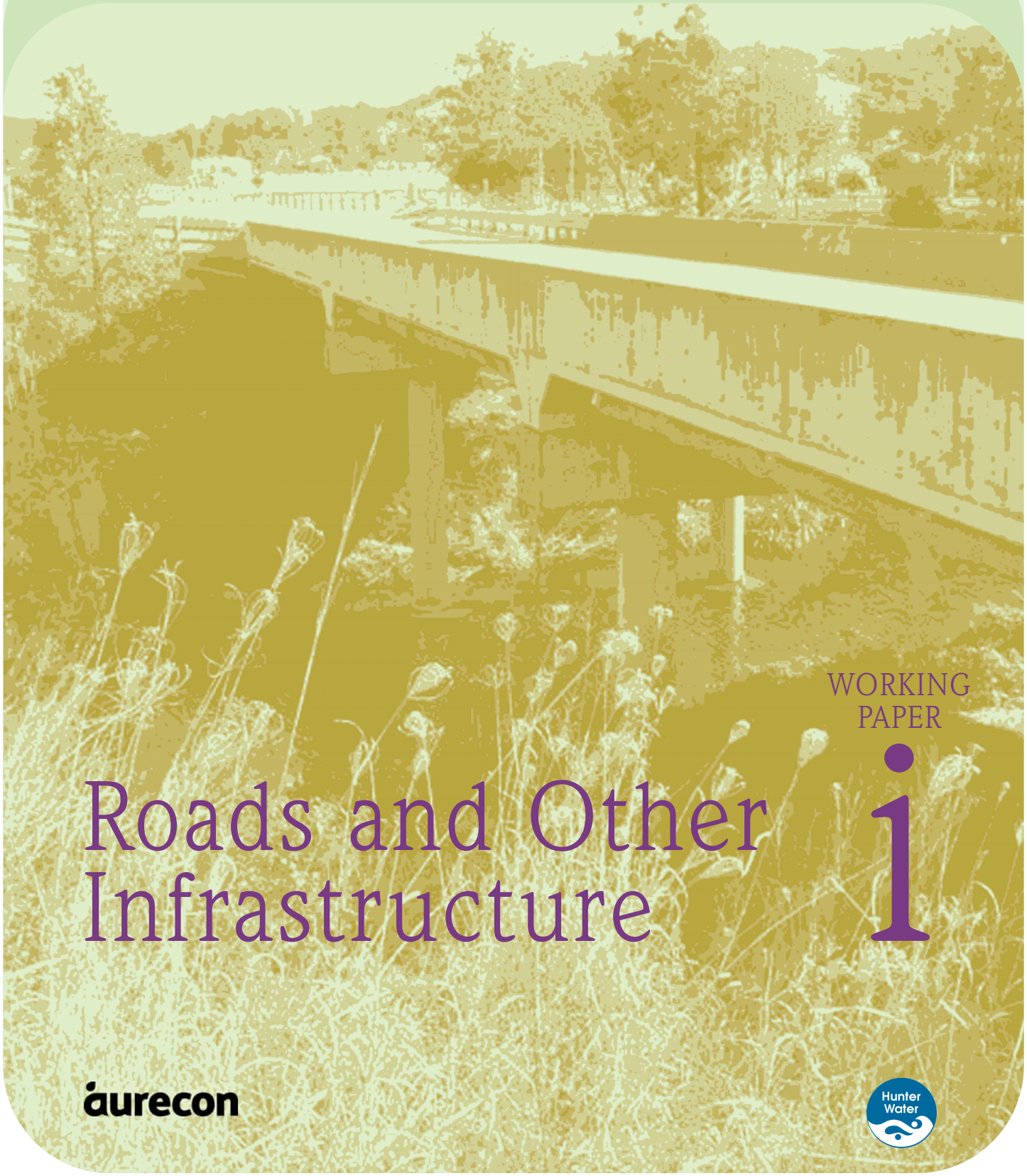
Tillegra Dam

Planning and Environmental Assessment



WORKING PAPER i

Roads and Other Infrastructure

aurecon

Hunter Water

Document Control

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1. Introduction

1.1 Background

Hunter Water Corporation ('Hunter Water') is proposing to construct a 450 gigalitre water supply storage dam on the Williams River for the purposes of providing greater drought security for the Hunter region. This would result in the inundation of approximately 2,100 hectares of land upstream of the dam wall at Tillegra.

Construction of the dam would require the relocation of a section of Salisbury Road, approximately 15 kilometres in length. The new section of road would run around the eastern side of the storage

While it is likely that some materials for construction of the dam and road would be sourced locally, it would still be necessary to transport a significant quantity of construction materials to the dam and road construction sites. This has implications in terms of:

- impacts upon the existing road network (such as wear and tear from construction vehicles)
- safety for other road users (including pedestrians and non-vehicle users such as cyclists, etc).

The two are related. Deterioration of the road pavement (such as the development of pot holes) would typically cause a reduction in safety.

Once the dam is constructed and the storage has filled, it would likely attract tourists and sightseers to the area which would also have some impact on the local road network though substantially less than construction traffic.

The Project would also affect a number of utilities (electricity and telecommunications) and public infrastructure, notably the Rural Fire Service (RFS) station at Bendolba which is located within the proposed inundation area.

Information in this report has drawn upon a Dungog Shire Council route access study which was formally adopted by Council at its ordinary meeting of 15 June 2008.

It is also noted that a Whole of Government Taskforce has been established to oversee strategic issues of relevance to the Project but not necessarily specific to the Project. It is understood that the local road network is one matter being examined by the Taskforce.

1.2 Objectives of the report

The objectives of this report are to:

- describe the local and regional road network and identify likely haulage routes for construction traffic
- identify major safety issues on roads likely to be used by construction traffic
- identify and describe pavement conditions on major haulage routes
- identify other infrastructure likely to be affected by the project
- consider the feasibility of transporting construction materials by rail (to Dungog)
- provide appropriate recommendations to address issues identified in this report.

1.3 Structure of the report

The report is structured as follows:

SECTION	DESCRIPTION
1	Introduction – synopsis of Project as the context for the report; objectives of the report, and structure of the report.
2	Roads – description of the existing road network likely to be used by construction traffic, existing traffic volumes, characteristics of major intersections, a qualitative assessment of existing pavement conditions, and road drainage. This section also provides a preliminary review of road safety issues on expected access routes.
3	Bridges and other infrastructure – qualitative description of the condition of bridges and waterway crossings on expected access routes and the area above the proposed dam wall location. Description of other infrastructure likely to be affected by the project, notably utilities and the RFS station at Bendolba.
5	Construction – description of construction-related matters with a bearing on assessment of impacts on roads and road safety. This covers the major construction activities and their timing, and construction traffic volumes.
6	Preliminary impact assessment – consideration of impacts of construction traffic principally in relation to road safety issues and pavement deterioration.
7	Conclusion and recommendations.

The following appendices are included:

A Qualitative assessment of the feasibility of transportation of construction materials by rail to Dungog

B Photographs of examples of existing road pavements on expected access routes

C Photographs of road safety issues.

2. Roads

The road network both from Raymond Terrace and Maitland through to Dungog and Tillegra consist of regional arterial routes as well as local roads. The two principal routes to Dungog from the south are Main Roads 101 and 301 (MR101 and MR301 respectively). MR101 links Maitland via Paterson to MR301 a few kilometres south of Dungog. MR301 links the town of Raymond Terrace via Seaham and Clarence Town to Dungog. From Dungog, Chichester Dam Road and Salisbury Road (local roads) provide access to the proposed dam and road construction sites.

The regional context of these routes is shown in Figure 2.1 and in more detail in Figure 2.2.

2.1 Existing road network

The existing road network in the Tillegra and wider Dungog area comprises a range of road types and functional classifications. A generalised description of the existing network is provided from upstream of the proposed Tillegra Dam to south of Dungog, within location based categories as follows:

- existing local roads upstream of the proposed inundation area
- existing local roads within the inundation area
- Salisbury Road and Chichester Dam Road between Tillegra and Dungog
- roads and streets within the town of Dungog
- classified roads/regional arterial routes south of Dungog to Raymond Terrace (via Clarence Town) and Maitland (via Paterson).

Each of the roads within these categories are characterised in the following sections. These are ordered from south to north, in terms of decreasing network importance and traffic volumes.

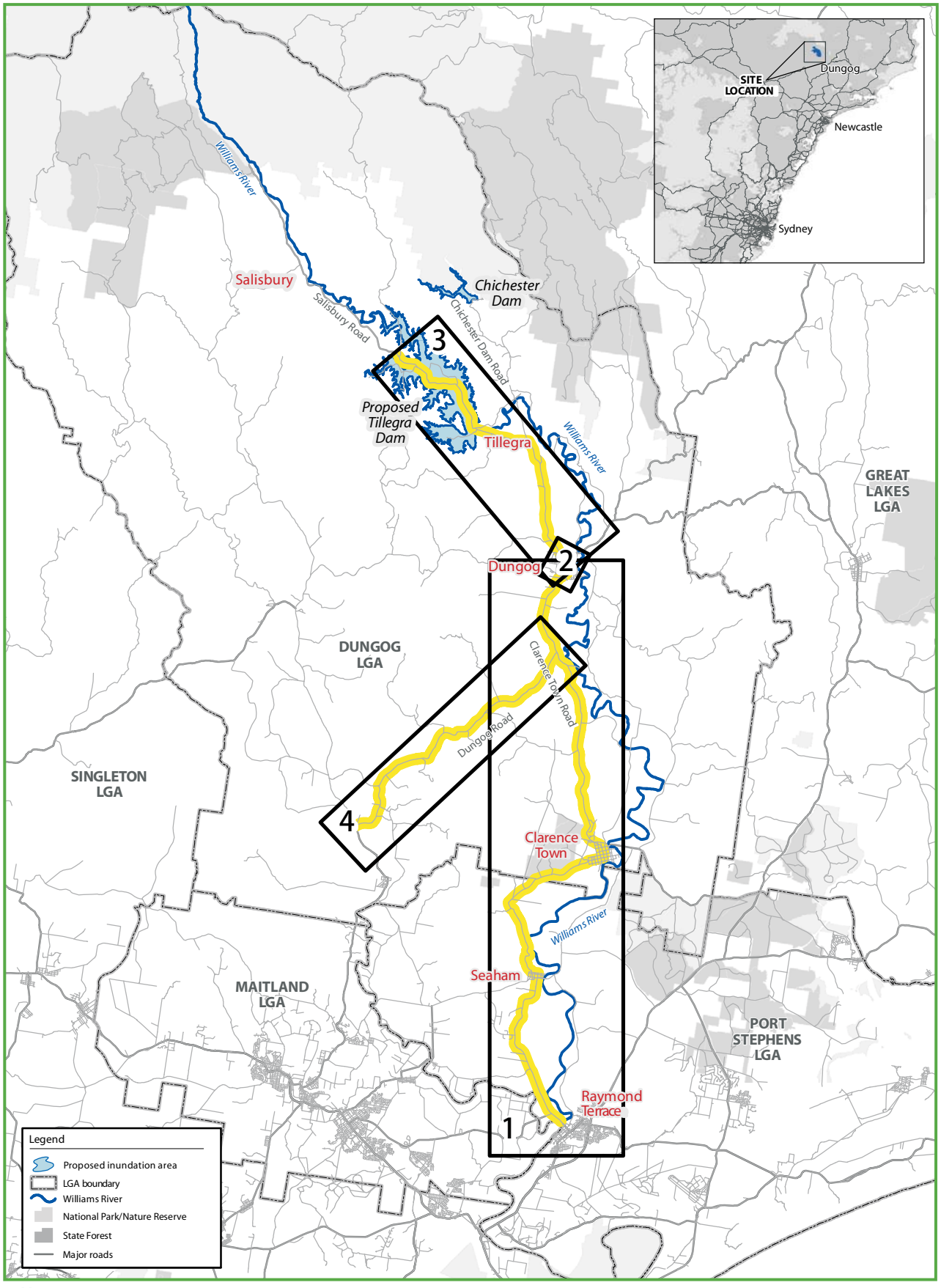


FIGURE 2.1 REAGIONAL ROAD MAP

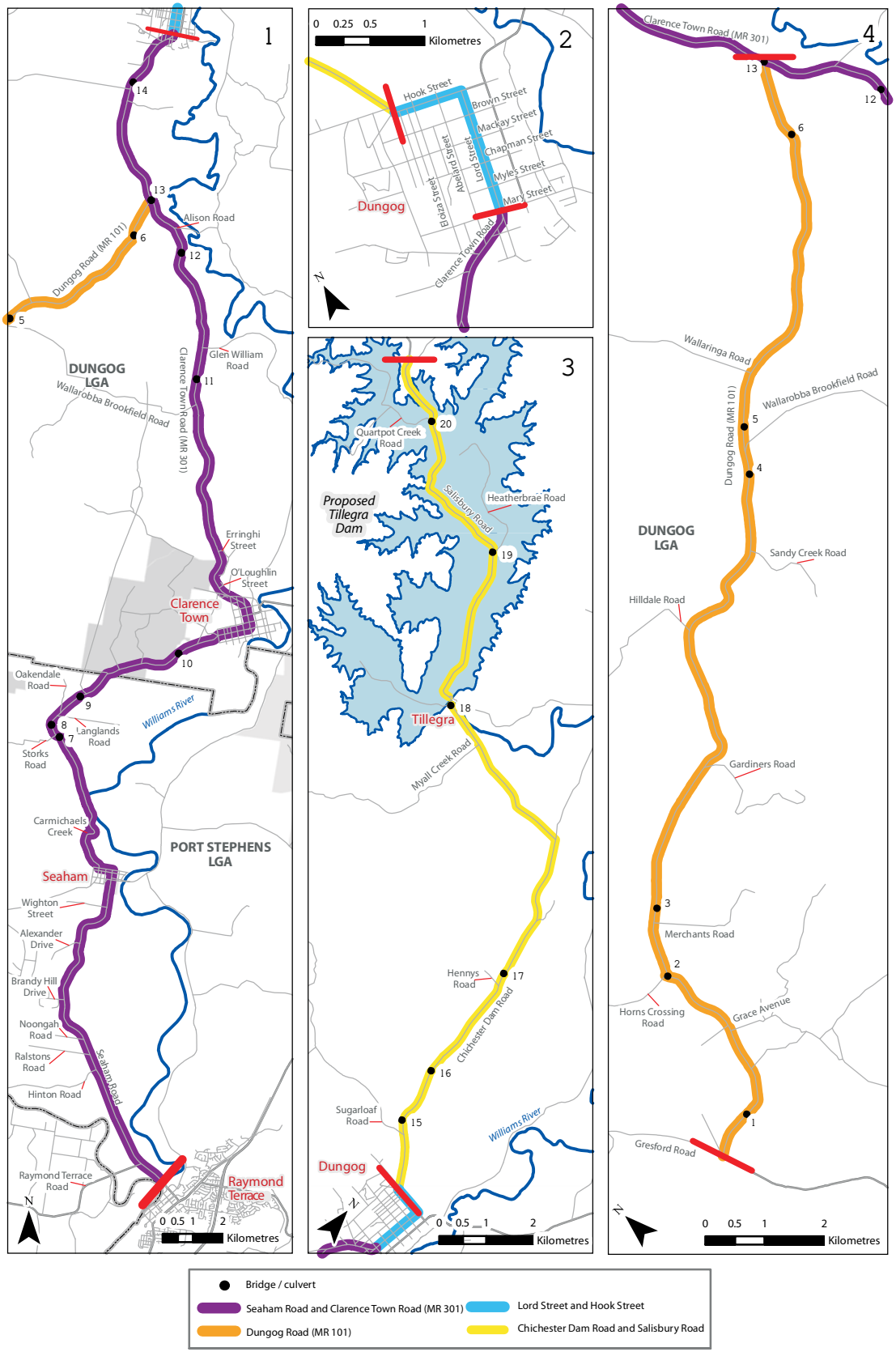


FIGURE 2.2 DETAILED ROUTE MAPS

2.1.1 MR101 Maitland to Paterson to Dungog

This predominantly north-south route provides a link between the New England Highway at Maitland and the township of Dungog. It is intersected by several roads along its route with the main intersections being with Gresford Road (MR7778) north of Paterson and Clarence Town Road (MR301) at Wirragulla, approximately five kilometres south of Dungog.

MR101 is a two lane Regional Road within the NSW Roads and Traffic Authority (RTA) hierarchy of the State Road Network. As a Regional Road it qualifies for funding assistance from the RTA for upgrades and improvement works. Sections between Maitland and Gresford Road are typically marked with edge lines and carriageway lines with sections north of this generally only provided with carriageway separation.

Key features of the MR101 route are as follows:

- the route passes through the Maitland suburbs of Lorn and Bolwarra and the towns of Paterson and Martins Creek in Dungog shire
- generally good pavement condition especially south of Gresford Road where regular maintenance of the road surface is evident. Further to the north small sections of pavement show evidence of extensive pothole repair and pavement deformation
- major road works were currently in progress on several kilometres of road immediately south of Wirragulla at the time fieldwork was undertaken for this report
- horizontal and vertical alignments are satisfactory except for several sharp right angled bends located at the intersection with Horns Crossing Road
- there is a level crossing of the railway line immediately north of the Wallarobba Brookfield Road while a railway overpass exists near the intersection with Horns Crossing Road
- the Chichester Trunk Gravity Main (CTGM) crosses beneath the road immediately south of Clarence Town Road (MR301) at Wirragulla
- MR101 continues as the main road to Dungog after the intersection with MR301 at Wirragula.

2.1.2 MR301– Raymond Terrace to Clarence Town to Wirragulla

This predominantly north-south route provides an approximate 52 kilometre link between the Pacific Highway at Raymond Terrace and the community of Wirragulla, south of Dungog. The route, which is typically two lanes with a single lane in each direction, is intersected by several roads along its length and caters for many private property frontages and residential accesses.

Key features of the MR301 route are as follows:

- the route passes through the Port Stephens suburbs of Nelsons Plains and Brandy Hill, as well as Seaham
- generally good pavement condition with some sections showing evidence of rutting and deformation especially Clarence Town along Queen Street; signs of recent maintenance are also evident
- there is generally good horizontal and vertical alignment along the length of route, although there are some sections of poor alignment that do not meet contemporary design standards for heavy vehicles, for example at Carmichaels Creek.

2.1.3 Dungog streets and road hierarchy

The roads and streets within the township of Dungog are generally set out in a north/south and

east/west grid pattern. On the immediate approach to the town, MR101 turns right from Lord Street into Mary Street and then left into Dowling Street, which is the main street through the town centre. At the northern end of Dowling Street, Hook Street runs westerly toward the north western extremity of town.

Lord Street continues north from Mary Street and parallels Dowling Street, also intersecting with Hook Street. It is a wide street with some residential frontages but has other adjacent land uses such as parks and commercial buildings.

2.1.4 Chichester Dam Road – Dungog to Bendolba

Chichester Dam Road runs from the western end of Hook Street, heading north toward the Tillegra area. A 10 kilometre section of this road links Dungog to Salisbury Road at Bendolba and is the first of the primary access roads to the dam site. The road continues past Bendolba for another 15 kilometres to Chichester Dam. The road is approximately six to seven metres in width to accommodate a single lane of traffic in each direction but there is no centre line marking or defined shoulder.

Key features of this road up to the Salisbury Road intersection are as follows:

- generally good pavement condition, however, a few sections of the road have high concentrations of repaired potholes
- there are a number of prominent crests with poor sight distance
- there are three bridges on this section of Chichester Dam Road: two small bridges in good condition and Myall Creek Bridge which is concrete, but significantly older.

2.1.5 Salisbury Road -Bendolba to Tillegra

This four kilometre section of Salisbury Road is the primary access route to the dam site at Tillegra and would be the centre of most construction activity. It has an approximate road width of six to seven metres, wider at some points, and can accommodate a single lane of traffic in each direction. The road has no line marking along its entire length.

The southern connection point for the Salisbury Road deviation proposal is approximately one kilometre from the proposed dam site. On the westerly approach to the dam site the proposed deviation swings to the north to join a prominent ridge above the inundation area.

2.1.6 Salisbury Road-Tillegra to Brownmore locality via Munni

This seven kilometre section of Salisbury Road would be inundated following filling of the dam storage. It is currently a winding section of road with a number of intersections with minor access roads.

The key features of this route are as follows:

- generally good pavement condition; large lengths of the road are in extremely good condition and show evidence of recent maintenance and resurfacing
- there are four bridges on this section of Salisbury Road of varying ages and structure type; Munni Bridge is a typical example of a dilapidated structure with inadequate barrier protection
- the horizontal alignment contains several sharp bends at approaches to bridges and along ridge lines which are poorly signposted; the intersection of Salisbury Road with Quart Pot Creek Road contains insufficient warning of the road curvature with missing signage.

Other roads which intersect with this section of Salisbury Road are as follows:

- Tillegra Reserve Road near Tillegra Bridge-this predominantly east-west vehicular track has a single lane of approximately four metres in total width. A private property gate is located approximately one kilometre along the track.
- Heatherbrae Road-links Salisbury Road, near Munni Bridge, to rural properties north of the Williams River. The road is a single lane, three to four metres in width, 3.5 kilometres long and unpaved.
- Quart Pot Creek Road this predominantly east-west minor road provides access to rural properties within the Quart Pot Creek valley from Salisbury Road, near Quart Pot Creek Bridge. Quart Pot Creek Road is a four kilometre long, single lane unpaved (gravel) road with a north-south side road that follows Black Camp Creek.
- Chichester Road this is a minor road which provides a 14 kilometre link from Salisbury Road to rural properties in Upper Chichester. The road is a single lane, four metres wide, with few opportunities for vehicles from opposing directions to pass one another. Toward Upper Chichester, the road is also known as 'Upper Chichester Road'.

The latter three roads are located within the inundation area.

2.1.7 Salisbury Road – northwest of Upper Chichester Road to Salisbury

The section of Salisbury Road upstream of the inundation area is in reasonably good condition for its function as a two way local road. The relocated section of Salisbury Road would connect back to the existing road north of the Underbank locality.

2.1.8 Summary

The preliminary assessment of existing roads within the study area shows them to be in reasonable condition for their current two-way rural road function. However, the narrow, sometimes winding nature of some sections of various roads is not ideal for larger vehicles and sight distance limitations in some areas are of concern from a road safety perspective.

South of Dungog the regional routes of MR101 and MR301 are in reasonable condition and are subject to upgrading by Dungog Shire Council. These routes pass through a number of smaller towns and villages.

North of Dungog, the roads investigated tend to be narrower with no line markings. There is evidence of recent and ongoing improvements throughout the road network including new bridges, new culverts and road resurfacing.

The existing roads decrease in standard and safety as they approach the proposed dam site and as such the expected impacts of the proposal are expected to be most significant in these areas. Further consideration of impacts is provided in Section 5.

2.2 Existing traffic volumes

As part of its study of access routes in Dungog Shire, Council conducted traffic measurements on key roads within the shire, including MR101 and MR301. Counts for sections of these routes are presented in the following table together with percentages and numbers for heavy vehicles.

TABLE 1 TRAFFIC VOLUMES ON MR101 AND MR301

ROAD	AADT[1]	%HV[2]	HV/day[3]
MR101			
MR101/MR301 intersection to Dungog	2,236	21	467
Dungog Rd from Wirragulla to Gostwyck intersection	940	17	160
Gostwyck intersection to Paterson level crossing	1,991	14	270
King St / Duke St / Maitland Rd (in Paterson)	2,950	8	244
Tocal Rd	2,345	11	264
MR301			
MR101/MR301 intersection to Earl St (Clarence Town)	1,321	13	177
Clarence Town (urban streets)	1,801	7	120
Cemetery Rd to Port Stephens LGA boundary	1,442	28	403

Source: Dungog Shire Access Routes Development Study (Dungog Shire Council 2008)
Notes:
1 Average annual daily traffic
2 Percentage of heavy vehicles
3 Average number of heavy vehicles per day

RTA publications provide historical records of daily traffic volumes in key areas on the roads identified in Section 2.1 and these are reproduced in Table 2. A recent survey undertaken on Salisbury Road near Tillegra is also included in the table.

TABLE 2.3 STATISTICAL ANALYSIS OF TILLEGRA BRIDGE HISTORIC FLOWS (MEGALITRES PER DAY)

ROAD	SITE	1995	1995	1995	1995	1995
Chichester Dam Rd[1]	South of Salisbury Road	–	–	–	–	500[1]
Salisbury Rd	West of Chichester Dam Road	–	–	–	–	279
MR101 Dungog Rd	South of Dungog[2]	–	3,407	1,963	2,100[2]	
	South of Wirragulla	978	845	835	870	
	South of Paterson	2,577	2,711	2,898	2,815	
	North of Lorn	11,940	13,062	13,112	13,369	
MR301	South of Wirragulla	1,142	1,200	1,239	1,341	
Clarence Town Rd	South of Clarence Town	1,930	1,753	2,157	2,270	
	South of Seaham	4,228	5,080	5,710	6,021	

Notes:
1 No traffic count available for Chichester Dam Road-estimated volume only
2 Volume on MR101 north of Wirragulla calculated from feeder southern legs of MR101 and MR301

The key points to note from this table are as follows.

- Salisbury Road, west of the intersection with Chichester Dam Road, was the subject of a vehicle classification count by Dungog Shire Council in November and December 2006. Both northbound and southbound traffic was included in the count. The results indicated that an average of 279 vehicles used the road per day with less than one per cent of vehicles using the road being heavy vehicles. Traffic flow peaks in the mornings at 8.00 am and in the afternoons between 3.00 pm and 5.00 pm but peak period volumes are only about 20 vehicles per hour. This figure is relatively consistent during daylight hours.
- Chichester Dam Road is located closer to Dungog than Salisbury Road. As such it is expected the southern portion of Chichester Dam Road would convey higher traffic volumes than Salisbury Road due to the addition of traffic from further north of Chichester Dam Road. However, the additional volume is not expected to be significant; accordingly volumes on this road have been estimated at 500 vehicles per day.

- MR101 south of Dungog has a daily volume of approximately 2,000 vehicles per day. This has been calculated from the sections of MR101 and MR301 south of Wirragulla. The traffic volume leaving and entering Dungog to/from the south is split approximately 60:40 in favour of the MR301 route to Clarence Town and Raymond Terrace over the MR101 route to Paterson and Maitland. This confirms the distance saving for travel to the Lower Hunter and Newcastle.
- MR101 and MR301 carry more traffic further to the south as the two regional routes pick up additional traffic from towns further south. While MR301 takes the majority of traffic to/from Dungog, it is MR101 which is the most heavily trafficked of the two at the southern end, with 13,000 vehicles per day at Lorn, just north of Maitland.

2.3 Major intersections

The major intersections on existing roads in the Dungog area are described as follows with regard to their respective intersection types and existing priority control.

MR301 and MR101

Dungog Road (MR101) meets Clarence Town Road (MR301) at a T-intersection with traffic movements north and south along Clarence Town Road having priority. There is also a rail bridge on Clarence Town Road south of the intersection. Dungog Road crosses the Chichester Trunk Gravity Main near the intersection.

Intersections in Dungog

These can be characterised as street intersections with the minor street giving way to the major through route. Intersections of note include:

- Lord Street and Mary Street – this is a four way intersection with priority for Mary Street east
- Lord Street has numerous cross intersections giving way to Lord Street as the dominant route
- Lord Street and Hook Street – this is a T-intersection with the priority to Hook Street.

Hook Street has priority over other local streets as it veers north on the outskirts of the township.

Hook Street and Bingleburra Road

This T-intersection is located approximately two kilometres north of Dungog along Chichester Dam Road, with Bingleburra Road providing a route (approximately 25 kilometres in length) between Dungog and Gresford. The intersection has no line markings and is in a generally poor condition with an abundance of repaired potholes and loose material on the surrounding road surface. Hook Road becomes Chichester Dam Road north of the intersection. Priority is given to traffic travelling north-south along Hook Road and Chichester Dam Road.

Chichester Dam Road and Salisbury Road

This intersection is situated near Bendolba, ten kilometres north of Dungog and represents the key turning point for travel to Tillegra and Salisbury. Signposting and transverse line marking at the intersection instructs vehicles on Salisbury Road west to give way, giving priority to traffic on the predominantly north-south Chichester Dam Road.

2.4 Pavements

As pavements are subjected to the effects of traffic and the environment, their condition deteriorates. Indicators of pavement performance are forms of structural distress, their magnitude,

location and extent. The principal forms of load-induced defects in sealed flexible roads can be one of the following three types:

- deformation (rutting, shoving, depressions or corrugations)
- cracking (transverse, longitudinal, meandering, crocodile)
- edge cracking (eg edge drop, edge break).

The rural roads likely to be used for the movement of construction traffic appear to be in reasonable condition for their current two-way rural road function. However, the visual inspection undertaken for the Project identified sections of MR101, MR301, Salisbury Road and other local roads which would benefit from rehabilitation or some form of remedial work being undertaken prior to construction.

The following locations have been identified as some of the higher priority sections along the expected construction routes that could require remedial works before construction of the dam begins. Refer to Appendix C for photographs:

Dungog Road (MR101)

- the intersection of Wallarobba Brookfield Road with Dungog Road contains significant pavement defects. The close proximity of the intersection to the rail level crossing contributes to the increased hazardous nature of the deficiency (Photo C1).
- the section between Sandy Creek Road and Hilldale Road contains steep inclines and declines with continuous and severe pavement defects, and steep unprotected embankments (Photo C2).

Clarence Town Road (MR301)

- at the Carmichaels Creek location along Clarence Town Road, the pavement condition is substandard. Construction traffic could potentially further damage the road surface or possibly veer off the steep terrain due to the lack of barrier protection (Photos C3 and C16).
- the wide range of pavement defects for the entire length of Queen Street in addition to the absence of standard line marking for the children's crossing at Clarence Town Public School could further deteriorate from use by construction traffic (Photos C4 and C14).

Salisbury Road

- directly north of Tillegra Bridge, the pavement along Salisbury Road becomes extremely narrow. It is also damaged with unprotected embankments (Photo C5).

Periodic inspections and assessments of the road pavement during the construction phase would assist in maintaining the road pavement at an acceptable level.

Dungog streets

In the township of Dungog it is anticipated that Lord Street would be used as the main thoroughfare for construction traffic. This street runs in a north-south direction parallel to Dowling Street which is the main street of Dungog. Lord Street comprises one lane in each direction with wide unformed shoulders. The road pavement is in fair condition for local traffic but could deteriorate further from use by construction traffic.

Remediation works may need to be undertaken along sections of Lord Street which currently exhibit marked pavement degradation to reduce the risk of further deterioration from construction traffic. The intersection with Brown Street is an example of the need for remedial works with regard to pavement condition and (the absence of) line marking.

Specific sections that would require rehabilitation are the intersections of Lord Street and Brown Street as well as Eloiza Street and Hook Street. These intersections contain faded pedestrian zebra crossings in addition to dilapidated pavement.

Pavement works required after project completion

It is recommended that periodic inspection of the construction haulage routes be undertaken during construction. The purpose of the inspections would be:

- to monitor pavement condition and identify (and schedule) any necessary repairs
- to identify any safety issues of concern and the necessary response(s).

This would also minimise the need for extensive pavement restoration following completion of construction.

2.5 Road drainage

From a visual inspection and review of photographs taken it is evident that the road drainage mainly consists of table drains along both side of the carriageway. To ensure that these drains work in an efficient manner, regular inspections would need to be undertaken to ensure that they are not filled with debris or material which could cause a build up of water.

A build up of water could also cause water to penetrate into the road pavement which could possibly lead to pavement failures.

2.6 Safety issues

A road safety audit was undertaken for part of the expected route which would be used by the vehicles including trucks and staff vehicles during the construction of Tillegra Dam. This extended from Raymond Terrace, through to Seaham, Clarence Town, Dungog and then north to the proposed construction site at Tillegra. Specifically, the route comprised:

- Clarence Town Road/Seaham Road (MR301) – from Fitzgerald Bridge at Raymond Terrace to Lord Street at Dungog
- Lord Street and Hook Street – from Clarence Town Road at Dungog to Chichester Dam Road at Dungog
- Chichester Dam Road and Salisbury Road – from Hook Street at Dungog to Chichester Road at Salisbury
- Dungog Road (MR101)-from Gresford Road at Martins Creek to Clarence Town Road at Wirrugulla.

Figure 2.2 shows the routes that were audited.

The purpose of the audit was to identify existing road safety deficiencies along the expected construction vehicle route. The audit included site inspections which were conducted on 6, 7 and 13 May 2008. Weather conditions were fine during the inspection. Should the Project be approved, it is anticipated that the audit would be followed up by periodic inspection and monitoring during and following construction that focus on pavement deformation and general deterioration.

The *Dungog Shire Access Routes Development Study* commented that, in general, access routes within the Shire are deficient in terms of all major indicators of asset condition. Most roads are excessively rough, narrow and have inadequate shoulder width. They have excessive pavement defects such as cracking, potholes, rutting, shoulder drop off and failed patches. They also lack any reasonable level of overtaking opportunities.

The study provided the following observations related to road safety:

- the extent of the roads with poor roughness and cracking in Dungog Shire is two and half times that compared with the average condition of equivalent roads across wide areas of northern NSW
- 57 per cent of access routes in Dungog Shire are less than the average of eight metres seal width across NSW
- three per cent of council bridges in Dungog Shire have clear widths greater than the NSW average width of eight metres
- there are no dedicated overtaking lanes within Dungog Shire with only 50 per cent of the number of safe overtaking opportunities (where line marked) provided
- traffic count data from Dungog Shire Council 2003-07 for the intersection of MR101/MR301 to Dungog along Clarence Town Road shows an AADT of 2,236 vehicles per day including 466 heavy vehicles per day (approximately 21 per cent of total vehicles).

2.6.1 General comments

A number of general road safety issues were identified along the proposed construction route inspected. Photographs of features of interest are provided as Appendix C and reference is made to these where appropriate. These issues included the following:

- excessive cracking, potholes, rutting and shoulder drop offs (Photos C6 and C7)
- inadequate seal width for roadways and bridges (Photo C8)
- lack of safe overtaking opportunities (Photos C9 and C10)
- faded or missing line marking (Photo C11)
- overgrown roadside vegetation on the shoulders that narrow the roadway and/or obstruct forward sight distance of oncoming vehicles and bridge structures (Photo C12)
- warning signs that are either faded or missing
- roadside objects such as trees which are located within the clear zone (Photo C13)
- numerous missing guide posts in addition to those obscured by overgrown vegetation
- most culverts along the route are unprotected and/or obscured by overgrown vegetation
- the majority of the routes are not well illuminated.

2.6.2 Specific comments

The following deficiencies were observed during the site inspection. It should be noted that these are restricted to the conditions along the route as they existed during the time of the site inspection.

Clarence Town Road (MR301)

- excessive rutting on all three approaches at the intersection of MR301 and MR101
- it appears that the reduction in posted speed limit from 100 km/h to 50 km/h occurs within a short distance on the approach to Dungog township (this could not be verified due to road works at the time of inspection)
- overtaking manoeuvres are allowed at locations with limited sight distances to the opposing traffic (Photo C9)

- the horizontal and vertical alignments along Clarence Town Road at Carmichaels Creek include adverse transitions in road curvature which could potentially be hazardous for an errant vehicle. There are no guard barriers for southbound traffic along the curves of this section.
- the combination of deficient line and pavement marking at the pedestrian crossing at Clarence Town Public School in addition to the continuous pavement defects along the entire length of Queen Street could possibly lead to further deterioration of the road surface with construction traffic (Photo C14)
- there are steep embankments that are protected with timber fences which appear to be old and/or damaged. No proper guard rail protection is provided for the steep embankment north of Earl Street at Clarence Town. There are unprotected steep embankments north of Tabbil Creek towards Dungog (Photos C15 and C16).

Dungog Road (MR101)

- there are pavement deformations and faded line marking at the intersection of Wallarobba Brookfield Road with Dungog Road
- the section between Sandy Creek Road and Hilldale Road along Dungog Road contains severe pavement defects that continue throughout the undulating terrain. The steep embankments along this section include old fencing where there are no guard barriers. The lack of signs to indicate the winding nature of the road contributes to the overall deficiency along the route.
- the intersection of Horns Crossing Road with Dungog Road consist of a narrow rail overpass, faded line marking, damaged signs in conjunction with inadequate guard barriers and incorrectly installed curve alignment markers (Photo C17)
- the bridge over Martins Creek on Dungog Road consists of old wooden fencing with no guard rail protection for the steep embankments on the southern approach (Photo C18).

Dungog Road – Clarence Town Road intersection

- substantial rutting at all approaches to the intersection (Photo C6)
- no line marking is provided at the Dungog Road approach
- line marking is faded along the acceleration lane on Clarence Town Road
- the guard rail on the south western corner of the junction, after the concrete bridge, is damaged and is located too close to the roadway
- the sight distance to the right turning vehicles is limited due to the crest which is located north of the intersection on Clarence Town Road (Photo C19)
- no right turn bay is provided on the northern approach of the Clarence Town Road
- no lighting is provided for this intersection.

Lord Street

- south of Mackay Street there are old and damaged crash barriers for a culvert (Photo C20).

Lord Street/Brown Street intersection

- faded pedestrian crossing marking observed at the southern and western leg of this intersection (Photo C21)
- adverse cross fall was observed at the departure side of the southern leg of this intersection (Photo C22).

Lord Street – Hook Street intersection

- substantial rutting at all approaches to the intersection
- no line marking provided at the Lord Street approach
- no 'Give Way' sign provided on Lord Street approach.

Hook Street – Eloiza Street intersection

- faded pedestrian crossing pavement marking observed at the eastern leg of this intersection (Photo C23).

Chichester Dam Road and Salisbury Road

- no centreline marking provided along this road; the delineation of the road is not clear at the crests and the curved sections of the road (Photo C24)
- roadside objects such as trees are located within the clear zone (Photo C13)
- guide posts are missing at several locations. The existing guide posts along the road are obscured by overgrown vegetation. The delineation is expected to be poor during night time with inadequate/missing guide posts and the lack of line marking along the road.
- most bridges along this road section are narrow and/or have substandard widths. Some of the narrow bridge signs are either missing or faded (Photo C8).
- north of Tillegra Bridge along Salisbury Road, the narrow and winding roadway is unprotected from the steep embankment drop off
- the intersection of Salisbury Road and Quart Pot Creek Road has poor delineation where there is insufficient warning to the change in road curvature (Photo C25).

Chichester Dam Road – Salisbury Road Intersection

- line marking faded at this intersection
- sight distance to right-turning vehicles is limited due to the crests located directly north and south of the intersection on Chichester Dam Road
- no protection provided adjacent to the verge which is located opposite to Salisbury Road
- no lighting provided for intersection.

Tillegra Dam locality

- no signage provided to warn motorists that the bridge over Williams River is a single lane bridge (Photo C20).

3. Bridges and other infrastructure

3.1 Bridges

There are numerous existing bridge structures both to the north and south of Dungog on the likely access routes. These are listed in Table 3 together with summary comments on the current condition of the structure and relevant issues relating to potential safety concerns. At the time of the field inspections, none of these structures were observed to have any posted load restrictions in place.

TABLE 3 WATERWAY CROSSINGS ON ACCESS ROUTES

ROAD	BRIDGE LOCATION[1]	COMMENT
MR101 Dungog Road	1. Paterson	Built more than 110 years ago, lattice truss bridge with historic values, good condition, three spans
	2. Railway line	Steel substructure with concrete and asphalt deck with w-beam guardrail. Bridge appears aged
	3. Shingle Splitters Creek	Twin box culvert, minor crossing, appears in good condition
	4. St Annes Bridge	Twin box culvert, minor crossing, appears in good condition
	5. Wallarobba Creek	Concrete superstructure and substructure in visibly good condition. Appears to be of a similar age to the bridge near Wirragulla
	6. Near Wirragulla	Plaque indicates commission in 1955, two lane, concrete bridge with concrete supports
MR301 Clarence Town Rd	7. Wattle Creek	
	8. Stock Creek	Twin box culvert, minor crossing, appears in good condition
	9. Tumbledown Bridge 10. Wallaroo Creek	Twin box culvert, minor crossing, appears in good condition
	11. Unwarrabin Creek	About 1km north of Wallarobba Brookfield Road, wooden deck, deteriorated surface
	12. Union Bridge	Relatively new, two lane, concrete
	13. Bridge over Rail Line	Near intersection with MR101
	14. Bridge over Tabbil Creek (JG Hawley Bridge)	Two lane, concrete

ROAD	BRIDGE LOCATION[1]	COMMENT
Chichester Dam Road	15. Small unnamed bridge	Visibly good condition
	16. Small unnamed bridge	Visibly good condition
	17. Myall Creek Bridge	Quite old, two lane, concrete, aged guardrail, 15-20m long
Salisbury Road	18. Tillegra Bridge	Very old, timber piers and timber deck, sharp bends on both approaches
	19. Munni Bridge	Single lane, concrete with old steel guardrail, aging, sharp bend on northern approach
	20. Quart Pot Creek Bridge	New two lane concrete bridge, new guardrail, sharp bend on southern approach lacks signposting.

1 Numbers refer to locations shown on Figure 2.2

3.2 Utilities

The Project would affect existing telecommunications infrastructure (Telstra copper lines and a fibre optic cable) and electricity supply (Country Energy). HWC has consulted with the utility owners to plan for the necessary relocations.

The Telstra infrastructure relocations would comprise:

- a temporary diversion of a copper service line around the dam wall site
- numerous relocations of copper service lines that would be affected by the new section of Salisbury Road and the storage (generally along the fringes at/near full supply level). These would be deepened and put in a conduit or diverted as appropriate.
- two relocations of the main fibre optic cable that runs between the Bandon Grove and Underbank exchanges. One small relocation would be required due to the new section of road. The other longer relocation would be placed in conduits and routed through the storage.
- a new copper line to the Quart Pot Creek area to replace the existing line.

The existing Country Energy line which follows Salisbury Road would be re-routed to generally follow the new alignment of Salisbury Road. A replacement connection to the Quart Pot Creek locality would be required. This would generally follow the route of the replacement road access to the area.

Any required works related to addressing road safety issues on access routes could potentially impact on adjacent infrastructure such as electricity transmission lines. Impacts and management strategies would need to be considered on a case by case basis and include consultation with the relevant utility owner.

3.3 Bendolba RFS station

The RFS station at Bendolba also lies within the inundation area and would need to be relocated. Following consultation between the RFS and HWC, an alternative location has been identified on land near where the new section of Salisbury Road joins the existing Salisbury Road. The prominent location would minimise the risk of vandalism. The location also addresses RFS concerns over quick and efficient access up and down the valley.

4. Construction

4.1 Construction phases and duration

Construction would proceed in three general phases for the dam and two for the new section of Salisbury Road. The principal activities associated with each phase are outlined in the following table together with the indicative the timing of each phase.

TABLE 4 CONSTRUCTION PROGRAM

PHASE AND ACTIVITIES	INDICATIVE TIMING[1]	
	START	END
Roads 1 – bridges and approaches (including temporary detour around dam construction site)	Q2 2009	Q3 2010
Roads 2 – remaining works (including Quart Pot Creek area access)	Q2 2010	Q3 2012
Dam 1 – planning and construction, preparatory works	Q2 2010	Q2 2011
Dam 2 – dam construction to commencement of filling	Q1 2011	Q2 2013
Dam 3 – dam completion works and ancillary components	Q2 2013	Q2 2014

Q1 = first quarter of year, Q2 = second quarter, etc

The proposed construction sequencing provides for substantial overlap between dam and road construction works which is attractive from the point of view of managing program risks.

4.2 Traffic generation

Earthworks for both road and dam construction would generally be constrained to site. Fill and associated material derived from earthworks would not be transported on public roads. For example, earth and rock fill to construct the dam wall would be won from sources within or adjacent to the inundation area. All concrete would be batched on site. Road construction works would seek a balance between cut and fill over the length of the Salisbury Road deviation.

Consequently, construction phase traffic generation relates principally to the delivery of plant and equipment and the provision of raw materials and manufactured elements. A summary of all incoming or delivered items and materials for each construction phase is outlined as follows.

Salisbury Road relocation

- setting up a major construction compound, site sheds, offices and amenities
- delivery of road construction plant and equipment, including dozers, small scrapers, graders, compactors, rollers, trucks and water carts

- delivery of road and bridge construction materials such as pre-cast spans, processed pavement material, bitumen and sealing aggregates
- delivery of manufactured road construction elements such as pipes, box culverts, bridge girders, guard fences and signs.

Tillegra Dam construction

- delivery of plant and equipment to construction site and compounds, including batching plants and crushers
- delivery of raw materials for on-site production of concrete
- delivery of reinforcing steel and other fabricated and miscellaneous items.

An estimate of construction traffic has been made based on the estimated types and quantities of materials required for construction of the dam and associated works, and the new section of Salisbury Road and related works (including the new access to the Quart Pot Creek area). In total there would be approximately 8,660 movements (two way) over the duration of construction. The split between dam and road construction activities is approximately equal and the estimates include a 20% contingency.

This equates to an average weekly number of movements (two way) of 24 for dam construction and 28 for road construction activities, the difference being due to the slightly shorter construction period (by about 34 weeks) for road construction.

From Table 4 it can be seen that Phase 2 of road construction activities overlaps with Phases 1 and 2 of dam construction. The average weekly number of movements (two way) for this period is 52 or about nine per day (six day working week).

As indicated, these are averages. At certain times during construction, the number of vehicle movements may be higher depending on the nature of specific construction activities and the types and quantities of materials required. Conversely, at other times the number of vehicle movements may be lower. The contribution of construction traffic to overall vehicle numbers on local roads is discussed in Section 5.

4.3 Transport of construction materials by rail

Rail has been considered as an alternate method of transporting cement, bitumen, steel and other construction material to the dam and road construction area. An assessment of the costs and benefits are attached as Appendix A. In summary, the assessment showed there would be minimal benefit in using rail in preference to road for the following reasons:

- the existing rail infrastructure does not extend to the construction area and therefore would require unloading, additional handling and final road transport from Dungog to Tillegra
- unloading from the existing rail siding could promote additional noise, dust and traffic issues in the main business and residential areas of Dungog
- over short distances, road transport is usually more financially viable than rail whereas rail is generally more cost effective for freight over much longer distances
- incremental impacts from construction traffic are likely to be minor given that increases in heavy vehicle movements in most areas are marginal compared to current annual average daily traffic counts. It should be noted however that many road sections that could be used by construction traffic are in an advanced state of disrepair.

5. Preliminary impact assessment

The increased number of vehicles (particularly heavy vehicles) associated with construction of the dam and related infrastructure (including the relocation of Salisbury Road) could have adverse impacts in relation to wear and tear on road pavements of MR101 and MR301, many sections of which are already in a poor condition. Increased vehicle numbers together with substandard pavement conditions and the existing layout of sections of the routes, eg intersections, could also have implications for road user safety.

The magnitude and nature of these impacts would, to a substantial degree, be influenced by the existing condition of roads in terms of the current condition of the road pavement and the existing layout.

This section provides a preliminary consideration of these impacts. At specific locations along the road, more detailed investigations may be required by the construction contractor to support preparation of the construction environmental management plan (EMP) should the Project be approved.

5.1 Additional traffic

The following table illustrates the contribution of construction traffic to overall local traffic volumes for the construction phase with the expected greatest number of vehicle movements. As indicated in Section 4, this occurs during the overlap of Phase 2 of road construction activities and Phases 1 and 2 of dam construction. The average weekly number of movements (two way, six day working week) during this period is 52 or about nine per day.

TABLE 1 TRAFFIC VOLUMES ON MR101 AND MR301

ROAD	AADT	CURRENT NOS. OF HV/day	% INCREASE IN HV/day
MR101			
MR101/MR301 intersection to Dungog	2,236	467	0.4
Dungog Rd from Wirragulla to Gostwyck intersection	940	160	0.9
Gostwyck intersection to Paterson level crossing	1,991	270	0.4
King St / Duke St / Maitland Rd (in Paterson)	2,950	244	0.3
Tocal Rd	2,345	264	0.4
MR301			
MR101/MR301 intersection to Earl St (Clarence Town)	1,321	177	0.7
Clarence Town (urban streets)	1,801	120	0.5
Cemetery Rd to Port Stephens LGA boundary	1,442	403	0.6

This table shows that of the two main routes to Dungog, the impact would be relatively greater for MR101 (on the section of Dungog Road from Wirragulla to Gostwyck intersection). However, with the predicted increase in heavy vehicles being less than one percent for both routes, the overall incremental impact of construction traffic would not be significant.

Table 2 (in Section 2) provided daily traffic counts of 279 and 500 (estimated) respectively for Salisbury Road west of Chichester Dam Road and Chichester Dam Road south of Salisbury Road. While the percentage of heavy vehicles on these two roads is not known, the worst case scenario for the total incremental increase in traffic would see vehicles movements increase by only approximately nine per day. For Salisbury Road which would experience the relatively greater impact, this represents about a three per cent increase in the number of daily vehicle movements.

In addition to heavy vehicles, there would also be light vehicle movements associated with the construction phase. These would largely be associated with the construction work force commuting and light delivery vehicles.

The increase in heavy vehicle numbers on MR101 and MR301 is not considered to be a significant impact. It is expected that effects such as delays, etc could be readily managed through the implementation of standard construction traffic control measures such as currently occur for road works undertaken by Council. It is recommended that these be incorporated as appropriate into a Project-specific construction traffic management plan.

5.2 Impacts on road pavements and related infrastructure

The route access study prepared by Dungog Shire Council acknowledges the existing poor condition of many of the Shire's roads. As noted in Section 1.1, the local road network is one of the strategic issues being considered by the Whole of Government Taskforce.

As indicated in the preceding section, the contribution of construction traffic to overall vehicle movements is not expected to be significant. It is acknowledged, however, that construction traffic, principally heavy vehicles, could still contribute to further pavement deterioration, particularly on sections of roads where the pavement is already in a poor condition. This in turn could have implications for general road safety. This is considered further in Section 5.3.

It is noted that approval or consent conditions for major infrastructure projects where a potentially significant impact on the roads through use by construction traffic has been identified generally include the requirements to undertake pre-construction and post-construction condition surveys and to rectify damage attributable to construction traffic.

Typically, such surveys comprise a complete visual capture of the road condition together with quantitative data collection such as by

- roughness car measurement
- laser spectrometer
- deflectograph measurement of pavement deflections.

Of these, the laser spectrometer is considered to be the best combination of cost effectiveness and data relevance.

Given the existing poor pavement condition of many sections of the likely access routes, and which was readily apparent through simple visual inspection (refer photographs in Appendices B and C), it was considered there would be little value in collecting quantitative data such as by the methods noted. In short, these approaches are not considered to be practical for two main reasons:

- existing poor road pavement conditions and the potential for further deterioration or other rapid changes
- relatively low traffic volumes associated with the Project relative to over all traffic volumes (including percentage of heavy vehicles), meaning that the majority of pavement damage would not be a result of the Project but through normal wear and tear attributable to all road users.

In terms of managing the contribution of construction traffic to further pavement deterioration (and noting the difficulty in obtaining valid quantitative data relating to this), two general options available are:

- to make ongoing repairs to affected sections of pavement during construction in order to prevent deterioration beyond the existing condition
- repair or reconstruction of the poorest sections of pavement.

Both options could also be effective in addressing some safety issues.

The second option potentially carries a significant cost in view of the extent of poor pavement conditions on the access routes. Given that the analysis of vehicle movements identified the likely minor contribution of project-related traffic to overall traffic numbers in Dungog Shire, it is considered there would be a significant equity issue if the Project was required to meet the cost of such remediation or repair works.

A more logical option could be for HWC to make a financial contribution toward the cost of any necessary pavement remediation works. This acknowledges the likely (minor) effect of construction traffic on the road network but recognises other contributing factors unrelated to the Project, notably the not insignificant proportion of other heavy vehicles which also use Shire roads. It is expected the quantum of any such contribution would be a matter for negotiation with Dungog Shire Council and the Department of Planning.

Table 3 (in Section 3) identifies 12 waterway crossings (and two rail crossings) on MR101 and MR301 together with a number of crossings on other roads which could be used by construction traffic. As

noted, at the time of inspection none had posted load limit restrictions on them. Consequently, it is assumed that they would be capable of accommodating construction traffic. However, it is expected that the principal construction contractor would conduct an assessment immediately prior to the start of construction, and particularly in relation to the transport of heavy items of construction plant or materials. It is expected that the assessment would also consider the approaches to the crossings.

5.3 Road user safety

As noted in Section 2.6, a road safety audit was undertaken for the principal routes expected to be used by construction traffic to access the dam site. The audit identified a range of deficiencies relating to road safety along the routes. Some of these issues, such as absent or faded line markings, could be readily remedied for relatively low cost. Others such as deteriorated pavements could cost significantly more to rectify.

The *Dungog Shire Access Routes Development Study* includes an accident analysis of the access routes. It notes that in Dungog Shire between 2003 and 2008, the accident rate was six times higher than in metropolitan areas and nearly twice that in country areas in general. The existing substandard condition of roads in the Shire are considered to be a major contributing factor.

The proposed access route through Dungog avoids the main thoroughfare (Dowling Street) which would reduce the likelihood of conflicts with pedestrian and other non-vehicle road users such as cyclists. Nonetheless, there would still be potential for these conflicts within the urban area. Appropriate management strategies, for example the imposition of a lower speed limit (similar to a school zone), would need to be implemented to address this issue. It is recommended that these be developed in consultation with Dungog Shire Council.

Should the Project be approved, it is recommended that prior to construction, the deficiencies identified in the road safety audit be addressed consistent with the *RTA Technical Direction for Road Safety Practitioners* (TD2003/RS03). This document outlines the policy and guidelines for the audit process with the purpose of proactively managing road safety by identifying and addressing the risks associated with road safety deficiencies. Risk rankings are applied to each deficiency to assist in employing corrective actions according to the level of priority.

Where appropriate, the identified corrective actions should be incorporated into a construction traffic management plan, which will form part of the overall environmental management plan for the Project.

It is also recommended that regular safety reviews be undertaken during construction and a final review conducted at the completion of construction activities.

Post-construction

In the long term, there may be an increase in vehicle movements due to local (Dungog) and out of town visitors to the dam (and storage) locality, this being associated with tourism and recreational use of the area surrounding the dam and storage. It is difficult to predict the magnitude of any such increase as it would in part be dependent on the type of development which may take place (beyond that proposed as part of the Project). In general, however, it is not expected that traffic volumes would increase substantially.

6. Conclusions and recommendations

The anticipated major access routes for construction vehicles have been identified and potential impacts, relating principally to road pavement dilapidation and road user safety, have been considered.

The likely incremental increase in the number of heavy vehicle movements is not considered to be significant. The analysis undertaken identified that the peak average increase would be nine heavy vehicle movements per day. As indicated in Section 4.2, at certain times during construction, the number of vehicle movements may be higher depending on the nature of specific construction activities and the types and quantities of materials required. Conversely, at other times the number of vehicle movements may be lower.

Given the small increase in heavy vehicle numbers associated with construction relative to both the current percentage of heavy vehicles and to overall traffic volumes, it was concluded that the impact of construction traffic on Shire roads would not be significant. It was acknowledged, however, that construction traffic, principally heavy vehicles, could still contribute to further pavement deterioration, particularly on sections of roads where the pavement is already in a poor condition, and which in turn could have implications for general road safety.

Eight waterway crossings have been identified on MR101 and MR301 together with a number of crossings on other roads which could be used by construction traffic. At the time of inspection none had posted load limit restrictions on them and it was assumed that they would be capable of accommodating construction traffic. It is considered that it would be prudent, however, for the principal construction contractor to conduct an assessment immediately prior to the start of construction, and particularly in relation to the transport of heavy items of construction plant or materials. The assessment should also consider the approaches to the crossings.

A road safety audit undertaken for the assessment identified a number of safety issues have been identified for the expected access routes in general in addition to more specific issues for MR101, MR 301, Chichester Dam Road and Salisbury Road.

It is anticipated that the issue of road pavement condition would be considered holistically through the Whole of Government Taskforce. It is expected this would also cover the related issue of road safety.

The Project would impact on a number of telecommunications and electricity supply utilities which currently cross the inundation area. Consultation has been undertaken with the owners of these utilities and alternative alignments identified.

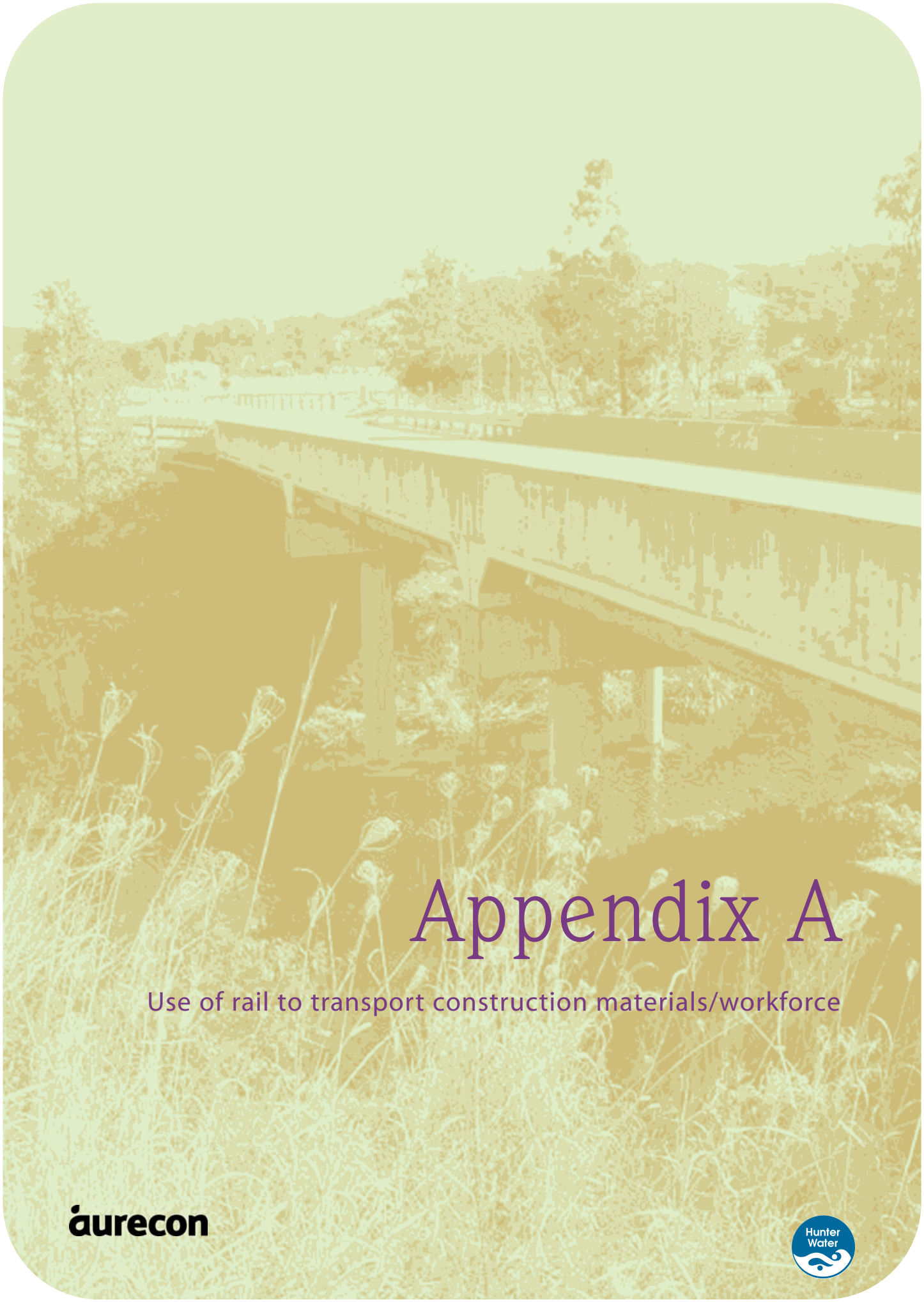
The RFS fire station at Bendolba also lies within the inundation area and would need to be relocated. This particular issue is being addressed through the draft integrated land use plan for the storage.

Consideration has been given to the feasibility of transporting construction materials by rail to reduce impacts on the main access routes to Dungog (MR101 and MR301). This has potential to reduce the number of heavy vehicle movements by approximately 25 per cent south of Dungog. It would still, however, be necessary to offload these materials at Dungog for transport to the construction site. This would result in a range of additional impacts such as noise, dust emissions and conflicts with other road users (including pedestrians) which would need to be managed.

Recommendations

The following recommendations are made with respect to addressing issues identified relating to roads, road safety and effective management of construction traffic.

- A Project-specific construction traffic management plan should be prepared prior to the start of construction. The plan should address all relevant matters arising from the environmental assessment and relevant approval conditions.
- HWC should consider making a financial contribution towards improving the condition of Dungog Shire roads used by construction traffic, by an amount commensurate with the estimated increase in use.
- The construction contractor should undertake a detailed condition assessment of relevant waterway crossings prior to the transport of heavy items of plant or materials. Any required remedial works should be undertaken in accordance with applicable codes and standards.
- The construction contractor should undertake periodic inspections of the construction haulage routes regularly during construction. Any required remedial works should be undertaken in accordance with applicable codes and standards.
- Development of any strategies to manage safety issues on streets within Dungog used by construction traffic should involve appropriate consultation with Dungog Shire Council.
- The deficiencies identified in the road safety audit should be addressed in accordance with the RTA *Technical Direction for Road Safety Practitioners* (TD2003/RS03). These should be actioned prior to the start of construction.



Appendix A

Use of rail to transport construction materials/workforce

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A1 Introduction

While a large proportion of construction materials would be sourced from within the inundation area (such as rock for the dam wall), it would still be necessary to transport a substantial quantity of construction materials to the dam and road construction sites from outside of the Dungog LGA. Given the existing substandard condition of many sections of MR101 and 301 within the LGA, it was considered that the possible option of transporting construction materials (and possibly construction personnel) to Dungog by rail should be investigated.

The existing rail infrastructure at Dungog comprises two sidings and a loop. The latter is used to park trains to allow others to pass. There is also a section of track running behind (to the west of) the platform. Access to the station is from Brown Street, east of Dowling Street.

The possible use of Dungog Station involved consideration of the following issues:

- Access to the network
- Access to rolling stock for the transport of materials
- Access to a siding/platform at Dungog for the offloading of materials
- Access from the Dungog railway station through the township to Chichester Dam Road
- Anticipated impacts associated with the offloading of materials and/or construction personnel at Dungog.

Comment on these is provided in Section A3.

In addition to the above issues, it would also be necessary to obtain access to the rail network for the loading of construction materials onto rolling stock. It is assumed that these would be undertaken at facilities with the necessary infrastructure and approvals. Similarly, construction personnel would access passenger trains at existing stations and would be required to observe all relevant safety requirements associated with their use. Consequently, issues associated with these two groups of activities have not been considered in this review.

It is assumed that the majority of construction materials which could potentially be transported by rail would be sourced from the greater Newcastle area.

A2 Quantities and types of construction materials

This section provides a preliminary consideration of the quantities and types of selected materials which could be transported by rail to Dungog. The three main types of construction materials which could offer the greatest potential to reduce the number of vehicle movements are cement, fly ash and steel mesh. Collectively, these total approximately 19,345 tonnes which, for a B-double with a 24 tonne load capacity, equates to approximately 800 loads or 1,600 vehicle movements.

Use of rail to transport these materials would reduce the total number of vehicle movements by about 19 per cent. However, as indicated previously, a key point to note is that the number of vehicle movements between Dungog and the construction site at Tillegra would not change. There would also be a range of impacts associated with this strategy, mostly in Dungog, which would need to be managed.

A3 Consideration of issues

Access to the network

The ARTC (Australian Rail Track Corporation) leases a number of rail corridors from the NSW government, including the Maitland to Border Tunnel corridor. Under the terms of the lease, ARTC has

full responsibility for all land and infrastructure vested in the NSW Rail Infrastructure Corporation (RIC) and StateRail (with some exclusions) within this corridor.

Access to the network would need to address the matters and requirements set out in The NSW Rail Access Regime (gazetted 28 March 2003 and last updated 4 September 2004). While these have not been examined in detail for this review, it is anticipated that there would be a substantial lead time associated with securing access.

Further information is available from the ARTC website at the following link:

- http://www.artc.com.au/Content.aspx?p=46

The ARTC has advised that it is likely that the train operators would require details on tonnages and frequency of running wagons.

Access to rolling stock for the transport of materials

The construction contractor would need to secure access to suitable rolling stock for the transfer of materials. This has not been investigated in any detail, however, it is noted that securing the use of rolling stock may have implications for the construction timeframe.

Access to a siding/platform at Dungog for offloading of materials

While there are existing sidings at Dungog, the ARTC has advised informally that it may not necessarily be possible to use these as they may be required for use by train operators. It may therefore be necessary to construct a new siding and provide suitable access to this from the local road network.

Access from Dungog railway station to Chichester Dam Road

Access to the existing platform at Dungog railway station is currently via Brown Street. The two most direct routes to reach Chichester Dam Road are as follows:

- cross Dowling Street, turn right into Lord Street and then left into Hook Street
- turn right into Dowling Street and then left into Hook Street.

Of these, the second is likely to have the greatest potential for conflicts with local traffic. There is also a signpost in the centre of the Dowling Street-Hook Street intersection which could impede turning movements of semi-trailers. Additionally, as the main commercial thoroughfare, Dowling Street would be likely to have a relatively greater number of pedestrian movements.

Anticipated impacts associated with the offloading of materials

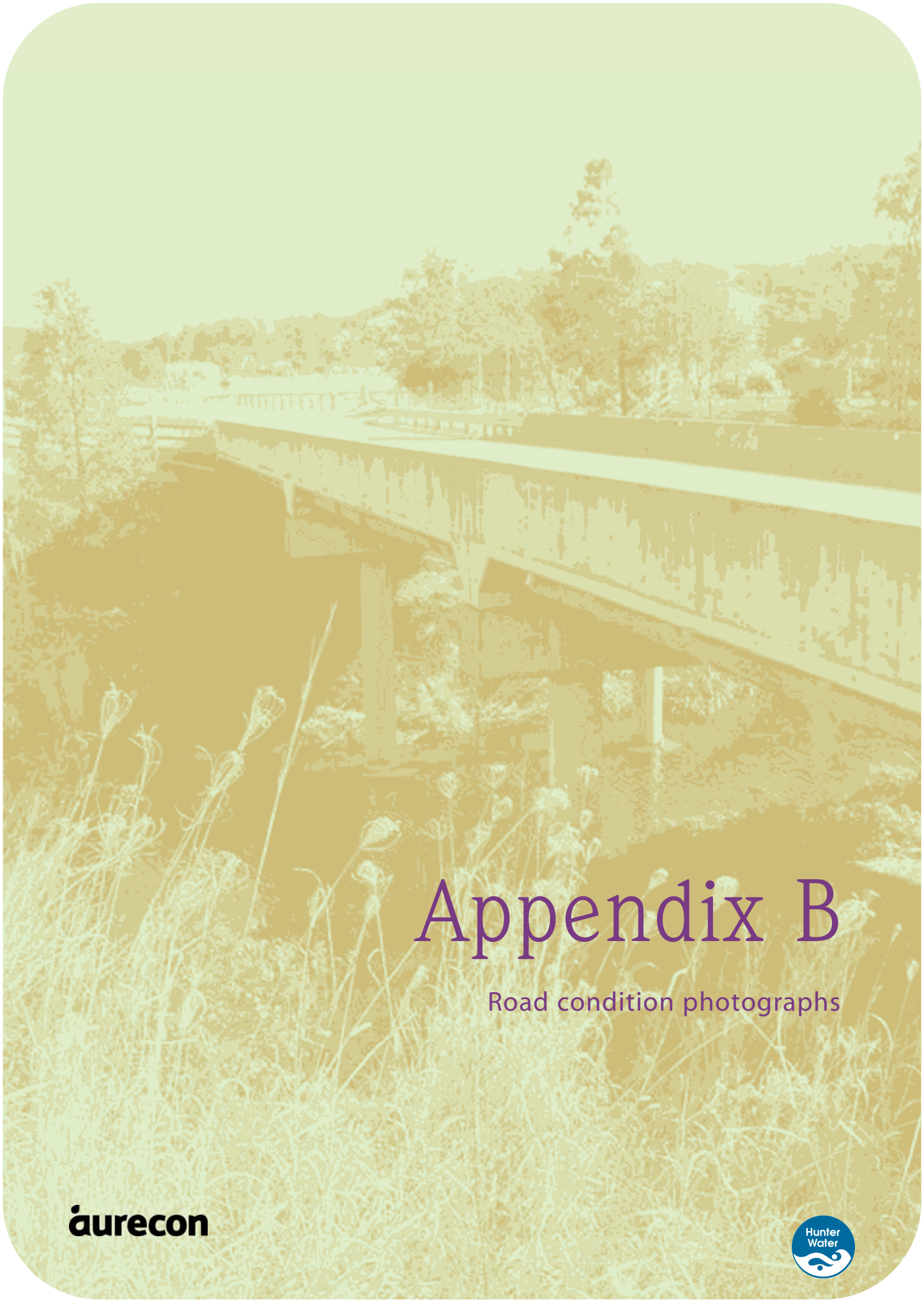
The main impacts likely to be associated with the offloading of materials would comprise:

- dust generation from vehicle movements on unsealed surfaces
- noise emissions and possibly vibration impacts
- conflicts with local traffic and pedestrians.

A4 Summary

There would appear to be limited benefit in using rail in preference to road to transport construction materials, particularly when it would be realised only for part of the access route to the construction site.

Additionally, over short distances, which would be the case for the Project assuming the majority of construction materials would be sourced from the greater Newcastle area, the movement of freight is more cost effective by road than rail.



Appendix B

Road condition photographs

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PHOTO B1
Surface deformations such as shoving and rutting along Clarence Town Road.

PHOTO B2
The road surface condition between Clarence Town and Wirragulla is in reasonable condition. There are no visual signs of pavement failure along this section of roadway.

PHOTO B3
Chichester Dam Road between Dungog and Salisbury Road.

PHOTO B4
Salisbury Road.

PHOTO B5
Edge patching undertaken along Salisbury Road.

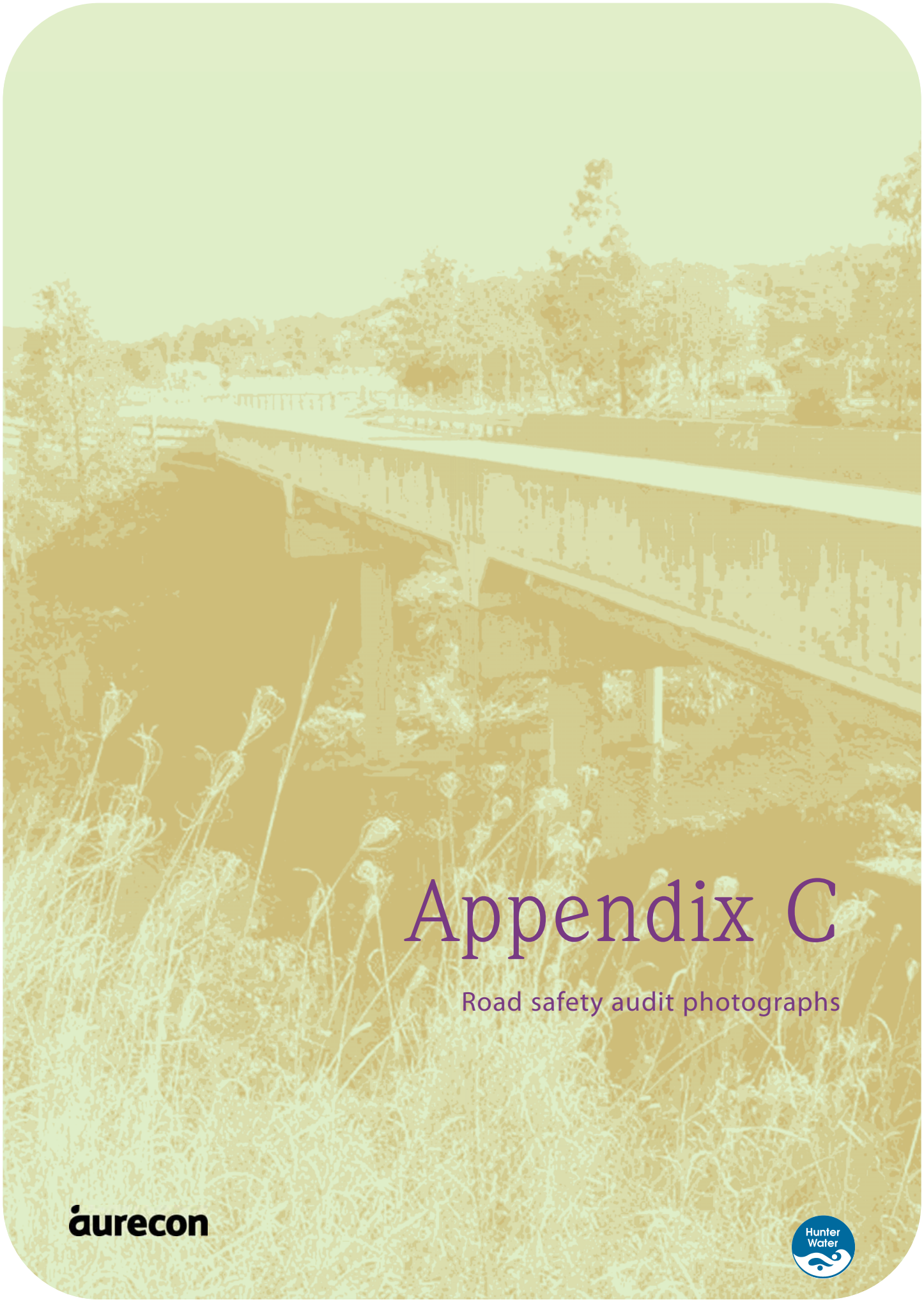
PHOTO B6
Sections of Salisbury Road are in reasonable condition.

PHOTO B7
Sections of Salisbury Road where there is limited sight distance in both directions. On the inside of the curve it can be seen that the pavement has failed.

PHOTO B8
Sections of Salisbury Road which have been patched after pot holes have occurred. This is a temporary measure to a pavement which has failed.

PHOTO B9
Salisbury Road with no line marking delineation.

PHOTO B10
Munni Bridge.



Appendix C

Road safety audit photographs

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PHOTO C1
Intersection of Wallarobba Brookfield Road and Dungog Road.

PHOTO C2
Dungog Road between Sandy Creek Road and Hilldale Road.

PHOTO C3
Clarence Town Road at Carmichaels Creek.

PHOTO C4
Queen Street, Clarence Town.

PHOTO C5
Salisbury Road, north of Tillegra Bridge.

PHOTO C6
Clarence Town Road/Dungog Road intersection, looking south on Clarence Town Road.

PHOTO C7
Shoulder drop off on eastern side of Chichester Dam Road/Salisbury Road intersection.

PHOTO C8
Narrow bridge width on Chichester Dam Road, southbound.

PHOTO C9
Unsafe overtaking northbound on Clarence Town Road, 100 m north of intersection with Dungog Road.

PHOTO C10
Unsafe overtaking southbound on Clarence Town Road, 200 m north of intersection with Dungog Road.

PHOTO C11
Chichester Dam Road/Salisbury Road intersection, looking east on Salisbury Road.

PHOTO C12
Overgrown vegetation in road verge on Salisbury Road, eastbound.

PHOTO C13
Trees located within clear zone, Chichester Dam Road.

PHOTO C14
Substandard pedestrian crossing at Clarence Town Public School.

PHOTO C15
Embankment north of Earl Street on Clarence Town Road, Clarence Town.

PHOTO C16
Unprotected embankment on Clarence Town Road at Carmichaels Creek, northbound.

PHOTO C17
Incorrect use of curve alignment markers on Dungog Road, approaching Horns Crossing Road intersection.

PHOTO C18
No guard rail protection on western approach of Martins Creek Bridge on Dungog Road.

PHOTO C19
Inadequate safe intersection sight distance southbound from Dungog Road.

PHOTO C20
Old and damaged guard rails south of Mackay Street on Lord Street, Dungog.

PHOTO C21
Faded pedestrian crossing markings, intersection of Lord Street/Brown Street, Dungog.

PHOTO C22
Adverse crossfall on Lord Street, looking south from intersection with Brown Street, Dungog.

PHOTO C23
Faded pedestrian crossing markings, looking west on Hook Street, Dungog.

PHOTO C24
Crest with no centreline markings.

PHOTO C25
Intersection of Salisbury Road and Quart Pot Creek Road.

PHOTO C26
Missing single lane bridge warning sign for existing bridge over Williams River.