allen *et al*, 2003).

All traps were set in the afternoon and collected early the following morning. Fish caught in the field were identified to species, counted and measured for total length. Native species were returned to the water as near to the point of capture as possible. Noxious fish species collected (including European Carp *Cyprinus carpio*) were euthanised in a humane manner according to permit requirements.

Fish surveys were conducted in accordance with the following permits:

- Victorian Department of Primary Industries (DPI) Fisheries – Research **Permit No. RP891**;
- Victorian DSE – Permit to take protected fish **Permit No. 10006248**; and
- NSW Industry and Investment – Scientific Collection **Permit No. PO7/0142-3.0.**

2.3 Assumptions and Limitations

GHD believes that the survey effort conducted was sufficient to determine the native fish species that were present at the sites during the survey period and the likelihood of other native fish species, not recorded during the survey, also occurring in the project area.

The conditions leading up to the April 2012 survey had been dry and flow rates for the Murray and Campaspe Rivers were both below the ten-year monthly April average (MDBA 2008). It should be noted that the conditions of these waterbodies and associated aquatic fauna populations are likely to change over time depending on seasonal factors, rainfall events and waterway flows.

GHD believes the level of investigation for this assessment (including the desktop review and field survey) was sufficient to ascertain the aquatic values of these waterways within the project area.

3. Results

3.1 Desktop Review

3.1.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool

Aquatic Matters of National Environmental Significance (NES) listed under the EPBC Act previously identified within the assessment area were investigated using the SEWPaC Protected Matters Search Tool (PMST) (SEWPaC, 2012). This tool lists species, species habitat, populations and ecological communities that are likely to occur, or may occur within the assessment area. Matters of NES identified in the search include:

- Murray Hardyhead *Craterocephalus fluviatilis* – listed as Vulnerable with habitat likely to occur within the assessment area;
- Murray Cod *Maccullochella peelii peelii* – listed as Vulnerable with habitat that may occur within the assessment area; and
- Macquarie Perch *Macquaria australasica* – listed as Endangered with habitat that may occur within the assessment area.

An assessment of the likelihood of these species occurring in the assessment area is provided in Section 3.1.6.

No aquatic flora species were returned in the PMST search.

3.1.2 Victorian DSE Data (AFD and AVW)

The DSE Aquatic Fauna database (AFD, 2007) and Atlas of Victorian Wildlife (AVW, 2010) were queried for accounts of aquatic fauna species previously recorded as occurring in the assessment area.

Combined, the AFD and AVW identified 37 species of aquatic fauna as previously recorded in the assessment area. This included; 31 fish, three invertebrate, two mammal and one reptile species. Of these, 11 were threatened species. Of the 31 fish species recorded, there were 23 native and eight exotic species.

The listed threatened species identified from the AFD and AVW database searches included:

- Australian Grayling *Prototroctes maraena* – EPBC Act Vulnerable, FFG Act listed and DSE Vulnerable;
- Eel-tailed Catfish *Tandanus tandanus* – FFG Act listed and DSE Endangered;
- Golden Perch *Macquaria ambigua* – DSE Vulnerable;
- Macquarie Perch – *Macquaria australasica* - EPBC Act Endangered, FFG Act listed and DSE Endangered;
- Murray Cod – *Maccullochella peelii peelii* - EPBC Act Vulnerable, FFG Act listed and DSE Endangered;
- Murray River Rainbowfish *Melanotaenia fluviatilis* – FFG Act listed and DSE Data Deficient;
- Murray River Turtle *Emydura macquarii* – DSE Data Deficient;
- Silver Perch *Bidyanus bidyanus* – FFG Act listed and DSE Critically Endangered;

- Trout Cod *Maccullochella macquariensis* – EPBC Act Endangered, FFG Act listed and DSE Critically Endangered; and
- Yarra Pygmy Perch *Nannoperca obscura* – EPBC Act Vulnerable, FFG Act listed, DSE Near Threatened.

The species recorded in the assessment area are tabled in Appendix A. An assessment of the likelihood of these listed species occurring in the assessment area is provided in Section 3.1.6.

3.1.3 Atlas of NSW Wildlife

The Atlas of NSW Wildlife (DECCW, 2010) was queried for records occurring in the assessment area. No aquatic fauna species were returned in the search.

3.1.4 NSW Threatened Fish, Aquatic Invertebrates and Marine Vegetation

The list of threatened fish, aquatic invertebrates and marine vegetation protected under the NSW *Fisheries Management Act 1994* (FM Act) (administered online by the NSW DPI, 2005[1]) was cross checked against the other database search records of aquatic species recorded in the assessment area. Five listed species were identified, including:

- Trout Cod – listed as Endangered;
- Silver Perch – listed as Endangered;
- Macquarie Perch – listed as Endangered;
- Murray Hardyhead – listed as Critically Endangered; and
- Southern Pigmy Perch – listed as Endangered.

Although no records were located in the assessment area, a number of other listed aquatic species and populations listed under the FM Act are considered to have, or have once had distributions in the Murray-Darling basin and therefore potentially occur in the assessment area. These include:

- Flathead Gudgeon/Murray Jollytail *Galaxias rostratus* – listed as Critically Endangered;
- Purple Spotted Gudgeon *Mogurnda adspersa* – listed as Endangered;
- River Snail *Notopala sublineata* – listed as Endangered; and
- Western population of Olive Perchlet *Ambassis agassizii* – listed as Endangered.

Other matters identified by this search included:

- Endangered Population: Murray-Darling Basin population of Eel-tailed Catfish. This species has been recorded in the assessment area (see AFD results); and
- Endangered Ecological Community: Lowland Murray Aquatic Ecological Community. All native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray, Murrumbidgee and Tumut rivers, as well as all their tributaries and branches are included within this community.

A table listing all of the species recorded in the assessment area is provided in Appendix A. An assessment of the likelihood of these listed species occurring in the assessment area is provided in Section 3.1.6.

[1] http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current Last accessed 10 May 2012

3.1.5 Literature Review

The following two documents were reviewed to obtain existing information on the aquatic fauna species previously recorded in the vicinity of the project area:

- Echuca-Moama Second Murray bridge crossing – aquatic fauna assessment (McGuckin, 2010); and
- Interim Environmental Watering Plan (NCCMA, 2009).

Areas of the Murray and Campaspe rivers (adjacent to the current project area) were sampled for fish diversity as part of a McGuckin (2010) survey. In the report McGuckin compiled data from the survey with data from previous studies conducted over the preceding ten years. Methods utilised in the McGuckin survey included gill nets, fyke nets and light traps. Sampling was undertaken between the 25 and 27 of August 2010 and McGuckin recorded 16 species of fish including 12 native and four exotic.

An Interim Environmental Watering Plan for the Campaspe River was developed by North Central Catchment Management Authority in 2009. The plan identified 10 native species including three migratory species, as being present in the Campaspe River (NCCMA 2009).

A table listing all of the species recorded in the assessment area is provided in Appendix A. An assessment of the likelihood of these listed species occurring in the assessment area is provided in Section 3.1.6.

3.1.6 Likelihood of Threatened Species Occurrence Assessment

For the identified Commonwealth and State listed threatened species, a likelihood of occurrence assessment was undertaken to determine those species likely to occur in the assessment area. The aim of the assessment is to determine whether they have been previously recorded in the vicinity of the study area and to make an assessment of how likely they are to occur and therefore be impacted upon by the project.

The assessment is provided in Table 1. Where a species was assessed as being unlikely to occur, it was given no further consideration. Of the 16 listed threatened species identified in the desktop assessment the following were assessed as either being likely to occur or possibly occurring in the assessment area:

- Likely to occur:
  - Golden Perch;
  - Murray Cod;
  - Silver Perch;
  - Trout Cod;
  - Eel-tailed Catfish; and
  - Macquarie Perch
- Possibly occurs:
  - Southern Pigmy Perch;
  - Murray River Rainbowfish; and
  - Murray River Turtle

Table 1 Likelihood of threatened species occurrence assessment

Common Name	Scientific Name	EPBC Act	FFG	DSE	NSW Fisheries Management Act 1994	Recorded in the Assessment Area	Comments
Australian Grayling	*Prototroctes maraena*	VU	L	Vu		*	**Unlikely**: outside of currently accepted range and only a single record in the AVW from 1987.
Eel-tailed Catfish	*Tandanus tandanus*		L	En		*	**Likely**: Species is known to occur throughout the Murray Darling Basin (Allen *et al* 2003) and in the area where it is a regular recreational fishing target species.
Golden Perch	*Macquaria ambigua*			Vu		*	**Likely**: Species is known to occur throughout the Murray Darling Basin (Allen *et al* 2003) and in the area where it is a regular recreational fishing target species.
Macquarie Perch	*Macquaria australasica*	EN	L	En	E	*	**Likely**: Species is known to occur in the middle reaches of the Murray River (Allen *et al* 2003) and in the assessment area where it is a regular recreational fishing target species.
Murray Cod, Cod, Goodoo	*Maccullochella peelii peelii*	VU	L	En		*	**Likely**: Species is known to occur throughout the Murray Darling Basin (Allen *et al* 2003) and in the area where it is a regular recreational fishing target species.
Murray Hardyhead	*Craterocephalus fluviatilis*	VU	L	CE	CE		**Unlikely**: Previously known to occur in the Murray River. Last surveyed in the 1980 which found only a few isolated populations near Swan Hill and Kerang (Allen *et al* 2003).
Murray Jollytail	*Galaxias rostratus*				CE		**Unlikely**: species has not recently been recorded and is considered locally extinct in the lower Murray. Now only known from the upper Murray River near Tintaldra (DPI NSW 2012).
Murray River Rainbowfish	*Melanotaenia fluviatilis*		L	Dd		*	**Possible**: Known to occur in the region, AFD shows one record, but no other records found.

Common Name	Scientific Name	EPBC Act	FFG	DSE	NSW Fisheries Management Act 1994	Recorded in the Assessment Area	Comments
Murray River Turtle	*Emydura macquarii*			Dd		*	**Possible**: Occur across much of the Murray system and suitable habitat is present in the project and assessment areas.
Purple Spotted Gudgeon	*Mogurnda adspersa*				E		**Unlikely**: Western population previously widespread in the Murray River system, but has experienced a significant decline in recent times. Now extremely rare in inland NSW, having been recorded from this area only once since 1983.
River Snail	*Notopala sublineata*				E		**Unlikely**: Endemic to the Murray/Darling Basin. Now restricted to a few populations in irrigation pipes near Mildura (DPI NSW 2012).
Silver Perch	*Bidyanus bidyanus*		L	CE	E	*	**Likely**: Species is known to occur throughout the Murray Darling Basin (Allen *et al* 2003) and in the area where it is a regular recreational fishing target species.
Southern Pigmy Perch	*Nannoperca australis*				E	*	**Possible**: Species is known to occur in the vicinity of the project area, however, its preferred habit (heavily vegetated (Allen *et al* 2003)) was not observed within the project area.
Trout Cod	*Maccullochella macquariensis*	EN	L	CE	E	*	**Likely**: Species is known to occur throughout the Murray Darling Basin (Allen *et al* 2003) and in the area where it is a regular recreational fishing target species.
Western population of Olive Perchlet	*Ambassis agassizii*				E		**Unlikely**: Western population was once widespread throughout the Murray-Darling system. Population has suffered a serious decline and is now found only at a few sites in the Darling River drainage.
Yarra Pigmy Perch	*Nannoperca obscura*	VU	L	Nt		*	**Unlikely**: Outside of currently accepted range (Allen *et al* 2003).

3.2 Habitat Description

3.2.1 Murray River

Alignment Options – 2A, 2B, 2C, 2D

The project area extends along the Murray River approximately 300 metres upstream and downstream of the boat ramp on the eastern side of Victoria Park Reserve (Figure 2 and Figure 3). In this reach the Murray River is an unconfined, meandering river with fine grained sediments, however, the section of the reach near the proposed crossing is relatively straight (Figure 1).

At the proposed crossing the Murray River is approximately 40 metres wide. The channel has sloped banks and sand deposition has occurred on the Victorian (left[2]) bank (Figure 3). In the vicinity of the proposed bridge crossing local erosion was observed and the banks on both sides were exposed within the riparian zone. There was no overhanging vegetation or large woody habitat observed instream towards the western bank, at the point of the crossing. The NSW (right) bank was less disturbed and some instream habitat was observed.

Good longitudinal and lateral vegetation connectivity was observed in the canopy on both banks but the ground cover was predominately bare or exotic grasses on the western bank. Shading at mid-day covered less than 5% of the channel.

The area is widely used for recreation and during the site visit speed boats, non-motor boats and house boats were observed within the river. The river at this site is used extensively for recreational fishing.

Figure 2 Boat ramp on left bank at proposed Murray River Crossing

Figure 3 Sandy left banks and houseboats looking upstream from the proposed Murray River Crossing

[2] Note that left and right bank designations always refer to the direction when facing downstream (EPA 2003a).

In terms of aquatic fauna habitat, this reach of the Murray River has low levels of instream wood or tree roots. In-stream timber is preferred shelter, breeding and ambush sites for many fish species. The high level of recreational activity and boat traffic is likely to result in this area being less preferred by many of the larger shy fish species (i.e. Murray Cod). The fish survey results (see Section 3.4) indicated there were fewer fish (for the same survey effort) in this reach of the Murray River compared to the Campaspe River reach. However, most aquatic fauna known or likely to occur in the project area are highly mobile and the surveyed reach of the Murray River should still be considered as providing suitable habitat for a range of the common and threaten fish species such as Golden Perch, Murray Cod, Silver Perch, Trout Cod, Eel-tailed Catfish and Macquarie Perch.

3.2.2 Campaspe River

Alignment Options – 2A and 2C

The alignment options 2A and 2C cross the Campaspe River at an angle along a relatively straight section of the river (see Figure 1). The river at the proposed crossing location has steep v-shaped banks that were exposed at the time of sampling due to low water levels in the river. Along this reach the Campaspe River is meandering with a bed of fine grained sediment. The section of the reach near the proposed crossing is relatively straight.

The proposed crossing of the Campaspe River is approximately 30 metres wide. In the vicinity of the proposed bridge crossing local erosion was observed, and the banks on both sides of the river had exposed riparian tree roots. There was overhanging vegetation (mainly eucalypts) and a moderate amount of large woody habitat (approximately one submerged log per 10-20 metres) was observed instream on both banks of the river.

Good longitudinal and lateral vegetation connectivity was observed in the canopy on both banks but the ground cover was predominately absent or composed of exotic grasses on the left bank (Figure 4). Shading at mid-day covered less than 10% of the channel. The floodplain was well forested on both banks and contained flood runners, back swamps and good lateral and longitudinal canopy cover. The understory is less established and there are large patches of bare earth.

As shown in Figure 5, timber pylons were observed instream indicating the presence of a previous bridge or structure within the waterway on the right bank (upstream of the proposed crossing). Scour was also observed along the right bank in line with the timber pylons which possibly resulted from the presence of this structure within the waterway (Figure 6).

Local land use on both banks is recreation, however, boats and boat access were not observed near the study area. The river at this site is also valued for recreational fishing.

Figure 4 Left bank looking upstream of the proposed crossing for options 2A and 2C

Figure 5 Pylons from old instream bridge or other structure on right bank

Figure 6 Left bank. Scour was observed which has potentially resulted from the instream structure observed at this location

Alignment Options – 2B and 2D

The crossing for options 2B and 2D is perpendicular to the Campaspe River immediately downstream of a meander in the river channel (see Figure 1). The river form and characteristics at this site is similar to the characteristics at the crossing for alignment options 2A and 2C.

The river banks were exposed along both banks (Figure 7 and Figure 8). There was some large wood, overhanging branches and other instream habitat features observed as well as sand and silt deposits on the inside bank of meander bends.

The floodplain was well forested on both banks with flood runners, back swamps and good lateral and longitudinal canopy cover. The understory is less established and there are large patches of bare earth across the banks and throughout the floodplain.

Figure 7 Left bank looking downstream of the crossing for options 2B and 2D. Exposed banks and small amounts of over-hanging timber can be observed.

Figure 8 Left bank looking upstream of the crossing for options 2B and 2D. Exposed banks and small amounts of over-hanging timber can be observed.

The two surveyed reaches of the Campaspe River provide good aquatic fauna habitat. They have large amounts of instream wood, tree roots and undercut banks which are preferred shelter, breeding and ambush sites for many fish species. Compared to the Murray River reach these reaches were also observed to have little recreational activity and boat traffic. Although higher in habitat quality than was observed at the Murray River site, these sites similarly provide potential habitat for a range of common and likely to occur threatened species such as Golden Perch, Murray Cod, Silver Perch, Trout Cod, Eel-tailed Catfish and Macquarie Perch.

3.2.3 Threatened Flora within Habitat Areas

No listed threatened aquatic or emergent flora was discovered in the desktop review and none was recorded during the field survey. Similarly, the aquatic habitat in the project area (both Murray and Campaspe Rivers) was void of obvious aquatic flora.

The PMST returned a number of EPBC Act listed threatened terrestrial flora species. Some of these may occur in the riparian zone and a suitably qualified terrestrial flora botanist will be required to assess for these species.

3.3 Water Quality

Surface water samples were taken upstream and downstream of the Campaspe and Murray River sites (see Figure 1). Sampling included *in situ* monitoring with a calibrated Aquaread water quality meter and the collection of water samples for later laboratory analysis. See Section 2.2.1 for further details on the method.

Due to the location of the Murray River and its adjacent floodplains, both the Victorian and New South Wales water quality objectives need to be compared to the *in situ w*ater quality results (Table 2). New South Wales water quality objectives (NSW DECCW, 2006) are required for all waters north of the southern bank (high water mark) while *the Victorian State environment protection policy – Waters of Victoria* (SEPP WoV) water quality objectives should be used for all waters including standing water, billabongs, anabranches and tributaries situated on the Victorian floodplain.

Dissolved Oxygen saturation (DO) results were below the objectives for both states across all sampling sites. However, upon analysis, the results appear outside of a reasonable range for DO and suggest that the meter may have been producing erroneous results on the day of the field survey. The omission of the DO results does not detract from the overall assessment. The remaining parameters (pH, turbidity, conductivity, TDS and temperature), in combination with the desktop review, habitat assessment and fish survey provide sufficient detail on the condition of the waterway at the time of the assessment.

Turbidity was observed to be above both the NSW and Victorian guideline values across all sites. Australia's inland river systems (including the Murray and Campaspe Rivers) are considered to be naturally relatively turbid. The higher levels of turbidity may have been a consequence of heavy rainfalls in early to mid-March carrying higher sediment loads from upstream catchments. See Figure 9 below for rainfall at Rochester, which is approximately 25 km upstream from the project area.

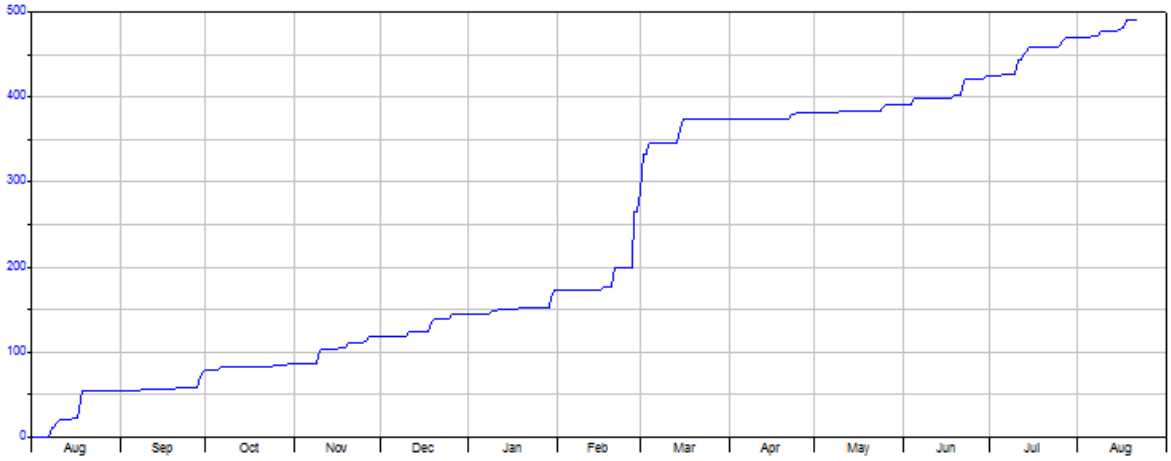

Figure 9 Cumulative rainfall (mm) at Rochester between August 2011 and August 2012 (Source: Murray Darling Basin Authority Water Data)

All other *in situ* parameters were within both Victorian and NSW objectives for this segment of the Murray River and its tributaries.

Table 2 *In-situ* Water Quality Data for Murray and Campaspe Rivers at Echuca

Parameter			Upstream Campaspe (C1)	Downstream Campaspe (C2)	Upstream Murray (M1)	Downstream Murray (M2)
	SEPP objective	NSW objective				
Temperature (˚C)			16.5	17.3	16.7	18.0
pH	6.5-8.3	6.5-8.5	6.99	7.02	6.80	7.10
Conductivity (µS/cm)	≤1500	122-2200	659	633	68	79
Sat. Dissolved Oxygen (%)*	80-110	85-110	6.4	6.4	15.9	10.2
Turbidity (NTU)	≤30	6-50	82.4	97.8	77.7	66.5
TDS (ppm)	NA	NA	429	411	44	52

Notes: Yellow highlight indicates objective/s not met.

As with the *in situ* results, laboratory water quality results (Table 3) need to be compared to New South Wales and SEPP WoV water quality objectives. Levels of total phosphorus (TP) and total nitrogen (TN) exceeded both SEPP and NSW objectives at all sampling sites. The Victorian Water Resources Data Warehouse provides historical water quality data for a site in the Campaspe River in Echuca (Site Code 406265) from between 2005 and 2009. This data shows average and median values, between these dates, were 0.717 and 0.680 mg/L for TN and 0.072 and 0.066 mg/L for TP. The recent more elevated levels are likely associated with the elevated turbidity as there is often a positive correlation of turbidity with TN and TP due to sediment-bound nutrients (Panta 2011).

Chlorophyll *a* also exceeded NSW objectives at C2 and both Murray River sites. It is possible this elevated level is associated with the similarly elevated levels of TN and TP.

Table 3 Laboratory Water Quality Data for Murray and Campaspe Rivers at Echuca

Parameter			Upstream Campaspe (C1)	Downstream Campaspe (C2)	Upstream Murray (M1)	Downstream Murray (M2)
	SEPP objective	NSW objective				
Total Nitrogen (mg/L)	≤0.9	0.50	1.8	1.9	0.9	0.9
Total Phosphorus (mg/L)	≤0.045	0.05	0.16	0.18	0.14	0.13
Chlorophyll a (mg/L)	NA	0.05	0.032	0.058	0.053	0.054

Note: Yellow highlight indicates objective/s not met.

The algal samples indicated slightly stressed waterway conditions (Figure 10 - Figure 13). The flora was dominated by diatoms (Bacillariophycae) and green algae (Chlorophycae) in every sample. Blue-green algae (Cyanophycae) were less abundant. None of the blue-green algal species collected were potentially toxic.

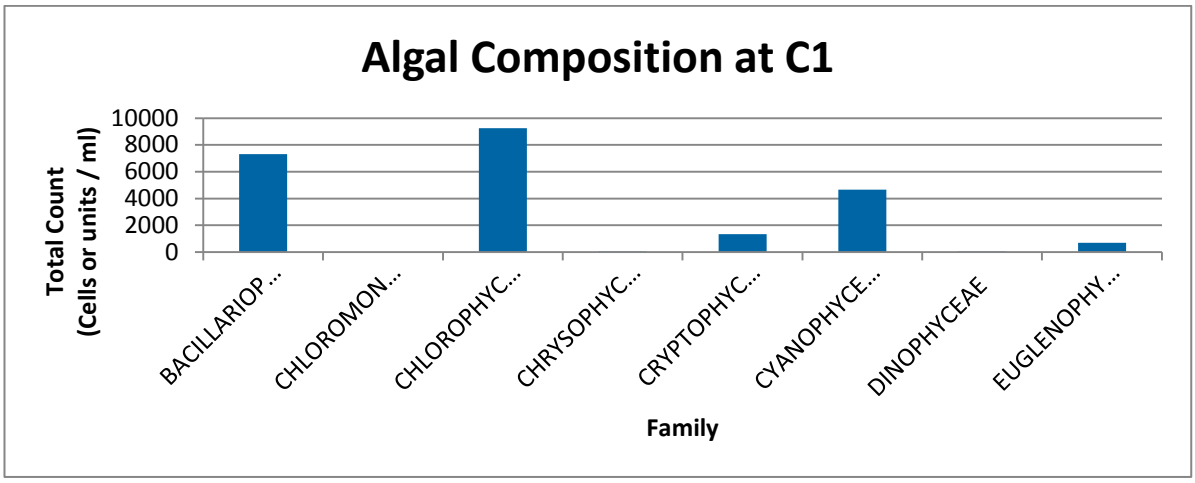

Figure 10 The abundance of major algal families at Campaspe River Site 1 (C1)

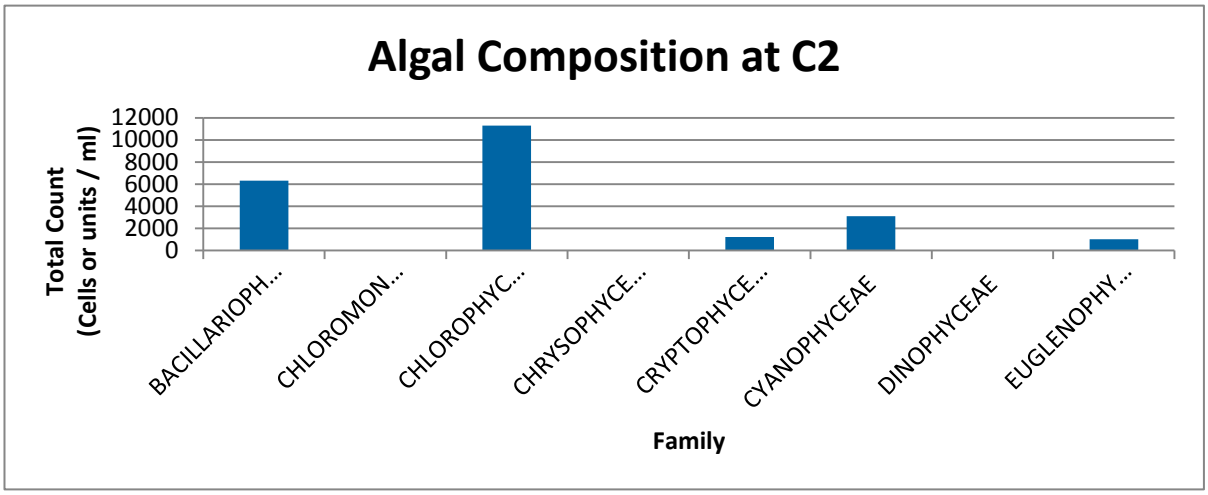

Figure 11 The abundance of major algal families at Campaspe River Site 2 (C2)

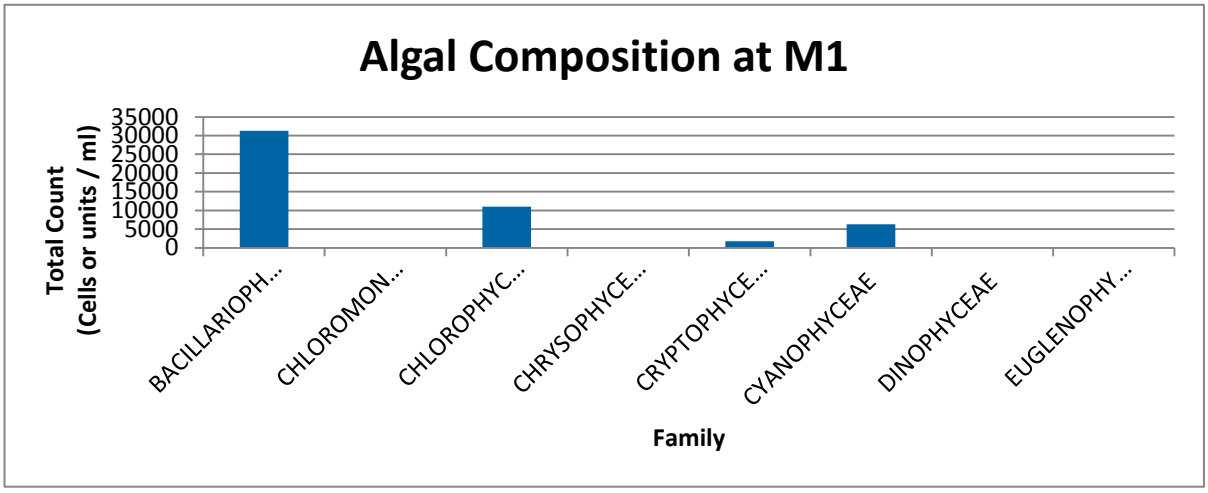

Figure 12 The abundance of major algal families at Murray River Site 1 (M1)

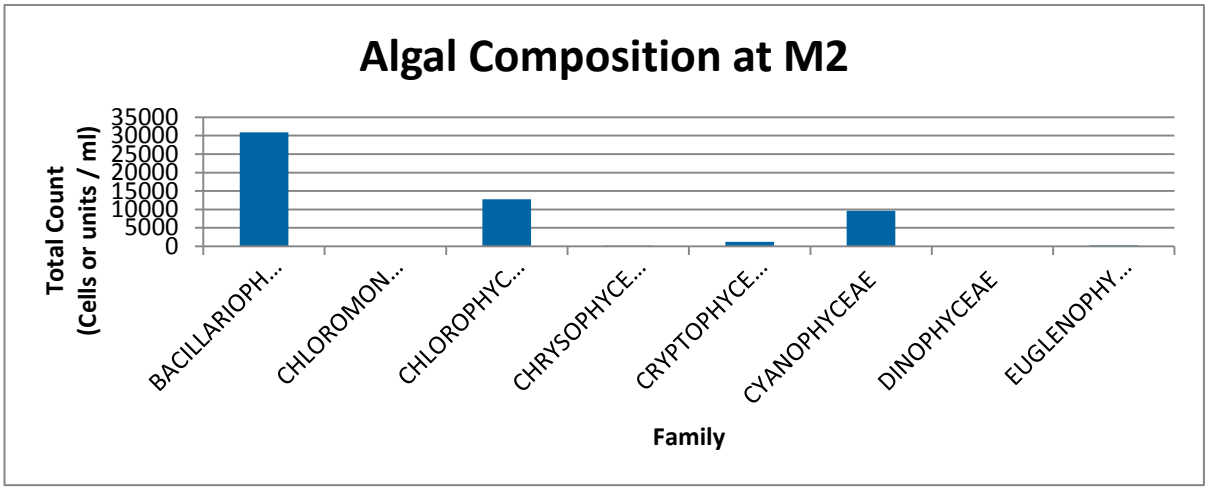

Figure 13 The abundance of major algal families at Murray River Site 2 (M2)

3.4 Fish Survey

The fish survey was conducted at sites accessed from the Victorian side of the Murray River and southern bank of the Campaspe River. Survey sites were within the project area and within 300 metres of the proposed bridge alignment options. See section 2.2.3 for further details on the method of the fish survey.

Due to the steep banks and steep sloping streambed, nets and traps were only set in locations where it was deemed safe to enter and exit the water and where water depth was sufficient to completely cover the net mouths and bait traps. In the Murray, nets and traps were set a small distance downstream of the boat launching ramp and main carpark in order to minimise the potential for interference and theft.

Six fish and two macroinvertebrate species were recorded during the survey (see Table 4). The six fish species included three common native and three introduced species. All three introduced species are included on the Victorian DPI's Noxious Aquatic Species list.

Juvenile Western Carp Gudgeon *Hypseleotris klunzingeri* (native) and juvenile European Carp (introduced) were the most abundant of the fish species sampled.

No Commonwealth or State listed threatened species were recorded during the fish survey, however, the desktop review returned a number of listed threatened species as potentially present within the project and assessment areas. A likelihood of occurrence assessment was undertaken (see Section 3.1.6) which determined that Golden Perch, Murray Cod, Silver Perch, Trout Cod, Eel-tailed Catfish and Macquarie Perch were likely to occur in the assessment area.

Accordingly, the absence of these species in the nets and traps during the fish survey should not be considered an indication of absence. Fish listed as previously identified in this section of river should be assumed to be present when developing mitigation controls for the construction of the bridge project.

Table 4 Fish survey results

Common Name	Species Name	Status	Number of Fish		Fork Length (mm range)
			Murray	Campaspe	
Australian Smelt	*Retropinna semoni*	Common	-	5	≈35
European Carp	*Cyprinus carpio*	Noxious	207	310+	10 – 30 + ≈1x180
Flat-headed Gudgeon	*Philypnodon grandiceps*	Common	-	2	25 – 30
Gambusia / Eastern Mosquitofish	Gambusia *holbrookii*	Noxious	3	-	20 – 25
Oriental Weather Loach	*Misgurnus anguillicaudatus*	Noxious	1	-	≈130
Western Carp Gudgeon	*Hypseleotris klunzingeri*	Common	705+	902+	15 – 30
Common Yabby	*Cherax destructor*	Common	1	4	NA
Freshwater Prawn	*Macrobrachium australiense*	Common	139	326+	NA

Representative photographs of the species recorded are included on the following pages (see Figure 14 to Figure 21).

Figure 14 Western Carp Gudgeon *Hypseleotris klunigeri*

Figure 15 Flat-headed Gudgeon *Philypnodon grandiceps*

Figure 16 Australian Smelt *Retropinna semoni*

Figure 17 European Carp *Cyprinus carpio*

Figure 18 Oriental Weather Loach Misgurnus anguillicaudatus

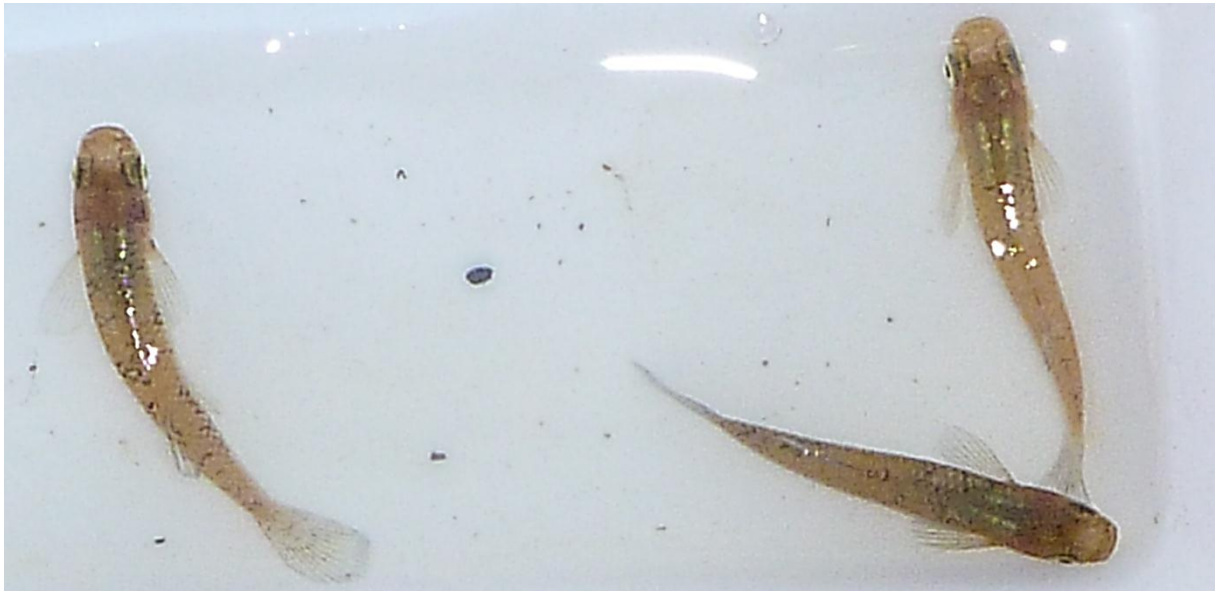

Figure 19 Gambusia / Eastern Mosquitofish *Gambusia holbrookii*

Figure 20 Common Yabby *Cherax destructor*

Figure 21 Freshwater Prawn *Macrobrachium australiense*

3.5 Relevant Legislation

3.5.1 Commonwealth

Environment Protection Biodiversity Conservation Act 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) aims to promote the conservation of biodiversity by providing protection for threatened species, threatened ecological communities, migratory and marine species and other protected matters. The Matters of National Environmental Significance listed under the EPBC Act 1999 relevant to this assessment are:

- Wetlands of International Significance (Ramsar Sites);
- Threatened Species and Ecological Communities; and
- Migratory Species;

Based on the desktop assessment and survey, there are a number of listed threatened fish species that may potentially occur in the vicinity of the study area (see Appendix A and Table 1). Of particular importance to the proposed project is the likely presence of the EPBC Act listed Trout Cod (Endangered), Macquarie Perch (Endangered) and Murray Cod (Vulnerable).

GHD has conducted a significance assessment in accordance with the EPBC Act Significant Impact Guidelines (SEWPaC, 2009) for the Trout Cod, Macquarie Perch and Murray Cod (refer to Appendix B). It was concluded that the project is unlikely to have a significant impact on these species or interfere with their recovery owing to the:

- Small construction footprint;
- Cantilever bridge design with no instream pier or pylon structures;
- Temporary nature of the disturbance arising from the project; and
- Likely negligible level of impact on critical fish habitat and the range of proposed mitigation measures,.

On this basis a referral under the EPBC Act (based on aquatic triggers only) should not be necessary.

3.5.2 New South Wales

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act* 1995 (TSC Act) lists threatened species, populations or ecological communities in NSW. Proponents should identify if their project is likely to have a significant impact on threatened biota, or their habitats. If any of these could be impacted by the proposal, an Assessment of Significance that addresses the requirements of section 5A of the *Environmental Planning and Assessment Act* 1979 must be completed.

The results of the assessment and field survey have concluded, the proposal is unlikely to have a significant impact on threatened species, populations or ecological communities listed under the TSC Act and are likely to occur in the project area. Therefore the impacts of the proposal should not trigger the need for a Species Impact Statement.

Fisheries Management Act 1994

The *Fisheries Management Act* 1994 (FM Act) aims to conserve, develop and share the fishery resources of the State for the benefit of present and future generations including conserving fish stocks and fish habitat and promoting ecologically sustainable development.

The FM Act requires an assessment of whether threatened species of fish and marine vegetation, populations or ecological communities are likely to be affected by the activity. If a significant effect on the threatened species is likely, a Species Impact Statement must be completed and concurrence of, or consultation with, NSW Fisheries is required.

This project potentially triggers a key threatening process listed under the FM Act; *degradation of native riparian vegetation along New South Wales water courses*.

Assessments of Significance were completed for threatened species and ecological communities listed under the FM Act as part of the aquatic ecology assessment (see Section 6). The assessment found that the proposal would be unlikely to have a significant impact on any threatened species or ecological communities listed under the FM Act. A Species Impact Statement is therefore not required for impacts on aquatic species.

Section 199 of the FM Act requires a public authority to notify the Minister of any dredging or reclamation work that it proposes to carry out at least 14 days prior to the work. Early involvement of NSW Department of Trade and Investment, Regional Infrastructure and Services - Fisheries division would be beneficial to the bridge design and timely approval.

State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. As the proposal is for a road and is to be carried out by the RMS in conjunction with VicRoads, development consent from council is not required. The proposal is therefore to be assessed under Part 5 of the New South Wales *Environmental Planning and Assessment Act* (1979) (EP&A Act). The effect on threatened species, populations or ecological communities, or their habitats needs to be determined under section 5A of the EP&A Act. This involves the application of the Assessment of Significance detailed in section 5A of the Act, and as required by the TSC Act in accordance with relevant assessment guidelines.

The proposal is not located on land reserved under the NPW Act and does not affect land or development regulated by *State Environmental Planning Policy No. 14 - Coastal Wetlands, State Environmental Planning Policy No. 26 - Littoral Rainforests* or *State Environmental Planning Policy (Major Projects) 2005*. Part 2 of ISEPP contains provisions for public authorities to consult with local councils and other public authorities prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), would be discussed in the Review of Environmental Factors (REF).

Murray Regional Environmental Plan No 2—Riverine Land

Murray Regional Environmental Plan No 2 – Riverine Land (MREP 2) has been deemed a State Environmental Planning Policy from 1 July 2009. The aims of MREP 2 are to conserve and enhance the riverine environment of the River Murray for the benefit of all users. It covers the riverine land of the River Murray. The Murray Shire is one of 11 Local Government Areas (LGA) to which MREP 2 applies.

Clause 8(c) states that the planning principles set out in Part 2 (clauses 9 and 10) must be applied when a public authority or person proposes to carry out a development which does not require development consent but which has the potential to adversely affect the riverine environment of the River Murray. As this proposal has the potential to adversely affect the riverine environment through clearing of native vegetation and construction on the Murray River floodplain, consultation with Murray Shire Council should be undertaken in accordance with MREP 2.

3.5.3 Victoria

Environment Effects Act 1978

The project would need to be referred to the Minister for Planning if one or more of the referral criteria outlined in the Ministerial guidelines for assessment of environmental effects under the *Environment Effects Act* 1978 (EE Act) are triggered. Some of these criteria relate to impacts upon FFG Act-listed threatened aquatic species. Based on the available information, it is presently considered unlikely that any threatened aquatic species will be significantly impacted with appropriate mitigation measures. On this basis a referral under the EE Act (based on aquatic triggers only) should be unnecessary.

State Environment Protection Policy (Waters of Victoria)

The *State environment protection policy (Waters of Victoria)* (SEPP WoV) aims to provide a coordinated approach for the protection and, where necessary, rehabilitation of the health of Victoria's water environments.

The SEPP identifies 'beneficial uses' of waterways and establishes environmental quality objectives at levels that will ensure the protection of these uses. SEPPs are legally enforceable statutory instruments. When undertaking works on or adjacent to surface water systems, management measures need to be implemented to minimise environmental risks to aquatic ecosystems and to protect other beneficial uses. When undertaking works on or adjacent to surface water systems, the SEPP will require management measures to be implemented to minimise environmental risks to the aquatic ecosystem and to protect beneficial uses.

Catchment and Land Protection Act 1994

The *Catchment and Land Protection Act 1994* (CaLP Act) has the objective of establishing a framework for the integrated and coordinated management of catchments that will:

- Maintain and enhance long-term land productivity while also conserving the environment; and
- Aim to ensure that the quality of the State's land and water resources and their associated plant and animal life are maintained and enhanced.

The CaLP Act establishes Catchment Management Authorities (CMAs) and provides for the development of Regional Catchment Strategies that must assess the nature, causes, extent and severity of land degradation of the catchments in the region and identify areas for priority attention. Local Planning Schemes must have regard for the Regional Catchment Strategies.

Campaspe Planning Scheme

The following provides a brief summary of the planning overlays that apply to crossing of Campaspe River and are of relevance to the aquatic flora and fauna survey. This section of the alignment is located in the Shire of Campaspe. The objectives of the following planning scheme overlays and zones for the Shire of Campaspe are consistent with the environmental requirements of this project.

Floodway Overlay

The purpose of the Floodway Overlay is as follows:

- To identify waterways, major floodpaths, drainage depressions and high hazard areas which have the greatest risk and frequency of being affected by flooding;

- To ensure that development maintains the free passage and temporary storage of floodwaters, minimises flood damage, is compatible with the flood hazard and local drainage conditions and would not cause any significant rise in flood level or flow velocity;
- To protect water quality in accordance with the provisions of relevant State Environment Protection Policies, particularly in accordance with Clauses 33 and 35 of the *State environment protection policy (Waters of Victoria)*; and
- To ensure that development maintains or improves river and wetland health, waterway protection and floodplain health.

Public Park and Recreation Zone

The purpose of the Public Park and Recreation Zone is as follows:

- To recognise areas for public recreation and open space; and
- To protect and conserve areas of significance where appropriate.

Water Act 1989

The *Water Act* 1989 (Water Act) is intended to ensure that water resources are conserved and properly managed for sustainable use for the benefit of present and future Victorians. It is also intended to provide formal means for the protection and enhancement of the environmental qualities of waterways and their in-stream uses and to provide for the protection of catchment conditions.

Part 10 of the *Water Act* outlines the Waterway Management responsibilities and requirements for regional drainage and floodplain management, as relevant to the Authorities responsible for waterway management districts. Any works undertaken in and around waterways and their floodplains will need to be undertaken in accordance with the *Water Act (1989)*. North Central Catchment Management Authority (NCCMA), as caretakers for river health under the W*ater Act (1989)* are responsible for issuing permits for works on waterways and therefore VicRoads will requires a permit from NCCMA prior to undertaking the works.

4. Potential Impacts

This section provides an indication of the potential impacts to aquatic flora and fauna and habitat associated with the construction and operational phases of the project. The assessment of potential impacts is based on the concept designs for the four potential bridge alignment options as provided by VicRoads. Based on information provided by VicRoads, the concept design for the two bridges uses a balanced cantilever construction method and there will be no pylons or pier structures required to be constructed within either the Campaspe or Murray River beds. Accordingly, this assessment of potential impacts is based on this information.

4.1 Impacts of Flooding Due to Channel Modification

Impacts on the river's aquatic ecosystem, and surrounding landscape, could arise if the design of the bridge structure is not adequately designed to permit flood-level flows to pass.

There are existing bridges upstream of the proposed new bridges, on both the Murray and Campaspe Rivers. The new bridges should be designed to ensure that they do not restrict river flows more than the existing upstream bridges. This would ensure impacts are not seen on ecological communities from flooding events.

4.2 Impacts of Construction on Aquatic Ecology

There are several potential sources of impact on fish populations and aquatic habitat, particularly during the construction phase of the project when working over or near the waterways.

Potential key impacts during the construction phase might include:

- Impedance to fish passage;
- Impacts / loss of aquatic habitat;
- Impacts / loss of riparian vegetation; and
- Reduced water quality.

4.2.1 Impedance of Fish Passage

It is unlikely that there would be any impacts to fish passage during construction as the proposed bridge is expected to span both rivers without structures within the river channel. If the bridge design was to incorporate structures within the channel (e.g. pylons), and dewatering for construction was required then resulting alterations to flow rates and temporary blockages of sections of the river could impede fish passage. The use of silt curtains within the river may also impede fish passage. Fish passage is important to provide:

- Access to habitat, food and shelter;
- The avoidance of predators; and
- Seasonal movement associated with breeding cycles (Fairfull and Witheridge 2003).

Debris from construction, including sediment, entering the waterway could also impact on fish passage in the area by creating blockages.

4.2.2 Impacts on Aquatic Habitat

Based on the design description provided by VicRoads (i.e. a cantilever design with no pier or pylon structures in the river bed), it is unlikely that there would be any impacts on aquatic habitat. The low or no impact is based on the assumption no works are undertaken within the river channel during the construction period.

However, if the construction works do require the disturbance, removal or destruction of emergent/instream aquatic habitat within the Murray River or Campaspe River channels, it is possible impacts to fish populations could occur

Emergent/instream snags and timber provide refuge and breeding grounds for a number of state and commonwealth listed fish species, such as the Murray Cod. The removal of instream habitat could place further negative pressure on of local fish populations.

4.2.3 Impacts to Riparian Vegetation

Riparian vegetation provides bank stability and shading for the aquatic ecosystem and contributes woody habitat (i.e. when old trees fall into the river) and plant litter (organic material at the base of the food chain). Woody debris and plant litter provides a carbon source for microbial activity, an important component of the food web. Removal of riparian vegetation and subsequent bank instability can lead to erosion, create blockages of the waterway's channel and flow patterns, and affect water quality. In turn this can lead to the potential loss or degradation of river edge habitat for fish and macroinvertebrates.

Riparian degradation can result from:

- Clearing of trees for construction areas;
- Direct disturbance from construction vehicles and machinery; and
- Introduction of weeds and pathogens on construction machinery.

If a buffer distance of 30 metres (for example) from the river bank were implemented during construction, and all construction was restricted to 30 metres away from the river bank then it is unlikely that there would be any impacts to riparian vegetation.

4.2.4 Reduced Water Quality

Sedimentation

Erosion and stormwater runoff containing sediment from disturbed areas are the most common impacts from construction projects.

Sediment discharges from construction are usually short-term and normally fish move away from highly turbid water. The release of highly turbid waters can block fish and limit movement and access to resources. This can limit fish breeding and migration. Impacts on fish species as a result of discharge of water with high levels of suspended particulate material and associated turbidity increases in a waterway can include:

- Smothering of gill surfaces with sediment leading to asphyxiation;
- Swallowing of large amounts of sediment leading to illness;
- Inhibition of light penetration into the water column which can effect predator-prey interactions;
- Release of toxins bound in the soils leading to effects on water quality (NRE, 2001); and
- Reduced habitat diversity by smothering or filling of interstitial spaces inhabited by fish species.

Spills and Chemicals

Water quality is important to fish populations and any toxic materials from construction could impact on the local aquatic fauna through poisoning. Potential impact sources include:

- Fuel, oil and grease leaking or spilling into the waterway;
- Bitumen, cements, grout, curing water and paints; and
- Chemicals bound in the soils of the bed or bank.

4.3 Long-term Operational Impacts to Aquatic Ecology

The potential impacts listed in the previous section are associated with short term impacts during construction. A number of potential longer-term impacts also need to be considered.

4.3.1 Structural Impedance and Fish Passage

The proposed bridge spans both rivers with no instream piers and consequently there would not be any long term direct impacts on the waterway fish population through flow alterations or blockage of passage.

Additional shading, artificial lighting and noise in an area of river, due to a bridge and its operations (i.e. vehicle use) can result in 'behavioural' impedance to fish passage (Thorncraft and Harris, 2000). For example some fish species will not enter an intensely shaded section of river during daylight (Fairfull and Witheridge, 2003).

The proposed two lane bridges crossing both the Murray and Campaspe Rivers would be at least 10 metres above the regular water level. At this height it is expected that the effect of shading from the two lane bridge would be reduced by reflected and scattered light during the day. The intensity of any light spill from the bridges, should lighting be installed, would be reduced by the distance to the water. It should be noted that the bridges may not warrant lighting. It is not expected that the level of light or shading under the bridges would form a barrier to fish passage in this case.

4.3.2 Riparian Vegetation

If riparian vegetation is removed as a result of construction and is not adequately rehabilitated though revegetation and landscaping, the impacts may include; long-term bank instability, erosion and weed invasion. Additionally, the loss of shading at the edge of the waterway may reduce the use of the area as a habitat by aquatic fauna and native fish.

4.3.3 Water Quality

Road runoff containing pollution and contaminants from vehicles has the potential to impact on local and downstream aquatic flora and fauna through toxic effects. In addition the increased usage of the area, due to the bridge, may result in an increase in gross pollutants such as rubbish and litter entering the waterway. This would detrimentally affect water and habitat quality as well as aesthetic values.

Environmentally responsible design would address water quality impacts from the new bridge. The new bridge would feature scuppers at regular intervals to manager storm water from the deck. These scuppers should be engineered to direct road runoff into water quality control structures reducing potential for contamination of the river.

4.3.4 Flood Events

Impacts on the river's aquatic ecosystem could arise if the design of the bridge is not adequate to permit flood flows to naturally pass in the vicinity of the bridge structure. There are existing bridges a short distance upstream and a natural choke in the Murray River about 1 km downstream of the proposed new bridge. The design of the new bridge would be such that it does not have the potential to restrict river flows more than the existing bridges. This would ensure impacts are not seen on ecological communities from flooding events.

4.3.5 Increased Visitation

The construction of an additional bridge through the Victoria Park Reserve has the potential to increase access to the river, river banks and riparian zone (visitation) within the vicinity of the bridge. Increased visitor numbers can lead to increased litter and increased damage to the river, aquatic and riparian habitat.

4.3.6 Overall long-term impacts

Give the small project area footprint, lack of instream works, short duration and proposed site rehabilitation works, if the long-term operational mitigation measures (outlined in Section 5) are implemented, then there are unlikely to be any significant longer-term impacts associated with the operational phase of the project.

5. Mitigation Measures

5.1 Mitigation measures during construction

5.1.1 Bridge Design

Due to the presence of Commonwealth and State listed fish species, other broader aquatic ecological values (such as fish and macroinvertebrates communities) and associated aquatic habitat in the vicinity of the proposed bridge the following bridge design recommendations should be implemented:

- Endeavour to retain the cantilever bridge design which eliminates the need for pylon or pier structures (supporting structures) in the river bed;
- Foundations for the bridge should be set as far back from the river channel and banks as possible to minimise disturbance and potential instream impacts;
- The bridge's design footprint should be minimised to reduce the loss of riparian vegetation;
- Ensure that reinstatement and revegetation of the riparian zone includes endemic native species and that this is reflected in the landscape design for the works;
- The bridge should be designed to minimise shading of the waterway. Sufficient light penetration should be enabled under the proposed bridge to encourage fish passage to occur. Design features that allow light to pass through the bridge, such as grated walkways are beneficial; and
- Storm water management should be designed to minimise storm water runoff directly to the river. Stormwater from the bridge and approaches should be directed to water quality control structures to manage chemical spills and gross pollutants from the bridge and approaches.

5.1.2 Construction Environmental Management Plan

It is recommended that a Construction Environmental Management Plan (CEMP) be developed that includes:

- Terrestrial and social environmental aspects;
- Maximisation of fish passage during construction and operation of the bridges;
- Erosion and sediment control plans to minimise turbid water discharges into either river;
- A waste minimisation plan with designated areas for storage of rubbish;
- During construction, if part of a waterway needs to be diverted or blocked the following mitigation measures would be incorporated to protect fish passage:
  - Ensure the duration is kept to a minimum;
  - Water velocities through the diversion should not exceed those of the natural waterway;
  - Submerge the inlet and outlet of diversion within the existing waterway so that fish access is not prevented; and
  - Where the diversion is a pumped diversion, provide screening over the inlet as to avoid drawing fauna into the pump.

- Avoidance of habitat removal:
  - The proposed cantilever bridge design does not require piers or pylons in the river bed and, therefore, should not require instream works. However, if works do intrude into the waterway, aquatic habitat (such as woody snags) is to be relocated up or down stream. The importance of avoiding aquatic habitat damage is to be reinforced through worker inductions.
  - The relocation of aquatic habitat such as snags should be included in the CEMP.
  - Riparian vegetation with a diameter at breast height between 400 and 1500 mm should be reused as snags in the river or coarse wood debris on the banks.
- Avoidance of erosion and sedimentation:
  - Development and implementation of an erosion and sediment control plan to reduce the impacts on the waterway.
  - Erosion management should be designed using the Victorian *EPA Best Practice Environmental Management – Environmental Guidelines for Major Construction Sites (1996)* and *EPA Construction Techniques for Sediment Pollution Control (1991)*.
  - Erosion and sediment control plans should also be designed using the *NSW DECC Guidelines Managing Urban Stormwater, Soils and Construction, Volume 2D Main Roads Construction* 2008.
  - The erosion and sediment control plan should be developed in accordance with the relevant state guidelines. Construction controls may include:
    - Diversion of clean water around the site;
    - Use of sediment control structures;
    - Stockpiling away from drainage lines;
    - Minimising areas of exposure; and
    - Progressive revegetation of earthworks.
  - Where possible earthworks should occur in the dryer summer months and work should cease during heavy rainfall or flood events.
  - A flood management plan should be developed and implement throughout construction.
- Effects on water quality:
  - A water quality management plan is to be developed and implemented that is consistent with NSW water guidelines and the Victorian SEPP WoV environmental quality objectives.
  - Water quality monitoring prior to and during construction should be conducted upstream and downstream of the proposed bridges. The results of monitoring should be used to assess project related changes to key water quality parameters.
  - Monitoring should also occur on the day following rain events greater than 15 mm.
  - All environmental controls should regularly inspected (at least weekly and after rainfall events), maintained and kept in good working order.
  - Inspections of environmental controls should be recorded/logged.
  - Repairs to controls should occur within five working days of damage.

5.1.3 VicRoads Requirements

VicRoads standard environmental protection measures, for surface water, that would be adopted for this Project include:

- Waters shall be monitored for the parameters identified in Table 1200.041 during all stages of construction to ensure that the water quality in the receiving waters:
  - Does not deteriorate between the upstream and downstream limits of the work site during the construction period (where upstream results become the background limits); or
  - Is as agreed between the Contractor, the Superintendent and EPA.
- The Contractor shall provide and maintain equipment capable of providing instantaneous monitoring of parameters as required in Table 1200.041 and have such equipment available on-site at all times. All equipment associated with monitoring shall be maintained and calibrated in accordance with the manufacturer's or equipment supplier's requirements.

Table 5 VicRoads Table 1200.041 - Construction Monitoring

Parameter	Method
Turbidity – NTU	Measure with on-site meter
Electrical Conductivity (EC) – µS/cm	Measure with on-site meter
pH	Measure with on-site meter
Dissolved oxygen (DO) – mg/L	Measure with on-site meter
Temperature (°C)	Measure with on-site meter
Suspended Solids (SS) – mg/L	Measure with on-site meter
Litter (definition, including solid inert waste)	Visual (prevent litter from entering waters and drainage systems)
Oils and Greases	Visual (No visible free oil or greases)

5.1.4 Roads and Maritime Services Requirements (RMS 2011)

RMS standard environmental protection measures, that would also be adopted for this project and incorporated into the CEMP, include:

- The project boundary should be clearly delineated and marked;
- No stockpiling of soil or materials near waterways or drainage lines;
- There is to be no release of dirty water into drainage lines and/or waterways;
- Visual monitoring of local water quality (i.e. turbidity, hydrocarbon spills/slicks) is to be undertaken on a regular basis to identify any potential spills or deficient erosion and sediment controls;
- Water quality control measures are to be used to prevent any materials (for example concrete, grout, and sediment) entering drain inlets or waterways;
- Measures to control pollutants from stormwater and spills would be incorporated in the pavement drainage system at locations where it discharges to the receiving drainage lines;
- Measures aimed at reducing flow rates during rain events and potential scour would also be incorporated in the design of the pavement drainage system;

- Diversion of clean water around the site, where possible;
- Potable water is used for wash down;
- Excess debris from cleaning and washing is removed using hand tools;
- Containment material is used to capture / filter water used in wash down;
- All fuels and chemicals to be stored in bunded areas away from waterways and drainage lines;
- Terrestrial and aquatic exclusion fencing would be marked on the design plans and included in the CEMP;
- The trees to be removed would be cut at ground level and the remaining stump left in situ to avoid potential impact to culturally sensitive areas;
- Progressive stabilisation of disturbed areas;
- A riparian vegetation management plan would be developed and implemented prior to construction. The plan would:
  - Address the cleaning of construction vehicles to reduce the import of weeds and soil borne pathogens;
  - Describe and delineate machinery movement areas and minimise vegetation clearance.
  - Describe the requirements to rehabilitate areas of riparian vegetation that are removed during construction; and
  - Delineate exclusion areas should be sign posted as “Environmentally sensitive area – Keep Out”.

6. Significance of Impacts to Aquatic Fauna

The proposed design of the bridge is an arching structure that is to span both the Campaspe and Murray Rivers with no support structures included in either waterway. The design is anticipated to have a minimal long-term impact to fish populations and habitat in the study area. Short term construction impacts are expected to be minimal if the recommended CEMP and mitigation measures are implemented.

It is also considered unlikely that the proposed bridge construction and resulting structure would have any significant effect on any of the known Commonwealth and State listed species or communities identified from the area, however, a seven part test of significance, in accordance with the NSW EP&A Act, DECCW Threatened Species Assessment Guidelines August 2007 was applied to the Lower Murray River EEC and four individual fish species. The fish species to which tests were applied were Silver Perch and Eel-tailed Catfish which are listed under the *Fisheries Management Act* (1995) as vulnerable and an endangered population in the Murray River respectively, and are likely to be present at the site. Murray Hardyhead and Murray Jollytail both of which are unlikely to be present but which are listed under the Fisheries Management Act as critically endangered.

With respect to fish listed under the *Environment Protection and Biodiversity Conservation Act* (1999) (EPBC Act), only the Murray Cod is likely to occur in this area of the Murray River and hence an EPBC Act Significance Assessment was completed for this species.

GHD's response to the seven part tests of significance and the EPBC Act Significance Assessment for the Murray Cod is provided below. The significance assessments have been conducted on the basis that all mitigation measures detailed in Section 5 are implemented.

6.1 The Lower Murray River EEC

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable as this is an endangered 'community'.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable as this is an endangered 'community'.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

– *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*

It is unlikely that the proposed development would have an adverse effect on the aquatic fauna community. The minor disturbances expected during construction would be of a short-term nature and still allow abundant fish passage. The small sedimentation risk associated with the project construction is not expected to lead to an adverse effect with the implementation of the suggested mitigation measures.

In conclusion, the proposed development is unlikely to have an adverse effect on the extent of the EEC such that its local occurrence is likely to be placed at risk of extinction.

– *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

It is unlikely that the proposed development would have an effect on the aquatic fauna community. The minor disturbances expected during construction would be of a short-term nature and still allow fish passage. The small sedimentation risk associated with the project construction is not expected to lead to an adverse effect with the implementation of the suggested mitigation measures.

In conclusion, it is considered that the proposed development is unlikely to substantially and adversely modify the composition of the EEC such that its local occurrence is likely to be placed at risk of extinction.

In relation to the habitat of a threatened species, population or ecological community:

i) the extent to which habitat is likely to be removed or modified as a result of the action proposed; and

(ii) whether the area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action; and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

It is considered that the proposed development would not isolate or fragment aquatic habitat, with fish and aquatic macroinvertebrates still being able to move freely through the reach of concern.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

Not Applicable.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Not Applicable.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The activity is not part of a key threatening process.

Conclusion: It is considered highly unlikely that the proposed project and bridge development would have a significant adverse impact on the Lower Murray River EEC.

6.2 Silver Perch *Bidyanus bidyanus*

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

It is highly unlikely that the development would have a significant impact on the life cycle of this species, because the disturbances during construction and expected to be minor, and would still allow abundant fish passage. The small sedimentation risk associated with the project's construction is not expected to lead to an adverse effect if the suggested mitigation measures are adhered to.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not Applicable.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

– *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*

  Not applicable.

– *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

  Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

  No habitat is expected to be impacted by the proposed development within the waterway.

(ii) Whether the area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action and,

  It is considered that the development would not isolate or fragment any habitat, with fish and invertebrates able to move freely through the reach of concern.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality;

  Not applicable.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly);

There would be no adverse effect on critical habitat as there is no critical habitat present and there are no activities proposed within the waterway. The nature of the design of the proposed bridge (having no support structures within the waterway) should have little to no effect on the aquatic fauna community, and the small sedimentation risk associated with the project is not expected to lead to a long-term adverse effect.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Not Applicable.

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process

The activity is not part of a key threatening process.

Conclusion: A significant adverse impact of the bridge construction on the Silver Perch is highly unlikely.

6.3 Eel-tailed Catfish *Tandanus tandanus*

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

It is highly unlikely that the development would have a significant impact on the life cycle of this species, because the disturbances during construction are expected to be minor and would still allow abundant fish passage. The small sedimentation risk associated with the project's construction is not expected to lead to an adverse effect if the suggested mitigation measures are adhered to.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not applicable.

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

– *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*

  Not applicable.

– *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

  Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

  Minimal habitat is expected to be impacted within the waterway (if any at all) and the footprint of the project would be insignificant in comparison to available surrounding habitat.

(ii) *Whether the area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action and,*

  It is considered that the development would not isolate or fragment any habitat, with fish and invertebrates able to move freely through the reach of concern.

(iii) *The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.*

  Not applicable.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

There would be no adverse effect on critical habitat because there is no critical habitat present and because there would be no activities within the waterway. The nature of the design of the proposed bridge having no support structures within the waterway should have little to no effect on the aquatic fauna community, and the small sedimentation risk associated with the project is not expected to lead to an adverse effect.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Not Applicable

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The activity is not part of a key threatening process.

Conclusion: A significant adverse impact of the bridge construction on the Eel-tailed Catfish is highly unlikely.

6.4 Murray Hardyhead *Craterocephalus fluviatilis*

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

It is highly unlikely that the development would have an impact on the life cycle of this species, because the disturbances during construction are expected to be minor and would still allow abundant fish passage. The small sedimentation risk associated with the project's construction is not expected to lead to an adverse effect if suggested mitigation is adhered to.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not Applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

– *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*

Not applicable

– *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Minimal habitat is expected to be impacted within the waterway (if any at all) and the footprint of the project would be insignificant in comparison to available surrounding habitat.

ii) Whether the area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action and,

It is considered that the development would not isolate or fragment any habitat, with fish and invertebrates able to move freely through the reach of concern.

iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Not applicable.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

There would be no adverse effect on critical habitat because there is no critical habitat present and because there would be no activities within the waterway. The nature of the design of the proposed bridge having no support structures within the waterway should have little to no effect on the aquatic fauna community, and the small sedimentation risk associated with the project is not expected to lead to an adverse effect.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Not Applicable

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The activity is not part of a key threatening process.

Conclusion: A significant adverse impact of the bridge construction on the Murray Hardyhead is highly unlikely.

6.5 Murray Jollytail *Galaxias rostratus*

In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

It is highly unlikely that the development would have an impact on the life cycle of this species because the disturbances during construction are expected to be minor and would still allow abundant fish passage. The small sedimentation risk associated with the project construction is not expected to lead to an adverse effect if suggested mitigation is adhered to.

In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

Not Applicable

In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

– *Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or*

  Not applicable

– *Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;*

  Not applicable.

In relation to the habitat of a threatened species, population or ecological community:

i) *The extent to which habitat is likely to be removed or modified as a result of the action proposed, and*

  Minimal habitat is expected to be impacted within the waterway (if any at all) and the footprint of the project would be insignificant in comparison to available surrounding habitat.

(ii) *Whether the area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action and,*

  It is considered that the development would not isolate or fragment any habitat, with fish and invertebrates able to move freely through the reach of concern.

(iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

Not applicable.

Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

There would be no adverse effect on critical habitat because there is no critical habitat present and because there would be no activities within the waterway. The nature of the design of the proposed bridge having no support structures within the waterway should have little to no effect on the aquatic fauna community, and the small sedimentation risk associated with the project is not expected to lead to an adverse effect.

Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

Not Applicable

Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The activity is not part of a key threatening process.

Conclusion: A significant adverse impact of the bridge construction on the Murray Jollytail is highly unlikely.

6.6 Murray Cod *Maccullochella peelii peelii*

Under the EPBC Act an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it would:

1. *Lead to a long-term decrease in the size of an important population of a species;*

   It is highly unlikely that the development would have an impact on the local population. The minor disturbances expected during construction would still allow abundant access underneath the bridge and there are expected to be no impediments to fish passage or net loss of fish habitat.

2. *Reduce the area of occupancy of an important population;*

   It is highly unlikely that the development would have an impact on the occupancy of the local population as the minor disturbances expected during construction would still allow abundant access underneath the bridge.

3. *Fragment an existing important population into two or more populations;*

   The development would not significantly alter passage in the waterway and hence the fragmentation of populations is unlikely to occur.

4. *Adversely affect habitat critical to the survival of a species;*

   Minimal habitat is expected to be impacted within the waterway (if any at all) and the footprint of the project would be insignificant in comparison to available surrounding habitat.

5. *Disrupt the breeding cycle of an important population;*

   Fish passage would be maintained through the design of the bridge, with sufficient passage still allowed and levels of shading similar to that already created by nearby existing bridges.

6. *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;*

   Little to no habitat would be removed or destroyed in the construction process.

7. *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;*

   It is unlikely that an invasive aquatic species would be introduced during the construction process, with barge use the only likely vector for transportation of introduced species, any vessels used would likely be local and if not, would be subject to usual interstate quarantine processes,

8. *Introduce disease that may cause the species to decline; or*

   The likelihood of the introduction of disease from the construction project is minimal, the area of concern is an urbanised environment and equipment used would be cleaned prior to working on site.

9. *Interfere substantially with the recovery of the species.*

   It is unlikely the project would affect the recovery of the species in any way, with only minor impacts expected, if any at all.

7. Options Assessment

The aim of this options assessment was to undertake an assessment of the potential impacts and benefits for each of the four alignment options using the Objective Based Evaluation Methodology (OBEM).

7.1 Objective Based Evaluation Methodology

The OBEM is commonly used for infrastructure projects to assess how alignment options perform against project objectives. The assessment rating tool in Table 6 will be used to assess how well each of the options performs against the above assessment criteria.

Table 6 Define values and descriptors for impact rating

Supplementary description	Defined values	Ratings	Impact
• Best practice • High level of policy compliance	Significant benefits for the region	Meets objective very well	Positive impact
• Improved practice • Policy compliance	High level of benefit for the local area or moderate benefit for the region	Meets objective well	
No distinct positive or negative impact		Meets objective moderately well	Neutral
• Policy non-compliance • Negative impact	High level of impact for local area or moderate level of impact over the region	Meets objective poorly	Negative impact
• Policy non-compliance • Major negative impact	High level of impact for the region	Meets objective very poorly	

7.2 Objective and Criteria

The OBEM criteria in Table 7 below have been developed to measure the four alignment options for the proposed bridge project. VicRoads provided the key project objective for use in this assessment. The assessment tool will evaluate how well each of the proposed corridor alignments performs against the objectives from a biodiversity perspective (specifically the aquatic environment).

Table 7 Biodiversity objective and assessment criteria

Key Project Objective	Assessment Criteria	Measure
To minimise impacts on biodiversity and provide appropriate mitigation measures to the extent practicable.	Occurrence of threatened flora and fauna species.	The number of threatened flora and fauna species.
	Potential habitat for threatened species.	Living conditions of threatened species.
	Native vegetation loss.	Loss of native vegetation.

7.3 Analysis of Alignments

Each of the alignment options has been assessed using the assessment criteria detailed in Sections 7.1 and 7.2. The four alignment options have been given a performance rating against each of the assessment criteria. This section provides an overall summary of the assessment and performance ratings.

Note: As this is an aquatic assessment, the options assessment only takes into consideration those sections of the proposed alignments that are over either the Murray or Campaspe Rivers and in the immediate riparian zone (generally less than 20 metres from the river's edge).

Table 8 Options assessment for the six broad corridors

Criteria	Alignment 2A	Alignment 2B	Alignment 2C	Alignment 2D
Occurrence of threatened flora and fauna species.	Meets objective moderately well	Meets objective moderately well	Meets objective moderately well	Meets objective moderately well
Potential habitat for threatened species.	Meets objective moderately well	Meets objective moderately well	Meets objective moderately well	Meets objective moderately well
Loss of native vegetation	Meets objective moderately well	Meets objective moderately well	Meets objective moderately well	Meets objective moderately well

Taking into consideration only those sections of the alignment options that are over the rivers or their immediate riparian zone, the options analysis was unable to differentiate any variation or difference between the four options. All four options have effectively the same values for threatened fauna, threated fauna habitat and loss of native vegetation as they occur in such close proximity and in the same aquatic and riparian landscape.

8. Recommendations

Based on the investigation completed by GHD, the following steps are suggested to comply with legislative requirements:

- Notify the Minister for Fisheries NSW before carrying out or authorising the carrying out of any works within a waterway involving dredging or reclamation as per Part 7 (Division 3) of the *Fisheries Management Act 1994* (FM Act), this requirement can be achieved by notifying in writing with sufficient project and aquatic survey information to:
  - Mr Luke Pearce, DPI Aquatic Habitat Protection Unit (South West region for Murrumbidgee, Murray, Lower Darling), Unit 3/556 Macauley Street, Albury NSW 2640;
- Develop a Construction Environment Management Plan for pre, during and post construction incorporating the mitigation measures discussed in Section 5 which includes measures to mitigate against the following potential impacts:
  - Impeding fish passage;
  - Aquatic habitat loss/removal;
  - Erosion and sedimentation;
  - Reduced water quality;
  - Riparian habitat and native vegetation loss/removal; and
  - Increased visitation of public when viewing the works.
- Undertake water quality monitoring for turbidity and total suspended solids (TSS) during construction in compliance with the *State environment protection policy Waters of Victoria*.

9. Conclusion

The desktop review identified 43 aquatic fauna species including eight exotic species and 16 listed threatened native species within the assessment area. Of the 16 listed threatened species six were listed under the Commonwealth EPBC Act, in Victoria nine were listed under the FFG Act and 11 were on the DSE's Advisory Lists and in NSW nine were listed under the NSW *Fisheries Management Act* (some of the 16 species were listed across two or more of these) that maybe found in the vicinity of the proposed crossing location. The fish survey recorded six species of fish including three native and three exotic. Two macroinvertebrates were also recorded during the survey. All of these common species have previously been recorded in the assessment area.

Listed threatened species, that were not recorded during the survey but were assessed as either being likely or possible to inhabit the project area in the Murray and Campaspe Rivers included Golden Perch (DSE), Murray Cod (EPBC, FFG and DSE), Trout Cod (EPBC, FFG, NSW FM and DSE), Silver Perch (FFG, NSW FM and DSE), Eel-tailed Catfish (FFG and DSE), Macquarie Perch (EPBC, FFG, NSW FM and DSE), Murray River Rainbowfish (FFG and DSE), Southern Pygmy Perch (NSW FM) and Murray River Turtle (DSE).

For the purpose of the construction of the bridge crossing it should be assumed that these species may also be present when developing mitigation procedures. Their absence from the field survey is not necessarily indicative of their absence from this section of the waterway. The protection of Commonwealth and state listed threatened species, and other non-listed native fish and aquatic biota, is important to maintaining biodiversity in the region. However, if the mitigation measures and recommendations outlined in this report are adopted, there is unlikely to be a long-term or significant impact to the identified species or aquatic environment.

Habitat within the project area was assessed as a component of the field program. The Murray and Campaspe Rivers have a range of instream habitat for aquatic fauna (namely fish) including instream woody habitat (i.e. fallen trees and tree roots) and bank undercuts. The banks were a muddy clay substrate and, as with similar reaches of the Murray River, a muddy silt substrate with snags and organic debris were present. The banks were mostly fine grained clay with a moderate erosion potential which should be considered when developing the CEMP. Bank disturbance could lead to the deposition of silt into the waterway increasing turbidity, impacting fish passage and aquatic fauna.

Water Quality data exhibited high turbidity, nutrient and algae levels, which were probably due to high sediment loads caused by rainfall events in the upstream catchments rivers through early to mid-March 2012. Despite this, the risk of algal blooms within both rivers is relatively low with low levels of non-toxigenic blue green algae present. All other water quality parameters measured were within both Victorian and NSW objectives for this segment Murray River and its tributaries.

A seven-part test of significance, in accordance with the NSW EP&A Act, DECCW Threatened Species Assessment Guidelines August 2007 was applied to assess potential impacts to the Lower Murray River Endangered Ecological Community and to four individual species: Silver Perch, Eel-tailed Catfish, Murray Hardyhead and Murray Jollytail. The assessment concluded that there would likely be no significant impact on any of these entities if the recommended mitigation measures were applied. An EPBC Act Significance Assessment was also undertaken for the Murray Cod. The assessment concluded that there would likely be no significant impact to Murray Cod populations if the recommended mitigation measures are applied. Based on aquatic fauna values, a referral of the project to the Federal Environment Minister under the EPBC Act is not required.

Overall, if the mitigation measures and recommendations outlined in this report are adopted, risks of impacts to local listed threatened and common aquatic fish and fauna biota populations are small and impacts would be localised and present only for a short period during construction.

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Appendices

Appendix A Aquatic Fauna Species Recorded in the Assessment Area

Common Name	*Scientific Name*	EPBC Act	FFG	DSE	Fisheries Management Act	Exotic
FISH						
Australian Lamprey	***Mordacia mordax***					
Australian Smelt	***Retropinna semoni***					
Bony Bream	***Nematalosa erebi***					
European Carp	***Cyprinus carpio***					*
Flat-headed Gudgeon	***Philypnodon grandiceps***					
Golden Perch	***Macquaria ambigua***			Vu		
Goldfish	***Carassius auratus***					*
Murray Cod, Cod, Goodoo	***Maccullochella peelii peelii***	VU	L	En		
Oriental Weather Loach	***Misgurnus anguillicaudatus***					*
Redfin Perch	***Perca fluviatilis***					*
River Blackfish	***Gadopsis marmoratus***					
Silver Perch	***Bidyanus bidyanus***		L	Ce	E	
Southern Pigmy Perch	***Nannoperca australis***				E	
Trout Cod	***Maccullochella macquariensis***	EN	L	Ce	E	
Western Carp Gudgeon	***Hypseleotris klunzingeri***					
Australian Grayling	***Prototroctes maraena***	VU	L	Vu		
Brown Trout	***Salmo trutta***					*
Common Galaxias	***Galaxias maculatus***					
Eel-tailed Catfish	***Tandanus tandanus***		L	En		
Fly-specked Hardyhead	***Craterocephalus stercusmuscarum***					
Gudgeon sp.	***Eleotridae family***					
Macquarie Perch	***Macquaria australasica***	EN	L	En	E	
Mosquito Fish	***Gambusia holbrooki***					*
Mountain Galaxias	***Galaxias olidus***					
Murray River Rainbowfish	***Melanotaenia fluviatilis***		L	Dd		
Rainbow Trout	***Oncorhynchus mykiss***					*
Short-finned Eel	***Anguilla australis***					
Spotted Galaxias	***Galaxias truttaceus***					
Tench	***Tinca tinca***					*
Tupong	***Pseudaphritis urvillii***					
Yarra Pigmy Perch	***Nannoperca obscura***	VU	L	Nt		
AQUATIC INVERTEBRATES						
Common Yabby	***Cherax Destructor***					

Common Name	*Scientific Name*	EPBC Act	FFG	DSE	Fisheries Management Act	Exotic
Granular Burrowing Cray	***Engaeus cunicularius***					
Southern Victorian Spiny Cray	***Euastacus yarraensis***					
AQUATIC MAMMALS						
Platypus	***Ornithorhynchus anatinus***					
Water Rat	***Hydromys chrysogaster***					
AQUATIC REPTILES						
Murray River Turtle	***Emydura macquarii***			**dd**		

Appendix B EPBC Act Matters of NES Assessment

Criteria	Trout Cod	Macquarie Perch	Murray Cod
Is it an important population?	Yes	Yes	Yes
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will result in one or more of the following:			
Lead to a long-term decrease in the size of an important population of a species	No The project is expected to have a minimal footprint, will not include instream works and will be short-term in nature.	No The project is expected to have a minimal footprint, will not include instream works and will be short-term in nature.	No The project is expected to have a minimal footprint, will not include instream works and will be short-term in nature.
Reduce the area of occupancy of an important population of the species	No Given the small project footprint and short duration of the project, at most possibly a single individual may be impacted and it would be inclined to depart and return to eh area once works have been completed.	No Given the small project footprint and short duration of the project, at most possibly a single individual may be impacted and it would be inclined to depart and return to eh area once works have been completed.	No Given the small project footprint and short duration of the project, at most possibly a single individual may be impacted and it would be inclined to depart and return to eh area once works have been completed.
Fragment an existing important population into two or more populations	No The small footprint and lack of instream works is unlikely to fragment the local population.	No The small footprint and lack of instream works is unlikely to fragment the local population.	No The small footprint and lack of instream works is unlikely to fragment the local population.
Adversely affect habitat critical to the survival of a species	No Works are not proposed to occur instream, however, any required for the removal of instream habitat (such as snags) will be reinstated once the works have been completed.	No Works are not proposed to occur instream, however, any required for the removal of instream habitat (such as snags) will be reinstated once the works have been completed.	No Works are not proposed to occur instream, however, any required for the removal of instream habitat (such as snags) will be reinstated once the works have been completed.

Criteria	Trout Cod	Macquarie Perch	Murray Cod
Disrupt the breeding cycle of an important population	Possible Works are proposed to be undertaken outside of the key breeding/migration period (spring to early summer)..	Possible Works are proposed to be undertaken outside of the key breeding/migration period (spring to early summer)..	Possible Works are proposed to be undertaken outside of the key breeding/migration period (spring to early summer)..
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No Works are not proposed to occur instream, however, any required for the removal of instream habitat (such as snags) will be reinstated once the works have been completed.	No Works are not proposed to occur instream, however, any required for the removal of instream habitat (such as snags) will be reinstated once the works have been completed.	No Works are not proposed to occur instream, however, any required for the removal of instream habitat (such as snags) will be reinstated once the works have been completed.
Introduce disease that may cause the species to decline	No	No	No

Appendix C Assignment Brief

THE ASSIGNMENT

AQUATIC FLORA AND FAUNA ASSESSMENT TASK BRIEF – ECHUCA-MOAMA BRIDGE PLANNING STUDY

1. PURPOSE OF THIS ASSIGNMENT

The purpose of this assignment is to provide an assessment of the Aquatic Flora and Fauna for the Mid-West 2 Murray River Crossing at Echuca-Moama to provide a connection between the Murray Valley Highway / Warren Street intersection, Echuca and the Cobb Highway/Perricoota Road intersection, Moama via a corridor to the north of Echuca Cemetery and crossing the Murray River to the north of Echuca Caravan Park. Please refer to Figure 1 for a locality plan.

VicRoads is seeking to appoint a competent, cost-effective and pre-qualified Provider who will add value to this process through their technical skills and work effectively in partnership with VicRoads. Providers are invited to submit a Tender for the provision of a aquatic flora and fauna assessment under agreement to VicRoads. The assessment must be conducted in such a manner as to satisfy the Assignment Scope and Objectives for the site as set out in this Brief.

2. BACKGROUND

2.1 Project Details

The existing bridge was built in 1878, and in 1989 a rail bridge was built parallel to the historic bridge. The Murray River crossing provides an important link for local traffic between Echuca and Southern New South Wales. This is the only crossing in the Echuca-Moama area, the nearest alternative bridge is at Barmah.

Agricultural production is the major economic activity at Echuca-Moama, involving both dryland and irrigated farming, with milk and rice being significant contributors to total agricultural production. Tourism is also a significant contributor to the economy of the area, with the historic Port of Echuca, river-based activities and recreation being the main attractions.

There are three major highways that intersect at Echuca-Moama; the Northern Highway and the Murray Valley Highway in Victoria, and the Cobb Highway in New South Wales. These highways are all significant transport routes. The existing bridge structure is narrow with one lane in each direction and has little capacity to cater for the long term traffic needs of the region.

The existing bridge is unable to provide a suitable level of service for the increasing volume of traffic in the area. Population growth, accompanied by growth in business, tourism, jobs and personal travel, all combine to indicate significant future ongoing growth in travel across the river at Echuca- Moama. The existing bridge has operational limitations in that traffic flow over the bridge is often delayed during peak tourist periods, and when wide loads or agricultural machinery need to cross the river and the traffic has to be stopped because of the narrow width of the bridge. Over dimensional vehicles are prohibited from crossing the bridge during morning, lunch and evening peak periods. This is inconvenient and costly for business operations. The existing bridge also requires extensive rehabilitation which would result in partial closure of the bridge, while work is being carried out. The second Murray River crossing will act as an alternative access between Echuca and Moama and provide relief for congestion on the existing bridge.

2.2 Study Area Description

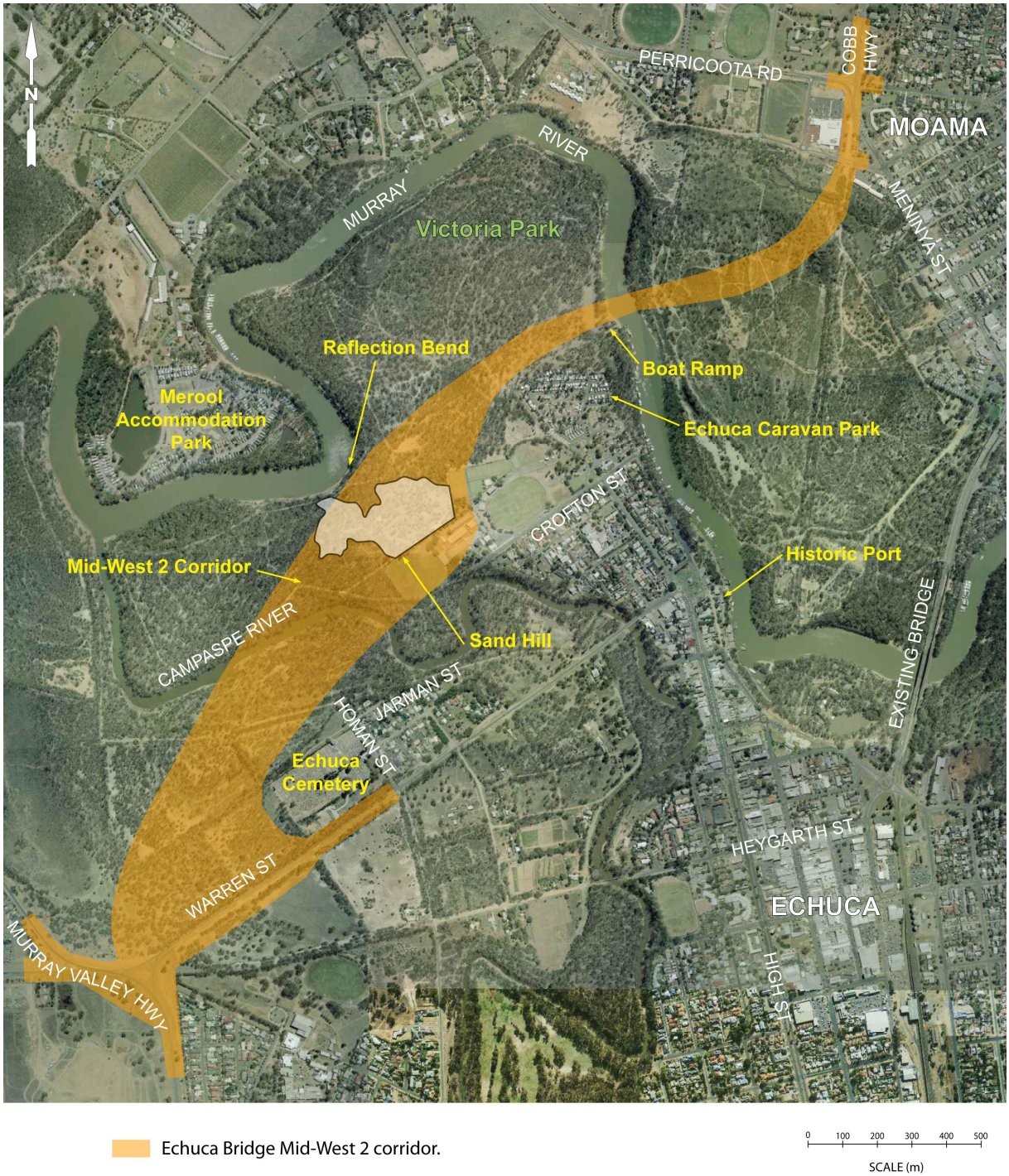

Figure 1 - Echuca Bridge Study area

A detailed literature and database review of the study area for both Victoria and NSW will be undertaken to locate information about aquatic flora and fauna. A fish survey is required to be undertaken based on crossing locations shown in Figure 2. Earlier field work can be drawn upon for common areas from previous investigations.

VicRoads is currently developing concept designs. It is anticipated that concept designs for 4 alignment options will be available around mid December. Broad concept design alignments shown in Figure 2 are provided for information only.

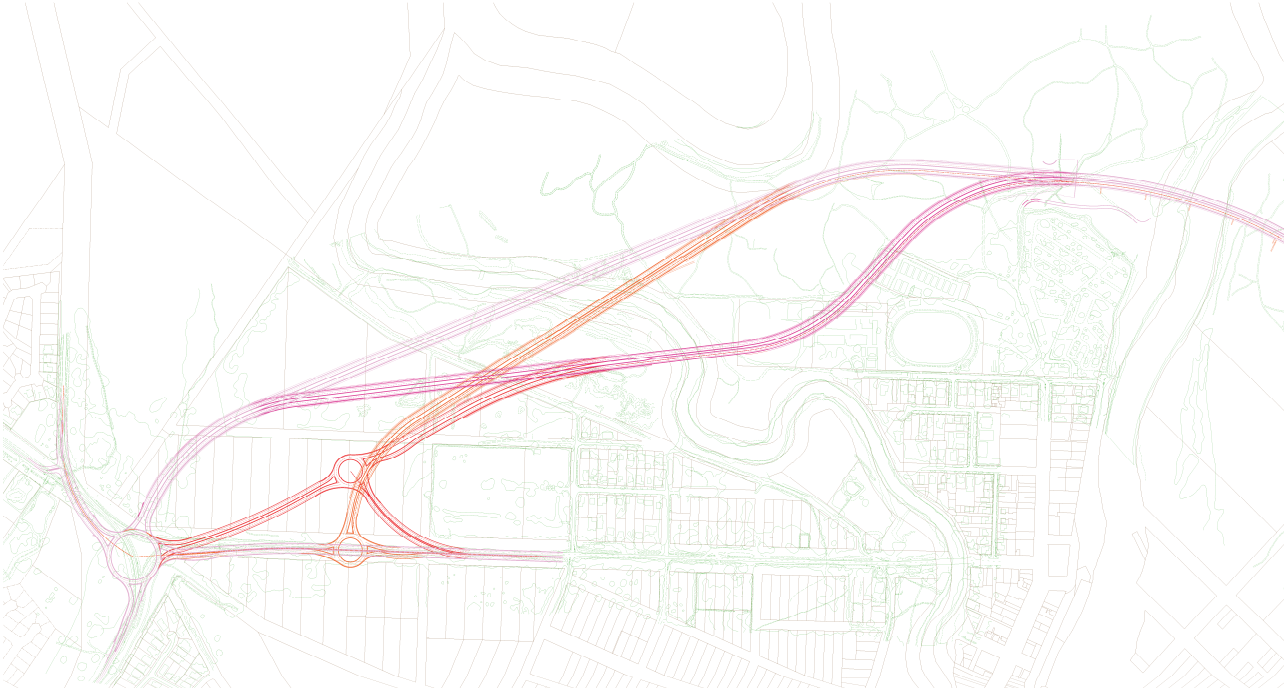

Figure 2 - Broad concept design alignment options for Mid West 2

2.3 Summary of Previous consultation

VicRoads has had preliminary discussions with DPCD and Campaspe Shire in relation to this study.

2.4 Other Information

- Brett Lane &Associates Pty Ltd *Report No 8194 (2.6) Second Murray River Crossing at Echuca-Moama detailed Flora and Fauna Study* Dated February 2011.
- Echuca-Moama Second Murray River bridge crossing - aquatic fauna assessment prepared by Streamline Research Pty. Ltd dated Oct 2010..
- The above information should be drawn upon to undertake this work as appropriate.

3. AGREEMENT OBJECTIVES

The objectives of this agreement, by which its performance will be assessed are:

- Relevant legislation and policies;
- Clear description of aquatic habitat;
- Fish survey of the Campaspe River;
- Visual survey within the project footprint of both the Campaspe and Murray Rivers;
- Potential impacts of the proposed activity on aquatic ecological values;
- Opportunities to avoid or mitigate these potential impacts through design or management;

4. ASSIGNMENT SCOPE

4.1. GENERAL

The Provider will be responsible for conducting the aquatic fauna assessment in accordance with this assignment scope and detailed task descriptions outlined in Section 5 of this Brief.

4.1.1. Compliance with Relevant Legislation

The Provider shall ensure that all aspects of the work conducted are in compliance with all Acts of parliament, legislation, regulations, and codes of practice, standards and government authority guidelines or consents which may be applicable to this Agreement.

4.1.2. Health and Safety

The Provider is responsible for the safety of all persons engaged in the fish survey and must undertake all things necessary to ensure their safety including (without limitation) complying with the requirements of any Act or Ordinance in Victoria relating to safety. This should be undertaken in part by the implementation of a site specific Health and Safety Plan to address the physical hazards including but not limited to live services (both underground and overhead), traffic, and contamination hazards associated with the flora and fauna and net gain assessment.

4.1.3. Meetings

The Provider shall attend all meetings, as instructed by the Superintendent.

Meeting	Location	Duration	Date
Study inception meeting	VicRoads Office Camberwell	1hr	To be determined
Draft report feedback meeting	VicRoads Office Camberwell	1hr	To be determined

NB. This clause is not intended to refer to or include any meetings the Provider may have with other stakeholders during the course of undertaking the assignment.

Where the Superintendent directs the Provider to attend additional meetings, payment for additional meetings shall be in accordance with the rates submitted in Schedule 2, Rates for Variation.

Panel Hearing

Preparation for and attendance at a Enquiry Panel for an EES, Planning Panel under the Planning and Environment Act, Advisory Committee under the Planning and Environment Act to include the following:

- The Provider team must include an experienced witness, with a suitable level of experience who could present findings at a Planning Panel VicRoads must agree to the person proposed to take on this role and that person must be actively involved in the study;
- Prepare a written submission (expert witness statement) and presentation on the access management aspects of the project. The expert witness statement will also take account of all matters arising from any earlier Directions Hearing(s);
- Submit the expert witness statement and presentation for review by VicRoads and its legal adviser and revise as agreed;
- Attend one day of the Panel Hearing as requested by VicRoads;
- Provide a written and oral submission to the Panel on the project's access management issues and impacts, the performance against access management objectives and on the submissions received during and after the exhibition period;
- Be prepared to respond objectively to cross-examination during the Panel Hearing and to provide succinct answers to any questions from the Panel/Committee members.
- Review the submissions on access management matters that are made during the Panel/Committee Hearing itself, and provide advice to VicRoads and its legal adviser on how a suitable response may be presented in VicRoads' closing statement.

NOTE: All written submissions and presentation material prepared by the Provider shall comply with the WoVG Accessibility Standard. Further details are provided in the Deliverables section of this brief.

If this item proves unnecessary, then the contract price will be adjusted by the amount shown in Schedule 1.

4.2. Information to be Provided by the Superintendant to the Provider

The Superintendent will provide copies of previous relevant reports and other relevant information they hold to the Provider at the commencement of the Agreement. Where requested by the Superintendent, these documents are to be returned to the Superintendent at the completion of the project.

The Superintendent will provide plans showing the proposed study area and alignment route(s).

VicRoads Sustainability and Climate Change Strategy 2010-2015 and Environmental Management Guidelines 2006, Biodiversity Guidelines (2005) and Guidelines for the Conduct of Biological Surveys – Flora and Fauna (2000) set the environmental policy framework within which VicRoads operates and consultants should be familiar with these documents set the environmental policy framework that VicRoads operates within and Providers should be familiar with these documents.

Copies are available on the VicRoads website – see www.vicroads.vic.gov.au/environment.

Environmental Management Policy (1997), Environmental Management System, set the environmental policy framework within which the NSW Roads and Maritime Services (RMS) operates and consultants should be familiar with these documents. Copies are available on the RMS's Website – see www.rms.nsw.gov.au.

4.3. Access to Properties

In Victoria

VicRoads may provide details of property owners, where available. VicRoads may also arrange access to private properties, or may inform the Provider where access is not available or of any known special requirements for access.

The Provider shall contact Neville Hallam of VicRoads Northern Region on (03) 5434 5038 prior to arranging access to private property. If the provider desires to enter any land beyond the road reserve boundary contact shall be made with VicRoads first.

Entry on public land or private property for the purpose of carrying out site inspections is only permitted after the Provider has contacted and received permission from the appropriate authorities or land owners. The provider must provide reasonable advance notice to the authority or land owner before entering public land or private property.

A letter of introduction will be provided by VicRoads to the Provider to be presented to property owners during the field surveys.

In New South Wales

If access is required in NSW the Roads and Maritime Services will issue a certification to enter (as required by the Roads Act). The Roads and Maritime Services will then contact any owners and acquaint them with the nature and extent of activities if requested and advise the contractor of approval for access.

The Superintendent will arrange, as far as possible, access to private property, or will inform the Provider where access is not available or of any known special requirements for access.

Entry on council land or private land for the purpose of carrying out site inspections is only permitted after the Provider has contacted and received permission from the appropriate authorities or landowners. The Provider must inform the authority, or landowner, as to the time and date of when the survey will be carried out.

4.4. Permits

The Provider is responsible for obtaining all necessary permits for undertaking the investigations required under this Agreement and for ensuring that all work is carried out in accordance with any such permits.

5. TASK DESCRIPTION

The investigation comprises of three main stages of assessment. Details of the stages are outlined below:

5.1. Stage 1 – Data and Literature Review

This stage of the assessment involves a detailed literature and database review (desktop study) of the specified study area to locate information about aquatic flora and fauna that may be in the vicinity, previous studies, geological details, relevant legislation and policy in Victoria and NSW.

Searches of relevant databases for Victoria and NSW should be made for the study area. Other databases may be relevant to specific surveys and the Provider should search these where appropriate.

Common Victorian and NSW study areas previously investigated in 2009 will now require further database review to allow for any updates which may have occurred over the 2 year period since the earlier review.

The Provider should advise whether further surveys of the Murray River are required.

5.2. Stage 2 – Field Survey

Obtain all permits for undertaking fish surveys prior to commencing surveys. Copies of the relevant permits should be provided to VicRoads' project manager prior to commencement of surveys. DSE should be notified, as per standard permit requirements, prior to any field surveys being undertaken.

Liaise with Department of Sustainability and Environment (DSE) in Victoria, Office of Heritage and Environment (OHE) (former Department of Environment and Climate Change (DECC)) in NSW, Local Government and Catchment Management Authorities regarding the aquatic flora and fauna values of the study area and the proposed development.

Conduct a fish survey of the Campaspe River within approximately 300m of the proposed bridge crossing. Describe the area surveyed, dates, time and season of surveys and list the names and qualifications of participants involved in the surveys and the identification of any threatened species and communities.

Conduct a visual survey within the project footprint of both the Campaspe and Murray Rivers to identify fish habitat.

Identify and describe the aquatic flora and fauna species, habitat, populations and ecological communities in the study area occurring or considered likely to occur within the study area listed under the provisions of the:

- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), National Parks and Wildlife Act 1974 (NPW Act);
- Victorian Flora and Fauna Guarantee Act 1988, Catchment and Land Protection Act 1994 and Fisheries Act 1995;
- NSW Threatened Species Conservation Act 1995 (TSC Act) and Fisheries Management Act 1994 (FM Act).

Comment on habitat quality as it relates to aquatic flora including salinity, eutrophication, turbidity, hydrological regime and level of weed invasion.

Comment on habitat quality as it relates to aquatic fauna, including water temperature, flow regimes, presence of in stream barriers and level of weed invasion.

Assess the aquatic habitat within the study area, with particular reference to altered flood flow characteristics, and any barriers to fish movement, impacts on riparian vegetation, water quality and impacts on aquatic fauna and flora.

Determine the nature, extent, frequency, duration and timing of potential impacts from flooding associated with the proposed works that may have direct and indirect effects on aquatic flora and fauna species, populations, critical habitats, ecological communities and their habitats.

An assessment of impacts during construction and operation of the proposed activity.

Determine the potential for the proposed works to introduce a short/long term barrier to the movement of fish species on a local and regional scale.

Assess the potential impacts of the proposed works (eg. waterway crossings) during the construction and operational phases on aquatic fauna, fish movements and habitat, taking into account possible changes to hydrology, water velocities and affluxes introduced by the new road and cumulative impacts of existing and new river crossings.

Assess the significance of the proposed works on species, ecological communities and populations listed under the Victorian FFG Act, NSW TSC Act and the EPBC Act.

Undertake a 7 part test of significance (in accordance with the NSW EP&A Act, DECCW Threatened Species Assessment Guidelines August 2007) for each aquatic fauna species, ecological community and population listed on the TSC Act or the Fisheries Management Act 1994 (FM Act) likely to be affected by the proposed activity. Species can only be assessed as a group based on taxonomic similarity or habitat specialisation.

Undertake a test of significance (in accordance with the Department of the Environment and Water Resources Significant Impact Guidelines May 2006) for each species, community or habitat listed on the EPBC Act that is likely to be affected by the proposed activity.

Identify any opportunities to avoid or mitigate the potential impacts through design or management. Recommendations should specifically refer to impacts to aquatic ecology.

Provide an assessment of the likely resultant level of impacts if mitigation measures are adopted.

Provisional Item

Conduct a fish survey of the Murray River within approximately 300m of the proposed bridge crossing. Describe the area surveyed, dates times and season of surveys and list the names and qualifications of participants involved in the surveys. The methodology proposed for the Murray River Fish Survey will need to be reviewed by the Superintendent prior to any fish survey being undertaken for the Murray River.

5.3 Assessment of Options

VicRoads is using an Objective Based Evaluation Matrix (OBEM) to help assess the performance of each of the route options. VicRoads will collate the assessments of all specialist consultants into an evaluation matrix, which will be used to facilitate discussion with the community and in formal statutory processes to seek environmental and planning approvals.

The relevant project objectives to this assignment include:

- to minimise impacts on biodiversity and provide appropriate mitigation measures to the extent practicable.

At the start of the Assignment the Provider shall propose "Sub-objectives" for each "Project Objective". These "Sub-objectives" will generally be derived from legislation, national, State and local policy and planning schemes.

The Provider shall also propose the "Assessment Criteria" to be used for each "Sub-objective" and nominate the verifiable data which would be used to support the assessments. For example, a flora and fauna consultant might nominate "hectares of habitat to be removed" to support an assessment of a sub-objective dealing with impacts on certain endangered species.

Hold Point: VicRoads will reach agreement with the Provider on the relevant "Project Objective(s)", the "Sub-objectives" and their related "Assessment Criteria" to be used for this Assignment.

The Provider shall then provide an assessment of the extent to which the existing route and each proposed route option meets each nominated project objective. The Provider shall use the sub-objectives, assessment criteria and also provide verifiable data to support this assessment. The assessment shall be in the form of an answer to the question "How well does the proposal meet each nominated project objective?" To ensure consistency, the following scale should be used:

Rating	Defined Values	Colour
Very Well	Best practice, strong level of compliance, major positive impact	Green
Well	Improved practice, good policy compliance, positive impact	Light Green
Moderately Well	Partial policy compliance, no distinct positive or negative impact	Yellow
Poor	Policy non-compliance and negative impact	Orange
Very Poor	Major policy non-compliance and major negative impact	Red

Consideration of proposed mitigations

Where the Provider has recommended measures to mitigate the impacts of each proposed route option, the Provider shall provide two assessments:

- with the proposed mitigation
- without the proposed mitigation

5.4. Stage 3 – Report Completion

The final stage includes completion of the report which will detail the results of the desktop study and site visit, the presence and likely occurrence of aquatic fauna species and relevant mitigation measures to either eliminate, reduce and/or remediate impact on these species from the proposed project.

In addition the report shall include a copy of this Provider Task Brief as an Appendix.

Detailed assessment requirements are outlined in Clause 4 of this task brief, while reporting requirements are specified in Clause 5.

6. DELIVERABLES.

6.1. Accessibility

VicRoads has adopted the Whole of Victorian Government (WoVG) Accessibility Standard which is based on the Web Content Accessibility Guidelines (WCAG) 2.0. This Standard aims to ensure that information on VicRoads' website will be available to all people without discrimination on the basis of disability and to make finding, using and interacting with the website easier. The Standard is available from the Policies and Standards section of the Victorian Government Department

of Treasury and Finance Chief Information Officer's website. The Accessibility Standard is under the "Website Management Framework" tab at the following website address: https://www.dtf.vic.gov.au/CA257310001D7FC4/pages/policies-and-standards-website-management-framework.

As the report produced for this Assignment could be made available for viewing via VicRoads' website, it needs to be prepared to comply with the WoVG Accessibility Standard which involves meeting all Level AA Success Criteria of WCAG 2.0. Further advice on how to meet the WoVG Accessibility Standard can be provided by the Superintendent, if required.

6.2. Timing of Report

Step	Timing	Details
1. Provider to submit draft report	six weeks after award of the agreement	A draft report will be required for the Superintendent's review six weeks after award of the Agreement. An electronic copy of the complete draft report is to be provided to the Superintendent in Microsoft Word (doc) format, along with electronic copies of all maps, drawings and photos in the format agreed with the Superintendent. If the draft report is incomplete or inappropriately structured, the Superintendent may request the draft report to be revised before reviewing it.
2. Superintendent to review draft report	2 weeks after receipt of the complete draft report	The Provider may be asked to consider making changes based on the reviewer's comments before the report is finalised. Where the Provider has concerns about any of the review comments, these are to be discussed with the VicRoads Superintendent's Representative prior to finalisation of the report.
3. Provider to submit final report	1 week after receipt of VicRoads comments on the draft report	An electronic copy of the final report should be provided to the Superintendent in a secured and unsecured Adobe Portable Document File (PDF) format as well as in Word format. A digital copy of all figures should also be provided in a format agreed with the Superintendent.
4. Superintendent acceptance of final report		The final report will only be accepted after all changes requested by the Superintendent in Step 2, and agreed by the Provider have been completed.

The work conducted shall be reported in a concise report providing the following:

- Executive Summary
- Introduction/Background
- Legislation and Policy Framework & applicable legislation
- Methodology
- Results and Data interpretation
- Conclusion
- Recommendations
- A copy of this Assignment brief as an Appendix
- Other Appendices as required

It is also expected that the report will contain:

- The version number (for both hard copy and electronic files)
- Numbering of all pages, and
- Text that is readable and not less than 10 point Verdana or equivalent

6.3. Format of Report

All reports shall conform to the following requirements:

- Margins:
  - Binding margin: 25mm
  - Open margin: 10mm (NB. In practical terms, provide the 25mm margin on both sides of each page so that VicRoads can produce double-sided documents.)
  - Top margin: 10mm

    - Bottom margin: 10mm
- Fonts:
    - Fonts to be generally no smaller than 12 point.
- Layout:
    - Start each section on the right hand page.
    - Start Chapter 1 on the right hand page. Start all other chapters as they occur.
    - First page of Chapter 1 is Page 1.
    - All preceding pages to be in Roman numerals.
    - Odd numbered pages to be right hand pages.
- Content:
    - Colour figures (including plans) should be capable of being reproduced in black and white.
    - Supply clean artwork (not photography).
    - Supply unfolded plans if greater than A4 size.
    - Supply loose photographic prints.
    - Where continuous alignment drawings are broken down to A3 size drawings, all annotation and text shown on the continuous alignment drawings must be self-contained within each A3 drawing.

6.3 Maps and Drawings

The report should include maps and drawings showing the study area and alignment options. The source of all maps and drawings used in the report needs to be quoted, unless they have been prepared using data collected specifically for this Assignment. Maps need to be prepared to an appropriate scale so that information is clearly legible. Font sizes should be large enough to be able to read legends and text e.g. road names, when produced in A4.

The Provider shall ensure that roads, features etc. referred to in the report are shown clearly on the relevant maps and drawings.

The Provider shall ensure that maps and drawings comply with the DPCD Communicating Data with Colour Guidelines.

6.4 Format of Electronic Versions of Maps, Drawings and Photos

Maps are to be produced using GIS software. GIS data should be provided in ESRI Shapefile format. GPS locations should be provided on GDA94 Lat/Long datum to at least and accuracy of 1m, or another similar standard agreed with the Superintendent prior to the assignment being awarded.

Drawings should be provided in a CADD file Microstation Version 8 or dxf, (coordinates in MGA, zone 54) or another similar standard agreed with the Superintendent prior to the agreement being awarded.

Photos are to be in jpeg format and taken with at least a 5 megapixel camera or another similar standard agreed with the Superintendent prior the agreement being awarded.

7. TENDER SUBMITTALS

The Provider shall submit as part of its Tender a proposed methodology reflecting the Assignment Scope set out above. The proposed methodology should also include a timeline program for completion of the works. The Provider shall highlight any key changes or value-add components in its methodology.

7.1. Key Project Personnel

Within Schedule 28, the Provider is to nominate key project personnel in their Tender submission. The key roles to be nominated include:

- Project Manager – The role of the Project Manager is to ensure that the project is completed in a timely and efficient manner. The Project Manager is expected to be the day to day contact between the Superintendent and the Provider.
- Field Manager – The role of the Field Manager is to ensure all field works are undertaken in an appropriate manner and comply with relevant guidelines and legislation. This role may also be completed by the Project Manager.
- Project Director – The role of the Project Director is to ensure that objectives of the project are being achieved in a timely and effective manner.

If the Provider intends to change any nominated key project personnel during the course of the contract, the Provider shall only do so with the agreement of the Superintendent.

7.2. Key Project Experience

The Provider shall nominate the experience of the key project personnel to demonstrate the organisation's ability to deliver the objectives set out in this Brief.

7.3. Project Pricing

Within Schedule 1, the Provider shall submit a lump sum price covering the following:

- Meetings with VicRoads
- Desktop study
- Field Survey
- GIS Mapping
- Preparation of draft report
- Preparation of final report
- Provisional sum for preparation, participation and presentation at Community Consultative Group meeting in Echuca
- Provisional sum to undertake a comparison of options
- Provisional sum for preparation and presentation of a submission to a Planning Panel Hearing in the vicinity of the study area (includes one preparation meeting with VicRoads, attendance at the hearing for one day, travel, accommodation, meals etc).

Where limited fieldwork is recommended by the Provider the Tender must detail and cost these as independent items as part of the lump sum. The Provider shall provide hourly rates and proposed time involvement for the nominated Key Project Personnel set out in Section 4.1 of the Tender.

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