watersecurity
MAJOR PROJECTS

Murrumbidgee to Googong Water Transfer

Construction Traffic Impact Assessment

June 2009

ACTEW
CORPORATION

Contents

List of tables

List of figures

Abbreviations

Abbreviations	Definition
AADT	Annual average daily traffic - the total volume of traffic passing a roadside observation point over the period of a calendar year, divided by the number of days in the year
ADT	Average daily traffic - a sample of the AADT and is the traffic count averaged over a particular month, a week or a few days.
LOS	Level of service - an index of the operational performance of traffic on a given traffic lane, carriageway or road when accommodating various traffic volumes under different combinations of operating conditions. It is usually defined in terms of the convenience of travel and safety performance.
veh/hr	Vehicles per hour
VPD	Vehicles per day - the number of vehicles passing a point on a road in both directions for 24 hours.

1 Introduction

1.1 Purpose of this report

ACTEW Corporation Limited (ACTEW) proposes to undertake the Murrumbidgee to Googong Water Transfer Project (referred to in this report as 'the project'). This report has been prepared to provide an assessment of the traffic impacts of the project as an input to the environmental impact assessment. The environmental impact assessment is being prepared in accordance with the requirements of Part 3A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and the ACT *Planning and Development Act 2007.*

The report addresses the requirements of the Director-General of the NSW Department of Planning (the Director-General's Requirements) dated 7 October 2008 and the Final Scoping Document prepared by the ACT Planning & Land Authority (the Scoping Document) dated 16 December 2008.

1.2 Project overview

In recent years the Australian Capital Territory (ACT) region has been experiencing severe drought conditions coupled with increased demand for water. Canberra and Queanbeyan have been subject to level three water restrictions since 2006. The current drought, together with predicted climate change and population growth, is driving the search for a more reliable water supply for the ACT. In response to this need, the ACT Government developed the Water Security Program, which identified a range of new water supply projects.

The project is one of the preferred options for delivering improved security to the ACT's water supply. It involves pumping water from the Murrumbidgee River (within the ACT) and transferring it via a pipeline to the Googong Reservoir via Burra Creek (in NSW). The Googong Reservoir supplies water treated to drinking quality standards to the ACT.

The project involves construction and operation of infrastructure required to transfer approximately 100 ML/day of water a distance of approximately 13 km from the Murrumbidgee River to Burra Creek.

The infrastructure required to transfer the water includes an intake/low lift pump station; a high lift pump station; an underground pipeline; a discharge structure and a power supply.

1.3 The location of the project

The intake/low lift pump station would be located on the east bank of the Murrumbidgee River, in the ACT, approximately 34 km south of Canberra. It would be located in an area known as Angle Crossing, approximately 4 km west of Williamsdale on the Monaro Highway.

The high lift pump station would be located within the ACT, approximately 290 m to the east of the intake/low lift pump station.

The pipeline would cross rural land in an east/north-east direction for approximately 13 km. It is located in the vicinity of Williamsdale and Burra Roads, within the districts of Williamsdale and Burra. The majority (approximately 10.2 km) of the pipeline would be located in NSW, with approximately 2.8 km located in the ACT.

The pipeline would discharge to the discharge structure, located on the banks of Burra Creek, just downstream of an existing flow measuring station approximately 10 km south of Googong Reservoir. The discharge structure is located within land know as the Googong Foreshores, which is Commonwealth land within NSW.

The general location of the pipeline relative to the southern suburbs of Canberra and the villages of Tharwa, Williamsdale and Burra are shown in 1.4.2Figure 1.

1.4 Methodology

The following steps were followed in preparing the Construction Traffic Impact Assessment:

1.4.1 Review of Existing Conditions

- Collect traffic flow data on affected roads using data provided by Roads ACT and Queanbeyan City Council
- Assess level of service for traffic flows on existing roads referring to Austroads Guide to Traffic Engineering Practice Part 2 – Roadway Capacity
- Assess the level of safety for local roads, referring to crash data provided by local government authorities and Roads ACT
- Review existing public transport, pedestrians and cyclists

1.4.2 Assess Traffic Impact of Project

- Estimate the construction traffic generated by the project based on information provided for the haulage of various construction materials and for construction staff movements
- Estimate the distribution of project generated traffic on local roads based on assumptions about the origins and destination of trips
- Assess the levels of service of roads and intersections impacted by the project traffic based on RTA and Austroads guidelines
- Assess the safety of roads and intersections impacted by the project traffic based on relevant Austroads guidelines

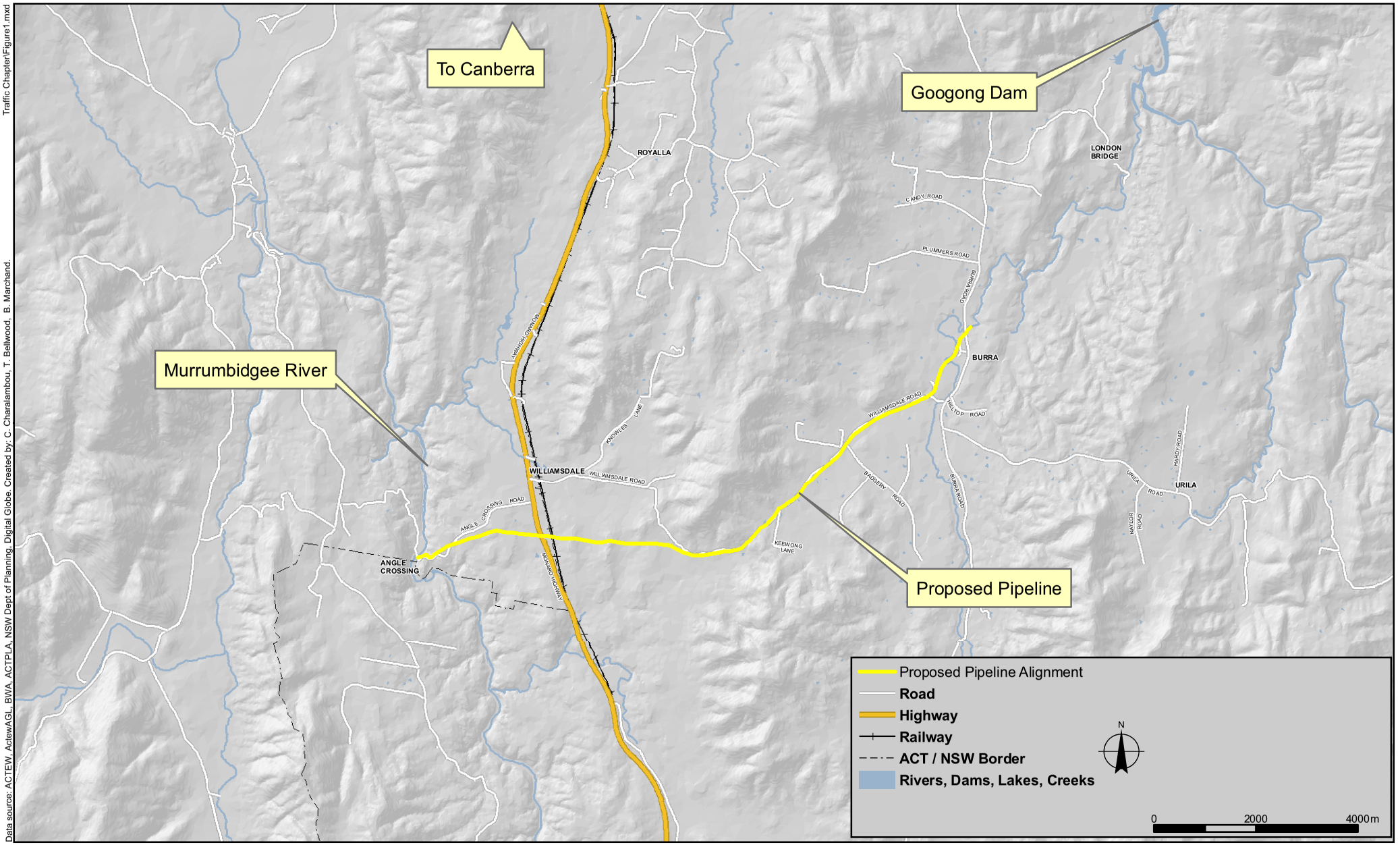


Figure 1 General Project Location

2 Existing Conditions

2.1 Description of Site

2.2Figure 2 shows a locality plan of the site. The pipeline crosses Angle Crossing Road, Monaro Highway, Williamsdale Road, Badgery Road, Macdiarmid Road and Burra Road.

2.2 Existing Road Network

The Monaro Highway connects Canberra and Cooma and is the major transport link for destinations south of Canberra.

Angle Crossing Road is an unsealed road that crosses the Murrumbidgee River near the ACT/NSW border. It intersects the Monaro Highway about 2.5 km from the river crossing. The intersection with Monaro Highway is sealed and line-marked. Angle Crossing Road crosses the Murrumbidgee as a causeway and is the southernmost crossing of the river in the ACT, providing a low level access to the Monaro Highway for residents of the village of Tharwa and for tourists. Tharwa Bridge at Tharwa and Point Hut Crossing are more frequently used as crossing points.

Williamsdale Road is unsealed for most of its length. The section between Monaro Highway and Knowles Lane is sealed and the section approaching its intersection with Burra Road is also sealed. Williamsdale Road is about 6 km long between Monaro Highway and Burra Road. Its function is primarily to provide access to properties. There is a single lane low level bridge on Williamsdale Road near its intersection with Burra Road. The grade approaching Williamsdale Road intersection is steep.

Badgery Road and Macdiarmid Roads are both no-through-roads that provide access to properties. Burra Road is a sealed road north of Williamsdale Road that connects to Queanbeyan via Old Cooma Road.

Lagoon Road and Hilltop Road intersect Burra Road between Williamsdale Road and the proposed Outlet Structure into Burra Creek. These roads are lightly trafficked and configured as simple T-junctions.

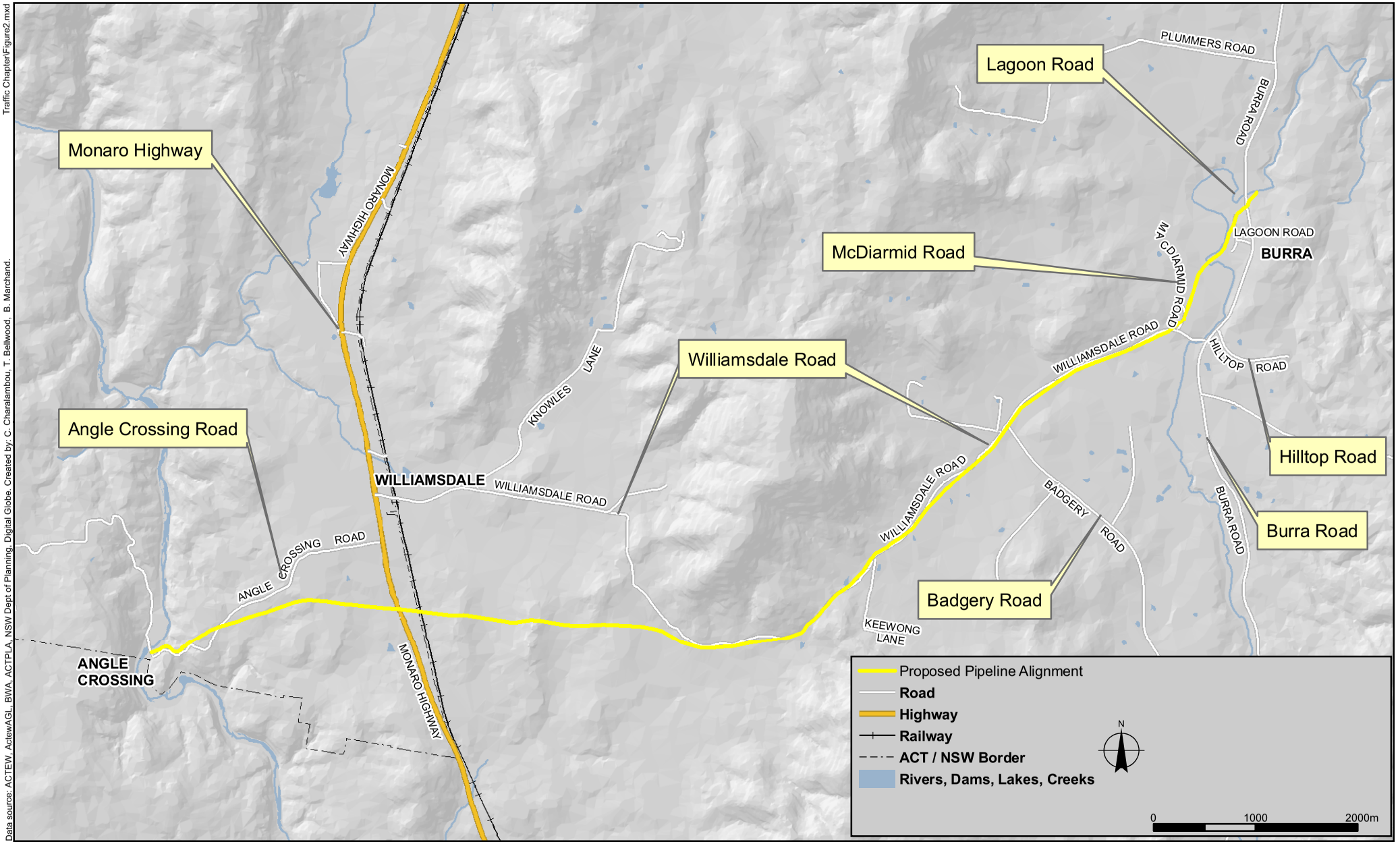


Figure 2 Site Location

2.3 Existing Traffic Conditions

2.3.1 Traffic Flows

Roads ACT and Queanbeyan City Council provided traffic count data for a number of roads in the project area to assist in the traffic assessment. The data is summarised in Table 1 below. The traffic counts for Monaro Highway in June are representative of normal traffic flows and do not include ski traffic.

Table 1 Existing traffic count data

Street	Traffic Count Date	Average Daily Traffic (ADT), vehicles per day (VPD)
Angle Crossing (east of Murrumbidgee River)	20/8/08 - 27/8/08	79 (9.5% heavy vehicles)
Monaro Highway ((between Angle crossing Rd and the NSW Border)	2/6/08 – 9/6/08	3162*
Williamsdale Road (near Monaro Hwy)	June 2006	281*
Williamsdale Road (near Burra Rd)	June 2006	200*
Badgery Road (near Williamsdale Rd)	June 2006	198*
Burra Road (nth of Hilltop Rd)	August 2008	436*

* no heavy vehicle data available for these roads

2.3.2 Existing Level of Service

Austroads defines level of service as a qualitative measure describing operational conditions within a traffic stream. Table 2 defines the term Level of Service (LOS) and its characteristics for two-lane rural roads.

Table 2 Level of Service (LOS) for Two-lane Roads

LOS	Description	AADT
A	Free, unrestricted flow	1,100
B	Mostly free flow, few disruptions	2,800
C	Stable flow	5,200
D	Mostly stable flow, some delays	8,000
E	Congested flow, delays common	14,800
F	Forced flow	n/a

Source: Austroads Guide to Traffic Engineering Practice Part 2 – Roadway Capacity

The volume and composition (type of vehicle) of traffic on a given road determines the level of interaction between vehicles and is measured as its LOS. LOS decreases with increasing traffic volumes. Generally, LOS A, LOS B and LOS C in a rural context are all satisfactory. LOS D can be satisfactory in some circumstances.

Based on the traffic volumes in Table 1 and the LOS threshold values in Table 2, the traffic volumes on all roads in the vicinity of the project, with the exception of the Monaro Highway, operate at LOS A. Monaro Highway operates at LOS C.

2.3.3 Traffic Safety

Williamsdale Road

A history of traffic crashes along Williamsdale Road was provided by Palerang Council for the period January 2000 to December 2007. During this period there were a total of six crashes, none involving injury.

Palerang Council also provided the following information on the current speed limits applying to roads affected by the project:

- Burra Road: currently 100 km/hr; and
- Williamsdale Road: currently 80 km/hr on the sealed section and between 60 and 80 km/hr on the unsealed section.

Palerang Council has confirmed that it has no current plans to upgrade the unsealed section of Williamsdale Road.

Angle Crossing Road

In the ACT, crash information was requested from Roads ACT for Angle Crossing Road between Murrumbidgee River and Monaro Highway for the period January 2003 to December 2007. During this period there were no reported crashes.

Roads ACT also advised that, based on a classified count in August 2007, the speed limit on Angle Crossing Road is 60 km/hr and that the 85th percentile travel speed is 38 km/hr.

Monaro Highway

The intersection of Monaro Highway and Williamsdale Road is linemarked to form a separate right turn lane into Williamsdale Road from the south and a separate left turn lane from the north. Sight distance in each direction along Monaro Highway is good. The posted speed limits on Monaro Highway on both approaches to the intersection are 80 km/hr. Williamsdale Road traffic faces a give-way sign at the intersection.

The intersection of Monaro Highway and Angle Crossing Road does not have separate turn lanes or acceleration/deceleration tapers. Monaro Highway centreline is marked with a double barrier line on the northern side of Angle Crossing Road indicating the need to restrict overtaking on the approach to the town of Williamsdale. There are no such restrictions to the south. Traffic entering the highway and turning left have a clear view of traffic approaching from the south. Similarly, traffic turning right into Angle Crossing Road from the highway has an unobstructed view of oncoming traffic. The posted speed limits on Monaro Highway on both approaches to the intersection are 80 km/hr. Angle Crossing Road traffic faces a give-way sign at the intersection.

2.4 Public Transport

Deanes Buslines runs two morning and two afternoon school bus services from Michelago to Queanbeyan Bus Interchange. The buses travel along Burra Road and Old Cooma Road between Michelago and Queanbeyan.

2.5 Pedestrians and cyclists

There are very few pedestrians or cyclists in the affected area.

3 Traffic Impact

3.1 Project Description

The proposed pipeline and associated pumping stations and outlet structure would be constructed over a period of 16 months. During this period, there would be a range of construction activities that would affect traffic operating conditions on roads in the area.

Project stages affecting traffic movements can be categorised as:

- Construction of Low Lift Pumping Station (LLPS) (approx 12 months);
- Construction of High Lift Pumping Station (HLPS) (approx 14 months);
- Construction of Pipeline (approx 12 months); and
- Construction of Outlet Structure (approx 5 months).

Working hours are between 7.00 am to 6.00 pm on weekdays and 7.00 am to 1.00 pm on Saturdays. Generally, no work is proposed on Sundays and Public Holidays.

Heavy vehicles will be required for the following haulage tasks:

- Construction and mechanical equipment (semi-trailers);
- Ready mixed concrete ($5m^3$ capacity concrete trucks);
- Reinforcement steel (semi-trailers);
- Pipes (semi-trailers); and
- Removal from site of trench spoil material

Other construction-related traffic includes light vehicles used by the workforce and by visitors to the site.

The volume of additional traffic during the operation of the pipeline is expected to be confined to operation and maintenance staff at the pumping stations and is expected to be minor and would have negligible traffic impacts.

Approved traffic management plan will be implemented throughout the construction period to regulate traffic movements and speeds. All restrictions on traffic movements and traffic speeds will only be in place for the duration of the 16 months construction period.

3.2 Construction Traffic

Table 3 summarises the heavy vehicle construction traffic generated during the construction phase of the project.

Table 3 Construction Traffic – Haulage Requirements

Location	Material	No. of vehicle trips per day (VPD)#
LLPS	Concrete Reinforcement Piling Mechanical equipment	12 8 12 6
HLPS	Concrete Reinforcement Structural components Mechanical equipment	47 8 20 40
Site compound	General supplies	12
Outlet	Concrete Reinforcement Mechanical equipment	12 6 2
Pipeline	Pipe deliveries Bedding material Spoil Imported fill Fuel and maintenance	20 30 38 12 4
LLPS	Concrete Reinforcement Piling Mechanical equipment	12 8 12 6

A trip is defined as one-way i.e. either to or from the site

As many of the activities will occur at different times, an estimate of the peak heavy vehicle traffic movements was made and is shown in Table 4 below. It is assumed that deliveries of concrete and reinforcement deliveries would not be concurrent with structural and mechanical equipment deliveries.

Table 4 Construction Traffic – Heavy Vehicle Movements

Location	Trips per day
LLPS	20
HLPS	55
Site compound	12

Location	Trips per day
Outlet	18
Pipeline	104

The light vehicle construction traffic generated on local roads during the construction phase of the project is summarised in Table 5 below.

Table 5 Construction Traffic – Light Vehicle Movements

Location	Workforce	Trips per day	Staff	Trips per day	Total trips per day
LLPS	10	2	1	2	22
HLPS	20	2	2	2	44
Site compound	-	-	12	2	24
Outlet	10	2	1	2	22
Pipeline	13	2	1	2	28

3.2.2 Assignment of Construction Traffic

The major routes taken by construction traffic to access the site are assumed to be:

- Monaro Highway/ Angle Crossing Road for equipment and materials delivered from Canberra to LLPS, HLPS and the section of the pipeline west of Monaro Highway as well as workforce and visitors to these locations;
- Monaro Highway/ Williamsdale Road for equipment and materials delivered from Canberra to the section of the pipeline east of Monaro Highway and a proportion of workers and visitors;
- Burra Road/ Williamsdale Road for equipment and materials delivered from Queanbeyan and a proportion of workers or visitors; and
- Angle Crossing Road, Monaro Highway and Williamsdale Road for the haulage of materials off-site. It is assumed that the spoil material will be taken to an existing gravel pit at Burra.

Based on these route assumptions, the heavy vehicle traffic in Table 4 was assigned to the various roads as shown in Table 6 below. This represents the expected maximum traffic volume during the construction period.

Table 6 Construction Traffic Assignment

Road	Location	Light Veh trips per day	Heavy Veh trips per day	Total Traffic
Monaro Highway	North of Williamsdale Road	140	127	267
Monaro Highway	Williamsdale Rd to Angle Crossing Rd	80	75	155

Road	Location	Light Veh trips per day	Heavy Veh trips per day	Total Traffic
Angle Crossing Rd	River crossing to Monaro Highway	80	75	155
Williamsdale Road	Monaro Highway to Burra Road	38	52	90
Burra Road	North of Williamsdale Road	29	32	61

3.3 Roads and Intersection Operation

3.3.1 Road Capacity

Austroads defines level of service as a qualitative measure describing operational conditions within a traffic stream. The term Level of Service (LOS) and its characteristics for rural roads is defined above in Table 2.

3.3.2 Impact on Roads

Table 7 summarises the existing traffic volumes and estimated additional traffic during construction.

Table 7 Construction Traffic

Road	Existing Traffic Volume (VPD)	Construction Traffic (VPD)	Total Traffic (VPD)
Monaro Highway (nth of Williamsdale Rd)	3162	267	3429
Monaro Highway (Williamsdale Rd to Angle Crossing Rd)	3162	155	3317
Angle Crossing Rd	79	155	234
Williamsdale Rd	281	90	371
Burra Road (nth of Williamsdale Rd)	436	61	497

Monaro Highway

The additional construction traffic on Monaro Highway represents an increase in the daily traffic of between 5% and 8%. This relatively small increase in traffic can be easily accommodated at the existing Level of Service C. LOS C is described as *"stable flow but most drivers are restricted to some extent in their freedom to select their desired speed"*. (*RTA Guide to Traffic Generating Developments*, Vers 2.2, 2002).

Angle Crossing Road

Angle Crossing Road is lightly trafficked so that the impact of the construction traffic is relatively substantial. However the increased traffic volume due to the project is less than 1100 VPD, the threshold for LOS A, where free and unrestricted traffic flow can be expected.

Angle Crossing Road crosses the Murrumbidgee River via a causeway. This is wide enough for only a single stream of traffic.

The construction of pumping stations may require road closures of Angle Crossing Road for short periods during delivery of large items of equipment. Such closures should only be used when other measures such as lane closures and traffic management would not be adequate to ensure public safety. Adequate notice of closures should be provided and warning signs should be in place advising of alternative routes across the river.

Williamsdale Road

Williamsdale Road carries more traffic than Angle Crossing Road but is also considered to be lightly trafficked. The increased traffic volume due to construction is below 1100 VPD and therefore the road would continue to operate LOS A or B described by Austroads as very good.

Williamsdale Road will be realigned between CH 8800 and CH 9160 to remove several tight horizontal curves. The pipeline will run parallel to and south of the realigned road.

Williamsdale Road crosses Burra Creek near its intersection with Burra Road. This is a single-lane low-level crossing and subject to flooding. The vertical alignment of Williamsdale Road across the creek and approaching Burra Road is constructed to a minimal standard (refer Photos 13 and 14 in Appendix A) with very limited sight distances at the intersection. This section of Williamsdale Road and its intersection with Burra Road will need to be carefully controlled to safely accommodate the additional traffic during construction.

Road Crossings

Table 8 details the pipeline road crossings.

Table 8 Road Crossings

Road	**Chainage**	**Crossing Method**
Angle Crossing Road	CH 750	Open cut
Monaro Highway	CH 2520	Thrust boring
Williamsdale Road	CH 6225	Open cut
Williamsdale Road	CH 7575	Open cut
Williamsdale Road	CH 8050 - 8130	Open Cut
Badgery Road	CH 9550	Open Cut
Williamsdale Road	CH 10615 – CH 10645	Open cut
Macdiarmid Road	CH 11650	Open cut
Lagoon Road	CH 12640	Open cut
Burra Road	CH 12840 – CH12852	Open cut

Road crossings will also be required at a number of property accesses. Part road closures will be required at all open cut road crossings. Traffic will be controlled in accordance with Council and State legislative requirements. Where possible it is proposed to divert traffic around the open trench or install steel plates across the trench to maintain access during pipe installation. Where possible all road crossings will be completed in one day, with any open trenches covered overnight.

Pipe Line in Road
The pipeline will be located in the Williamsdale Road reserve between Ch 6650 and Ch 7300. Lane closures will be required during the construction of the pipeline at the locations where the works impact on the normal flow of traffic.

The works will be staged in order to reduce the likelihood of multiple closures on any one day. It is expected that pipe works within the road will require approximately 80 days to complete.

The implementation and maintenance of these traffic control measures in accordance in accordance with approved Traffic Management Plans will mitigate the impact of the pipeline construction on traffic.

3.3.3 Impact on Intersections

Williamsdale Road/ Monaro Highway
The intersection of Monaro Highway and Williamsdale Road is line marked to form a separate right turn lane into Williamsdale Road from the south and a separate left turn lane from the north. This arrangement provides safe deceleration space for construction traffic slowing and turning into Williamsdale Road. Traffic turning right out of Williamsdale Road has good sight distance in both directions. Traffic turning left onto the highway is able to use the acceleration lane to merge with highway traffic.

The traffic volume on Monaro Highway is estimated to be about 3400 VPD with the addition of construction traffic. This corresponds to a two-way peak flow of about 340 veh/hr. Williamsdale Road is estimated to carry about 370 VPD including construction traffic, which corresponds to about 34 veh/hr. For this low combination of flows, the highway can comfortably absorb the minor road traffic (refer Table 9 Austroads Part 2, Roadway Capacity).

Table 9 Intersection Volumes below which Capacity Analysis is Unnecessary

Type of Road	Light Cross & Turning Volumes - Maximum Design Hour Volumes - vehicles per hour (two way)		
Two lane major road	400	500	650
Cross road	250	200	100
Four lane major road	1,000	1,500	2,000
Cross road	100	50	25

Source: Austroads Part 2, Roadway Capacity

Monaro Highway/ Angle Crossing Road
The intersection of Monaro Highway and Angle Crossing Road is a simple T-junction with no channelisation. Most of the construction traffic is expected to turn between the northern leg of the highway and Angle Crossing Road. Traffic turning left out of and right into Angle Crossing Road has good sight distance to oncoming traffic.

The traffic volume on Monaro Highway is estimated to be about 3400 VPD with the addition of construction traffic. This corresponds to a two-way peak flow of about 340 veh/hr. Angle Crossing Road estimated to carry about 240 VPD including construction traffic, which corresponds to about 24 veh/hr. For this low combination of flows, the highway can easily absorb the minor road traffic (refer Table 9 Austroads Part 2, Roadway Capacity).

SIDRA analysis of the peak period turning flows during the construction period was undertaken assuming that peak flows are about 10% of daily traffic flows. A 60/40 directional split was assumed for the analysis. The results indicate that a 95th percentile queue of two vehicles can be expected during the peak period. Table 10 shows the results of the analysis.

Table 10 SIDRA Intersection Analyses

Intersection Approach	Queue (m)	LOS
Monaro Hwy (north)	2	A/B
Monaro Hwy (south)	0	B
Angle Crossing Rd	0	A/B

The safety implications of a right turning vehicle stopped on the highway are discussed in Section 3.5 below.

Williamsdale Road/ Burra Road Intersection
The steep approach to the Burra Road intersection restricts sight distance at the intersection and the additional traffic during the construction phase will add to the risk of collisions. A stop sign is recommended to address the risk of Williamsdale Road traffic turning onto Burra Road.

Discharge Structure Access Road/Burra Road Intersection
The proposed access road is located about 20 metres south of the bridge over Burra Creek. At this location the embankment to the south and the bridge rail to the north may limit sight distance for traffic entering Burra Road. This should be addressed in the Construction Traffic management Plan.

Other Intersections
Badgery Road and Macdiarmid Roads that intersect with Williamsdale Road are both no-through-roads that provide access to properties. These roads have been recently surfaced but are not line marked. Sight distances are adequate for the 80 km/hr speed limit.

Hilltop Road, Burra Road and Lagoon Road are minor roads that intersect with Burra Road between Williamsdale Road and the proposed Outlet Structure site.

3.4 Impact on Road Pavement

Angle Crossing Road is unsealed and would require regular grading in the vicinity of the pipeline construction to maintain an acceptable riding surface. Similarly, the unsealed sections of Williamsdale Road may deteriorate under construction traffic and would require regular maintenance in the vicinity of the pipeline construction works; Palerang Council advised that it grades Williamsdale Road on an average of thee time per year.

Burra Road is a sealed road north of Williamsdale Road and is not expected to carry a significant proportion of construction traffic.

Monaro Highway carries a high volume of traffic and the additional traffic generated by the project is not expected to significantly affect the condition of the pavement.

3.5 Road Safety

Existing traffic volumes on the lightly trafficked roads affected by the project could increase the risk of collisions, particularly early in the project, until local drivers become accustomed to the project construction traffic.

On the Monaro Highway appropriate warning signs should be included in the traffic management plans to warn drivers of entering construction traffic at Williamsdale Road and Angle Crossing Roads. Particular attention needs to be given to management of traffic during peak traffic periods on Monaro Highway such as the ski season when traffic volumes increase significantly. Drivers travelling to and from the snowfields are typically unfamiliar with local conditions and would probably not be aware of the construction traffic movements in the vicinity.

At Angle Crossing Road, the southbound shoulder of the highway has a sealed width of about one metre; the remainder of the shoulder has a gravelled surface. The traffic analysis results in Table 10 above indicate

that the 95th percentile queue for traffic turning right into Angle Crossing Road during the construction period is two vehicles. Southbound through traffic would be blocked by the right turning traffic as the existing sealed shoulder is not wide enough to permit traffic to pass safely. This arrangement would increase the risk of rear-end and out-of-control crashes. Austroads Guide to Traffic Engineering Practice, Part 5: Intersections at Grade refers to a threshold traffic volume of greater than 50 vpd on the side road for the implementation of the 'Basic Right Turn' and 'Basic Left Turn' (BAR/BAL) type intersection. This type of intersection improvement is the minimum treatment available and would involve widening and sealing the southbound shoulder through the intersection and improving the left turn geometry for vehicles leaving Angle Crossing Road. Refer to Appendix B for a typical BAR/BAL intersection layout.

Appropriate traffic control devices would be installed during the construction period in accordance with approved traffic management plans.

4 Conclusions and Recommendations

It is concluded that:

- The additional construction traffic due to the project can be adequately accommodated on Angle Crossing Road, Monaro Highway, Williamsdale Road and Burra Road at acceptable levels of service;
- The additional traffic due to the construction of the pipeline would not have a significant impact on existing traffic operating under the control of approved traffic management plans;
- There is likely to be disruption to traffic where the pipeline crosses roads and where the pipeline is laid along sections of the road;
- Additional traffic generated during the construction phase can be satisfactorily accommodated within the existing layouts of the intersections of Williamsdale Road/ Monaro Highway at acceptable levels of service;
- The increased traffic volume on Angle Crossing Road will cause some queuing to develop on the highway, increasing the risk of crashes;
- There is an increased risk of collisions at the Burra Road/ Williamsdale road intersection due to the vertical grading of the existing approach to Burra Road; and
- The location of the proposed access road for the outlet structure may not provide sufficient sight distance for traffic entering Burra Road.

It is recommended that:

- Traffic management plans during construction include appropriate signs on Monaro Highway and Burra Road warning of trucks entering Angle Crossing Road and Williamsdale Road;
- Traffic management plans are implemented where traffic flow is affected by the construction pipeline and in particular at locations where the pipeline crosses the road or is located along and within the road reserve;
- Traffic management plans during construction include reduced speed limits on Burra Road on the approaches to Williamsdale Road intersection to moderate the risk of collisions;
- Monaro Highway/ Angle Crossing Road intersection be improved by providing a wider sealed shoulder on Monaro Highway and improved geometry for the left turn from Angle Crossing Road;
- Grading of Angle Crossing Road and unsealed sections of Williamsdale Road in the vicinity of the pipeline construction be undertaken as required;
- Where closure of Angle Crossing Road is required, adequate notice of closure should be provided and warning signs should be in place advising of alternative routes across the Murrumbidgee River; and
- The traffic management plans address the limited sight distance at proposed access road to the outlet structure on Burra Road.

Appendix A Photographs

Photo 1: Angle Crossing Road at Causeway

Photo 2: Angle Crossing Road approaching Causeway

Photo 3: Angle Crossing Road westbound from Monaro Highway

Photo 4: Angle Crossing Road approaching Monaro Highway

Photo 5: Angle Crossing Road/ Monaro Highway intersection looking north

Photo 6: Angle Crossing Road/ Monaro Highway intersection looking south

Photo 7: Williamsdale/ Monaro Highway intersection looking south

Photo 8: Williamsdale/ Monaro Highway looking north

Photo 9: Williamsdale Eastbound near Monaro Highway

Photo 10: Williamsdale Road unsealed

Photo 11: Williamsdale Road at Badgery Road intersection

Photo 12: Williamsdale Road at Macdiarmid Road intersection

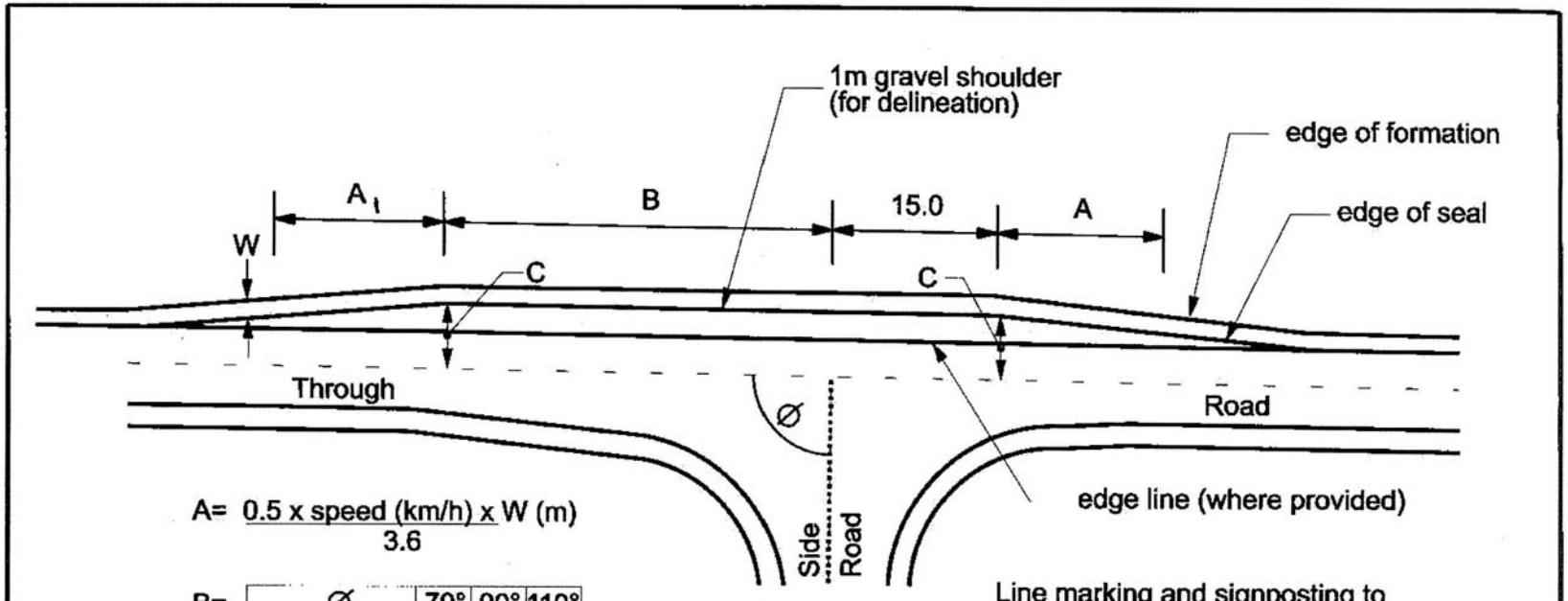
Photo 13: Williamsdale Road looking west from Burra Road intersection

Phot 14: Williamsdale Road looking east at Burra Road intersection

Photo 15: Burra Road northbound approaching Williamsdale Road intersection

Photo 16: Burra Road southbound from Williamsdale Road

Appendix B BAR/BAL Type Intersection Improvement



$$A = \frac{0.5 \times \text{speed (km/h)} \times W \text{ (m)}}{3.6}$$

B=

Ø	70°	90°	110°
Length (m)	40	35	30

Line marking and signposting to be in accordance with "Signs and Markings" Manual

C= on straight - 6.0m min.
on curve - 2 x (3.0 + corresponding widening for curve radius)m min.
refer Section 2 - Table 2.2.2

W= formation widening (if required)

$$A_1 = \frac{1.0 \times \text{speed (km/h)} \times W(m)}{3.6}$$

Modified 'BAR' Right-Turn Treatment

SCALES: NOT TO SCALE	RTA PROJECT DESIGN TECHNICAL SERVICES RTA OPERATIONS	ROADS AND TRAFFIC AUTHORITY OF NSW MODEL DRAWINGS MODIFIED 'BAR' RIGHT-TURN TREATMENT	FILE No.	DRAWING: Standard Drawings.dgn	PRINTED DATE: 19/08/2005	SHEET No.: MD