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Murrumbidgee to Googong Water Transfer - Noise and Vibration Management Plan

BWA-M2G-EN-ECP-005-5

16th January 2012

Delivered by the Bulk Water Alliance

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Abbreviations – List of Abbreviations

Abbreviation	
ACT	Australian Capital Territory
ACTPLA	Australian Capital Territory Planning and Land Authority
ANZECC	Australian and New Zealand Environment Conservation Council
BWA	Bulk Water Alliance
CEMP	Construction Environment Management Plan
CESM	Community Engagement Stakeholder Management
CMS	Construction Method Statement
TAMS	Territory and Municipal Services (ACT)
DA	Development Application (ACT)
dB(A)	Decibel (A weighted)
DECCEW	Department of Environment, Climate Change, Energy and Water (ACT)
DECCW	Department of Environment, Climate Change and Water (Former NSW EPA)
EA	Environmental Assessment (NSW)

Abbreviation	
ECRTN	DECCW Environmental Criteria for Road Traffic Noise (NSW)
EIS	Environmental Impact Statement (ACT)
ENCM	DECCW Environmental Noise Control Manual (NSW)
INP	Industrial Noise Policy (NSW)
ICNG	Interim Construction Noise Guidelines
M2G	Murrumbidgee to Googong
NVMP	Noise and Vibration Management Plan
PPV	Peak Particle Velocity
VDV	Vibration Dose Values

Environmental Commitments and Approval Conditions

Table 1.1 EIS/ EA Commitments

EIS Commitment No.	Commitment	Reference within NVMP
EIS Condition 49	A Noise and Vibration Management Sub Plan will be prepared as part of the CEMP to minimise the potential for impacts from noise during construction	NVMP
EIS Condition 50	It is recommended that community consultation or notification (e.g. Letter box drop) be undertaken prior to pipeline maintenance involving air valve operation. Landowners should be provided with details of the time and date at which the maintenance event is to be conducted, so that domestic livestock and pets can be restrained or housed appropriately.	To be included in the Operational CEMP and CESM Plan

Table 1.2 M2G Conditions of Approval (NSW)

Condition No.	Condition	Reference within NVMP
Construction Noise (2.13)	The proponent shall only undertake construction activities associated with the project that would generate an audible noise at any residential premises during the following hours: a) 7:00 am to 6:00 pm, Mondays to Fridays, inclusive; b) 8:00 am to 1:00 pm on Saturdays; and c) At no time on Sundays or public holidays.	Section 4.3 of NVMP
Construction Noise (2.14)	This condition does not apply in the event of a direction from police or other relevant authority for safety reasons, to prevent environmental harm or risk to life.	Section 4.3 of NVMP
Construction Noise (2.15)	The hours of construction activities may be varied with the prior written approval of the Director-General. Any request to alter the hours of construction shall be: a) Considered on a case-by-case basis; b) Accompanied by details of the nature and need for activities to be conducted during the varied construction hours and any other information necessary to reasonably determine that activities undertaken during the varied construction hours will not adversely impact on the acoustic amenity of receptors in the vicinity of the site; and c) Affected residential receivers being informed of the timing and duration of work approved under this condition at least 48 hours before that work commences.	Section 4.3 of NVMP

Condition No.	Condition	Reference within NVMP
Construction Blasting (2.16)	Blasting associated with the construction of the project shall only be undertaken during the following hours: a) 9:00 am to 5:00 pm , Mondays to Fridays, inclusive; b) 9:00 am to 5:00 pm on Saturdays; and c) At no time on Sundays or public holidays.	Section 4.3 of NVMP
Construction Blasting (2.17)	The Proponent shall ensure that air blast overpressure generated by blasting associated with the project does not exceed the following criteria when measured at the most-affected residential or sensitive receiver. 115dB (Lin Peak) – an allowable exceedance is 5% of the total number of blasts over a 12 month period *(i.e. one exceedance of 115dB (Lin Peak) per twenty blasts is considered acceptable)* 120dB (Lin Peak) – is never permitted to be exceeded	Section 4.3 of NVMP
Construction Blasting (2.18)	The Proponent shall ensure that the ground vibration generated by blasting associated with the project does not exceed the following criteria when measured at the most-affected residential or sensitive receiver: 5mm/s Peak Particle Velocity – an allowable exceedance is 5% of the total number of blasts over a 12 month period *(i.e. one exceedance of 5mm/s Peak Particle Velocity per twenty blasts is considered acceptable)* 10mm/s Peak Particle Velocity – is never permitted to be exceeded	Section 4.3 of NVMP
Construction Blasting (2.19)	Prior to each blasting event, the Proponent shall notify the relevant local council and potentially-affected landowners, including details of time and location of the blasting event and providing a contact point for inquiries and complaints.	Section 6 of NVMP
Operation Noise and Vibration (2.20)	The proponent shall take all reasonable measures to minimise noise emissions and vibration from all plant and equipment operated on the site such that they do not exceed noise and vibration criteria derived by application of the *NSW Industrial Policy* (DECC, 2000) and *Assessing Vibration: A Technical Guideline* (DECC, 2006)	Section 5 of NVMP
6.3 c)	A Construction and Noise Vibration Management Plan to manage noise and vibration impacts during construction and to identify all reasonable and feasible noise and vibration mitigation measures. This plan shall be developed by a qualified acoustic consultant, agreed to by the Director-General and demonstrate the maximum feasible noise attenuation. The Plan shall address the requirements of the DECCW and shall include, but not necessarily limited to:	NVMP Acoustic Consultant Tristan Gribble & Evan Milton, Acoustic Engineers, GHD Mitigation Measures refer Section 5
6.3 c) i)	details of all potentially affected sensitive receivers modelled to have noise construction exceedances	NVMP Mitigation Measures refer Section 5

Condition No.	Condition	Reference within NVMP
	according to the NSW Interim Construction Noise Guidelines (July, 2009) where exceedances are shown an analysis of all feasible mitigation measures to reduce construction noise and vibration impacts including the use of noise attenuation barriers, alternative construction methods and work practices where potential noise impacts exceed the relevant objectives	
6.3 c) ii)	an alternative construction schedule may be developed with the prior consent of the potentially affected receivers	Section 6 of NVMP
6.3 c) iii)	description and commitment to work practices which limit noise	Section 5 of NVMP
6.3 c) iv)	procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity	Section 6 of NVMP
6.3 c) v)	extent of noise monitoring (as well as blast monitoring)	Section 5 and Appendix B of NVMP
6.3 c) vi)	contingency plans to be implemented in the event of non-compliance and / or noise and vibration complaints	Section 6 of NVMP
6.3 c) i)	site contact person to follow up complaints	Section 6 of NVMP

Table 1.3 ACTPLA Notice of Decision (ACT)

No.	Condition	Reference within NVMP
B6 (d)	A *Noise and Vibration Management sub-plan* that includes noise control measures and monitoring during construction and operation endorsed by EPA	NVMP

Table 1.4 M2G Environmental Authorisation No. 802 Conditions

No.	Condition	Reference within NVMP
18.3	Noise monitoring shall be carried out in accordance with Schedule 2, Table 4, Conditions 2 – 4.	Section 2.4, NVMP
18.4	Blasting on the site shall be monitored in accordance with Schedule 2, Table 5, Condition 4 and 5.	Section 2.8, NVMP
Schedule 2, Table 4 Noise Pollution		
1	Operations at the site shall be managed to ensure noise levels do not exceed the following levels at any of the compliance points. Mon – Saturday 7 am to 6pm 60dB(A) 6pm to 10pm 45dB(A) 10pm to 7am 35dB(A) Sunday and Public Holidays 8 am to 10pm 45dB(A) 10pm to 8am 35dB(A)	Section 2.4
2	For the purpose of assessment of noise limits, noise from the activities shall be measured at the most affected point within the residential boundary of the compliance point or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the residential boundary.	Appendix A, Air, Noise and Vibration Monitoring Plan
3	For the purpose of assessment, monitoring shall be carried out in accordance with the Environment Protection Regulation 2005 by a competent person who has obtained noise measurement qualifications from an Australian University, registered training organisation or qualifications acceptable to the Authority.	Section 8.2
4	Construction noise levels shall be monitored at each compliance point during the following periods: 1) 7am to 6pm once a week on alternative days whilst work is being carried out within 1000 metres of a compliance point; 2) 6pm to 10pm* daily, or time period and frequency agreed to by the Authority; and 3) 10pm to 7am* daily, or time period and frequency agreed to by the Authority. * Not required where works have ceased.	Section 8.2
5	Compliance Points 1 – 3 detailed in Schedule 1 are only considered compliance points where there is a permanent resident.	Section 8.2

No.	Condition	Reference within NVMP
Schedule 2, Table 5, Blasting		
1	Blasting on the site is only permitted between the hours of 8 am to 5 pm Monday to Friday, excluding Public Holidays.	Section 2.6
2	The airblast overpressure level from blasting operations in or on the site shall not exceed the following at any point at the compliance points detailed in Schedule 1: 1. 120dB (Linear Peak) for any blast; and 2. 115dB (Linear Peak) for 9 out of any 10 consecutive blasts initiated regardless of the interval between blasts.	Section 2.8 and Blast Management Plan
3	The ground vibration peak particle velocity from blasting operations carried out in or on the premises shall not exceed the following at any point at the compliance points detailed in Schedule 1: 1) 10 mm/s for any blast; and 2) a peak particle velocity of 5 mm/s for 9 out of any 10 consecutive blasts initiated regardless of the interval between blasts.	Section 2.8 and Blast Management Plan
4	For the purposes of assessment, monitoring shall be carried out by a person or body possessing appropriate qualifications and experience to perform the required measurements and in accordance with Australian Standard AS 2187.2-2006 *Explosives – Storage and use – Use of explosives*.	Section 8.2
5	For the purpose of assessment, monitoring shall be carried out for each blasting operation.	Section 8.2

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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.

This plan has 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.

The project comprises of the following key features:

Table 1.5 Key features of the M2G construction project

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.
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. The mini-hydro power generator will have the capacity to recover approximately 18% (without Tantangara flows) and 20% (with Tantangara flows) of the 1,138 kWh/ML of electricity required for pumping activities.

1.2 Purpose

This Noise and Vibration Management Plan (NVMP) forming part of the overarching Construction Environmental Management Plan (CEMP), details the mitigation measures and monitoring requirements required during the construction phase to manage potential noise and vibration related impacts associated with the construction of the Murrumbidgee to Googong Water Transfer (the project).

The purpose of the NVMP is to:

- Distinguish the potentially affected noise and vibration sensitive receivers based on predictive modelling;
- Determine the likely noise and vibration impacts predicted at sensitive receivers by works occurring onsite;
- Identify compliance monitoring locations based on occupied residences;
- Specify noise and vibration monitoring criteria; and
- Identify noise and vibration management strategies to mitigate noise and vibration impacts.

1.3 Objectives

The objectives and targets of this NVMP include:

- Detail proposed mitigation measures and best practice procedures to be adopted in the design and construction phases of the project to ensure noise and vibration impacts associated with construction activities comply with requirements;
- Outline the roles and responsibilities of site personnel with regards to vibration management on site;
- Detail the management procedures with regards to the implementation, monitoring, auditing and reporting requirements of this management plan; and
- Provide an efficient and proactive approach to addressing noise and vibration for the duration of the project.

1.4 Performance Goals

1.4.1 Noise

- ACT – Compliance with all noise and vibration level criteria as specified in the *ACT Environment Protection Regulation (2005);*
- NSW - Compliance with DECCW Interim Construction Noise Guideline;
- All noise and vibration level criteria to meet conditions specified in the NSW *Protection of the Environment Operations Act 1997* and *Protection of the Environment (Noise Control) Regulation 2008;*
- Zero noise complaints as a result of construction activities;
- Lower than predicted noise impacts; and
- Zero prosecutions or infringements by Regulatory Authorities.

1.4.2 Vibration

- Prevent damage to adjacent public utilities, structures and commercial and residential buildings from construction vibration;
- Prevent detrimental health impacts on the public and personnel in the vicinity of the pipeline associated with vibration; and
- Compliance with NSW and ACT Legislation and corresponding licences as detailed in Section 2.

2 Legislative & Regulatory Compliance

2.1 Relevant Legislation

Table 2.1 Relevant Noise and Vibration Legislation

Legislative Jurisdiction	Relevant Act
Australian Capital Territory (ACT)	*Environmental Protection Act 1997 (re published 2005)* *Environment Protection Regulation 2005*
New South Wales (NSW)	*Protection of the Environment Operations Act 1997* *Environment Planning and Assessment Act (1979)* *Protection of the Environment (Noise Control) Regulation 2008*

2.2 Guidelines and Standards

The following guidelines and standards are applicable:

2.2.1 NSW

- DECCW Interim Construction Noise Guidelines (2009);
- DECCW Assessing Vibration: a technical guideline;
- DECCW Environmental Noise Control Manual (ENCM);
- DECCW Environmental Criteria for Road Traffic Noise (ECRTN), May 1999; and
- DECCW Industrial Noise Policy 2000.

2.2.2 ACT

- Noise Environment Protection Policy, Environment Protection Authority, January 2010/

2.2.3 Other (Vibration)

- Australian Standard AS 2187.2 – 2006 –Ground Vibration and Airblast Overpressure;
- German Standard DIN 4150, Part 3;
- British Standard BS7385: Part 2-1993;
- British Standard BS6472: 1992; and
- ANZECC Guidelines “Technical Basis for Guidelines to Minimise Noise Annoyance Due to Blasting Over Pressure and Ground Vibration” (Sept 1990).

2.3 Noise - NSW

There is approximately 10km of works to be undertaken within New South Wales (NSW) from the ACT/NSW border near the Monaro Highway to the discharge point near Burra.

Construction noise in NSW is assessed with consideration to DECCW's *New South Wales Interim Construction Noise Guidelines (ICNG): July 2009*.

The recommended standard hours for construction activity as specified in the construction noise guidelines (in NSW) are as follows:

- Monday to Friday: 7 am to 6 pm;
- Saturday: 8 am to 1 pm; and
- No work on Sunday or public holidays.

Table 2.3 details the adopted construction noise goals for the proposed construction works in NSW. The *noise affected level* represents the point above which there may be some community reaction to noise. The *highly noise affected level* represents the point above which there may be strong community reaction to noise.

Table 2.2 NSW construction noise criteria, dB(A)

Time period	Management level L_{Aeq}(15 min)
Recommended standard hours Monday to Friday: 7 am to 6 pm; Saturday: 8 am to 1 pm;	Noise affected level – 40dB(A) Highly noise affected level – 75dB(A)
Outside recommended standard hours	Noise affected level – 35dB(A)

2.4 Noise - ACT

In the ACT there is currently no specific construction noise goals required to be met at identified receivers during the recommended construction hours. However, there are noise goals and mitigation measures required to be met with works exceeding 45 dB(A) at residential receivers or for works outside the recommended hours.

There is approximately 3km of works to be undertaken within the ACT from Angle Crossing to the ACT/NSW border near the Monaro Highway. The predominant legislation relating to environmental noise is the *Environment Protection Act 1997.* This Act is accompanied by the *Environment Protection Regulation 2005* which defines noise emissions taken to cause environmental harm.

Section 25 of the *Regulation* defines "Noise taken to cause environmental harm" as:

> *"For the Act, noise emitted from a place in the ACT is taken to cause environmental harm in an affected place if the noise level at the compliance point for the place from which the noise is emitted is louder than the noise standard for that place"*

Table 2.3 below defines noise standards applicable to M2G construction activities as specified in the *Regulation*. However, under Section 28 of the *Regulation*:

> *"noise is not taken to cause environmental harm in an affected place if the noise is emitted in the course of conducting an activity for which an approval is in force."*

An Environmental Authorisation will be acquired under Part 8 of the *Environment Protection Act 1997.* Environmental Authorisation No. 802 has specified revised noise criteria which would take precedence over those outlined in the Regulation. Revised noise criteria are defined in Table 2.3 below. The BWA will undertake construction activities in a manner which complies with all noise criteria stipulated in Environmental Authorisation No. 802.

Table 2.3 Noise criteria at sensitive receivers in ACT during construction activities – L_{10} dB(A)

Compliance Criteria	Mon – Sat 7am to 6pm (Day)	Mon – Sat 6pm to 10pm (Evening)	Mon – Sat 10pm - 7am (Night)	Sunday & Public Holidays 8am to 10pm	Sunday and Public Holidays 10pm to 8am
ACT Environment Protection Regulation **(Zone G)**	60 dB	45 dB	35 dB	45 dB	35 dB
Environmental Authorisation 802	60 dB #	45 dB #	35 dB #	45 dB #	35 dB #

- No specific noise goals for works within the recommended construction hours.

 # indicates applicable compliance levels for construction activities.

2.5 Vibration - NSW

The most recent NSW EPA guideline for assessing vibration impacts is *'Assessing Vibration; a technical guideline'* (February 2006). This NSW EPA guideline is based on British Standard BS 6472-1992. The February 2006 guideline allows for the summation effects of vibration at different frequencies using overall root mean square acceleration and also uses vibration dose values for intermittent construction activities, which are sensitive to peaks in the acceleration waveform. This method of assessment is currently best practice.

Disturbance to building occupants

For disturbance to human occupants of buildings, we refer to the NSW EPA's *'Assessing Vibration; a technical guideline'*. This document provides criteria which are based on the British Standard BS 6472-1992, *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*. Vibration sources are defined as C*ontinuous, Impulsive or Intermittent.* Section 2 of the technical guideline defines each type of vibration as follows:

Continuous vibration continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).

Impulsive vibration is a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.

Intermittent vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude'.

The criteria are to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis, as required in Section 2.3 of the guideline. Preferred and maximum values for continuous and impulsive vibration are defined in Table 2.4.

Table 2.4 Preferred and Maximum Weighted rms Values for Continuous and Impulsive Vibration Acceleration (m/s^2) 1-80Hz

(Source: DECC guidelines for vibration, 2006)

Location	Assessment period[1]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous Vibration					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or Night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or Night-time	0.04	0.029	0.080	0.058
Impulsive Vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or Night-time	0.64	0.46	1.28	0.92
Workshops	Day or Night-time	0.64	0.46	1.28	0.92
Notes:	Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am				

Intermittent vibration is to be assessed using vibration dose values (VDVs), measured in millimetres per second (mm/s). The VDV method is more sensitive to peaks in the acceleration waveform and makes corrections to the criteria based on the duration of the source's operation. The VDV can be calculated using the overall weighted rms acceleration of the vibrating source in each orthogonal axis and the total period during which the vibration may occur. Weighting curves are provided in each orthogonal axis in the DECCW guideline. Preferred and maximum VDV's are defined in Table 2.4 of the DECCW guideline and are reproduced in Table 2.5

Table 2.5 Acceptable Vibration Dose Values for intermittent vibration ($m/s^{1.75}$)

(reference: DECC Guideline for Vibration, 2006)

Location	Daytime [1]		Night-time [1]	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60
Notes:	*Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am* *Critical areas include hospital operating theatres and precision laboratories where sensitive operations are occurring.*			

Structural damage to buildings

Currently no Australian Standard exists for assessment of structural building damage caused by vibration. Therefore, reference is made to the British standard which is relevant to the assessment of structural damage.

British Standard

British Standard 7385: Part 2 "*Evaluation and measurement of vibration in buildings*", can be used as a guide to assess the likelihood of building damage from ground vibration including piling, compaction, construction equipment, road and rail traffic. BS 7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

BS 7385 recommends that the peak particle velocity is used to quantify vibration and specifies damage criteria for frequencies within the range 4Hz to 250Hz, which is the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The levels from the standard are given below in Table 2.6.

Table 2.6 BS 7385 Structural damage criteria

Group	Type of Structure	Peak Component Particle Velocity, mm/s		
		4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures, Industrial and heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 to 20	20 to 50	50

The levels set by this standard are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular types of buildings. These values relate to intermittent vibrations. Continuous vibration can give rise to magnifications due to resonances and may need to be reduced by up to 50%.

2.6 Blasting Criteria

Blasting produces ground-borne vibration and air blast overpressure, both of which can cause discomfort and, at higher levels, damage to property.

The *ANZECC Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (1990) have been adopted by the NSW EPA and used to establish ground vibration and airblast overpressure criteria for potentially affected locations.

Airblast overpressure is a pressure wave in the atmosphere which is caused by the detonation of explosives. Overpressure consists of both an audible (noise) and inaudible energy and is measured in dB (Lin Peak).

Ground vibration is the motion of the ground caused by the passage of seismic waves originating from a blast – measured as peak particle velocity (ppv).

The maximum level for airblast overpressure is 115dB (Lin Peak), and the maximum level for ground vibration is 5mm/sec (peak particle velocity – ppv). An allowable exceedance of 5% of the total number of blasts over a 12 month period is specified under the NSW Department of Planning's Conditions of Approval for both airblast overpressure and ppv.

2.7 Working Hours

The following work hours will apply to construction activities:

2.7.1 NSW

- General working hours will occur between 7.00 AM to 6.00 PM on Monday to Friday and 8.00 AM to 1.00 PM on Saturday, excluding public holidays; and
- Blasting activities will only occur between 9.00 AM and 5.00 PM Monday to Friday and 9.00 AM and 1.00 PM Saturday.

2.7.2 A.C.T

- General working hours will occur between 7.00 AM to 6.00 PM on Monday to Saturday. No works generating significant noise levels will be permitted on Sundays or public holidays.
- Blasting activities will only occur between 8.00 AM and 5.00 PM Monday to Friday, excluding Public Holidays.

2.8 DECCW Environment Protection Licence (NSW)

One of the activities on the project is excavation of material to allow the installation of the pipe work. Excavation (extractive activities) is a scheduled activity under the *Protection of the Environment Operations Administration (Scheduled Activities and Waste) Regulation 2008* – when it involves the extraction, processing or storage of more than 30,000 tonnes per year of extractive materials. As such, an Environment Protection Licence (EPL) is required to be obtained from the NSW Department of Environment, Climate Change and Water (DECCW). The EPL will detail noise and vibration compliance limits for this part of the project.

2.9 ACT EPA Environmental Authorisation (802)

Similarly to NSW, the ACT Environment Protection Authority, under Section 49 (1)(a) of the *Environment Protection Act 1997* will grant an Environmental Authorisation to John Holland Pty Ltd for the purposes of constructing the M2G pipeline. This Environmental Authorisation (No. 802) has stipulated blasting limits for the ACT section of the project and they are as follows:

Table 2.7 Blasting Criteria, Environmental Authorisation 802

Compliance Criteria	Blasting Limits
Airblast Overpressure (Environmental Authorisation 802)	The airblast overpressure level from blasting operations in or on the site shall not exceed the following at any point at the compliance points detailed in Schedule 1: 1. 120dB (Linear Peak) for any blast; and 2. 115dB (Linear Peak) for 9 out of any 10 consecutive blasts initiated regardless of the interval between blasts.
Peak Particle Velocity (Environmental Authorisation 802)	The ground vibration peak particle velocity from blasting operations carried out in or on the premises shall not exceed the following at any point at the compliance points detailed in Schedule 1: 1. 10 mm/s for any blast; and 2. a peak particle velocity of 5 mm/s for 9 out of any 10 consecutive blasts initiated regardless of the interval between blasts.

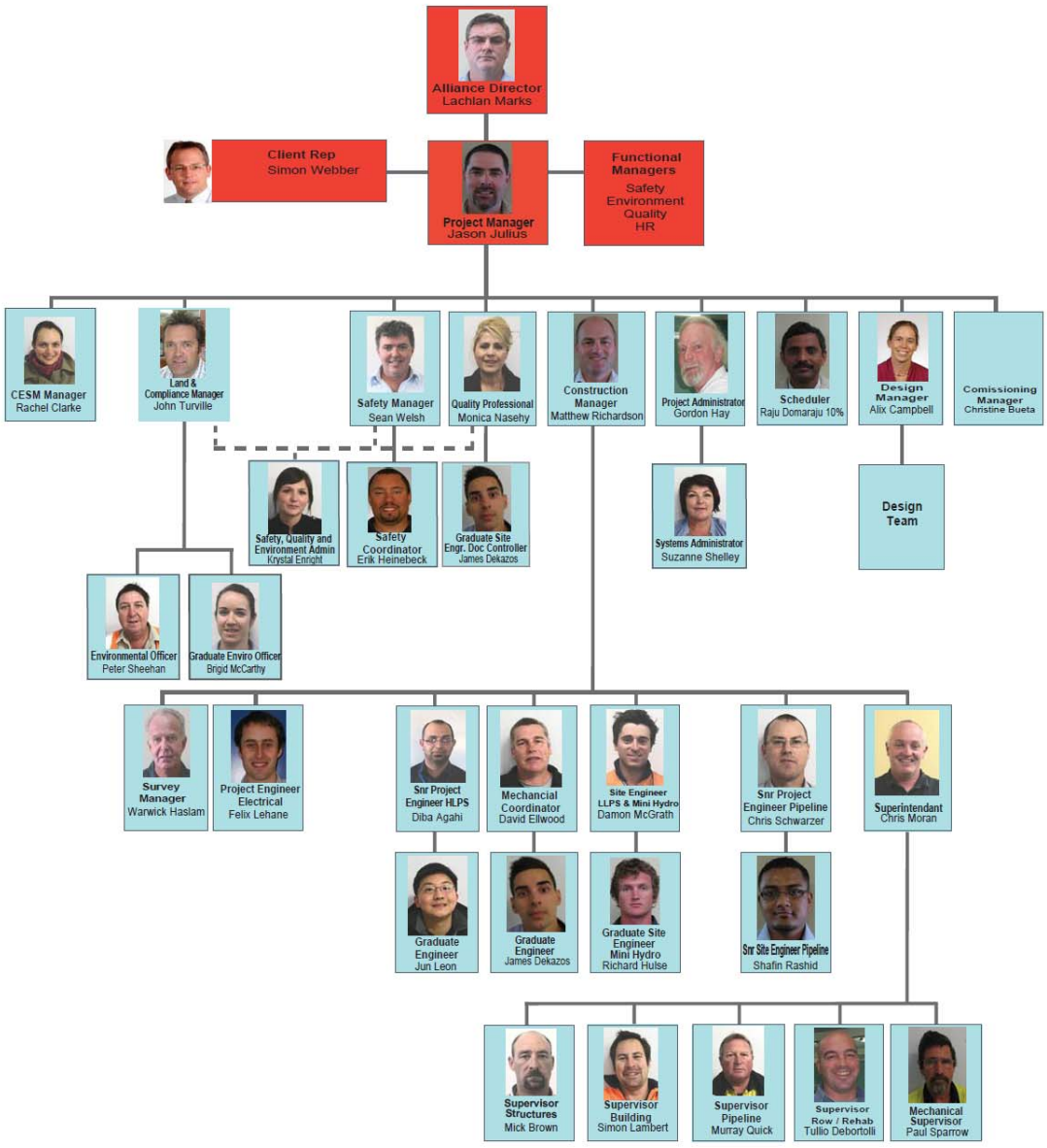
The monitoring compliance points are detailed in Appendix A, Air, Noise and Vibration Monitoring Plan.

3 Structure and Responsibilities

3.1 Site Structure

The CEMP details the M2G's organisational hierarchy and environmental responsibilities allocated to specific site personnel. It is the responsibility of the BWA to ensure compliance with all relevant conditions and legislative requirements.

Figure 3.1 Murrumbidgee to Googong Project Management Hierarchy



Project Management Group

Jason Julius
Simon Webber
Alix Campbell

3.2 Organisational Environmental Responsibilities

The M2G Land and Compliance Manager and other members of the environment and construction team including Engineers will be responsible for the day-to-day management of on-site Noise and Vibration environmental control and monitoring procedures. With assistance from the construction team, the M2G Land and Compliance Manager, or their delegate, will:

- Develop and deliver an appropriate Noise and Vibration monitoring program to ensure emissions to the environment are adequately measured and can be effectively managed;
- Review, and modify where required, the Noise and Vibration management program on a regular basis; and
- Monitor community feedback, monitoring results and program effectiveness and discuss with the relevant State and/or Territory Regulatory Authorities (EPA, Councils etc.) to ensure the on-going program is to the satisfaction of stakeholders.

The organisational responsibilities of other construction personnel are summarised in Table 3.1.

Table 3.1 Roles and responsibilities of construction personnel

Personnel	Responsibility
Project Manager	• Ensure that sufficient resources are in place to implement this Management Plan and to meet NSW Environment Protection Licence (EPL) and development consent conditions, and ACT Development Approval and Environmental Authorisation conditions.
Construction Manager	• Ensure that sub-contractors comply with Noise and Vibration Management Plan (NVMP) • Ensure environmental controls are implemented as per the NVMP • Liaise with CESM Manager regarding project progress and any potentially affected receivers on a daily basis. Construction Manager to be available to discuss impacts with landowners and community as required
Community Engagement and Stakeholder Manager	• Ensure that all potentially affected noise receivers are informed of the project, its stages, this NVMP and the results of monthly monitoring
Project Engineer	• Ensure compliance with NVMP • Monitoring of environmental controls
M2G Land and Compliance Manager	• Overarching compliance to statutory obligations and environmental management arrangements
M2G Environmental Officer	• Ensure compliance with this management plan, including training and monitoring • Liaise with the CESM Manager to keep potentially affected receivers up to date with project progress

3.3 Additional Specialist Resources

The general structure of environmental management on site is detailed in the CEMP. When required, additional specialist support will be outsourced to complement noise and vibration management on site. Specialist support may include the following:

3.3.1 Acoustic Specialist

Where required, a qualified acoustic and vibration specialist can be engaged to assist the project with the development, implementation and review of all proposed mitigation measures implemented on site. This specialist can assist the site management team by providing:

- Specialised input and advice during the planning and construction phases of activities which have a potential to generate noise and/or vibration impacts above predicted limits;
- Assist with the development of Environmental Work Method Statements (EWMS') for specific activities which require a higher degree of specialised input;
- Assist in the development of environmental training and toolboxes with regards to noise and vibration impacts;
- Support the Environmental Management Team in ongoing monitoring and improvement of noise and vibration control on site; and
- Assist CESM Manager with technical support when dealing with potentially affected receivers.

3.3.2 Dilapidation Inspector

Where required, a dilapidation inspector will be engaged to record and document the condition of identified structures which are at risk of vibration impacts prior to construction activities commencing. The dilapidation inspector can assist the site management team by:

- Accurately recording the present condition of structures identified at risk of vibration impacts;
- Accurately record the condition of structures after the completion of construction activities; and
- Assist in the comparison between pre and post construction dilapidation reports.

4 Environmental Aspects and Impacts – Noise and Vibration

4.1 Environmental Aspect, Impact and Risk Identification

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. 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 noise and vibration 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 discharge	Uncontrolled Discharges in minor quantities	Moderate breach of environmental Statutes	Major 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 Noise and Vibration Impacts and Risks

Table 4.3 Key Aspects, Potential Impacts and Risk Analysis for the Proposed Project

Aspect	Potential impact	Current Risk Category	Mitigation Measure (Refer to Tables 5.1, 5.2 & 5.3, Section 5)	Revised Risk Category
Vegetation clearing and Grubbing	Noise generated by machinery including bulldozers, chainsaws and mobile chippers	High	A1, A2, A5, A7, A8, A9, A11, A12, A13, A15, A16, A21, A22, A23, A24, A25, A26, A29, A30, A33	Medium

Aspect	Potential impact	Current Risk Category	Mitigation Measure (Refer to Tables 5.1, 5.2 & 5.3, Section 5)	Revised Risk Category
Bulk earthworks (site preparation, site offices, pipeline excavation)	Vibrations and noise associated with compaction and bulk earthworks impacting on sensitive receivers.	Extreme	A1, A2, A5, A7, A8, A9, A11, A12, A13, A15, A16, A17, A21, A22, A24, A25, A26	Medium
	Excessive noise generated during bulk earthworks resulting in a community complaint.	Extreme	A1, A2, A5, A8, A9, A13, A22, A23, A24, A25, A29, A30, A31, A32, A33, A34	High
Construction Phase	Excessive noise generated by construction fleet resulting in community complaints or public nuisance.	Extreme	A1, A2, A5, A7, A9, A10, A11, A12, A13, A14, A15, A16, A17, A20, A21, A22, A25, A26, A27, A28, A34	Medium
	Damage to structural buildings due to vibration impacts associated with construction activities.	Extreme	A1, A2, A4, A5, A6, A19, A21, A35, A37	Medium
Blasting Activities	Air blast overpressure from blasting activities resulting in community complaints or property damage.	Extreme	A1, A2, A4, A5, A19, A21, A30,	Low
	Ground vibration as a result of blasting activities resulting in structural damage to existing infrastructure or community complaints	Extreme	A1, A2, A4, A19, A21, A29, A30, A32, A33, A35, A36, 37, A38	Low
	Ground vibration as a result of blasting activities resulting in damage to surrounding fauna habitat	High	A1, A2, A4, A19, A21, A35	Low

4.3 Predicted Construction Impacts

Predicted construction noise has been broken up into the following construction categories:

- Angle crossing (low lift and high lift pump stations);
- Pipeline construction noise;
- Discharge construction noise;
- Construction compound noise;
- Construction traffic noise;
- Construction vibration; and
- Construction blasting.

Appendix A shows the locations of all sensitive receivers along the pipeline route.

4.3.1 Angle crossing (low lift and high lift pump stations)

The predicted construction noise at the ACT and NSW potentially impacted receivers for each stage of the Angle crossing works at the low lift pump station and high lift pump station is shown in Table 4.4.

Table 4.4 Predicted construction noise at ACT and NSW potentially impacted receivers for each stage of Angle crossing works at the low and high lift pump stations, dB(A)

Receivers	Excavation		Piling	Blasting	Oversized deliveries	
	Low lift pump station	High lift pump station	Low lift pump station	High lift pump station	Low lift pump station	High lift pump station
Angle crossing beach, north end	78	50	78	47	72	50
Angle crossing beach, south end	68	47	67	45	62	47
Most affected ACT residence	29	26	31	22	20	25
Most affected NSW residence	24	33	28	28	16	33

During the recommended construction hours, construction noise generated by activities at the low lift pump station and high lift pump station are expected to comply with the noise criterion of 60 dB(A) at the surrounding ACT residences.

In addition, due to concerns of public safety during construction, it has been agreed with ACT Parks Conservation Service (PCS) that Angle Crossing beach and parking area be temporarily closed for the duration of construction – a period of approximately 16 months. As a result, there should not be any recreational users within the immediate vicinity of the construction area, mitigating the potential for adverse impact.

4.3.2 Pipeline construction noise

The predicted construction noise for each stage of the project has been estimated for different distances and is shown in Table 4.5.

Table 4.5 Predicted pipeline construction noise for different distances, dB(A)

Construction stage	Distance (m)						
	50	100	250	500	1000	2000	3000
Construction	73	65	56	49	42	33	27
Oversize deliveries	66	58	49	42	35	26	20

For receivers within NSW, *noise affected level* during recommended construction hours is 40 dB(A), therefore construction activities have the potential to exceed the NSW *noise affected level* when they are within approximately 1,200 m of residences for construction activities. The *highly noise affected level* of 75 dB(A) may be exceeded when construction activities are within 40 m of construction works.

Outside of the recommended construction hours there is the potential for oversized deliveries to occur which could exceed the ACT and NSW noise goal of 35 dB(A) when residential receivers are within 1,000 m.

Up to 10 residential receivers have the potential to exceed *the highly noise affected level* where there is likely to be a reaction to construction noise. Approximately 100 residential receivers have the potential to exceed the *noise affected level* where there may be some reaction to construction noise, though to a lesser extent. Due to the transient nature of the construction activity, residential receivers should only be exposed to the *highly noise affected level* for less than 1 day, which is considered only a short duration and is likely to significantly mitigate the reaction to construction noise. There is the potential for residential receivers to be exposed to the *noise affected level* (40 dB(A) to 75 dB(A)) for up to 37 days.

The mitigation measures detailed in section 6 would be implemented and all potentially impacted residents will be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

4.3.3 Discharge structure construction noise

The revised location of the discharge structure reduces the number of receivers potentially affected by the discharge structure in terms of construction and operation noise.

Based on the location of the discharge structure, preliminary model results indicate the predicted received noise level due to operation of the discharge structure at the nearest affected receiver is expected to be approximately 28 dB(A), which is below the *noise affected level* for night time activities of 35 dB(A).

The mitigation measures detailed in section 5 would be implemented and all potentially impacted residents will be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

4.3.4 Construction compound noise

The predicted compound construction noise at the nearest potentially impacted receivers is shown in table 4.6.

Table 4.6 Predicted Compound Construction Noise at Nearest Potentially Impacted Receivers

Compound area (chainage)	Potentially impacted receiver	Noise level
Low lift pump station lay down	Angle Crossing beach, north end	**53**
	Angle Crossing beach, south end	**48**
	All other receivers	<35
High lift pump station compound	Angle Crossing beach, north end	39
	Angle Crossing beach, south end	36
	All other receivers	<35
Pipe laydown (CH 650)	All receivers	<35
Main office (CH 2000)	Residence	**42**
	All other receivers	<35
Pipe lay down (CH 4800)	All receivers	<35
Spoil and pipe storage (CH 6950)	Residence	**43**
	Residence	37
	All other receivers	<35
Pipe lay down and material storage (CH 10800)	Residence	**51**
	Residence	**42**
	All other receivers	<35
Discharge compound	All receivers	<35

The *noise affected level* during recommended construction hours is 40 dB(A) therefore compound activities have the potential to exceed the NSW *noise affected level* at 5 residences within close proximity to the compounds. The *highly noise affected level* of 75 dB(A) is not expected to be exceeded. Potentially noise affected residences and the location of the construction compounds are shown in Appendix A.

The mitigation measures detailed in section 6 would be implemented and all potentially impacted residents will be informed of the nature of the works, expected noise levels, duration of works and a method of contact.

A number of activities have proven to be particularly annoying to nearby residences[1]. These include the activities listed on Table 4.7.

Table 4.7 List of annoying noise activities and BWA response

(taken from INCG, DECC, July, 2009)

Activity	Project Response
Use of 'beeper' style reversing or movement alarms, particularly at night-time	No planned night works. If out of hours works (OOHW) are required, an approval must be received prior to undertaking OOHW by the Director-General of the NSW Department of Planning
Use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work	Not applicable
Grinding metal, concrete or masonry	Only occurs in pump stations (ACT), Burra Creek outlet (NSW) and pits. This would be a minor part of the works. Respite periods as per Table 5.2 A23 will be implemented. Project specific respite offer and specific notification A32 & A33
Rock Drilling	Rock drilling may occur prior to blasting. Respite periods as per Table 5.2 A23 will be implemented. Project specific respite offer and specific notification A32 & A33
Line Drilling	Not Applicable
Vibratory Rolling	Respite periods as per Table 5.2 A23 will be implemented. Project specific respite offer and specific notification A32 & A33

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MURRUMBIDGEE TO GOOGONG WATER TRANSFER - NOISE AND VIBRATION MANAGEMENT PLAN
BWA-M2G-EN-ECP-005-5 20

[1] *Interim Construction Noise Guidelines Department of Environment and Climate Change July 2009 pp16*

Activity	Project Response
Rail tamping and regulating	Not applicable
Bitumen milling or profiling	Not applicable in NSW
Jack hammering, rock hammering or rock breaking	Respite periods as per Table 5.2 A23 will be implemented. Project specific respite offer and specific notification A32 & A33
Impact piling	Not applicable

If any of these activities are to be undertaken they should be factored into the quantitative assessment by adding 5 dB to the predicted levels.

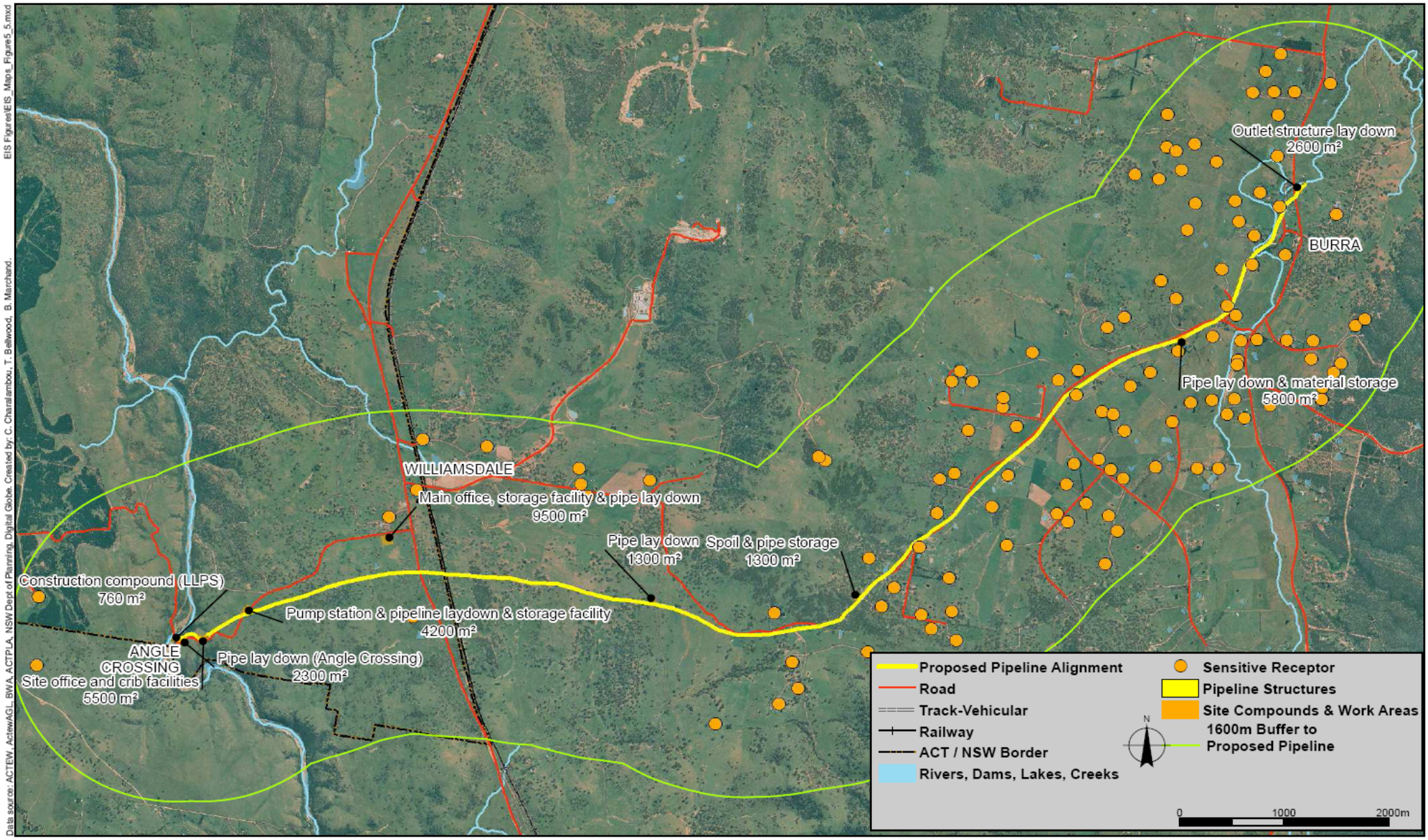


Figure 4.1 Construction site and sensitive receiver location

4.3.5 Construction traffic noise

Heavy vehicles will be required for the following haulage tasks:

- Construction and mechanical equipment (semi-trailers);
- Ready mixed concrete ($5m^3$ capacity trucks);
- Reinforcement steel (semi-trailers); and
- Pipes (semi-trailers).

The major routes expected to be taken by construction vehicles to access the site are:

- Monaro Highway.
- Angle Crossing Road.
- Burra Road; and
- Williamsdale Road.

The construction traffic on the Monaro Highway and Burra Road would not lead to an increase in existing noise levels of more than 2 dB(A). The predicted traffic noise at the most exposed resident on Angle Crossing Road is $L_{A10(18hr)}$ 52 dB(A), which is below the ACT road traffic noise criteria of $L_{A10(18hr)}$ 63 dB(A).

The closest residence to Williamsdale Road is located approximately 50 m from the road. The predicted construction traffic noise at the closest residence is $L_{Aeq(1hr,peak)}$ 49 dB(A) which is below the NSW road traffic noise criteria of $L_{Aeq(1hr,peak)}$ 55 dB(A). Refer to Section 5.3 in the Noise and Vibration Assessment report (BWA, July 2009).

Heavy vehicles attending the site would be restricted, where possible, to between 7:00 am and 6:00 pm to minimise the risk of sleep disturbance. Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours. The mitigation measures detailed in section 6 would be implemented to reduce the impact of sleep disturbance. All drivers would be sensitised to the potential for sleep disturbance on local residents and would be expected to take practical and reasonable measures to minimise the impact during the course of their delivery activities. Residents to be impacted by such activities outside of normal construction hours will be notified as early as possible prior to activity (pending approval from the Department of Planning).

4.3.6 Construction vibration

Pile driving may be undertaken at the low lift pump station, which is located at a distance greater than 300 m from the nearest residence. At these distances vibration levels from pile driving are not expected to be perceptible.

The majority of construction activities along the pipeline would not produce perceptible levels of vibration due to the distance from the receivers. However, some activities such as excavation, rock breaking, rolling and compacting may produce levels of vibration that are perceptible and potentially intrusive when construction activities are located within 50 m of residences. The expected levels of ground vibration will not be sufficient to cause building damage. Resident would be informed that the vibration levels are minimal and should not give rise to structural damage.

Ten residential receivers have the potential to occasionally exceed human comfort levels briefly. Residential receivers should only be exposed to intermittent vibration for less than 1 day per event, which is considered only a short duration and is likely to significantly mitigate the reaction to construction vibration impact. Potentially impacted residents would be informed of the nature of the works, expected noise and vibration levels, duration of works and a method of contact.

Vibration mitigation measures detailed in section 6 would be considered when construction works are within 50 m of residents.

Appendix A maps the pipeline construction noise contours and surrounding residential receivers.

4.3.7 Construction blasting

There is the potential for blasting to be required for excavations of the low lift pump station, high lift pump station, sections of the pipeline and the discharge structure. Blasting will be used in areas where hydraulic excavators with hammer attachments are ineffective due to large formations of hard rock. Areas of rock that potentially require blasting have been identified at the following pipeline chainages and areas:

- CH387 – CH950; (ACT Lot 0 DP 1654)
- CH1892 – CH1985; (ACT Lot 0 DP 1653)
- CH6850 – CH6921(NSW Lot 1 & 2 DP1065476) and
- Low lift pump station for construction of the base.

The assessment of blasting noise and vibration impacts revealed that there are up to 22 residents within 800m of the potential blast locations, where there is the potential to exceed the ANZECC blasting criteria.

No residential receivers are expected to exceed the building damage criteria.

All residential receivers should be informed when blasting is to be undertaken. Methods to reduce the impact of airblast overpressure are detailed in Section 6 (Environmental Mitigation Measures), though the blast contractor would determine their effectiveness and practicability. Blast monitoring should be undertaken to assess compliance and confirm the predictions. Prior to a blast the parameters are designed and confirmed by an interdependent consultant who will ratify the site constants will not be exceeded.

5 Environmental Mitigation Measures

This section provides a range of noise and vibration mitigation measures. General environmental control measures have been identified in Section 5.1 to highlight generic measures that will be adopted during construction.

Reasonable and feasible mitigation measures have been identified in Section 5.2 as recommended in DECCW's Interim Construction Noise Guidelines. Should project specific noise levels be exceeded, the Bulk Water Alliance will examine feasible and reasonable mitigation measures, considering community preferences, and determine resultant responses (e.g. considering actual noise levels versus predicted noise levels, number of people affected, likely impacts on activities, % of time impact occurs).

Drilling and Blast Impact Mitigation Measures have been tabled in Section 5.4.

The management of community and stakeholder issues / concerns will be addressed in the Community Engagement and Stakeholder Management Plan (CESM Plan).

All control measures and safeguards will be monitored and audited as detailed in Section 8 of this NVMP.

5.1 General Noise and Vibration Control Measures

Table 5.1 General Environmental Control Measures

Ref	Control Measure	Responsibility	Timing / Frequency
A1	Ensure strict compliance with construction hours. This requirement to be communicated to all Bulk Water Alliance staff through inductions and toolbox meetings. This will mean that no plant or machinery is to be started ("warmed up") prior to the approved start time.	Project Manager / Construction Manager	Ongoing
A2	Provide an induction to site personnel (including sub-contractors) addressing the requirements of this NVMP and their responsibilities with regard to noise and vibration management.	Land and Compliance Manager (or their delegate)	Pre-construction
A3	Submit reports to the BWA (and relevant State or Territory Regulatory Authorities when requested) outlining environmental performance and compliance with this NVMP.	Land and Compliance Manager / Environmental Manager	Ongoing
A4	Prepare a Blast Management Strategy to the satisfaction of the relevant Regulatory Authority (ACT EPA / NSW EPA) ensuring blasting times are strictly adhered to and blasting criteria are met.	Blast contractor	Pre-blasting
A5	Provide continuous education of supervisors, operators and sub-contractors on the need to minimise noise through Toolbox meetings and on-site training.	M2G Land and Compliance Manager	Ongoing
A6	Select appropriate sized rock excavation equipment and design procedures for their use in order to comply with vibration emission limits.	Project Engineer / Foreman	Ongoing

Ref	Control Measure	Responsibility	Timing / Frequency
A7	Ensure equipment is operated in the correct manner including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components, repair of leakages in compressed air lines and shutting down equipment not in use.	Superintendent / Foreman	Ongoing
A8	Position plant on site to reduce emission of noise to the surrounding area. i.e. away from potentially effected receivers.	Foreman	Ongoing
A9	Select site access points and haul road locations away from sensitive receivers.	Construction Manager	Ongoing
A10	Regularly grade access roads to reduce noise from trucks rattling.	Construction Manager	Ongoing
A11	Ensure equipment and diesel combustion engines (including delivery and disposal trucks) are turned off when not in use.	Construction Manager / Foreman	Ongoing
A12	Ensure machinery used is appropriately sized to prevent overloading and associated over-revving.	Foreman	Ongoing
A13	Where possible, locate construction equipment in a position that provides the most acoustic shielding from buildings and topography.	Foreman	Ongoing
A14	Ensure traffic movement is kept to a minimum, e.g. ensure trucks are fully loaded so that the volume of each delivery is maximised and the number of trips is therefore minimised.	Foreman	Ongoing
A15	Ensure plant and equipment is adequately maintained.	Foreman	Ongoing
A16	Undertake monitoring of noise levels from a selection of fixed and mobile plant every six months and ensure that levels are not degraded by lack of maintenance and comply with respective Australian Standards (Refer AS 2436 -1981).	M2G Land and Compliance Manager	At commencement of project and thereafter every six months
A17	Undertake monthly monitoring of construction noise levels at sensitive receivers to check for compliance. Prepare monthly monitoring summaries for submission to the Bulk Water Alliance and relevant Regulatory Authorities when requested.	M2G Land and Compliance Manager	When new activities are commenced in new areas
A18	All monitoring results will be reported to the satisfaction of the BWA. A monitoring summary report will be submitted to the BWA and records will be maintained for submission to relevant Regulatory Authorities upon request.	M2G Land and Compliance Manager	Monthly
A19	Design blasts to not exceed the ANZECC limits or, alternatively, develop other mitigation measures that mitigate the potential impacts (negotiate with the	Construction Manager	Each blast event

Ref	Control Measure	Responsibility	Timing / Frequency
	potentially affected residents)		
A20	Stabilise access tracks with gravel or similar, all weather material and position access points away from sensitive receivers	Superintendent	Pre-construction
A21	Develop Construction Method Statement (CMS) to assist in minimising noise and vibration generating activities. This CMS to be toolboxed to construction staff regularly.	M2G Land and Compliance Manager	Pre-construction

5.2 Reasonable and Feasible Noise Mitigation

When noise impacts exceed the guideline levels at residences, an evaluation of reasonable and feasible mitigation measures will be undertaken to reduce the impacts.

Table 5.21 provides a list of noise mitigation measures that may be applied wherever reasonable and feasible. The person responsible for undertaking this evaluation is also highlighted. This list is not exhaustive and other measures may also be identified by the Construction Manager, CESM Team Leader or Superintendent during the course of the project.

Table 5.2 Reasonable and Feasible Noise Mitigation Measures

Ref	Control Measure	Responsibility	Timing / Frequency
A22	Construction hours and scheduling Where feasible and reasonable, noisy activity will be carried out in the least sensitive time periods (to be determined through community consultation)	Superintendent	Ongoing
A23	Construction respite period Noisy activities will be carried out in blocks of time (e.g. all rock hammer operators have lunch break at the same time)	Construction Manager / Superintendent	Ongoing
A24	Equipment selection Where feasible and reasonable, use quieter construction methods (e.g. choice of plant / equipment or methods). E.g. Enclosing noisy compressors or pumps and fitting silencers to any pressure operated equipment and engines, reducing need for rock hammers by blast design or rock splitters.	Construction Manager / Superintendent	Ongoing
A25	Maximum noise levels Plant and equipment will have noise levels monitored and checked. Ensure maintenance of machinery is carried out regularly. Vehicles found to produce excessive noise compared to normal industry expectations should be stood down until repairs or modifications can be made.	M2G Land and Compliance Manager / Superintendent	Ongoing (Including Monthly Monitoring at set locations)

Ref	Control Measure	Responsibility	Timing / Frequency
A26	Use and siting of plant Noise emitting plant to be directed away from sensitive receivers. Shielding from terrain and objects should be considered in equipment location. Simultaneous operation of noisy plant within discernable range of sensitive receiver is to be avoided	Construction Manager / Superintendent	Ongoing
A27	Plan worksites and activities to minimise noise and vibration Plan traffic flow, parking and loading/unloading areas to minimize reversing movements within the site (min. reverse beepers)	Construction Manager / Superintendent	Ongoing
A28	Minimise disturbance arising from delivery of goods to construction sites Loading and unloading of materials/deliveries is to occur as far as possible away from sensitive receivers. Select site access points as far as possible away from sensitive receivers	Construction Manager / Superintendent	Ongoing
A29	Letterbox drops Project updates provided in letterboxes of sensitive receivers	CESM Manager	Ongoing
A30	Individual briefing Visit resident at least 48 hours ahead of potentially disturbing activities	CESM Manager / Construction Manager	Prior to upcoming noisy activities
A31	Project specific respite offer When residents are subject to lengthy periods of noise or vibration. The offer could comprise pre-purchased movie tickets, alternative temporary accommodation or similar offer	CESM Manager	Ongoing
A32	Specific notifications These notifications are letterbox dropped or hand delivered 7 days ahead of particularly noisy activities. This supports other periodic notifications or to advertise unscheduled works	CESM Manager	Prior to upcoming noisy activities
A33	Phone calls Directly notify residents ahead of upcoming noisy activities.	CESM Manager	Prior to and during upcoming noisy activities
A34	On going Evaluation As the project proceedes, re-evaluation of construction methodology to assess the feasibility and reasonableness of using quieter methods, wherever practicable.	Construction Manager or Superintendent	Ongoing

5.3 Drilling and Blasting Mitigation Measures

Drilling and blasting provides for an efficient and cost effective means of fracturing rock from its parent material.

The BWA is committed to minimising blast related impacts (both in intensity and duration) on sensitive receivers by implementing a robust Community Engagement and Stakeholder Management program (via the CESM Plan).

Table 5.3 Drill and Blast Mitigation Measures

Ref	Control Measure	Responsibility	Timing / Frequency
A35	The blast charge configuration will be selected by the specialist Blasting Sub-Contractor to minimise impacts on sensitive receivers. Before blasting can commence at a site, critical locations will be identified and appropriate measures taken (e.g. reduction of blast size) to limit overpressure and vibration to acceptable levels.	Construction Manager	Prior to intended blasts
A36	All sensitive receivers will be informed of blasting activities, as per the CESM Plan with blasting to be scheduled for a set time and day so that blasting will not occur more than once on any set day. Any alteration from the agreed arrangement will be communicated to nearby residences to avoid any surprises.	CESM Manager	Prior to intended blasts
A37	A monitoring regime for all blasts will be developed which includes obtaining waveform traces at the three most affected locations.	Construction Manager	Prior to intended blasts
A38	Where airblast overpressure levels are anticipated to exceed ANZECC guidelines, the Bulk Water Alliance will negotiate an arrangement with the potentially affected residential receivers so as to mitigate any adverse impact on amenity.	CESM Manager	Periodic – prior to intended blasts
A39	Consideration will be given to delaying or cancelling the blast under extreme enhancing weather conditions. E.g. Temperature inversion layer	Construction Manager	Prior to intended blasts

6 Communication and Consultation

6.1 Community Engagement and Stakeholder Management

Close community liaison will be maintained to ensure that local residents are aware of the times and durations when they may be affected by construction noise and vibration and to provide an avenue for communication between the community and the Bulk Water Alliance.

All communication and consultation will be undertaken in accordance with the project Community Engagement and Stakeholder Management (CESM) Plan. The CESM Manager is responsible for the interface with the community. This includes (but is not limited to) notification of blasts, notification of temporary road closures, community engagement regarding construction (including blasting) and the complaints process. The CESM Manager reports to the M2G Client representative whilst working in conjunction with the M2G Project Manager, M2G Construction Manager, Site Superintendent, M2G Land and Compliance Manager, M2G 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 NVMP, site management practices, monitoring results and any other relevant issues.

Table 6.1 Communication Network

Communication	Actions
Project personnel including sub-contractors/suppliers	• A site induction and environmental 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** • Environment and Sustainable Development Directorate (ACT EPA) • Parks, Conservation Service (PCS) • ACT Heritage Unit **NSW** • NSW EPA • 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 Management 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 noise and vibration 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, particularly prior to significant noise and vibration generating activities such as drilling and blasting and rock crushing and placement.

The community and stakeholder groups identified in the CESM Plan will be informed of the duration of the works, what noise or vibration impacts that they are likely to expect and they will be given a 1800 toll free number to contact the BWA CESM team should they wish to register a complaint regarding any aspect of the construction project, not just noise and/or vibration related impacts.

The BWA CESM team will automatically 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.

6.3 Noise management consultation

A copy of this NVMP will be made available to potentially affected noise receivers before commencement of works by the CESM Manager. Noise monitoring results will also be made available for the potentially affected receivers upon request.

7 Training, Awareness and Competence

An open communication process will be fostered between the BWA, its staff and sub-contractors, government agencies and the community. The Community Engagement and Stakeholder Management Plan (CESM Plan) outlines the networks of communication that will occur throughout the project.

Table 7.1 Communication Network

Communication required with:	Type of Communication and Training
Project personnel including sub-contractors	A site induction and environmental 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.
Government agencies	On-going consultation will occur with agencies including : **NSW** - Palerang Council, NSW EPA **ACT** – ACT EPA and PCL (TAMS) An annual report will be prepared addressing all conditions contained in the EPL and submitted to NSW EPA
Community	Project information will be made available to the community in accordance with the CESM Plan through advertisements, community notices and newsletters. Community complaints will be handled in accordance with the complaints system detailed in the CESM Plan.

The outcomes of inspections, monitoring, audits and the completion of checklists will facilitate the identification of problems, recurring issues or areas for improvement.

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

8 Inspection, Auditing & Monitoring

8.1 Inspection

The M2G Land and Compliance Manager or their delegate will undertake monthly inspections of construction activities to ensure compliance with the requirements of the NVMP and the noise control measures identified in Section 5. This will also identify opportunities for improvement in noise management performance.

An inspection report would be requested to facilitate follow up of any identified issues. A copy of the report will be distributed to relevant site personnel and a response will be prepared outlining the action taken/proposed within 7 working days. A summary of inspection outcomes will be provided to the Bulk Water Alliance on a monthly basis.

8.2 Monitoring

Noise and vibration monitoring will be undertaken on a monthly basis (unless otherwise specified in ACT Environmental Authorisation or NSW EPL) by a suitably qualified environmental professional. A detailed air, noise and vibration monitoring plan has been developed and is included as Appendix B of this document.

Monitoring during the construction works will be undertaken for a number of reasons:

- Equipment monitoring (with expected noise emissions levels);
- Complaint response;
- Construction Noise Levels; and
- Blasting overpressure levels.

8.2.1 Equipment noise

Monitoring of plant and equipment noise will be undertaken to assess noise emission levels and any increase in noise levels detected in order that these be addressed. Plant and equipment operating on the site for more than 6 months will be re-tested. Any plant or equipment perceived as being noisy or noisier than other similar machines will be checked for mechanical repairs or replacement.

8.2.2 Complaint response

Noise monitoring will be undertaken at a complainant's property after receiving a complaint related to construction noise and/or vibration in order to assess the nature and cause of the complaint where reasonable and feasible noise mitigation measures will be implemented.

8.2.3 Construction noise

Construction noise levels will be monitored to:

- Compare the actual construction noise emissions against predicted levels; and
- Identify opportunities for implementation of new feasible and reasonable noise management strategies.
- Confirm predicted noise levels.

Monitoring would be undertaken at representative sensitive receivers at least monthly in proximity to construction activities. Should monitoring of noise exceed predicted levels, reasonable and feasible mitigation measures outlined in Section 6 will be investigated and implemented.

Vibration
Vibration monitoring will be undertaken at the commencement of construction activities to ensure that predicted peak particle velocity (mm/s) levels are not being exceeded. Vibration monitoring to be undertaken where works are occurring within 50m of a residential receiver.

Blasting
Blast overpressure and vibration will be monitored at sensitive receivers to assess levels generated from blasting activities. Monitoring will be undertaken at the three most affected sensitive receivers within 2000 m of blasting activities to measure air blast overpressure.

The Bulk Water Alliance will negotiate an agreed outcome with potentially affected residents who are predicted to receive blasting overpressure levels greater than the ANZECC criteria. The BWA may provide temporary alternative accommodation to receivers to be adversely impacted by noise and vibration levels above acceptable levels for more than 48 hours

8.3 Auditing

The monthly noise monitoring form will provide a framework for on-going auditing of control measures and safeguards identified in this NVMP.

The NVMP will be audited at least annually.

8.4 Reporting

Performance reports will be made available to the Bulk Water Alliance on a monthly basis. The reports will summarise:

- Monitoring results and comparison with noise objectives;
- Complaints (received by the Bulk Water Alliance);
- Inspection outcomes;
- Community notifications and;
- Other relevant issues.

Where monitored noise levels exceed the predicted noise levels, feasible and reasonable mitigation measures will be identified and implemented.

9 Review and Improvement of NVMP

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 this NVMP will be reviewed and opportunities for improvement will be identified and discussed with site personnel.

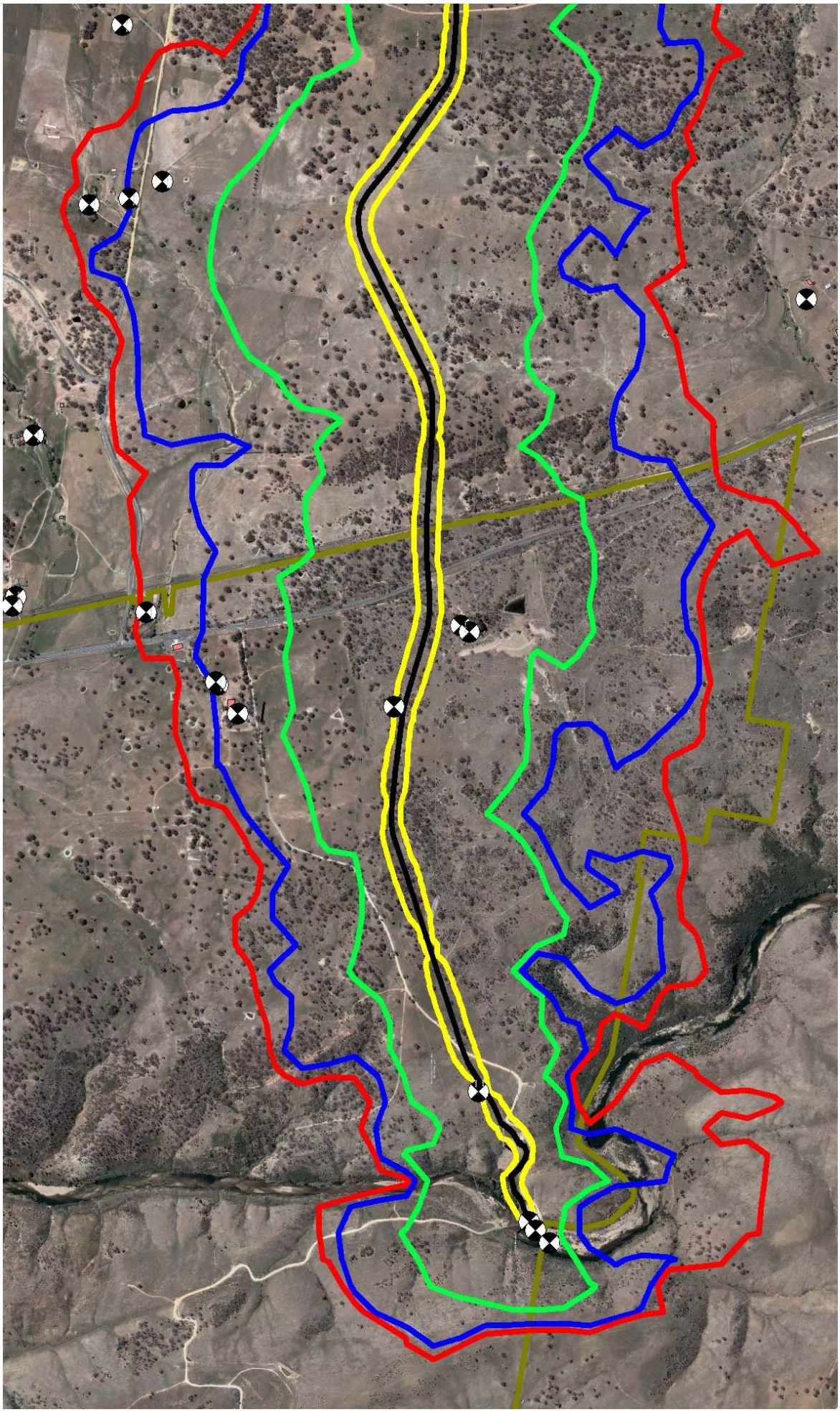
A system for the review and improvement of the environmental management system is detailed in the CEMP.

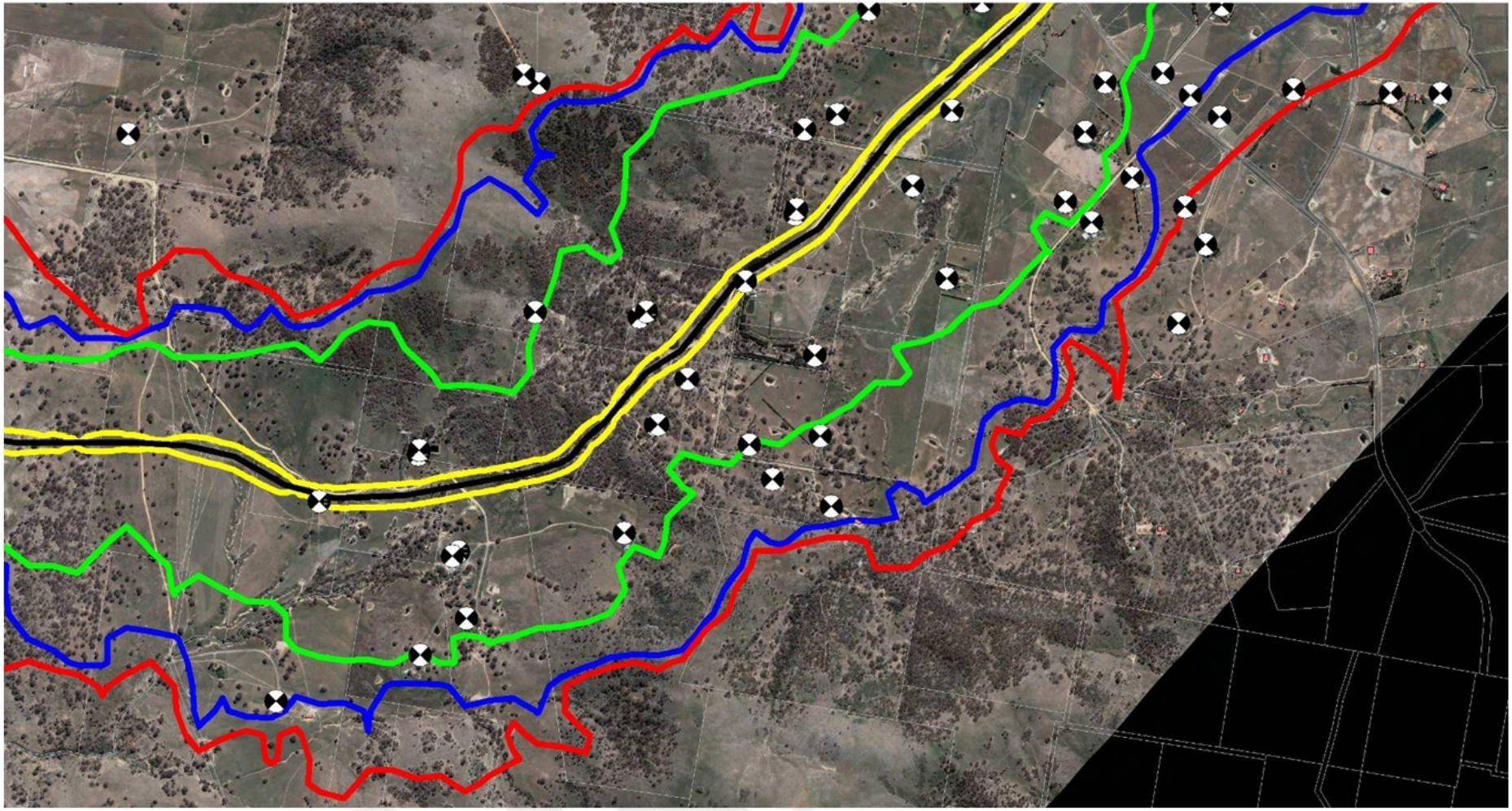
Table 9.1 should be utilised to annotate identified amendments in between annual reviews.

Table 9.1 Review Register of Significant Changes

Reference	Amendment Required	Status
1	Revised alignment – Hard rock realignment – Revise CNVMP to incorporate revised noise contours	Closed
2	Table 3.1 or App. C – Noise monitoring – NSW – 3-4 monitoring events – 1 is sufficient	Closed
3	Reference to Construction Noise Guidelines	Closed
Appendix B	Removal of Appendix B 800 metre Blasting Buffer Contour and locations of sensitive receivers	Closed

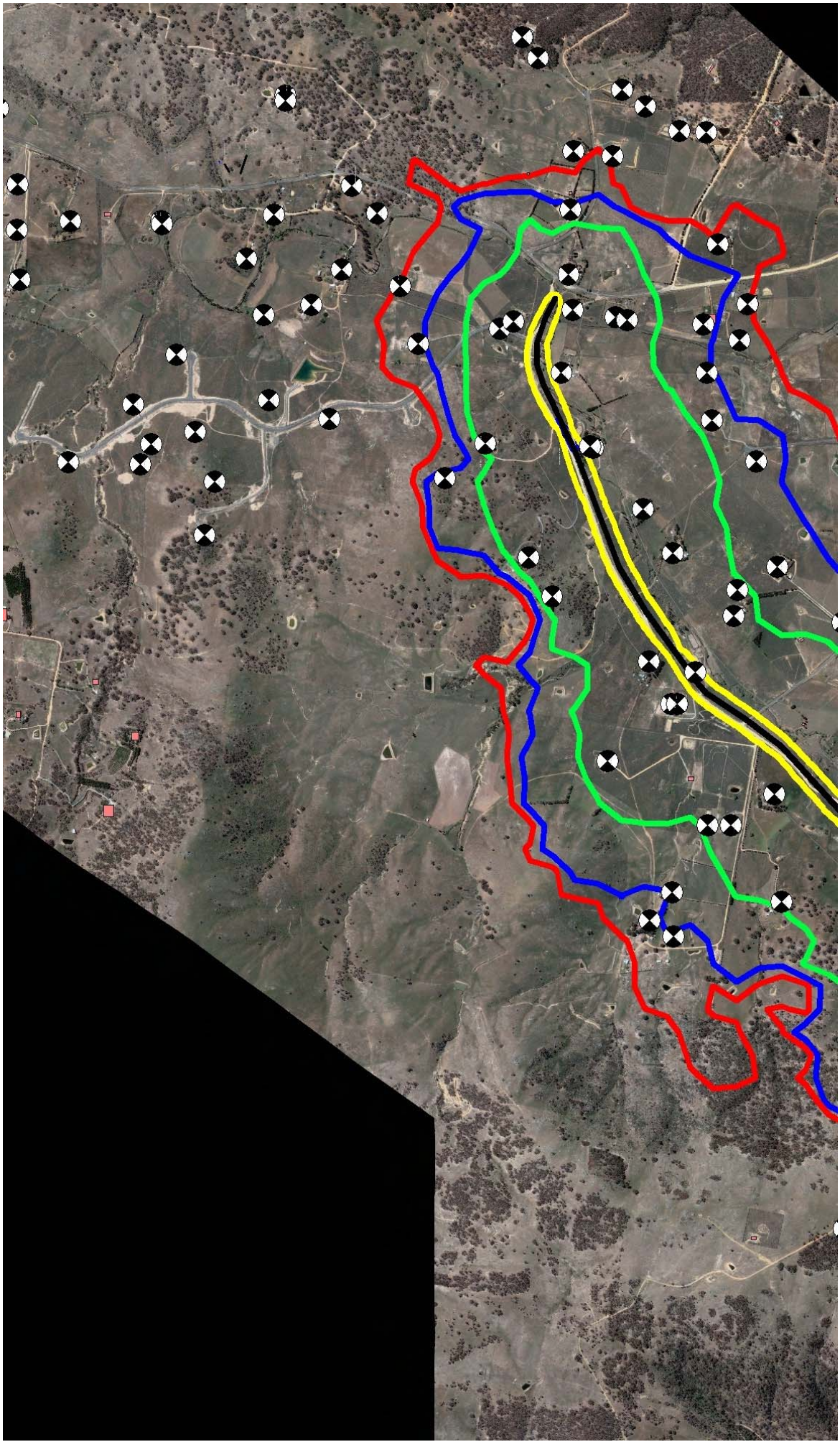
Appendix A **Construction Pipeline Noise Contours and Surrounding Residential Receivers**





Noise Level Contours dB(A) with sensitive receivers denoted by black and white circle symbols

- 35 dB(A) Night-time *Noise affected level* for oversized delivery activities
- 40 dB(A) Day-time *Noise affected level* for blasting associated activities
- 40 dB(A) Day-time *Noise affected level* for construction activities
- 75 dB(A) Day-time *Highly Noise affected level* for construction activities



Appendix B **Air, Noise and Vibration Monitoring Plan**

ACTEW CORPORATION | ActewAGL Always.

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Murrumbidgee to Googong Water Transfer - Air, Noise and Vibration Monitoring Plan

BWA-M2G-EN-ECP-010-1

January 2012

Delivered by the Bulk Water Alliance

Abigroup Constructing Australia's Future | ACTEW CORPORATION | GHD | John Holland

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Certificate of approval for issue of documents

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	Position	Name	Signature	Date
Prepared by	Land and Compliance Manager	John Turville		September 2012
Reviewed by	Land and Compliance Manager	John Turville		January 2012
Approved by	Project Manager	Jason Julius		

Document revision control

Version	Author	Date	Description	Approval
1	John Turville	16 January 2012	Annual Review	
2	Peter Sheehan	14 Feb 2012	Audit Actions	JT

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ACTEW CORPORATION

ACTEW Corporation Ltd ABN 86 069 381 960

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1 Introduction

Monitoring air, noise and vibration impacts is a central component of the M2G Construction Environment Management Plan, as well as the Air Quality Management Plan and Noise and Vibration Management Plan which were prepared as part of the CEMP, which allows us to better identify and manage the impacts that construction activities are having on sensitive receivers.

This Air, Noise and Vibration Monitoring Plan has been prepared as a supplement to both the Air Quality Management Plan (AQMP) and the Noise and Vibration Management Plan (NVMP) to assist in undertaking the monitoring requirements for the project.

Construction noise, vibration and air quality monitoring undertaken by Bulk Water Alliance (BWA) includes the following:

- Dust – deposition.
- Noise (routine and complaint response).
- Vibration – ground borne and
- Blasting – blast overpressure.

Air, noise and vibration monitoring will be conducted on a monthly basis at each of the identified monitoring locations. Additional monitoring can be conducted at locations where complaints relating to air quality, noise or vibration are received. These will be assessed on a case-by-case basis.

Procedures relating to the type of monitoring, details on monitoring locations and guidance notes for undertaking monitoring are provided below.

2 Monitoring Locations

Air, noise and vibration monitoring will be conducted at sensitive receiver locations adjoining the pipeline during construction. The aim of this monitoring is to check compliance against the adopted noise and vibration goals listed in the NVMP. Therefore, the focus of this monitoring is on the receivers with the greatest potential to exceed recommended levels. Generally this is the receivers that are closest to the areas of construction.

The identified monitoring locations are shown in Table 2.1.

Table 2.1 Identified Monitoring Locations

Monitoring Location Number	Resident contact or Surname	Approximate Address	Distance to construction works or construction traffic
1	Block 108. District Tennent	Angle Crossing Road, ACT	1200 metres
2	Moore. Block 1470	Cnr Monaro Highway and Angle Crossing Road, ACT	130 metres
3	Block 1675	Monaro Highway, ACT	140 metres
4	Johanson	Williamsdale Road, NSW	150 metres
5	Barton	Williamsdale Road, NSW	150 metres
6	Blinksell (noise) Bos (air)	Williamsdale Road, NSW (near Keewong Lane)	100 metres
7	Motbey	Williamsdale Road, NSW	120 metres
8	Latimer	Williamsdale Road, NSW	140 metres
9	Hanns	Williamsdale Road, NSW	70 metres
10	Johnston	Williamsdale Road, NSW	110 metres
11	Podmore	Burra Road, NSW	100 metres

Appendix A shows maps of the identified monitoring locations.

3 Monitoring Procedures

3.1 Standards and Guidelines

Air, noise, vibration and blasting monitoring will be conducted with consideration to the relevant guidelines and standards, including:

ACT

- Noise Environment Protection Policy, Environment Protection Authority, January 2010.
- Air Environment Protection Policy, Environment Protection Authority, November 1999.

NSW

- DECCW Interim Construction Noise Guidelines (2009);
- DECCW Assessing Vibration: a technical guideline;
- DECCW Environmental Noise Control Manual (ENCM);
- DECCW Environmental Criteria for Road Traffic Noise (ECRTN), May 1999; and
- DECCW Industrial Noise Policy 2000.

OTHER (Vibration)

- German Standard DIN 4150, Part 3;
- British Standard BS7385: Part 2-1993;
- British Standard BS6472: 1992; and
- ANZECC Guidelines “Technical Basis for Guidelines to Minimise Noise Annoyance Due to Blasting Over Pressure and Ground Vibration” (Sept 1990).
- AS 1055 – 1997 Acoustics – Description and Measurement of Environmental Noise.
- British Standard BS 6472–1992, Evaluation of Human Exposure to Vibration in Buildings (1–80 Hz).
- German Standard DIN 4150, 1999. Part 3, Structural Vibration – Effects of Vibration on Structures.
- AS 2187.2 –2006 Explosives – Storage and Use Part 2: Use of Explosives.
- Department of Environment, Climate Change and Water (NSW) – Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales (2000).

The following equipment may be used for air (dust), noise and vibration monitoring, subject to statutory approval conditions:

- Dust gauges.
- Sound level meters or environmental noise loggers
- Vibration loggers.
- Blast monitors.
- Anemometer or automatic weather station

Local wind and meteorological conditions have a significant influence on the propagation of air pollutants and noise from a source. For this reason, a weather station will be set up on site (or a representative location) to monitor and record weather conditions including:

- Wind speed.
- Wind direction.
- Ambient temperature.
- Relative humidity.
- Rainfall.

The equipment used for the measurements will have current calibration certificates and will be appropriate for the measurements with regards to the relevant Standards.

3.2 Air Quality

Dust is a generic term used to describe fine particles that are suspended in the atmosphere. Deposited dust refers to any dust that falls out of suspension in the atmosphere. Activities that have been identified as possible sources of dust emissions are:

- Clearance of vegetation, rock and soil material.
- Material handling e.g. excavation.
- Vehicle induced dust emissions on haul routes.
- Loading and dumping of cleared material.
- Leveling and grading of disturbed soil surfaces.
- Passage of construction and administrative vehicles over unsealed sections of road or localised unconsolidated soil surfaces.
- Wind erosion of all unstable/uncovered stockpiles and other unconsolidated surfaces.

3.2.1 Deposited Dust

Deposited dust is measured in accordance with AS/NZS 3580.10.1:2003 *Methods for sampling and analysis of ambient air* and all dust gauges are sited in accordance with AS 2922-1987 Ambient air – *Guide for the siting of sampling units*.

Dust deposition is measured using gauges. This method measures dust deposition rate and involves the passive deposition and capture of dust within a funnel and bottle arrangement. Data is usually collected over monthly periods and results are expressed in g/m2/month (i.e. the mass of dust deposited per m2 per month).

The principle of the technique is that, over a given sampling period, particles that settle from the ambient air are collected in a vessel together with any rainwater. The sample mass deposition rate of deposited matter is calculated from the mass of solids obtained, the funnel cross-sectional area and the exposure period (i.e. one month).

Subject to approval and licence conditions, a deposited dust gauge and stand will be placed at each of the selected monitoring locations. In siting, it is important to maintain a minimum of 5 m from any trees or obstacles, unrestricted air flow around the sampling inlet and clear sky angle of 120º above the inlet. An example of a dust deposition gauge is shown in Figure 3.1.

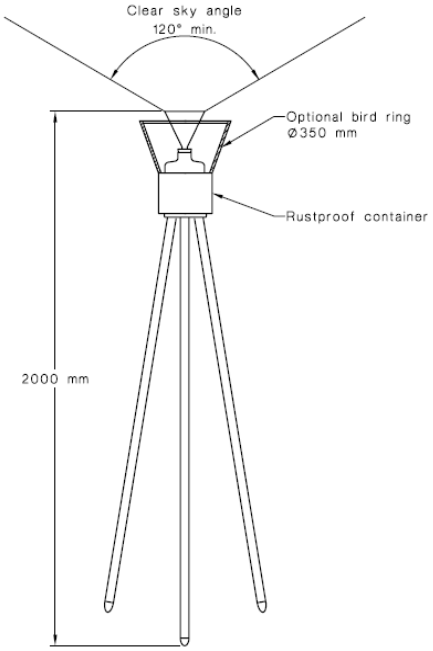

Figure 3.1 Typical Dust Deposition Stand with Gauge

3.3 Noise

If required, environmental noise monitoring will be carried out at the most affected receivers with regards to the activities being monitored. Measurements will typically be based on operator attended monitoring so that construction noise and vibration sources can be readily identified.

Some guidelines for noise monitoring procedures are outlined below:

- Noise monitoring is to be undertaken using a sound level meter (SLM) capable of recording continuous A-weighted noise levels and will capture airborne construction noise levels received external to any sensitive receiver.
- In addition to measuring and reporting overall A-weighted noise levels, statistical L_{90}, L_{eq}, L_{10} and L_{max} noise levels will also be measured and reported in third octave band centre frequencies from 31.5 Hz to 8 kHz.
- Monitoring of construction noise should be undertaken for a minimum of 15 minutes at each monitoring location.
- With consideration to the NSW INP, monitoring should be conducted at the property boundary, or where this is more than 30 metres from the residence, at 30 metres from the most affected façade.

- The SLM should be mounted on a tripod at a height of 1.2 - 1.5 metres above ground level. The SLM should be sited in an open location, away from trees and shielding objects where possible.
- Monitoring should be undertaken on days of light winds (<5 m/s) and no rain. Rain and excessive wind may elevate the ambient noise level. Monitoring should be ceased when wind speeds exceed 5 m/s or when rainfall occurs.

It is important to distinguish between construction noise and other noises such as traffic in order to comment on which is the most dominant and estimate the noise level of construction activities in isolation. The SLM display can be used while monitoring to estimate the noise level from sources dominant at the time, e.g. when no traffic is present and construction equipment is strongly dominant or where construction is inaudible over the traffic. If background noise levels are high (i.e. within 10 dB of construction activity) at receiver locations, monitoring can be conducted closer to construction activity. The distance from construction activity should be recorded to allow for calculations to be made of noise levels at receiver locations, based on attenuation properties.

3.4 Vibration and Blasting

Measurements of blasting activities will be used to assess compliance as well as determine site constants to be used in future calculations.

Construction activities such as rock breaking, excavation and compaction may produce vibration levels that are perceptible within 50 metres of the activity. Therefore, monitoring of vibration levels will only occur when residences are within 50 metres of these activities.

Vibration measurements will capture PPV data for assessment against structural damage and VDV data for assessment against human exposure criteria. Vibration monitoring can be undertaken using a number of vibration monitors and the operating manual should always be referred to.

Blasting measurements will capture PPV data for vibration and linear peak noise levels for overpressure.

Some general guidelines on the setup of vibration monitoring equipment are outlined below:

- The sensor should be placed at the location where vibration is of concern.
- It is important to ensure a good coupling with the ground. The sensor should be placed on a solid surface such as concrete or asphalt paving. If this isn't available, the transducer may be bedded in soil.
- Human exposure to vibration should usually be measured in all three axes (x, y and z), so that the results can be combined and compared to the adopted criteria. Where possible, measurements should be taken where human activity is likely.
- The transducer should be located at a sufficient distance from any structure (including large trees) so as to avoid undue interference from vibration 'feeding back' from the structure.

3.5 Monitoring Records

Each monitoring record will include the following information:

- Date and time of monitoring.
- Activities occurring during monitoring and the location of construction activities.
- Location of monitoring.
- Equipment used and method of monitoring.
- Weather conditions during monitoring.
- Monitoring results obtained.
- A comparison of the results with the adopted goals.
- Recommendations for corrective actions to further minimise impacts where appropriate.

Table 3.1 displays a summary of monitoring tasks over the duration of the construction phase

.

3.6 Summary of Monitoring Tasks

Table 3.1 Summary of Air, Noise and Vibration Monitoring Tasks (subject to approval and licence requirements)

Monitoring	Frequency	Duration	Criterion *	Monitoring Locations	Description
Dust – deposition	Continuous	30 days ±2	NSW 4 g/m^2/month ACT - no criteria (adopt NSW criteria) Stipulated in EA 802	Monitoring locations: 1 – 11	Dust gauges are placed at each location for the duration of the project (or while construction work is within 300 metres). The bottles are replaced with fresh bottles at the end of each month.
Noise – monitoring	NSW As least monthly – when construction activity is within 200 metres ACT • 7am to 6pm once a week on alternative days whilst work is being carried out • 6pm to 10pm daily, or time period and frequency agreed to by the EPA* • 10pm to 7am, daily, or time period and frequency agreed to by the EPA* * not required where works ceased	15 minutes	NSW daytime ($L_{Aeq,\ 15\ min}$) 40 dB(A) – noise affected level 75 dB(A) – highly affected noise level Outside recommended standard hours 35dB(A) – noise affected level ACT *Mon –Sat* 7am to 6pm - 60dB(A) 6pm to 10pm - 45dB(A) 10pm to 7am - 35dB(A) *Sun & Public Holidays* 8am to 10pm - 45dB(A) 10pm to 8am - 35dB(A)	Monitoring locations: 1 –11	NSW Monitoring shall be undertaken at each monitoring location at a minimum of once each calendar month. If there is no activity to monitor, this shall be recorded. ACT Construction noise levels shall be monitored at each compliance point during the following periods: i. 7am to 6pm once a week on alternative days whilst work is being carried out within 1000 metres of a compliance point; ii. 6pm to 10pm* daily, or time period and frequency agreed to by the Authority; and iii. 10pm to 7am* daily, or

Monitoring	Frequency	Duration	Criterion *	Monitoring Locations	Description
					time period and frequency agreed to by the Authority. * not required where works have ceased and/or a permanent resident does not reside at the compliance point.
Vibration monitoring	As required when work is within 50 metres	Duration of works or as long as necessary to characterise vibration	NSW VDV for residences during daytime 0.2 $m/s^{1.75}$	Monitoring locations: 1 – 11	When work is being carried out within 50 - 100 metres of a sensitive structure, vibration monitoring shall be undertaken at the sensitive structure at commencement of the activity and during the worst-case scenario (e.g. closest or highest vibration setting). Background monitoring at each sensitive structure should also be undertaken prior to commencement of the activity for comparison purposes. Dilapidation surveys may also be conducted.
Blasting	Every blast	Duration of blast	NSW Airblast Overpressure: 115 dB (Lin peak) Ground vibration: 5 mm/sec ppv ACT Air blast overpressure i. 120dB (Linear Peak) for any blast	Monitoring stations: Closest sensitive receiver. Additional monitoring locations may be required depending on the final location and size of the blast.	When known, the M2G Construction Manager should communicate the location and expected size of the blast to the M2G Environmental Manager.

Monitoring	Frequency	Duration	Criterion *	Monitoring Locations	Description
			ii. 115dB (Linear Peak) for 9 out of 10 consecutive blasts initiated regardless of the interval between blasts. <u>Ground vibration</u> i. 10mm/s for any blast ii. A peak particle velocity of 5mm/s for 9 out of 10 consecutive blasts initiated regardless of the interval between blasts.		

- A full list of project specific criteria can be found in the M2G Noise and Vibration Management Plan (NVMP) and M2G Air Quality Management Plan (AQMP)

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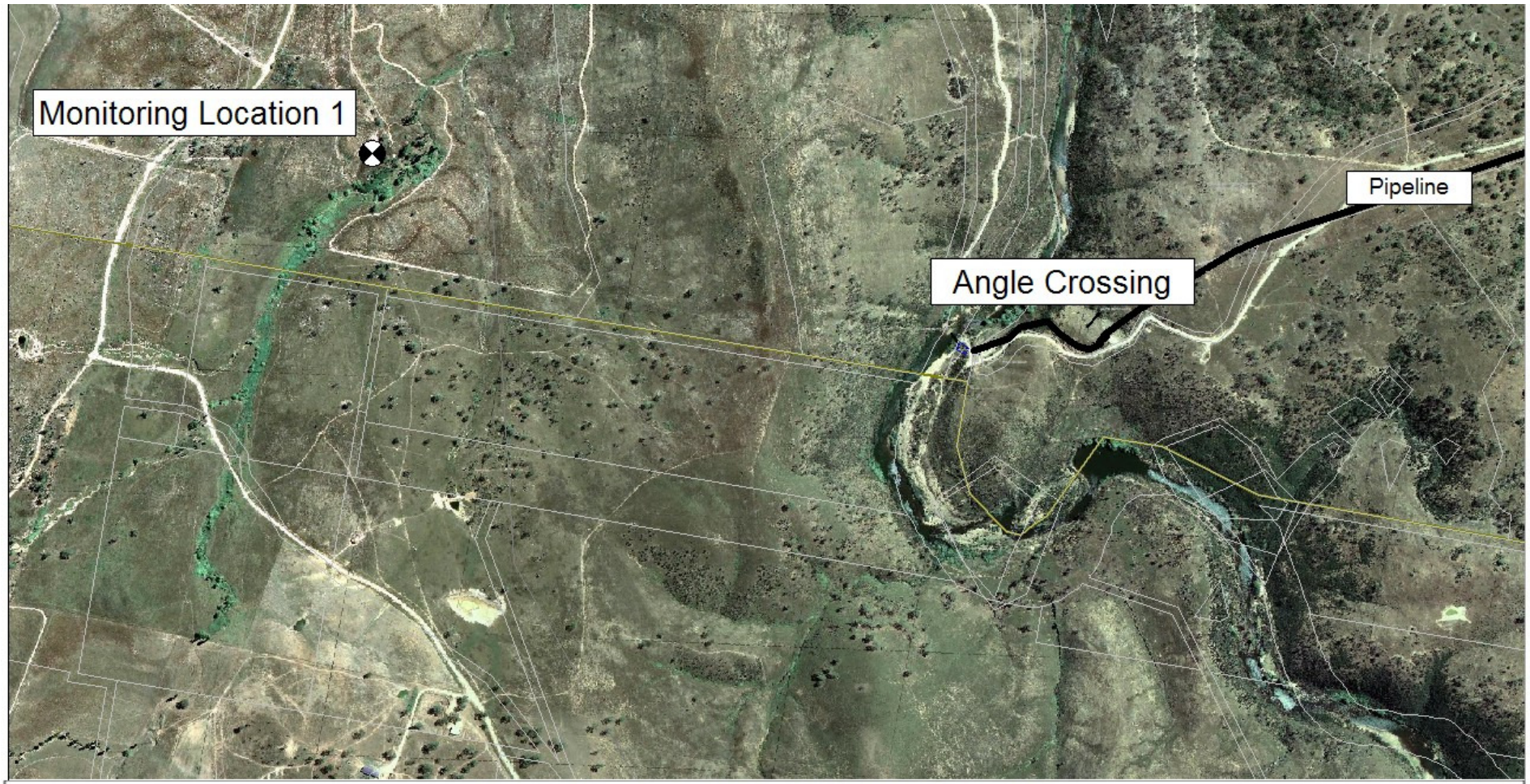
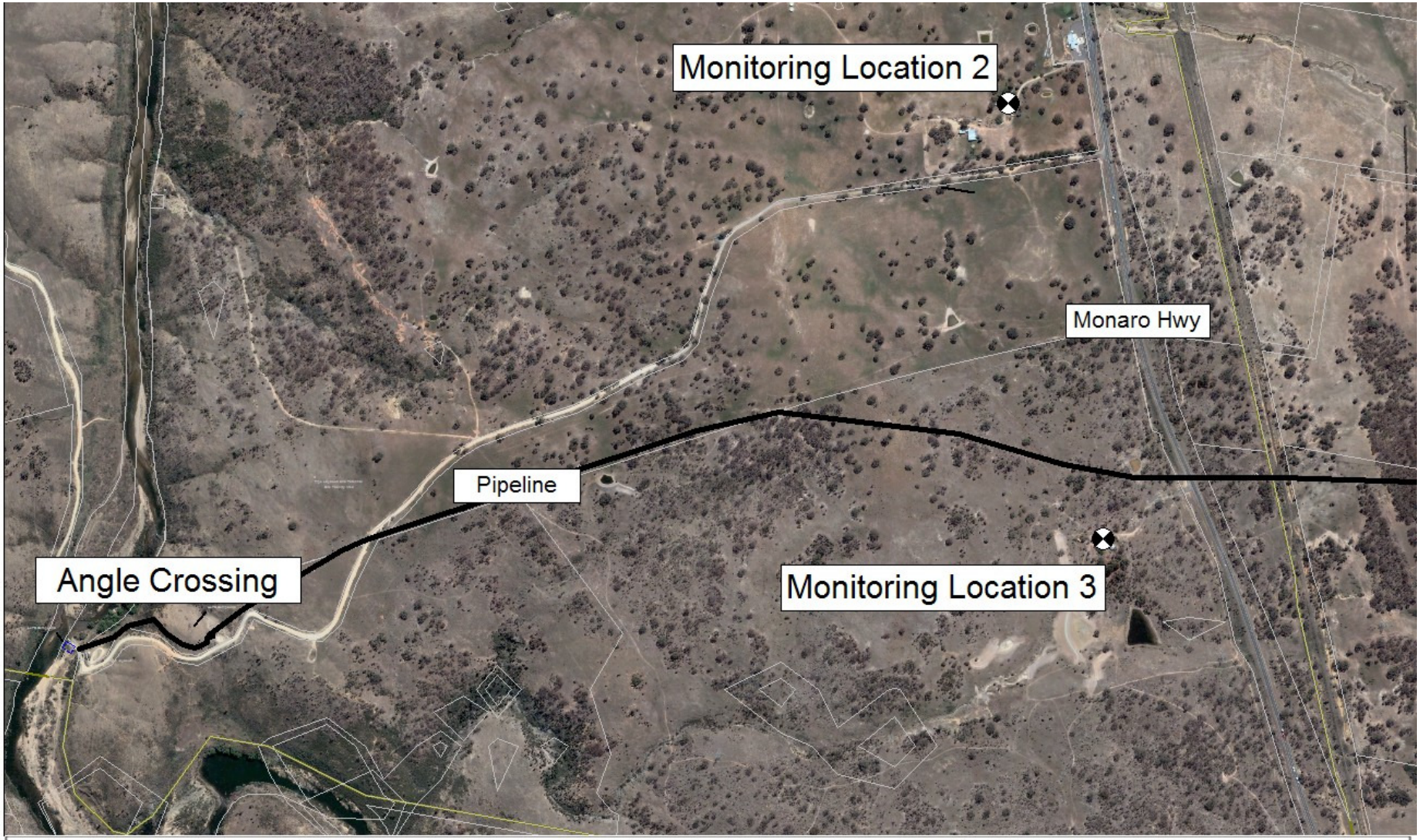
Appendix A **Monitoring Location Maps**



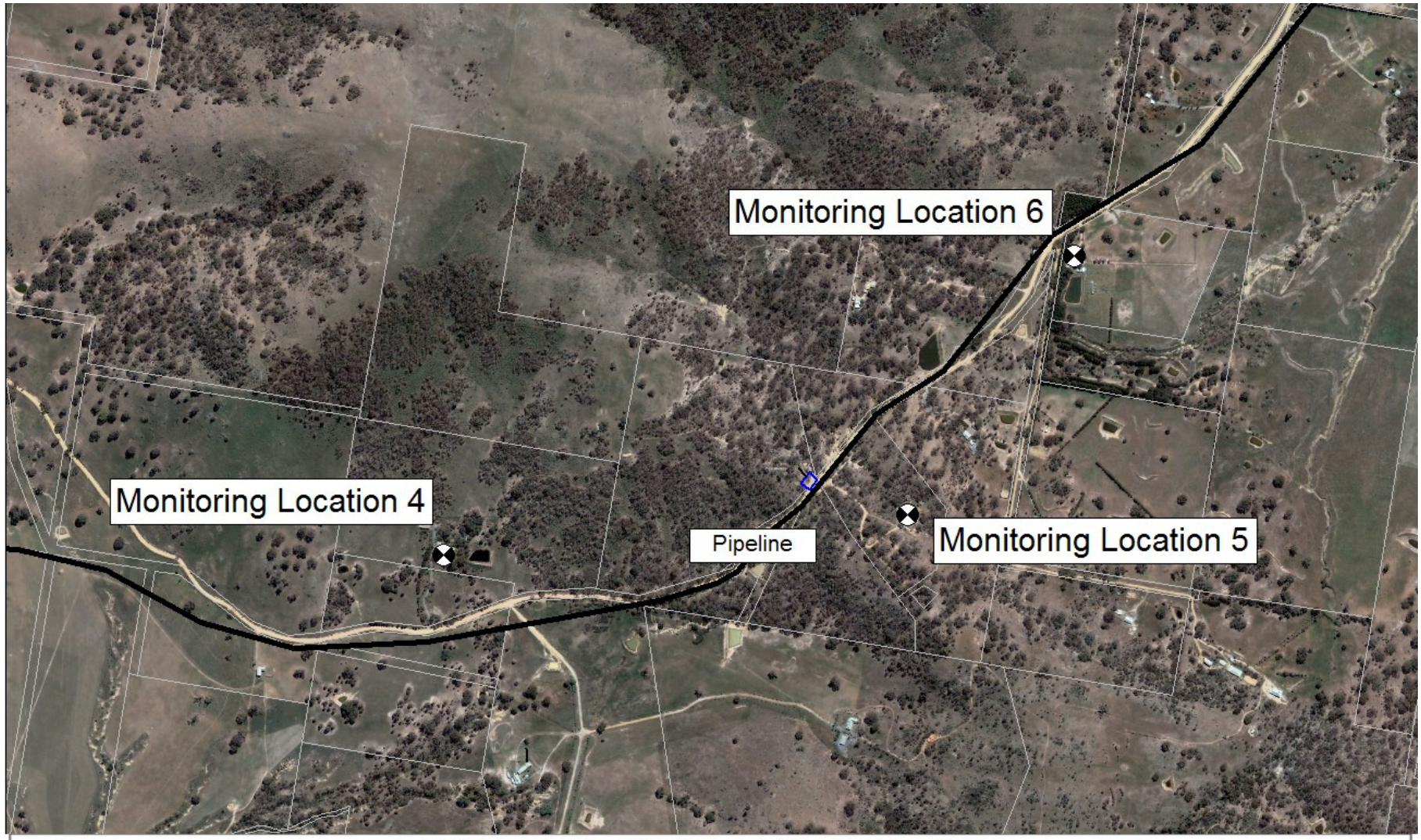
Murrumbidgee to Googong Water Transfer

Bulk Water Alliance



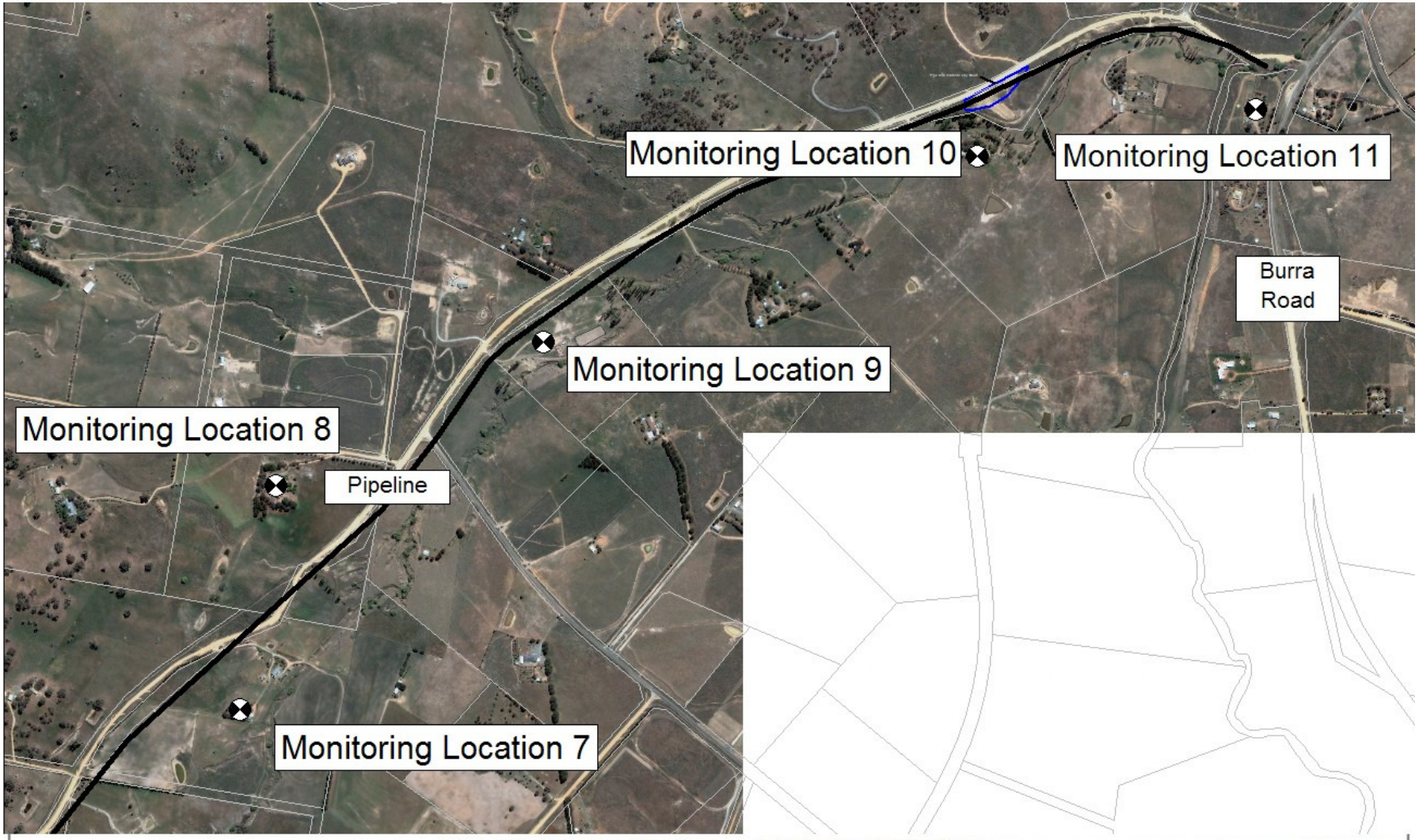
Murrumbidgee to Googong Water Transfer

Bulk Water Alliance



Murrumbidgee to Googong Water Transfer

Bulk Water Alliance


Monitoring Location 10
Monitoring Location 11
Burra Road
Monitoring Location 9
Monitoring Location 8
Pipeline
Monitoring Location 7
Murrumbidgee to Googong Water Transfer
Bulk Water Alliance

Appendix C **M2G Sensitive Area Diagrams**

Monitoring Location 1
(approximately 1.4km to
the North West)

Eductor pipes

Site to be fenced off
until salvaged

LLPS

Note: Turning area to be
maintained for public use

01

1003

25m microwave tower

Note: Parking area
closed to public

02

1003

Site to be fenced off
until salvaged

1

HLPS

Site to be fenced off
during construction

Site to be fenced off
until salvaged

1003

Angle Crossing Road

Note: Angle CrossingRoad
will remain open unless
closure is approved by TAMS

Works in waterways to be carried out in
accordance with "Working in Waterway - EWMS"
(BWA-M2G-EN-EWMS-006) and relevant drawings

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

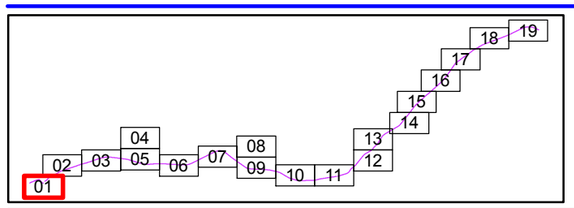
Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box
- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

- Arthropodium fimbriatus
- Discaria pubescens
- Leucochrysum albicans var. tricolor
- Linum marginale
- Lotus australis
- Microseris lanceolata
- Pterostylis sp.
- Swainsona recta
- Swainsona sericea
- Zornia dyctiocarpa
- Diamond Firetail
- Eastern Bentwing-bat
- Gang-gang Cockatoo
- Jacky Winter
- Large-footed Myotis
- Pink-tailed Worm Lizard
- Restless Flycatcher
- Scarlet Robin
- Southern Whiteface
- Speckled Warbler
- Varied Sittella
- White-winged Triller
- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)
- Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 1 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

1003B

1002A

1003B

02

1003B

Pipe Laydown Area 1

4200m^2

1002A

Site to be fenced off until salvaged

1003B

1003

1003

01

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
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- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

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- Pink-tailed Worm Lizard
- Restless Flycatcher
- Scarlet Robin

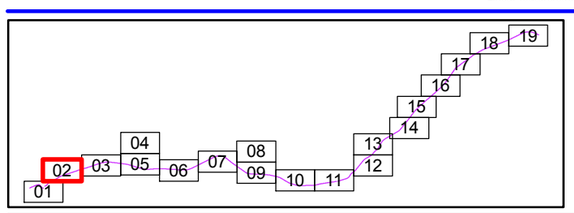
- Southern Whiteface
- Speckled Warbler
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)

- Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 2 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

1003A

1003A

1003B

1003B

1003B

Access restricted during construction

Site to be fenced off until salvaged

03

05

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
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- Linear feature/structure

Land owner constraint/feature

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- Southern Whiteface
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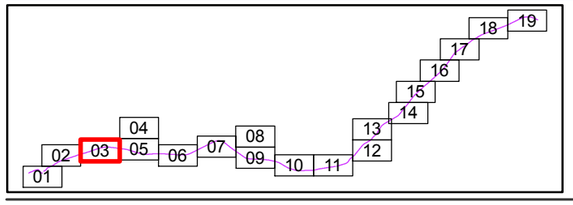
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)

Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 3 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Site to be fenced off until salvaged

Main Office

1003A

04

Monaro Highway

Monitoring Location 3

1003A

1003A

1003B

05

Subject to further investigations by Ecological Asutralia

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
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- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

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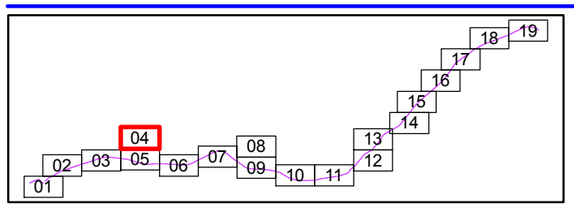
- TSC
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)
- Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 4 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Site to be archivally recorded and fenced off during construction

Note: Access to be provided for stock to cross corridor

1003A
1003B
1003B
1003B
1003B
1006
1006
Monaro Highway
04
05
03
2

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

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- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

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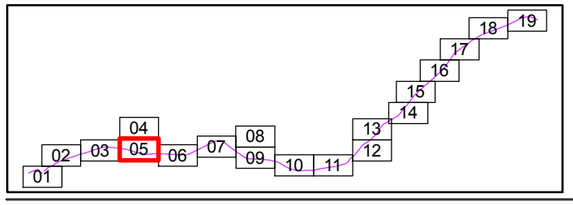
- Pink-tailed Worm Lizard
- Restless Flycatcher
- Scarlet Robin
- Southern Whiteface
- Speckled Warbler
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)

Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 5 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Significant threatened species - to be identified and fenced off prior to construction commencing

Note: Access to be provided for stock to cross corridor

Soil contamination assessment to be undertaken prior to construction commencement

Erosion gully adjacent construction corridor

1102

1103

1006

DISUSED RAILWAY

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

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- Scarlet Robin

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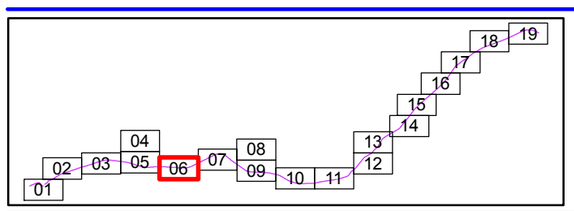
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)
- Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 6 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

08

07

1102

1104

1104

1106

Site to be fenced off during construction

Note: Access to be provided for stock to cross construction corridor

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
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- Driveway
- Tree to be preserved
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- Previous Cultural Heritage Recording
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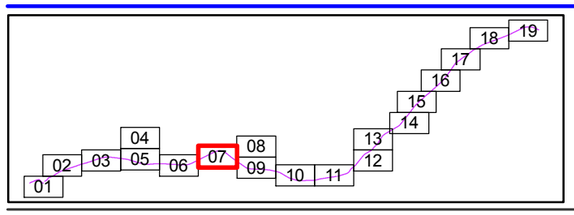
- Construction Corridor (Variable width)

- Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
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Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 7 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

08

1107

1107

07

1106

09

Property Access Track

Williamsdale Road

Works in waterways to be carried out in

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

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- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
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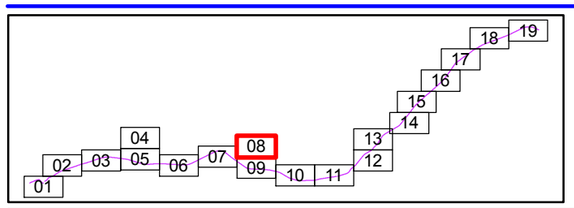

N

0 25 50 75 100

Metres (at A3)

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Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 8 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
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Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

08

09

Williamsdale Road

Site to be fenced off until salvaged

Site to be fenced off until salvaged

Pipe Laydown Area 2 10,000m^2

Access to be restricted during construction following subsurface testing

Site to be fenced off until salvaged

Site to be fenced off until salvaged

Property Access Track

Note: Access to be provided for stock to cross construction corridor

Access to be restricted during construction

1106

1107

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
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- Linear feature/structure

Land owner constraint/feature

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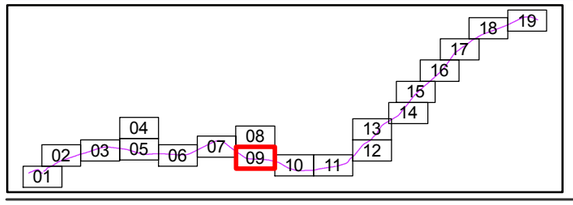
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)
- Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

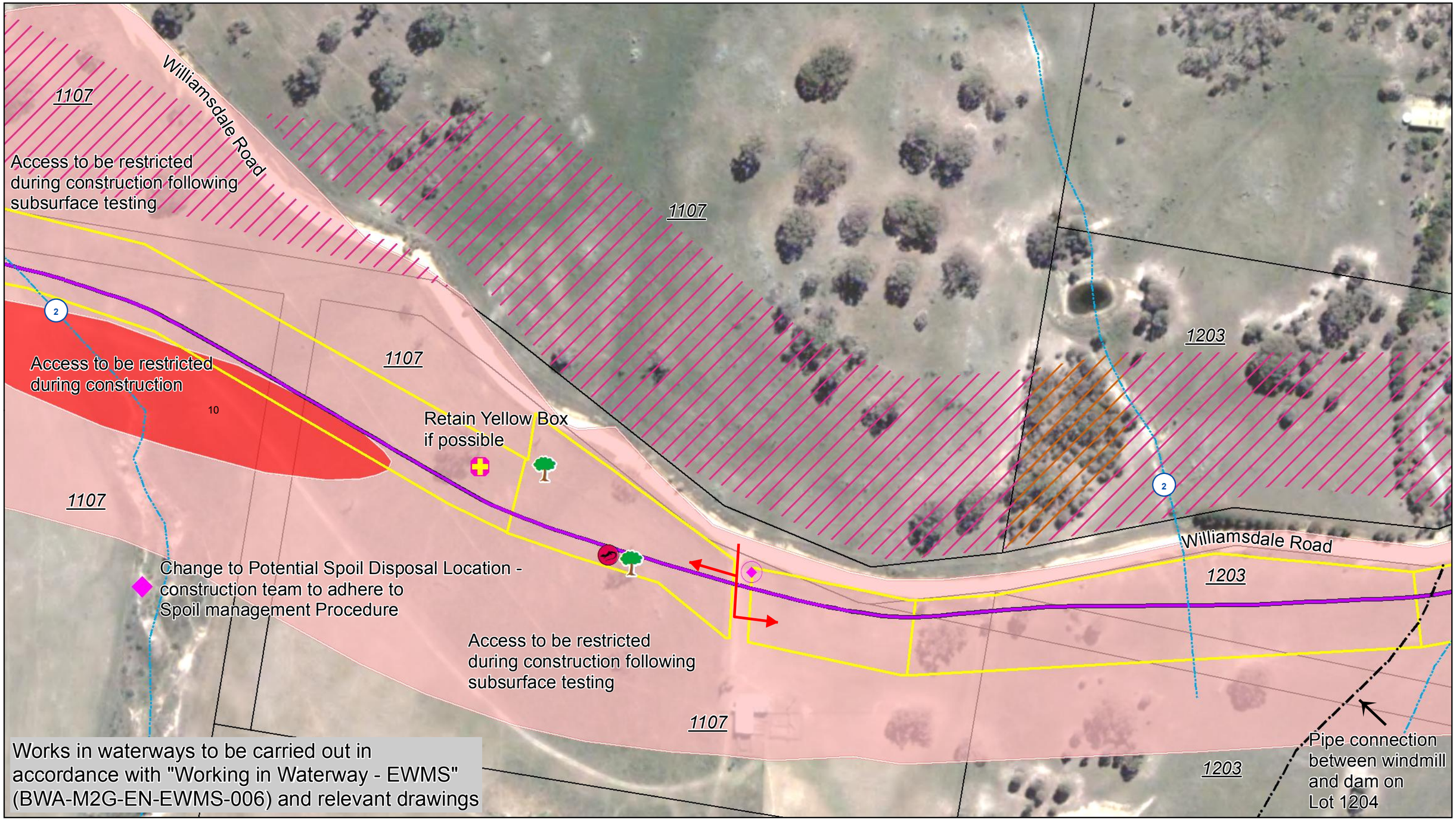
ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 9 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:



Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
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- Linear feature/structure

Land owner constraint/feature

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- Swainsona recta

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- Zornia dyctiocarpa
- Diamond Firetail
- Eastern Bentwing-bat
- Gang-gang Cockatoo

- Jacky Winter
- Large-footed Myotis
- Pink-tailed Worm Lizard
- Restless Flycatcher
- Scarlet Robin

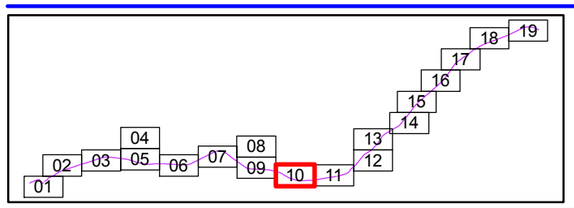
- Southern Whiteface
- Speckled Warbler
- Varied Sittella
- White-winged Triller

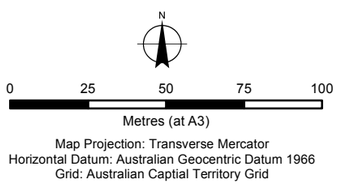
- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)

- Vehicle access and movement direction





Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 10 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Monitoring Location 4

Reinstate gravity feed from dam post construction

Access to be restricted during construction

Site to be fenced off during construction

Access to be restricted during construction following subsurface testing

Site to be fenced off during construction

Protect downslope dam from sediment

Owners requested felled timber be stockpiled for firewood

1203 1203 1203 1205 2002

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

- Arthropodium fimbriatus
- Discaria pubescens
- Leucochrysum albicans var. tricolor
- Linum marginale

- Lotus australis
- Microseris lanceolata
- Pterostylis sp.
- Swainsona recta

- Swainsona sericea
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- Restless Flycatcher
- Scarlet Robin

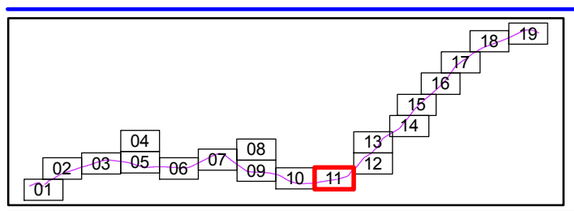
- Southern Whiteface
- Speckled Warbler
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)

- Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

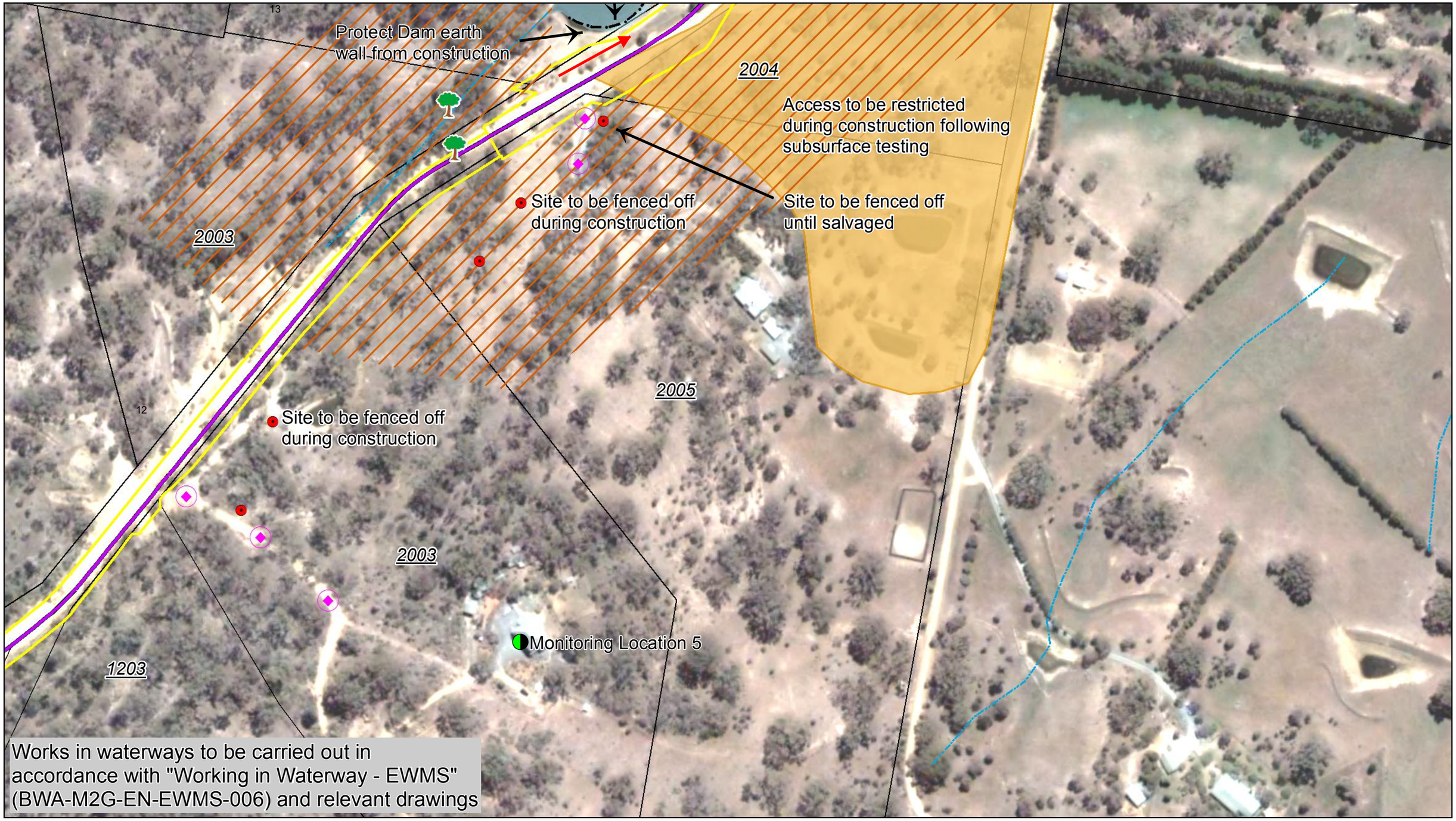
ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 11 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:



Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

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- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

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- Swainsona sericea
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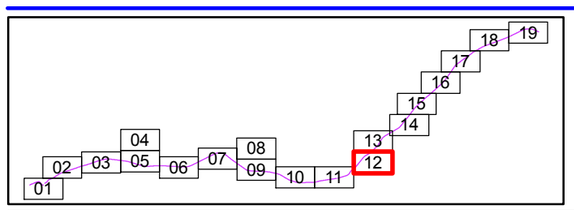
- Speckled Warbler
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)

Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 12 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Pine Trees - to be preserved. Only overhanging limbs to be removed

Access to be restricted during construction

Monitoring Location 6

Access to be restricted during construction following subsurface testing

Protect Dam earth wall from construction

Be aware of drainage line gully

Access to be restricted during construction following subsurface testing

1223
2006
2006
2006
1217
1217
2004
2004
13
14
12
1
2

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

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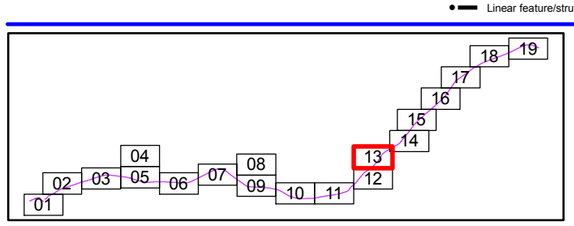
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)
- Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 13 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
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Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Access to be restricted during construction following subsurface testing

Site to be fenced off until salvaged

Reinstatement of pipework to dam not required

Access to be restricted during construction following surface collection and subsurface testing

1222A
1223
1225
2006

13
14
15

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

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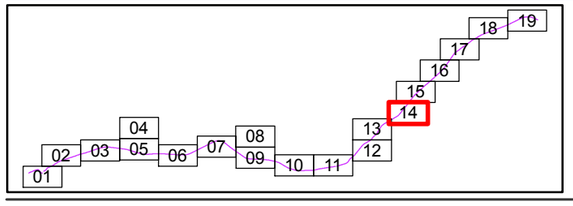
- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)

Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 14 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Reinstate roadside verge with either rock armouring or hyrdomulch.
Netting fence on roadside needs repair

Site to be fenced off until salvaged

Site to be fenced off during construction

Access to be restricted during construction

Access to be restricted during construction following subsurface testing

Monitoring Location 7

1303

1302

1302

1302

1223

1225

1225

16

15

14

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

- Arthropodium fimbriatus
- Discaria pubescens
- Leucochrysum albicans var. tricolor
- Linum marginale
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- Speckled Warbler
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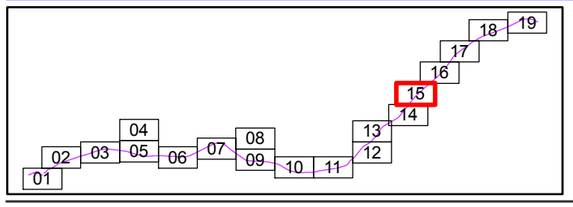
- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)

Vehicle access and movement direction



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Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 15 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Monitoring Location 8

Site to be fenced off until salvaged

Site to be fenced off until salvaged

Access to be restricted during construction following subsurface testing

Change to "Drainage Line" - refer to Enviro report for erosion and sediment controls and rehabilitation of waterways

Williamsdale Road

Badgery Road

1309

1305

1303

16

17

15

3

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

- Surface Aboriginal Artefacts
- Historical (European) Recording
- Previous Cultural Heritage Recording
- New Navin Data (TBC)

- Arthropodium fimbriatus
- Discaria pubescens
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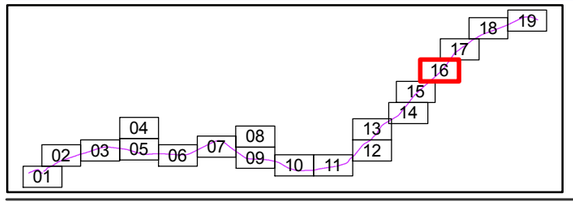
- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)
- Construction Corridor (Variable width)

Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 16 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

High Value Trees - Poplar species - DO NOT REMOVE

Site to be fenced off until salvaged

Monitoring Location 9

Access to be restricted during construction following subsurface testing

Site to be fenced off until salvaged

1312

1310

1309

17

18

16

4

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
- Yellow box

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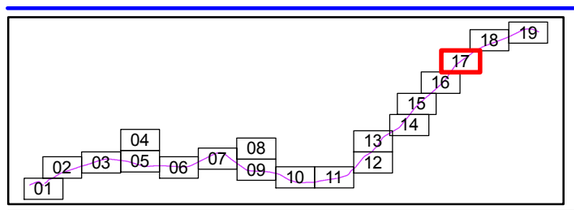
- Construction Corridor (Variable width)

Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

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BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams Landholder Constraints

Map 17 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
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Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

18

17

Site to be fenced off during construction

Trees to be preserved

1315

1315

1312

Access to be rrestricted during construction following subsurface testing

Do not prevent landholder retaining access to cattle yards. DO NOT FENCE OFF

2

4

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
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- Driveway
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- Historical (European) Recording
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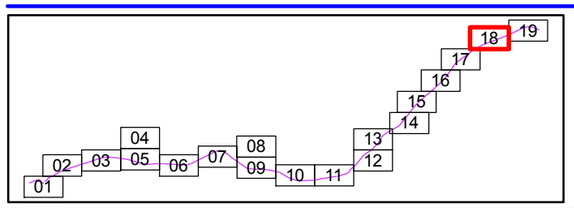
Vehicle access and movement direction



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0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
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BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 18 of 19

Project Reference: GHD_M2G_GEN_EN_SAD_001_A_3
Revision: F
Date: 11 Mar 2011
Peer review:
Technical review:

Works in waterways to be carried out in accordance with "Working in Waterway - EWMS" (BWA-M2G-EN-EWMS-006) and relevant drawings

Site to be fenced off during construction

Williamsdale Road

Macdiarmid Rd

Williamsdale Road

1317

Be aware of Burra Creek waterway

1317

1317

Possible old sheep dip in construction corridor. Soil contamination assessment to be undertaken prior to construction commencement

Mini-Hydro

Discharge structure

Pipe Laydown Area 3 5000m^2

Trees to be preserved

1315

Monitoring Location 10

BURRA CREEK

Monitoring Location 11

Legend

- Monitoring Location
- Electrical Transmission Line
- New Electrical Alignment
- River/Creek
- Fenced Work Compounds & Laydown Areas
- Pipeline Structures
- Cadastral Boundary
- New Electrical Easement
- Waterbody

Pre-clearance survey data

- Hollow Bearing Tree
- Pink Tail Worm Lizard
- Swansonia Recta
- Wombat Burrow
- Linear feature/structure

Land owner constraint/feature

- Be Aware of: "XYZ"
- Farm dam
- Driveway
- Tree to be preserved
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- Restless Flycatcher
- Scarlet Robin

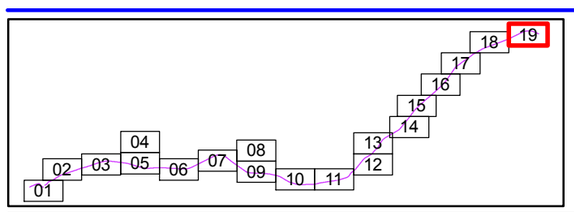
- Southern Whiteface
- Speckled Warbler
- Varied Sittella
- White-winged Triller

- EPBC/NC
- EPBC/TSC
- Nominal TSC
- TSC

- Historical (European) Recording
- Surface Artefacts and PAD
- Surface Aboriginal Artefacts and PAD
- Potential Archeological Deposits (PAD)

- Construction Corridor (Variable width)

- Vehicle access and movement direction



N

0 25 50 75 100

Metres (at A3)

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geocentric Datum 1966
Grid: Australian Captial Territory Grid

BULK WATER ALLIANCE

ACTEW CORPORATION

Murrumbidgee to Googong Water Transfer Project

Sensitive Area Diagrams
Landholder Constraints

Map 19 of 19

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Revision: F
Date: 11 Mar 2011
Peer review:
Technical review: