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Murrumbidgee to Googong Water Transfer - Aquatic Ecology Management Plan

BWA-M2G-EN-ECP-003-2

February 2012

Delivered by the Bulk Water Alliance

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Prepared by	BWA Environmental Manager	John Turville		
Reviewed by	M2G Owner's Project Manager	Simon Webber		
Approved by	M2G Project Manager	Jason Julius		

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electronic	Bulk Water Alliance – Owner's Project Manager		Simon Webber
electronic	Bulk Water Alliance – Project Manager		Jason Julius
electronic	M2G Construction Manager		Matthew Richardson
electronic	Bulk Water Alliance – Environmental Manager		John Turville
electronic	Bulk Water Alliance – Community Engagement and Stakeholder Manager		Rachel Clarke
electronic	DECCW (NSW EPA)		Sandie Jones
electronic	NSW Fisheries (DII)		Trevor Daly
electronic	NSW Office of Water (NOW)		Tim Smith
electronic	ACT Parks, Conservation and Lands (TAMS)		Brett McNamara
electronic	DECCEW (ACT Environment Protection Authority)		Rodney Dix
electronic	ACT Planning and Land Authority (ACTPLA)		Michaela Watts

Abbreviations

Abbreviation	
ACTEW	ACTEW Corporation Limited
ACTPLA	ACT Planning and Land Authority
AEMP	Aquatic Ecology Management Plan
AQMP	Air Quality Management Plan
BWA	Bulk Water Alliance
CEMP	Construction Environment Management Plan
CESM	Community Engagement and Stakeholder Management
CMS	Construction Method Statement
CPR	Conservation, Planning and Research (PCL, TAMS)
DECCW	NSW Department of Environment, Climate Change and Water
DECCEW	ACT Department of Environment, Climate Change, Energy and Water

Abbreviation	
ECP	Environmental Control Plan
EMS	Environmental Management System
EPA	Environment Protection Authority
EPBC ACT 1999	*Environmental Protection and Biodiversity Conservation ACT 1999*
ESCP	Erosion and Sediment Control Plan
HLPS	High Lift Pump Station
IRMP	Incident Response Management Plan
LALC	Local Aboriginal Land Council
LLPS	Low Lift Pump Station
M2G	Murrumbidgee to Googong
NVMP	Noise and Vibration Management Plan
OEMP	Operation Environment Management Plan
PCL	Parks, Conservation and Lands
PER	Public Environment Report
POEO	NSW *Protection of the Environment Operations ACT 1997*
RAO's	Representative Aboriginal Organisations
SAD	Sensitive Area Diagram
SEP	Site Environmental Plan
SWMP	Soil and Water Management Plan
TAMS	Territory and Municipal Services
TEMP	Terrestrial Ecology Management Plan
WMP	Waste Management Plan

Environmental Commitments

Table 1.1 EIS Commitments

Reference Document	Commitment	Reference within AEMP
EIS Condition 11	Maintenance of flow transfers where possible during the fish breeding season to protect any spawning populations of threatened fish species. If flows need be altered, then the 48 hour step up/down operating regime will be utilised to allow fish to exit the creek.	See OEMP (Flow Management Sub Plan)
EIS Condition 12	Prior to construction, inspection of river and creek banks within the construction footprint for platypus burrow entrances. Excavation will be undertaken in small scoops with an un-toothed bucket in case a lactating female and/or dependent young are present. Procedures for the management of any platypus detected during construction will be included in the aquatic ecology management sub-plan.	Section 5.4
EIS Condition 13	Regular review of the results of the aquatic monitoring program and the development of management actions that may be required to address any observed impacts	See OEMP and Sub Plans
EIS Condition 14	Design measures into the project, to prevent the spread of invasive fish species including: • A proposed mesh size on the intake screen of 0.5 mm to prevent transfer of fish and eggs; • Provide continuous filtering and monitoring of transfer flows at the outlet into Burra Creek; • Use filters year round, rather than only during the spawning season; and • Investigate the known current presence of carp in the near vicinity of Googong Reservoir, within the Googong catchment.	Section 5.6 See also OEMP (Flow Management Sub Plan
EIS Condition 15	An aquatic ecology management sub-plan will be prepared as part of the CEMP, outlining the procedures to manage and minimise the potential for impact to aquatic environments.	This Plan and OEMP (Ecological Monitoring Sub Plan)
EIS Condition 16	Regular review of aquatic ecology monitoring results for any trends toward significant impacts in Murrumbidgee River, Burra Creek or Googong Reservoir. The monitoring and adaptive management plan will include actions required to address any identified trends in a timely manner.	See OEMP (Ecological Monitoring sub Plan)

Table 1.2 Conditions of Approval (NSW)

Reference Document	Commitments	Reference within AEMP
Ecological Impacts - Aquatic		
Condition 2.11	The Proponent shall implement the aquatic ecology management measures committed to in the documents set out in condition 1.1c) or elsewhere in these conditions of approval, including: a) monitoring and subsequent maintenance of flow transfer volumes to reasonably and feasibly mimic the natural flow regime based on stochastic data defined in the Preferred Project Report of Burra Creek during the native fish breeding season in order to protect any spawning populations of threatened fish species; b) design measures to prevent the spread of invasive fish species; c) design measures for the protection of natural ponding habitat. If the current natural ponds along Burra Creek are lost as a result of increased flows, the Proponent is required to re-establish natural ponding habitat; and d) regular review of aquatic ecology monitoring results for any trends toward significant impacts in Burra Creek or Googong Reservoir.	Section 5, Appendix A See also OEMP and Sub-plans
Condition 2.12	Prior to commencement of construction, the Proponent shall consult with the Department of Industry and Investment regarding the final design of the fish eggs screens and proposed operating procedures of the pump stations. The pumping station shall be designed and operated in such a way that pumping cannot occur when adequate fish egg screens are not in place.	Section 5.6
Environmental Monitoring And Auditing		
Ecological Monitoring - Condition 3.3	Prior to the commencement of construction the Proponent shall prepare and implement an **Ecological Monitoring Program** to monitor the impact of the project on the ecology that may be impacted by the proposal. The program shall be developed in consultation with the DECCW and Department of Industry and Investment NSW and shall include but not necessarily be limited to: a) set out monitoring requirements as detailed in the documents referred to in Condition 1.1 c), in order to assess the impact of the project on Ecology present along the easement and at Burra Creek at the pipeline outlet location and downstream including the Googong Reservoir; b) baseline monitoring prior to the introduction of flows through Burra Creek in order to establish any ecological changes resulting from the project; c) provisions for monitoring trench areas for any native fauna impacts likely to result from this work. Any native fauna found in the open trench shall be recorded and managed in consultation with DECCW; d) provisions for monitoring during construction, operational and non-operational phases; e) mechanisms for immediately investigating any anomalous monitoring results; f) mechanisms for the management and mitigation of any impacts on the waterways including cessation of flows where necessary; and g) details of how the monitoring results will be reported to the Director-General and the DECCW and the Department of Industry and Investment. The Program shall be submitted for the approval of the Director-General no later than one month prior to the commencement of construction, or within such period otherwise agreed by the Director-General, accompanied by evidence that the DECCW has been	Section 5, Appendix A See also: OEMP, SWMP & TEMP

Reference Document	Commitments	Reference within AEMP
	consulted regarding the Program. Construction shall not commence until written approval has been received from the Director-General.	
Water Qualilty Monitoring **Condition 3.2**	Prior to the commencement of construction, the Proponent shall prepare and implement a **Surface Water Monitoring Program** to monitor and manage the impact of the project on the waterways into which any extracted Murrumbidgee River water is discharged. The Program shall be prepared in accordance with sections 8.2.3.3 and 8.2.3.4 of *Australian and New Zealand Guidelines for Fresh and Marine Water Quality – Volume 2: Aquatic Ecosystems* (ANZECC & ARMCANZ, 2000) The Program shall be developed in consultation with the DECCW and shall include but not necessarily be limited to: a) the monitoring framework detailed in the documents referred to in condition 1.1; b) a baseline monitoring program; c) an evaluation of the discharges in terms of temporal and spatial scales; d) a comparison of discharge data with baseline data; e) sampling and data collection at representative sites, both impact (downstream of the discharge point) and control (upstream of the discharge point) sites; f) sampling and data collection for the discharges and immediate receiving environment to quantify the changes in ecosystem health and water quality with specific reference to phytoplankton, aquatic vegetation, macroinvertebrates, fish, temperature, salinity, dissolved oxygen, iron and manganese; g) provisions for the review of the Program within six months of commencement of the first full operational flow into Burra Creek; h) identification of key water parameters including but not limited to flow rate, temperature, ph, salinity, total dissolved solids and nutrient parameters for the operation of the project; i) details of how the monitoring results will be reported to the Director-General and DECCW. management actions for the parameters identified in h) should they be breached; and The Program shall be submitted for the approval of the Director-General no later than one month prior to the commencement of construction, or within such period otherwise agreed by the Director-General, accompanied by evidence that the DECCW has been consulted regarding the Program. Construction shall not commence until written approval has been received from the Director-General.	Sections 5, 8 See also SWMP & OEMP (Ecological and Flow Management Sub Plans)

Table 1.3 DA Conditions (ACT)

Reference Document	Commitments	Reference within AEMP
B7	Prior to the commencement of works a Rehabilitation and Landscape Management Plan that details the rehabilitation management and activities necessary to assess and rehabilitate areas impacted by the construction of the Murrumbidgee to Googong pipeline works must be endorsed by the PCL TAMS and EPA. The plan must include as a minimum, the following sub-plans and mitigation measures: a) An Aquatic Ecology Management sub-plan that details the procedures to manage and minimise the potential impact on aquatic environments;	This plan
B10	Ejector Pipe System Associated with the Low Lift Pump Station Prior to the commencement of works on site, the applicant must submit to and obtain the endorsement of PCL TAMS and the EPA for further details of the ejector pipe system associated with the Low Lift Pump Station, including but not limited to: iv. mitigation measures to prevent the entrainment of fish moving upstream	Section 5.6

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1 Introduction

1.1 Background

The Murrumbidgee to Googong (M2G) Water Transfer is one of the recommended options for delivering improved security to the water supply for the ACT and region. It involves pumping water from the Murrumbidgee River (within the ACT) and transferring it via a pipeline to Burra Creek (in NSW), from where it would flow for approximately 13km to the Googong Reservoir.

The potential for significant impacts on the aquatic ecology (flora and fauna) within the Murrumbidgee River and Burra Creek as a consequence of delivering the project will arise due to construction related impacts such as sediment escape from construction areas into waterways and other potential impacts on in-stream habitat, loss or reduced quality of riparian vegetation, and changes in water quality parameters as well as the transport of eggs of invasive fish species. Project construction activities can also affect local permanent and ephemeral watercourses through increased sediment and erosion as well as loss of riparian vegetation and changes to natural bank and bed profiles and will also be addressed in the Soil and Water Management Plan (SWMP). These activities include earthworks, construction and blasting activities in or near watercourses.

The BWA is aware that the aquatic habitats of Burra Creek and the Murrumbidgee River support important habitats for various threatened species. As a result, the M2G project construction activities in or near watercourses must be conducted in a manner which minimises potential adverse impacts to threatened species and their habitats.

Effective management and mitigation strategies are critical to minimising the potential for significant impacts to aquatic flora and fauna, and in particular, listed threatened species. In order to effectively manage the above matters and other potential ecological issues associated with the pipeline construction, this Aquatic Ecology Management Plan (AEMP) has been prepared to:

- identify potential risks to aquatic flora and fauna values associated with construction activities;
- detail proposed mitigation measures and strategies to manage identified risks; and
- summarise compliance monitoring and auditing schedules.

The BWA will ensure that the controls are properly implemented and are regularly monitored and audited to assess their effectiveness. Changes to the stipulated controls will be instigated if they are not achieving their objectives.

The project comprises of the following key features:

Table 1.1 Project Composition

Infrastructure	Description
Intake/low lift pump station	The intake/low lift pump station will comprise a concrete box structure built into the riverbank. The low lift pump station will include a screen, grit collection and removal, pumps and valves and filtration to prevent fish transfer.
High lift pump station	The pump station will pump water to a high point at Gibraltar Range, from where it will run under gravity to the discharge point. The high lift pump station will consist of a building enclosing a pump hall and electrical services and an amenities area.
Pipeline	The pipeline will transfer the water from the low lift pump station to the high lift pump station, then onto the outlet structure. It will be constructed of 1016 mm diameter steel pipe. The pipeline will be approximately 12 km long, with the pipe located approximately 1.8 m to 4 m below ground level. Air valves and scour valves will be located at regular intervals along the pipeline to provide pressure relief and to allow cleaning.

Infrastructure	Description
Outlet structure	The outlet structure will take the form of a weir box arrangement located on the bank of Burra Creek. It will comprise a rectangular concrete box approximately 12 m along the creek bank with a 250 mm grated opening along the west bank of Burra Creek. Water will flow into the weir box from the pipeline and will discharge over the weir and run down the creek bank to the creek, which flows to Googong Reservoir. This method of discharge is designed to minimise scouring of the creek bed near the outlet.
Electric power supply	The electrical infrastructure will comprise a 132 kV/11 kV substation in Williamsdale and a single 11 kV cable to the high lift pump station.
Mini-hydro power generator	Electricity provided by the grid will be supplemented by electricity generated by a mini-hydro electric power facility which will be constructed as part of the project.

1.2 Purpose of the AEMP

The purpose of developing and implementing this AEMP is to ensure the effective management and mitigation of potential impacts to aquatic flora and fauna as a consequence of delivering the M2G project. Mitigation measures to manage impacts will be implemented through this AEMP.

This plan details the methods, techniques and timing in relation to relevant construction phases from pre-clearance fauna surveys (where applicable), and reinforces the requirements for the establishment of sediment and erosion controls for protection of water quality (as detailed in the SWMP) for mitigating impacts on aquatic flora and fauna as a consequence of the construction activities. It incorporates the recommendations contained within the EIS for ecological impact mitigation requirements within the construction boundary. This AEMP also details how construction will be monitored to ensure that the objectives of this plan and the construction phase commitments of the EIS have been achieved.

This plan is a component of the overarching M2G Construction Environmental Management Plan (CEMP) which outlines the mitigation measures implemented onsite to minimise the potential of adverse environmental impacts during construction.

Aquatic impact mitigation strategies associated with sediment run-off and fuel/chemical contamination have been addressed comprehensively within the M2G Soil and Water Management Plan (SWMP) and are not reproduced in this document. On this note, minor/ephemeral waterway crossings may have the potential for aquatic impacts, however the aquatic values within these waterways are limited and the main concern is the escape of sediment from these areas into the major permanent waterways of the Murrumbidgee River and Burra Creek. These issues will be covered in the SWMP and are dealt with only briefly in this AEMP.

A separate management plan will be prepared to deal with the potential environmental impacts related to the operational phase of the project, including ongoing monitoring and evaluation of potential aquatic ecology impacts.

This plan has also been designed to address client expectations and requirements, and adequately address risks and stakeholder concerns. The BWA is committed to providing the services it offers in a manner that conforms to the contractual requirements and to all relevant regulatory and legislative requirements. This plan does not cover potential risks outside the control of the BWA including risks associated with recreational activities such as fishing, four-wheel driving and the like as well as natural occurring risks.

The plan is designed as a practical guide for use during the construction phase of the project. This document is dynamic and if a non-conformance is detected in the plan, if project implementation methodology changes, or if mitigation measures improve, the AEMP will be revised so it remains effective in managing ecological impacts arising from the project.

1.3 Objectives of the AEMP

This Plan provides a framework for procedures and techniques to ensure that the Bulk Water Alliance will establish management, mitigation and protection measures to minimise the potential for (significant) impacts on aquatic flora and fauna. The objectives of the AEMP are to:

- increase site personnel awareness of endangered/threatened species within the Murrumbidgee River and Burra Creek waterways and their associated tributaries and to increase their understanding of potential adverse construction impacts on these sensitive areas (aquatic habitats);
- outline BWA legal requirements, commitments and obligations to the ongoing management of construction activities in the vicinity of aquatic habitats for threatened and endangered aquatic fauna;
- identify potential risks to aquatic flora and fauna species (especially endangered and threatened species) as a result of construction activities;
- outline effective management and mitigation measures to minimise the identified risks to aquatic flora and fauna species;
- summarise monitoring and surveillance requirements;
- communicate the emergency response procedures in the event of an accident with the potential for impact on aquatic ecology values (e.g. chemical/fuel spill etc); and,
- to outline the roles and responsibilities of those involved in the design and implementation of aquatic ecology management actions.

1.4 Performance goals

The performance goals of this AEMP are:

- to mitigate against impacts on the ecology of the surrounding environment, particularly direct impacts on aquatic threatened species and their habitats through the application of best management practices and innovation;
- for all members of aquatic threatened species to be protected through management actions including identification of the presence of habitat areas, relocation of individuals where necessary, pre-construction fauna clearance, prevention of entering construction areas (fencing) where appropriate;
- to ensure work areas will be kept to the minimum area necessary for safe working operations to minimise exposed surfaces that might lead to increased erosion and sedimentation entering waterways and affecting water quality;
- to provide rehabilitation of disturbed riparian areas as required; and
- to comply with ACT, NSW and Commonwealth legislative requirements for conservation and reinstatement of native vegetation communities.

2 Legislative & Regulatory Compliance

2.1 Relevant Legislation

The BWA will comply with all legislation, NSW DoP Conditions of Approval, Development Application conditions, permits, guidelines and standards relevant to the project activities.

Table 2.1 Legislation

Legislative Jurisdiction	Relevant Act
Commonwealth	*Environmental Protection and Biodiversity Conservation Act 1999*
Territory (ACT)	*Nature Conservation Act 1980* *Environment Protection Act 1997* *Fisheries Act 2000* *Pest Plants and Animals Act 2005* *Water Resources Act 2007*
New South Wales	*Environmental Planning and Assessment Act 1979* and *Amendment 2008* *Protection of the Environment Operations Act (POEO Act) 1997.* *Fisheries Act 1935* *Fisheries Management Act (1994)* and *Amendment 2009* *Water Management Act (2000)* *Noxious Weeds Act 1993* *Catchment Management Authorities Act 2003* *Native Vegetation Act 2003*

2.2 Guidelines and Standards

The key reference materials relevant to management of aquatic flora and fauna during design and construction of the M2G project include:

- ACT Aquatic Species and Riparian Zone Conservation Strategy (Action Plan 29);
- ACT Government, 1999. Murray River Crayfish (*Eustacus armatus*): A vulnerable species. Action Plan No. 14. Environment ACT, Canberra;
- NSW Department of Primary Industries Fish Habitat Classification Scheme 1999;
- ACT Code of Forest Practice, August 2005, Version 1;
- ACT Government, Murrumbidgee River Corridor Management Plan 1999;
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000);
- *Environment Protection Guidelines for the Preparation of an Environment Management Plan*, Environment Protection Authority, ACT, August, 2007;
- *Environment Protection Guidelines for Construction and Land Development in the ACT*, Environment Protection Authority, ACT, August, 2007;
- Fishnote – Policy and Guidelines for Fish Friendly Waterway Crossings - November 2003;
- NSW DII *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation*, 1999;
- Managing Urban Stormwater: *Soils and Construction.* (2004) Volume 1 (4th ed.) Landcom: Sydney.
- Managing Urban Stormwater: *Soils and Construction, Volume 2C, Unsealed Road Construction* (DECC, 2008);

- NSW EPA - Bunding and Spill Management, November 1997;
- NSW Fisheries, 1999. Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures;
- Preparation of Environmental Management Plan Guidelines (DIPNR 2004); and
- Why do fish need to cross the road? Fish Passage Requirements for Waterway Crossings – NSW Fisheries - January 2003.

2.3 Conditions of Approval

The CoA's for the Project are detailed in **Tables 1.1- 1.3** of this document. Where a specific condition of approval or commitment has been documented, this has been listed with a reference to where this document or other EMP documents addresses this specific condition.

2.4 Licences & Permits

Tables 2.2 and **2.3** identify the approvals, permits and licences relevant to terrestrial flora and fauna that are required for the project.

Table 2.2 Approval Requirements for NSW

Approval Required	Relevant Legislation	Authority
Environment Protection Licence	*Protection of Environment Operations Act. 1997*	Department of Environment, Climate Change & Water (DECCW)

Should a licence be required for NSW, it would need to be issued by the NSW Department of Industry and Investment (Fisheries) under Section 37 of the NSW *Fisheries Management Act 1994*.

Table 2.3 Approval Requirements for the ACT

Approval required	Relevant Legislation	Authority
Licence to Take (Native Plants)	*Nature Conservation Act 1980*	DECCEW (Environment Protection Authority)
Licence to Take (Native Animals)	*Nature Conservation Act 1980*	DECCEW (Environment Protection Authority)
Waterway Works Licence	*Water Resources Act 2007*	DECCEW (Water Resources Unit)

3 Structure and Responsibilities

3.1 Site Structure

The project structure and responsibilities of site personnel are detailed in the M2G Organisation Chart Figure 3.1 below.

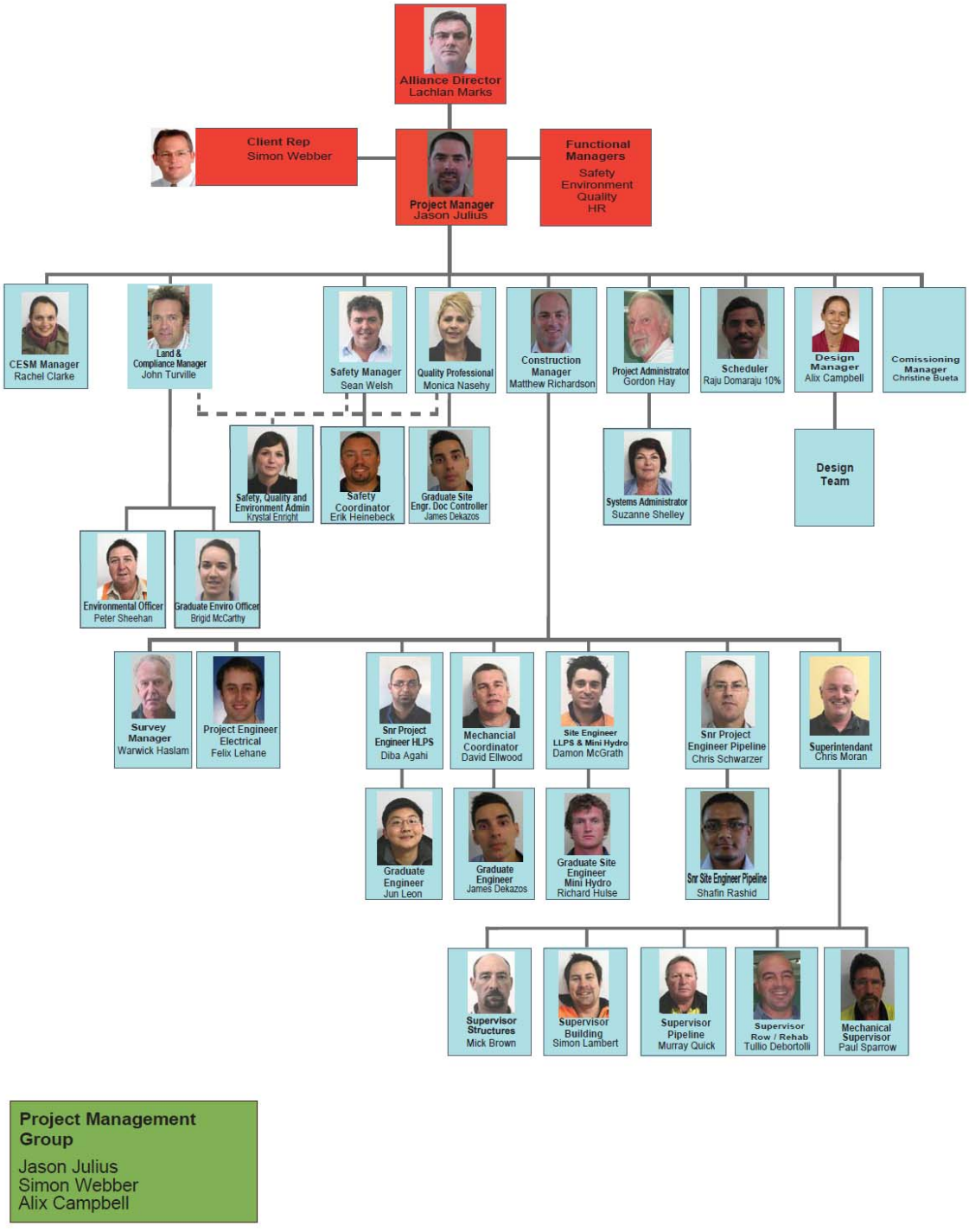

Figure 3.1
Murrumbidgee to Googong Management Hierarchy

3.2 M2G Project Manager

The M2G Project Manager has the role of ensuring that the project is delivered on time, within budget and is consistent with the aims and objectives of the Bulk Water Alliance. This role is accountable for all aspects of the project including safety, environment and heritage, quality, budget and deliverables.

3.3 M2G Construction Manager

The M2G Construction Manager is responsible for delivery of the construction phase of the Project to ensure that impacts are minimised and obligations are met. The M2G Construction Manager will be working with the M2G Land and Compliance Manager to ensure that the Bulk Water Alliance's prescribed environmental outcomes are achieved.

3.4 M2G Environmental Manager and Environmental Officer

The M2G Land and Compliance Manager has primary on-site responsibility for managing all aspects of environmental management and compliance for the construction and rehabilitation phase of the project.

The key responsibilities of the M2G Land and Compliance Manager and Environmental Officer will be to:

- liaise with government agencies and relevant stakeholders regarding the implementation of this AEMP;
- provide a regular construction program identifying critical construction activities;
- monitor the construction activities in consultation with the relevant Consultant Ecologist (see below) to ensure that the AEMP is being appropriately implemented and that the objectives of the plan are being achieved;
- monitor the (riparian) revegetation activities within the project site;
- relocation/translocation of threatened species/significant species;
- organise nursery contractors to germinate and grow native (riparian) plants for planting within the M2G project; and
- coordinate direct seeding and planting contractors to implement the Landscape Rehabilitation Management Plan.

3.5 Specialist Resources

Consultant Aquatic Ecologist

A qualified aquatic ecologist will be engaged by the BWA to assist the project with the development, implementation and review of all mitigation measures implemented during the construction phase. The qualifications and experience of the aquatic ecologist will be provided, on request, to the NSW DII (Fisheries), ACT EPA as well as the Conservation, Planning and Research (CPR) group of PCL. The project ecologist may be responsible for the following:

- provide specialised input and advice during the planning and construction phases with regards to managing aquatic biodiversity values on site;
- monitoring construction activities, particularly during the construction of waterway crossings and some works within waterways (e.g. blasting and coffer dam installation) as well as clearing and grubbing phases of the project, to ensure compliance with approval conditions;
- educating and advising construction staff on biodiversity related issues such as protection of biodiversity values and aquatic fauna relocation;

- contribute to the overall management of potential and actual biodiversity impacts during the construction phase of the M2G project; and
- support the M2G Environmental Management Team in ongoing monitoring and improvement of controls relating to the management of aquatic biodiversity on site.

As part of the Ecological Monitoring Plan prepared as a sub-plan to the Operational EMP (OEMP), a qualified aquatic ecologist will be engaged to fulfil the requirements of this plan after construction is deemed complete.

3.6 M2G Community Engagement & Stakeholder Manager

The M2G Community Engagement & Stakeholder Manager has primary on-site responsibility for managing all aspects of community and stakeholder communication. Such activities include:

- consulting with landholders, the community and other stakeholders and provide them with feedback;
- reporting on community and stakeholder feedback to M2G managers;
- managing community complaints and coordinate a response.
- documenting community and stakeholder consultation and feedback.
- developing and implementing the Construction Community and Engagement Stakeholder Management Plan (CESM Plan) and its procedures.

4 Environmental Aspects and Impacts

The following section describes the physical characteristics of the site and discusses the potential impacts on those aspects of the (local) environment.

4.1 Environmental Aspects and Impacts

Environmental aspects as referred to in this document are those activities associated with the project that have the potential to cause, or result in, adverse environmental impacts, particularly in terms of those on aquatic ecology values. Due to the complexity of the project, it is conceivable that various aspects of the project would carry a varying degree of environmental risk which needs to be managed accordingly.

Effective environmental management should be proactive rather than reactive. In order to facilitate a proactive style of environmental management, a risk management style of assessment has been utilised to identify and assess environmental aspects associated with the project, and to implement appropriate mitigation strategies to minimise the likelihood of environmental risks associated with each aspect. This process involves:

1. Identifying the risk/aspect
2. Analysing the risk/aspect (determining likelihood and consequence)
3. Evaluating the risk/aspect
4. Treating the risk

All identified aspects are assessed based on the risk assessment matrix (Table 4.1). Risk assessment is based on (1) the likelihood of an impact occurring as a result of the aspect; and (2) the consequences of the impact if the event occurred. Following this assessment, each impact is assigned a risk category which ranges from “low” (low likelihood and consequence) to “extreme” (high likelihood and consequence). Table 4.2 describes each level of risk.

A risk category identified as having an extreme or high risk (a significant impact) may be downgraded if appropriate environmental controls and measures are implemented and maintained. Proactive planning, installation and maintenance of appropriate environmental controls and ongoing monitoring will reduce the risks associated with each environmental impact identified for the project. Table 4.3 details the environmental aspects identified for the project, the initial risk category prior to appropriate management strategies, the proposed management strategy and a revised risk category.

Table 4.1 Risk Scoring Matrix

		Consequences				
	Likelihood	1	2	3	4	5
		Negligible Impact	Minor Impact	Moderate Impact/ breach of environmental Statutes	Major Impact/ breach of environmental statutes	Shutdown of project due to Environmental breach
A	Almost Certain	H	H	E	E	E
B	Likely	M	H	H	E	E
C	Moderate	L	M	H	E	E
D	Unlikely	L	L	M	H	E
E	Rare	L	L	M	H	H

Table 4.2 Risk Definition and Classification – Qualitative Measures and Likelihood Scale

Level	Categorisation Of likelihood	Description
A	Almost certain	Is expected to occur during the project, 90% or > probability
B	Likely	Will probably occur during the project, ~50% probability
C	Moderate	Might occur at sometime during the project, ~10% probability
D	Unlikely	Could occur at some time during the project, ~1% probability
E	Rare	Only occur in exceptional circumstances, < 1% probability

4.2 Assessment of Impacts on Aquatic Flora and Fauna

The key aspects of the M2G project construction program that could result in adverse impacts on aquatic flora and fauna include:

- installation of coffer dams;
- disturbance to the Murrumbidgee River bed and/ or bank and Burra Creek bed or banks;
- blasting in the Murrumbidgee River;
- construction of ancillary structures and access tracks; and
- construction of waterway crossings (riparian vegetation and removal of possible fauna movement corridors).

Impacts arising from construction may include:

- loss of habitat value and biodiversity;

- reduced aquatic fauna numbers and diversity;
- damage to riparian areas and wildlife corridors;
- direct mortality and injury to fauna; and
- aquatic weed infestation.

Table 4.3 Identified ecological impacts associated with the M2G pipeline project

Activity	Aspect	Potential Impact	Risk Category[1]	Mitigation Measures (refer to Table 5.1)	Revised Risk Category
Vegetation Clearing & Topsoil Stripping	Over clearing of vegetation.	Exposure of unconsolidated material/earth which may escape to waterways resulting in increased turbidity and smothering of creek/river bed substrate.	M	3, 4, 9, 11, 14, 15	L
	The inappropriate stockpiling of material (overburden, topsoil etc).	Sediment escape to waterways resulting in increased turbidity and smothering of creek/river bed substrate.	H	9, 10, 11, 13	M
Bulk Earthworks	Exposure of large areas of material susceptible to erosion.	Exposure of unconsolidated material/earth which may escape to waterways resulting in increased turbidity and smothering of creek/river bed substrate leading to impacts on aquatic biodiversity	H	3, 4, 9, 10, 11, 13, 14, 15	M

[1] *For Risk Categories, refer to Table 4.1 Risk Scoring Matrix*

Activity	Aspect	Potential Impact	Risk Category[1]	Mitigation Measures (refer to Table 5.1)	Revised Risk Category
Construction Phase – General	Construction activities (site preparation/bulk earthworks/site offices/ /pipeline excavation etc).	• Degradation of riparian vegetation – loss of habitat value for threatened species e.g. Latham's Snipe (Burra Creek) • Construction equipment infected with weed seeds or eggs of exotic aquatic species • Impacts on bank stability which may lead to impacts on water quality through increased sediment entering waterways, loss of or reduced habitat values including impacts to burrows (for wombats and possibly platypus) • Exposure of unconsolidated material/earth which may escape to waterways resulting in increased turbidity and smothering of creek/river bed substrate leading to impacts on aquatic biodiversity	H	3, 4, 9, 10, 11, 13, 14, 15	M
	Transport of water for construction purposes	Transfer of alien species	M	6	L
	Chemical / Fuel spills and leaks.	Contamination of the natural environment and/or waterways including poisoning of aquatic fauna, including possible direct mortality to aquatic fauna (fish kills) or deterioration of aquatic and riparian flora condition resulting in reduced habitat quality.	M	13, 16	L
Low Lift Pump Station	Coffer Dam establishment and dewatering	• Entrapment of animals within the coffer dam, particularly during dewatering • In stream structures may directly limit fish movements or affect flow rates which can influence fish movements	H	1, 2, 5, 7, 8	M
		Sediment released into the Murrumbidgee River during the installation of the coffer dam.	H	3, 8, 9, 11, 13	M

Activity	Aspect	Potential Impact	Risk Category[1]	Mitigation Measures (refer to Table 5.1)	Revised Risk Category
	Blasting	• Vibration and shock waves which may cause stress and/or direct mortality to aquatic fauna • Impacts on bank stability including potential collapse of burrows within embankments	H	1, 2, 4, 5, 7	M
	Construction of LLPS	Concreting works within coffer dam increasing pH.	H	8, 9, 11, 13	M
		Sediment released into the Murrumbidgee River during the construction of LLPS	H	3, 8, 9, 11, 13	M
		Inappropriate dewatering of sediment laden water from coffer dam into Murrumbidgee River.	M	3, 8, 9, 11, 13	L
Eductor Pipe	Coffer Dam establishment and dewatering	• Entrapment of animals within the coffer dam, particularly during dewatering • Instream structures may directly limit fish movements or affect flow rates which can influence fish movements	H	1, 2, 5, 7, 8	M
		Sediment released into the Murrumbidgee River during the installation of the coffer dam.	H	9, 10, 11, 13	M
	Construction of Educt Pipe	Inappropriate dewatering of sediment laden water from coffer dam into Murrumbidgee River.	M	9, 10, 11, 13	L
		Sediment released into the Murrumbidgee River during the construction of LLPS	H	9, 10, 11, 13	M
Burra Creek Outlet Structure	Coffer Dam establishment and dewatering	• Entrapment of animals within the coffer dam, particularly during dewatering • In stream structures may directly limit fish movements or affect flow rates which can influence fish movements	H	1, 2, 5, 7, 8	M

Activity	Aspect	Potential Impact	Risk Category[1]	Mitigation Measures (refer to Table 5.1)	Revised Risk Category
	Outlet dissipation structure & Rip Rap	Earthworks may reduce bank stability and lead to increased erosion of the bank causing increased sediment loads and turbidity in waterway thus reducing water quality and potentially impacting aquatic flora and fauna	H	1, 2, 3, 4, 5, 7, 9, 11, 14, 15	M
		Sediment released into the Burra Creek during the construction of outlet dissipation structure and rip rap	H	1, 2, 3, 4, 5, 7, 9, 11, 14, 15	M
Minor Waterway Crossings	Inappropriate sediment control measures/inappropriate stockpiling of material	Sediment escape to major/permanent waterways resulting in increased turbidity and smothering of creek/river bed substrate.	M	3, 9, 10, 11, 12, 13, 14, 15, 17	L
Decommissioning of Engineering cControls	Removal of Coffer Dams and other instream or bank structures	Sediment escape to major/permanent waterways resulting in increased turbidity and smothering of creek/river bed substrate.	H	3, 4, 7, 9, 10, 11, 12, 13, 14	M
Rehabilitation and Decommissioning	Slow implementation of rehabilitation activities.	Increased erosion risk causing increased turbidity and reduction in water quality	M	14, 15, 17	L
	Failed rehabilitation attempts.	Large areas of exposed surfaces prone to erosion causing increased turbidity and reduction in water quality.	M	14, 15, 17	L

4.3 Aquatic ecology values of the existing environment

4.3.1 Aquatic Habitats

Aquatic habitats of Burra Creek between the outlet and Burra Rd Bridge

The creek varies between 0 and 6 m wide and consists of short pools braided by infrequent, shallow riffling with pools up to 0.7 m deep. Bank structure varies from stable to actively eroding along some curves and constrictions of the channel. Stream substrates in the early part of this reach consist of soft silt and sand sediments with high cover of detritus and green filamentous algae on submerged woody debris and vegetation. Further on, stream substrates are predominantly silt and bedrock with some cobbles and sands.

Instream habitat consists of long beds of herbaceous vegetation dominated by exotic and native grasses, with rush/reed vegetation patches surrounding shallow pools consisting primarily of the emergent reeds, *Phragmites australis* and *Typha orientalis* with small sections of large woody debris and branches interspersed.

Dense beds of *Eleocharis sp.* are common throughout the early parts of the reach in the shallow pools. In pools of moderate depth (to 60 cm) dense clumps of *Chara sp*. algae and some filamentous algae are also common. Large beds of vegetation patches consisting primarily of the emergent reeds *Phragmites australis* and *Typha sp* are common throughout the reach. Near the gauging station, creeping mats of *Ranunculus sp.* along with isolated rushes of the genus *Juncus* are present.

The riparian zone is predominantly cleared for agricultural purposes and dominated by grass or patches of exotic species such as *Salix sp, Rubus fruticosa, Populus alba* and *P. nigra* with some native trees downstream of the gauging station. Snow Gum *Eucalyptus pauciflora* - Candlebark *E. rubida* – Apple Box *E. bridgesiana* grassy woodland occurs along Burra Creek. This community is not currently listed as an EEC although a nomination for its listing has been made. These sections are considered to be highly disturbed and in poor to moderate condition.

This reach is classified as Class 2- Moderate fish habitat, under the DPI fish habitat classification scheme.

Aquatic habitats of Murrumbidgee River at Angle Crossing

Angle Crossing is a low level concrete road crossing located upon a natural bedrock and cobble riffle. Upstream of the crossing the river forms a series of large pools up to 300 m long and 50 m wide, with occasional braiding for approximately 1 km of river. Short riffle sections link the pools. The depth in the crossing pool is generally greater than 1.5 m deep with the minimum depth occurring over the crossing of 0.1 m deep. The substrate of the pools is predominantly sand, silt and gravel with occasional areas of bedrock and cobble. In-stream habitat includes large woody debris, overhanging vegetation and overhanging banks. Occasional beds of emergent macrophytes including *Typha sp., Phragmites australis* and *Baumea articulata* occur in shallow areas and along the banks, along with scattered clumps of submergent macrophytes, predominantly *Myriophyllum sp*. in the pools. The steep western bank is comprised of rock and gravel and well covered in native shrubs and occasional trees. The eastern bank included large deposits of sand with patches of native shrubs. Patches of exotic plants, particularly Blackberry *Rubus sp*. and African Lovegrass *Eragrostis curvula* are common on both banks. The area is currently being impacted by the crossing, sedimentation and presence of exotic flora species.

This reach is classified as class 1-major fish habitat under the NSW Department of Primary Industries Fish Habitat Classification Scheme.

A shallow riffle section is located directly below Angle Crossing. The riffle section is 35-45 m long and up to 30 m wide at the crossing while depth varies from 0.1 m to 0.4 m. The riffle substrate is generally comprised of a mixture of pebbles, gravel and cobbles, embedded with few interstitial spaces but with several beds of submergent and emergent macrophytes.

4.3.2 Aquatic Flora

Aquatic flora occurring in Burra Creek and the Murrumbidgee River

The following aquatic plants were recorded in the two waterways during the course of the field study for the EIS. The list is not comprehensive, but is illustrative of the differences between the two.

Table 4.4 Aquatic Plants occurring in Burra Creek and in the Murrumbidgee River near Angle Crossing.

Burra Creek	Murrumbidgee River
Typha orientalis	*Typha orientalis*
Phragmites australis	*Phragmites australis*
Ranunculus sp.	*Baumea articulate*
Chara sp.	*Vallisneria gigantea*

Burra Creek	Murrumbidgee River
Myriophyllum sp.	*Myriophyllum sp.*
Nasturtium officinale	
Eleocharis sp.	
Juncus sp.	

4.3.3 Aquatic Fauna

Fish

The study area provides habitat for several native and alien fish species.

Table 4.5 lists native species and alien fish species recorded by the ACT's Department of Territory and Municipal Services along the length of the Murrumbidgee River and Burra Creek and in the Googong Reservoir.

Alien fish species, Carp *Cyprinus carpio* and Oriental Weatherloach *Misgurnus anguillicaudatus* are common in the Murrumbidgee River.

Gigerline Gorge/Angle Crossing also represents the upper extent of the normal distribution range of a number of native fish such as Golden Perch *Macquaria ambigua*, Murray Cod *Maccullochella peeli peeli* and Silver Perch *Bidyanus bidyanus*.

Table 4.5 Fish species previously recorded in the Murrumbidgee River and Googong Reservior

Fish species previously recorded in the Murrumbidgee River and Googong ReservoirScientific name	Common name	Upstream of Angle Crossing, Murrumbidgee River	Downstream of Angle Crossing, Murrumbidgee River	Burra Creek and Googong Reservoir
Native fish species				
Bidyanus bidyanus	Silver Perch	-	X	X stocked
Euastacus armartus	Murray Crayfish	X	X	-
Galaxias olidus	Mountain Galaxias	X	X	X
Hypseleotris sp.	Carp Gudgeon	-	X	X
Maccullochella macquariensis	Trout Cod	X stocked	X stocked	-
Maccullochella peeli peeli	Murray Cod	-	X	X stocked
Macquaria ambigua	Golden Perch	-	X	X stocked
Macquaria australasica	Macquarie Perch	X	X	X
Retropinna semoni	Australian Smelt	X	X	-

Fish species previously recorded in the Murrumbidgee River and Googong ReservoirScientific name	Common name	Upstream of Angle Crossing, Murrumbidgee River	Downstream of Angle Crossing, Murrumbidgee River	Burra Creek and Googong Reservoir
Alien fish species				
Carassius auratus	Goldfish	X	X	X
Cyprinus carpio	Carp	X	X	-
Gambusia holbrooki	Eastern Gambusia	X	X	X
Misgurnus anguillicaudatus	Oriental Weatherloach	X	X	-
Oncorhynchus mykiss	Rainbow Trout	X	X	X stocked
Perca fluviatilis	Redfin Perch	X	X	X
Salmo trutta	Brown Trout	X	X	X stocked

Other aquatic fauna

Burra Creek and Murrumbidgee River support a diverse assemblage of aquatic organisms other than fish. These include vertebrates such as turtles, water dragons and platypus as well as invertebrates. The diverse and abundant plant assemblage mainly in the pools is particularly important for ecology of the stream. The aquatic plant life has been noted by several stakeholders as a valued stream attribute, and it is certainly the key feature supporting much of the other biota. It will provide shelter for both vertebrate and invertebrate aquatic organisms, and periphytic algae growing on the aquatic plants are probably the major energy source for invertebrates which in turn provide the energy source for many of the vertebrates.

The Murrumbidgee River also provides habitat for other aquatic or semi-aquatic fauna including Eastern Water Dragons *Physignathus lesuerii*, Eastern Water Rat *Hydromys chrysogaster* and Long-necked Turtle *Chelodina longicollis*, all of which are relatively common in the area. Platypus *Ornithorhynchus anatinus* is also commonly sighted at Angle Crossing and is likely to be present through Gigerline Gorge. Murray River Crayfish *Euastacus armatus* and a variety of other macroinvertebrates and frogs also form an important part of the aquatic community.

Burra Creek also provides habitat for a diverse range of other aquatic animals including macroinvertebrates, Long-necked Turtle, frogs, Eastern Water Rat, Latham's Snipe and Platypus.

An assessment of Burra Creek, as a likely habitat for Platypus, was undertaken in January 2009. No platypus was found. Based on an assessment of the current creek habitat and hydrology and past research undertaken, it is considered likely that, being an ephemeral stream, platypi in Burra Creek may be reduced to low numbers (or even die out) during periods of extended low and/or no flows. The stream may be repopulated by dispersal from source populations, known to persist in the Queanbeyan River and/or the headwaters of the Googong Reservoir if flows increase. Habitat quality, even when the stream is flowing between pools, is assessed as low. The paucity of foraging areas, lack of connectivity between the remnant pools and between Burra Creek and the Queanbeyan River and/or headwaters of the Googong Reservoir suggests that, if still present, platypuses occupying Burra Creek would be in very low numbers and would be under stresses from a reduced availability of foraging areas and exposure to predation.

4.3.4 Threatened aquatic species

Threatened aquatic species listed in Table 4.6 are listed under the NSW *Fisheries Management Act 1994*, the ACT *Nature Conservation Act 1980* and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and have the potential to occur within the local area of both the Murrumbidgee River and Burra Creek.

None of the species in Table 4.6 was observed during the field surveys undertaken by Biosis Research within the Murrumbidgee River (2008) and Burra Creek (2007). However, existing data for the region indicates that the study area is considered to provide potential or known habitat for the majority of these species. Silver Perch and Murray Cod do not occur naturally above Gigerline Gorge and are only present as a stocked recreational fish in Googong Reservoir.

Murray River Crayfish *Euastacus armatus* are likely to occur in the study area of the proposed intake water transfer pipeline at Angle Crossing on the Murrumbidgee River (an Assessment of Significance for the Murray River Crayfish is provided in Appendix G2 of the completed EIS). There are no records of *E. armatus* within Burra Creek and as such Burra Creek has not been considered in this Assessment.

The NSW Department of Primary Industries has developed a number of recovery strategies for Trout Cod since the mid 1980s. Angle Crossing was considered a primary site in the stocking program up to 2004, with the latest stocking consisting of 15,000 fingerlings released in that year. These actions have been incorporated into the Recovery Plan for the species (NSW DPI Fisheries 2006). In 2006-2007, the stocking site for Trout Cod in this section of the Murrumbidgee River was relocated from Angle Crossing to an alternative site, Kambah Pool, located on the Murrumbidgee River 30.5 km downstream of Angle Crossing.

Table 4.6 Threatened aquatic species with the potential to occur in the region

Scientific name	Common Name	FM Act	NC Act	EPBC Act	Habitat	Potential habitat
Maccullochella macquariensis	Trout Cod	E	E	E	Inhabits large rivers and streams in the upper Murray Darling Basin often in fast flowing zones often associated with cover such as LWD, rock outcrops, boulders and deep holes.	Yes. Stocked into Angle Crossing from 1996 to 2004 for conservation purposes.
Bidyanus bidyanus	Silver Perch	V			Inhabits a variety of streams, rivers and lakes including slower sluggish rivers with LWD. It can be found in fast flowing waters but is not suited to the upper reaches of streams.	Yes. Recreationally stocked into Googong Reservoir.
Gadopsis bispinosus	Two-Spined Blackfish		V		Inhabits cool clear montane streams. Requires cobbles and boulders with interstitial spaces for shelter and breeding sites. Adult maintains a home range of approximately 10-15 m.	No. Historically known from the Murrumbidgee River in the ACT.
Macquaria australasica	Macquarie Perch	E	E	E	Inhabits slow flowing sections of creeks, rivers and impoundments with suitable aquatic vegetation, rocks and snags. Requires access to flowing riffles for breeding.	Yes. Small wild population occurs in the Murrumbidgee River.
Maccullochella peeli peeli	Murray Cod			V	Inhabits a wide range of streams and rivers often in deep, slow flowing areas with good cover, such as LWD, undercut banks or overhanging vegetation.	Yes. Occurs in the Murrumbidgee River below Gigerline Gorge. Recreationally stocked into Googong Reservoir.
Euastacus armartus	Murray River Crayfish		V		Inhabits a variety of habitats from lowland rivers to streams. It prefers the faster deeper and cooler sections of the main channels of rivers. Digs burrows or utilises interstitial spaces for shelter.	Yes. Wild population occurs in the Murrumbidgee River.

Key: E-Endangered, V- Vulnerable, FM Act – NSW *Fisheries Management Act 1994*, NC Act – ACT *Nature Conservation Act 1980*, EPBC Act – Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Table 4.7 Invasive alien fish species present in the Murrumbidgee and Googong catchments

Scientific name	Common name	Upstream of Angle Crossing	Angle Crossing	Downstream of Angle Crossing	Burra Creek and Googong Reservoir
Cyprinus carpio	Carp	X	X	X	-
Carassius auratus	Goldfish	X	X	X	X
Oncorhynchus mykiss	Rainbow Trout	X	X	X	X
Salmo trutta	Brown Trout	X	-	X	X (stocked)
Perca fluviatilis	Redfin Perch	X	-	X	X
Gambusia holbrooki	Eastern Gambusia	X	X	X	X
Misgurnus anguillicaudatus	Oriental Weatherloach	X	X	X	-

4.3.5 Environmentally sensitive areas

The Murrumbidgee River Corridor is protected in the ACT under the *Murrumbidgee River Corridor Management Plan 1998.* Under the plan, a number of strategies are in place to conserve and protect the endemic aquatic, riparian and riverine ecosystems and aquatic animal species within the river corridor.

4.3.6 Invasive species

Flora

Localised infestations of African Lovegrass *Eragrostis curvula* were noted at both the Angle Crossing 'beach' on the Murrumbidgee River and on the lower banks of Burra Creek below the gauging station and roadsides during surveys undertaken in the study areas. *Eragrostis curvula* is a declared class 4 locally controlled noxious weed under the NSW *Noxious Weeds Act 1993*. Patches of exotic plants, particularly Blackberry *Rubus sp.* and *Eragrostis curvula* are common on the banks of the Murrumbidgee River. No in-stream aquatic weeds were recorded in the Murrumbidgee River.

The riparian zone at Burra Creek is predominantly cleared for agricultural purposes and is dominated by grass and patches of exotic species such as Willow *Salix sp.*, Blackberry, Poplar *Populus alba* and *P. nigra.* A number of Willow *Salix* sp. seedlings are established in Burra Creek below the gauging station. In-stream weeds include the Curly Pondweed *Potamogeton crispus*. The management of weeds is described in detail in the Weed Management Strategy included in the Landscape Rehabilitation Management Plan (LRMP).

Fauna

Fish surveys undertaken by TAMS and previous studies undertaken and described by Biosis Research (2007) indicate that a number of invasive alien fish species are present in both the Murrumbidgee and Googong catchments. Table 4.7 presents the occurrence of invasive alien fish species surveyed in the catchments.

Two species of alien fish which are common in the Murrumbidgee River - Carp and Oriental Weatherloach – have not been recorded as yet in the Googong Reservoir. Carp, *Cyprinus carpio,* are however, present in many water bodies in the Googong catchment but not in the Googong Reservoir itself. Oriental

Weatherloach *Misgurnus anguillicaudatus* and Carp have been commonly recorded throughout the Angle Crossing area in the Murrumbidgee River.

Both of these species are present in the Queanbeyan River downstream of the Googong dam wall, with the spread of Oriental Weatherloach in particular related to its illegal use as bait fish by some anglers. Since the 1980s, Carp have been documented on at least two occasions from farm dams in the Googong catchment.

Similarly, two large Carp individuals were recorded in the 1990 fish monitoring program for Googong Reservoir, but they have not established a population. It is likely that the individuals captured in the reservoir and those detected in farm dams are the result of illegal introductions to farm dams in the catchment, and subsequent overflow events.

It is believed that this is how Redfin perch became established in Googong Reservoir. The increased settlement of the Googong catchment for residential housing is also likely to increase the chance of illegal introductions of undesirable fish species such as carp or Oriental Weatherloach.

Due to the invasive nature of Carp and their previous illegal introduction into farm dams within the Googong catchment, it is likely that the species may already be, or become, established in Googong Reservoir at some future point due to means other than this proposed water transfer project. . Carp are already present in farm dams within Googong system so the long term prospect of keeping them out of the reservoir is not good. However, Googong Reservoir has been maintained as a carp-free environment since its construction in the late 1970s, and efforts to exclude Carp from entering this water body will be a major focus.

EHN virus

The EHN virus is already well established in Googong Reservoir having first been confirmed in 1994, having previously caused fish kills. The virus is long-lived and resistant, and redfin perch are known to act as a host. To establish the presence of the virus within the reservoir now, or within Burra Creek would require the capture and collection of samples from tens, if not hundreds of fish. Detection of the virus in a single fish is proof that it is present in the system, but its absence cannot be proven. Even failure to detect the virus in 100 fish specimens would not prove it is absent.

The virus is not known to have been eliminated from any large water body in which it has been recorded, so it is most likely to still be present within the Googong Reservoir, and by extension, in Burra Creek. As it is known that viable virus has been confirmed to be present in the crop of piscivorous birds (Whittington et al. 1996) that have consumed infected fish, it is likely that the virus has spread further into the Burra creek drainage than fish movement alone would have distributed it. The exotic redfin perch (Perca fluviatilis) are a known reservoir for the virus and are present both in the Googong Reservoir and in Burra Creek, and presumably, when flows are sufficient, they move between the two.

5 Environmental Control Measures

The implementation of various environmental control measures during the course of construction can reduce the risk category of environmental aspects associated with the project (i.e. controlling the risk). In addition to implementing "best management practices" on site, the following environmental control measures will be implemented on site to minimise impacts on aquatic flora and fauna associated with construction activities.

The following table identifies the general and specific mitigation measures to be implemented to minimise the impacts on terrestrial flora and fauna.

Environmental Work Method Statements (EWMS') and relevant toolbox talks will be prepared for specific activities to minimise the risks to terrestrial flora and fauna associated with the project.

Sensitive area diagrams have been prepared in conjunction with the EWMS'. The sensitive area diagrams will include locations of all sensitive receptors, such as threatened species and trees to be retained. These will be distributed for display in site compounds. The diagrams will also provide a visual, day to day management tool for on-site environmental personnel, auditors and regulatory agencies.

Table 5.1 Mitigation measures

Ref.	Mitigation Measure	Responsibility
1.	Prior to the commencement of construction activities, arrange an inspection of all habitat to be disturbed (using a qualified ecological specialist). Any fauna encountered during this pre-clearance survey should be removed if possible, or its shelter/burrow site clearly marked so that an attempt can be made at a later/more suitable time to remove the fauna. All locations that need to be dewatered must be cleared of fauna with fauna to be relocated immediately upstream of the work site or to an appropriate area predetermined by the ecologist.	Environmental Officer
2.	Iconic and listed threatened species to be specifically targeted during fauna pre-clearance surveys and is to include the following: ***Platypus*** Prior to construction, undertake Inspection of river and creek banks within the construction footprint for Platypus burrow entrances including nocturnal spotlighting and dusk surveys to detect presence of Platypus in the vicinity of the construction site. If burrows are located, careful excavation in small scoops with an un-toothed bucket is to be undertaken, in case a lactating female and/or dependent young are present. Where appropriate, arrangements will be made for the transfer of any dependent Platypus young to an establishment with established protocols for rearing platypus young (e.g. Taronga Zoo, Sydney). Any adults found in burrow to be left to return to the stream or to be captured and released, depending on the proximity to the construction site and the assessment of the ecologist . ***Murray River Crayfish*** Regular inspections of sediment controls, including the Coffer Dam and Silt Curtains to be undertaken to ensure sediment is not escaping and that turbidity in the river is maintained at acceptable levels. The Environmental Officer is to be present during dewatering of the coffer dam to capture and release any individuals stranded within the coffer dam. An Ecologist will be on standby if	Environmental Officer Superintendent Ecologist

Ref.	Mitigation Measure	Responsibility
	required to assist with this task. ***Threatened Fish Species*** As above, the Environmental Officer is to be present during dewatering of the coffer dam to capture and release any individuals stranded within the coffer dam. An Ecologist will be on standby if required to assist with this task.	
3.	During any near stream works such as trenching or excavating, water quality will be protected under the construction environmental management plan, including suitably designed and maintained sediment controls (detailed in ESCPs) designed to cope with a greater than average rainfall and/or flow event and regularly inspected and maintained throughout the construction and rehabilitation phase Mesh netting will not be used as part of the sediment and erosion control measures as it has the ability to trap, kill and/or injure aquatic fauna that may try to pass through	Environmental Officer Superintendent
4.	Avoid undertaking excavation or other works in or near the Murrumbidgee River or Burra Creek during periods of actual or predicted heavy rain or higher than average flows as per the requirements of the SWMP	Environmental Officer Superintendent
5.	Cease work immediately if any previously unknown threatened flora or fauna species are encountered and consult the Ecologist with regards to the actions to be taken. Refer to the procedures in Section 5.4 of this document for summary information on how rescued fauna are to be treated. PCL, RSPCA, Wildcare or WIRES would be consulted in relation to injured animals.	Environmental Officer Superintendent
6.	Water will be extracted from the Murrumbidgee River for construction purposes (predominantly for dust suppression). No Murrumbidgee water will be taken east beyond the Gibraltar Gap. This is to prevent the potential transfer of pest species between catchments. Construction staff will undertake training to ensure that they are aware of the requirements on this and other ecological issues subject to potential construction impacts.	Environmental Officer Superintendent
7.	In the event of high flows/rainfall there is the possibility of an overflow of water into the Coffer Dams which may then have the potential to accumulate silt in the base of structure. During occasional maintenance operations this silt may need to be removed in accordance with the EWMS.05 – Dewatering, LLPS Coffer Dam Refer to the SWMP for more information on this strategy.	Environmental Officer Superintendent
8.	Any waters extracted from the proposed coffer dams must be certified clean from contamination (oils, spills) associated with the construction before release back into the Murrumbidgee River or Burra Creek. This applies to the initial dewatering of the Coffer Dams. This activity is to be undertaken under the guidance of the SWMP.	Environmental Officer Superintendent

Ref.	Mitigation Measure	Responsibility
	Dewatering will be undertaken in accordance with EWMS.05 – Dewatering.	
9.	Turbidity controls to ensure water quality standards comply with the relevant guideline/agreed standards as per the requirements of the SWMP.	Environmental Officer Engineer
10.	Stockpiles will be located away from the Murrumbidgee River and Burra Creek. Approvals from relevant agencies will be gained prior to the disposal and placement of soil material.	Environmental Officer Superintendent
11.	Erosion and sediment control measures will be implemented according to site specific Erosion and Sediment Control Plans (ESCPs) for works adjacent to waterways.	
12.	Disturbed areas will be rehabilitated and/or landscaped as soon as practical, through a progressive landscaping regime to ensure stabilisation of bare areas and to take advantage of optimal growing conditions. This will be undertaken in accordance with the approved Landscape Rehabilitation Management Plan (LRMP).	Environmental Officer Construction Manager
13.	A waste management plan (WMP) has been prepared and will be implemented to avoid potential contamination of water bodies through inappropriate storage and/or stockpiling of construction waste material. Key strategies of the WMP will be to ensure that all construction waste material is stored properly and located well away from any watercourses. The WMP will provide management strategies for the handling of chemicals and other hazardous construction materials and to detail the immediate action to be undertaken for any spills	Environmental Officer Superintendent
14.	All stream bed and banks will be reinstated and revegetated with appropriate (locally occurring) species to ensure long term bank stability	Superintendent Environmental Officer
15.	Rehabilitation of aquatic ecology impacted by pipeline construction at waterway crossings will be undertaken as soon as practical following the completion of construction (refer to the LRMP for further details)	Environmental Officer
16.	Ensure fuels and chemicals are bunded and stored appropriately on site in accordance with ACT EPA and NSW DECCW guidelines.	Superintendent / Construction Managers
17.	Monitor rehabilitation activities in accordance with the objectives stated in the approved Landscape Rehabilitation Management Plan (LRMP)	Construction Manager / Environmental Officers

5.2 Coffer Dams

The Intake Structure and Eductor Pipe Outlet at the Low Lift Pump Station (LLPS) on the Murrumbidgee River and the Outlet Structure at Burra Creek require construction and earthworks in or adjacent to waterways. The construction of these features will incorporate the use of Coffer Dams and Silt Curtains (as required). The coffer dams will be dewatered prior to construction commencing so that the works are conducted in a dry environment.

Silt curtains will be established as required around the perimeter of each coffer dam. These actions and the erosion and sediment control measures stipulated in the ESCP's are regarded as adequate to appropriately manage potential construction-related impacts on water quality from increased sediment loads and turbidity (refer also to the SWMP for further information on managing water quality during the construction phase).

During the dewatering, the Environmental Officer will be present to capture and release any fauna trapped within the coffer dams and to manage the release of this fauna as per the procedures listed in Section 5.4. An ecologist will be on standby to assist if required.

Blasting activities may be required as part of the construction of the LLPS, eductor discharge pipe or outlet structure and these will be undertaken within the dewatered coffer dams so that they will be dry-blasts (see below).

The coffer dams will not extend across the entire width of the waterways so that aquatic fauna may move past these structures unimpeded. Additionally, the structures are not expected to significantly increase flow velocities to the extent that they might impact on the ability of fish to swim past these points. In addition to this, the Murrumbidgee River already contains a number of artificial and natural barriers to fish passage, including Gigerline Gorge and Angle Crossing Road. These structures already impact on native fish in the river by restricting movements upstream of the structures. The Intake structure (and associated coffer dam during its construction) is upstream of Angle Crossing and as such, will not affect fish passage. The eductor pipe (and associated coffer dam during its construction), is of a smaller scale and will not impact on fish movements. Importantly, the depth of water would not be decreased to the point where fish cannot navigate past this point (the minimum required depth being approx 360mm).

Throughout the course of the construction period and until the coffer dams are decommissioned, regular inspections of the bank profile are to be undertaken to ensure that increased scouring of the opposite bank is not occurring. Should this be found to occur, immediate bank stabilisation measures are to be implemented.

5.3 Blasting

Blasting may be required for the construction of the LLPS as the hardness of the bedrock at this location has been assessed as too great to allow successful drilling and excavation. As mentioned above, the blasting will be undertaken within dewatered coffer dams that have been pre-cleared of aquatic fauna. Given that the blasting will be undertaken in a dry environment, whilst there may be some noise and minor vibration (through the bedrock) associated with this activity, there is unlikely to be any transferral of shock waves into the adjacent waterbodies that might otherwise impact on fish and other aquatic fauna. The EIS has however stated that there is unlikely to be any significant fish species present at the Angle Crossing locality given the major barrier to fish movement from the Gigerline Gorge downstream of Angle Crossing.

5.4 Pre-clearance Surveys and Fauna Rescue Procedures

A local fauna specialist/project ecologist will undertake a pre-clearing assessment of aquatic and riparian habitats impacted by the proposed project with particular attention being paid to the clearance of the Coffer Dams during the dewatering process (refer to Section 5.2, Above) as well as the survey for and clearance of any burrows, specifically wombat burrows on or near the creek/river banks and platypus burrows within the Murrumbidgee River (see below). These pre-clearance fauna surveys will be conducted in conjunction with the pre-clearance surveys detailed in the Terrestrial Ecology Management Plan (TEMP).

Equipment for fauna rescue (esky or other water-holding implement, hessian sacks, gloves, and transport boxes) will be kept in designated locations for emergency use by site staff if required. Staff will undertake toolbox training that will include procedures on these issues. The fauna specialist will carry a fauna rescue kit in a site vehicle, and an additional kit would be located in the site office.

Burrow Inspections

As part of the fauna pre-clearance survey procedures, all reasonable attempts will be made to locate any wombat or platypus burrows within the immediate vicinity of the construction works. In accordance with Condition 6.3 b) i) of the NSW Conditions of Approval, any located burrows will be shown on the Site Environment Plans (refer also to Appendix D of the TEMP - Hollows/Burrows Inspection Checklist for further information).

Should any wombat burrows be located within the vicinity of the construction works, they will be checked for occupancy and if found to be occupied, the animal will be encouraged to move from the burrow or the burrow boarded up on the evening prior to disturbance to prevent the wombat entering the burrow again. Once satisfied that the burrow is unoccupied, it will be collapsed so that the animal cannot re-enter the burrow.

Should any platypus burrows be located, all reasonable attempts will be made to capture the individual and relocate it further away from the construction area (in accordance with Mitigation Measure No.2 of Table 5.1 above). In reality, this is likely to be difficult given the extremely shy and secretive nature of the animal and furthermore, may not even be required, as it is considered likely that once initial construction activities commence (such as site establishment and installing the Coffer Dams, which are activities that are unlikely to have any direct impacts on platypus), any platypus within the immediate area are likely to move away from the construction area, with the possible exception of females with dependant young, in which case the animals are to be captured and taken to an appropriate facility for caring for platypus with dependant young (e.g. Taronga Zoo).

Rescued Fauna

If an injured, shocked or juvenile animal or eggs are discovered on the study site, including during activities associated with the clearance and collapsing (where required) of burrows, the following procedures will be followed:

- if fauna require handling, this will be done with care and by the licensed fauna specialist;
- for aquatic fauna, these should be stored temporarily in an esky or similar type of container and sufficiently filled with water from the body of water from which it was collected. Aquatic animals must be relocated to the nearest practical location for release as soon as possible after capture. A designated site for the release of fauna would be decided upon in advance of any construction work;
- details on the time, location of release and capture, species, fate and size should be recorded on all animals captured and these details provided to TAMS as part of the licence to take. Any threatened species captured and released should be reported immediately to the land manager in TAMS and CPR;
- if the animal is seriously injured and requires immediate attention, as determined by the fauna specialist, the rescue agency should be contacted immediately;
- if the fauna specialist is not present when an injured/juvenile animal is found, the rescue agency should be called immediately;
- if the animal does not require immediate attention, as determined by the fauna specialist, the rescue agency should be called in the afternoon and they would collect any animals requiring attention;
- if the animal is reluctant to move away or is injured, then it shouldn't be released and a fauna rescue agency should be contacted;
- some animals require particular handling (e.g. Platypus) and should not be handled by site personnel;

- if the animal cannot be handled, record the exact location of the animal and contact the rescue agency;
- once the rescue agency arrives at the site, they would be responsible for the animal. Any decisions regarding the care of the animal would be made by the rescue agency; and
- if the rescue agency cannot be contacted, the fauna specialist would deliver the injured/captured animal to the agency as soon as practically possible.

The M2G Environmental Manager, or their delegate on-site, will hold the contact details of fauna rescue services and local veterinary surgeons. Contact details will be made readily available to site staff at all locations where clearing is to be undertaken. Staff will also undertake Toolbox training on the above matters.

Identified local fauna rescue agencies and contacts are detailed in Table 5.2.

Table 5.2 Fauna Rescue Agencies

Name	Contact details
R.S.P.C.A. (ACT) **Branch Contact (injured Wildlife)**	6287 8113 (Business Hours) 0413 495 031 (After Hours)
Wildcare	6299 1966
WIRES – NSW	13000WIRES (1300 094 737)

Release Procedure
If the animal is not injured, it should be released immediately into a nearby suitable area (of the riparian zone or sufficiently downstream in the river) that is not to be disturbed by construction in accordance with the following procedures:

- prior to works commencing at or near Burra Creek and the Murrumbidgee River, several (aquatic and riparian) sites near the project site would be identified as suitable release points by the ecologist;
- the fauna specialist or Environmental Officer would be responsible for undertaking any release; and
- if the species is nocturnal, release would be carried out at the appropriate time – preferably at dusk or before work commences the following morning (e.g. Platypus).

5.5 Murray River Crayfish

The construction activities of the project has the potential to impact upon the Murray River Crayfish *Euastacus armatus* occurring in the Murrumbidgee River within the immediate vicinity and shortly downstream of the offtake structure and eductor pipe. In particular, it is predicted that water quality within the Murrumbidgee River may see a temporary decline during the construction phase of the development as earthworks and the movement of heavy equipment and materials have the potential to cause degradation of banks and surrounding ground vegetation that could lead to an increase in soil loss and exposure. This may result in increased sedimentation within the vicinity of the Angle Crossing and the initial construction phases would likely introduce greater levels than normal of sediments increasing turbidity, and decreasing light penetration. If sediment is introduced to the river at a significant level the project is likely to impact upon habitat availability for this species to the extent of the infilling of interstitial spacing between rocks within the Murrumbidgee River. This will also be the case if water levels decline significantly downstream of the extraction point.

Additionally, construction in the vicinity of permanent waterways, construction through ephemeral waterways and minor gullies and the construction of haul roads also has the potential to generate suspended solids and increased turbidity in downstream waterways if significant rainfall occurs during the construction period. There is considerable opportunity to limit these impacts via implementation of mitigation strategies to be developed as part of the CEMP.

One of the main focuses of the CEMP and SWMP and the ESCPs, in conjunction with this plan, is to provide sufficient mitigation measures to control sediment and erosion throughout the construction period to limit the potential impacts on water quality so that impacts upon habitats for *E. armatus* will be temporary at worst and therefore should not be significant. The NSW Department of Industry and Investment (DII) *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation* (1999) is to be adhered to in the protection of the Murray River Crayfish.

5.6 Design Measures to Mitigate Aquatic Impacts (non-construction)

5.6.1 Transfer of alien species

Whilst not an impact as a direct consequence of the construction phase of the project, the water transfer scheme does have the potential to transfer alien pest species, particularly carp which are not present in the Googong Reservoir system but are common in the Murrumbidgee system.

To mitigate against the potential transfer of alien fish species from the Murrumbidgee River to Burra Creek, the project incorporates specialised fish egg filtration units to prevent the transfer of fish. The filter includes a screen that will prevent anything larger than 0.5mm to get through, which will effectively remove carp eggs juvenile fish and the majority of aquatic species or their eggs from entering the system. The design of the fish egg filtration units has been undertaken in consultation with the Department of Industry and Investment as required by NSW DoP Conditions of Approval, Condition 2.12.

There will be comprehensive testing of the fish filters prior to commissioning of the pipeline. This testing will be completed prior to the pressure testing, to ensure that, prior to commissioning, the fish egg filtration units are in place and functioning appropriately.

Additionally, the system provides for ongoing monitoring and includes a self-cleaning mechanism as well as an alarm system in the event of a system failure (e.g. tears in the filtration screen). This issue is covered in further detail in Section 3.4 of the OEMP (Flow Management Sub Plan).

5.6.2 Entrainment of aquatic species

The potential for entrainment of fish and Murray Crayfish into the off-take structure will be mitigated through design of the low lift pump station. Specifically, the design of off take screens incorporates structural steel rectangular hollow sections installed in removable panels spaced 25 mm apart. The off take screen (including the 0.5mm fish filter screen) will be designed to prevent adult and juvenile fish as well as eggs being entrained or transferred through the pipeline and is not expected to significantly impact threatened fish species within the Murrumbidgee River.

Additionally, the anticipated flow velocities resulting from the abstraction of water through the off-take will be below 0.5m/s (estimated to be between 0.15 and 0.3m/s) and based on evidence from previous similar projects (including the Murrumbidgee to Cotter water transfer), fish and crayfish would be able to avoid becoming entrained into the flow of water into the off-take.

5.7 Waterway Crossings

The pipeline easement crosses a number of minor/ephemeral watercourses, and hence will involve construction activities within these waterways. Detailed designs of permanent watercourse crossings are provided in Appendix C of the SWMP and primarily involve the establishment of appropriate erosion and sediment controls. These controls will be documented on site-specific ESCPs and EWMS'.

Importantly, these waterways, given their ephemeral nature with extended periods where they are completely dry, provide little aquatic habitat value with no records made of any significant aquatic flora or fauna within these environments during the EIS surveys periods.

5.8 Environmental Work Method Statements

Environmental Work Method Statements (EWMS') will be developed for activities which are considered "high risk" to the management of aquatic flora and fauna species. The EWMS' provide a step-by-step analysis of construction activities identifies significant risks and documents the appropriate management strategies to minimise these potential risks. The management of aquatic flora and fauna will be incorporated into these EWMS documents as required.

5.9 Landscape Rehabilitation

A Landscape Rehabilitation Management Plan (LRMP) has been developed to specifically detail how the construction activities and structures within or in proximity to riparian areas would be appropriately designed and managed to ensure the integrity, function and condition of these areas are maintained and/or suitably rehabilitated.

The proposed landscape rehabilitation program is designed to help ameliorate the impact of the project on the environmental values of the area and to improve the condition of existing areas of depleted natural habitat.

This will be achieved by:

- protecting and enhancing existing remnant vegetation; and
- planting well designed blocks and corridors of indigenous species.

The rehabilitation of watercourse crossings will be categorised using the Strahler System of stream order classification. As shown in Appendix B, Landscape Design Details of the LRMP, the pipeline crosses:

- 6 first order watercourses;
- 7 second order watercourses;
- 1 third order watercourse; and
- 2 fourth order watercourses.

Burra Creek is classified as a fifth order stream where the pipeline intersects it.

Table 5.3 of the LRMP and **Table 5.7** of the SWMP outlines the rehabilitation methodology of watercourse crossings for each identified stream order.

The landscape treatments of both the Murrumbidgee River intake (Low Lift Pump Station) and Burra Creek discharge can be found within Appendix B, Landscape Design Details of the LRMP.

6 Communication & Consultation

6.1 Community Engagement and Stakeholder Management

All communication and consultation will be undertaken in accordance with the Community Engagement and Stakeholder Management (CESM) Plan – there will be one CESM Plan for Construction and then one dealing with Operational matters. The CESM Manager is responsible for the interface with the community. This includes (but is not limited to) notification of temporary road closures, community engagement regarding construction and the complaints process. The CESM Manager reports to the M2G Client Representative whilst working in conjunction with the M2G Project Manager, Superintendent, Land and Compliance Manager, Safety Manager and Project Engineers.

In addition, consultation with government agencies will be undertaken regularly as described in the CEMP with the intention of reviewing the effectiveness of the AEMP, site management practices, monitoring results and any other relevant issues.

Table 6.1 Communication Network

Communication	
Project personnel including sub-contractors/suppliers	• A site induction and CESM training will be provided to all personnel and sub-contractors engaged to work on the site. • Feedback on environmental matters, new legislation etc. will be provided and encouraged. • Close communication will be maintained between the Construction Manager, M2G Land and Compliance Manager, Foremen and Environmental Officer.
Government agencies	**ACT** • Department of the Environment, Climate Change, Energy and Water (DECCEW) • TAMS (PC&L – Rural region and Cotter Depot and CPR – Gungahlin) • ACT Heritage Unit **NSW** • Department of the Environment, Climate Change and Water (DECCW) • Department of Planning (DoP) • Australian Rail Track Corporation (ARTC)
Community and Landholders	• Individual Landholders will be informed in advance of construction activity affecting them in accordance with the CESM Plan • Project information will be made available to the community in accordance with the CESM Plan through advertisements, community notices and newsletters. • A protocol for registering and responding to complaints will be established as detailed in the Complaints Management Procedure and CESM Management Plan.

6.2 Complaints management strategy

The Bulk Water Alliance is committed to managing aquatic flora and fauna related complaints from affected residents or stakeholders in a proactive and conciliatory manner.

Relevant community and stakeholder groups will be progressively informed of the various stages of construction by the Community Engagement and Stakeholder Management (CESM) team.

The community and stakeholder groups identified in the Construction CESM Plan will be informed of the duration of the works and they will be given an 1800 toll free number to contact the BWA CESM team should they wish to register a complaint regarding any aspect of the construction project.

The BWA CESM Manager will implement a process for registering and responding to the lodged complaint as per the Complaints Management Procedure. The CESM Manager will report back to the project team on impact and mitigation effectiveness on a weekly basis.

The Water Security Hotline phone number (6248 3563) is available during business hours for general questions, project updates and to provide feedback. A toll free number (1800 211 242) is available 24 hours a day for emergencies. Complaints and comments can also be sent via email to watersecurity@actew.com.au. The toll free number for registering complaints will be available once construction commences.

7 Training, Awareness & Competence

Training is a key element of effective environmental management on site. Ensuring that all site personnel are aware of their roles and responsibilities with respect to environmental aspects of the project not only assists in the implementation of management strategies on site, but more importantly increase environmental awareness among employees potentially leading to behavioural changes in common work practices.

Three main forms of training will be implemented on site:

- site induction;
- environmental management training; and
- “toolbox” training

Records of all site inductions and on site training will be kept on a database, including details of the training topic(s) presented, participants and training dates. All participants will be required to “sign-off” that they have been informed and understand their environmental obligations at the conclusion of each training session.

Training will generally be prepared and delivered by the Environmental Officer, or by personnel delegated by the M2G Environmental Manager.

7.1 Site Induction

Prior to working on site, all personnel and subcontractors will undertake a site induction detailing significant environmental and OHS requirements associated with the M2G project. The will include, but not be limited to, the following environmental components:

- the EWMS and CEMP (purpose, objectives, etc) and the requirements of this AEMP;
- legal requirements including due diligence, duty of care and potential consequences of infringements;
- environmental responsibilities;
- conditions of licences, permits and approvals;
- BWA policies;
- significant environmental issues and areas of the site, including the identification of project boundaries, location of refuse bins, washing, refuelling and maintenance of vehicles, plant and equipment;
- environmental management techniques for key environmental elements (soil and water, waste and recycling, flora and fauna, heritage etc) e.g. EWMS;
- incident management and emergency plans;
- reporting process for environmental harm/incidents;
- protection and maintenance of environmental controls; and
- BWA sustainability objectives.

7.2 Environmental Management Training

Targeted environmental management training will be provided to individuals responsible for environmental management on site, or groups who are undertaking activities which have been identified as “high risk”. This environmental training is designed to achieve a level of awareness and competence appropriate to their assigned activities.

Specific links will be made between environmental objectives and sustainability principles during training sessions (where possible). A comprehensive overview of sustainability may also need to be included (i.e. social, economic and environmental aspects, and inter-generational equity).

Of relevance to this AEMP, staff will be trained on responses to the presence of significant fauna within the construction site, working with the ecologist and/or fauna spotter/catcher, being aware of sensitive areas and other requirements such as weed removal from vehicles and machinery etc.

Records will be maintained on site of all training sessions conducted and personnel attendance. These records will be maintained by the Environmental Officer.

7.3 Toolbox Training

Toolbox training will help to ensure that relevant information is communicated to the workforce and that feedback can be provided on issues of interest or concern. Toolbox training will generally be prepared and delivered by the Project Engineers, Superintendent, Site Foreman and/or the Environmental Officer and will reflect risks and concerns associated with construction activities occurring on site.

EWMSs will draw reference to specific toolboxes based on risks associated with the proposed construction activity. The toolboxes will complement the AEMP by providing additional details on the management and mitigation of identified environmental impacts. Environmental toolbox training topics may include but are not limited to:

- working within or in close proximity to waterways;
- Aquatic species identification (for works in Murrumbidgee River and Burra Creek);
- clearing and grubbing procedures;
- concrete washout procedures;
- dust control;
- response to encounters with fauna, including injured fauna;
- protecting waterways and riparian zones;
- wastewater control;
- spills and leaks (including the application of remediation products);
- emergency response procedures;
- wet weather procedures and inspections;
- fauna rescue agencies and fauna management procedures
- changes to recent legislation; and
- other general site issues.

8 Inspection, Auditing & Monitoring

8.1 Site Inspections

As outlined in the CEMP, environmental site inspections will take place on a regular basis to ensure appropriate mitigation measures and controls are implemented and that they are fully operational and effective. A variety of site inspections will be initiated for the project. These are described in Table 8.1 below:

Table 8.1 Aquatic Ecology Inspection and Monitoring

Frequency	Inspection/Monitoring Activities	Delegated Responsibility
As required	Fauna pre-clearance survey of construction site (this is largely in relation to the survey for and inspection of Platypus burrows and wombat burrows located within the riparian zone within or immediately adjacent to the proposed construction works.	Ecologist Environmental Officer
As required	Inspections, where deemed necessary, of areas to be cleared to ensure environmental controls are being followed. Inspections to ensure no mortality of threatened fauna are occurring as a direct result of construction activities.	Ecologist Environmental Officer
Weekly	A general inspection of works.	Environmental Officer Construction staff
	Inspections of all Sediment and Erosion control measures by the Environmental Officers to check the integrity of protective fencing and that water quality is not being affected by the construction works.	Environmental Officer
Ongoing	A Fauna Specialist will be present during riparian vegetation clearing and river bank works, including all blasting activities and dewatering of coffer dams.	Ecologist Environmental Officer
Ongoing	Monitoring of aquatic and riparian habitat condition within the works boundary.	Ecologist Environmental Officer
Ongoing	Monitoring of the river bank landscaping and riparian rehabilitation works post construction is outside the Bulk Water Alliance scope of works. Post construction monitoring will be undertaken by Actew AGL as part of its ongoing monitoring program.	M2G Land and Compliance Manager Actew AGL representative.

8.2 Environmental Monitoring

The monitoring of the performance of aquatic ecology management will be largely covered under this Aquatic Ecology Management Plan and its overarching CEMP. Following a period of 1 year on completion of the project, the monitoring will transfer over to the Operational Environment Management Plan (OEMP) and its specific sub-plans.

With regard to aquatic flora and fauna, monitoring will include predominantly fauna injuries or death as a consequence of the project construction activities. An Ecological Monitoring Plan has been prepared and sits between the CEMP and Operational EMP documentation. The monitoring of flora will largely fall under the

responsibility of the LRMP, which includes the monitoring of rehabilitation performance and weed management success.

8.3 Auditing

Periodic audits of the AEMP are detailed within the CEMP Audit Schedule. Audits will include:

- compliance with legislative requirements and project approvals;
- compliance with this AEMP;
- full review of environmental records (e.g. checklist and inspections);
- review of monitoring results;
- closure of non-conformances and previous audit findings
- an assessment of the suitability of the AEMP with regards to current construction activities. This may initiate an AEMP review/revision; and
- recommendations for further improvements.

8.4 Non-conformance, Preventative and Corrective Actions

8.4.1 Environmental Actions Lists and Improvement Notices

The M2G Environmental Officer will issue Environmental Maintenance Observation and Action Lists or an Environmental Improvement Notice (EIN) as required. Environmental Maintenance Observation and Action Lists will be issued to the Superintendent and/or Foremen for deficiencies that are minor in nature but require rectification. An Environmental Improvement Notice (EIN) will be issued for more serious deficiencies which pose a greater level of environmental risk, or for when a reprimand is required for poor performance.

8.4.2 Resolving Non-conformances and implementing Corrective Actions

The process for managing environmental non-conformances will be as follows:

- When an environmental non-conformance is detected, the nature of the issue will be evaluated by the M2G Land and Compliance Manager and/or Environmental Officer and the requirement for new or additional controls will be discussed to prevent reoccurrences. Corrective actions will subsequently be identified and entered into the Environmental Action Register (EAR) for reference. This EAR will detail the non-conformance, corrective and/or preventative action, timing and the personnel responsible for implementing the action. The non-conformance will remain “Open” until corrective actions have been implemented.
- Once the corrective action has been implemented, the EAR will be updated to “Closed” status with details of the closure date attached.
- The EAR will be reviewed regularly by the Environmental Team to ensure actions are being completed in a timely manner. Any issues arising from these reviews will be discussed between the M2G Environmental Manager and relevant construction personnel.
- Government agencies will, upon request, be given details of any identified non-conformances and corrective actions arising out of audits or inspections undertaken during construction activities.

8.5 Environmental Records

The Environmental Officer with the assistance of the M2G Land and Compliance Manager will maintain the following records:

- the AEMP;
- relevant approvals, regulatory licences and permits;
- inspection records and checklists;
- environmental monitoring results and chain-of-custody forms;
- environmental accident/incident/emergency reports;
- environmental Non-conformance and EIN documentation;
- audit reports; and
- management review minutes and action taken

Where hard copy records are provided they will be scanned and made available electronically. Each set of records will be allocated a register/index for easy reference and filing. Records will be maintained for at least 5 years after the date of final completion and will be available to ACTEW Representatives and Regulatory Agencies as required.

8.6 Document and Data Control

All environmental documentation associated with this management plan will be documented and maintained on site in accordance with "*document and data control*" requirements detailed in the CEMP.

An independent auditor will be appointed and the details of this have been summarised within the CEMP. In general, the independent auditor will assess compliance against project conditions and licences during the course of construction.

8.7 Environmental Monitoring

Aquatic ecology monitoring will be conducted in accordance with the Ecological Monitoring Sub Plan. Monitoring would be managed by the M2G Land and Compliance Manager and for the construction phase in particular (as required by Condition 3.3 d) of the NSW Conditions of Approval), would include the regular inspection of silt fences to ensure that they are intact and functioning properly to limit sediment escape into waterways. This monitoring should continue until the site has become stabilised and, following this, all silt fences and erosion sediment control devices should be removed. This activity is more fully described in the Soil and Water Management Plan (SWMP).

9 Review and Improvement of the AEMP

The outcomes of inspections, monitoring, audits and the completion of checklists will facilitate the identification of problems, recurring issues or areas for improvement. Where identified, the effectiveness of the AEMP will be reviewed and opportunities for improvement will be identified and discussed with site personnel.

A system for the review and improvement of the environmental management system is described within the CEMP.

Table 9.1 Register of pending AEMP updates

Reference	Amendment Required	Status
Table 5.1	Movement of Murrumbidgee Water	Closed

Appendix A **Pre-clearance Fauna Survey Checklist**

ACTEW CORPORATION

BWA Environmental Form
Pre Clearing Checklist

Form: BWA-2-806C

Revision: 0

Logistical Information	
Project:	Date of Inspection:
Location:	Activity Occurring:
Tree Species:	Tree Number(s):
Person completing checklist:	

Pre Clearing Checklist			**Comments**
Boundary of clearing zone fenced?	Yes ☐	No ☐	
Has the Ecologist marked populations and/or individuals of threatened plants using the recognised colour coding protocol?	Yes ☐	No ☐	
Has Ecologist completed Pre-clearing surveys for Threatened Species	Yes ☐	No ☐	
Has the Ecologist marked habitats to be disturbed using the recognised colour coding protocol?	Yes ☐	No ☐	
If habitats have been marked, have they been cleared or if not is the ecologist present?	Yes ☐	No ☐	
Protective fencing installed around threatened ecological communities and vegetation to be retained?	Yes ☐	No ☐	
Protective fencing around termite mounds located within the works boundary?	Yes ☐	No ☐	
Has vegetation to be salvaged for re-use been identified?	Yes ☐	No ☐	
Mulching and chipping plant established?	Yes ☐	No ☐	
Have all residents adjoining the corridor been advised at least 5 days prior to clearing vegetation?	Yes ☐	No ☐	
Any other issues to add or delete from the checklist?	Yes ☐	No ☐	

ACTEW CORPORATION

BWA Environmental Form
Pre Clearing Checklist

Form: BWA-2-806C

Revision: 0

Location Diagram (or insert photograph or map)

Potential Environmental Hazards

Comment / Notes

Return to Environmental Representative for Electronic Filing on Completion			
Environmental Representative Signature:		Date:	

Appendix B **Hollows/Burrows Inspection Checklist**

ACTEW CORPORATION

BWA Environmental Form Hollow/Burrow Inspection Checklist

Form: BWA-2-806B

Revision: 1

Logistical Information	
Project:	Date of Inspection:
Location:	Activity Occurring:
Species:	Species Number(s):
Person completing checklist:	Position:

Hollows Checklist	**Yes**	**No**	**N/A**
Have the tree(s) been marked and identified?	Yes ☐	No ☐	N/A ☐
Number and size of hollows (small/medium/large):			
Fauna species inhabiting hollows (if identifiable)			
Fauna relocated or removed?	Yes ☐	No ☐	N/A ☐
Specific details:			
Injured/Deceased Fauna?	Injured ☐	Deceased ☐	N/A ☐
If so, was it a native species, or endangered or threatened?	Yes ☐	No ☐	N/A ☐
Specific Details/Comments: (E.g. Juvenile, Pregnant, Fauna rescue agency arrival time, Release location etc.)			

BWA Environmental Form Hollow/Burrow Inspection Checklist

Form: BWA-2-806B

Revision: 1

Burrows Checklist	Yes	No	N/A
Type of habitat i.e. burrow, rock scree etc.			
Fauna species inhabiting burrows (if identifiable)			
Species inhabiting burrow (if identifiable):			
Species relocated or removed	Yes ☐	No ☐	N/A ☐
Specific Details:			
Injured/Deceased Fauna?	Injured ☐	Deceased ☐	N/A ☐
If so, was it a native species, or endangered or threatened?	Yes ☐	No ☐	N/A ☐
Specific Details/Comments: (E.g. Juvenile, Pregnant, Fauna rescue agency arrival time, Release location etc.)			

BWA Environmental Form Hollow/Burrow Inspection Checklist

Form: BWA-2-806B

Revision: 1

Location Diagram (or insert photograph or map)

Potential Environmental Hazards

Comment / Notes

Sign Off			
Name:	Position:	Date	Signature
Return to Environmental Representative for Electronic Filing on Completion			
Name:	Position:	Date	Signature

Appendix C **Clearing and Grubbing Checklist**

BWA Environmental Form
Clearing & Grubbing Checklist

Form: BWA-2F-806A
Revision: 0

Logistical Information	
Project:	Date of Assessment:
Location:	Activity Occurring (circle): Clearing Grubbing
Meteorological Conditions:	Recent Rain (mm):
Person completing checklist:	

Control Measures			Comments
Are protected trees and vegetation marked with flagging tape/fenced?	Yes ☐	No ☐	
Is the boundary of clearing zone clearly delineated?	Yes ☐	No ☐	
Are erosion and sediment controls in place PRIOR to clearing works commencing?	Yes ☐	No ☐	
If clearing adjacent to waterways, have appropriate safeguards been implemented to protect against impacts on fish species? E.g. erosion & Sediment Controls	Yes ☐	No ☐	
Have fish been relocated from waterways in accordance with relevant license conditions?	Yes ☐	No ☐	
Have areas of weed infected topsoil been marked and/or removed for disposal?	Yes ☐	No ☐	
Has vegetation been checked for the presence of fauna?	Yes ☐	No ☐	
Have unsuitable stockpiles been identified for the permanent storage of weed infested topsoil?	Yes ☐	No ☐	
Are stockpiles located away from vegetation (root zone and canopy drip line)?	Yes ☐	No ☐	
Can cleared vegetation be used for erosion control?	Yes ☐	No ☐	

BWA Environmental Form
Clearing & Grubbing Checklist

Form: BWA-2F-806A

Revision: 0

Has cleared vegetation been retained for mulching or relocation as fauna habitat	Yes ☐	No ☐	
Are disturbed areas being progressively stabilized?	Yes ☐	No ☐	
Have habitat boxes been installed prior to clearing.	Yes ☐	No ☐	

Location Diagram (or insert photograph or map)

Potential Environmental Hazards

Comment / Notes

Return to Environmental Representative for Electronic Filing on Completion			
Environmental Representative Signature:		**Date:**	