Transport
Roads & Maritime
Services

RICHMOND BRIDGE APPROACHES – INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

Project review of environmental factors

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Roads and Maritime Services

Richmond Bridge Approaches – Intersection Upgrade at Bells Line of Road/Grose Vale Road

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Executive summary

The proposal

The New South Wales (NSW) Roads and Maritime Services (Roads and Maritime) propose to upgrade the intersection of Bells Line of Road/Grose Vale Road at North Richmond. The work was identified as part of the preferred short-term solution for the broader Richmond Bridge and Approaches strategy to alleviate traffic congestion on Richmond Bridge and its approach roads.

The general features of the proposed intersection upgrade at Bells Line of Road/Grose Vale Road include the following:

- Provision of two dedicated right turn lanes from Grose Vale Road (eastbound) into Bells Line of Road (southbound) and
- A dedicated left turn lane from Bells Line of Road (northbound) into Grose Vale Road (westbound)
- Provision of two westbound through lanes on Bells Line of Road
- Extension of the eastbound merge on Bells Line of Road by about 65 metres
- Provision of a clearway on Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods
- Relocation of the existing traffic signals and associated equipment at Bells Line of Road/Grose Vale Road to suit the proposed new road configuration. Phasing of traffic signals would be changed to suit the new turn arrangements
- Relocation of existing street lighting where the locations of power poles conflict with the proposed road widening work
- Relocation and protection of public utilities (electrical transmission lines, water mains and telecommunications infrastructure) within the proposal area
- Relocation of an existing bus stop from the northern kerb of Bells Line of Road east of Grose Vale Road, to a new kerbside location approximately 90 metres further to the east
- Removal of street trees
- Road and gutter excavation and removal
- Acquisition of 685 square metres of private land adjacent to the work area, with associated boundary adjustments and reinstatement of fencing on a like-for-like basis
- Removal of some kerbside parking, and/or adjustments to kerbside parking restrictions, to make way for the provision of clearways and additional through and turning lane capacity.

A detailed description of the proposed works to upgrade Bells Line of Road/Grose Vale Road intersection is provided in chapter 3 of this REF. General arrangement drawings detailing the design of the proposed upgrade are provided in Appendix B.

Roads and Maritime also proposed to carry out work at the Kurrajong Road/Old Kurrajong Road intersection and at the March Street/Bosworth Street intersection (Richmond), as part of the broader Richmond Bridge and Approaches strategy. These intersection upgrades are the subject of separate Reviews of Environmental Factors (REFs) being prepared and determined separately, and which are therefore outside the scope of this REF. The Kurrajong Road/Old Kurrajong Road intersection upgrade REF was determined by Roads and Maritime on 17 November 2014 and the works were completed in December 2015. The March Street/Bosworth Street intersection upgrade REF was determined by Roads and Maritime on 3 May 2016 Roads and Maritime proposes to complete all of the works associated with the Richmond Bridge and Approaches strategy by the end of 2017.

Need for the proposal

The proposal is part of a broader strategy to improve travel conditions and road safety along the road corridor between Richmond and North Richmond (comprising Richmond Bridge and its approach roads). Bells Line of Road and Kurrajong Road run through the North Richmond and

Richmond town centres and provides a supplementary link between the Sydney Basin and the Central West Region of NSW.

Traffic modelling (Hyder Consulting Pty Ltd 2012) indicates that Richmond Bridge is close to saturation traffic levels, with the operation of Richmond Bridge being adversely affected by the following three intersections during the morning and afternoon peaks:

- Bells Line of Road/Grose Vale Road (signalised intersection) – the subject of this REF.
- Kurrajong Road/Old Kurrajong Road (unsignalised intersection) – the subject of a separate REF.
- March Street/Bosworth Street (signalised intersection) – the subject of a separate REF.

The intersection of Bells Line of Road/Grose Vale Road is currently a four-leg, signalised intersection. The intersection has dedicated right turn lanes from Bells Line of Road (northbound and southbound) into both Grose Vale Road (westbound) and The Terrace Road (eastbound), as well as signalised pedestrian crossings at all approaches.

During the morning peak, traffic flow through the Bells Line of Road/Grose Vale Road intersection from the western and southern approaches is often affected by slow moving queues of vehicles travelling eastbound on Bells Line of Road. Bells Line of Road, east of Grose Vale Road, has two existing lanes; however, the road narrows to one lane resulting in vehicles needing to merge into one lane. This downstream merging has some effect in slowing down vehicles.

A significant volume of traffic (about 500 vehicles per hour) has been observed to use Pitt Lane travelling along Riverview Street and then turn left into Grose Vale Road. This is often due to delays at the Bells Line of Road/Grose Vale Road intersection.

The proposal is specifically required to improve safety and traffic performance at the Bells Line of Road/Grose Vale Road intersection and along nearby roads.

Options considered

Eight options (referred to as Options A to H) were considered during the development of the preferred short-term solution for the Richmond Bridge and Approaches strategy. These options included intersection widening, prohibiting parking during peak periods and/or banning some turn movements at the intersections of Bells Line of Road/Grose Vale Road, Kurrajong Road/Old Kurrajong Road; and improving intersection LoS at March Street/Bosworth Street.

After consultation with stakeholders, Option H was slightly modified and reassessed to also include a clearway restriction on both sides of March Street between Chapel Street and Bosworth Street.

Statutory and planning framework

State Environmental Planning Policy (Infrastructure) 2007 aims to facilitate the effective delivery of infrastructure across the State. Claus 94 of the ISEPP permits development of any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. The proposal can therefore be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* by Roads and Maritime as both the proponent and the determining authority. Development consent from Hawkesbury City Council is not required.

Community and stakeholder consultation

Broad consultation with respect to the Richmond Bridge and Approaches Congestion Study (which preceded the proposal) has been ongoing since July 2012, and included consultation with the community; Hawkesbury City Council; State MPs for Hawkesbury and Londonderry; Federal MP

for Macquarie; Transport for NSW; Heritage Council of NSW; Sydney Catchment Authority; and NSW Department of Planning and Environment.

Roads and Maritime publicly exhibited the *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012) in July 2012. During the exhibition period, Roads and Maritime invited submissions and feedback from the community and other project stakeholders in respect of the Stage 1 proposals. In response, 56 written submissions were received. As part of this consultation, Roads and Maritime held a community workshop (on 24 July 2012) and conducted interviews with members from a number of local organisations and associations.

The issues raised at the workshop and through written submissions – which are documented in the *Richmond Bridge and Approaches Congestion Study: Community Issues Report* (Roads and Maritime 2012) – were used to inform the short-term and long-term improvements to alleviate traffic congestion on Richmond Bridge and its approach roads.

Consultation activities focussing on the proposed intersection upgrades at March Street/Bosworth Street and Bells Line of Road/Grose Vale Road have been ongoing since July 2012. A door knock campaign targeting residents and local businesses has been ongoing since May 2014.

Letters to property owners were sent by post on Wednesday 14 May 2014 and door-knocking occurred on Tuesday 20 May 2014. A community update was also distributed to the wider community on 27 June 2014 detailing project information, project contact details and mechanisms for community and stakeholder feedback.

Feedback about the proposal was sought from the community during the concept design phase. A “Have Your Say” newsletter was distributed to 5000 community members in September 2015 to advise the community of the proposal and to seek community feedback on the proposal. The “Have Your Say” newsletter was then extended to include a further 5800 community members in November 2015. The “Have Your Say” newsletter included information about the proposal, contact details for the project team and details on how the community could access project information (including this REF) and provide formal feedback about the proposal to the project team. A door knock of 180 properties at the intersection was undertaken in October 2015. Of the 75 community members reached, 13 expressed their support for the proposal, six were against the proposal, five were specifically against the loss of parking and 51 were neutral.

Community consultation will continue throughout the project’s development until the completion of construction.

Environmental impacts

The main environmental impacts of this proposal would comprise the following:

- Temporary construction noise impacts that are predicted to exceed the applicable noise management levels by up to 24dB(A) at the nearest noise sensitive receivers. Exceedances of the ‘highly noise affected’ construction noise management level of 75dB(A) are also predicted to occur at some receivers
- Temporary disruptions to traffic flows and access due to traffic lane closures, the implementation of roadwork speed limits and/or when manual traffic control is in operation to facilitate the movement of construction vehicles into and out of work areas
- The permanent relocation of an existing bus stop (number 275455) from the northern kerb of Bells Line of Road east of Grose Vale Road, to a new kerbside location approximately 90 metres further to the east
- The modification of one bus stop (number 275419) located at the southern kerb of Bells Line of Road, about 200 metres east of Grose Vale Road, to accommodate an additional dedicated northbound lane

- The temporary loss of on-street parking spaces during road widening work, potentially affecting the accessibility of surrounding residential properties and local businesses
- The permanent loss of up to six time-restricted (15 minute) on-street parking spaces from Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods due to the provision of the proposed clearway
- A 'moderate to high' impact on the existing landscape character of the area surrounding Bells Line of Road/Grose Vale Road intersection due to the removal of six road trees from the northern corner of the intersection, up to five from Grose Vale Road as well as the removal of up to 11 visually prominent roadside trees within the existing traffic island on the westbound approach along Bells Line of Road
- A 'moderate to high' visual impact on residential properties fronting Grose Vale Road and Bells Line of Road due to the removals of street trees and widening of the existing road pavement.
- The permanent acquisition of about 575 square metres of privately owned land involving seven properties and seven separate landowners to accommodate the proposed road widening work. The majority of this land would comprise strips of residential land; although, one full property acquisition, affecting a commercial property, would also be required
- The permanent acquisition of approximately 110 square metres of publically owned land (public reserve owned by Hawkesbury Council) at the corner of Bells Line of Road and Terrace Road, to accommodate the proposed road widening work
- Clearing of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection, as well as other planted native and exotic vegetation from the area surrounding Bells Line of Road/Grose Vale Road intersection
- Minor clearing of potential food resources for the Grey-headed Flying-Fox, due to the removal of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection. Threatened species assessments were undertaken for the Grey-headed Flying-Fox, which are presented in Appendix C. These assessments concluded that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox.

Beneficial effects of the proposal

The preferred strategy would improve eastbound and westbound traffic flows on March Street, Kurrajong Road and Bells Line of Road in the morning and evening peaks. Improvements to the local road network include:

- Improved safety for turning movements for traffic in and out of Bells Line of Road, Kurrajong Road and March Street
- Significant improvements in peak period travel speeds for westbound traffic on Kurrajong Road – from 17 kilometres per hour to 46 kilometres per hour. Improved safety and improved travel speeds are a result of providing a left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road (westbound) and a westbound acceleration lane on Kurrajong Road
- Improvements in peak period travel speeds for eastbound traffic on Kurrajong Road – from 48 kilometres per hour to 50 kilometres per hour
- Improved traffic flows on Grose Vale Road due to the proposed extension of the eastbound merge on Bells Line of Road, east of Grose Vale Road/Terrace Road.

As a discrete project within the preferred strategy for the Richmond Bridge and approaches, the proposed upgrade of the Bells Line of Road/Grose Vale Road intersection will deliver local benefits in terms of improved traffic flows and intersection LOS on Bells Line of Road and Grose Vale Road, as well as making an important contribution to the achievement of the overall strategic objectives.

Justification and conclusion

The REF has examined and taken into account to the fullest extent possible all matters affecting, or likely to affect, the environment by reason of the proposed activity. In accordance with

Environmental Planning and Assessment Regulation 2000, the REF has considered the requirements of the guideline *Is an EIS required?* and the factors listed in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000.*

A number of potential environmental impacts resulting from the proposal have been avoided or reduced during the options assessment and development of the concept design. The proposal, as described in this REF, best meets the proposal objectives.

The proposal would still result in some minor residual impacts including:

- Construction noise and vibration
- Temporary disruptions to traffic flow and access during construction
- The acquisition of about 575 square metres of privately owned land, and 110 square metres of publicly owned land (affecting seven properties and seven separate landowners)
- Necessary and unavoidable visual and landscape character impacts associated with the removal of prominent trees that define the intersection and approaches, and increasing the width of the existing road pavement. However, the overall potential landscape character impact and visual impact of the proposed works to the intersection of Bells Line of Road with Grose Vale Road and Terrace Road in North Richmond has been assessed as 'generally moderate'.

A range of measures have been developed to minimise and mitigate the potential adverse impacts of the proposal, and these are summarised in this REF.

This REF has concluded that the adverse impacts of the proposal would be outweighed by the longer term beneficial impacts of providing improved traffic flow, reduced congestion and improved safety for all road users. On balance, the proposal is therefore considered justified. This REF has concluded that the proposal is not likely to significantly affect the environment and, therefore, an environmental impact statement and assessment under Part 5.1 of the EP&A Act is not required. This REF has also found there would be no significant impacts to matters of national environmental significance or to the environment of Commonwealth land.

Contents

Appendices

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1 Introduction

1.1 Proposal identification

1.1.1 Background

Richmond Bridge is located in the town of Richmond within the Hawkesbury City Council local government area (LGA). The bridge is a two-lane (providing one lane in each direction), 212 metres long, 13 span reinforced concrete arch bridge that spans the Hawkesbury River, connecting Richmond to the east with North Richmond to the west. Richmond Bridge is the only crossing of the Hawkesbury River that provides access to the residential catchment of North Richmond, Kurrajong, Bilpin, Bell and beyond.

Urban expansion and land use changes in north-western Sydney have contributed to traffic growth on the existing road network, which has resulted in traffic congestion on the existing road infrastructure (including Richmond Bridge) during peak hours.

Peak period traffic flows across Richmond Bridge generally occur in a distinct pattern, with heavy eastbound traffic occurring during the morning peak and heavy westbound traffic occurring during the afternoon peak. It is anticipated that planned new residential developments within the region will add further pressure to Richmond Bridge and the surrounding road network.

In April 2011, the Australian Government allocated $2 million to the NSW Government to carry out a congestion study of the corridor between Richmond and North Richmond. Roads and Maritime Services (Roads and Maritime) initiated this congestion study to investigate short-term and long-term options to alleviate traffic congestion on Richmond Bridge and its approach roads between East Market Street (at Richmond) and Grose Vale Road (at North Richmond).

In July 2012, Roads and Maritime publicly exhibited the *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012), which analysed the cause of traffic congestion on Richmond Bridge and its approach roads; investigated the structural suitability of the existing bridge structure; and identified short-term options to improve road and intersections performance (up to 2021). These options included intersection widening, prohibiting parking during peak periods and banning some turn movements.

In July 2012, a community consultation workshop was held to seek community feedback on the Stage 1 proposals.

In September 2012, Roads and Maritime released the *Richmond Bridge and Approaches Congestion Study – Long-term Options Report* (Roads and Maritime 2012), which assessed the short-term proposals developed for Stage 1 and identified long-term options to address congestion (beyond 2021 to 2036). These long-term options included the identification of strategic road corridors that catered for future traffic requirements in the vicinity of the existing bridge. A range of technical investigations were carried out to identify the project constraints and develop a shortlist of four long-term options (referred to as Options A to D), in addition to the short-term options identified in the *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012), for further investigation and development.

In February 2013, Roads and Maritime published the *Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report* (Roads and Maritime 2013), which recommended the preferred short-term (to 2021) and long-term (to 2036) strategy to address congestion on Richmond Bridge and its approaches.

Relevant to this review of environmental factors (REF), the *Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report* (Roads and Maritime

2013) identified the immediate cause of congestion in the area and improvements to three intersections that would enable the route to operate satisfactorily in the short-term (until 2021).

Key short-term recommendations of the strategy focus on improvements to the following three key intersections:

- Bells Line of Road/Grose Vale Road (the subject of this REF)
- Kurrajong Road/Old Kurrajong Road (project complete)
- March Street/Bosworth Street (the subject of a separate REF)

The locations of the above three intersections are shown in Figure 1-1.

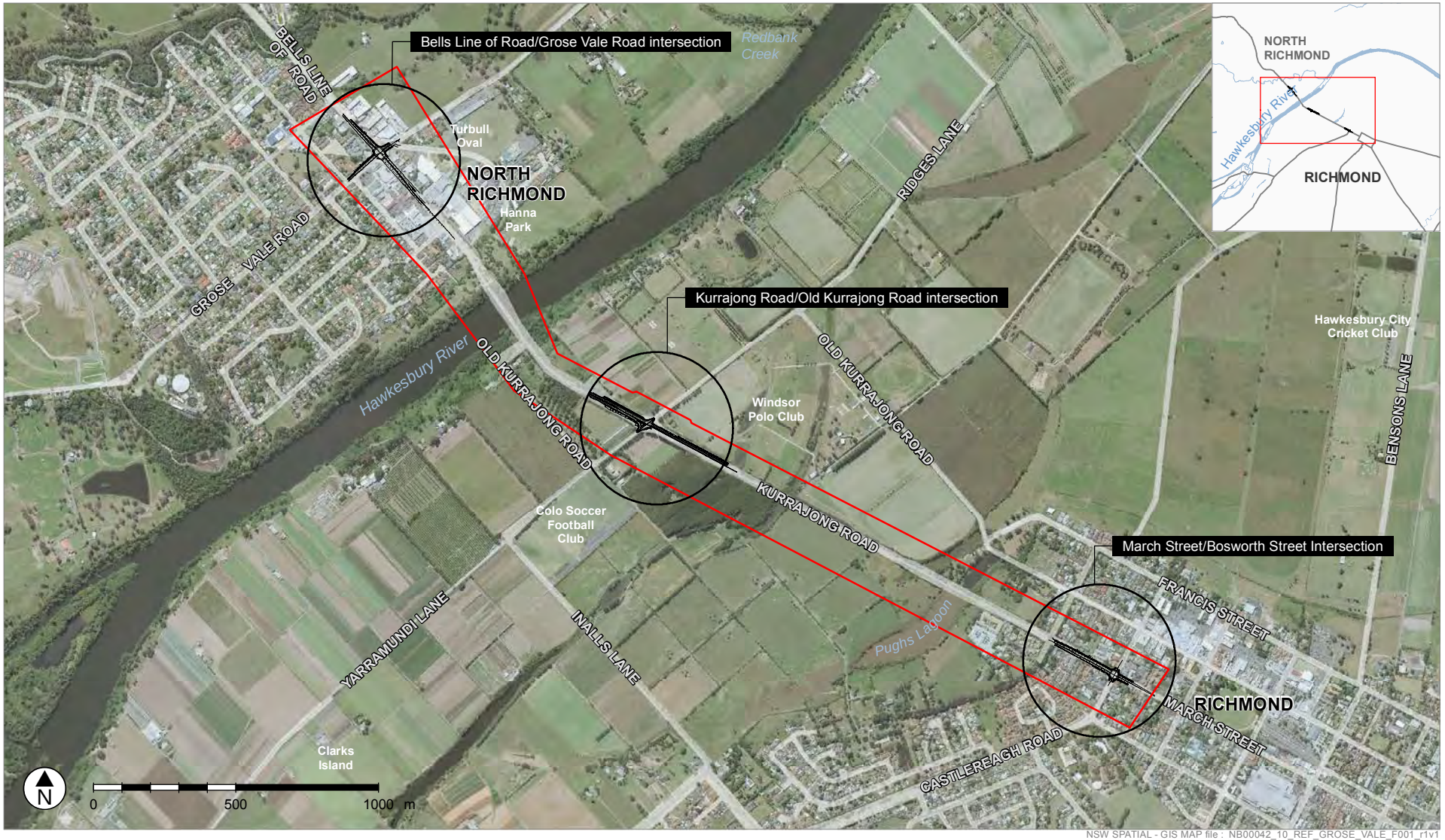
The Australian Government has since committed $18 million to the NSW Government (in addition to the $2 million in funding for the *Richmond Bridge and Approaches Congestion Study*) under the Nation Building 2 program from 2014-15 to 2018-19 to improve the traffic conditions on and around Richmond Bridge and its approaches.

1.1.2 The proposal

Roads and Maritime propose to upgrade the intersection of Bells Line of Road/Grose Vale Road at North Richmond. The work was identified as part of the preferred short-term solution for the broader Richmond Bridge and Approaches strategy to alleviate traffic congestion on Richmond Bridge and its approach roads.

An overview of the proposal is provided in Figure 1-2, while a detailed description of the proposal is provided in Chapter 3. General arrangement drawings detailing the design of the proposed upgrade are provided in Appendix B.

Roads and Maritime also proposed to carry out work at the Kurrajong Road/Old Kurrajong Road intersection and at the March Street/Bosworth Street intersection (Richmond), as part of the broader Richmond Bridge and Approaches strategy. These intersection upgrades are the subject of separate REFs being prepared and determined separately and which are therefore outside of the scope of this REF. The Kurrajong Road/Old Kurrajong Road intersection upgrade REF was determined by Roads and Maritime on 17 November 2014 and the works were completed in December 2015. The March Street/Bosworth Street intersection upgrade REF was determined on 3 May 2016 and Roads and Maritime propose to complete all of the works associated with the Richmond Bridge and Approaches strategy by the end of 2017.



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Study area

Proposed project design

Figure 1-1
Overview of the short-term solutions for the Richmond Bridge and Approaches project

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

Figure 1-2
Overview of the proposed Bells Line of Road/Grose Vale Road intersection upgrade

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

1.1.3 The locality

The proposal is located entirely within the Hawkesbury City Council LGA. The Bells Line of Road/Grose Vale Road intersection is located in the commercial centre of North Richmond, about 600 metres north-west of the Hawkesbury River and is currently a four-way signalised intersection. The intersection has dedicated right turn lanes from Bells Line of Road (northbound and southbound) into Grose Vale Road (westbound) and The Terrace Road (eastbound) and signalised pedestrian crossings at all approaches.

The area surrounding the Bells Line of Road/Grose Vale Road intersection is typically characterised by a variety of single and double-storey residential, commercial and light industrial buildings.

The closest sensitive receivers to the proposal comprise residential and commercial properties, located between five and 60 metres to the proposed work, as well as the North Richmond Seventh Day Adventist Church (located about 10 metres away), and the Richmond North Public School (located 45 metres away). Further details are provided in Chapter 6.

1.1.4 Terms used in this report

For the purposes of this report, the 'proposal' refers to the work as generally described in Chapter 3 of this REF. The 'proposal area' refers to the area that would be potentially directly impacted by the proposal, which is shown in Figure 1-2. This includes those areas potentially impacted during construction, including the location and access to the compound site, stockpile sites and storage of equipment and plant.

The 'study area' encompasses all three intersections that are being upgraded under the Richmond Bridge and Approaches strategy and the area that may be indirectly affected by the proposal. Unless otherwise stated, the 'study area' adopted for this REF was broadly defined as the sections of March Street, Kurrajong Road and Bells Line of Road located between Bosworth Street (to the south-east) and Grose Vale Road/Terrace Road (to the north-west). The extent of the study area is shown in Figure 1-1. The 'proposal area' refers to the intersection of Bells Line of Road and Grose Vale Road as shown in Figure 1-2, including those properties immediately adjacent to the proposed work.

1.2 Purpose of the report

This REF has been prepared by Jacobs (Australia) Pty Ltd (Jacobs) on behalf of Roads and Maritime. For the purposes of the proposal, Roads and Maritime is the proponent and the determining authority under Part 5 of the EP&A Act.

The purpose of this REF is to describe the proposal, to document the likely impacts of the proposal on the environment, and to detail protective measures to be implemented.

The description of the proposed work, and associated environmental impacts, have been carried out in consideration of the guideline *Is an EIS Required?*, clause 228 of the *Environmental Planning and Assessment Regulation 2000*, the *Threatened Species Conservation Act 1995* (TSC Act), the *Fisheries Management Act 1994* (FM Act), and the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). In doing so, this REF addresses the requirements of Section 111 of the EP&A Act that Roads and Maritime examine and take into account to the fullest extent possible, all matters affecting or likely to affect the environment by reason of the activity.

The findings of this REF would be considered when assessing:

- Whether the proposal is likely to significantly affect the environment and therefore the necessity for an Environmental Impact Statement to be prepared and approval to be sought from the Minister for Planning and Environment under Part 5.1 of the EP&A Act
- Whether the proposal is likely to significantly affect threatened species as defined by the TSC Act and/or FM Act, and therefore the requirement for a Species Impact Statement
- The potential for the proposal to significantly impact a matter of national environmental significance or Commonwealth land and the need to make a referral to the Australian Government Department of Environment for a decision by the Commonwealth Minister for the Environment on whether assessment and approval is required under the EPBC Act

2 Need and options considered

The following sections present a summary of the strategic need for the proposal; an overview of existing road infrastructure within the study area; the proposal objectives; and the alternate options that were considered for the proposal, based on the following documents:

- *Richmond Bridge and Approaches Congestion Study – Traffic Analysis Report* (Hyder Consulting Pty Ltd 2012)
- *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012)
- *Richmond Bridge and Approaches Congestion Study – Long-term Options Report* (Roads and Maritime 2012)
- *Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report* (Roads and Maritime 2013)

2.1 Strategic need for the proposal

2.1.1 Overview for the need for the proposal (local context)

The proposal is required to improve travel conditions and road safety along the road corridor between Richmond and North Richmond (comprising Richmond Bridge and its approach roads). Bells Line of Road, Kurrajong Road and March Street run through the North Richmond and Richmond town centres. The Bells Line of Road provides a supplementary link between the Sydney Basin and the Central West Region of NSW. It is one of the few escarpment crossings directly accessible from the Sydney region, and provides an alternative to the Great Western Highway.

In 2011, Richmond Bridge carried around 27,000 vehicles per day, which included around 1,500 heavy vehicles (comprising more than five per cent of the total traffic). The peak hour traffic volume on Richmond Bridge (in 2011) was in the order of 1,400 to 1,500 vehicles per hour per direction.

Traffic modelling carried out for the proposal (Hyder Consulting Pty Ltd 2012) indicated that Richmond Bridge is close to saturation traffic levels, with the operation of Richmond Bridge being adversely affected by the following three intersections during the morning and afternoon peaks:

- Bells Line of Road/Grose Vale Road (signalised intersection)
- Kurrajong Road/Old Kurrajong Road (unsignalised intersection)
- March Street/Bosworth Street (signalised intersection)

In addition to poor road network performance, a review of recent crash history data for the Bells Line of Road/Grose Vale Road intersection indicated that a total of 16 crashes were recorded at this location between 1 July 2003 and 30 June 2013. These included eight injury crashes (resulting in 11 people being injured) and eight non-casualty crashes (i.e. those crashes not resulting in an injury). No fatalities were recorded at this location between 1 July 2003 and 30 June 2013.

The proposal is specifically required to improve safety and traffic performance at the Bells Line of Road/Grose Vale Road intersection and along nearby roads.

2.1.2 Strategic need for the proposal

The proposal would address a number of objectives outlined in the following strategic plans:

- NSW 2021: A plan to make NSW Number One
- NSW State Infrastructure Strategy
- NSW Long Term Transport Master Plan

These strategies and relevant objectives are discussed further in the following sections.

NSW 2021: A Plan to Make NSW Number One

NSW 2021: A Plan to Make NSW Number One (NSW 2021 Plan) (NSW Department of Premier and Cabinet 2011) is the NSW Government's 10 year strategic business plan which sets priorities for action and guides resource allocation to deliver economic growth and critical infrastructure throughout NSW. NSW 2021 places emphasis on investing in and delivering an efficient and effective transport system including road infrastructure that will relieve congestion, improve safety and expand capacity on road corridors.

The proposal directly addresses two objectives relating to transport and infrastructure identified in the NSW 2021 Plan – 'reduction of travel times' and 'improving road safety'. Through the provision of dedicated turning lanes and peak hour clearways at the Bells Line of Road/Grose Vale Road and March Street/Bosworth Street intersections, the proposal would result in a reduction in traffic congestion on Bells Line of Road/Kurrajong Road. As such, travel times would be reduced. The provision of additional turning lanes at these intersections would also be expected to improve road safety.

State Infrastructure Strategy 2012-2032

The State Infrastructure Strategy 2012-2032 (SIS) (Infrastructure NSW 2012), developed by Infrastructure NSW, is a 20 year strategy which identifies and prioritises the delivery of critical public infrastructure to drive productivity and economic growth. This assessment of the State's existing infrastructure highlighted critical deficiencies in urban road capacity and provides strategic options to meet the challenges of population growth and substantial increases in freight volumes.

One of the objectives of the SIS is to reduce delays and manage traffic on major arterial roads across Sydney, including at pinch points (peak hour congestion problem areas). The Bells Line of Road, Kurrajong Road and March Street, which run through the North Richmond and Richmond town centres, are arterial roads. The intersections of Bells Line of Road/Grose Vale Road and March Street/Bosworth Street have been identified as pinch points. The proposal is consistent with the SIS, in that it reduces traffic congestion by addressing an identified pinch point.

NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan (LTTMP) (Transport for NSW 2012) provides a framework to deliver an integrated, modern transport system by identifying NSW's transport actions and investment priorities over the next 20 years.

The LTTMP has identified a number of challenges and actions relevant to the proposal including:

- Congestion and pinch point management in Greater Sydney to respond to the growing pressure on the road network. One of the actions of the LTTMP is to investigate traffic flow enhancements to Richmond Bridge, through working with the Australian Government and Hawkesbury City Council on planning and investigation work to address congestion on the Richmond Bridge and adjoining approach roads. The proposal was identified as a key short-term solution for alleviating traffic congestion on Richmond Bridge and its approach roads between East Market Street (at Richmond) and Grose Vale Road (at North Richmond). Therefore, the proposal is consistent with the above action of the LTTMP
- Being able to travel safer, including the provision of safe travel options and networks. The provision of additional turning lanes at the Bells Line of Road/Grose Vale Road intersection would be expected to improve road safety at this location
- Take action to identify, preserve and protect future transport corridors in regional NSW, including the Bells Line of Road. The LTTMP specifically identifies that Roads and Maritime will review the existing Bells Line of Road to identify safety issues, including potential improvements such as overtaking lanes, safer intersections and better local access arrangements. The proposal would be consistent with the above action.

2.2 Existing road and infrastructure

2.2.1 Key roads within the proposal area

An overview of the current configuration of key roads within the proposal area is provided in Table 2-1. Further discussion on the traffic, transport and access environment of the proposal area is provided in Section 6-2 of this REF.

Table 2-1 Overview of key roads within the study area

Road	Description
Bells Line of Road	At the Richmond Bridge over the Hawkesbury River, Kurrajong Road terminates and north of the river becomes the Bells Line of Road. Bells Line of Road comprises a single carriageway with one lane in each direction for the majority of its length. Within the study area, Bells Line of Road is within North Richmond and has a posted speed limit of 60 kilometres per hour. Bells Line of Road has a signalised intersection with Grose Vale Road/Terrace Road. Right-turn bays are provided into Grose Vale Road and Terrace Road, with lengths of around 40 metres and 58 metres (including taper), respectively. A left-turn lane of around 130 metres is provided into Grose Vale Road. A second departure lane of about 170 metres is provided on Bells Line of Road, south-east of its intersection with Grose Vale Road and Terrace Road. A channelised giveway controlled intersection is located at Bells Line of Road and Pitt Lane. A left-turn lane of around 155 metres and a right-turn bay of around 70 metres are provided from Bells Line of Road into Pitt Lane.
Grose Vale Road	Grose Vale Road is a two-way, two-laned configuration for the majority of its length. At its signalised intersection with Bells Line of Road, it consists of two lanes in each direction, including a dedicated right turn lane onto Bells Line of Road. Grose Vale Road has a posted speed limit of 60 kilometres per hour with a school zone commencing around 70 metres southwest of the intersection with Kurrajong Road.

Source: Table 6 (Description of existing road network) of the *Richmond Bridge and Approaches Congestion Study –Long-term Options Report* (Roads and Maritime 2012).

2.2.2 Key Intersection within the study area

Bells Line of Road/ Grose Vale Road intersection

The intersection of Bells Line of Road and Grose Vale Road is a four-leg signalised intersection, with signalised pedestrian crossings at all approaches (see Figure 1-2). During the morning peak, traffic flow through the intersection from the western and southern approaches is often affected by slow moving queues of vehicles travelling eastbound on Bells Line of Road.

Bells Line of Road, east of Grose Vale Road, has two existing lanes; however, the road narrows to one lane further to the east. Vehicles on the kerbside lane are currently required to merge into one lane. This downstream merging has some effect in slowing down vehicles.

A significant volume of northbound traffic (about 500 vehicles per hour) has been observed to use Pitt Lane and Riverview Street as a short cut to bypass the Bells Line of Road/Grose Vale Road intersection, to travel west on Grose Vale Road. This is often due to delays at the Bells Line of Road/Grose Vale Road traffic signal.

2.2.3 Drainage

The existing road drainage at the Bells Line of Road/Grose Vale Road intersection consists of a conventional urban pit and pipe network that drains towards the north-west, with the point of discharge being an open gully located to the rear of the light industrial buildings located at number

5 Terrace Road, North Richmond. A large Rocla CDS gross pollutant trap (GPT) is located outside 5 Terrace Road, North Richmond and is designed to capture and retain gross pollutants, litter, grit, sediments and associated oils.

South of Grose Vale Road approximately adjacent to the North Richmond Village shopping centre is a natural crest, which forms a partial boundary between the local catchments of Redbank Creek, to the north, and the Hawkesbury River, to the south. Drainage to the south from the natural crest appears to be via a shallow channel located beneath the road pavement, draining into the Hawkesbury River, approximately 600 metres to the south.

2.3 Proposal objectives

The objectives of the proposal are to:

- Reduce traffic congestion and improve traffic flow
- Improve accessibility and efficiency for freight and private vehicles
- Improve safety for motorists, cyclists and pedestrians
- Minimise socio-economic and environmental impacts.

2.4 Alternatives and options considered

As outlined in Section 1.1.2, the proposal forms part of the preferred short-term solution for the broader Richmond Bridge and Approaches strategy to alleviate traffic congestion on Richmond Bridge and its approach roads.

Roads and Maritime also proposed to carry out work at the Kurrajong Road/Old Kurrajong Road intersection and at the March Street/Bosworth Street intersection (Richmond), as part of the broader Richmond Bridge and Approaches strategy. These intersection upgrades are the subject of separate REFs being prepared and determined separately, and which are therefore outside the scope of this REF. The Kurrajong Road/Old Kurrajong Road intersection upgrade REF was determined by Roads and Maritime on 17 November 2014 and the works were completed in December 2015. The March Street/Bosworth Street intersection upgrade REF was determined on 3 May 2016and Roads and Maritime proposes to complete all of the works associated with the Richmond Bridge and Approaches strategy by the end of 2017.

2.4.1 Methodology for selection of preferred option

Each option for the proposal was tested against the following criteria using Paramics or SIDRA traffic modelling where relevant:

- Improve Bells Line of Road eastbound traffic flows
- Improve Bells Line of Road westbound traffic flows
- Vehicle Kilometres Travelled (VKT) in the study area network
- Vehicle Hours Travelled (VHT) in the study area network
- Improve Grose Vale Road Traffic Flows
- Improve key intersection Level of Service with
  - Bells Line of Road/Grose Vale Road (Signal)
  - Kurrajong Road/Old Kurrajong Road (Priority)
  - March Street/Bosworth Street (Signal)
- Impact on nearby intersections
  - Area A, Richmond
  - Area B, Castlereagh Road
  - Area C, North Richmond.

2.4.2 Identified options

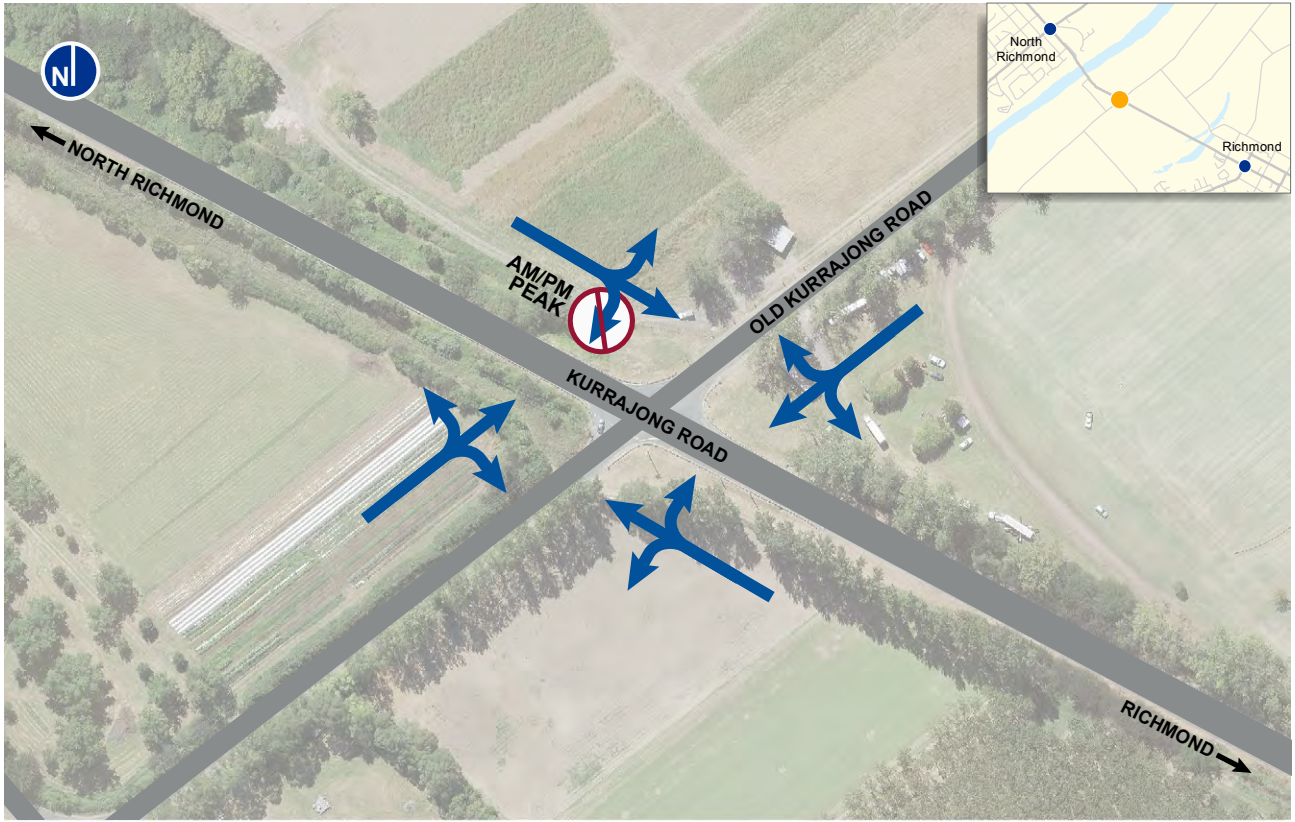
A road based traffic model was developed for the proposal (using Paramics and SIDRA software) to investigate the performance of Richmond Bridge and the sections of March Street, Kurrajong Road, and Bells Line of Road between East Market Street in Richmond and Grose Vale Road in North Richmond (Hyder Consulting Pty Ltd 2012). This model identified key network issues that affect the performance of Richmond Bridge and the adjoining approach roads, and short-term options for the improvement of traffic flow. A Road Safety Audit of the existing road conditions and the proposed improvements to intersections was also conducted.

Based on the traffic modelling investigations, 10 preliminary options were identified, eight of which were short-listed for detailed assessment in consultation with stakeholders. These options involved minor improvements, such as intersection widening and the imposition of clearway (no street parking) conditions during peak periods to maintain an acceptable level of traffic operation and congestion management.

The following eight options, shown in Figures 2-1 A-H, were considered during the development of the preferred short-term solution for the Richmond Bridge and Approaches strategy:

- Option A – Ban eastbound right turns from Kurrajong Road to Old Kurrajong Road southbound during the morning and afternoon peak periods
- Option B – Ban eastbound right turns from Kurrajong Road to Old Kurrajong Road southbound during the morning and afternoon peak periods; Ban eastbound left turns from Kurrajong Road to Old Kurrajong Road northbound during peak periods
- Option C – Ban eastbound right turns from Kurrajong Road to Old Kurrajong Road southbound during the morning and afternoon peak periods; Provide an eastbound exclusive right turn bay from March Street to Bosworth Street; Ban westbound right turns from March Street to Bosworth Street
- Option D – Provide a shared through/left-turn lane on Bells Line of Road, at the Grose Vale Road intersection, to replace the existing left turn lane on the eastern approach; Provide an additional westbound short through lane on Bells Line of Road, west of Grose Vale Road; Option D allows for all movements at the intersection and may require some widening work.
- Option E – Provide a shared through/left-turn lane on Bells Line of Road, at the Grose Vale Road intersection, to replace the existing left turn lane on the eastern approach; Provide an additional westbound short through lane on Bells Line of Road, west of Grose Vale Road; Prohibit on-street parking during peak periods on the southern side of Bells Line of Road between Pitt Lane and Grose Vale Road; Ban eastbound right turns from Bells Line of Road into Grose Vale Road; Convert the existing eastbound right-turn bay to a second westbound through lane; Option E avoids the need for widening at the intersection by banning the eastbound right turn movement.
- Option F – Carry out work at the Bells Line of Road/Grose Vale Road intersection, as described for Option E; provide an eastbound exclusive right turn bay from Kurrajong Road to Old Kurrajong Road southbound.
- Option G – Ban eastbound right turns to Old Kurrajong Road southbound during peak periods; Provide a left turn slip lane out of Old Kurrajong Road northbound with an acceleration lane on Kurrajong Road (westbound direction); Carry out work at the March Street/Bosworth Street intersection, as described for Option C; Carry out work at the Bells Line of Road/Grose Vale Road intersection, as described for Option E, in addition to extending the merge kerb side lane east of the Grose Vale Road intersection.
- Option H – Provide an eastbound exclusive right turn bay from Kurrajong Road to Old Kurrajong Road southbound; Provide a left turn slip lane out of Old Kurrajong Road northbound with an acceleration lane on Kurrajong Road (westbound direction); Carry out work at the Bells Line of Road/Grose Vale Road intersection, as described for Option G; Carry out work at the March Street/Bosworth Street intersection, as described for Option C.

OPTION A



NB00042_010_F002_OPTA_r1v1

Figure 2-1
Option A

JACOBS

OPTION B - Option A **Plus**

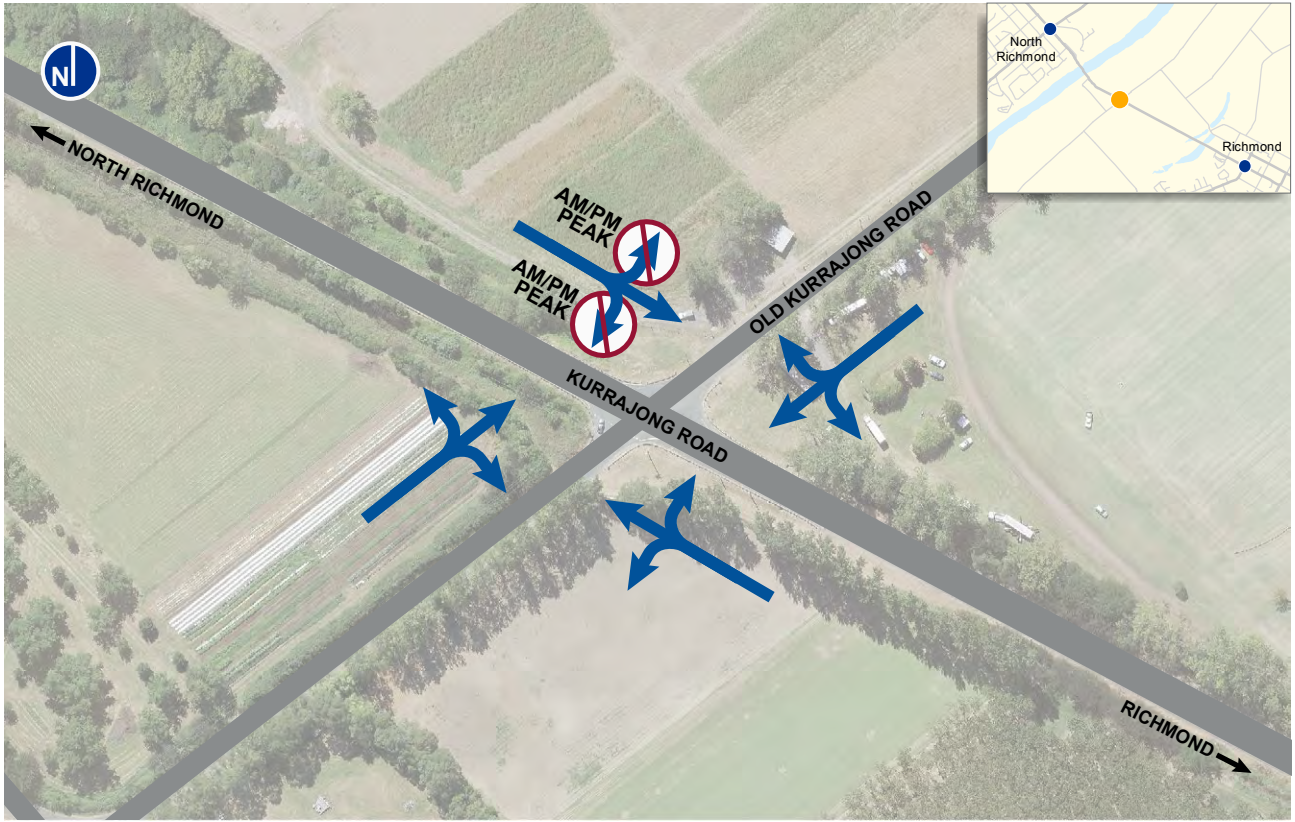


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Figure 2-2
Option B

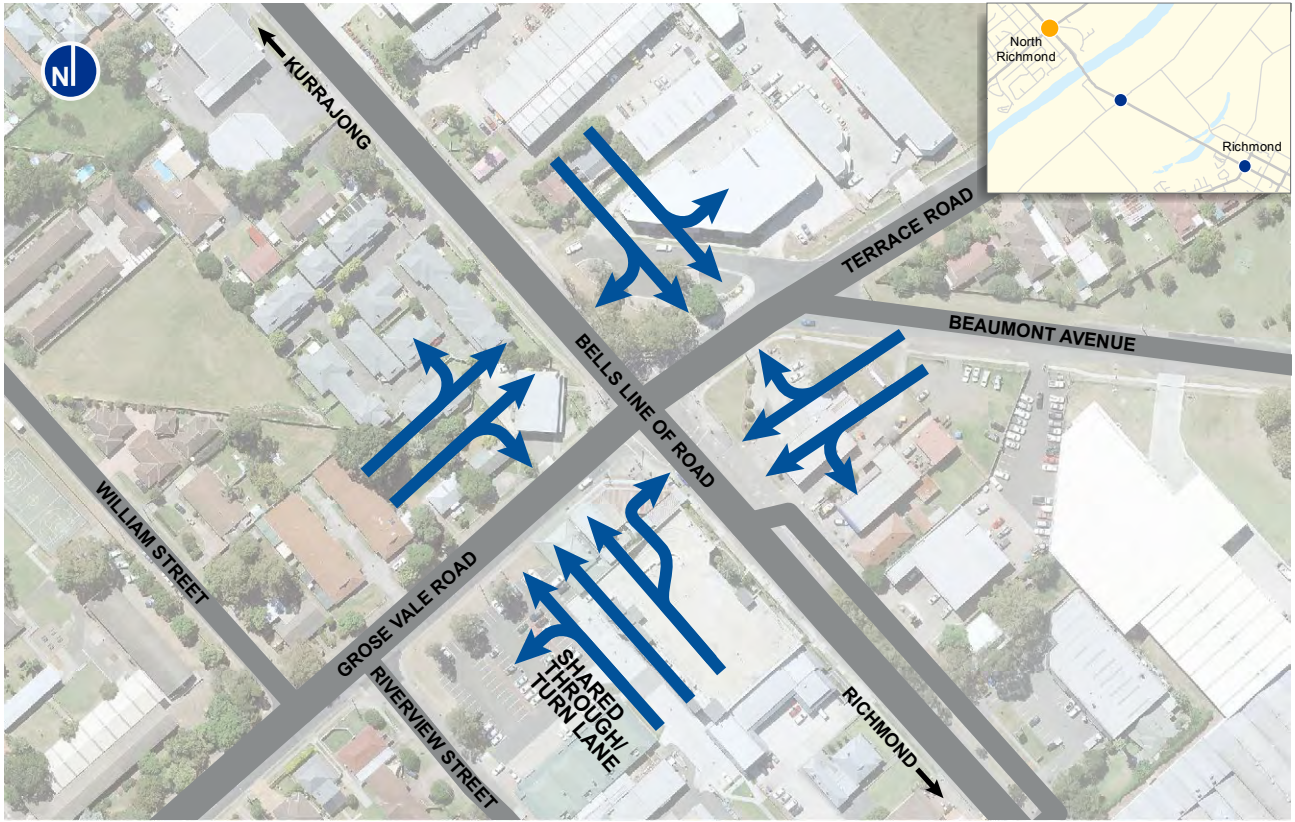
JACOBS

OPTION C - Option A **Plus**

Figure 2-3
Option C

JACOBS

OPTION D



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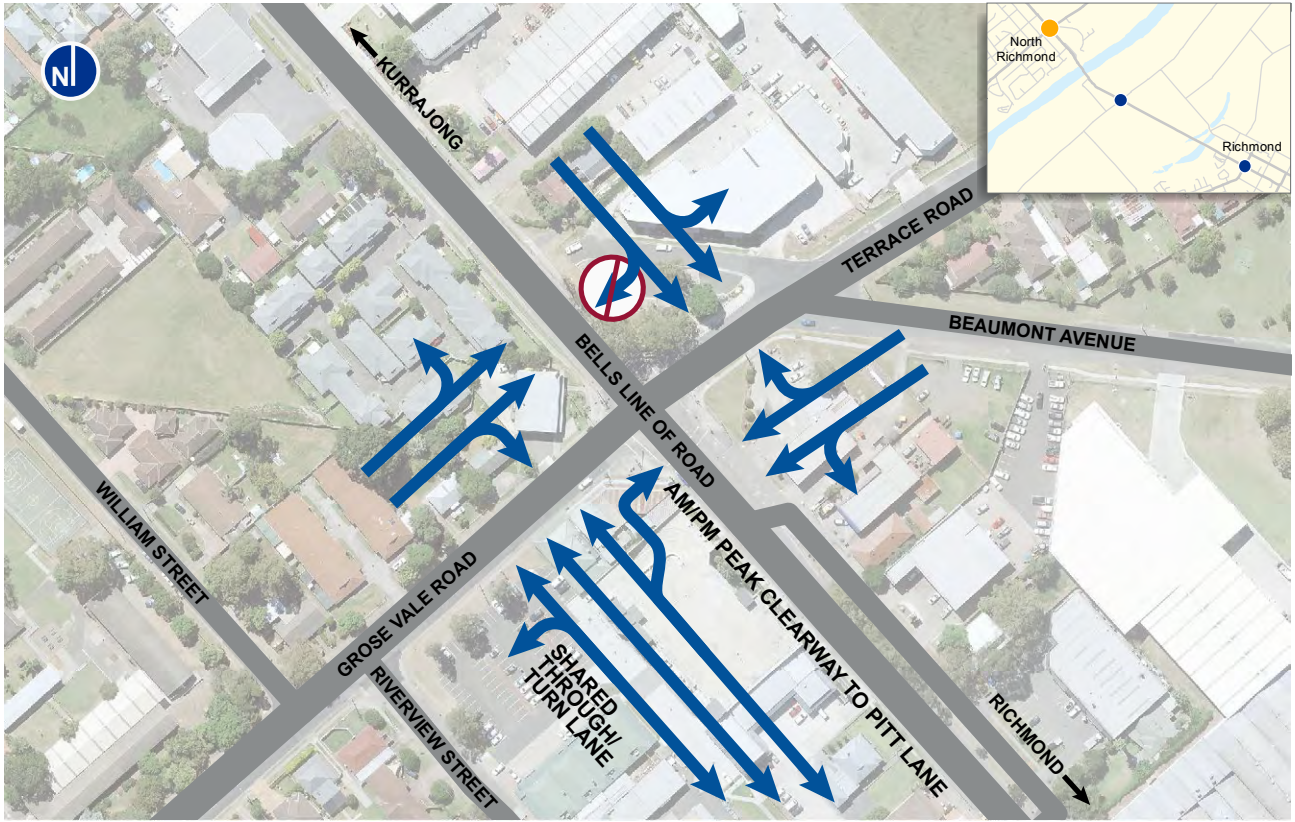
JACOBS

OPTION E - Same as Option D **Plus**



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OPTION F - Combination of Option E **Plus**

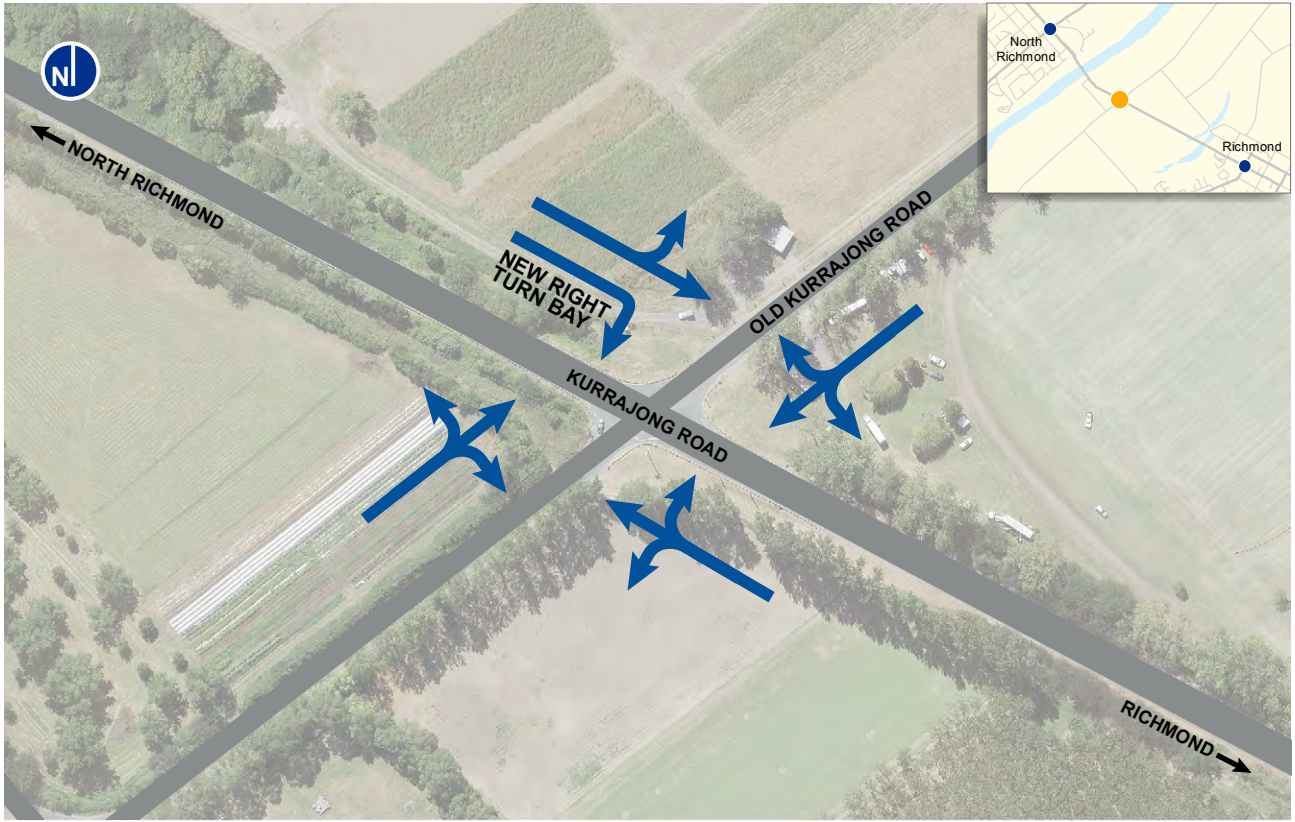

Figure 2-6
Option F

JACOBS

OPTION G - Combination of Option C & Option E **Plus**

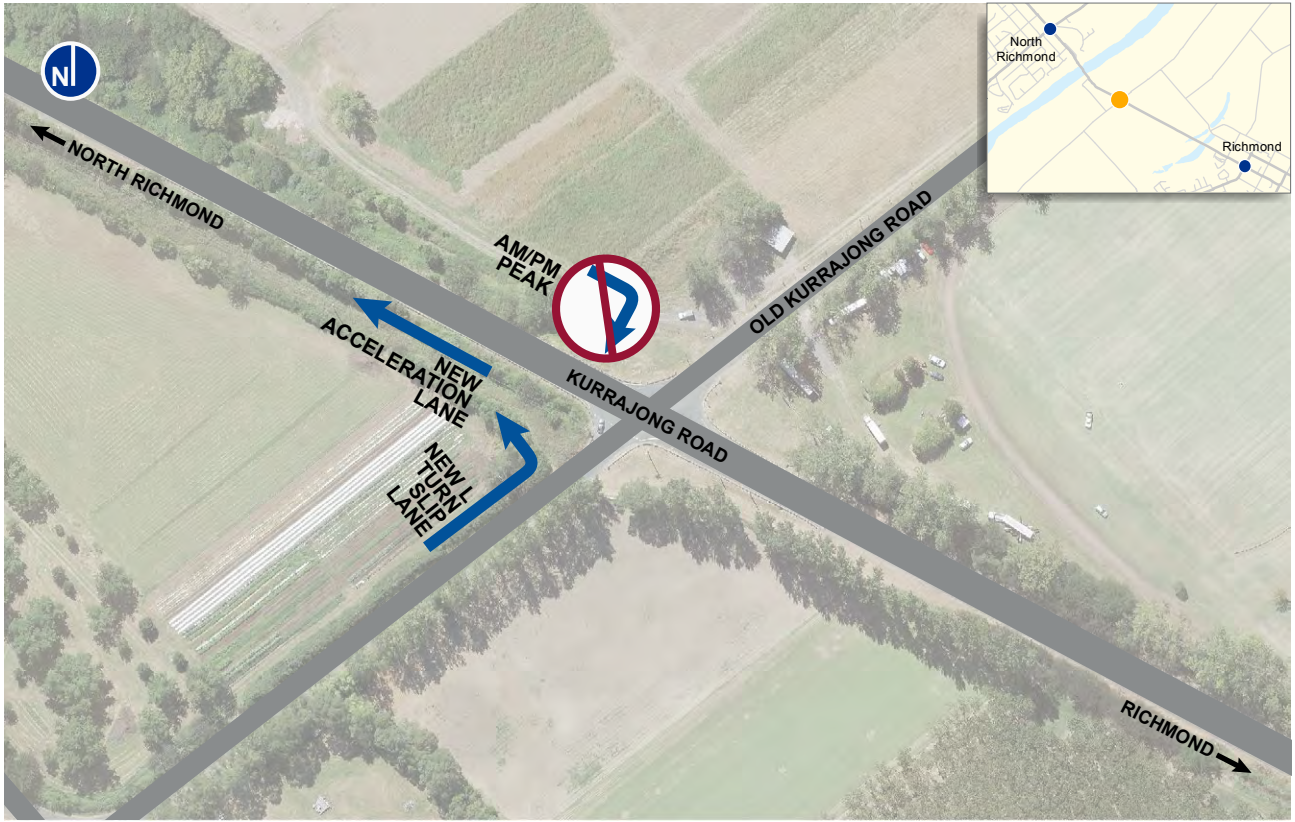

Figure 2-7
Option G

JACOBS

OPTION H - Combination of Option C & Option G **Plus**

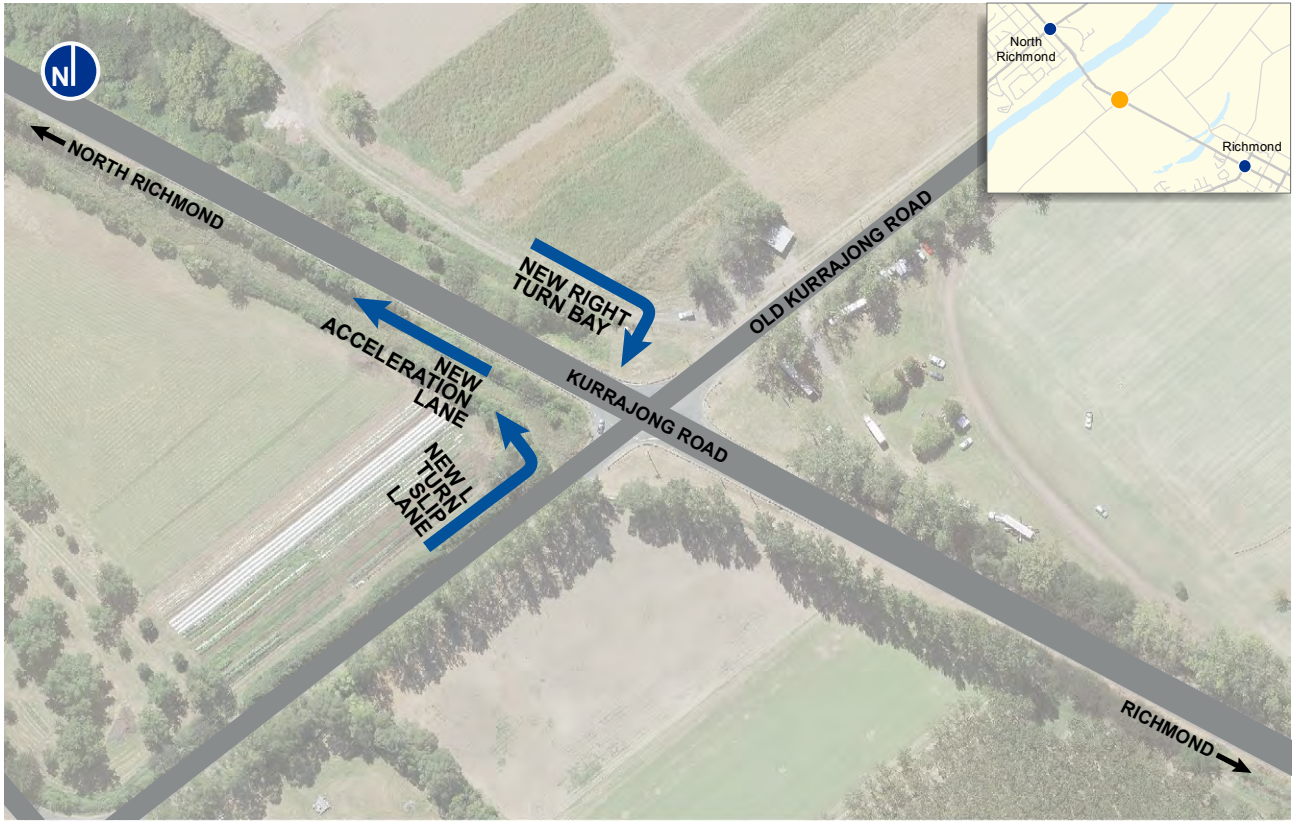

Figure 2-8
Option H

JACOBS

2.4.3 Analysis of options

The following sections present the key results and conclusions from the Richmond Bridge and Approaches Congestion Study- Traffic Analysis Report (Hyder Consulting Pty Ltd 2012) that are relevant to the Bells Line of Road/Grose Vale Road intersections.

Options A and B

Options A and B would not improve eastbound and westbound traffic flows between Grose Vale Road and East Market Street. The modelling analysis suggested that banning eastbound right turns on Kurrajong Road to Old Kurrajong Road (southbound) would adversely impact the operation of the March Street/Bosworth Street intersection. The modelling outcome of Options A and B identifies the need for an additional eastbound exclusive right turn lane on March Street at the March Street/Bosworth Street intersection.

Table 2-2 summarises the assessment of Options A and B against the proposal objectives, and the intersection performance criteria outlined above in section 2.4.1.

Table 2-2 Assessment: Options A and B

Objective/Criteria	Option performance against objectives/criteria
Reduce traffic congestion and improve traffic flow	Would not improve eastbound and westbound traffic flows between Grose Vale Road and East Market Street.
Improve accessibility and efficiency for freight and private vehicles	Banning selected turn movements during peak periods would impact on freight accessibility and efficiency (by causing unnecessary delays and detours for freight vehicles)
Improve safety for motorists, cyclists and pedestrians	Partially achieves. Does not address safety at key intersections in Richmond and North Richmond.
Minimise socio-economic and environmental impacts	Minimal works footprint would have good environmental and socio-economic outcome.
Improve Bells Line of Road eastbound traffic flows	Partially achieves – but does not address congestion at Grose Vale Road intersection.
Improve Bells Line of Road westbound traffic flows	Partially achieves – but does not address congestion at Grose Vale Road intersection.
Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) in the study area network	Banning selected turn movements would result in delays and detours for some motorists.
Improve Grose Vale Road traffic flows	This option has no discernible impact on Grose Vale Road traffic flows.
Improve key intersection Level of Service with: • Bells Line of Road/Grose Vale Road (Signal) • Kurrajong Road/Old Kurrajong Road (Priority) • March Street/Bosworth Street (Signal)	Modelling results suggest that banning eastbound right turns on Kurrajong Road to Old Kurrajong Road (southbound) would adversely impact the operation of the March Street/Bosworth Street intersection. The modelling outcome of Options A and B identifies the need for an additional eastbound exclusive right turn lane on March Street at the March Street/Bosworth Street intersection.
Impact on nearby intersections: • Area A, Richmond • Area B, Castlereagh Road	Banning eastbound right turn on Kurrajong Road to Old Kurrajong Road (southbound) would adversely impact the operation of the March Street/Bosworth Street intersection

Objective/Criteria	Option performance against objectives/criteria
• Area C, North Richmond	as traffic would be forced into this detour to reach Castlereagh Road.

Option C

The identified improvement (one eastbound exclusive right turn lane on March Street) in Options A and B formed the basis of Option C. Option C performs relatively better than previous Options A and B. The modelling results from Option C have reaffirmed the need for an additional eastbound dedicated right turn lane on March Street at the March Street/Bosworth Street intersection. With this improvement in place, Option C would improve eastbound traffic flows between Grose Vale Road and East Market Street.

Table 2-3 summarises the assessment of Option C against the proposal objectives, and the intersection performance criteria outlined above in section 2.4.1.

Table 2-3 Assessment: Option C

Objective/Criteria	Option performance against objectives/criteria
Reduce traffic congestion and improve traffic flow	Marginal improvement over Option A; as dedicated eastbound right turn lane from March Street into Bosworth Street would compensate for any disadvantages caused by ban on eastbound right turns from Kurrajong Road into Old Kurrajong Road.
Improve accessibility and efficiency for freight and private vehicles	Marginal improvement over Option A; dedicated eastbound right turn into Bosworth Street would partially compensate for the ban on eastbound right turns from Kurrajong Road into Old Kurrajong Road.
Improve safety for motorists, cyclists and pedestrians	Marginal improvement over Option A; improves safety at March Street/Bosworth Street intersection.
Minimise socio-economic and environmental impacts	Would result in some impacts at March/Bosworth Street due to larger intersection footprint required, which would impact on some adjoining properties and cause some temporary disruptions during construction.
Improve Bells Line of Road eastbound traffic flows	Partially achieves – but does not address congestion at Grose Vale Road intersection.
Improve Bells Line of Road westbound traffic flows	Partially achieves – but does not address congestion at Grose Vale Road intersection.
Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) in the study area network	No improvement over Option A as turn bans at Old Kurrajong Road would result in delays and detours for some motorists.
Improve Grose Vale Road Traffic Flows	This option has no discernible impact on Grose Vale Road traffic flows.
Improve key intersection Level of Service with: • Bells Line of Road/Grose Vale Road (Signal) • Kurrajong Road/Old Kurrajong Road (Priority) • March Street/Bosworth Street (Signal)	Improvement over Options A, B achieved by introduction of a dedicated right turn bay for eastbound right turn from March Street into Bosworth Street to compensate for right turn ban at Old Kurrajong Road. Would not address intersection LOS at Bells Line of Road/Grose Vale Road, or Kurrajong Road/Old Kurrajong Road.

Objective/Criteria	Option performance against objectives/criteria
Impact on nearby intersections: • Area A, Richmond • Area B, Castlereagh Road • Area C, North Richmond	Improves access to Castlereagh Road and partially compensates for right turn ban at Kurrajong Road/Old Kurrajong Road. Right turn ban westbound into Bosworth Street may result in traffic diverting via West Market Street or Chapel Street. No impact on intersections in North Richmond.

Options D and E

Unlike Options A to C, Options D and E are developed with a view to improving westbound flows of this section of Bells Line of Road and Kurrajong Road. In general, both Options D and E would improve westbound traffic flows between Grose Vale Road and East Market Street in the afternoon peak. The proposed improvements at Bells Line of Road/Grose Vale Road intersection are forecast to improve Levels of Service for westbound traffic, particularly in the afternoon peak. To achieve efficient traffic flows in the westbound direction, the analysis identifies the need for an additional left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road.

Table 2-4 summarises the assessment of Options D and E against the proposal objectives, and the intersection performance criteria outlined above in section 2.4.1.

Table 2-4 Assessment: Options D and E

Objective/Criteria	Option performance against objectives/criteria
Reduce traffic congestion and improve traffic flow	Partial achievement; Options D and E would improve traffic flows in North Richmond, and westbound flows between Richmond and North Richmond, but would not improve traffic flows or intersection performance in Richmond itself.
Improve accessibility and efficiency for freight and private vehicles	Partial achievement; no measurable improvement in freight efficiency in Richmond Town Centre
Improve safety for motorists, cyclists and pedestrians	Partial achievement; no measurable improvement in road safety in Richmond Town Centre
Minimise socio-economic and environmental impacts	Would result in some impacts at Bells Line of Road/Grose Vale Road due to larger intersection footprint required, which would impact on some adjoining properties and cause some temporary disruptions during construction.
Improve Bells Line of Road eastbound traffic flows	Partial achievement; these options focus more on improving westbound flows in Bells Line of Road.
Improve Bells Line of Road westbound traffic flows	Options D and E both achieve this objective.
Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) in the study area network	Options D and E both partially achieve this objective through improvement to westbound flows in Bells Line of Road.
Improve Grose Vale Road Traffic Flows	Options D and E would both result in a general improvement of traffic flows in Grose Vale Road.
Improve key intersection Level of Service with: • Bells Line of Road/Grose Vale Road (Signal) • Kurrajong Road/Old Kurrajong	Options D and E would both result in improvement of intersection LOS at Bells Line of Road/Grose Vale Road. Would not address intersection LOS at March Street/Bosworth Street. LOS at Kurrajong Road/Old Kurrajong Road would only be improved with addition of northbound left turn slip lane (as mentioned above).

Objective/Criteria	Option performance against objectives/criteria
Road (Priority) • March Street/Bosworth Street (Signal)	
Impact on nearby intersections: • Area A, Richmond • Area B, Castlereagh Road • Area C, North Richmond	No change to Areas A or B. Right turn ban eastbound to Grose Vale Road under Option E may result in congestion and delays at Charles Street/William Street/Grose Vale Road caused by detouring southbound traffic.

Option F

Option F is developed with the view that intersection widening to the March Street/Bosworth Street (as per Option C) may have timing implications due to the need for potential property acquisitions. In that context, intersection widening work may not be implemented in the immediate short term (0-5 years). In addition, the proposed eastbound right turn ban on Kurrajong Road to Old Kurrajong Road (southbound) may have potential accessibility issues for the local community. Instead, in Option F, an additional eastbound exclusive right turn bay from Kurrajong Road to Old Kurrajong Road (southbound) is proposed. In general, Option F is forecast to improve both eastbound and westbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks. Minor improvements are forecast for westbound traffic. To achieve efficient traffic flows in the westbound direction, the Option F analysis identifies the need for an additional left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road.

Table 2-5 summarises the assessment of Option F against the proposal objectives, and the intersection performance criteria outlined above in section 2.4.1.

Table 2-5 Assessment: Option F

Objective/Criteria	Option performance against objectives/criteria
Reduce traffic congestion and improve traffic flow	Partial achievement; improves traffic flows and level of service through North Richmond and at Old Kurrajong Road, but unlikely to make a significant difference to traffic flows or intersection performance in Richmond itself
Improve accessibility and efficiency for freight and private vehicles	Partial achievement; this option would not contribute to any measurable improvement in freight efficiency in Richmond town centre.
Improve safety for motorists, cyclists and pedestrians	Partial achievement; this option would not contribute to any measurable improvement in road safety in Richmond town centre.
Minimise socio-economic and environmental impacts	Would result in some impacts at Bells Line of Road/Grose Vale Road due to larger intersection footprint required, which would impact on some adjoining properties and cause some temporary disruptions during construction.
Improve Bells Line of Road eastbound traffic flows	Option F is forecast to improve eastbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks.
Improve Bells Line of Road westbound traffic flows	Only minor improvements are forecast for westbound traffic. For westbound improvements, traffic analysis identified the need for an additional left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road.
Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) in	Option F partially achieves this objective through improvement to eastbound and westbound flows in Bells

Objective/Criteria	Option performance against objectives/criteria
the study area network	Line of Road.
Improve Grose Vale Road Traffic Flows	Option F would both result in a general improvement of traffic flows in Grose Vale Road.
Improve key intersection Level of Service with: • Bells Line of Road/Grose Vale Road (Signal) • Kurrajong Road/Old Kurrajong Road (Priority) • March Street/Bosworth Street (Signal)	Option F targets specific improvements at Bells Line of Road/Grose Vale Road, and at Kurrajong Road/Old Kurrajong Road only. The need for improvements at March Street/Bosworth Street would not be satisfied by this option. For westbound improvements, traffic analysis identified the need for an additional left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road.
Impact on nearby intersections: • Area A, Richmond • Area B, Castlereagh Road • Area C, North Richmond	No change to Areas A or B. Right turn ban eastbound to Grose Vale Road under Option F may result in congestion and delays at Charles Street/William Street/Grose Vale Road caused by detouring southbound traffic.

Option G

In general, Option G is a combination of previous Options C and E. Option G is forecast to improve both eastbound and westbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks. Option G performs better than the previous Options C and E alone. However, in Option G, the proposed eastbound right turn ban on Kurrajong Road to Old Kurrajong Road (southbound) may have potential accessibility issues for the local communityIn addition, the provision of a dedicated eastbound right turn bay on March Street to Bosworth Street may have time implications due to the need for potential property acquisition.

Table 2-6 summarises the assessment of Option G against the proposal objectives, and the intersection performance criteria outlined above in section 2.4.1.

Table 2-6 Assessment: Option G

Objective/Criteria	Option performance against objectives/criteria
Reduce traffic congestion and improve traffic flow	Option G would improve traffic eastbound and westbound traffic flows across all three intersections. However right turn bans would reduce efficiencies by forcing some motorists to detour and cause delays.
Improve accessibility and efficiency for freight and private vehicles	Achieves improvements at Richmond and North Richmond. Dedicated eastbound right turn into Bosworth Street would partially compensate for the ban on eastbound right turns from Kurrajong Road into Old Kurrajong Road.
Improve safety for motorists, cyclists and pedestrians	Achieves satisfactory safety improvements at Richmond and North Richmond
Minimise socio-economic and environmental impacts	Would involve enlarged intersection footprints and some property impacts at Richmond and North Richmond. Improved traffic flows would improve overall economic justification for the upgrades.
Improve Bells Line of Road eastbound traffic flows	Option G is forecast to improve eastbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks. Also recognises the semi-permanent peak flows caused by weekend/tourist traffic.

Objective/Criteria	Option performance against objectives/criteria
Improve Bells Line of Road westbound traffic flows	Option G is forecast to improve westbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks. Also recognises the semi-permanent peak flows caused by weekend/tourist traffic.
Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) in the study area network	Option G achieves partial improvements; however eastbound right turn ban on Kurrajong Road to Old Kurrajong Road (southbound) may have potential accessibility issues for the local community
Improve Grose Vale Road Traffic Flows	Partially achieves; right turn ban eastbound to Grose Vale Road may result in congestion and delays at William Street/ Grose Vale Road caused by detouring southbound traffic.
Improve key intersection Level of Service with: • Bells Line of Road/Grose Vale Road (Signal) • Kurrajong Road/Old Kurrajong Road (Priority) • March Street/Bosworth Street (Signal)	Achieves LOS improvements at all 3 intersections.
Impact on nearby intersections: • Area A, Richmond • Area B, Castlereagh Road • Area C, North Richmond	Area A: may result in some diversion of westbound traffic into West Market Street or Chapel Street, to turn right/head north. Area B: no change. Area C: Right turn ban eastbound to Grose Vale Road may result in congestion and delays at Charles Street/William Street/Grose Vale Road caused by detouring southbound traffic.

Option H

Option H is a further modification to previous Options E and F. The analysis found that Option H performed relatively better than other competing options for the following reasons:

- Unlike previous Options (A, B, C, and G), Option H eliminates potential east bound right turn bans to Old Kurrajong Road (southbound). Instead, improvements are proposed to the Kurrajong Road/Old Kurrajong Road intersection that improves turning traffic performance in and out of Old Kurrajong Road. This would also improve local accessibility to Old Kurrajong Road
- Option H alone would improve both eastbound and westbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks
- Compared to other competing options, Option H has addressed most of the key traffic criteria being used. Of the seven key criteria, Option H shows improvement in six criteria
- Option H would not alter the existing traffic patterns thus minimising the impact on other nearby roads and intersections
- Option H would provide the best overall contribution to road safety as it makes allowance for all movements, while also catering for all pedestrian movements and desire lines.
- In general, improvements identified to Kurrajong Road/Old Kurrajong Road, Bells Line of Road/Grose Vale Road and March Street/Bosworth Street intersections in Option H are relatively easy to implement in the short term.

Table 2-7 summarises the assessment of Option H against the proposal objectives, and the intersection performance criteria outlined above in section 2.4.1.

Table 2-7 Assessment: Option H

Objective/Criteria	Option performance against objectives/criteria
Reduce traffic congestion and improve traffic flow	Option H alone would improve both eastbound and westbound traffic flows between Grose Vale Road and East Market Street in the morning and afternoon peaks, and also eliminates potential east bound right turn bans to Old Kurrajong Road (southbound).
Improve accessibility and efficiency for freight and private vehicles	Improvements to Kurrajong Road/Old Kurrajong Road intersection would improve local accessibility to Old Kurrajong Road.
Improve safety for motorists, cyclists and pedestrians	Option H would provide the best overall contribution to road safety as it makes allowance for all movements, while also catering for all pedestrian movements and desire lines.
Minimise socio-economic and environmental impacts	Option H minimises impacts by maximising overall benefits in particular through reduced delays leading to improved economic performance.
Improve Bells Line of Road eastbound traffic flows	Option H would improve eastbound traffic flows between Grose Vale Road and East Market Street during peak periods including weekend/tourist peak periods.
Improve Bells Line of Road westbound traffic flows	Option H would improve westbound traffic flows between Grose Vale Road and East Market Street during peak periods including weekend/tourist peak periods.
Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT) in the study area network	Option H achieves general improvements; however eastbound right turn ban on Bells Line of Road to Grose Vale Road (southbound) may have potential accessibility issues for the local community
Improve Grose Vale Road Traffic Flows	Right turn ban eastbound to Grose Vale Road may result in congestion and delays at Charles Street/William Street/ Grose Vale Road caused by detouring southbound traffic.
Improve key intersection Level of Service with: • Bells Line of Road/Grose Vale Road (Signal) • Kurrajong Road/Old Kurrajong Road (Priority) • March Street/Bosworth Street (Signal)	Achieves LOS improvements at all 3 intersections.
Impact on nearby intersections: • Area A, Richmond • Area B, Castlereagh Road • Area C, North Richmond	Area A: may result in some diversion of westbound traffic into West Market Street or Chapel Street, to turn right/head north. Area B: improvements achieved with additional turning lanes. Area C: Eastbound right turn ban to Grose Vale Road (southbound) may result in congestion and delays at Charles Street/William Street/Grose Vale Road caused by detouring southbound traffic.

2.5 Preferred strategy

Option H was selected as the preferred solution as it would provide the best outcome in terms of meeting the proposal objectives and criteria as outlined in sections 2.3 Proposal objectives, and 2.4.1 Methodology for selection of preferred option:

Improvements to traffic flow on Bells Line of Road and Grose Vale Road; improving intersection Level of Service (LoS) at Bells Line of Road/Grose Vale Road; improving intersection LoS at Kurrajong Road/Old Kurrajong Road; and improving intersection LoS at March Street/Bosworth Street.

2.6 Refinement of the proposal as part of the preferred strategy

In consultation with stakeholders, Option H was modified and reassessed to include some changes to the March Street/Boswell Street intersection (Richmond), to improve capacity at that intersection. In adopting Option H as the preferred strategy, no modifications were considered necessary for the proposed changes at Bells Line of Road/Grose Vale Road.

General arrangement drawings of the proposed design, which provide further design detail, are provided in Appendix B.

3 Description of the proposal

This chapter describes the proposal and provides descriptions of existing conditions, the design parameters including major design features, the construction method and associated infrastructure and activities.

3.1 The proposal

The proposal involves the upgrade of the intersection at Bells Line of Road/Grose Vale Road in North Richmond. Detailed design drawings for the proposal are provided in Appendix B.

The general features of the proposed intersection upgrade at Bells Line of Road/Grose Vale Road are shown in Figure 1-2 and include:

- Provision of two dedicated right turn lanes from Grose Vale Road (eastbound) into Bells Line of Road (southbound) and a dedicated left turn lane from Bells Line of Road (northbound) into Grose Vale Road (westbound).
- Provision of two westbound through lanes on Bells Line of Road.
- Extension of the eastbound merge on Bells Line of Road by about 65 metres, which would involve the loss or further time restriction of about eight kerbside parking spaces.
- Provision of a clearway on Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods, resulting in the loss of six 15-minute kerbside car parking spaces during clearway restriction periods.
- The permanent loss of up to 13 restricted on-street parking spaces from Grose Vale Road (western kerb) due to the proposed road widening work.
- Relocation of the existing traffic signals and associated equipment at the Bells Line of Road/Grose Vale Road to suit the proposed new road configuration. Phasing of traffic signals would be changed to suit the new turn arrangements.
- Relocation of existing street lighting where the locations of power poles conflict with the proposed road widening work.
- Relocation and protection of public utilities (electrical transmission lines, water mains and telecommunications infrastructure) within the proposal area.
- The permanent acquisition of about 575 square metres of privately owned land involving seven properties and seven separate landowners to accommodate the proposed road widening work. The majority of this land would comprise strips of residential land; although, one full property acquisition, affecting a commercial property, would also be required.
- The permanent acquisition of approximately 110 square metres of publicly owned land (public reserve owned by Hawkesbury Council) at the corner of Bells Line of Road and Terrace Road, to accommodate the proposed road widening work.
- Associated boundary adjustments and reinstatement of fencing on a like-for-like basis.
- The permanent relocation of an existing bus stop (number 275455) from the northern kerb of Bells Line of Road east of Grose Vale Road, to a new kerbside location approximately 90 metres further to the east.
- The modification of one bus stop (number 275419) located on the southern kerb of Bells Line of Road, about 200 metres east of Grose Vale Road, to accommodate an additional dedicated northbound lane.
- A ‘moderate to high’ impact on the existing landscape character of the area surrounding the Bells Line of Road/Grose Vale Road intersection due to the removal of six road trees from the northern corner of the intersection, up to five from Grose Vale Road as well as the removal of up to 11 visually prominent roadside trees within the existing traffic island on the westbound approach along Bells Line of Road.
- A ‘moderate to high’ visual impact on residential properties fronting Grose Vale Road and Bells Line of Road due to the removal of street trees and widening of the existing road pavement.

- Clearing of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection, as well as other planted native and exotic vegetation from the area surrounding the Bells Line of Road/Grose Vale Road intersection.
- Minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection. Threatened species assessments were undertaken for the Grey-headed Flying Fox, which are presented in Appendix C. These assessments concluded that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox.
- Road and gutter excavation and removal.

A typical cross-section of the proposed intersection upgrade at Bells Line of Road/Grose Vale Road is shown in Figure 3-1.

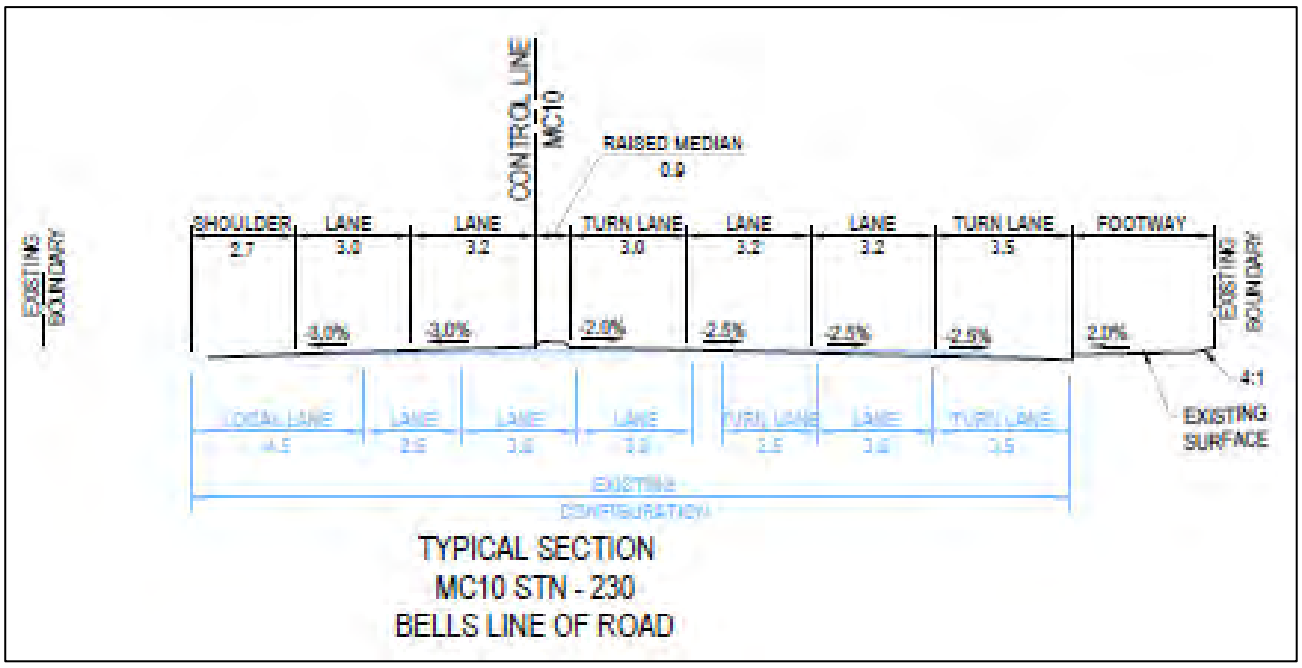

Figure 3-1 Typical cross section of the proposed Bells Line of Road/Grose Vale Road intersection upgrade

3.2 Design

This section provides a description of the design of the proposal.

3.2.1 Design criteria

General

The road design has been developed in accordance with the following guidelines, standards and correspondence:

- Information received in meetings/emails from Roads and Maritime and Downer Mouchel
- Minor Project – Project Plan (Maintenance)
- Roads and Maritime QA Specification G1: Job Specific Requirements
- Roads and Maritime Documents
- Published Roads and Maritime supplements to Austroad Guidelines
- Austroad Design Guidelines
- Published Roads and Maritime supplements to Australian Standards
- Australian Standards
- Standards Australia handbooks.

The proposal

The design criteria specific to the design for the proposal are outlined in Table 3-1.

Table 3-1 Design Criteria

Design feature	Bells Line of Road/Grose Vale Road Design requirement
Design and posted speed	Design speed and posted speed limit of 60 kilometres per hour.
Minimum Lane Width	Minimum width of through lanes and turning lanes would be 3.2 metres.
Horizontal alignment	The horizontal alignment of Bells Line of Road has been modified from the existing alignment to create additional through lanes. The horizontal alignments of Grose Vale Road and The Terrace Road are a 'best fit' alignment and have not been modified from the existing alignments. Safe Intersection Site Distance (SISD) of 114 metres is achieved for all intersection movements. Superelevation, cross fall and transition criteria are for the most part in accordance with Austroads read in conjunction with Roads and Maritime supplements. Due to existing kerb lanes and pavement construction constraints, cross falls on the left turn lane from Bells Line of Road to Grose Vale Road and the left through lane of Grose Vale Road do not comply.
Vertical alignment	The intent of the vertical alignment is to follow the existing pavement surface, thereby minimising road works, ensuring minimum pavement depths and eliminating boxing out of pavement. Areas where the roadway is to be widened will be constructed by crossfall extensions. Vertical grades are generally flat longitudinally; there is sufficient crossfall for pavement drainage. The design is in accordance with Austroads read in conjunction with RMS supplements.
Stopping sight distance	64 metres for cars.
Design for errant vehicles	The clear zone width for a 60 kilometres per hour design speed is greater than three metres in accordance with Austroads with Roads and Maritime Supplements Part 6 – Roadside Design, Safety and Barriers, Figure 6.1. Being an urban intersection it is difficult to meet this criterion, as such SA kerb formalises all road edges and proposed identified hazards will be placed at the back of footway.
Intersection treatment	The Bells Line of Road and Grose Vale Road intersection is traffic signal controlled. The existing traffic controls and associated equipment would need to be relocated due to the road widening works. Phasing of traffic signals would be changed to suit the new turn arrangements.

Design feature	Bells Line of Road/Grose Vale Road Design requirement
Street lighting	Existing street lighting in the proposal area would need to be relocated due to the road widening work. To reduce hazards, poles would be placed at the back of the footway.
Design vehicle	B-double and 19 metre long semi-trailer.
Pavement type	Full depth asphalt (in road widening areas).
Footway	Generally a 1.2 metre wide footway has been adopted, within a (nominal) 3.5 metre wide verge
Drainage (surface flow and runoff from ramps or turning roadways)	For the 50 millimetre per hour rainfall design event: • The maximum water depths at any point on the pavement must not be more than five millimetres. • The maximum change in the depth of flow across the pavement must not exceed five millimetres over 10 metres. Runoff from ramps or turning roadways must not flow beyond noses and across the main carriageway for a one in two year storm event.
Utilities	Adjustments to utilities (including water mains, overhead electricity transmission lines and telecommunications infrastructure) have been designed in consultation with the relevant authorities/asset owners.

3.2.2 Constraints – design, construction and operation

A series of constraints were identified during the development of the design, including the construction and operational phases of the proposal. The main constraints associated with the proposed intersection upgrade at Bells Line of Road/Grose Vale Road include the following:

- Traffic disruptions especially during peak hours
- The amount of space required to accommodate heavy vehicle turning paths for a 19 metre semi-trailer and B-double truck
- Minimisation of property acquisitions and adjustments
- Services relocations
- Community perceptions about the need for the proposal, and its impacts during construction and operation
- Accommodating heavy vehicles whilst providing improved pedestrian facilities.

3.2.3 Major design features – Bells Line of Road/Grose Vale Road intersection

Major design features of the proposed intersection upgrade at Bells Line of Road/Grose Vale Road (illustrated on the design drawings in Appendix B) include the following:

- Two new dedicated right turn lanes from Grose Vale Road (eastbound) into Bells Line of Road (southbound)
- A new dedicated left turn lane from Bells Line of Road (northbound) into Grose Vale Road (westbound)
- Maintaining two westbound through lanes on Bells Line of Road
- Extension of the eastbound merge on Bells Line of Road by about 65 metres

- Provision of a clearway on Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods
- Relocation of the existing traffic signals
- Relocation of existing street lighting where the locations of power poles conflict with the proposed road widening work
- Rearrangement of kerbside car parking, including the loss of some parking kerbside spaces and/or tighter parking restrictions in some locations
- Removal of the existing traffic island and slip road adjoining the eastbound lanes of Bells Line of Road
- Upgrading of existing road drainage
- The permanent relocation of an existing bus stop (number 275455) from the northern kerb of Bells Line of Road east of Grose Vale Road, to a new kerbside location approximately 90 metres further to the east
- The modification of one bus stop (number 275419) located on the southern kerb of Bells Line of Road, about 200 metres east of Grose Vale Road, to accommodate an additional dedicated northbound lane
- Acquisition of 685 square metres of private and public land adjacent to the work area, with associated boundary adjustments and reinstatement of fencing on a like-for-like basis
- Removal of roadside vegetation where it is required to facilitate road pavement widening.

A description of the above design features is provided in the following sections. The proposed extent of drainage works is the same as the overall extent of the proposed road works, as shown in the drawings in Appendix B.

New dedicated right turn lanes from Grose Vale Road (eastbound)

The proposed new dedicated right turn lanes from Grose Vale Road (northbound) to Bells Line of Road (eastbound) would be about 3.1 metres wide and about 120 metres in length.

New dedicated left turn lane from Bells Line of Road (northbound)

The proposed new dedicated left turn lane from Bells Line of Road (westbound) into Grose Vale Road (southbound) would be about 3.2 metres wide and about 120 metres in length.

Westbound through lanes on Bells Line of Road

Two westbound through lanes would be retained on Bells Line of Road, each being about 3.2 metres wide and 90 metres in length.

Extended eastbound merge on Bells Line of Road

The existing eastbound merge lane on Bells Line of Road (southbound) would be extended for a length of about 65 metres. This would require the removal of the existing slip road and traffic island, and the removal or further time restriction of eight existing kerbside parking spaces along the slip road. All kerbside parking spaces would be restricted to 15 minutes parking from 9.30 am to 6.00 pm Monday to Friday. The width of this merge lane would be about 3.2 metres.

Clearway on Bells Line of Road (westbound)

The proposed clearway on Bells Line of Road (westbound) would extend between Pitt Lane and Grose Vale Road and would be in operation during peak periods. The establishment of this clearway would require the removal of up to six time-restricted (15 minute) on-street parking spaces.

Relocated traffic signals

The existing traffic signals would be relocated to suit the proposed new intersection arrangement.

Relocated street lighting

Existing street lighting in the proposal area would need to be relocated due to the road widening work. Any relocated power pole would be situated behind pedestrian footpaths to reduce hazards for road users. Relocated street lighting would be designed to minimise visual amenity impacts on

surrounding residential and other sensitive viewpoints and would comply with relevant Australian Standards, including AS4282- 1997 (*Control of the obtrusive effects of outdoor lighting*).

Locations of existing and proposed new street lighting are shown in the design drawings in Appendix B.

Road drainage

Given the natural terrain, none of the stormwater collected from the Bells Line of Road/Grose Vale Road intersection discharges south of Grose Vale Road. The proposed intersection upgrade works would therefore not have any impact on the existing stormwater discharge volumes south of Grose Vale Road, as all stormwater from the Bells Line of Road/Grose Vale Road intersection drains toward the north in the direction of Redbank Creek. Therefore the proposed works would not result in any change in stormwater discharges into the Hawkesbury River.

Road drainage work proposed at the Bells Line of Road/Grose Vale Road intersection would generally comprise the following (see design drawings (Construction staging plans) in Appendix B):

- Installation of a 375 millimetre diameter pipe along the western side of Grose Vale Road. This pipe would be about 78 metres in length and would connect via a new 750 millimetre diameter pipe into the existing drainage system at the Bells Line of Road/Grose Vale Road intersection. This drainage infrastructure would be installed via an open trench method
- Installation of 375 to 600 millimetre diameter pipes along the northern and southern sides of Bells Line of Road. The total length of new piping that would be installed along the northern and southern sides of Bells Line of Road is about 250 metres and 210 metres, respectively. Pipes would be installed via an open trench method
- No drainage work is proposed to be carried out directly across the Bells Line of Road/Grose Vale Road intersection
- One drainage line of 600 millimetre diameter pipe is proposed that directly crosses Terrace Road. This pipe would be about 32 metres in length and would be installed via an open trench method
- One drainage line of 375 millimetre diameter pipe is proposed along Beaumont Avenue. This pipe would be about 30 metres in length and would be installed via an open trench method
- As a result of the proposed works, the total area of impervious surface will increase by approximately 1,100 square metres.

An analysis of existing and proposed pipe hydraulic capacity and an assessment of pit spacing was carried out for the proposed road widening work along the western kerb of Grose Vale Road, the northern kerb of Bells Line of Road and the corresponding change in catchment area at the intersection. Results of these investigations confirmed that the existing stormwater drainage network is inadequate to accommodate a 10 year Annual Recurrence Interval (ARI) storm event, resulting in some pits surcharging.

The proposed new drainage infrastructure within the project limit of works meets the current design criteria for the 10 year ARI storm event.

During a 100 year ARI storm event, the existing system upwells, due to a combination of a high tailwater level and inadequate outlet pipe diameters. The proposed drainage system is an improvement to the current design but does not satisfy the 100 year ARI storm event criteria.

Property adjustments, relocation of fencing

Where partial property acquisition or boundary adjustments are required (see Section 3.6), Roads and Maritime would relocate any existing boundary fences to the affected properties. Fences would be replaced on a like-for-like basis and reconstructed on the new surveyed or adjusted boundary.

Removal of street trees

Construction of the proposal would require the removal of a number of planted roadside trees (refer to Section 6-9 and Figure 6-8 for the extent of this work and a description of the vegetation to be removed). All tree clearing work would comply with Roads and Maritime's Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects.

3.3 Construction activities

This section provides a summary of the likely construction methodology, staging, work hours, plant and equipment that would be used to construct the proposal and associated activities. For the purpose of this REF, an indicative construction staging and methodology are provided. The detailed construction staging plans and methods would be determined by the construction contractor(s) after completion of the detailed design.

The actual construction method may vary from the description in this chapter as a result of factors such as identification of on-site conditions identified during pre-construction activities, ongoing refinement of the detailed design and consultation with property owners and businesses. Roads and Maritime approval would be obtained for any changes to the approved scope of work (as described in Chapter 3 of this REF) that has the potential to substantially alter the construction footprint (as shown in Appendix B) and/or the location, magnitude, extent or duration of an environmental impact (as described in Chapter 6 of this REF).

3.3.1 Work methodology

Construction activities would be guided by a Construction Environmental Management Plan (CEMP) that would be developed in accordance with the requirements of the Roads and Maritime QA Specification G36 Environmental Protection (Management System). The work area would be specified in the CEMP and would incorporate all safeguards as described in this REF and any other relevant Roads and Maritime environmental specifications.

The proposal would involve the following general work methodology and general sequencing (refer also to Table 3-2):

- Establishment of temporary fencing and concrete safety barriers
- Installation of erosion and sediment controls
- Relocation of utilities
- Establishment of construction compound sites and access
- Vegetation clearing and grubbing
- Stripping, stockpiling and management of topsoil and unsuitable material
- Earthworks construction
- Stormwater and subsurface drainage construction
- Pavement construction
- Restoration of temporary stockpile areas
- Landscaping
- Ancillary work including installation of safety barriers, fencing, pavement marking, and signposting
- Removal and restoration of construction compound and site tidy up.

Further discussion on the construction work methodology for the proposal is provided in the following sections.

Construction staging

The indicative construction staging for the proposal is outlined in Table 3-2. The timing of construction work at each of the proposed intersection upgrade locations (and thus, the potential for cumulative traffic impacts to occur) was not known at the time of preparing this REF, and would need to be reviewed as part of the final work methodology during the detailed design phase.

The proposed staging strategy outlined in Table 3-2 was developed with consideration of the following:

- Minimising construction of temporary pavement
- Provision of pedestrian access during construction
- Providing safe movement of vehicles through and around the construction site at all times
- Minimising disruptions to traffic, with traffic maintained close to existing service levels
- Providing adequate separation between construction zones and vehicles
- Maintaining property access during construction
- Providing smooth transitioning in and out of the traffic switches
- Providing drainage of traffic lanes and construction areas

The majority of the construction work would be carried out during Stages 1 and 2 in order to minimise the number of traffic switches and make large work areas available to the Construction Contractor. The Contractor would consult with all emergency service authorities before any traffic changes are implemented.

Before the commencement of each stage, the following general provisions are proposed:

- Temporary safety barriers would be installed where required including end treatments to ensure safety of temporary traffic arrangements and protection of construction zone from traffic
- Temporary erosion and sedimentation controls would be completed.

3.3.2 Construction hours and duration

Construction is anticipated to start in mid to late 2016, with completion anticipated by the end of 2017, weather permitting.

Construction work for the proposal would be carried out during standard working hours where practicable, as follows:

- Monday to Friday, 7am to 6pm
- Saturday, 8am to 1pm
- Sunday and Public Holidays, generally no work (other than under special circumstances and only as approved)

Night and weekend work would also be required, subject to permitted road occupancy licences and construction staging. This is necessary to minimise traffic disruptions on a major road corridor. When out of hours work is required, work would be carried out in accordance with procedures contained within the Office of Environment and Heritage (OEH) *Interim Construction Noise Guideline* (DECC 2009).

Procedures to be adopted before any out of hours works, or before any noisy construction activities would include notifying the local community including local residents and businesses before any work commencing.

Table 3-2 Indicative construction staging for the proposal

Stage	Aspect	Construction activity Bells Line of Road/Grose Vale Road
Stage 1	Traffic	• Shift eastbound and westbound traffic lanes to the southern side of Bells Line of Road • Provide right turn lanes into The Terrace Road and Gross Vale Road.
	Construction	• Construct pavement drainage lines on the northern side of Bells Line of Road • Construct widening on the northern side of Bells Line of Road including clearing and grubbing, earthworks, subsurface drainage, pavement and temporary pavement marking. The asphalt wearing course would not be placed in this stage • Landscape the northern side of Bells Line of Road.
	Utility relocations	• Protect sewer on the northern side of Bells Line of Road • Relocate overhead electricity poles and associated cables on the northern side of Bells Line of Road and the eastern side of The Terrace Road • Relocate telecommunications assets on the northern side of Bells Line of Road • Relocate traffic signal posts and associated equipment on the northern side of Bells Line of Road.
Stage 2	Traffic	• Switch eastbound and westbound traffic to the new lane configuration • Shift northbound and southbound traffic lanes to the eastern side of Gross Vale Road. Provide No Stopping on the eastern side of Gross Vale Road for the length of the work zone.
	Construction	• Construct pavement drainage line on the western side of Gross Vale Road • Construct widening on the western side of Gross Vale Road including clearing and grubbing, earthworks, subsurface drainage, pavement and temporary pavement marking. The asphalt wearing course would not be placed in this stage • Landscape the western side of Gross Vale Road.
	Utility relocations	• Relocate water main on the western side of Gross Vale Road • Relocate overhead electricity poles and associated cables on the western side of Gross Vale Road • Relocate telecommunications assets on the western side of Gross Vale Road • Relocate traffic signal posts and associated equipment on the western side of Gross Vale Road.
Stage 3	Traffic	• Complete construction under or adjacent to traffic outside peak periods with at least one lane remaining open to traffic.

Stage	Aspect	Construction activity Bells Line of Road/Grose Vale Road
	Construction	• Mill existing pavement • Place asphalt wearing course and pavement marking • Open all lanes to traffic • Restore all disturbed areas such as areas for compounds, material storage and access roads.

3.3.3 Plant and equipment

Plant and equipment needed for the proposal would be determined during the construction planning phase. It is anticipated that the plant and equipment used for the proposal would include those outlined in Table 3-3.

Table 3-3 Plant and equipment required for thr proposal

Construction phase	Plant and equipment
General	• Cranes • Excavators • Bobcat • Road sweeper • Water cart • Haulage trucks • Fuel cart • Semi-trailers and large delivery trucks • Various small hand tools and equipment • Water pumps • Light commercial and passenger vehicles.
Road embankment and drainage construction	• Truck and dog trailer. • Semi-trailer. • Excavator. • Pad foot and smooth drum roller. • Compactor. • Hand compactor (various). • Grader. • Backhoe. • Trenching machine • Mulch blower • Hydro mulch truck (if required).
Road pavement construction	• Milling machine • Grader • Smooth drum roller • Bitumen sprayer • Asphalt paver • Asphalt roller • Truck and dog • Kerb extrusion machine (if required) • Line marking machine • Line Remover.
Utility relocations	• Excavators • Trucks • Hand compactor equipment.
Traffic management and control	• Attenuation vehicles • Trailer mounted VMS boards • Water filled and concrete barriers • Trailer mounted traffic lights.

3.3.4 Earthworks

The proposal would require earthworks for the construction of the widened intersections and public utility adjustments (as described in Section 3.5). The estimated quantities of earthworks required for the proposal are outlined in Table 3-4. These quantities would be refined during detailed design.

Where possible, imported fill would be sourced from local supplies and would be delivered during normal working hours (however, outside of peak periods, where possible).

Table 3-4 Indicative earthworks estimated to be required for the proposal

Intersection	Cut (m^3)	Fill (m^3)	Topsoil (m^3)	Excess (m^3)	Import (m^3)
Bells Line of Road/Grose Vale Road	3,900	100	600	4,400	1,100

3.3.5 Source and quantity of materials

Materials and estimated quantities are outlined in Table 3-5 and would be refined at the detailed design phase. Materials would be sourced from local areas where practicable.

Table 3-5 Materials and estimated quantities required for the proposal

Material	Estimated quantity (m^3) Bells Line of Road/Grose Vale Road
Asphalt	860
Road base	460

Water would also be required for construction activities, such as the compaction of earthworks and pavement layers and for dust suppression. Water for the work would be obtained from authorised sources, and where possible would include recycled water with appropriate licences. No water would be extracted from any surface waterways.

Surplus material that cannot be used on site would be reused or disposed of in the following order of priority:

1) Transfer to other Roads and Maritime projects for immediate re-use in accordance with the NSW Environmental Protection Authority (EPA) Excavated Public Road Material resource recovery exemption.
2) Transfer to an approved Roads and Maritime stockpile site for future re-use only if a specific project has been identified before stockpiling and *Protection of the Environment Operations Act 1997* (POEO Act) waste regulatory requirements are met. If a project cannot be identified the material would not be stockpiled.
3) Transported off-site for re-use by a third party in accordance with a relevant EPA resource recovery exemption.
4) Disposed of at an approved materials recycling or waste disposal facility.
5) As otherwise provided for by the relevant waste legislation.

3.3.6 Traffic management and access

Vehicle movements

Road traffic, bicycles and pedestrians are likely to be impacted throughout all stages of construction. As identified in Section 3.3.1, construction has been staged to minimise the number

of traffic switches required for the proposal and to make large work areas available to the Construction Contractor.

It is anticipated that during normal working days five to ten heavy vehicle and five to ten light vehicle movements would be required per day on and off-site. Heavy vehicles would be used to deliver construction material to the site and to transfer construction materials to nominated stockpile sites within the proposal area.

Construction traffic would generally use March Street, Kurrajong Road and Bells Line of Road to travel to and from the proposal site. Construction vehicle movements would also occur to and from the proposed construction compounds.

Traffic management, control and signage

Where possible, the proposed construction work would be programmed to minimise impact on traffic using the local and regional road network. Standard traffic management measures would be employed to minimise short-term traffic impacts expected during construction. These measures would be identified in a traffic management plan (TMP) for the proposal and would be developed in accordance with the Roads and Maritime's Traffic Control at Works Sites Manual (RTA 2010) and Roads and Maritime Specification G10 – Control of Traffic.

The TMP would provide details of traffic management to be implemented during construction, to ensure that traffic flow along all affected roads is maintained throughout construction. Impacts to the public (including traffic and cyclists) during construction would be managed through the TMP.

Road and lane closures

The traffic staging would be designed to ensure maintenance of traffic flow throughout the construction period. Some short-term work under traffic control or lane closure would be required for traffic switches, barriers work and asphalt overlay work. Traffic delays may occur as a result of construction and would be managed with the TMP (refer to Section 6.2).

Construction parking impacts would be managed through measures identified in the TMP that would form part of the CEMP. Further details about the potential traffic impacts during construction are provided in Section 6.2.

Property access

Access to affected properties would be maintained during construction and temporary property access would be provided to residences where required. The management of property access would be considered by the construction contractor and detailed as part of the final staging plan for the proposal.

Bus stop relocations

The proposal would require the relocation of an existing bus stop (number 275455) from the northern kerb of Bells Line of Road about 90 metres east of Grose Vale Road. This bus stop comprises a substantial brick shelter with seating and a litter bin. An alternate location for this bus stop was identified and communicated to stakeholders in the 'Have Your Say' newsletter distributed in November, 2015. The proposed new bus stop location is beside the kerb approximately 90 metres further to the east from the existing location, adjacent to the North Richmond Business Park at 30 Bells Line of Road..

The proposal would also require the modification of a second bus stop located on the southern kerb of Bells Line of Road, about 200 metres east of Grose Vale Road (bus stop number 275419) to accommodate an additional dedicated northbound lane. The existing bus stop at this location consists of a post and sign only; there is no shelter, seating or other facilities. The extent to which this bus stop would need to be modified is yet to be confirmed and would be determined in consultation with Transport for NSW and Busways, and after consultation with the local resident and business community.

Roads and Maritime held two consultation meetings with members of the North Richmond community, local business representatives and Council staff, on 6 November and 26 November 2015, at the North Richmond Post Office and Hawkesbury City Council offices, respectively. Relocation of bus stops was discussed at the meetings, and the community's primary issues or concerns in relation to bus stops, and Roads and Maritime's responses, were the following:

Westbound buses:

- Pedestrian safety in the car park adjacent to the existing westbound bus stop and across Bells Line of Road, given the distance between the existing stop and the nearest formal pedestrian crossing. Roads and Maritime response: Roads and Maritime explained that following completion of the design a road safety audit will be carried out to assess safety
- Three or four buses can arrive simultaneously in the afternoons. How will that be accommodated? Roads and Maritime response: Roads and Maritime explained that a 'No Parking' zone during peak times would help the flow of buses
- Would safety be improved with the introduction of an indented bus zone? Roads and Maritime response: Roads and Maritime explained that this raised issues in terms of land acquisition, grading and safety, and made it more difficult for buses to re-enter traffic lanes. This is not part of the scope for this project but Roads and Maritime will consider it for future work.

Eastbound buses:

- Can the bus stop be moved to the reserve on the western side of the intersection? Roads and Maritime response: The preference is to have bus stops after intersections, rather than on the approach, in order to reduce travel times and improve intersection performance.

Parking loss

There is the potential for a number of on-street parking spaces to be temporarily removed from the proposal site to facilitate construction works. The extent to which existing on-street parking may be affected during construction of the proposal is yet to be confirmed and would be determined in consultation with neighbouring properties and businesses.

3.4 Ancillary facilities

At least one construction compound would be required for the proposal. The location of the construction compound(s) was not confirmed at the time of preparing this REF. However, two potential sites have been identified and are shown in Figure 3-2. A preferred site compound location would be determined by the construction contractor. If the construction contractor's preferred construction compound(s) differs from the two potential sites identified within this REF then this would subsequently be assessed as an Addendum to this REF. Written approval for use of land for construction compounds would be obtained from the respective landowner(s) prior to construction commencement.

3.5 Public utility adjustment

Consultation with public utility authorities and other relevant asset owners has been carried out as part of the development of the design to identify and locate existing utilities and incorporate utility authority requirements for relocations and/or adjustments. A summary of the consultation carried out for the proposal is provided in Chapter 5 of this REF.

Preliminary investigations have indicated that a number of utilities would require relocation or protection as part of the proposal. An outline of the public utility work anticipated to be required for the proposal is provided in the following sections. This work would be carried out in consultation with the relevant utility authorities.

All utility works would be within the proposal area as shown on Figure 1-2. All subcontractor works would operate under the construction contractor's CEMP.

Figure 3-2
Bells Line of Road/Grose Vale Road intersection upgrade: Potential construction compound locations

3.5.1 Electricity transmission lines

A number of Endeavour Energy assets have been identified within the study area, which include power poles, transmission lines, street lighting and underground electrical cables. The proposed road widening work would require the relocation of six electricity power poles (including the provision of replacement street lighting) at the following locations:

- Three power poles on Bells Line of Road
- One power pole on The Terrace Road
- Two power poles on Grose Vale Road.

Relocated poles will be placed within the road reserve at locations in the footpath, in the general vicinity of those poles that are being replaced. Location of new poles will take into consideration the location of existing property access points (driveways, gates etc.) and the locations of other existing street furniture and infrastructure such as signs, traffic lights, and other underground utilities and services.

The above utility work would be carried out by an Endeavour Energy approved subcontractor prior to the commencement of the main civil construction work.

3.5.2 Water and sewer mains

Water infrastructure in the proposal area is owned and operated by Sydney Water. The proposal would require the relocation or protection of the following Sydney Water assets:

- Two 150 millimetre PVC water mains at the Bells Line of Road/Grose Vale Road intersection would need to be protected and reconnected to accommodate the proposed road cutting at this location
- An existing 200 millimetre water main on Grose Vale Road would need to be relocated to the proposed new footpath location to accommodate the road widening work
- Sydney Water assets located throughout the proposal area would require protection where such utilities are located in close vicinity to construction work.

The above utility work would be carried out by a Sydney Water approved subcontractor prior to the commencement of the main civil construction work.

3.5.3 Gas mains

No gas mains have been identified in the vicinity of the Bells Line of Road/Grose Vale Road intersection (at the time of preparing this REF).

3.5.4 Telecommunications infrastructure

Telstra and Optus assets have been identified within the proposal area. The proposal would require the relocation or protection of the following assets:

- Telstra and Optus cables (including pits) located along the northern side of Bells Line of Road would require relocation to proposed new footpath
- Telstra cables (including pits) located along the northern side of Grose Vale Road would require relocation to proposed new footpath
- Telstra and Optus cables and pits located throughout the proposal area would require protection where such utilities are located in close vicinity to construction work

The above work would be carried out by the relevant asset owner prior to the commencement of the main civil construction works.

3.5.5 Roads and Maritime assets

A number of Roads and Maritime assets have been identified in the study area, which include traffic signals and associated equipment. It is anticipated that a number of Road and Maritime

assets would need to be relocated as part of the proposal. Assets requiring relocation would be determined in consultation with Roads and Maritime during detailed design. Any asset requiring relocation would be assessed and relocated by Roads and Maritime.

3.6 Property acquisition

The proposal would require the acquisition of about 575 square metres of private land involving six properties and six separate landowners. It would also require the acquisition of about 110 square metres of public land (Council-owned public reserve) on the northern corner of Bells Line of Road and Terrace Road.

The majority of the private land to be acquired would comprise strips of residential land. However, one full property acquisition would also be required, affecting a commercial property at 60 Bells Line of Road.

The extent of land acquisition required for the proposal is shown in Figure 3-3, while an overview of all affected properties (including property address, Lot/DP, current land use and proposed area of acquisition) is provided in Table 3-6.

Consultation with relevant land owners commenced on 3 March 2015. All affected property owners would continue to be consulted during the detailed design and construction stages of the proposal. Further discussion on the consultation that has occurred with relevant lands owner is provided in Section 5.2.2.

All land acquisitions would be undertaken in accordance with the provisions of the *Land Acquisition (Just Terms) Compensation Act 1991*.

Table 3-6 Property acquisition requirements for the proposal

Property	Lot/DP	Current land use	Area to be acquired	Full or partial property acquisition
Private land				
2 Grose Vale Road, North Richmond	Lot 1 DP161148	Commercial	233 m^2	Partial
4 Grose Vale Road, North Richmond	Lot 2 DP161148	Residential	63 m^2	Partial
6 Grose Vale Road, North Richmond	Lot 1 DP250109	Residential	67 m^2	Partial
8-10 Grose Vale Road, North Richmond	DP38319	Residential	95 m^2	Partial
60 Bells Line of Road, North Richmond	DP783403	Commercial	75 m^2	Full
64 Bells Line of Road, North Richmond	DP80355	Commercial	42 m^2	Partial

Property	Lot/DP	Current land use	Area to be acquired	Full or partial property acquisition
Sub-total area of acquisition	–	–	***575 m²***	–
Public land				
1 Terrace Road, North Richmond	Lot 1 DP	Public Reserve	110 m²	Partial
Total area of acquisition for the proposal	**–**	**–**	***685 m²***	**–**

Figure 3-3
Property acquisition requirements

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

4 Statutory and planning framework

This chapter provides the statutory and planning framework for the proposal and considers provisions of relevant state environmental planning policies, local environmental plans and other legislation.

4.1 State Environmental Planning Policies

4.1.1 State Environmental Planning Policy (Infrastructure) 2007

State Environmental Planning Policy (Infrastructure) 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State.

Clause 94 of ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. As the proposal is for a road and is to be carried out by or on behalf of Roads and Maritime, it can be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Development consent from Hawkesbury City Council is not required.

The proposal is not located on land reserved under the *National Parks and Wildlife Act 1974* and does not affect land or development regulated by *State Environmental Planning Policy No. 14 – Coastal Wetlands, State Environmental Planning Policy No. 26 – Littoral Rainforests, State Environmental Planning Policy (State and Regional Development) 2011* or *State Environmental Planning Policy (Major Development) 2005.*

Part 2 of the ISEPP contains provisions for public authorities to consult with local councils and other public authorities before the start of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in chapter 5 of this REF.

4.1.2 State Environmental Planning Policy No. 55 – Remediation of Land

State Environmental Planning Policy No. 55 – Remediation of Land (SEPP No. 55) aims to provide for a State-wide planning approach to the remediation of contaminated land. Clause 7 of SEPP No. 55 provides that a consent authority must not consent to the carrying out of any development on land unless:

- It has considered whether the land is contaminated.
- If the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out.
- If the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

As outlined in Section 6.6, it is considered unlikely that any large-scale remediation work would be required as part of the proposal. Any remediation work required for the proposal would be carried out in accordance with SEPP No. 55.

4.2 Deemed State Environmental Planning Policies

4.2.1 Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No. 2– 1997)

Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River (No. 2 –1997) (SREP 20) aims to protect the environment of the Hawkesbury-Nepean River system by ensuring that the

impacts of future land uses are considered in a regional context. SREP 20 applies to land within the Hawkesbury LGA (amongst other LGAs located within the Greater Metropolitan Region).

Clause 4 of SREP provides that the general planning considerations (set out in clause 5), as well as specific planning policies and related recommended strategies (set out in Clause 6) are applicable to proposed developments on land to which this plan applies, and must be taken into consideration:

- By a consent authority determining an application for consent to the carrying out of development on land to which this plan applies.
- By a person, company, public authority or a company State owned corporation proposing to carry out development which does not require development consent.

The proposal is located in proximity to the Hawkesbury River and its tributaries, which forms part of the Hawkesbury-Nepean catchment area. As such, SREP 20 applies to land that would be affected by the proposal. As outlined in Section 6.10, the proposal would not directly impact on primary watercourses or tributaries. Further, as discussed in Section 3.2.3, the proposed improvements to road drainage infrastructure can be accommodated without overloading or exceeding the capacity of the existing stormwater network. Therefore it is considered that the proposed works will not result in any discernible increase in stormwater discharge to the Hawkesbury River (or its tributaries), or any reduction in the quality of stormwater being discharged. As an added precaution, appropriate water quality measures would be adopted during the proposed work to manage any potential impacts to water quality (which would include the implementation of adequate erosion and sediment control measures).

4.3 Local Environmental Plans

The proposal is located entirely within the Hawkesbury LGA. Development within the Hawkesbury LGA is regulated by the *Hawkesbury Local Environmental Plan 2012* (Hawkesbury LEP); however, as outlined in Section 4.1.1, the ISEPP removes the requirement for development consent from councils. The provisions of the relevant LEP zonings within the proposal area are identified in the following sections and shown in Figure 4-1.

4.3.1 Hawkesbury Local Environmental Plan 2012

Land directly affected by the proposal is zoned as follows under the Hawkesbury LEP (refer to Figure 4-1):

- SP2 (Infrastructure; Classified Road).
- R2 (Low Density Residential).
- R3 (Medium Density Residential).
- B1 (Neighbourhood Centre).
- B3 (Local Centre).
- RU1 (Primary Production).

The proposal is permitted with consent within the above land zones; however, as outlined in Section 4.1.1, the ISEPP removes the requirement for development consent.

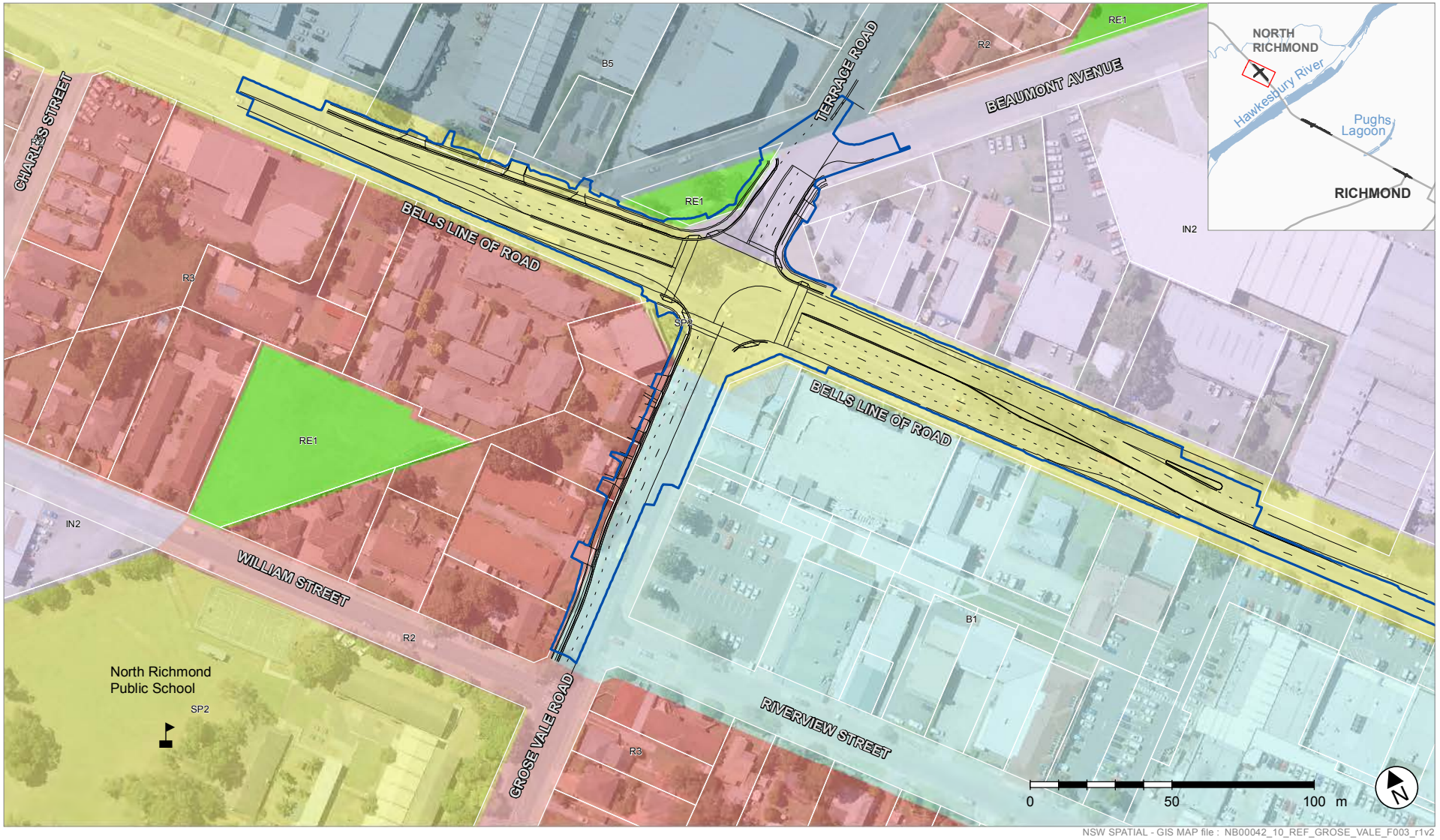

Figure 4-1
Land zoning for the Bells Line of Road/Grose Vale Road intersection study area

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

4.4 Other relevant legislation

4.4.1 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides for the conservation of buildings, work, relics and places that are of historic, scientific, cultural, social, archaeological, architectural, natural or aesthetic significance to the State. Matters protected under the Act include items subject to an Interim Heritage Order and items listed on the State Heritage Register, the heritage schedules of local council LEPs, and the heritage and conservation registers established under Section 170 of the Act by NSW state government agencies (Section 170 Registers). The Act also provides for the protection of archaeological 'relics', being any deposit, object or material evidence that relates to the non-Aboriginal settlement of NSW and is of State or local heritage significance.

Approval under Section 60 of the Act is required for any action that would adversely affect an item that is subject to an Interim Heritage Order or a listing on the State Heritage Register. An excavation permit under Section 139 of the Act is required for activities that will result in or are likely to result in the disturbance or excavation of a 'relic'.

Relics are defined by the Heritage Act as 'any deposit, artefact, object or material evidence that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement; and is of State or local heritage significance'. Archaeological features such as historic public works and services are not considered relics under this definition and, therefore, not subject to the Section 139(4) relics provision of the Heritage Act. Examples of these 'works' include previous road infrastructure features and services like culverts, previous road formation, buried road retaining walls, tramlines, cisterns and conduits.

Heritage items are located within or immediately adjacent to the proposed work at the Bells Line of Road/Grose Vale Road intersection. A description of the heritage assessment, potential impacts and proposed management measures is provided in Section 6.12 and in the Non-Aboriginal Heritage Assessment report in Appendix D.

4.4.2 National Parks and Wildlife Act 1974

The National Parks and Wildlife Act 1974 (NPW Act) is administered by the NSW Office of Environment and Heritage (OEH) and provides for:

- Protection of flora and fauna, including threatened species listed under the TSC Act and protected flora and fauna listed under the NPW Act.
- Protection of Aboriginal sites or remains.
- Reservation of land for protection under the Act, including reservation of National Parks.

Under section 90(1) of the Act, where harm to an Aboriginal object or Aboriginal place cannot be avoided, an Aboriginal Heritage Impact Permit (AHIP) is required. An assessment of the potential impacts of the proposal on Aboriginal heritage has been undertaken and is presented in Section 6.3 of this REF. Impacts on Aboriginal heritage are not expected to occur and an AHIP is not required.

The provisions of the NPW Act relating to protected fauna (Part 7 of the NPW Act) and native plants (Part 8 of the Act), being protected fauna and native plants other than threatened species, populations and ecological communities, do not apply to activities by determining authorities carried out in accordance with Part 5 of the EP&A Act. As such, the provisions of the NPW Act relating the protected fauna and native plants do not to the proposal.

The harming of threatened species, populations and ecological communities is prohibited under section 118A of the Act. However, given that the proposal constitutes an activity by a determining authority under Part 5 of the EP&A Act, section 118A does not apply to the proposal.

4.4.3 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) establishes a process for investigating, managing and remediating contaminated land. The Office of Environment and Heritage (OEH) uses its powers under the CLM Act to regulate any site contamination that poses a significant risk of harm to current or approved land uses. This includes maintaining a register of contaminated sites and determining the remediation requirements. Where contamination is known to be present but does not pose an unacceptable risk to the current or approval land use, management of the contamination and identification of remediation requirements may be dealt with by the local council under the planning and development framework of the EP&A Act.

In preparing this REF, a search of existing nearby registered contaminated sites was undertaken. The results of this search and implications on the proposed works are discussed in Section 6.6.

4.4.4 Threatened Species Conservation Act 1995

The Threatened Species Conservation Act 1995 (TSC Act) aims to conserve threatened species, populations and ecological communities through ensuring appropriate assessment, management and regulation of actions that may damage critical or other habitat for a listed threatened species, or may otherwise significantly affect a threatened species, population or ecological community. Schedules 1, 1A and 2 of the TSC Act lists species, populations and ecological communities that have been identified as being 'endangered', 'critically endangered' and 'vulnerable' to extinction, respectively. If a threatened species, population, ecological community or their habitat could be impacted by an activity, an assessment that addresses the requirements of section 5A of the EP&A Act must be completed to determine the significance of the impact.

An ecological assessment was undertaken to determine the potential impacts of this proposal on threatened species. The results of this assessment are described in Section 6.9.

4.5 Commonwealth legislation

4.5.1 Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) a referral is required to the Australian Government for proposed actions that have the potential to significantly impact on matters of national environmental significance (NES) or the environment of Commonwealth land. These matters of NES are considered in detail in Appendix A and Section 6.9 of the REF.

The proposed works are not considered likely to have any impact on any NES matters or the environment of Commonwealth land, and therefore the proposal does not require referral or assessment under the provisions of the EPBC Act.

4.6 Confirmation of statutory position

Clause 94 of the ISEPP provides that the proposal may be carried out without development consent. The proposal is therefore subject to assessment under Part 5 of the EP&A Act. Roads and Maritime is both the proponent and the determining authority for the purposes of Part 5 of the Act.

The proposal is not likely to impact on any NES matters or the environment of Commonwealth land and a referral to the Commonwealth Department of the Environment is not required.

5 Stakeholder and community consultation

This chapter discusses the consultation undertaken to date for the proposal and the consultation proposed for the future. The description contains the consultation strategy or approach used and the results of consulting with the community, the Aboriginal community and relevant government agencies and stakeholders.

5.1 Consultation strategy

DownerMouchel has prepared a Community Engagement Plan for the proposal. The overall aim of the consultation process for the proposal is to keep the community and stakeholders informed about the proposal and to seek feedback for consideration in the development of the design.

In the delivery of communications on the proposal, the project team aims to:

- Build a positive working relationship with the local community and key stakeholders.
- Promptly investigate and, where possible, resolve issues affecting the community and stakeholders.
- Minimise disruption for residents living next to the work site or to any construction compound.
- Proactively communicate to minimise impacts
- Meet the reasonable needs and desires of the community for information and consideration of their views.

Communication activities will be underpinned by the following key objectives:

- Provide opportunities for stakeholders to be sufficiently informed about the project in a timely manner.
- Provide two-way communication channels and personalised one-to-one contacts to encourage feedback.
- Provide an open, accountable and transparent involvement process which demonstrates how the community and stakeholder input is considered.
- Identify, track and address issues early to implement project controls which minimise further disruption.

Details of the consultation activities that have occurred, or would occur, for the proposal are provided in the following sections.

5.2 Community involvement

5.2.1 Overview of consultation carried out during the Richmond Bridge and Approaches Congestion Study

Broad consultation with respect to the Richmond Bridge and Approaches Congestion Study (which preceded the proposal) has been ongoing since July 2012, and included consultation with the community; Hawkesbury City Council; State MPs for Hawkesbury and Londonderry; Federal MP for Macquarie; Transport for NSW; Heritage Council of NSW; Sydney Catchment Authority; and NSW Department of Planning and Environment.

As outlined in Section 1.1, Roads and Maritime publicly exhibited the *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012) in July 2012. During the exhibition period, Roads and Maritime invited submissions from the community and other project stakeholders to seek community feedback on the Stage 1 proposals, during which 56 written submissions were received. As part of this consultation, Roads and Maritime held a community workshop (on 24 July 2012) and conducted interviews with members of the following local organisations and associations:

- North Richmond District Community Action Association.
- North Richmond Public School.
- Kurrajong Comleroy Historical Society.
- North Richmond Community Centre.
- Hawkesbury Chamber of Commerce (incorporating Richmond and North Richmond).
- Kurrajong/North Richmond Rotary Club.
- Hannapak.
- RAAF.
- Hawkesbury Hospital.
- Hawkesbury Local Area Command.
- Lower Nepean/Hawkesbury Water Users Association (commercial farmers).
- Westbus.

The objective of the interviews was to obtain a snapshot of local concerns and opinion, rather than organisations' endorsed views or position statements, to inform ongoing consultation activities. The questions asked during this initial consultation were also used to inform the community workshop held on 24 July 2012.

The issues raised at the workshop and through written submissions – which are documented in the *Richmond Bridge and Approaches Congestion Study: Community Issues Report* (Roads and Maritime 2012) – were used to inform the short-term and long-term improvements to alleviate traffic congestion on Richmond Bridge and its approach roads.

Further information about consultation that has occurred during the development of the preferred short-term and long-term solutions for the *Richmond Bridge and Approaches strategy is documented in the Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report* (Roads and Maritime 2013) and the *Richmond Bridge and Approaches Congestion Study: Community Issues Report* (Roads and Maritime 2012). These documents (along with other project information) are available on the Roads and Maritime Project website.

5.2.2 Consultation carried out during the preparation of this REF

Table 5-1 provides a summary of the key issues that were raised in community feedback on the proposal, as well as details on where these issues have been addressed in this REF.

Table 5-1 Key issues raised in community feedback on the proposal

Stakeholder	Issue raised	Response
Community	Safety at the Chapel Street intersection needs to be improved with a traffic light, roundabout or no right turn	The objectives of this proposal are to reduce traffic congestion and improve safety in the Richmond and North Richmond areas. Improvements to the Chapel Street intersection are outside of the scope of this proposal, however the work is expected to improve traffic flow, in turn producing wider gaps in traffic which would improve site lines for motorists.
Community	The consultation notification was not distributed to enough people, consultation should also have been advertised in the local newspapers	Roads and Maritime distributed the September 'have your say' notification to 5,000 community members in Richmond and North Richmond, extra copies were left at North Richmond post office and the notification was emailed to emergency services, schools, large businesses, hospitals and community groups in the local area. The November extension of consultation notification was delivered to 5,800 community members in Richmond and North Richmond, extra copies were left at the North Richmond post office and the notification was emailed to emergency services, schools, large businesses, hospitals and community groups in the local area. Roads and Maritime regularly places print advertisements for road work and consultation for major projects, however we do not typically advertise 'have your say' periods for these types of proposals. Media releases were distributed to local newspapers notifying them of the consultation period.

Stakeholder	Issue raised	Response
Community	The short term solutions would not ease congestion, a long term solution (Richmond Bridge duplication) is needed	In 2012 Roads and Maritime published the Richmond Bridge and Approaches Congestion Study report, which identified three key intersections to be upgraded: In February 2013, Roads and Maritime published the Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report, which recommends short-term to 2021 and long-term to 2036 options to address congestion on Richmond Bridge and its approaches. The study assessed traffic movements, considered environmental and heritage issues, safety concerns and the bridge's structural integrity. This work is part of the short-term to 2021 solution. The duplication of Richmond Bridge and provision of four lanes between Richmond and North Richmond is part of the long term solution. Roads and Maritime has assessed the cost to benefit ratio for the proposed short term solutions by considering reduction in travel times and improvements to road safety. This assessment indicates that the short term solutions would result in significant improvements.
Community	A bypass of Richmond and North Richmond should be considered as an alternative to this proposal.	Options that bypass the towns of Richmond and North Richmond were not considered in the Richmond Bridge and Approaches Congestion Study - Preferred Short-term and Long-term Options Report as these will be examined as part of the overall transport planning for the north-west region of Sydney.
Community and Bicycle NSW	Bike lanes are needed in the area and all road upgrades should give regard to road cycling standards	The objectives of this proposal are to reduce traffic congestion and improve safety in the Richmond and North Richmond areas. There are bike lanes in some sections of Kurrajong Road. To limit impacts on private property, further bike lanes were not considered as part of this project. Roads and Maritime is considering the addition of bike lanes as part of its planning for the long term solution for the area. All road upgrades follow road safety standards.

Stakeholder	Issue raised	Response
Community	The loss of parking would result in considerable inconvenience to local residents and businesses	Roads and Maritime must carefully balance the need to provide a road network that facilitates smooth traffic movements whilst accommodating the needs of the local community. In this case, parking has been reduced or restricted for safety reasons and alternate off-street parking is available close by. A parking study was carried out which indicated that the various kerbside parking locations experience variable levels of demand but that overall, at the time of the study the peak demand for all available on-street parking was about 50 per cent, while the overall (average) occupancy of available spaces was less than 25 per cent (see Section 6.2.3 for further discussion of the proposal's potential impact on on-street parking).

Consultation activities were carried out between 25 September 2015 and 29 November 2015. Community members and stakeholders were encouraged to provide their feedback via mail, email or phone contact with the project team. Table 5-2 provides an outline of the key consultation methods that were used for the proposal.

Table 5-2 Consultation activities undertaken for the proposal

Activity	Details
Stakeholder meetings and discussions	The project team has held regular discussions with Hawkesbury City Council and community members who are directly impacted by the proposal through property adjustments. A meeting was held with the North Richmond and District Community Action Association (NRDCAA) at North Richmond Post Office, this was attended by local business owners and the project team on Friday 6 November 2015.Roads and Maritime presented the proposal to Hawkesbury City Councillors on Thursday 26 November 2015.
Have Your Say letter September 2015	• Delivered to 5,000 community members in Richmond and North Richmond. • Emailed to emergency services, schools, large businesses, hospitals and community groups in the local area. Extra copies were left at the North Richmond post office
Extension of Have Your Say letter November 2015	• Delivered to 5,800 community members in Richmond and North Richmond. • Emailed to emergency services, schools, large businesses, hospitals and community groups in the local area. Extra copies were left at the North Richmond post office.
Web page	Details of the proposal were provided on Roads and Maritime Services website and also the NSW Government's community consultation website.
Door knock	The project team doorknocked over 70 properties at the intersection on 2 October 2015. Of the 45 community members reached 8 were supportive, 1 was not supportive, 5 were against loss of parking, and 31 were neutral.

5.3 Aboriginal community involvement

The proposal has been considered against the requirements of the Procedure for Aboriginal Heritage Consultation and Investigation (PACHCI) (Roads and Maritime 2011). This procedure involves the following:

- Stage 1 – an internal Roads and Maritime assessment to determine whether a proposal is likely to affect Aboriginal cultural heritage.
- Stage 2 – a preliminary external assessment with limited stakeholder consultation to determine whether a proposal requires Part 6 approval from the NSW Office of Environment

and Heritage under the National Parks and Wildlife Act 1974.

- Stage 3 – if approval is required, Aboriginal community consultation and investigation.
- Stage 4 – implementation of the assessment process.

As outlined in Section 6.3, Aboriginal cultural heritage impacts are not anticipated as a result of the proposal.

A search of the Aboriginal Heritage Information Management System (AHIMS) database was carried out on 28 May 2014 as part of this REF. The results of this database search confirmed that there are no known Aboriginal heritage sites located within 200 metres of the proposal (however, a total of five Aboriginal sites are located within 1.5 kilometres of the proposal). An Aboriginal heritage due diligence assessment was completed as part of this REF, which concluded that it is unlikely that in-situ sub-surface Aboriginal objects are present within the proposed work area, due to the degree of previous ground disturbance that has occurred within this location.

The Aboriginal Cultural Heritage Adviser for Roads and Maritime Sydney Region has considered the documentation referred to above and has agreed there is no requirement to proceed to Stage 2 of the PACHCI. An Aboriginal Heritage Impact Permit under the *National Parks and Wildlife Act 1974* would not be required for the proposal. A PACHCI clearance letter is provided within Appendix E.

5.4 ISEPP consultation

Part 2 Division 1 of the ISEPP requires consultation with councils for development with impacts on council-related infrastructure or services and/or local heritage; and for development with impacts on flood liable land (that will change flood patterns other than to a minor extent). The consultation requirements must be met before carrying out the subject development and includes giving written notice of the intention to carry out the development and taking into consideration any response to the notification provided by council within 21 days after the notice is given.

While the proposal would not impact on council-related infrastructure or services or flood liable land, the proposal has the potential to impact on local heritage items. A non-Aboriginal heritage assessment for the proposal is provided in Section 6.12 and Appendix D. This assessment concluded that the proposal's impact on non-Aboriginal heritage items would be relatively minor and would be reduced to an acceptable level through the implementation of the general and site-specific mitigation measures documented in Section 6.12.4, which include the mapping of heritage items, heritage awareness training and protocols for unexpected finds of heritage items.

The proposal will have no direct physical impact on any local heritage items (see section 6.12). Therefore, consultation with Hawkesbury City Council under ISEPP in respect of local heritage was not required.

5.5 Government agency and stakeholder involvement

In addition to the consultation activities outlined in 5.2.2, government agency and stakeholder involvement will be ongoing in this project.

5.6 Ongoing or future consultation

5.6.1 Overview of ongoing consultation tools and activities

A Consultation Report (Appendix F) has been prepared. Stakeholders and community members who made comments during consultation activities would receive a response letter and a copy of the Consultation Report.

Consultation would continue to be carried out with potentially affected residents prior to the commencement of, and during works in accordance with the Roads and Maritime's Community Involvement and Communications Resource Manual. Consultation would include but not limited to door knocks, newsletters or letter box drops providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.

Prior to construction the community and identified stakeholders would be notified about any planning out of hours work.

The project infoline and email address would remain in place for the duration of the project and would provide a platform for community members to provide ongoing feedback about the project, including during the construction phase.

A range of engagement tools and activities will be carried out during the planning approval and design phases of the overarching Richmond Bridge and Approaches strategy to provide information to, and receive feedback from, project stakeholders and the local community. Engagement tools and activities that will be employed for the proposal are outlined in Table 5-3. This list will be updated after detailed design to customise the tools required during construction.

Table 5-3 Engagement tools and activities to be carried out for the proposal

Tools and activities	Description	Stakeholder groups
Project Infoline and email	All communication materials will direct enquiries and correspondence to the generic DownerMouchel SMC project communication channels: • Project Infoline: 1800 332 660 • Email: enquiries_nsw@downermouchel.com	All stakeholders
Communicating with community members of non-English speaking background	A foreign languages translation and interpreting service is available for phone enquiries/complaints. Non-English-speaking stakeholders are able to phone a dedicated translation service number to reach a translator who will speak to a member of the Communications team on their behalf. This number will be promoted on key notifications and updates.	Stakeholders from non-English-speaking backgrounds

Tools and activities	Description	Stakeholder groups
Meetings/door-knocks	Meetings or door-knocks will be used: • In circumstances where a discrete section of the community are affected by the work (eg work affecting a particular property) • To deliver information to businesses (eg delivery of project updates) • As required and appropriate as a follow up to a complaint or enquiry.	Residents, businesses and property owners where work is scheduled in close proximity, or those who have made an enquiry or complaint or have requested to be added to the project mailing list
Information tools		
Targeted notifications	Distributed to properties affected by a specific activity, emailed to the distribution list and placed on the project website. This will generally be in the form of a double-sided A4 notice that provides additional information of specific activities and out of hours work listed in monthly notifications.	Stakeholders in close proximity to the work and state MPs
Written correspondence (letters/emails)	Sent to provide personalised information about an upcoming activity or in response to queries/complaints from community stakeholders.	Those who may be directly affected by a work activity or those who have made an enquiry or complaint
Site signage	Fixed and variable message signs will be placed at key locations and road intersections to advise of path and lane closures, traffic management measures.	Road users
Newsletters or Community Updates	Distributed to all the properties in close proximity to the site, to local businesses, to commuters at local stations, nearby bus stops, emailed to the distribution list and placed on the project website. Provide an overview of project progress, upcoming community engagement activities, work planned for the forthcoming period.	Local community including residents, businesses and property owners in the distribution area, and project mailing list, bus commuters.

Tools and activities	Description	Stakeholder groups
Email (distribution list)	Newsletters, notifications and factsheets will be distributed to those residents that opt to go onto the project's email distribution list.	All stakeholders
Contact cards	All members of the project team are issued with project contact cards to distribute to members of the community who approach them for project information. The cards feature the project's Infoline number.	Community members and stakeholders on site
Presentations	Targeted presentations will be developed for specific stakeholder groups, where required (eg community follow up meetings, council and government agency meetings).	Community members and stakeholders that attend presentations
Online tools		
Roads and Maritime Services webpage	Project information will be available online at the Roads and Maritime Services website (www.rms.nsw.gov.au). The website displays copies of key current project notifications and updates, as well as general project information, including key project plans. The website will be regularly updated and the URL will be promoted on all written communications.	All stakeholders
Live Traffic	A report will be provided to Traffic Management Centre to identify upcoming work that will impact road users and/or their journey times. The website will be regularly updated and the URL will be promoted on all written communications.	All stakeholders

5.6.2 Specific consultation activities to be carried out for the proposal

It has not yet been determined whether this REF will be placed on public display. However, stakeholder and community engagement in relation to the proposal will continue. If Roads and Maritime determines to proceed with the proposal, the consultation activities listed in Table 5-4 would be carried out.

Table 5-4 Specific engagement tools and activities to be carried out for the proposal

Activity	Nature and purpose	Audience
Community Engagement Plan (CEP)	Develop and submit a draft Project Specific CEP to Roads and Maritime for review. Any comments will be incorporated and a final version prepared and submitted. Stakeholder identification will be included in this scope.	Roads and Maritime
Consultation with local government	Discuss existing issues and the proposed work with Hawkesbury City Council. Includes organising meetings, minutes of meetings, and follow-up actions, if necessary.	Hawkesbury City Council
Consultation with RMS	Discuss issues relevant to the development phase of the project including budget control, programme and technical direction and reviews associated with the design and environmental impacts. Includes progress meetings and routine email communication.	Contracts Management Office and Technical Reviewers
Consultation with local State MP's	Roads and Maritime to brief the local State Members of the NSW Parliament: Ray Williams MP, Member for Hawkesbury; and Bart Bassett MP, Member for Londonderry, on the work and project and ascertain their feedback. DownerMouchel to help in this consultation.	Ray Williams MP and Bart Bassett MP
Community Updates	Community updates would be issued via the Roads and Maritime website at the start of construction work, and then every two months for the duration of construction. The updates would include project information, project contact details and mechanisms for community and stakeholder feedback.	Local community
"Have Your Say" newsletter	One further 'Have Your Say' newsletter would be issued to inform the community about the start of works and scheduling of night works. The newsletter would include project information, project contact details and mechanisms for community and stakeholder feedback, and details on how to access and comment on the REF.	Local community

Activity	Nature and purpose	Audience
Door-knock	Inform local residents, property owners, and local businesses of the proposed work and feedback mechanisms. Hand out copies of the second Community Update. Door-knock property owners where access is required for project work purposes.	Targeted residents, local businesses, and educational institutions
Advertisement	Ad in the Hawkesbury Gazette and Hawkesbury Courier to advise of project (if required).	Local community
Community Information Sessions (if required)	Provision of relevant information to the local community on the proposal, with feedback mechanisms. One session on a Thursday night, and a second on a Saturday morning, one in Richmond and the other in North Richmond.	Local community
Respond to community enquiries	Timely and informative responses to community enquiries received via DownerMouchel 1800 phone line and project email address, with effective and timely resolution of any complaints to be provided.	Local community

5.6.3 Consultation to be carried out during construction

Should Roads and Maritime determine to proceed with the proposal, the community will be kept informed of project progress and activities that may impact them or the local environment. Activities that would be notified include:

- The start of work in a given location.
- Work outside normal construction hours.
- Work that may create additional noise over an extended period.
- Work that may temporarily change motorist or pedestrian access routes or involve traffic detours.
- Community engagement opportunities.

Notification of the above activities will be made available (as appropriate) by:

- Letterbox delivery of printed notification.
- Personal visits and/or telephone contact from the Communication team members, especially for out-of-hours work.
- Advertisements in area specific local newspapers, where necessary (such as the Hawkesbury Courier and Hawkesbury Gazette).
- Project website and the email distribution list.
- Signage throughout the work site.
- Directional signposting (notifying motorist and pedestrian traffic impacts).
- Variable message signs (notifying motorist and pedestrian traffic impacts).

All construction notifications will include project contact details so that people can seek further information or provide feedback on the project.

6 Environmental assessment

This section of the REF provides an assessment of the potential environmental impacts associated with the construction and operation of the proposal, as well as the environmental safeguards and management measures that are proposed to ameliorate the identified potential impacts.

All matters affecting or likely to affect the environment by the proposal have been considered. This includes consideration of the factors specified in the guidelines *Is an EIS required?* (DUAP 1999) and *Roads and Related Facilities* (DUAP 1996) as required under clause 228(1)(b) of the Environmental Planning and Assessment Regulation 2000. A summary of consideration specified under clause 228(2) of the Environmental Planning and Assessment Regulation 2000 is provided in Appendix A.

6.1 Noise and vibration

A specialist assessment of noise and vibration impacts has been carried out for the proposal as part of this REF. The full impact assessment report is attached as Appendix G and is summarised below.

6.1.1 Existing environment

Study area and surrounding receivers

The Bells Line of Road/Grose Vale Road intersection is located in the commercial centre of North Richmond and is typically characterised by road infrastructure (Bells Line of Road, Grose Vale Road, Terrace Road and Beaumont Avenue) and a variety of single and double-storey residential, commercial and light industrial buildings.

The closest sensitive receivers to the proposal are listed in Table 6-1, while the locations of these receivers are shown in Figure 6-1.

Table 6-1 Closest sensitive receivers to the proposal

Receiver	Receiver type	Distance to closest works
13 Grose Vale Road	Residential	10 metres
1/8-10 Grose Vale Road	Residential	10 metres
12 Grose Vale Road	Commercial	10 metres
4 Grose Vale Road	Residential	8 metres
35 Riverview Street	Commercial	60 metres
77 Bells Line of Road	Residential	23 metres
North Richmond Seventh Day Adventist Church	Place of worship	10 metres
41 Bells Line of Road	Residential	12 metres
Richmond North Public School	Classrooms at schools and other educational institutions	45 metres
46 Bells Line of Road	Commercial	12 metres

Regarding vibration, the nearest affected receivers were identified to be nearby residential and commercial receivers located about eight metres to 15 metres from the proposal (some of which are heritage listed) and the North Richmond Seventh Day Adventist Church, located about 10 metres from the proposed work.

The locations of the nearest sensitive receivers are shown in Figure 6-1.

Background noise monitoring

The quantitative noise assessment method in the Interim Construction Noise Guideline (ICNG) (DECC, 2009) requires an understanding of existing ambient and background noise levels around the proposal site. To address this requirement, long-term continuous noise monitoring was carried out between Friday 20 June and Friday 27 June 2014 at residential premises at 8-10 Grose Vale Road, North Richmond as shown in Figure 6-1. This monitoring location was selected on the following basis:

- The eastbound kerb of Grose Vale Road is subject to proposed widening wherein the road lane(s) would be moved closer to residential receivers. As the location of proposed intensive works, this location was considered to be representative of the worst case scenario for both construction and operational noise
- Most premises in Bells Line of Road (in close proximity to the intersection with Grose Vale Road) are commercial premises which do not require an understanding of background noise levels to assess construction noise
- Residences at 4 or 6 Grose Vale Road (closer to the intersection) would have been preferred as monitoring locations, being closer to the intersection with Bells Line of Road. However at the time that background noise monitoring was being planned, access to these properties for the placement of a noise logger was not granted.

Results from this monitoring are summarised below. It is noted that the terms 'L_{A10}' and 'L_{A90}' are statistical descriptors which describe the noise level exceeded 10 and 90 per cent of the time during the monitoring period respectively. The L_{A90} descriptor is commonly used to define the background noise level. 'L_{Aeq}' is the equivalent continuous sound level or energy-time average for the period of monitoring.

Table 6-2 Measured background noise levels

Monitoring location	Time of day	Background noise levels (dB)		
		$L_{A10\ 15min}$ 50th percentile	$L_{A90\ 15min}$ 10th percentile	$L_{Aeq\ 15min}$
1/8-10 Grose Vale Road	Day	65	53	63
	Evening	64	45	61
	Night	57	30	57

Review of operational noise impacts requires an understanding of different ambient noise descriptors. These are presented below in Table 6-3. The terms L_{Aeq} 15 hr and L_{Aeq} 9 hr are the 15 hour day time and 9 hour night time equivalent road noise levels, where day is considered to be from 7am to 10pm, and night from 10pm to 7am.

Table 6-3 Road Noise Policy traffic noise monitoring results

Monitoring location	Background noise levels dB	
	Day L_{Aeq} 15 hr	Night L_{Aeq} 9 hr
1/8-10 Grose Vale Road	63	57

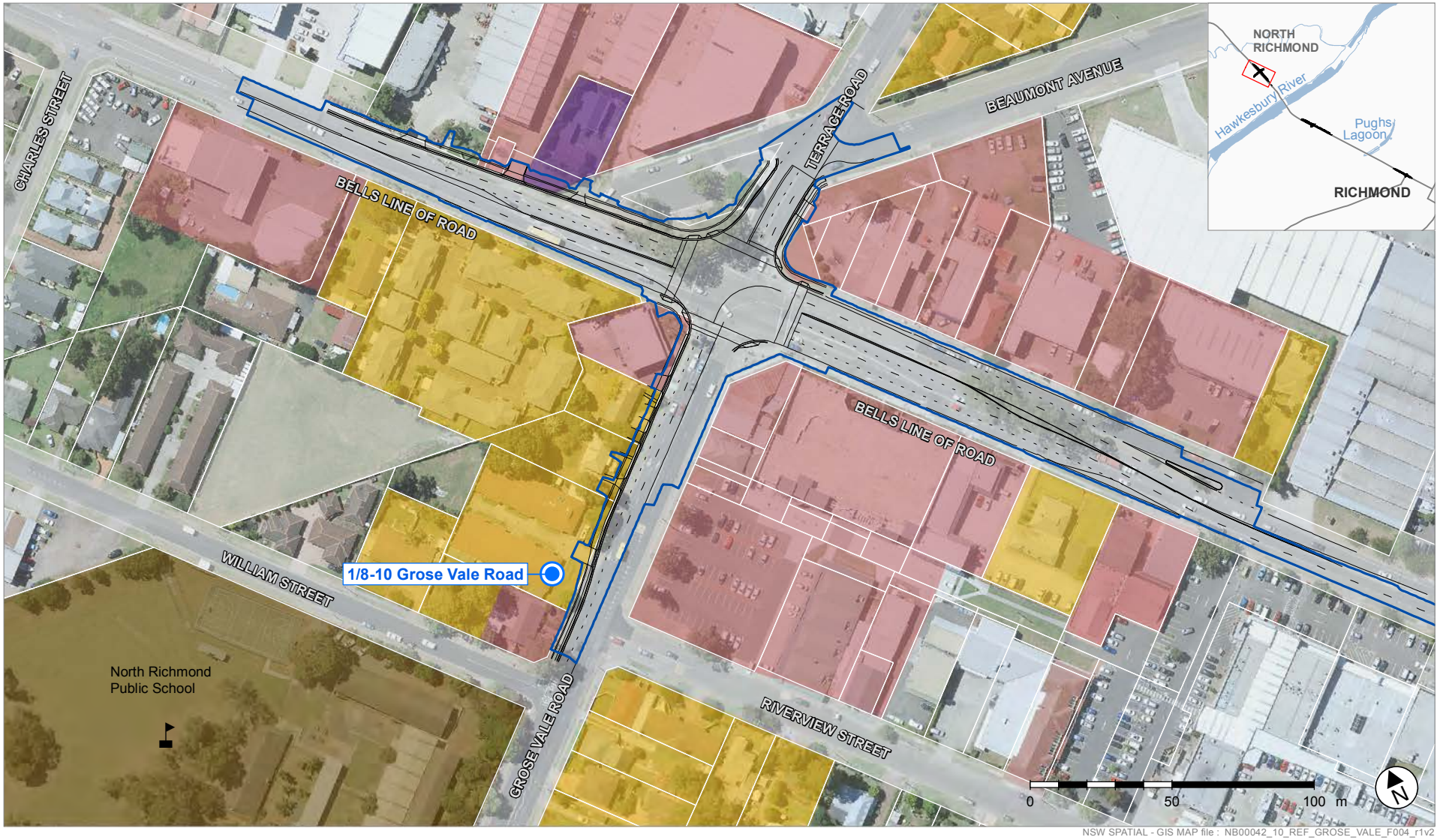

Figure 6-1
Background noise monitoring location and nearest sensitive receivers

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

6.1.2 Criteria

Construction noise criteria

In NSW, noise impacts arising from construction activities are managed in accordance with the ICNG. The guideline has been developed to assist with the management of noise impacts, rather than to present strict numeric noise criteria for construction activities.

The ICNG describes two methods for assessing noise impacts from construction activities; the quantitative method which is suited to noise intensive works and / or proposals running longer than three weeks; and a qualitative method which is suited for minor, short-term (i.e. duration less than three weeks) activities which would occur during standard hours of construction.

Owing to the expected duration of the proposal and the potential for some works being required to be completed outside the standard hours of construction, a quantitative approach was considered for this assessment.

The ICNG recommends establishing noise management levels (NMLs) at receiver locations adjacent to the works, using information on the existing background noise level at these locations. Where the NML may be exceeded as a result of the proposed works and there is potential for adverse noise impacts to occur, appropriate management measures should be implemented.

Table 6-4 details the method for determining NMLs for residential receivers potentially affected by the proposal. Often works that may cause inconvenience within the community (e.g. traffic congestion) or safety concerns are done outside standard hours. NMLs during these periods are presented in the table for works 'Outside recommended standard hours'.

Table 6-4 Construction noise management levels (NML) and working hours

Time of day	NML ($L_{Aeq(15\ min)}$)	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected (Rating Background Level + 10 dB)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The contractor would also inform all potentially impacted residents of the nature of the work to be carried out, the expected noise levels and the duration, as well as contact details.

Time of day	NML ($L_{Aeq(15\ min)}$)	How to apply
	Highly noise affected (75 dB(A))	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1) Times identified by the community when they are less sensitive to noise (such as before and after school for work near schools, or mid-morning or mid-afternoon for work near residences). If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (Rating Background Level + 5 dB)	A strong justification would typically be required for work outside the recommended standard hours. The contractor would apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, Roads and Maritime and/or the contractor would negotiate with the community. For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC 2009).

Source: Table 2 of the *Interim Construction Noise Guideline* (DECC 2009).

Considering this guidance and the measure background noise levels presented above in Table 6-5, the following noise management levels (NMLs) were established to assess and manage noise impacts at surrounding residential receivers during construction.

Table 6-5 Construction NMLs for residential receivers

Receiver type	Noise management level (NML) $L_{Aeq\ 15\ minute}$ dB(A)		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
63	63	50	35

The ICNG also provides guidance for other types of receivers. Recommended management levels for relevant receiver types within the vicinity of the proposal and construction compound areas have been reproduced below. These criteria only apply when such premises are in use.

Table 6-6 Construction NMLs for non-residential receivers

Land use (when in use)	NML dB(A)
Classrooms at schools and other educational institutions (internal)	45 LAeq(15 minute)
Places of worship (internal)	45 LAeq(15 minute)
Active recreation	65 LAeq(15 minute)
Commercial premises	70 LAeq(15 minute)

Vibration criteria

Guidance for limiting vibration levels during construction in Australia is presently informed by the German Standard DIN 4150-3 Structural Vibration Part 3: Effects of vibration on structures [DIN4150-3], (Building and Civil Engineering Standards Committee, February 1999). The following guideline values are provided in DIN 4150-3 for evaluating the effect of short-term vibration on structures. It is noted that exceedance of the values listed below '…does not necessarily lead to damage; should they be significantly exceeded, however further investigations are necessary'.

Table 6-7 Guideline values for evaluation of short-term vibration on structures, (DIN4150-3)

Line vibration level	Type of structure	Guidance values for velocity (mm/s)		
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz*
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10
*At frequencies above 100 Hz, the values listed in the 50 Hz to 100 Hz column may be used as minimum values				

To establish human comfort criteria, *Assessing Vibration: a technical guideline,* (DEC, February 2006) was considered. Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 6-7 for different types of sensitive receivers.

Table 6-8 Acceptable vibration dose values for intermittent vibration (m/s1.75), (BS 6427-2008)

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8
Workshops	When in use	0.8	1.6

Operational (road traffic) noise criteria

The roads subject to this assessment are classified as 'arterial/sub-arterial' roads, in the context of the Road Noise Policy (Department of Environment Climate Change and Water (DECCW) 2011).

Road traffic noise criteria applicable to the proposal are outlined in Table 6-9. Where these criteria are already exceeded, as indicated by the monitoring results displayed in Table 6-2, the objective to reduce the relative increase in noise levels by not more than 2 dB(A) becomes the principle assessment criterion. As such, this criterion was considered for this assessment.

Table 6-9 Road Noise Policy noise assessment criteria

Road category	Type of project/land use	Assessment criteria dB(A)	
		Day (7am to 10 pm)	Night (10pm to 7am)
Freeway/ arterial/ sub-arterial roads	Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	LAeq(15 hr) 60 (external)	LAeq (9 hr) 55 (external)

Source: *Road Noise Policy* (DECCW 2011).

6.1.3 Potential impacts

Construction

Construction noise

Overall sound power levels (SWLs) were predicted for each activity and phase of construction associated with the proposal as described below in Table 6-10

Table 6-10 Typical sound power levels from construction plant and equipment

Construction Activity	Typical plant/equipment used (sound power level)	Sound power level during activity dB(A)
1.Preliminary work Removal of existing concrete road furnishings, redundant signage, pavement and redundant line markings	Jackhammer* (111 dB(A))	108
	Excavator (107 dB(A))	
	Dump truck (101 dB(A))	
	Elevated working platform (89 dB(A))	
	Hand tools (94 dB(A))	
	Asphalt milling machine* (101 dB(A))	
	Line marking removal plant (100 dB(A))	
2.Earthworks Earthworks and pavement sub-grade preparation	Excavator (107 dB(A))	109
	Dump truck (101 dB(A))	
	Water cart (100 dB(A))	
	Grader (100 dB(A))	
	Roller* (105 dB(A))	
	Wacker packer (108 dB(A))	
3.Pavement work Pavement, road furnishings, kerb and drainage	Paver (112 dB(A))	112
	Asphalt truck (93 dB(A))	
	Roller (105 dB(A))	
	Spray sealing equipment (109 dB(A))	
	Road sweeper (100 dB(A))	
4.Final detailing work Line marking and signage installation	Line marking plant (93 dB(A))	101
	Elevated working platform (89 dB(A))	
	Mobile crane (101 dB(A))	
	Concrete truck (103 dB(A))	

To evaluate potential impacts associated with each phase of construction, noise levels were predicted at surrounding receivers based on the distance between source and receiver. Attenuation factors such as air and ground absorption were neglected, as well as corrections for topographical or structural screening. Hence results are conservative.

These results are summarised below in Table 6-11, noting that phases 1, 2, 3 and 4 are as detailed above in Table 6-10. Noise levels exceeding relevant NMLs have been shaded red.

Table 6-11 Predicted construction noise impacts at nearest sensitive receivers

Receiver	Receiver type	Distance	Noise management level for receiver dB(A)			Predicted noise level by phase $L_{Aeq15min}$ dB(A)			
			Day	Evening	Night	1.	2.	3.	4.
13 Grose Vale Road	Residential	10 m	63	50	35	80	81	84	73
1/8-10 Grose Vale Road	Residential	10 m	63	50	35	80	81	84	73
12 Grose Vale Road	Commercial	10 m	70 when in use			80	81	84	73
4 Grose Vale Road	Residential	8 m	63	50	35	82	83	86	75
35 Riverview Street	Commercial	60 m	70 when in use			64	65	68	57
77 Bells Line of Road	Residential	23 m	63	50	35	73	74	77	66
North Richmond Seventh Day Adventist Church	Places of worship	10 m	45 when in use			80	81	84	73
41 Bells Line of Road	Residential	12 m	63	50	35	78	79	82	71
Richmond North Public School	Educational	45 m	45 when in use			67	68	71	60
46 Bells Line of Road	Commercial	12 m	70 when in use			78	79	82	71

As shown in Table 6-11 by the shaded figures, exceedances of the NMLs are predicted to occur most of the nearby assessed receivers. These exceedances would occur during all work carried out during the daytime, evening and night-time periods, with the largest exceedances at residential receivers predicted during earthworks (day time exceedances of up to 21 dB(A) predicted) and pavement work (day time exceedances of up to 23 dB(A) predicted).

The exceedance of noise management levels is due to the small offset distance between construction work and surrounding sensitive receivers, a number of which are located within 15 metres of the proposal. Therefore, it is likely that receivers located in close proximity to the proposal area would experience noise levels that would exceed the ICNG 'highly noise affected' construction noise management level of 75 dB(A).

The predicted exceedances of the noise management levels at the nearest sensitive receivers do not indicate that the proposed work should not be carried out. Rather, the exceedances indicate that all feasible and reasonable work practices should be implemented to reduce noise impacts on these sensitive receivers. Standard and additional noise management measures developed with reference to the guidance presented in the ENMM, ICNG, Construction Noise Strategy 7TP-ST-157/2.0 [CNS], (former Transport for NSW [TfNSW], April 2012) are discussed below in Section 6.1.4.

Construction vibration

The magnitude of impact from vibration-intensive activities is largely dependent on the distance from source to receiver for any given ground type. Considering the distances to receivers from the proposed works (typically 8 to 15 metres) and the vibration-intensive plant and equipment intended to be used (rolling and jackhammering equipment); it was identified that there is the potential for human comfort and cosmetic structural impacts should vibratory rolling techniques be applied.

Where vibration-intensive equipment is used in closer proximity to heritage-listed properties (10 m or closer to closest façade) it was identified that the relevant criterion for building damage could be exceeded.

Mitigation measures to manage these potential impacts are discussed below in Section 6.1.4.

Operation

Operational road traffic noise

Predicted changes in operational road traffic noise were calculated for each of the assessed nearest sensitive receivers using the *Calculation of Road Traffic Noise* (UK Department of Transport 1988). Results of the operational traffic noise modelling for the proposal are provided in Table 6-12.

As shown in Table 6-12, changes in operational traffic noise at the nearest sensitive receivers are predicted to be below the relative increase criterion of more than 2dB(A). As such, there is no trigger for further investigation for noise mitigation measures in accordance with the ENMM.

Similarly, noise levels at the North Richmond Seventh Day Adventist Church (56 Bells Line of Road) are predicted to comply with the applicable road noise assessment criteria of $L_{Aeq(1\ hr)}$ 40 dB(A) (internal). It appears that the most exposed façade of the North Richmond Seventh Day Adventist Church is masonry with a corrugated steel roof. Considering a conservative transmission loss estimate through the façade to the internal space of 30 dB(A), the resulting internal noise levels would be below the recommended internal level.

The removal of roadside vegetation would not increase the road traffic noise as it provides negligible noise reduction. Dense vegetation provides about 1 dB(A) reduction per 10 metres of

dense vegetation, as discussed in the Environmental Noise Management Manual 2001 (RTA, 2001). The change to the human ear would need to be 3 dB(A) to be perceptible.

Table 6-12 Estimated change in sound power levels at the nearest sensitive receivers

Receiver	Distance from traffic flows		Predicted change in sound pressure level (dB(A))
	Existing	Future	
12 Grose Vale Road	10	10	0
13 Grose Vale Road	10	10	0
8-10 Grose Vale Road	10	10	0
6 Grose Vale Road	10	10	0
4 Grose Vale Road	8	6	+1.2
77 Bells Line of Road	23	23	0
63 Bells Line of Road	12	12	0
56 Bells Line of Road (Place of worship)	15	10	+1.8
41 Bells Line of Road	13	12	+0.3
36 Bells Line or Road	21	19	+0.4

Operational vibration

The proposal consists of an activity which currently operates (i.e. a road). As such, operational vibration within the study area is expected to be similar to the existing environment and below perceptible levels at the closest receivers.

6.1.4 Safeguards and management measures

A Construction Noise and Vibration Management Plan (CNVMP) should be developed which incorporates the safeguards and management measures for noise and vibration identified in Appendix G which have been summarised below.

Table 6-13 Mitigation measures

Impact	Environmental safeguards	Responsibility	Timing
Construction noise	• Limit work to standard hours of construction and then daylight hours where possible. Consider implementing respite periods with low noise/vibration-producing construction activities where noisy works continue past 10 pm • Perform noisy work during less sensitive time periods • Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner • Where possible, use quieter and less vibration emitting construction methods • Only have necessary equipment on-site and turn off when not in use • Where possible, concentrate noisy activities at one location and move to another as quickly as possible • Vehicle movements, including deliveries outside standard hours should be minimised and avoided where possible • Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices • Use only the necessary size and powered equipment for tasks • Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms • Where practicable, install enclosures around noisy mobile and stationary equipment as necessary • Locate noisy plant as far away from noise-sensitive plant as possible • Project info-line • Construction response/complaints telephone line	Construction contractor	During construction

Impact	Environmental safeguards	Responsibility	Timing
	• Avoid simultaneous operation of two or more noisy plant close to receivers • The offset distance between noisy plant and sensitive receivers should be maximised • Plan traffic flow, parking and loading/unloading areas to minimise reversing movements • Delivery and loading / unloading of materials should occur as far as possible from sensitive receivers • Select site access points and roads as far as possible from sensitive receivers • Induct all employees, contractors and subcontractors on environmental details of the project including the following with respect to noise: - Standard hours of construction - Any limitations of the use of high-noise plant or equipment - Standard and additional noise mitigation measures to be applied - How to handle complaints or enquiries • Limit loud communications • Avoid dropping materials from height, throwing of metal items or slamming of doors which may generate unnecessary noise • Consult with the affected community prior to construction to identify times when they are less sensitive to noise, and determine whether they are prepared to accept a longer period of construction in exchange for greater restrictions on construction times and increased respite periods • Provide periodic updates on the progress of the project and upcoming works to surrounding receivers		

Impact	Environmental safeguards	Responsibility	Timing
	• A Construction Noise and Vibration Management Plan (CNVMP) would be prepared as part of the CEMP. This plan would include, but would not be limited to, the following: - A map indicating the locations of sensitive receivers including residential properties and vibration sensitive items - Procedures for prior notification of nearby residents in advance of high noise construction activities and work outside of standard hours - Procedure for notifying residents about the program of work, duration of works including high noise activities, noise management and mitigation methods, and complaints procedure - Management measures to minimise potential noise impacts from mobile, high noise construction activities such as concrete cutting - Mitigation measures to avoid noise and vibration impacts associated with truck movements during construction - A process for assessing the performance of the implemented mitigation measures, including a noise and vibration monitoring program for sensitive receivers - A process for documenting and resolving issues and complaints - A process for updating the plan when activities affecting construction noise and vibration change - Identify in toolbox talks where noise and vibration management is required - Implement EPA Interim Construction Noise Guidelines (DECCW 2009).		

Impact	Environmental safeguards	Responsibility	Timing
Construction vibration	• Wherever possible, adhere to recommended safe setback distances as detailed in the CNS • Where these distances need to be encroached, conduct detailed inspections including the preparation of a written and photographic report to document the structural condition prior to and after the completion of the activities. Complete monitoring vibration monitoring during the works to verify that cosmetic building and human comfort criterion are not being exceeded • Scale back or suspend vibration-intensive works in response to vibration-related complaints until verification can be completed to determine whether criteria are being exceeded • Make good any vibration-related damages which arise during construction.	Construction contractor	During construction
Construction vibration	• Provide prior notification of any vibration-intensive works to surrounding receivers.	Construction contractor	Prior to and during construction

Regarding construction noise, the recommendations from the CNS for additional mitigation where impacts persist after the implementation of the standard measures recommended above should also be considered as necessary.

Table 6-14 CNS additional mitigation measures

Time period		Mitigation measures			
		L_{Aeq}(15 minute) noise level above background RBL (Qualitative assessment)			
		0 to 10 dB(A) (Noticeable)	10 to 20 dB(A) (Clearly audible)	20 to 30 dB(A) (Moderately intrusive)	> 30 dB(A) (Highly intrusive)
Standard	Mon-Fri (7am-6pm)	-	-	LB,M	LB,M
	Sat (8am-1pm)				
	Sun/Pub Hol (Nil)				
OOHW Period 1	Mon-Fri (6pm-10pm)	-	LB	M,LB	M,IB,LB,RO,PC,SN
	Sat (7am-8am)				
	Sun/Pub Hol (8am-6pm)				
OOHW Period 2	Mon-Fri (10pm-7am)	LB	M,LB	M,IB,LB,PC,SN	AA,M,IB,LB,PC,SN
	Sat (10pm-8am)				
	Sun/Pub Hol (6pm-7am)				

Time period	Mitigation measures			
	L_{Aeq}(15 minute) noise level above background RBL (Qualitative assessment)			
	0 to 10 dB(A) (Noticeable)	10 to 20 dB(A) (Clearly audible)	20 to 30 dB(A) (Moderately intrusive)	> 30 dB(A) (Highly intrusive)

Key

LB – Letterbox drop
M – Monitoring
IB – Individual briefings
RO – project specific respite offer
PC – Phone calls
SN – Special notification
AA – alternative accommodation

Note: the mitigation measures in Table 4-6 are based on noise in excess of the RBL rather than the NML, which are the assessment criteria for this study. For quick comparison, subtract 10 dB(A) for standard time and 5 dB(A) for OOHW periods.

Considering the predicted noise levels at receivers around the proposal area, the following additional mitigation measures are also likely to be required during construction:

During standard hours of construction at nearby residential receivers -

- Noise verification measurements to determine actual noise levels at receivers against those predicted in this assessment
- Provision of advanced warning notifications to potentially affected residences to advise them of potential disturbances at least five days prior to the commencement of works
- Provision of additional respite periods
- Targeted consultation with each potentially affected receiver.

During standard hours of construction at nearby non-residential receivers -

- Provision of advanced warning notifications to advise of potential disturbances at least five days prior to the commencement of works

Outside standard hours of construction -

- All of the measure detailed above
- Provision of additional respite periods (if agreeable with the potentially affected receivers)
- Provision of short-term accommodation will be considered for acutely affected receivers on a case-by-case basis, where the noise levels are verified to be greater than 30dBA above the night time NML and is considered to be having a significant sleep disturbance impact.

6.2 Traffic, transport and access

Detailed traffic modelling and investigations for the Richmond Bridge and Approaches strategy were previously carried out as part of the *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012) the *Richmond Bridge and Approaches Congestion Study – Long-term Options Report* (Roads and Maritime 2012), and the *Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report* (Roads and Maritime 2013).

The following sections provide a desktop traffic, transport and access assessment for the proposal, based on a review of the above documents and other publicly available information, including aerial photographs of the study area.

6.2.1 Methodology

Study area

The study area that was adopted for the *Richmond Bridge and Approaches Congestion Study – Stage 1* (Roads and Maritime 2012) and the *Richmond Bridge and Approaches Congestion Study – Preferred Short-term and Long-term Options Report* (Roads and Maritime 2013) is shown in Figure 1-1 and was broadly defined as the sections of Old Kurrajong Road and Bells Line of Road located between March Street/Bosworth Street (to the south-east) and Grose Vale Road/Terrace Road (to the north-west).

The study area adopted for the previous traffic assessments included the Bells Line of Road/Grose Vale Road (which is the subject of this REF) and March Street/Bosworth Street intersections and, therefore, is applicable to the current proposal.

Previous traffic surveys carried out for the Richmond Bridge and Approaches strategy

Traffic surveys carried out for the previous stages of the Richmond Bridge and Approaches strategy comprised the following:

- Stage 1 (June 2011) – Mid-block tube counts carried out on Richmond Bridge for a duration of one week; as well as intersection turning counts at 12 key intersections during the morning and evening peak periods. These traffic surveys were carried out during normal traffic conditions when no road closures were in place.
- Stage 2 (July 2011) – Intersection turning counts carried out at Kurrajong Road/Old Kurrajong Road and March Street/Bosworth Street during the morning and evening peak periods. Queue length surveys were also carried out for the March Street/Bosworth Street intersection. These traffic surveys were carried out during a closure of Old Kurrajong Road (closed for road resurfacing between 18 July 2011 and 15 August 2011) with collected traffic data used as a sensitivity check during the traffic modelling process.
- Stage 3 (August 2011) – Intersection turning counts and queue length surveys carried out at Bells Line of Road/Charles Street, Lennox Street/Bourke Street and Windsor Street/Bourke Street during the morning and evening peak periods. These traffic surveys were carried out during normal traffic conditions when no road closures were in place.

Assessment of intersection performance

Level of service (LoS) is a qualitative measure used to assess the efficiency of an intersection. The assessment of intersection performance is based on the criteria outlined in Roads and Maritime's *Guide to Traffic Generating Developments* (RTA 2002) and summarised in Table 6-15.

As shown in Table 6-15, LoS ranges between A and F, with the 'average delay per vehicle' (seconds) at signalised intersections being assessed as the average vehicle delay experienced for all traffic movements at that intersection.

Table 6-15 Level of service criteria for intersections

Level of service	Average delay per vehicle (seconds)	Traffic signals	Roundabout, giveway and stop signs
A	Less than15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity

Level of service	Average delay per vehicle (seconds)	Traffic signals	Roundabout, giveway and stop signs
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause delays	At capacity, requires other control mode
F	Greater than 70	Demand exceeds capacity. Unstable traffic flow. Extra capacity required.	Extreme delay, traffic signal or other major treatment required

Source: *Guide to Traffic Generating Developments* (RTA 2002).

6.2.2 Existing environment

Road network

A detailed description of the key roads and intersections within the study area is provided in Section 2.2, with the main features of relevance to the current proposal provided in Table 6-16.

Table 6-16 Key features of the existing road network

Road	Description
Bells Line of Road[1]	Bells Line of Road comprises a single carriageway with one lane in each direction for the majority of its length. Within the study area, Bells Line of Road is within North Richmond and has a posted speed limit of 60 kilometres per hour. Bells Line of Road has a signalised intersection with Grose Vale Road/Terrace Road. Right-turn bays are provided into Grose Vale Road and Terrace Road, with lengths of around 40 metres and 58 metres (including taper), respectively. A left-turn lane of around 130 metres is provided into Grose Vale Road. A second departure lane of about 170 metres is provided on Bells Line of Road, southeast of its intersection with Grose Vale Road and Terrace Road. A channelised giveway controlled intersection is located at Bells Line of Road and Pitt Lane. A left-turn lane of around 155 metres and a right-turn bay of around 70 metres are provided from Bells Line of Road into Pitt Lane.
Grose Vale Road[1]	Grose Vale Road is a two-way, two-lane configuration for the majority of its length. At its signalised intersection with Kurrajong Road/Bells Line of Road, it consists of two lanes in each direction, including a dedicated right-turn lane onto Kurrajong Road. Grose Vale Road has a posted speed limit of 60 kilometres per hour with a school zone commencing around 70 metres southwest of the intersection with Kurrajong Road.
Bells Line of Road/Grose Vale Road intersection[2]	The intersection of Bells Line of Road and Grose Vale Road is a four-leg signalised intersection, with signalised pedestrian crossings at all approaches. During the morning peak, traffic flow through the intersection from the western and southern approaches is often affected by slow moving queues of vehicles travelling eastbound on Bells Line of Road. Bells Line of Road, east of Grose Vale Road, has two existing lanes; however, the road narrows to one lane further to the east. Vehicles on the kerbside lane are currently required to merge into one lane. This downstream merging has some effect in slowing down vehicles. A significant volume of traffic (about 500 vehicles per hour) has been observed to use Pitt Lane travelling along Riverview Street and then turn left into Grose Vale Road. This is often due to delays at the Bells Line of Road/Grose Vale Road intersection.

Road	Description
Kurrajong Road[1]	Kurrajong Road comprises a single carriageway with one lane in each direction for the majority of its length. It has a posted speed limit of 60 kilometres per hour from around 300 metres south-east of its intersection with Old Kurrajong Road to North Richmond and a posted speed limit of 80 kilometres per hour from around 300 metres south-east of its intersection with Old Kurrajong Road to Richmond. Kurrajong Road continues into March Street (southeast from its intersection with Chapel Street) and Bells Line of Road (north west from the northern side of Richmond Bridge). The intersection of Kurrajong Road and Chapel Street is a four-way, giveway-controlled intersection with all movements allowed. The intersection of Kurrajong Road and Old Kurrajong Road is a four-way, giveway-controlled intersection with all movements allowed.

Note 1: Source: Table 6 (Description of existing road network) of the Richmond Bridge and Approaches Congestion Study – Long-term Options Report (Roads and Maritime 2012c).

Note 2: Source: Richmond Bridge and Approaches Congestion Study – Traffic Analysis Report (Hyder Consulting Pty Ltd 2012).

Existing peak hour traffic volumes

Existing (2011 data) morning and evening peak hour traffic volumes on key roads in the study area are shown in Table 6-17. The data in Table 6-17 show that:

- The highest two-way traffic volume in the study area occurs on Bells Line of Road at Richmond Bridge. In 2011, the bridge carried about 2,150 to 2,250 vehicles per hour in the morning and evening peaks, respectively. Eastbound traffic was highest in the morning peak and westbound traffic was highest in the evening peak.
- Kurrajong Road west of Bosworth Street showed the second highest two-way flow in the study area, carrying about 1,400 to 1,500 vehicles per hour in the morning and evening peaks, respectively. Eastbound traffic was highest in the morning peak and westbound traffic was highest in the evening peak.

Table 6-17 Existing peak hour traffic volumes (for 2011)

Road	Morning peak hour		Evening peak hour	
	Direction	Vehicles per hour	Direction	Vehicles per hour
Bells Line of Road, Richmond Bridge	Eastbound	1,537	Eastbound	917
	Westbound	635	Westbound	1,333
Bells Line of Road, west of Grose Vale Road	Eastbound	899	Eastbound	595
	Westbound	389	Westbound	741
Kurrajong Road, west of Bosworth Street	Eastbound	942	Eastbound	652
	Westbound	489	Westbound	855

Source: Richmond Bridge and Approaches Congestion Study – Stage 1 (Roads and Maritime 2012).

Intersection performance

The performance of key intersections in the study area was assessed as part of the *Richmond Bridge and Approaches Congestion Study – Traffic Analysis Report* (Hyder Consulting Pty Ltd 2012) using SIDRA Intersection. SIDRA Intersection is a micro-analytical tool for the evaluation of intersection performance mainly in terms of capacity, Level of Service (LoS) and a wide range of other performance measures such as delay, queue length and stops for vehicles and pedestrians, as well as fuel consumption, pollutant emissions and operating cost. It can be used as an aid for design and evaluation of fixed-time/pre-timed and actuated signalised intersections, signalised pedestrian crossings, signalised single point interchanges, roundabouts, roundabout metering, two-way stop sign control, all-way stop sign control, and giveway/yield sign-control.

Results of the intersection performance assessment (existing intersection performance) for key intersections in the study area are provided in Table 6-18. In the context of the current proposal, it is generally accepted that in the long-term (15 years plus) LoS at key road intersections should be LoS D or better, while in the short-term, intersections should be operating at LoS C or better.

Table 6-18 Existing intersection performance (for 2011)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Bells Line of Road / Grose Vale Road / Terrace Road	C	38	C	39
Bells Line of Road / Charles Street	B	27	A	13

Source: Roads and Maritime, Richmond Bridge and Approaches Congestion Study Stage 1 summary report Volume 2 Appendix 4, 2012, pp.5-8

On-street parking

Existing on-street parking provisions within the study area are shown in Figure 6-2 and outlined in Table 6-19.

Table 6-19 Existing on-street parking provisions

Road	Description
Bells Line of Road	About 30 metres of quarter-hour parking (9am to 6pm) is located along southern kerb of Bells Line of Road, about 130 metres to the east of the Grose Vale Road intersection and next to commercial businesses fronting onto the road corridor. A large number of nearby off-street car parking spaces (2-hour) are provided in the North Richmond Village shopping centre carpark. About 90 metres of one hour parking and 25 metres of ¼ hour parking is also available along the northern side of Bells Line of Road, about 80 metres to the east of the Grose Vale Road intersection. This parking is located along a local access lane for the nearby commercial developments and is separated from the eastbound lane of Bells Line of Road by a vegetated island. Additional parking spaces are provided in this area in off-street parking bays. No on-street parking is available to the west of the Grose Vale

Road	Description
	Road intersection
Grose Vale Road	About 70 metres of half-hour parking (8.30am – 6pm Monday to Friday and 8.30am – 12pm on Saturdays) is located along the eastern kerb of Grose Vale Road, about 10 metres to the south of the Bells Line of Road intersection. A large number of additional parking spaces are located in an off-street carpark for the adjoining shopping centre. An existing clearway is in place along the western kerb of Grose Vale Road between Bells Line of Road and William Street. This clearway is in operation between 6am and 6pm, Monday to Friday and between 6am and 12pm on Saturdays, with unrestricted parking permitted at all other times.
The Terrace Road	Unrestricted parking is available at all times of the day along both the eastern and western kerbs of The Terrace Road, north of the Beaumont Avenue intersection.

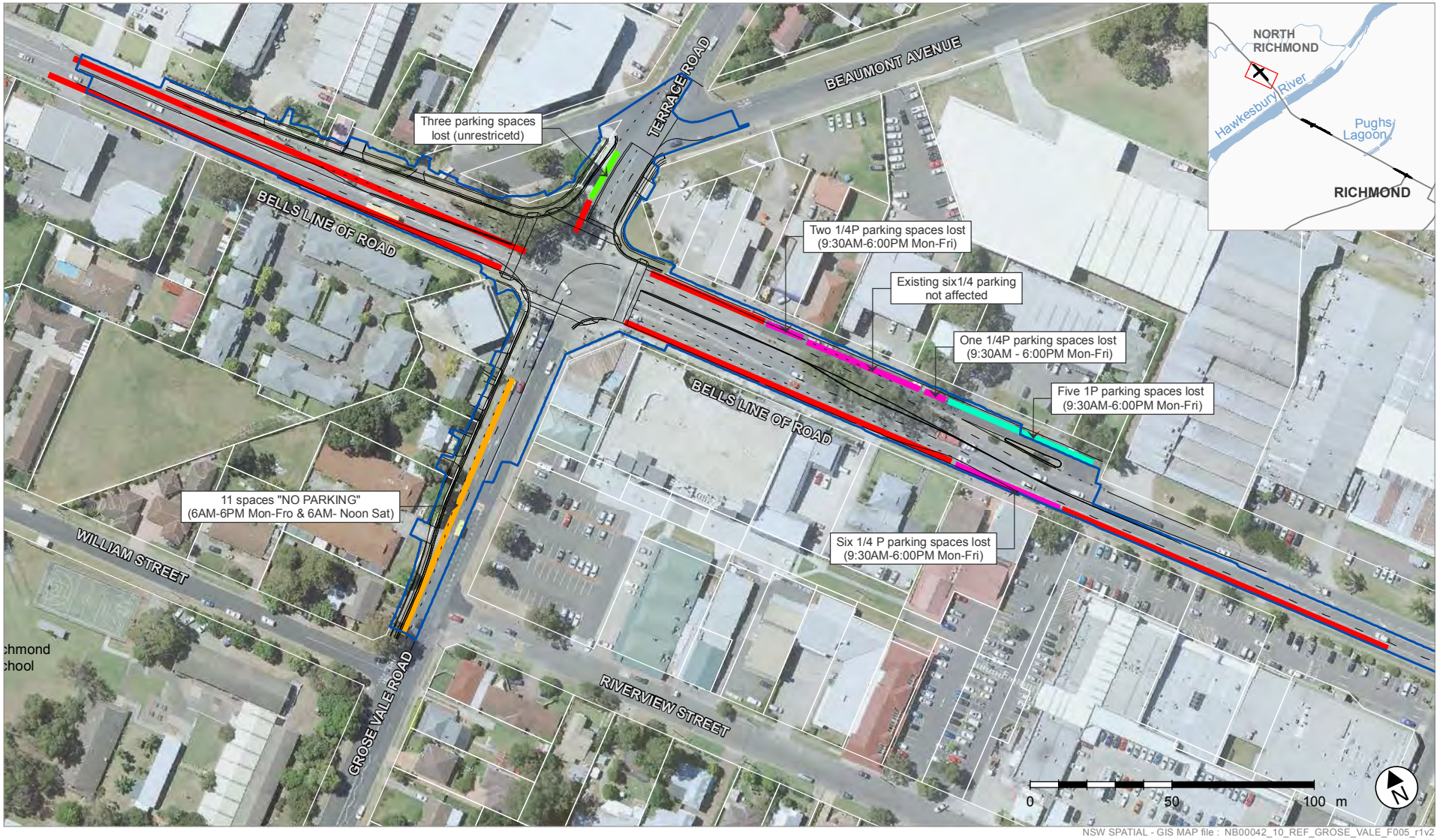

Figure 6-2
Locations of existing on-street parking provisions

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

Public transport

Bus routes

Three regular bus routes currently operate in the proposal area. These bus routes are outlined in Table 6-20. In addition to the bus routes listed in Table 6-20, a NightRide bus route (route N71) also operates between Richmond and Town Hall on Fridays, Saturdays, Sundays and public holidays.

Table 6-20 Regular bus routes in the study area

Bus route (Operator)	Roads used in study area	Buses per weekday (bi-directional)
668 – Richmond to Windsor via North Richmond, Glossodia and Wilberforce (Busways)	East Market Street, Windsor Street, Bosworth Street (services from Richmond), Chapel Street (services to Richmond), Kurrajong Road, Bells Line of Road, Terrace Road	8
680 – Richmond to Kurrajong via Grose Vale, Grose Wold and Bowen Mountain (Busways)	East Market Street, Windsor Street, Bosworth Street (services from Richmond), Chapel Street (services to Richmond), Kurrajong Road, Bells Line of Road, Terrace Road	10
682 – Richmond to Kurrajong via Bells Line of Road (Busways)	East Market Street, Windsor Street, Bosworth Street (services from Richmond), Chapel Street (services to Richmond), Kurrajong Road, Bells Line of Road, Terrace Road	18

Source: Transport for NSW, Maps & timetables, 2014, retrieved June 18 2014 from Transport for NSW: http://www.transportnsw.info/en/maps-and-timetables/index.page?#bus-status-updates-item-tab

Bus stops

There are three bus stops located in the vicinity of the proposal. Details of these bus stops are provided in Table 6-21. The majority of the bus stops located in the study area comprise sign-posted kerbside spaces with no formalised bus shelters or seating.

Table 6-21 Bus stops located in the vicinity of the proposal

Bus stop number	Bus stop description	Location	Bus routes served
275455	Brick bus shelter with seating	Northern kerb of Bells Line of Road about 90 metres east of Grose Vale Road	668, 680, 682
275419	Sign posted bus stop with no shelter or seating	Southern kerb of Bells Line of Road, about 200 metres east of Grose Vale Road	668, 680, 682

Bus stop number	Bus stop description	Location	Bus routes served
275466	Sign posted bus stop with no shelter or seating	Eastern kerb of Grose Vale Road, about 80 metres west of Bells Line of Road	680

Heavy rail services

The nearest railway station is at Richmond, located at the eastern end of the study area. Richmond is the terminating station on the Richmond branch of the T1 North Shore, Northern and Western Line. There are 38 weekday services departing from Richmond and 40 weekday services arriving at Richmond.

Pedestrian facilities

Pedestrian facilities within the study area consist of the following:

- The Bells Line of Road/Grose Vale Road intersection, which provides a signalised pedestrian crossing across all approaches.
- A pedestrian footpath on the northern side of Bells Line of Road between about 160 metres west of Pitt Lane and Grose Vale Road.
- A pedestrian footpath on the southern side of Bells Line of Road between about 35 metres east of Pitt Lane and Grose Vale Road.
- A pedestrian refuge on the northern kerb of Bells Line of Road, about 70 metres west of Pitt Lane.

With the exception of a formalised pedestrian footpath on the southern side of Richmond Bridge, there are no pedestrian facilities along Bells Line of Road between the Richmond Bridge and Pitt Lane.

Cyclist facilities

The bicycle network in the study area contains a mixture of off-road and on-road facilities, which include:

- An on-road cycle route on Bells Line of Road between the Richmond Bridge and Grose Vale Road (high difficulty cycling route).
- An off-road shared path running through Hanna Park and Hawkesbury Park, located next to the western side of the Hawkesbury River.
- An off-road shared path located on the southern side of the Richmond Bridge.

Property access

Properties with direct access onto roads affected by the proposal are summarised in Table 6-22.

Table 6-22 Properties with direct access onto roads affected by the proposal

Property	Current land use	Property access location(s)
64 Bells Line of Road, North Richmond	Commercial	Bells Line of Road
58 Bells Line of Road, North Richmond	Commercial	Bells Line of Road
52 Bells Line of Road, North Richmond	Other	Grose Vale Road
2 Grose Vale Road, North Richmond	Commercial	Grose Vale Road
4 Grose Vale Road, North Richmond	Residential	Grose Vale Road
6 Grose Vale Road, North Richmond	Residential	Grose Vale Road

Property	Current land use	Property access location(s)
8-10 Grose Vale Road, North Richmond	Residential	Grose Vale Road

Road crash history

A review of recent crash history data for the Bells Line of Road/Grose Vale Road intersection indicated that a total of 16 crashes were recorded at this location between 1 July 2003 and 30 June 2013. These included eight injury crashes (resulting in 11 people being injured) and eight non-casualty crashes (ie those crashes not resulting in an injury). No fatalities were recorded at this location between 1 July 2003 and 30 June 2013.

6.2.3 Potential impacts

Construction

The proposed construction activities are outlined in Section 3.3. Construction related impacts of the proposal would be associated with carrying out some short-term work under traffic control or lane closure (eg during traffic switches, barriers work and asphalt overlay work). An assessment of potential construction traffic, transport and access impacts associated with the proposal is provided in the following sections.

Construction traffic volumes

Construction is anticipated to start in mid to late 2016, with anticipated completion by the end of 2017. Construction traffic comprising light vehicles, haulage trucks, concrete trucks and delivery trucks would lead to a temporary increase in traffic along haulage routes (which are anticipated to include Bells Line of Road, Kurrajong Road, Castlereagh Road, Londonderry Road, Blacktown Road, Richmond Road, The Northern Road and Hawkesbury Valley Way).

As outlined in Section 3.3.6, it is anticipated that during normal working days five to ten heavy vehicle and five to ten light vehicle movements would be required per day on and off-site. These construction traffic movements would be relatively low compared to existing traffic volumes, as outlined in Table 6-17.

Therefore, construction of the proposal is not anticipated to result in significant impacts to the performance of the existing road network. Notwithstanding, where road network performance is likely to be reduced beyond an acceptable level, traffic management measures would be developed and implemented by the construction contractor to minimise the proposal's impact.

Haulage routes

Designated access routes for construction vehicles would typically be along the arterial road network; however, there is the potential for some vehicle movements to occur on local roads. Details of all routes used for access and haulage during construction would be contained in Construction Traffic Management Plans upon confirmation of quarry and material supplier locations. Roads that would likely be used for access and haulage include Bells Line of Road, Kurrajong Road, Castlereagh Road, Londonderry Road, Blacktown Road, Richmond Road, The Northern Road and Hawkesbury Valley Way.

Road pavement surveys would be carried out for any local roads that are proposed to be used for vehicle haulage during the construction of the proposal. The construction contractor would make good any damage caused to existing road pavements that are a direct result of the proposal.

Construction site access

Access points to construction areas, compounds and stockpile areas would be required to facilitate construction activities. All access points would have safe intersection sight distances, would be

able to accommodate the turning movements of the largest heavy vehicles, and where possible provide for left-in/left-out only movements.

Impact on traffic flows

Construction of the proposal is anticipated to result in delays for other road users due to traffic lane closures, the implementation of roadwork speed limits and/or when manual traffic control is in operation to facilitate the movement of construction vehicles into and out of work areas. Delays for other road users would also likely occur during the integration of the newly constructed sections of road with the existing road network. This work would generally be scheduled to occur outside of the morning and evening peak periods to minimise potential traffic impacts.

Traffic delays that may occur as a result of construction would be managed under a Traffic Management Plan. Before the start of construction, the construction contractor would develop detailed Construction Traffic Management Plans and Traffic Control Plans to ensure the safe and efficient movement of traffic through the worksite.

Bus routes and services

There would be minimal disruption to existing bus routes during construction of the proposal, as vehicular access would be maintained along all roads. However, bus services travelling along affected roads would be subject to minor delays and increased travel times as a result of increased congestion at intersections due to the implementation of roadwork speed limits and/or short-term traffic control.

In addition to the above delays, the construction of the proposal would impact on the following two bus stops:

- Bus stop number 275455 – The proposal would require the permanent relocation of this bus stop (comprising a brick shelter with seating), which is currently situated on the northern kerb of Bells Line of Road about 90 metres east of Grose Vale Road. An alternate location for this bus stop was identified and communicated to stakeholders in the 'Have Your Say' newsletter distributed in November, 2015. The proposed new bus stop location is beside the kerb approximately 90 metres further to the east from the existing location, adjacent to the North Richmond Business Park at 30 Bells Line of Road.
- Bus stop number 275419 – The proposal would require the modification of this bus stop, which is located on the southern kerb of Bells Line of Road about 200 metres east of Grose Vale Road, to accommodate an additional dedicated northbound lane. The extent to which this bus stop (a kerb-mounted sign only, with no shelter or seating) would need to be modified is yet to be confirmed and would be determined in consultation with Transport for NSW and Busways. Where access to this bus stop cannot be maintained during construction, a temporary bus stop would be installed, in consultation with Busways. The existing bus stop would be reinstated at the completion of construction. Adjacent neighbouring properties and businesses would be consulted about the proposed bus stop modification and any proposed temporary relocation of this stop.

Pedestrians and cyclists

During construction, the proposal would require the road shoulders and/or kerbside traffic lanes on approach to the Bells Line of Road/Grose Vale Road intersection to be narrowed. This work has the potential to impact on cyclist movements in the proposal area, as cyclists travelling along the affected roads would need to move further into the adjacent traffic lane in order to travel around the construction worksite.

As outlined in Section 6.2.2, cyclist provisions within the study area comprise moderate to high difficulty on-road cycle routes running along Bells Line of Road and Grose Vale Road. Therefore, cyclists using these roads are already likely to be sharing the existing traffic lanes with other vehicles and would likely be experienced in interacting with passing motor vehicles. The potential provision of a reduced roadwork speed limit would potentially help cyclists to progress through the work areas with traffic.

Pedestrian traffic has the potential to be temporarily disrupted during the construction of the proposal, particularly in situations where footpath realignments are required to accommodate the proposed road widening work. Safe pedestrian access around the work site would need to be provided by the construction contractor and captured within the traffic management plan.

Emergency vehicle access

Emergency vehicle access would be maintained at all times for the duration of construction. Emergency services would be consulted about the proposal before the start of construction to advise of the upcoming work and any potential changes to access.

Access to private property

As outlined in Table 6-22, a number of properties currently have direct access onto roads that would be affected by the proposal. These accesses have the potential to be temporarily disrupted by the proposal during road widening work. Construction of the proposal would need to be carried out in such a way so as to maintain access to these properties. A strategy for maintaining access to private property would be developed by the construction contractor, in consultation with the affected land owner.

Where temporary, short-term disruptions to property access are unavoidable, the land owner would be adequately consulted about the timing and duration of the scheduled conflicting work. Any disruptions to property accesses would be short in duration and would be by agreement with affected land owners.

On-street parking

The proposal has the potential to temporarily reduce the supply of on-street parking spaces during road widening work. The extent to which existing on-street parking may be affected during construction of the proposal is yet to be confirmed and would be determined in consultation with neighbouring properties and businesses.

The loss of on-street parking has the potential to temporarily affect the accessibility of surrounding residential properties and local businesses, particularly in situations where sufficient alternative parking provisions are not located nearby. The demand (ie how many vehicles park in the area) and rate of turnover (ie how long each vehicle is parked in the area) for the affected on-street parking spaces was investigated in a parking study undertaken by Jacobs on behalf of Roads and Maritime in 2015 (see assessment of operational impacts below for further details). However, while parking impacts would be greatest in those locations where unrestricted parking spaces are removed, there is a good supply of existing off-street parking in and around the North Richmond shopping centre including the North Richmond Shopping Village and the Aldi Supermarket centre, most of which is 2-hour (or longer) unrestricted parking.

Construction parking impacts would be managed through measures identified in the Traffic Management Plan. Where appropriate, neighbouring property owners and businesses would be consulted about any proposed loss of on-street parking prior to its removal.

To minimise the proposal's impact on the existing parking supply within the study area, the parking of light construction vehicles (eg staff vehicles) would be restricted to designated areas within the proposed construction compounds, wherever possible.

Operation

Road network performance

As outlined in Section 1.1.2, the proposal forms part of the preferred short-term solution for the broader Richmond Bridge and Approaches strategy to alleviate traffic congestion on Richmond Bridge and its approach roads.

The preferred short-term solutions for the Richmond Bridge and Approaches strategy are predicted to result in improved eastbound and westbound traffic flows on Bells Line of Road, Kurrajong Road and March Street between Grose Vale Road/Terrace Road and East Market Street in the morning and evening peaks.

Traffic modelling carried out for the proposal (Roads and Maritime 2012) has identified that the proposal (in conjunction with other works under the Richmond Bridge Approaches strategy) would result in the following improvements to existing road network performance on the above roads:

- improved eastbound and westbound traffic flows on Bells Line of Road, Kurrajong Road and March Street between Grose Vale Road/Terrace Road and East Market Street in the morning and evening peaks
- Improved safety for turning movements for traffic in and out of Bells Line of Road, Kurrajong Road and March Street
- Improved traffic flows through the intersection of Bells Line of Road and Grose Vale Road, for all vehicle movements including turning movements in and out of Bells Line of Road
- Significant improvements in peak period travel speeds for westbound traffic on Kurrajong Road – from 17 kilometres per hour to 46 kilometres per hour. Improved safety and improved travel speeds are a result of providing a left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road (westbound) and a westbound acceleration lane on Kurrajong Road
- Improvements in peak period travel speeds for eastbound traffic on Kurrajong Road – from 48 kilometres per hour to 50 kilometres per hour
- Improved traffic flows on Grose Vale Road due to the proposed extension of the eastbound merge on Bells Line of Road, east of Grose Vale Road/Terrace Road.

A summary of the predicted changes in intersection performance (following the implementation of the proposed intersection upgrade work) for the assessment year of 2021 is provided in Table 6-23.

The intersection improvements are expected to result in an improvement in road safety with a reduction in the number of crashes occurring at intersections, a reduction in the number of rear-end crashes and a reduction in the number of crashes involving vehicles undertaking turning manoeuvres.

Table 6-23 Forecast intersection performance (with proposed intersection upgrade work) during year 2021

Intersection	Approach	Time period	Level of service	
			2011 (existing)	2021
Bells Line of Road / Grose Vale Road / Terrace Road	Bells Line of Road (westbound approach)	Morning peak hour	B	D
	Grose Vale Road (northbound approach)	Evening peak hour	D	C

Source: Roads and Maritime, Richmond Bridge and Approaches Congestion Study Stage 1 summary report Volume 1, 2012, p.68

The level of service in Bells Line of Road is predicted to decline at 2021 during the morning peak, because the performance of Bells Line of Road governs the level of service of whole intersection. The addition of a shared through/left turn lane (as proposed) would result in a slight improvement in performance, but the predicted 2021 increases in traffic volumes on Bells Line of Road during

the morning peak would continue to constrain the performance of the intersection even with the proposed improvements.

Traffic detours

The proposed intersection upgrade works will not result in any operational changes to existing traffic patterns or movements. No new turning or entry/exit restrictions will be introduced, and no existing restrictions will be relaxed or lifted. Therefore, the works are not likely to result in any traffic detours.

To the contrary, through the planned improvements to traffic flows along Bells Line of Road and through North Richmond generally, the proposal aims to alleviate some of the delays and queuing that are drawing traffic to detour between Bells Line of Road and Grose Vale Road, via Pitt Lane and Riverview Street.

Bus routes and services

The proposal would not impact on existing bus routes during the operational phase. Bus services in the study area would be subject to the same road network performance benefits as general traffic (refer to the operational road network performance subsection above), with increased bus service speeds and reliability anticipated, particularly in the westbound direction in the evening peak.

During the operation of the proposal, the proposal would require the permanent relocation of an existing bus stop (number 275455) from the northern kerb of Bells Line of Road, about 90 metres east of Grose Vale Road. This bus stop comprises a substantial brick shelter with seating and a litter bin. An alternate location for this bus stop was identified and communicated to stakeholders in the 'Have Your Say' newsletter distributed in November, 2015. The proposed new bus stop location is beside the kerb approximately 90 metres further to the east from the existing location, adjacent to the North Richmond Business Park at 30 Bells Line of Road.

Pedestrians and cyclists

The proposal is not anticipated to result in any long-term disruptions to pedestrians or cyclists. After the completion of construction, pedestrians would still be able to use existing foot paths and signalised pedestrian crossings, while cyclists would still be able to travel along existing on-road cycle routes, as per the existing situation.

On-street parking

The proposal would result in the permanent loss of about six time-restricted (15-minute) on-street parking spaces from Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods due to the provision of the proposed clearway. Three unrestricted spaces would also be lost along the western kerb of Terrace Road, to make way for widening near the intersection of Bells Line of Road.

The proposed extension of the southbound merge lane and removal of the existing traffic island in Bells Line of Road would also result in the loss or further time restriction of about eight kerbside parking spaces. Further, the proposal would also require the removal of up to 13 on-street parking spaces from Grose Vale Road (western kerb) due to the proposed road widening work (this is an existing clearway 6am – 6pm Monday to Friday, 6am – 12pm Saturday).

The distribution of affected parking spaces within the study area is summarised in Table 6-24 and illustrated in Figure 6-2. Land uses likely to be supported by the affected on-street car parking are also outlined in Table 6-24.

A parking demand and turnover survey was carried out in North Richmond in November 2015. Occupancy and turnover rates at the on-street parking locations potentially affected by the proposal were surveyed on a Tuesday and Saturday, from 6.00 am to 7.00 pm, with utilisation and turnover recorded every 15 minutes.

The results of the survey are summarised in the graph in Figure 6.3. The results show that the maximum utilisation rate for available parking spaces was about 50 per cent, but overall, the average utilisation of available on-street parking spaces was less than 25 per cent.

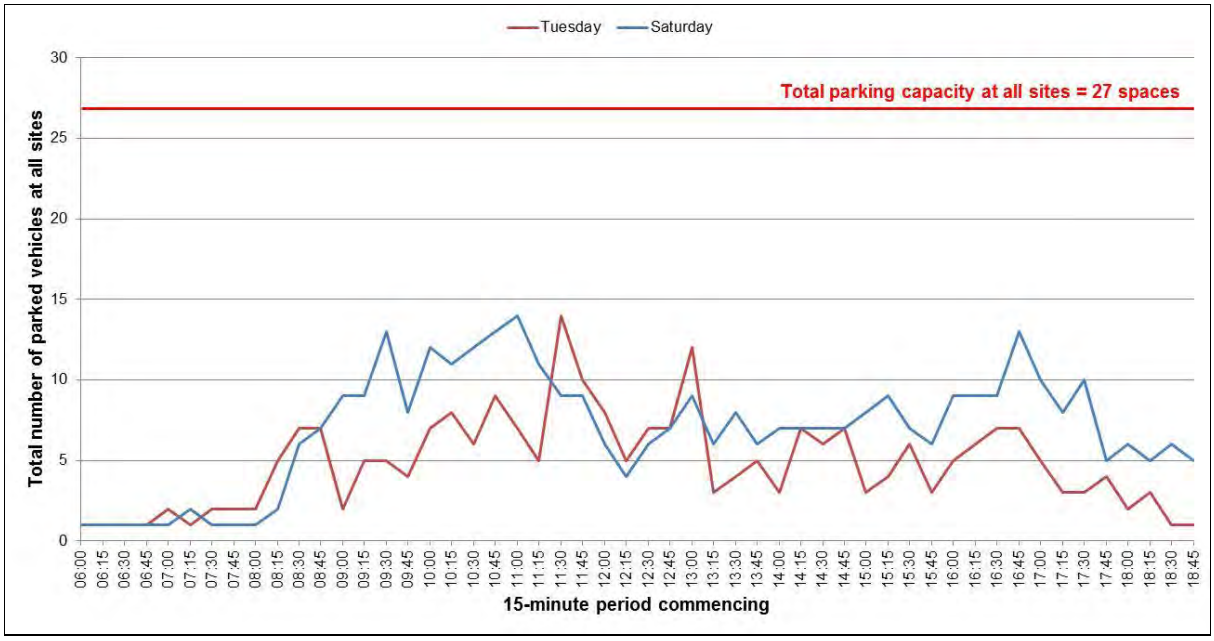

Figure 6.3 Total parking demand at all sites during survey periods

The loss of on-street parking has the potential to affect the accessibility of surrounding residential properties and local businesses, particularly in situations where sufficient alternative parking provisions are not located nearby. However, while parking impacts would be greatest in those locations where unrestricted parking spaces are removed, the parking demand survey concluded that there is existing on-street parking capacity that is not fully utilised.

Additional on-street parking capacity exists in Terrace Road and in Beaumont Avenue, at the rear of businesses (such as the Post Office) with a frontage to Bells Line of Road. There is also a good supply of existing off-street parking in and around the North Richmond shopping centre including the North Richmond Shopping Village and the Aldi Supermarket centre, most of which is two-hour (or longer) unrestricted parking.

As discussed in Chapter 5, the local community and businesses have been consulted in regard to the potential loss of parking. A primary concern raised in consultation is the potential loss of business to those traders who currently rely on the convenience of kerbside parking, for both customers and delivery vehicles.

The results of the parking demand survey suggest that the community's concerns regarding the loss of on-street parking can be alleviated, through the availability of alternative on-street parking and through higher utilisation and occupancy of existing available parking. Further, the supply of off-street parking in the vicinity of the proposal, and the retention of some on-street parking (with additional restrictions at some locations) would ensure that short-stay parking needs in North Richmond are met. Where applicable, the tighter parking restrictions would help to increase the turnover of parking spaces and to offset the loss of spaces nearby.

For vehicles travelling west along Bells Line of Road, the loss of parking would be minimal given the amount of available off street parking in the adjacent shopping centre. For vehicles travelling east, there is alternative parking available within adjacent premises. However, for some of these businesses there would be a loss of convenience given that alternative parking is at the rear of those premises.

Figure 6-2 illustrates where on-street parking will be retained along the northern kerb of Bells Line of Road. The figure also illustrates the availability of off-street parking associated with the businesses fronting the road at this location. Given the availability of alternative off street parking, the proposal is not considered to warrant the provision of additional on street or off street parking to replace the parking spaces that will be removed.

Where appropriate, neighbouring property owners and businesses would be further consulted about any proposed loss of on-street parking prior to its removal, and about how the retained parking spaces would best be utilised.

Table 6-24 Potential loss of on-street parking provisions

Road name and location	Existing parking provisions[1]	Affected parking[1]	Surrounding land use	Nearby parking availability
Bells Line of Rd, southern kerb, about 130m east of Grose Vale Rd	30m of ¼ hour parking (9am to 6pm)	6 spaces	Commercial	North Richmond Village shopping centre carpark, Aldi Supermarket (2 hours)
Bells Line of Rd, northern side, about 80m east of Grose Vale Rd	90m of one hour parking 9am to 6pm)	5 spaces	Commercial	Off-street carpark located within commercial development (2 hours)
	25m of ¼ hour parking (9am to 6pm)	3 spaces	Commercial	Off-street carpark located within commercial development (2 hours)
Grose Vale Rd, eastern kerb about 10m south of Bells Line of Rd	70m of ½ hour parking (8.30am–6pm Monday to Friday; 8.30am – 12pm Saturdays)	Nil	Commercial	Aldi Supermarket car park/North Richmond Village shopping centre car park (2 hours)
Grose Vale Rd, western kerb between Bells Line of Rd and William St	110m existing clearway (6am-6pm, Monday to Friday; 6am-12pm, Saturdays) Unrestricted parking outside of clearway times	13 spaces	Residential, commercial	William St (unrestricted), Aldi Supermarket/ North Richmond Village shopping centre car park (2 hours)
The Terrace Rd, western kerb south of Beaumont Ave	Unrestricted parking	3 spaces	Residential, commercial, rural	Further north along The Terrace Rd and Beaumont Ave (all unrestricted)

Note 1: Stated lengths are approximate only.

Access to private property

The operation of the proposal would not result in any long-term impacts to private property access.

6.2.4 Safeguards and management measures

The proposed safeguards and management measures for traffic, transport and access are listed in Table 6-25.

Table 6-25 Safeguards and management measures for traffic, transport and access

Impact	Environmental safeguards	Responsibility	Timing
Construction traffic management	A detailed traffic management plan would be prepared in accordance with Traffic Control at Work Sites (Roads and Traffic Authority 2010) and QA Specification G10 Control of Traffic (Roads and Traffic Authority 2005) to provide a comprehensive and objective approach to minimise any potential impacts on road network operations during construction. The traffic management plan would include measures to minimise heavy vehicle usage on local roads. Where practicable, deliveries of plant and materials would be carried out outside of peak traffic periods.	Construction Contractor	Pre-Construction and Construction
	The Construction Contractor would review the proposed timing of construction works at each of the intersection upgrade locations, with the objective of minimising the potential for cumulative traffic impacts.	Construction Contractor	Pre-Construction and Construction
	Consultation would be carried out with emergency services. Emergency vehicle access would be maintained at all times for the duration of construction.	Construction Contractor	Pre-Construction and Construction
Public transport	Access to bus stop locations would be maintained during construction wherever possible in consultation with bus operators (Busways).	Construction Contractor	Construction
	The existing bus stop on Bells Line of Road (bus stop number 275455) would not be removed until a replacement stop has been established.	Construction Contractor	Pre-Construction and Construction
	Updates on the location of temporary and permanent bus stops would be provided to the community during the construction period to ensure disruption is minimised.	Roads and Maritime and Construction Contractor	Pre-Construction and Construction

Impact	Environmental safeguards	Responsibility	Timing
	The community would be kept informed about upcoming road construction activities. Notifications would include advertisements in the local media and prominently placed advisory notices and/or variable message signs.	Roads and Maritime	Construction
Road user delay	Safe pedestrian access around the worksite would be provided by the construction contractor (in consultation with Roads and Maritime and Hawkesbury City Council) and captured within the traffic management plan.	Construction Contractor	Pre-Construction and Construction
Pedestrian access	Signage outlining pedestrian and cyclist diversion routes would be displayed during construction (where required).	Construction Contractor	Construction
Property access	Access to affected residential properties and businesses would be maintained during construction and temporary property access would be provided to residences and businesses where required. The management of property access would be considered by the construction contractor and detailed as part of the final staging plan for the proposal.	Construction Contractor	Pre-Construction and Construction
On-street parking	The parking of light construction vehicles (eg staff vehicles) would be restricted to designated areas within proposed construction compounds, or areas of unrestricted on-street parking outside the study area, to minimise the proposal's impact on the existing parking supply within the study area.	Construction Contractor	Construction

6.3 Aboriginal heritage

6.3.1 Methodology

A search of the Aboriginal Heritage Information System (AHIMS) register was carried out on 28 May 2014 to identify Aboriginal cultural heritage sites or places within, or immediately next to, the proposal area. The search area covered the general study area for the preferred short-term solutions for the broader Richmond Bridge and Approaches strategy (as shown in Figure 6-4).

The AHIMS search was repeated on 13 April 2016, to identify Aboriginal cultural heritage sites or places within 200 metres of the proposal area. The search report is attached in Appendix E.

6.3.2 Existing environment

The proposal is situated within built up residential areas comprising of existing road reserves and infrastructure and privately owned residential and commercial land. The proposal area has experienced a substantial degree of ground disturbances associated with past and present land use activities.

A search of the AHIMS register indicated that there are no known registered Aboriginal heritage sites or sensitive landforms located within 200 metres of the proposed work at the Bells Line of Road/Grose Vale Road intersection. However, a total of five Aboriginal sites were identified within three kilometres of the proposal. These sites comprise three stone artefact scatters (including one isolated stone artefact), a rockshelter containing artwork and one stone axe grinding groove site. The locations of these items are shown in Figure 6-4.

6.3.3 Potential impacts

Any potential for impacts on Aboriginal heritage would be limited to the construction phase. Given the degree of previous ground disturbance that has occurred within the locality, the proposal area is considered unlikely to contain any items of Aboriginal heritage or Aboriginal archaeological remains. Therefore, the proposal is not expected to impact any Aboriginal heritage items or Aboriginal cultural heritage values. A PACHCI clearance letter was obtained from the RMS Aboriginal cultural heritage advisor and is provided in Appendix E.

In the event that unexpected Aboriginal objects, historical archaeological relics, historic work, structures, buildings or movable objects, or human skeletal remains are uncovered during the work, all work would cease in the vicinity of the material/find and the steps in the *Standard Management Procedure: Unexpected Archaeological Finds Procedure* (Roads and Maritime 2012) would be followed.

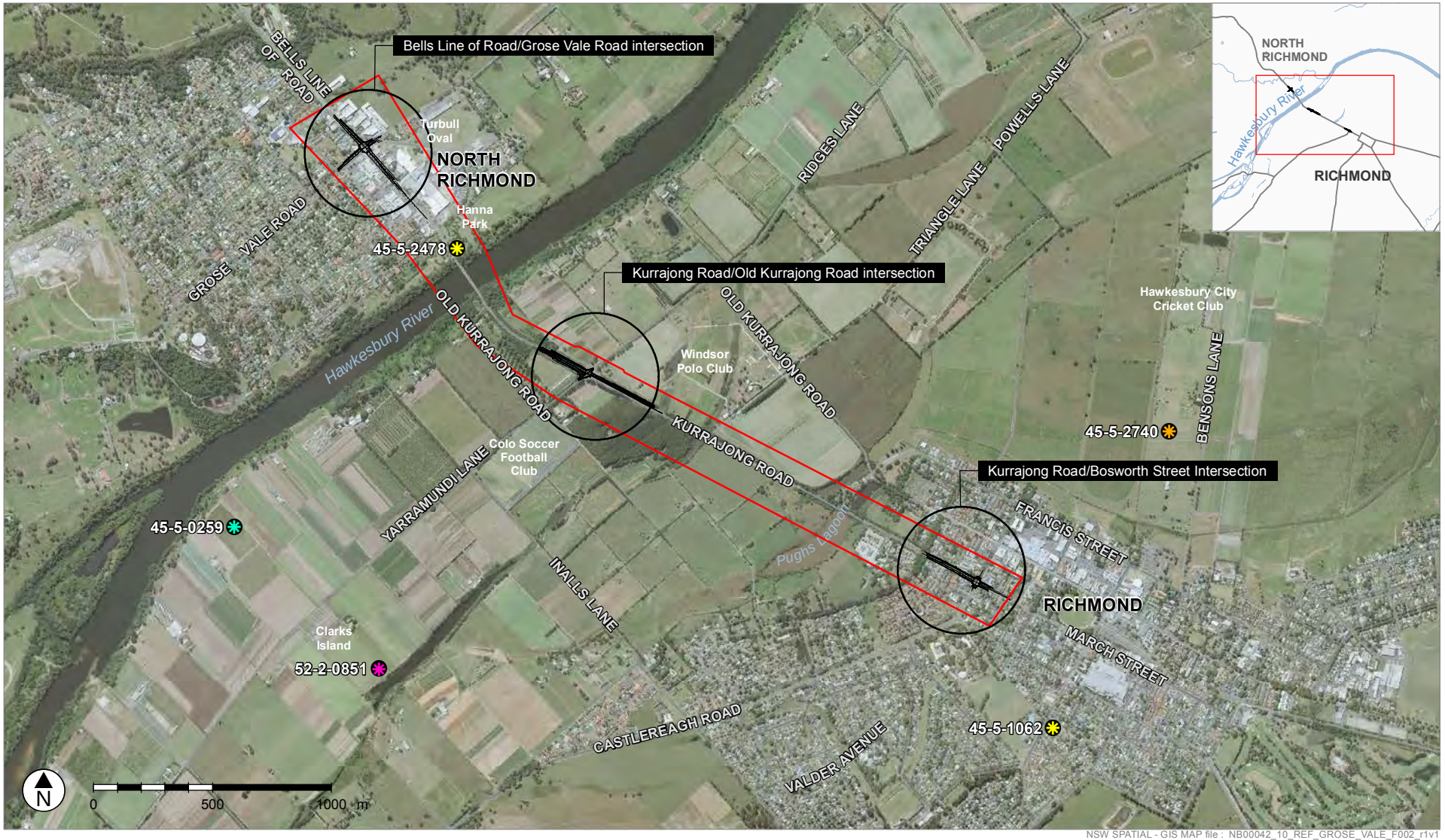

Figure 6-4
Locations of registered AHIMS sites

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

6.3.4 Safeguards and management measures

The proposed safeguards and management measures for Aboriginal heritage are listed in Table 6-26.

Table 6-26 Safeguards and management measures for Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing
Discovery/ disturbance of previously unrecorded Aboriginal sites	In the event of an unexpected find of Aboriginal cultural heritage, work will cease in the affected area and the Standard Management Procedure – Unexpected Archaeological Finds (Roads and Maritime 2012) will be implemented. This would include stopping all work in the vicinity of the find and contacting Roads and Maritime's Aboriginal Cultural Heritage Advisor or the relevant Roads and Maritime Environmental Officer immediately to identify the appropriate course of action. Work would not recommence until receipt of written approval from Roads and Maritime.	Construction contractor	Construction

6.4 Landscape character and visual impact

A detailed landscape character and visual impact assessment has been carried out for the proposal as part of this REF. The full impact assessment report is attached as Appendix H and is summarised below.

6.4.1 Methodology

The landscape character and visual impact assessment was carried out in accordance with the Roads and Maritime (2013) *Environmental Impact Assessment Guidance Note: Guidelines for landscape character and visual impact assessment*.

The proposal's overall level of impact on the existing landscape character of the area (generally defined as the areas built, natural and cultural sense of 'place') was determined through consideration of the landscape's sensitivity to visual change and the magnitude of the proposed work. Similarly, the proposal's overall predicted level of visual impact was determined through consideration of the visual sensitivity of key representative viewpoints and the magnitude of the proposed work.

Visual sensitivity and magnitude are broadly defined as follows:

- Visual sensitivity – refers to the quality of the view and how sensitive it is to any changes that would result from the proposed work. The sensitivity of viewers varies significantly depending on context of the view and activity of the viewer (eg residence, workplace, shops, school, recreation/open space, etc) and importance of the view to the viewer.
- Magnitude – refers to the scale, form and character of the proposed work. In the case of visual impact assessment, it also takes account of how far the proposal is from the viewer.

Key representative viewports, from which the proposed work could potentially be visible, were used to determine the proposal's visual impact.

Viewpoints selected to assess visual impacts associated with the proposed intersection upgrade at Bells Line of Road/Grose Vale Road are shown in Figure 6-5 and included the following:

- Views from vehicles travelling westbound and eastbound along Bells Line of Road.
- Views from vehicles travelling northbound and southbound along Grose Vale Road.
- Views from residential properties fronting Bells Line of Road and Grose Vale Road, in the vicinity of the proposed work.
- Views from footpaths along Bells Line of Road and Grose Vale Road.
- Views from commercial and light industrial development located next to the proposed work.

Using the sensitivity and magnitude rating presented in Appendix H (which ranges from 'negligible' to 'high' sensitivity/magnitude), an overall visual impact rating was determined for each of the above key representative viewpoints using the sensitivity-magnitude rating matrix presented in the Landscape Character and Visual Impact Assessment Report (refer to Appendix H).

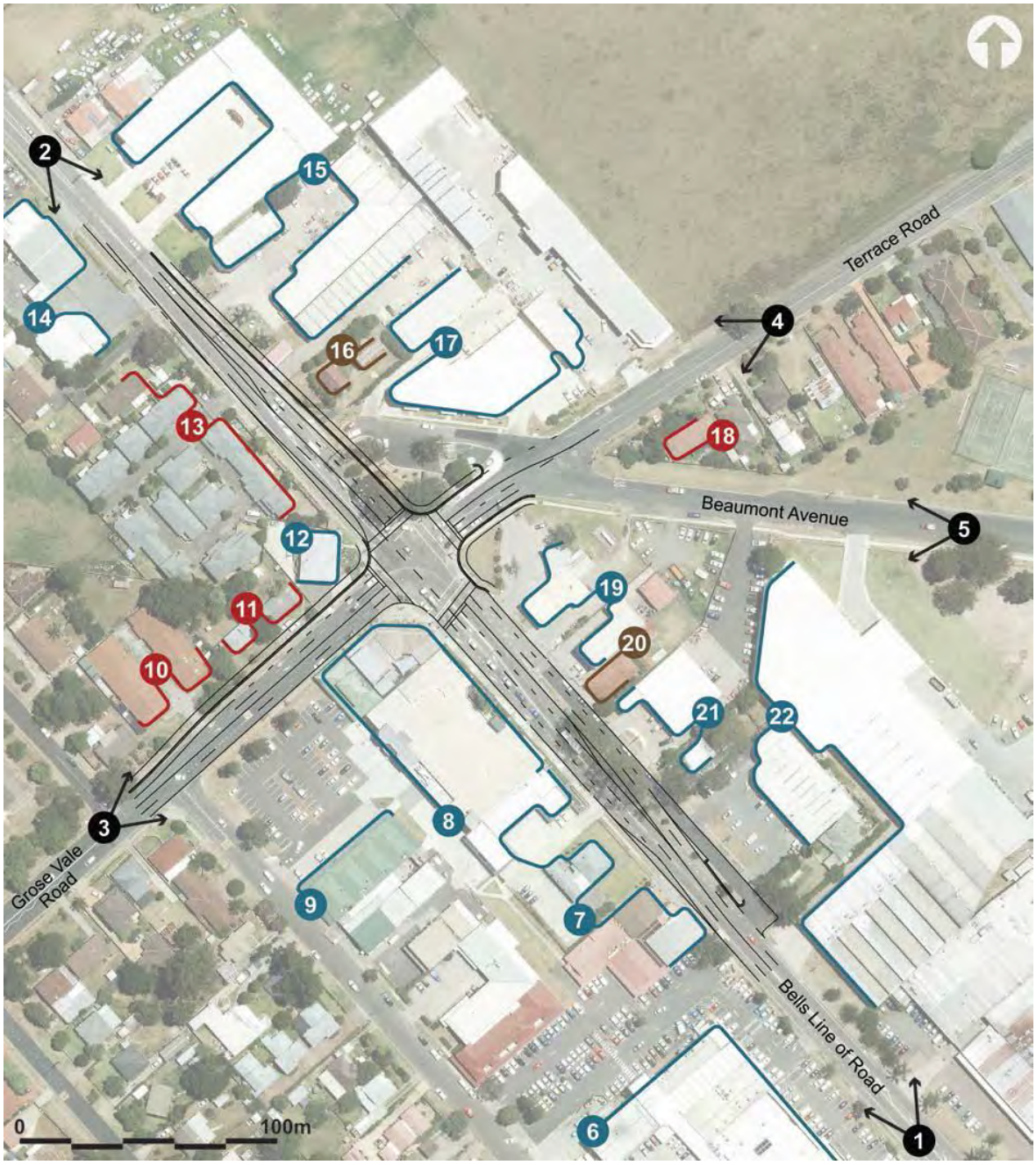

Figure 6-5 Key representative viewpoints for the proposed Bells Line of Road/Grose Vale Road intersection upgrade

6.4.2 Existing environment

The Bells Line of Road/Grose Vale Road intersection is located in the commercial centre of North Richmond, about 600 metres north-west of the Hawkesbury River. The urban landscape character of the area is defined by a variety of single and double-storey residential, commercial and light industrial buildings. Pedestrian footpaths are located on both sides of Bells Line of Road and Grose Vale Road, while a short section of an on-road cycle lane is located along the northern kerb of Bells Line of Road, to the east of the intersection (generally next to the Caltex Service Station).

Roadside trees form a significant component of the character of the area. Trees adjoining the intersection itself are limited to the northern corner, where mature Eucalyptus and semi-mature Spotted Gums are located about two to three metres from the road edge. Landscape beds with formal planting border the commercial development on the southern side of the intersection, while two palms are located on the western corner in front of a commercial building.

Given the existing Bells Line of Road/Grose Vale Road intersection's location within the urban environment, the sensitivity of its landscape character is considered to be moderate to low. Although, the visual sensitivity of residential properties fronting Grose Vale Road and Terrace Road are considered to be high due to their location in close proximity to the proposal area (visual elements along the road would be situated within foreground views) and the duration of views that these receivers have of the proposal area. The sensitivity of viewpoints for motorists travelling along the existing roadway is considered to be low due to the duration of views of the proposal area. The visual sensitivity of each key representative viewpoint in the vicinity of the Bells Line of Road/Grose Vale Road intersection is listed in Appendix H.

6.4.3 Potential impacts

Construction

The majority of visual impacts during construction would be caused by the equipment associated with the road widening, including temporary fencing, signage and construction machinery. The presence of hoardings and temporary signage would result in a more cluttered streetscape and there may be a visible increase in traffic congestion due to construction zone speed limits and the presence of construction vehicles. Vegetation removal to accommodate the road widening work would also occur at this stage, which would reduce the screening of residential and other sensitive viewpoints.

As outlined in Chapter 3, there is the potential for some of the construction work to be carried out at night to minimise traffic impacts associated with the proposal. Light spill from the use of portable lighting may also impact on the visual amenity of surrounding residential and other sensitive viewpoints. Where required, lighting for night-time work would comply with relevant Australian Standards, including AS4282- 1997 (*Control of the obtrusive effects of outdoor lighting*).

An assessment of the proposal's impact on existing landscape character and visual amenity during construction is provided in the following sections. It should be noted that the construction phase impacts, such as temporary fencing and work areas would be temporary, and would be reduced in the medium to long-term (ie at the completion of construction) through the restoration of work areas.

Operation

Landscape character

Bells Line of Road/Grose Vale Road intersection

As outlined in Section 6.4.2, the sensitivity of the existing landscape character of the area surrounding the Bells Line of Road/Grose Vale Road intersection is considered to be 'moderate to low' due to the proposal area's setting within an urban environment. In the context of landscape character, the proposed upgrade of the Bells Line of Road/Grose Vale Road intersection would likely have a 'moderate to high' impact. This impact would be due to the removal of six road trees

from the northern corner of the intersection, up to five from Grose Vale Road as well as the removal of up to 11 visually prominent roadside trees within the existing traffic island on the westbound approach along Bells Line of Road. Removal of these trees is unavoidable and would impact the existing semi-urban character of the intersection.

Negative landscape character impacts resulting from the establishment of additional road paving surfaces and the removal of a substantial number of roadside trees could be offset overtime by implementing mitigation measures discussed in Section 6.4.4 (eg vegetation planting). However, it is unlikely that mitigation measures will reduce the landscape character impact to a negligible level.

Visual impact

The proposal would result in permanent visual changes to the streetscape on the approaches to the Bells Line of Road/Grose Vale Road intersection. The main visual changes would be those associated with the removal of roadside trees and the widening of the existing road pavement.

The indicative extent of work along Bells Line of Road and Grose Vale Road is shown in Figures 6-6 and 6-7. An assessment of the proposal's visual impact on the assessed key representative viewpoints (as described in Section 6.4.1) is provided in Appendix H, while a summary of this assessment is provided below.

The proposed intersection upgrade at Bells Line of Road/Grose Vale Road is predicted to have the greatest visual impact on residential properties fronting and/or overlooking Grose Vale Road (viewpoint 11, as shown in Figure 6-5) and Bells Line of Road (viewpoint 13, as shown in Figure 6-5). The proposal is likely to have a 'moderate to high' visual impact on these sensitive visual receivers due to the removal of street trees and widening of the road pavement. Measures that would be required to reduce the proposal's visual impact on these receivers are outlined in Appendix H.

The proposal is also likely to have a 'moderate' visual impact on the following viewpoints:

- Motorists travelling north-west along Bells Line of Road (viewpoint 1, as shown in Figure 6-5 and Figure 6-6), who would experience a high magnitude of visual change due the removal of roadside trees and an increase in the road width from four to six lanes; however, the sensitivity of these viewpoints are generally considered to be low. Visual impacts could be reduced in the medium to long-term through vegetation planting.
- Commercial development fronting onto the Bells Line of Road/Grose Vale Road intersection (viewpoints 8, 12 and 17, as shown in Figure 6-5). These land uses would experience a high magnitude of visual change due the removal of roadside trees and an increase in the footprint of the Bells Line of Road/Grose Vale Road intersection. However, the sensitivity of these viewpoints is generally considered to be low. Visual impacts could be reduced in the medium to long-term through vegetation planting.
- Caltex Service Station, post office and commercial/industrial development fronting Bells Line of Road (viewpoints 19 to 22, as shown in Figure 6-5). These land uses would experience a high magnitude of visual change due to the removal of roadside trees and an increase in the road width from four to six lanes; however, the sensitivity of these viewpoints are generally considered to be low. Visual impacts could be reduced in the medium to long-term through vegetation planting.

Figure 6-6 Indicative extent of proposed work as viewed from the Bells Line of Road westbound approach to the Grose Vale Road intersection

Figure 6-7 Indicative extent of proposed work as viewed from the Grose Vale Road northbound approach to the Bells Line of Road intersection

Overall, the proposal is considered to be in keeping with the scale and bulk of existing road infrastructure in the locality. While the proposal would be expected to have a 'moderate to high' visual impact on residential properties located in close proximity to the Bells Line of Road/Grose Vale Road intersection, these impacts would be balanced to some extent by reductions in local traffic congestion as a result of the road upgrade, which may improve the overall amenity of the area for local residents.

The loss of existing mature street trees would be the most noticeable change for existing visually sensitive receivers and road users and could potentially be minimised in the medium to long-term through the revegetation of the road reserve.

6.4.4 Safeguards and management measures

The proposed safeguards and management measures for visual and landscape impacts are listed in Table 6-27 and Appendix H.

Table 6-27 Safeguards and management measures for visual and landscape impacts

Impact	Environmental safeguards	Responsibility	Timing
Visual amenity impact – sensitive receivers	Replacement tree planting (Viewpoints 1-5, 7-8, 10-13, 16-17, 19-22)	Construction Contractor	Construction
	Where required, lighting for night-time work is to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting) (Viewpoints 7-8, 10-19, 21-22).	RMS maintenance	Operation
Visual amenity impact – vegetation removal	Existing native roadside trees would be retained where possible to minimise the potential landscape character and visual impact of the work.	Construction Contractor	Construction
Visual amenity impact – vegetation removal	The landscaping plan is to incorporate planting for screening purposes where feasible.	Construction Contractor	Construction
Visual impacts of construction activities	The work site will be left in a tidy manner at the end of each work day.	Construction Contractor	Construction
	Where appropriate, fencing with material attached (eg shade cloth) would be provided around the construction compound to screen views of the construction compounds from adjoining properties.	Construction Contractor	Construction
	Where required, lighting for night-time work would be positioned to minimise light spill or disturbance to nearby residential receivers, and to minimise glare for motorists.	Construction Contractor	Construction

6.5 Topography, geology and soils

The following sections provide a desktop analysis of topography, geology and soils of the study area based on existing topographic and geological maps, database searches and other publicly available information.

The study area included for this assessment is shown in Figures 1-1 and 1-2 and extends about 500 metres along the Bells Line of Road, as well as 300 metres along Grose Vale Road/Terrace Road. Based on the current design for the proposal, it has been assumed that the maximum depth of excavations would be two metres below the existing ground surface.

6.5.1 Existing environment

Topography

The topography of the project alignment is relatively flat with a slight fall west of the Bells Line of Road/Grose Vale Road intersection. Regional topography surrounding the site is typically rising west of the project and falling towards the Hawkesbury River, which is located about 600 metres to the south-east of the site. A review of the Penrith 1:100,000 Topographic map (9030, 1st edition 1975) indicates the elevation of the site is about 20 metres Australian Height Datum (AHD).

Geology

The Sydney 1:250,000 Geological Sheet (S1 56-5, 3rd edition 1966) indicates the proposal site is underlain by Quaternary alluviums, gravels, sands, silts and clays.

Soils

Information within the NSW Government (accessed 4 November 2014), NSW Natural Resource Atlas website (http://www.nratlas.nsw.gov.au) identified four registered groundwater bores surrounding the proposed site. Further information on the registered groundwater bores is provided in Section 6.6.2.

Acid sulfate soils

Acid sulfate soils (ASS) are the common name given to naturally occurring sediments and soils containing iron sulphides (principally iron sulphide or iron disulfide or their precursors). The exposure of the sulphide in these soils to oxygen by drainage or excavation leads to the generation of sulphuric acid.

The Australian Soil Resource Information System (ASRIS, compiled by the CSIRO, 9 April 2013) provides an interactive tool to assess land constraints, including ASS and Potential ASS (PASS) at the proposal site. The ASRIS tool identifies the soils at the site as having a Low Probability of ASS/PASS; however, the tool also indicates that there is low confidence of the soil types within the proposal area. Areas of acid sulfate soils can typically be found in low lying and flat locations which are often swampy or prone to flooding. The *NSW RTA, Guidelines for the Management of Acid Sulfate Materials: Procedure 1, April 2005*, indicates ASS/PASS materials are expected at elevations below 10mAHD. The proposal site is located at an elevation of about 20mAHD (refer to Topography Section), and is therefore above the expected height range for ASS/PASS materials; and would be considered to hold a low risk of ASS/PASS impacts during construction.

6.5.2 Potential impacts

Construction

Construction activities for the proposal are likely to involve ground disturbance across the whole paved area of the intersection, including footpaths, as shown in Figure 1.2. It would also involve some vegetation clearing at locations as discussed in Section 3.1 and as illustrated in Figure 6.9. It is anticipated that the deepest excavation work would be associated with the proposed drainage trenches, which are likely to be to a maximum depth of two metres below the existing ground surface (at locations as described in Section 3.2.3). In addition, Sydney Water infrastructure for water and sewer reticulation would be relocated at the locations as described in Section 3.5.2.

The removal of vegetation and ground disturbance has the potential to expose ASS (if present) and increase the possibility of erosion and sedimentation. If uncontrolled, the site activities have the potential to cause adverse impacts to downstream water bodies and the surrounding areas, via surface water flows.

As outlined in Section 6.5.1, there is an increased risk of ASS/PASS being encountered during construction work due to the low confidence in soil types that was indicated during a search of the ASRIS. The exposure of ASS or PASS materials (if present) during excavation work could result in the release of acid sulfates, which could cause damage to surrounding vegetation and drainage lines. Acknowledging relatively low risk of encountering ASS or PASS materials during the construction of the proposal, it is prudent to allow for management measures to be developed and implemented to identify, contain and monitor ASS/PASS (if encountered) throughout the construction work.

Due to the relatively flat nature of the proposed work site, the risk of erosion and sedimentation is considered low and could be easily managed through the implementation of standard safeguards and management measures.

Operation

The operation of the proposal is not anticipated to result in impacts to the topography, geology or soils of the study area.

6.5.3 Safeguards and management measures

The proposed safeguards and management measures for topography, geology and soils are listed in Table 6-28. Safeguards and management measures specific to water quality and hydrology are outlined in Table 6-38.

Table 6-28 Safeguards and management measures for topography, geology and soils

Impact	Environmental safeguards	Responsibility	Timing
Soil and Water Quality	Erosion and sedimentation controls would be incorporated into the CEMP, in accordance with Landcom's (2004) *Managing Urban Stormwater: Soils and Construction*. Controls would include, but not be limited to: • Identify the site catchment, high risk areas and sensitive areas (eg ground disturbance areas). • Confirm the size of the above areas and catchments. • Proposed staging plans for the proposal to ensure appropriate erosion and sediment controls measures are possible. • The likely run-off from each worksite and direction of on and off site water flow. • Diversion of clean water around the work site. • A mapped plan identifying the above.	Construction Contractor	Pre-Construction
Soil and Water Quality	An Acid Sulphate Soil Management Plan would be prepared and incorporated into the CEMP. The plan would include, but not be limited to: • A summary of the available ASS	Construction Contractor	Pre-Construction

Impact	Environmental safeguards	Responsibility	Timing
	information relevant to the site. • Confirm the process for identification of ASS/PASS throughout construction. • Indicate the management measures to be implemented if ASS/PASS is identified. • Outline the monitoring requirements for ASS/PASS to confirm the surrounding area is being protected. • Confirm the treatment and disposal requirements for any ASS/PASS encountered. • Detail the reporting requirements.		

6.6 Contaminated land

The following sections provide a preliminary desktop contamination assessment of the study area, based on a review of publicly available information (as outlined in Section 6.6.1). The study area included for this assessment is shown in Figures 1-1 and 1-2 and described in Section 6.5.

6.6.1 Methodology

The preliminary contamination assessment included a desktop assessment of potential contamination risks associated with the construction of the proposal. The assessment included a desktop review of the following publicly available information:

- The NSW Environment/Contaminated Land Register.
- Current aerial photographs (covering adjacent land uses).
- Locations of registered bores/pumps and the associated use of local ground/surface waters.
- Information held by Government Departments (NSW EPA and Hawkesbury City Council).

The scope of the desktop contamination assessment carried out for the proposal did not include a site inspection, a search of land title information, review of planning certificates, review of historical aerial images or the completion of a dangerous goods search for the site, in accordance with the RMS approved scope of works. Specifically, no environmental samples of any matrices (soil/water/air) were collected or analysed.

6.6.2 Existing environment

Land uses directly affected by the proposal are shown in Figure 4-1 and typically comprise existing road reserve and residential and commercial property. Residential and commercial properties are located surrounding the project site. A primary school (Richmond North Public School) is located adjacent to the southern extent of the proposal, and in addition to the residences located at or close to the intersection, is also considered to be a sensitive receptor for the proposal, based on the proximity to proposed construction activities. Commercial properties surrounding the proposed alignment include a hotel; retail food outlets; a shopping plaza; offices; industrial printing facility; two petrol stations (a Caltex and a United service station with car washing facilities) and automotive service centres.

The nearest registered contaminated site on the NSW EPA database is a BP service station located at 501 Bells Line of Road, Kurrajong, NSW, which is about 3.9 kilometres north-west of the proposal. The contamination risk associated with this registered contaminated site is considered to be very low, due to the large distance between the site and the proposal, as well as the presence of the Hawkesbury River between the contaminated site and the proposal site.

Three Environmental Protection Licences (EPLs) were confirmed within a 5 kilometre radius of the proposal. All of the EPLs were issued to Sydney Water and are summarised in Table 6-29.

Table 6-29 Environmental Protection Licences within a 5 kilometre radius of the study area

EPL ID	Issued to	Address	Purpose	Distance from the proposal
EPL190	Sydney Water Corporation	Corner Bells Line of Road and Crooked Lane, North Richmond	Sewage Treatment Plant	600m north-west
EPL1726	Sydney Water Corporation	Grose Vale Road, North Richmond	Sewage Treatment Plant	1km south-west
EPL5425	Sydney Water Corporation	Blacktown Road, Richmond	Water Filtration Plant	4.8km south-east

A search of registered groundwater wells located within one kilometre (approximate) of the proposal identified four bores. Details of these bores are summarised in Table 6-30. Based on the groundwater levels indicated at each of the registered bore locations, it is anticipated that the likely depth of groundwater within the study area would be encountered at about eight metres below the ground surface

Table 6-30 Registered groundwater bores within a 1 kilometre radius of the study area

Bore ID	Water level	Screened Interval	Total depth	Owner Type	Distance from proposal
GW105626	Unknown	18-108m	108m	Unknown	800m north west
GW109698	8m	139-216m	216m	Local Govt	250m north east
GW100756	8m	14-19m	19.4m	Private	800m north east
GW019913	Unknown	1-3m	18.8m	Private	720m south

Note 1: All distances and depths are approximate only, based on available information.

A review of the Hawkesbury City Council flood level maps indicates that the proposal site is located within the probable maximum flood level. This appears to be consistent with the information within the registered groundwater bores and the geological maps described in Section 6.5.1.

6.6.3 Potential impacts

Potential contamination sources

After the completion of the preliminary contamination assessment, the following potential contamination sources/environmental risks have been identified for the proposal site:

- Acid Sulfate Soils (discussed in Section 6.5).
- Metals and herbicides/pesticides and hydrocarbons associated with former railway line and station in the vicinity of the proposal site.
- Hydrocarbons, metals associated with the two petrol stations (Caltex, corner Bells Line of Road and Terrace Road North Richmond; and United Petroleum, Bells Line of Road North Richmond).
- Detergents associated with an operational car wash (at United service station, Bells Line of Road) including acids, oils and ammonia.
- Hydrocarbons associated with the operations of automotive service centres.

- Metals, etching solutions (including a variety of acids and ammonia), dyes and solvents, associated with industrial printing facilities.
- Exhaust particulates and hydrocarbons released from motor vehicles on Bells Line of Road and Grose Vale/Terrace Road.
- Unlawfully dumped waste at the proposal site.

Discussion on the potential risks of encountering contamination during the construction and operation of the proposal is provided in the following sections.

Construction

Ground disturbance activities at the site may encounter contamination sources, as outlined above. The exposure of any contaminated materials at the site during construction may increase the potential for contaminant mobilisation and may create additional exposure pathways to sensitive receptors including workers, the general public, surface water bodies, groundwater bodies and terrestrial ecosystems.

An initial assessment has been completed on the identified potential contamination sources, proposed construction activities and potential exposure pathways to determine a contamination risk rating for the proposal. The assessment is summarised in Table 6–31.

Table 6-31 Contamination risk

Potential contamination source	Potential exposure pathway	Risk rating
Petrol Stations (Caltex North Richmond; United Petroleum North Richmond)	Petrol service stations store large quantities of petroleum compounds in underground storage tanks (USTs) over long periods of time. USTs can commonly leak when used over long periods (ie in excess of 10 years). Petroleum products that leak from the USTs may impact surrounding soils and groundwater. The excavation of impacted soils may release the hydrocarbons into the surrounding environment; potentially impacting site workers and the general public via ingestion, inhalation, and surface or groundwater flows.	High – based on known risk of storage tanks leaking into the surrounding environment, the assumption of a complete exposure pathway, and lack of current information.
Car wash (United North Richmond)	Automated car wash systems (eg the model at the United service station) use a variety of detergents and oil products throughout their operations. Leaks from the car wash system may cause contamination of surrounding soils and groundwater. The excavation of impacted soils may release the detergents and oils into the surrounding environment; potentially impacting site workers and the general public via ingestion, inhalation, and surface or groundwater flows	Moderate – based on the assumption of a complete exposure pathway and on the lack of current information.
Automotive service centres (Caltex North Richmond; United Petroleum North Richmond)	Automotive centres may be used to store waste oil and other associated waste products collected during the servicing of vehicles. These can be stored within UST's located at the site that may potentially leak into the surrounding soils and groundwater. Excavation of these impacted soils may expose the waste oils	High – based on known risk of storage tanks leaking into the surrounding environment, the assumption of a

Potential contamination source	Potential exposure pathway	Risk rating
	potentially impacting site workers or the surrounding environment.	complete exposure pathway and the lack of current information.
Industrial Printers (Hannapak, Bells Line of Road)	Historical printing establishments are often impacted by metals (generally from in the form of dust from metal alloy founding operations) and through the inappropriate disposal of printing inks, solvents and etching solutions. Excavation of any soils/groundwater impacted by metals, inks, solvents or etching solutions may increase the risk of migration to the surrounding environment and impact site workers and members of the public.	Moderate – based on the assumption of a complete exposure pathway, and on the lack of current information.
Exhaust particulates and hydrocarbons	Deposition of exhaust particulates and/or release of hydrocarbons from motor vehicles using the intersection may be present. Exposure to the particulates and/or hydrocarbons may impact workers, the general public and the surrounding environment via inhalation, surface or groundwater flows.	Low – based on no information about the volume of hydrocarbons released at the site.
Unlawfully dumped waste	Unlawfully dumped waste may contain hazardous materials. Exposure to the unlawfully dumped waste may impact workers, general public and the surrounding environment via inhalation, and surface or groundwater flows.	Low – based on the likelihood of encountering unlawfully dumped waste.

Operation

Operation of the proposal is not anticipated to result in an increased risk of contaminated land. Completion of the intersection upgrade would be anticipated to increase visibility and merge times for motor vehicles at this intersection; thereby reducing the risk of motor vehicle accidents and the potential for spills/releases at the site.

6.6.4 Safeguards and management measures

The proposed safeguards and management measures for contaminated land are listed in Table 6-32.

Table 6-32 Safeguards and management measures for contaminated land

Impact	Environmental safeguards	Responsibility	Timing
Existing contamination	A limited site investigation of the project alignment should be completed to confirm the presence/absence of potential contaminants within the alignment. The limited site investigation would include as a minimum: • An investigation of soils to the	Roads and Maritime	Pre-Construction

Impact	Environmental safeguards	Responsibility	Timing
	maximum anticipated depth of excavation (including sampling and analysis) at locations identified as being potentially impacted. • A comparison of analytical results against appropriate guidelines. • Preparation of a factual report outlining the presence/absence of contaminants within the project alignment		
Potential exposure of contamination to site workers, public and environmental receptors	A Contamination Management Plan (CMP) would be prepared for the proposal in accordance with the Contaminated Land Management Act 1997 and relevant EPA guidelines. The CMP would include as a minimum: • Contaminated land legislation and guidelines. • Potential contamination sources that may be encountered at the site. • Procedures for the identification, management and reporting of contamination, including procedures for: – Finding unexpected contamination. – Handling and stockpiling of contaminated materials. – Dewatering and disposal of contaminated liquid waste. – Disposal of contaminated soils. • Incident management procedure and reporting procedure. • A process for reviewing and updating the plan.	Construction Contractor	Pre-Construction
Exposure to contamination	The CMP would be sent to the Roads and Maritime Environmental Manager for review, before construction.	Construction contractor	Pre-Construction

6.7 Socio-economic

This section assesses the potential socio-economic impacts of the proposal, and outlines safeguards and management measures to be implemented in order to manage the occurrence of any potential impacts.

6.7.1 Methodology

Study area

The study area for the socio-economic assessment includes the North Richmond and Richmond state suburbs, as defined by the Australian Bureau of Statistics (ABS). The study area includes those residents and businesses that are likely to be most affected by the proposal's construction and operation. As Bells Line of Road provides a supplementary link to the Great Western Highway (between the Sydney Basin and the Central West Region of NSW) potential socio-economic impacts on the wider region are also considered, where relevant.

Assessment

The desktop socio-economic assessment was guided by the Roads and Maritime Draft Environmental Impact Assessment Practice Note: Socio-economic assessment (EIA-N05) (Roads and Maritime 2013).

6.7.2 Existing environment

Population and growth

At the 2011 Census, North Richmond had a residential population of about 4,601 people, while Richmond had a population of about 5,274 people (ABS 2011). The majority of residents in North Richmond live in the residential area west of Bells Line of Road, and north and south of Grose Vale Road.

The population of the Hawkesbury LGA is projected to grow at a similar rate to NSW over the 20 years to 2031, although lower than the projected rate of growth for the Sydney Metropolitan area. By 2031, the LGA is projected to grow to 80,650 people, an average of 1.1 percent annually. This is compared to 1.2 percent in NSW and 1.6 percent in the Sydney Metropolitan area (Department of Planning and Environment 2014).

In 2011, of the 2,363 people being reported in the North Richmond work force, about 62.3 percent were employed full-time and about 27.5 percent were employed part-time. In comparison, of the 2,580 people being reported in the Richmond work force, about 64.1 percent were employed full-time and about 25.0 percent were employed part-time. The most common occupation of residents within both North Richmond and Richmond included technicians and trade workers, professionals, and clerical and administrative workers (ABS 2011).

Demography

Key population characteristics of North Richmond and Richmond are summarised in Table 6-33, along with the Hawkesbury LGA and New South Wales.

This shows that the community of North Richmond is characterised by:

- An age profile similar to NSW as a whole, although with slightly lower proportion of older people.
- Relatively low levels of cultural diversity, with high proportions of people who speak only English at home.
- A relatively high need for assistance compared to NSW.
- Relatively high reliance on private car, with higher proportions of people who travel to work by car and lower proportions of people who travel by public transport, compared to NSW.
- Lower rate of unemployment and households with higher incomes compared to NSW.

Key employment industries for residents in North Richmond and Richmond include public administration and safety, retail, manufacturing, and health care and social assistance.

Table 6-33 Population characteristics

Socio-economic characteristics	North Richmond*	Richmond*	New South Wales
Total population	4,601	5,274	6,917,658
Median age	37 years	40 years	38 years
0-14 years (percent)	20.4	13.2	19.2
65 + years (percent)	13.1	22.5	14.7
Aboriginal and Torres Strait Islander (percent)	2.7	2.6	2.5
English only spoken at home (percent)	91.7	72.8	72.5
People with need for assistance (percent)	4.2	10.0	4.9
Travel to work by car (as driver or passenger) (percent)	75.4	60.8	62.8
Travel to work by public transport (percent)	4.6	8.1	13.8
Median weekly household income	$1,300	$950	$1,237
Unemployment rate	4.6	5.9	5.9
Industry of employment	Public administration and safety Retail trade Manufacturing	Public administration and safety Health care and social assistance Retail trade	Health care and social assistance, Retail trade, Manufacturing

*State Suburbs

Source: ABS (2011) Census QuickStats: North Richmond; ABS (2011) Census QuickStats: Richmond (State Suburbs); ABS (2011) Census QuickStats: Hawkesbury (LGA)

Social infrastructure

Social infrastructure refers to community facilities, services and networks which help individuals, families, groups and communities meet their social needs, maximise their potential for development and enhance community well-being.

A number of community facilities are located either adjacent or near to the proposal. These include:

Bells Line of Road/Grose Vale Road, North Richmond

- Educational facilities, including North Richmond Public School located at William Street, which is accessed from Grose Vale Road.
- Religious facilities, including North Richmond Seventh Day Adventist Church at Bells Line of Road near the corner of Terrace Road/Grose Vale Road.
- Small areas of open space at the corner of Bells Line of Road and Terrace Road, which provide shelter, and seating areas, as well as larger open space areas at Turnbull Oval and Hanna Park located at Beaumont Avenue, which is accessed via Terrace Road.

- Public transport facilities, including one bus stop located at Bells Line of Road, east of Terrace Road/Grose Vale Road that is serviced by three regular bus routes.
- Pedestrian facilities and cyclist networks, including footpaths on either side of Bells Line of Road and Grose Vale Road, and shared vehicle-cycle lanes (refer to Section 6.2.2).
- Parking provisions (refer to Table 6-19).

Local business

ABS data on local business is presented at SA2 level. The study area is located within the Richmond-Clarendon SA2 area.

In June 2013, there were 1,076 businesses within the Richmond-Clarendon SA2, of which about 86 percent employed four people or less or where 'non-employing'. The main industries of businesses were construction; rental, hiring and real estate services; and professional scientific and technical services (ABS, 2015).

There are a number of local businesses located within or near to the proposal area, including:

- Retail and commercial businesses on the northern side of Bells Line of Road, west of Terrace Road, including a financial services business at 60 Bells Line of Road.
- Retail businesses on the south side of Bells Line of Road, at the intersection of Grose Vale Road.
- Retail and commercial businesses at 3 Terrace Road.
- Caltex Petrol Station at the corner of Bells Line of Road and Terrace Road.

Community values

Community values are those elements considered to be important to quality of life and wellbeing. They include physical elements, such as parks, buildings and landscapes, and social elements, such as a sense of belonging and community identity. In the Richmond area, the community are those that are permanent residents, as well as those that work or visit the area on a daily or intermittent basis.

The Hawkesbury Community Strategic Plan (2013) outlines the community's vision for the future of the Hawkesbury local government area. Those things outlined in the plan relevant to the proposal include:

- Supporting business and local jobs
- Vibrant townships with appropriate infrastructure, services, tourism and housing
- Connection within and beyond the area via efficient transport networks

The area immediately surrounding the intersection of Bells Line of Road and Terrace Road/ Grose Vale Road is characterised by a mix of retail and commercial uses as well as an area of medium-density retail uses west of Grose Vale Road. More broadly, the area north of Bells Line of Road comprises mainly rural uses, while urban residential uses are located south of Bells Line of Road. Grose Vale Road is an important access road for residents of this area to Bells Line of Road and the wider Richmond area.

A small area of open space is located at the intersection of Bells Line of Road and Terrace Road. This space comprises a number of established trees and seating/ shelter area. The open space is likely to offer some landscaping and visual relief for road users and occupants of surrounding properties, although amenity for users of the open space is likely to be affected by existing traffic through the intersection.

6.7.3 Potential impacts

The proposal has the potential for local and regional benefits in the medium to longer-term through reduced traffic congestion, improved access and connectivity, and improved safety for motorists.

The following provides an overview of potential impacts of the proposal on businesses, social infrastructure and community values.

Property acquisition and property adjustments

Property acquisition and property adjustments are discussed in detail in Section 6.8.2. A total of seven properties would be affected by the proposal, including one property that would be fully acquired and six properties that would be impacted by partial acquisition. Six of the affected properties are privately held, while one is a Council-owned public reserve.

Properties impacted by partial property acquisitions comprise a mix of residential, commercial and community uses as illustrated in Figure 3-3. This would result in a small loss of land from these properties, the replacement and relocation of fences (on a like-for-like basis), and removal of small amounts of vegetation from some properties. This is not expected to impact on the use of commercial or community properties that are set back from the road reserve. However, the relocation of the road reserve closer to dwellings is likely to have impacts on perceptions of amenity for some residents, particularly at Grose Vale Road where buildings are currently located relatively close to the front boundary.

The single property to be fully acquired for the proposal is a commercial property at 60 Bells Line of Road, North Richmond, which currently accommodates a financial services business. The existing commercial business at Bells Line of Road would be required to relocate prior to construction of the proposal, as it is apparent that the building would be demolished to accommodate the road works. There is a good supply of alternative commercial accommodation in the North Richmond central business district and while Roads and Maritime will acquire the land at fair value in accordance with statutory requirements (see below), relocation will be the responsibility of the proprietor.

Affected property owners would be compensated in accordance with the *Land Acquisition (Just Terms) Compensation Act 1991*. Roads and Maritime has commenced consultation with affected property owners about property impacts and the acquisition process and will continue to consult with property owners during the detailed design and construction stages.

Access and connectivity

Construction

During construction, temporary impacts on access and connectivity may be experienced by local residents and road users, including motorists, cyclists, pedestrians and public transport users, due to:

- The implementation of roadwork speed limits and/or short-term traffic control on both sides of Bells Line of Road, Grose Vale Road and Terrace Road in the vicinity of the respective intersections, resulting in minor traffic delays and disruptions (refer to Section 6.2.3)
- Changes in conditions for cyclists near to construction works, particularly where road shoulders and/or kerbside traffic lanes on the approach to the Bells Line of Road/Grose Vale Road intersection are temporarily narrowed (refer to Section 6.2.3)
- Changed access for pedestrians near to construction activities, particularly where footpath realignments are required at Bells Line of Road, Grose Vale Road and Terrace Road. This may impact on perceptions of safety for some pedestrians, including children and people with mobility difficulties, including elderly people (refer to Section 6.2.3).
- Temporary changes to property access for residents and local businesses that have direct access onto Bells Line of Road, Grose Vale Road and Terrace Road near to the proposed works (refer to Table 6-22).

The proposal would also result in the temporary loss of or restrictions to on-street parking within or near to the construction footprint. The majority of properties near to the construction works have access to off-street parking, which would assist in minimising potential impacts on surrounding residential and commercial properties (refer to Table 6-24). In addition, alternative on-street parking is available in nearby local streets, but would possibly require some people to walk further to access residential, commercial or community uses.

The number and location of affected on-street parking spaces will be confirmed following consultation with property owners and businesses.

Operation

During operation, the proposal would result in reduced traffic congestion, improved access and efficiency for freight and motorists, and improved safety for cyclists, pedestrians and motorists.

The proposal would require the relocation of bus stop number 275455 as well as the modification of bus stop number 275419 (refer to Section 6.2.3). A new bus stop location is proposed, approximately 90 metres east of the existing bus stop. However, potential impacts for bus users are expected to be minimal with bus stops located within the same general location. Consultation would be undertaken with neighbouring property owners and businesses during this process, to ensure that impacts on neighbouring properties are also managed.

The provision of a new clearway (and other road configuration changes) would result in the partial or permanent loss of up to 24 on-street parking spaces at North Richmond (refer to Section 6.2.3). This includes a combination of short term (for example 15 minute and one hour) parking spaces as well as other restricted and unrestricted parking spaces. The distribution of affected parking spaces within the study area is shown in Figure 6-2.

The majority of properties near to the proposal have access to off-street parking, which would assist in minimising potential impacts on surrounding residential, commercial and community properties. Alternative on-street parking is also available in nearby local streets or designated parking areas (refer to Table 6-24), although this may require some people to walk further to access residential, commercial or community uses. This may change some people's perceptions around the convenience of access to these uses, although the impact of this is expected to be minor. Consultation would be undertaken with neighbouring property owners and businesses about any proposed loss of on-street parking and proposed mitigation measures prior to its removal.

Local economy

During construction, temporary impacts may be experienced by local businesses nearest to construction works due to temporary changes to access for motorists and pedestrians, temporary loss of some on-street parking, and changes to amenity resulting from noise and vibration impacts (refer to Section 6.1) and dust impacts (refer to Section 6.11). These impacts are expected to be minor and would be managed through the implementation of environmental management measures.

During operation, benefits for local and regional businesses are likely to result from reduced traffic congestion, improved access and efficiency for freight and motorists, and improved safety for cyclists, pedestrians and motorists.

As indicated previously, the existing commercial property to be acquired at Bells Line of Road would be required to relocate prior to construction of the proposal. It is anticipated that alternative accommodation would be available within the general area for this business, helping to avoid any on-going impacts on this business.

More broadly, potential changes to on-street parking may change some people's perceptions around convenience of access to local businesses, although the impact of this is expected to be minor.

Community values

The proposal would improve access and road safety for cyclists, pedestrians and motorists, which would support community values identified through the Hawkesbury Community Strategic Plan relating to efficient transport networks.

The proposal would require the removal of roadside trees, including up to six trees at the northern corner of the Bells Line of Road/Grose Vale Road intersection, up to five trees on Grose Vale Road and up to 11 trees within the existing traffic island on the westbound approach of Bells Line of Road. As indicated in Section 6.4, these trees are likely to offer some landscaping and visual relief for road users and occupants of surrounding properties and the loss of these trees is likely to be a concern for some people. These impacts would be mitigated through the implementation of safeguards and management measures outlined in Section 6.4.4.

Local amenity

The project's construction may result in temporary impacts on local amenity for residents, businesses and users of community facilities closest to construction activities due to increased construction noise, vibration and dust (refer to Section 6.1 and 6.11). Impacts on night-time amenity may also be experienced for some residents, should night works be required. This may temporarily impact on sleeping patterns for some people. It is expected that these impacts would be appropriately managed through the implementation of safeguards and management measures outlined in Section 6.11.4.

Social Infrastructure

Temporary changes to on-street parking arrangements and minor traffic disruptions during the construction stage may have short-term impacts on social infrastructure near to the proposal. There may also be changes to the amenity of both intersections due to the change and/or removal of open space. There is not anticipated to be any direct impact to the North Richmond Seventh Day Adventist Church.

The proposal would support access to local and regional social infrastructure through reduced traffic congestion, improved access and connectivity, and improved safety for motorists travelling via the Bells Line of Road/Grose Vale Road intersection.

6.7.4 Safeguards and management measures

The proposed safeguards and management measures for socio-economic impacts are listed in Table 6-34. Refer to Section 6.1 for noise and vibration management measures; Section 6.2 for traffic, transport and access management measures; Section 6.4 for visual impact management measures; and Section 6.11 for air quality management measures.

Table 6-34 Safeguards and management measures for socio-economic impacts

Impact	Environmental safeguards	Responsibility	Timing
Community consultation	A Communication Engagement Plan (CEP) will be prepared and included in the CEMP. The CEP will include (as a minimum): • Requirements to provide details and timing of proposed activities to affected residents. • Contact name and number for complaints. • Procedure to notify nearby land users for changed conditions during the construction period such as traffic, pedestrian and	Construction contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	driveway access. The communications plan will be prepared in accordance with G36 requirements and Roads and Maritime Community Engagement and Communications Manual (2012).		
Property access	During construction, access to properties within the proposal area will be maintained. Temporary property access will be provided to residences and businesses where required. Consultation will be undertaken with the North Richmond Seventh Day Adventist Church to ensure access is maintained for pedestrians and vehicles at this site.	Construction contractor	Construction
Emergency vehicle access	Access will be maintained for emergency vehicles near construction areas. Roads and Maritime will consult with emergency services throughout construction to ensure that potential impacts are identified and appropriately managed.	Construction contractor	Construction

6.8 Land use and property

The following sections provide a desktop land use and property assessment for the proposal, based on the land use zoning, current aerial photography and property boundaries for the proposal site.

6.8.1 Existing environment

As outlined in Section 4.3, the proposal is located entirely within the Hawkesbury LGA with land directly affected by the proposal zoned as SP2 (Infrastructure), R2 (Low Density Residential), R3 (Medium Density Residential), B1 (Neighbourhood Centre), B3 (Local Centre) and RU1 (Primary Production) under Hawkesbury LEP. LEP zoning for the proposal is further discussed on Section 4.3.1 and shown in Figure 4-1.

Land uses located within the footprint of the proposal typically comprise existing road infrastructure (eg road pavement, drainage and guard rails), utility easements (comprising overhead electricity supplies, water mains and telecommunications infrastructure), residential and other privately owned property and vacant land located within the existing road reserve.

The proposal is largely surrounded by single and double-storey residential properties as well as commercial and light industrial buildings.

The closest sensitive receivers to the proposal are listed in Table 6-1 and generally comprise residential properties commercial premises, education facilities and places of worship. The locations of these receivers are shown in Figure 6-1.

6.8.2 Potential impacts

Direct land use and property impacts

Construction

Construction of the proposal would not directly impact on land use as the proposed work would be carried out within the existing road reserve and those areas next to the road reserve that would be permanently acquired for the proposal.

Operation

The proposal would require the permanent acquisition of about 575 square metres of privately owned land involving six properties and six separate land owners. It would also require the acquisition of about 110 square metres of public land (Council-owned public reserve) on the northern corner of Bells Line of Road and Terrace Road.

The majority of the private land to be acquired would comprise strips of residential land. However, one full property acquisition would also be required, affecting a commercial property at 60 Bells Line of Road.

The extent of land acquisition required for the proposal is shown in Figure 3-2, while an overview of all affected properties (including property address, Lot/DP, current land use and proposed area of acquisition) is provided in Table 3-6.

Consultation with relevant land owners commenced on 3 March 2015. All affected property owners would continue to be consulted during the detailed design and construction stages of the proposal. Further discussion on the consultation that has occurred with relevant lands owner is provided in Section 5.2.2.

All land acquisitions would be undertaken in accordance with the provisions of the *Land Acquisition (Just Terms) Compensation Act 1991*. Discussion on the socio-economic impacts associated with property acquisitions is provided in Section 6.7.

Indirect land use and property impacts

Construction

Indirect land use impacts associated with the construction of the proposal would typically relate to adverse amenity impacts (eg noise, dust and visual) on nearby land uses. Amenity related impacts are discussed in Sections 6.1 (noise and vibration), 6.4 (visual) and 6.11 (air quality). Adverse amenity impacts during the construction of the proposal would be temporary and would be manageable through the application of the safeguards and management measures outlined in Sections 6.1.5 (noise and vibration), 6.4.6 (visual) and 6.11.4 (air quality). Therefore, amenity related impacts associated with the proposal are not considered to be of an extent, magnitude or duration that would have the potential to impact on the current use of nearby properties.

Operation

The operation of the proposal would not result in any indirect long-term land use or property impacts. While the proposal would result in permanent visual amenity impacts associated with the removal of roadside trees and road pavement widening, changes to the existing visual environment are not considered likely to have the potential to impact on the current and/or future uses of nearby properties. Amenity related impacts are discussed further in Sections 6.1 (noise and vibration), 6.4 (visual) and 6.11 (air quality).

6.8.3 Safeguards and management measures

The proposed safeguards and management measures for land use and property are listed in Table 6-35.

Table 6-35 Safeguards and management measures for land use and property

Impact	Environmental safeguards	Responsibility	Timing
Direct land use and property impacts	Land directly affected during the establishment and operation of the construction compounds would be restored to its pre-construction condition.	Construction Contractor	Construction
Property acquisition	All land acquisitions would be undertaken in accordance with the provisions of the *Land Acquisition (Just Terms) Compensation Act 1991*.	Roads and Maritime	Pre-Construction
Leasing of private land	Land owner consent would be sought before the establishment of the construction compounds or any other ancillary facilities on private property. The construction compounds would not be established until a signed lease agreement has been received from the relevant land owner. Roads and Maritime Services would be consulted before contacting any land owners about the temporary leasing of their land.	Construction Contractor	Pre-Construction

6.9 Biodiversity

A detailed biodiversity assessment has been carried out for the proposal as part of this REF. The full impact assessment report is attached as Appendix C and is summarised below.

6.9.1 Methodology

A review of the following available ecological data and information sources was carried out to identify and describe vegetation and habitat characteristics and spatial distributions of potential threatened species, populations and ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database (post 1980 records) (OEH 2014).
- OEH Threatened Species Profile Search (OEH 2014).
- OEH Spatial Data Online Access (OEH 2014).
- Department of Environment (DoE) Protected Matters Search Tool (DoE 2014).
- DoE online species profiles and threats database (DoE 2013b).
- DPI Noxious weed declarations for relevant LGAs (DPI 2013).
- Native vegetation of southeast NSW (Tozer et al 2010).
- The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities (Tozer 2003).
- The Natural Vegetation of the Penrith 1:100 000 map sheet (Benson 1992).

The list of records of threatened biodiversity with potential to occur within the study area was reviewed for direct relevance to the proposal by taking the present condition of habitat types into consideration in relation to the broader study area.

A site visit was carried out by a suitably qualified Jacobs ecologist at midday on 2 June 2014 to complement the background review and to ground-truth existing ecological constraints in relation to the proposal. Weather conditions at the time of the site visit were typically fine and sunny with light winds.

6.9.2 Existing environment

Vegetation communities and habitat

Broadscale vegetation mapping

A review of existing broadscale vegetation mapping identified six native vegetation communities within two kilometres of the study area (refer to Table 3-2 of Appendix C for a list of these communities), five of which are listed as a threatened ecological community under the TSC Act and/or the EPBC Act. An overview of the vegetation communities that have been previously mapped within two kilometres of the study area, as well as their corresponding conservation status under the TSC Act and EPBC Act is provided in Table 3-2 of Appendix C (biodiversity assessment report; Jacobs 2014).

Ground-truthed vegetation communities

Ground-truthed vegetation mapping for the proposal area for the Bells Line of Road/Grose Vale Road intersection is provided in Figure 6-8. Vegetation within the proposal area consists of:

- Isolated stands of remnant native trees – comprising two Forest Red Gums (Eucalyptus tereticornis), a Narrow-leaved Ironbark (Eucalyptus crebra) and a planted Lemon-scented Gum (Corymbia citriodora) on the north-western side of the intersection, and a row of eight Forest Red Gums situated in the median of Bells Line of Road, to the east of the Bells Line of Road/Grose Vale Road intersection.
- Planted exotic and native trees – including Jacaranda (Jacaranda mimosifolia) and Crepe Myrtle (Lagerstroemia indica) on the north-western side of the Bells Line of Road/Grose Vale Road intersection.

The Forest Red Gums and Narrow-leaved Ironbarks are likely remnants of Cumberland Plain Woodland (listed as critically endangered under the TSC Act and EPBC Act). However, given the highly modified nature of the proposal area, vegetation located in the vicinity of the Bells Line of Road/Grose Vale Road intersection is not commensurate with a native vegetation community. Notwithstanding this, the remnant Forest Red Gums and Narrow-leaved Ironbarks have conservation value as 'stepping stones' for wildlife habitat connectivity as well as a genetic resource for recovery of the Cumberland Plain Woodland.

Figure 6-8
Ground-truthed vegetation mapping for the proposal area

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

Fauna habitat

Forest Red Gums (*Eucalyptus tereticornis*) within the study area (located on the north-western side of the Bells Line of Road/Grose Vale Road intersection as well as in the median of Bells Line of Road, to the east of the intersection) are a potential food resource for a variety of fauna species, including the Grey-headed Flying-fox (*Pteropus poliocephalus*; listed as Vulnerable under the TSC Act and the EPBC Act). Remnant Forest Red Gums and Narrow-leaved Ironbarks within the study area also have conservation value as 'stepping stones' for wildlife habitat connectivity.

Wildlife connectivity

There are no major wildlife corridors located within the proposal area. While the Hawkesbury River would act as an important connection for a variety of fish and birds; this wildlife corridor is located outside the proposal area and would not be impacted by the proposed work.

Threatened species and endangered populations

Threatened flora

The review of the Atlas of NSW Wildlife database identified a total of 31 threatened flora recorded within 10 kilometres of the study area. A full list of these species, as well as an assessment of the likely presence of these species within the proposal area, is provided in Appendix C. All of the threatened flora species identified within the vicinity of the study area are considered to have either a low potential to occur or are unlikely to occur in the proposal area due to the absence of these non-cryptic species and/or the absence of suitable habitat for these species.

Threatened fauna

A total of 59 threatened terrestrial and aquatic fauna species have been either previously recorded or are predicted to occur within 10 kilometres of the study area. A full list of these species, as well as an assessment of the likely presence of these species within the proposal area, is provided in Appendix C. The majority of the species are considered unlikely or have a low potential to occur within the proposal area (54 species); however, one species – the Grey-headed Flying-fox (listed as vulnerable under the TSC Act EPBC Act) – is considered to have a moderate potential to occur based on the habitats present and their condition.

A known Grey-headed Flying-fox camp is located about six kilometres from the study area at Yarramundi. Forest Red Gums in the study area are a potential food resource for the Grey-headed Flying-fox. The Forest Red Gum is considered a significant food tree species with a high nectar production and good annual flowering reliability (Eby and Law 2008). Grey-headed Flying-fox individuals are expected to occasionally fly over the study area at dawn and dusk.

Migratory species

A total of 15 migratory species have been either previously recorded or are predicted to occur within 10 kilometres of the study area.

6.9.3 Potential impacts

Loss of vegetation/habitat

The proposal would result in the clearing of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection, as well as other planted native and exotic vegetation from the area surrounding the proposal (see Figure 6-9).

Forest Red Gums within the study area are a potential food resource for a variety of fauna species, including the Grey-headed Flying-fox (listed as Vulnerable under the TSC Act and the EPBC Act), while remnant Forest Red Gums and Narrow-leaved Ironbarks have conservation value as 'stepping stones' for wildlife habitat connectivity. All vegetation and habitats that would be affected by the proposal are in very poor condition. Safeguards and management measures to minimise the extent of native vegetation clearing by the proposal are provided in Section 6.9.4.

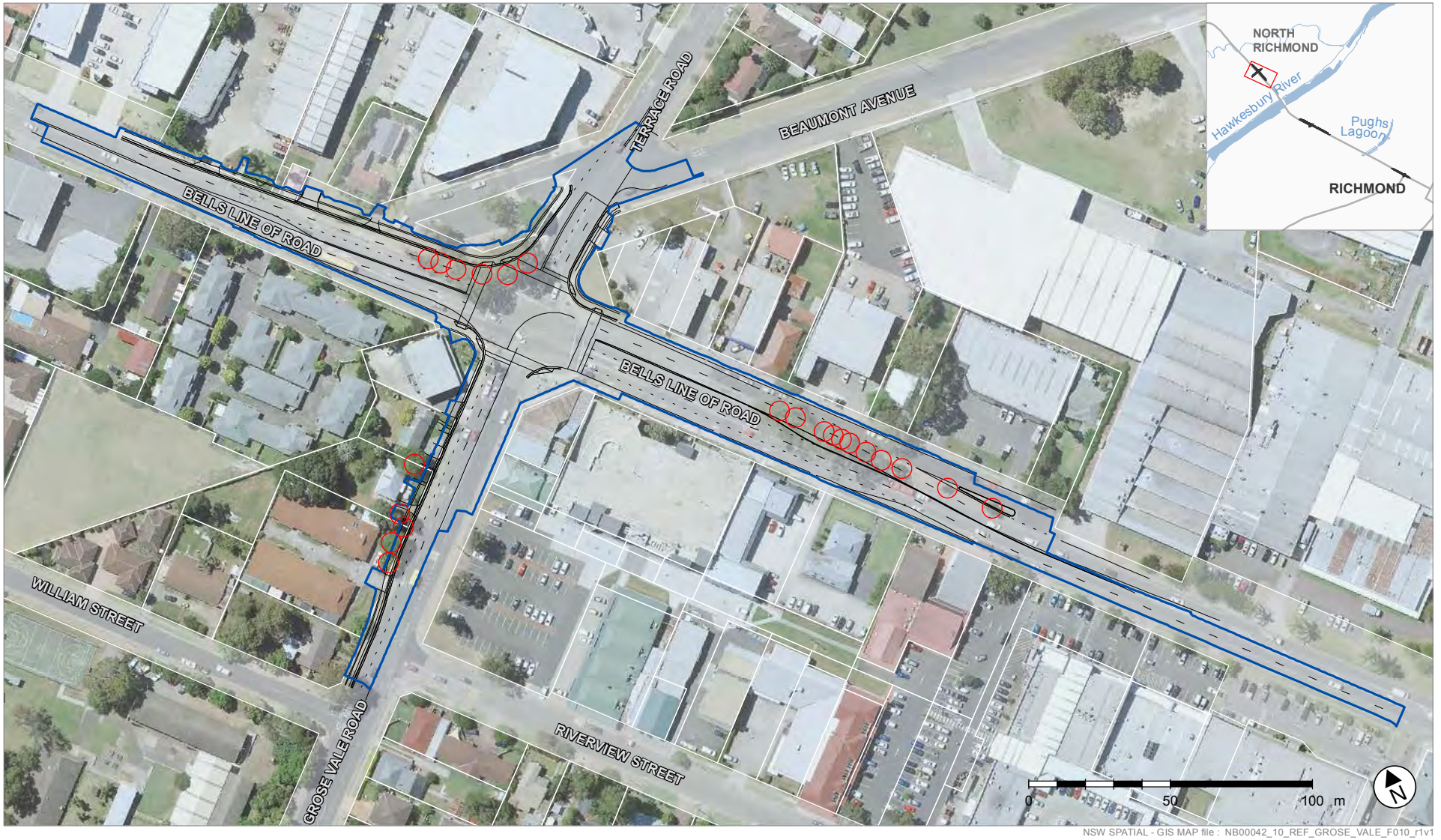

Figure 6-9
Locations of trees to be removed

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

Impact to threatened species

Threatened flora

No threatened flora species were identified within the proposal area during the field survey. All of the threatened flora species identified in the vicinity of the study area are considered to have either a low potential to occur or are unlikely to occur in the proposal area due to the absence of these non-cryptic species and/or the absence of suitable habitat for these species. Therefore, it is unlikely that threatened flora species would be impacted by the proposal.

Threatened fauna

The proposal would result in minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of the two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection.

Threatened species assessments were undertaken for the Grey-headed Flying Fox, which are presented in Appendix C. These assessments concluded that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox as:

- No camps or other important habitat would be impacted.
- The proposal is unlikely to reduce the population size, or decrease the reproductive success, of this species.

Wildlife connectivity and habitat fragmentation

The study area does not include any land identified that forms part of a regional biodiversity corridor. The study area is already highly fragmented; the removal of two remnant Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection and other planted native and exotic vegetation from the proposal area would not significantly increase habitat fragmentation.

Fauna injury and mortality

Given the lack of fauna observed across the study area, together with the mobility of the species that may exist in the area, it is considered unlikely that fauna species would suffer injury and mortality as a result of the proposal.

Weeds

The proposal has the potential to result in the dispersal of weed propagules (seeds, stems and flowers) during earthworks, movement of machinery and construction equipment and workers shoes and clothing. The proposal area was observed to contain a high abundance of weed species, five of which are listed under the *Noxious Weeds Act 1993* for the Hawkesbury City Council LGA, comprising African Boxthorn (*Lycium ferocissimum*), Blackberry (*Rubus fruticosus* aggregate species), Bridal Creeper (*Asparagus asparagoides*), Lantana (*Lantana camara*) and Large leaved privet (*Ligustrum lucidum*). All of these noxious weed species are listed as ‘class 4’ noxious weeds under the *Noxious Weeds Act 1993* and are also weeds of national significance. Weed dispersal risks associated with the proposal would be manageable through the application of standard safeguards and management measures, which would include the application of the relevant control requirements for ‘class 4’ weeds in accordance with the *Noxious Weeds Act 1993*.

Pests and pathogens

The proposal is for the upgrade of existing road infrastructure in a built up urban environment that would affect small pockets of vegetation. With the application and implementation of adequate safeguards, the proposal would not increase the abundance of pest species within the study area, or the risk of the spread of pathogens.

Noise, vibration and light

Given the low habitat potential of the proposal area, it is considered unlikely that noise, vibration or light associated with the proposal would have an adverse impact on the surrounding fauna. As the proposal comprises the upgrade of an existing road intersection in a highly urbanised environment

that experiences heavy traffic flows, fauna species occurring within and nearby to the proposal area are likely to be accustomed to road noise and constant presence of light; while construction noise and vibration would be temporary.

Impacts of relevant key threatening processes

The proposal would be associated with one potentially key threatening process as listed under the TSC Act and the EPBC Act, comprising the 'clearing of native vegetation' (listed under the TSC Act and the EPBC Act). The existing vegetation is not considered to be a 'native plant community' due to the lack of understorey or any associated structure, and the fact that the significant specimens (two Forest Red Gums at the corner of Bells Line of Road and Terrace Road) are isolated individuals.

As outlined above, clearing of native vegetation would be restricted to the removal of the two mature remnant Forest Red Gum trees at the proposal site. Safeguards and management measures to minimise the extent of native vegetation clearing by the proposal are provided in Section 6.9.4. All other vegetation and habitats that would be cleared by the proposal are in very poor condition and comprise planted exotic and native trees.

Without appropriate mitigation and management, the proposal has the potential to increase the risk of invasion and spread of the weeds within the study area. African lovegrass (*Eragrostis curvula*) is an exotic perennial grass in the study area which readily colonises overgrazed and disturbed sites such as roadsides and railway lines. It can form dense monocultures, increase fuel loads and limit native species regeneration. The proposal would physically remove vegetation from the construction corridor and disturb the soil. If left unmanaged there would be a high potential for the proposal area to become sites for invasion and spread of perennial grasses. These residual risks would be manageable through the application of standard safeguards and management measures as outlined below.

6.9.4 Safeguards and management measures

The proposed safeguards and management measures for biodiversity are listed in Table 6-36.

Table 6-36 Safeguards and management measures for biodiversity

Impact	Environmental safeguards	Responsibility	Timing
Inductions	Environmental awareness training would include the locations of protected vegetation, and requirements and safeguards for biodiversity included in the CEMP.	Construction Contractor	Construction
Clearing limits/Habitat trees	Clearing limits would be marked out by a surveyor prior to the commencement of works and would be clearly demarcated.	Construction contractor	Pre-construction
	All works are to comply with Roads and Maritime Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects. This would include managing the spread of Phytophthora and Chytrid fungus.	Construction contractor	Construction
	The removal of habitat trees (if they are found to be providing habitat) is to be staged in accordance with the RMS Biodiversity Guidelines	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	procedure.		
	A suitably qualified ecologist is to be present for the removal of any identified habitat trees. The ecologist is to be suitably vaccinated to handle bats.	Construction contractor	Construction
Noxious weeds	Develop and implement weed management measures including specific measures in accordance with the regulations set out under the Noxious Weeds Act 1993.	Construction contractor	Construction
	A machinery hygiene procedure would be implemented to prevent spread of weeds.	Construction Contractor	Construction
	Weeds are to be kept separate from general green waste and appropriately disposed of.	Construction Contractor	Construction
General	Locate temporary infrastructure (plant sites and offices etc.) in cleared areas away from vegetation, outside of the dripline of trees. Erect bunting around the dripline of trees to prevent stockpiling in tree protection zones.	Construction Contractor	Pre-construction

6.10 Water quality and hydrology

6.10.1 Existing environment

The following sections provide a desktop analysis of the hydrology and flooding of the study area based on a site inspection of existing drainage infrastructure and a desktop review of Hawkesbury City Council's (2011) Approximate Flood Extents of the Hawkesbury River and other publicly available information.

Surface waterways

Two surface waterways are located in the vicinity of the proposal area for the Bells Line of Road/Grose Vale Road intersection upgrade. These comprise Redbank Creek and the Hawkesbury River, which are located about 330 metres north and 830 metres south of the proposal, respectively.

The proposal area for the Bells Line of Road/Grose Vale Road intersection covers a catchment of about 14.22 hectares.

The existing road drainage for this intersection consists of a conventional urban pit and pipe network that drains towards the north-west, with the point of discharge being an open gully located to the rear of the light industrial buildings located at number 5 Terrace Road, North Richmond. A large Rocla CDS gross pollutant trap (GPT) is located next to 5 Terrace Road, North Richmond and is designed to capture and retain gross pollutants, litter, grit, sediments and associated oils.

The receiving gully appears stable and is lightly vegetated with moderate bank erosion. The existing headwall and 1,050 diameter discharge pipe also appear in good condition. Aerial

photographs indicate that this receiving gully discharges into a larger watercourse about 50 metres north-west of the pipe headwall.

South of Grose Vale Road approximately adjacent to the North Richmond Village shopping centre is a natural crest, which forms a partial boundary between the local catchments of Redbank Creek, to the north, and the Hawkesbury River, to the south. Drainage to the south from the natural crest appears to be via a shallow channel located beneath the road pavement, draining into the Hawkesbury River approximately 600 metres to the south.

Given the natural terrain, none of the stormwater collected in the (existing or upgraded) drainage network at the Bells Line of Road/Grose Vale Road intersection discharges south of Grose Vale Road.

Flooding

The proposal area is located on the floodplain of the Hawkesbury River. Flooding in the area has been previously investigated by Bewsher Consulting (2012) in the preparation of the Hawkesbury Floodplain Risk Management Study and Plan for Hawkesbury City Council.

Hawkesbury River flood levels at North Richmond Bridge for various storm events up to and including the Probable Maximum Flood (PMF) are shown in Table 6-37.

A review of Hawkesbury City Council's (2011) Approximate Flood Extents of the Hawkesbury River indicates that the proposal is located outside of the flood extent for a 100 year Average Recurrence Interval (ARI) event. However, the area would be inundated during the Probable Maximum Flood (PMF).

Table 6-37 Existing flood levels at North Richmond Bridge

Flood event	Flood level at North Richmond Bridge (m AHD)
10 year ARI	14.0
20 year ARI	15.3
50 year ARI	16.4
100 year ARI	17.5
200 year ARI	18.9
500 year ARI	20.4
1000 year ARI	22.1
PMF	26.5

6.10.2 Potential impacts

Construction

Water quality

The construction phase of the proposal has the potential to result in impacts on local water quality through:

- Construction activities with a risk of erosion including bulk earthworks, grubbing of vegetation and trenching for utilities.
- Erosion of soil and sedimentation through stormwater runoff and transport of eroded sediments to nearby waterways, particularly Redbank Creek, about 500 metres north from the proposal at its closest point.
- Accidental spills of fuels, oils or other chemicals from construction vehicles or equipment.

Contaminants could enter the local stormwater system and be transported to nearby waterways, as identified in Section 6.10.1. This impact can be managed through mitigation measures and therefore the risk to water quality is low.

- Risk of alkaline runoff from concrete works and washout areas.

Given the distance to natural waterways, and the relatively flat nature of the topography, the risks to water quality during construction are considered to be minor and can be readily mitigated with standard construction site management measures. With the implementation of the proposed safeguards and management measures, the risks to water quality would be minimal. In respect of the requirements of the Hawkesbury-Nepean River REP (discussed in Section 4.2.1), the proposed intersection upgrade and the associated improvements to road drainage infrastructure can be accommodated without overloading or exceeding the capacity of the existing stormwater network. Therefore it is considered that the proposed works will not result in any discernible increase in stormwater discharge to the Hawkesbury River (or its tributaries), or any reduction in the quality of stormwater being discharged.

Flooding

The proposal is located outside of the flood extent for a 100 year Average Recurrence Interval (ARI) event and is unlikely to be at risk of flooding. Potential flood risks associated with localised inundation events (eg due to blockages or failure of existing stormwater infrastructure) would be manageable through the application of standard safeguards and management measures (such as regularly observing weather forecasts for the region and not storing materials in the vicinity of stormwater infrastructure). Flooding would have the greatest potential impact on water quality if it were to occur during the earthworks phase.

Operation

Water quality

The operation of the proposal is not expected to impact on downstream water quality. The downstream receiving waterways are impacted by runoff from urban and rural residential areas, including roadways under the existing situation. The proposal constitutes minor widening of short sections of existing roads and creates only a minor increase in paved surface area. Additionally it incorporates upgraded road drainage and scour protection, designed to current industry standards of best practice. As such, the proposed works will not result in any discernible increase in stormwater discharge to the Hawkesbury River (or its tributaries), or any reduction in the quality of stormwater being discharged.

Flooding

The proposal is located outside of the flood extent for a 100 year Average Recurrence Interval (ARI) event and would not result in a discernible impact on existing flood behaviour.

6.10.3 Safeguards and management measures

The proposed safeguards and management measures for water quality and hydrology are listed in Table 6-38. Safeguards and management measures specific to soils are outlined in Table 6-28.

Table 6-38 Safeguards and management measures for water quality and hydrology

Impact	Environmental safeguards	Responsibility	Timing
Water quality management	Soil and water management measures will be included in the CEMP. The CEMP will address the: • Roads and Maritime Code of Practice for Water Management (1999), the Roads and Maritime Erosion and Sedimentation Procedure.	Construction Contractor	Pre-Construction

Impact	Environmental safeguards	Responsibility	Timing
	• The NSW Soils and Construction – Managing Urban Stormwater Volume 1 "The Blue Book" (Landcom, 2004) and Volume 2 (DECC, 2008). • Roads and Maritime Technical Guideline: Temporary Stormwater Drainage for Road Construction, 2011. • Roads and Maritime Technical Guideline: Environmental Management of Construction Site Dewatering, 2011. • Erosion and Sediment Management Procedures (P143P), Nov 2008.		
Water quality management	Before the start of work, erosion and sedimentation controls are to be developed and implemented in accordance with the requirements of the Blue Book. The controls are to address the following as a minimum: • A process to routinely monitor the BOM weather forecast and identification of additional controls to be implemented ahead of rain. • A procedure for routine inspection and maintenance of erosion and sediment controls. • Nominated concrete washout areas away from watercourses and drainage. • Nominated spill kit locations. • Progressive stabilisation plan. • Stockpiles are to be restricted to the identified construction compounds, and managed in accordance with Roads and Maritime Stockpile Site Management Guideline, RMS Environmental Protection (Management System) QA Specification G36 and RMS Vegetation QA Specification R178. • Any dewatering required would be in accordance with Roads and Maritime Environmental Management of Construction Site Dewatering 2011. • Controls are to be implemented at exit points to minimise tracking soil and particulates onto pavement surfaces outside of the	Construction Contractor	Pre-Construction

Impact	Environmental safeguards	Responsibility	Timing
	construction site area. • Any material transported onto pavements would be swept and removed at the end of each working shift and before rainfall.		
Flood risk	A Flood preparedness plan would be incorporated within the CEMP and include measures to prepare the site for flood events. This is to include (but not be limited to): • Requirements to remove site plant and equipment outside of flood hazard areas • Stabilise disturbed areas • Maintain safe evacuation routes for the public and construction contractors and staff.	Construction contractor	Pre-construction

6.11 Air quality

6.11.1 Criteria

For this proposal, emissions from construction equipment and vehicles using the roadway have the potential to impact on local amenity. The most substantial emissions produced from motor vehicles are:

- Oxides of nitrogen (NOx).
- Carbon monoxide (CO).
- Particulate matter (PM10).

Of particular relevance to the proposed construction activities are criteria for particulate matter. There are various classifications of particulate matter, with the EPA providing assessment criteria for:

- Total suspended particulates (TSP).
- Particulate matter with equivalent aerodynamic diameter less than or equal to 10 micrometres (PM10).
- Deposited dust.

The EPA has set air quality assessment criteria as part of the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC 2005). Table 6-39 summarises the EPA air quality assessment criteria that are relevant to the proposal. Note that while health research identifies $PM_{2.5}$ as a particular concern, there are currently no EPA assessment criteria for $PM_{2.5}$.

Table 6-39 EPA assessment criteria for relevant air pollutants

Pollutant	Averaging time	Criterion
Carbon monoxide (CO)	Maximum 1-hour average	30 mg/m^3
	Maximum 8-hour average	10 mg/m^3
Nitrogen dioxide (NO2)	Maximum 1-hour average	246 µg/m^3
	Annual average	62 µg/m^3

Pollutant	Averaging time	Criterion
Particulate matter (as PM10)	Maximum 24-hour average	50 µg/m^3
	Annual average	30 µg/m^3
Total suspended particulates (TSP)	Annual average	90 µg/m^3
Dust deposition	Annual average (maximum increase)	2 g/m^2/month
	Annual average (maximum total)	4 g/m^2/month

6.11.2 Existing environment

Ambient air quality

No air quality monitoring was carried out specifically for this proposal. However, the NSW Office of Environment and Heritage operate an air quality monitoring station at Richmond, which has been assumed to be representative of the air quality for broader study area. The Richmond air quality monitoring station currently records ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and particulates under 10 microns in size (PM_{10}).

A review of data collected in 2012 from the Richmond air quality monitoring station (the most current publicly available data) against EPA assessment criteria (refer to Table 6-39) identified that the concentrations of O_3, SO_2 and NO_2 were below the relevant air quality criteria; however, three exceedances of the applicable criteria were recorded for PM_{10}. No measurements of carbon monoxide (CO) are made at the Richmond air quality monitoring station.

Ambient air quality within the proposal area is likely to primarily be affected by local air emission sources, including exhaust emissions from vehicles using the existing road network, particulate emissions (dust) from wind erosion from exposed areas and agricultural activities occurring on nearby rural land.

Sensitive receivers

The closest sensitive receivers to the proposal comprise the following:

- Five residential properties, located between five metres and 23 metres from the proposed work (refer to Table 6-1 for a list of these properties).
- Three commercial premises, located between five metres and 60 metres from the proposed work (refer to Table 6-1 for a list of these properties).
- The Richmond North Public School, located about 45 metres from the proposed work at the Bells Line of Road/Grose Vale Road intersection.
- The North Richmond Seventh Day Adventist Church, located about 10 metres from the proposed work at the Bells Line of Road/Grose Vale Road intersection.

The locations of these sensitive receivers are shown in Figure 6-1.

6.11.3 Potential impacts

Construction

Construction of the proposal would result in particulate (dust) and gaseous emissions due the undertaking of dust generating activities and the combustion of diesel and petrol fuel in construction plant, vehicles and equipment. Potential air quality impacts during construction would largely result from dust generated during earthworks, particularly excavation activities. Particulate

emissions from construction have the potential to affect amenity and, in extreme cases, human health.

Primary sources of emissions of airborne particulate matter associated with the construction of the proposal would include:

- Vegetation clearing and the stripping of topsoil.
- Demolition, handling and removal of concrete and pavement materials by excavators and trucks.
- Wind erosion from unsealed surfaces and stockpiles.
- The loading/unloading of construction materials.
- The movement of construction vehicles along paved and unsealed haulage routes and other work areas.
- Vehicle (exhaust) emissions.

While the volume of dust generated during a typical work day is anticipated to be small, there are a number of sensitive receivers (including residential properties) located in close proximity to the proposed work, some of which are located within 10 metres of the proposal area. Adequate management measures would be implemented to ensure dust generated during construction would not impact on local air quality. Dust and air quality management measures that would be implemented for the proposal are outlined in Section 6.11.4.

Operation

No adverse air quality impacts are expected to result from the operation of the proposal. Improved traffic flow and reduced congestion could potentially have a minor beneficial effect to air quality in the immediate vicinity of the proposal; however, such benefits have not been quantified as part of this REF.

6.11.4 Safeguards and management measures

The proposed safeguards and management measures for air quality are listed in Table 6-40.

Table 6-40 Safeguards and management measures for air quality

Impact	Environmental safeguards	Responsibility	Timing
Dust and air quality management	Dust emissions during construction of the proposal would be minimised through the implementation of standard mitigation measures, which would include (but would not be limited to) the following: • Measures (including watering or covering exposed areas) are to be used to minimise or prevent air pollution and dust. • Work (including the spraying of paint and other materials) are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely. • Vehicles transporting waste or other materials that may produce odours or dust are to be covered during transportation. • Stockpiles or areas that may	Construction contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	generate dust are to be managed to suppress dust emissions in accordance with the Roads and Maritime Stockpile Site Management Guideline (2011). • Communications material such as the project website and community notification would include a contact person and phone number to enable complaints to be received and responded to. Erosion and sediment controls would be reviewed for adequacy in response to any dust complaints.		

6.12 Non-Aboriginal heritage

A specialist non-Aboriginal heritage assessment has been carried out for the proposal as part of this REF. The full impact assessment report is attached as Appendix D and is summarised below.

6.12.1 Methodology

Register searches and literature review

A search of the following non-Aboriginal heritage registers and previous broad-scale heritage assessments was carried out on 26 May 2014 to identify heritage places within or immediately next to the proposal:

- NSW State Heritage Register.
- Roads and Maritime Section 170 Heritage and Conservation Register.
- Hawkesbury LEP 2012.
- Commonwealth Heritage List.
- National Heritage List.
- World Heritage List.
- Register of the National Estate.
- Heritage Study of the North Western Sector of Sydney (Howard Tanner and Associates 1984).
- Richmond NSW Townscape Study (Shellshear 1986).

Site survey

A site survey of the study area was carried out on 30 May 2014 to verify previously recorded historical heritage items and associated heritage curtilages identified during the register searches. The site survey was also used to identify any previously unrecorded historical heritage items, archaeological sites, as well as assess the potential for archaeological resources to be present on site.

6.12.2 Existing environment

History of the study area

The Hawkesbury region was taken up by small farmers as early as the 1790s, growing wheat and maize and shipping it to Sydney on the Hawkesbury River. From around 1821, the Hawkesbury

River was crossed at North Richmond by a punt which operated close to the site of the current Richmond Bridge.

In 1857, the Richmond Bridge Company was formed to replace the punt with a bridge. A wooden bridge was opened in 1860, which was the first bridge crossing over the Hawkesbury River. This wooden bridge was eventually weakened by continual floods, with construction of a new bridge commencing in 1904. Additions to the new bridge were carried out in 1926 to allow the Richmond Kurrajong railway line to cross the Hawkesbury River (Nichols 2003).

During World War I, the Richmond airfield was established on Ham Common as a NSW Government Flying School. During World War II, Richmond developed into a base of major importance to Australia's defence, and has since evolved from a combat centre to the home of Air Lift Group. The base is now the hub of logistics support for the Australian Defence Force (Royal Australian Air Force 2009; 2012).

The Richmond-Kurrajong Railway Line opened in 1926 after about 40 years of lobbying from local residents and farmers, but its opening coincided with a period of extensive road building and it struggled to earn income.

The line operated until 1952, along a corridor from Richmond Station via March Street and a separate right-of-way parallel to the northern side of Kurrajong Road, before crossing the Hawkesbury River on a bridge that was built as an extension of the adjacent road bridge. The line then followed an alignment close to the existing Beaumont Avenue alignment, before crossing Bells Line of Road at a 45 degree angle and into North Richmond Station, near the north-west corner of Bells Line of Road and Grose Vale Road.

The railway closed in 1952 after heavy flooding had caused a cutting to collapse, and the cost of repairs would have been higher than the line's total annual income.

Listed heritage items

Three listed heritage items were identified within or immediately adjacent to the proposed work for the proposal. These heritage items are outlined in Table 6-41 (along with their associated listing(s) on non-Aboriginal heritage registers), while the locations of the items are shown in Figure 6-10. Figure 6-10 identifies a fourth listed heritage item, being a house on Charles Street near the intersection of Grose Vale Road (Item I410). This item will not be impacted by the proposed works and is therefore not discussed further in this assessment.

As indicated in Table 6-41, all of the identified listed heritage items are of local heritage significance under the *Hawkesbury Local Environmental Plan 2012* (Hawkesbury LEP). There were no heritage items listed on the Roads and Maritime Section 170 Heritage and Conservation Register, the State Heritage Register, the Commonwealth Heritage List, the National Heritage List or the World Heritage List located within or adjacent to the proposal.

The Richmond-Kurrajong Railway Line is not listed under the Hawkesbury LEP, the State Heritage Register, the NSW Railways (RailCorp) Section 170 Register, the NSW National Trust register, the National Heritage List, the Commonwealth Heritage List, the World Heritage List or the Register of the National Estate. There is a minor mention of the Richmond-Kurrajong Railway Line in the listing for the Richmond Railway Station and Yard Group (which is on the State Heritage Register and s170 RailCorp Register). It states:

> "KURRAJONG LINE AND YARD REMAINS (1926)
> The former Kurrajong line sidings, former sidings, stock yards, turntable and engine shed appear to be visible under the car park which has been topped with asphalt surface. Remnants may survive below the new surface."

However, the extent of these (potential) remains is within the Richmond Railway Station carpark only, which is outside the proposal area.

Table 6-41 Existing non-Aboriginal heritage items located within and adjacent to the proposal

Heritage item	Register(s) listed	Heritage significance	Location
Seventh Day Adventist Church (Item I407)	Hawkesbury LEP	Local	54 Bells Line of Road, North Richmond
House (Item I495)	Hawkesbury LEP	Local	15 Grose Vale Road, North Richmond
Former Police Station and Residence (Item I406)	Hawkesbury LEP	Local	39 Bells Line of Road, North Richmond
Kurrajong to Richmond Railway line (see discussion below)	Not listed	N/A	Former North Richmond Station located at intersection of Bells Line of Road and Grose Vale Road.

NSW SPATIAL - GIS MAP file : NB00042_10_REF_GROSE_VALE_F007_r1v1

Heritage items*

Hawkesbury LEP heritage data

NSW State Heritage Register data

* Standard Instrument Local Environmental Plan (SILEP) - Office of Environment & Heritage 2016

Figure 6-10
Non-Aboriginal heritage items located within and adjacent to the proposal

RICHMOND BRIDGE APPROACHES
INTERSECTION UPGRADE AT BELLS LINE OF ROAD/GROSE VALE ROAD

Previously unknown heritage items and areas of archaeological potential

No previously unknown heritage items or areas of archaeological potential were identified during the site inspection. However, subsequent information received from Roads and Maritime indicated the potential for the remains of the Richmond to Kurrajong Railway Line to exist within the study area.

Richmond to Kurrajong railway line

Parish maps dating 1915 and 1916 indicate that the railway line ran from the Richmond Railway Station in East Market Street, Richmond, along what is now Kurrajong Road to the Richmond Bridge, before crossing the river and ascending the bank along a curved alignment that follows what is now the alignment of Beaumont Avenue (Currency Parish map 1916, Ham Common Parish map 1915). The railway crossed Bells Line of Road at Terrace Road, into the North Richmond Station which was situated on the western side of the existing Bells Line of Road/Grose Vale Road intersection. The prevailing pattern of cadastral boundaries on the western side of the intersection, clearly visible in Figure 6-10, still bears the imprint of the former rail corridor.

No evidence of the existence of the Richmond-Kurrajong Railway Line remaining under the road surface was noted during the site inspection (such as subsidence or visible ridges in the road surface). However, there is the potential for the rails, sleepers or other remains of the line to be present.

Investigations in respect of the former railway line have been undertaken and documented in the *Strategic Concept Options Study, Richmond Bridge and Approaches: Historic Heritage Impact Assessment*, prepared by Australian Museum Business Services (AMBS) in 2012. The AMBS report confirms that the former railway holds no statutory or non-statutory (registered) significance. However, the report makes numerous references to the former railway and its historic importance to the region. It also refers to the railway in the context of the overall Richmond Bridge and Approaches Strategy, and emphasises the potential presence of archaeological material associated with the railway at all of the sites affected by the Strategy.

6.12.3 Potential impacts

Potential impacts that the proposal would have on each of the identified non-Aboriginal heritage items is provided in Table 6-42. Table 6-42 also presents specific safeguards and management measures that would be required to reduce any potential impacts to an acceptable level.

Direct impacts on previously identified heritage items

As indicated in Table 6-42, the proposal will not have a direct impact on any of the three listed non-Aboriginal heritage items identified in the vicinity of the proposal.

In respect of the former Richmond to Kurrajong railway, the AMBS (2012) report notes that physical evidence associated with the railway and the station at North Richmond "is likely to be exposed by works adjacent to Beaumont Avenue". The report then concludes that the proposed works are:

> *"… likely to have a significant impact on surviving physical evidence associated with the alignment of the Richmond to Kurrajong railway along Beaumont Avenue, including the platform on the west side of the intersection. There will be an adverse impact on the historic and technical heritage values of the railway. Site specific Archaeological Assessments will be required to ensure that archaeological resources will be managed appropriately."* (AMBS, 2012).

Safeguards and management measures to ensure the appropriate management of potential archaeological material associated with the Richmond to Kurrajong railway are outlined in Table 6-42 and in Section 6.12.4.

Indirect impacts on previously identified heritage items

The proposal has the potential to indirectly impact on listed heritage items during vibration intensive construction work. As outlined in Section 6.1.4, where vibration-intensive equipment is used in closer proximity to residential and heritage-listed properties (which could be carried out within 10 metres of the closest façade), it is possible that the lowest values (for 1 to 10 Hz) for building damage could be exceeded.

Of the three listed heritage items identified, two are situated adjacent to the proposed works and are considered to be potentially sensitive to construction vibration: the Seventh Day Adventist Church at 54 Bells Line of Road; and the former Police Station and residence at 39 Bells Line of Road. Because of their proximity to the works, it is considered that the added safeguard of a pre-condition survey be implemented for these two properties, prior to construction commencing.

Safeguards and management measures that would be implemented to manage construction vibration impacts on surrounding sensitive receivers are outlined in Section 6.1.5.

Overall significance of non-Aboriginal heritage impacts

Overall, the level of impact on non-Aboriginal heritage items would be relatively minor and would be reduced to an acceptable level through the implementation of the general and site-specific mitigation measures as documented in Section 6.12.4, which include the mapping of heritage items, heritage awareness training and protocols for unexpected finds of heritage items.

Table 6-42 Potential impacts on non-Aboriginal heritage items

Heritage item	Significance of item	Proposed nearest work	Potential impacts of the proposed work	Mitigation measures
Seventh Day Adventist Church, 54 Bells Line of Road	Historical significance as an early church in North Richmond.	Reduction of existing footpath in front of the Church to accommodate two westbound lanes on Bells Line of Road. Construction work would be undertaken outside of the Hawkesbury LEP heritage boundary of this item.	Potential for damage to the fabric of the Church building due to vibration caused by construction machinery.	A pre-condition survey is to be carried out on the Church building prior to commencement of construction. Repair of any damage to the building's fabric attributable to construction vibration shall be the responsibility of the contractor.
House, 15 Grose Vale Road	Historical significance as an early example of residence in North Richmond.	Construction work would be undertaken about 20 metres to the north of the Hawkesbury LEP heritage boundary of this item.	No impact	None required
Former Police Station and Residence, 39 Bells Line of Road	Historical significance as an early government building in North Richmond.	Increase of existing footpath in front of Former Police Station to accommodate dedicated left turn lane into Grose Vale Road. Construction work would be undertaken outside of the Hawkesbury LEP heritage boundary of this item.	Potential for damage to the fabric of the Police Station building due to vibration caused by construction machinery.	A pre-condition survey is to be carried out on the Police Station building prior to commencement of construction. Repair of any damage to the building's fabric attributable to construction vibration shall be the responsibility of the contractor.
Richmond to Kurrajong railway line, Kurrajong Road	Significance not assessed in this REF, but likely to be of local significance (if physical evidence still exists).	Excavation works beneath the current road surface at Bells Line of Road/Grose Vale Road intersection.	Potential damage to railway line remains which may exist beneath the road surface.	A pre-construction site specific archaeological assessment, by a suitably qualified person, is to be conducted where the former railway alignment is affected by proposed excavation or ground disturbance works. The assessment may make a recommendation for monitoring of

Heritage item	Significance of item	Proposed nearest work	Potential impacts of the proposed work	Mitigation measures
				any excavation works by a suitably qualified person, during construction. The assessment and monitoring would then (if required) support and inform an application for excavation permit under s.139 of the *Heritage Act*.

6.12.4 Safeguards and management measures

The proposed safeguards and management measures for non-Aboriginal heritage are listed in Table 6-43. Safeguards in respect of construction vibration are listed in Table 6-13 under Section 6.1 Noise and vibration and are therefore not repeated here.

Table 6-43 Safeguards and management measures for non-Aboriginal heritage

Impact	Environmental safeguards	Responsibility	Timing
Unexpected archaeological remains	If unexpected archaeological remains are uncovered during the works, all works must cease in the vicinity of the material/find and the steps in the Roads and Maritime Standard Management Procedure: Unexpected Archaeological Finds procedure must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.	Construction Contractor	Construction
Richmond-Kurrajong railway line	A pre-construction site specific archaeological assessment, by a suitably qualified person, is to be conducted where the former railway alignment is affected by proposed excavation or ground disturbance works. The assessment may make a recommendation for monitoring of any excavation works by a suitably qualified person, during construction. The assessment and monitoring would then (if required) support and inform an application for excavation permit under s.139 of the *Heritage Act*.	Construction Contractor	Pre-construction
Inductions	Environmental awareness is to include responsibilities under heritage legislation and the contractors EMP.	Construction Contractor	Pre-Construction

6.13 Resource use and waste

6.13.1 Policy setting

The NSW Waste Avoidance and Resource Recovery Strategy 2007 (WARR Strategy) aims to minimise waste generated across all government sectors and improve the efficient use of resources. This reflects the community's view that waste should be treated as a resource. The WARR Strategy identifies the following waste avoidance and resource recovery goals and targets:

- Prevent and avoid waste.
- Increase recovery and use of secondary materials.
- Reducing toxicity in products and materials.
- Reducing litter and illegal dumping.

Roads and Maritime is dedicated to the minimisation of waste and the use of recycled products where possible. Roads and Maritime contractors are required to propose recycled-content materials where they are cost and performance competitive.

By adopting the principles of the WARR Strategy, Roads and Maritime seeks to ensure the most efficient use of resources and reduce cost and environmental harm in accordance with the principles of ecologically sustainable development, as outlined in Section 8.2 of this REF.

6.13.2 Existing environment

The existing road network within the proposal area currently generates minimal waste. Waste sources are currently limited to roadside litter, some waste material from clearing roadside drainage features and green waste associated with the maintenance of roadside vegetation

6.13.3 Potential impacts

Construction

Waste

Construction would generate waste streams typical of road construction work, including:

- Green waste from cleared vegetation.
- Waste road and other infrastructure materials (signposts, telecommunications conduits, electricity transmission poles, water mains and gas mains).
- Oil, grease and other liquid wastes from the maintenance of construction plant and equipment.
- General wastes and sewage from site compounds and offices.
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics and wrapping materials.
- Potential contaminated material unearthed during construction (refer to Section 6.6 for discussion on contamination issues for the proposal).

The volumes of waste generated by the proposal would be typical of comparable road infrastructure work and would be readily manageable through the application of standard mitigation measures.

Resource use

Construction of the proposal would require the use of various construction materials, including pavement sealant, asphalt, road base, topsoil, concrete, steel and water. The anticipated quantities of construction materials required for the proposal are outlined in Table 3-5.

The volume of construction materials required for the proposal would be comparable with other similar sized road infrastructure projects. The resources required for the proposal are considered to be readily available. The proposal would not create any significant demand on these resources, such that they would become in short supply.

Operation

Potential impacts associated with the operation of the proposal include littering by road users and potential vehicle spills; both of which are not anticipated to significantly change as a direct result of the proposal.

6.13.4 Safeguards and management measures

The proposed safeguards and management measures for resource use and waste are listed in Table 6-44.

Table 6-44 Safeguards and management measures for resource use and waste

Impact	Environmental safeguards	Responsibility	Timing
Resource use and waste	The following resource management hierarchy principles are to be followed: • Avoid unnecessary resource consumption as a priority. • Avoidance is followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery). • Disposal is carried out as a last resort (in accordance with the Waste Avoidance & Resource Recovery Act 2001). All waste would be disposed of in accordance with the EPA waste classification guidelines at an appropriately licensed waste facility. Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day. Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Construction Contractor	Construction

6.14 Greenhouse gas emissions and climate change

6.14.1 Existing environment

Greenhouse gases include carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons. These gases absorb heat that is reflected from the earth, which results in warming of the air. This effect is known as the greenhouse effect. The primary human produced greenhouse gas is carbon dioxide.

Human activities such as the combustion of carbon-based fuels increase the amount of greenhouse gases in the atmosphere. This leads to an increase in atmospheric temperatures and is known as the enhanced greenhouse effect.

Climate change refers to the projected long-term changes to global climatic patterns as a result of increases in the concentration of greenhouse gases in the atmosphere. There is a need to understand these projected changes to future climatic conditions and the effect they could have on existing and potential projects and infrastructure. Moreover, it is important to understand how the proposal might influence these changes.

Climate change projections detailed in this assessment have utilised publicly available information. Table 6-45 provides information on climate change forecasts for the Sydney Metropolitan and Sydney/ Central Coast regions of NSW (an area surrounding Sydney fringed by the Blue Mountains and the Woronora, Yengo and Wollemi plateaus). The table provides details of the climatic change projections for the area surrounding the proposal to the year 2070, adapted from the NSW Climate Impact Profile (DECCW 2010) and the Metropolitan Sydney Climate Change Snapshot (OEH 2014).

Table 6-45 Projected climatic change predictions for the Sydney/Central Coast region, NSW

Season	Seasonal rainfall	Temperature		Evaporation
		Minimum	Maximum	
Spring	↑ 0-5%	↑ 1.35-2.55°C	↑ 1.6-3.0°C	↑ 10-20%
Summer	↑ 10-20%	↑ 1.75-3.0°C	↑ 1.45-2.9°C	↑ 10-20%
Autumn	↑ 10-20%	↑ 1.4-2.6°C	↑ 1.4-2.2°C	No clear pattern
Winter	↓ 0-5%	↑ 1.25-2.2°C	↑ 1.4-1.9°C	No clear pattern

Source: Adapted from the results for 'far future' (2060-2075) climate change in the *Metropolitan Sydney Climate Change Snapshot* (OEH 2014) and the *NSW Climate Impact Profile* (DECCW 2010)

Expected regional climatic changes for the Sydney/ Central Coast region of NSW as defined in DECCW (2010) are as follows:

- Increase in average daily minimum and maximum temperatures.
- Shifts in current patterns of climate variability, including increased rainfall in summer and decreased rainfall in winter.
- Increased intensity of extreme events (eg droughts, floods, severe storm events).
- Changes in seasonality and amount of precipitation (the direction and magnitude of changes will vary between geographic locations).

By 2070, the Sydney Metropolitan region of NSW is expected to experience a hotter climate, with temperatures projected to increase by between 1.25°C to 3°C throughout the year. Rainfall is projected to increase in spring, summer and autumn, and a decrease in winter. Evaporation in spring and summer will increase, with no clear change in evaporation patterns in autumn and winter.

6.14.2 Potential impacts

Construction

Greenhouse gas emissions

Construction of the proposal is anticipated to be completed within about 12 months. During this time, greenhouse gas emissions would be produced, including:

- Carbon dioxide, methane and nitrous oxide generated from liquid fuel use in plant and vehicles (diesel, petrol).
- Embedded emissions associated with the manufacture and delivery of construction materials.
- Methane generated from land filling any carbon based waste.

The volume of greenhouse gas emissions that would be generated during the construction of the proposal would be dependent on the quantity of construction materials used and the types of construction plant and equipment operated on site.

Given the nature of the proposal, it would not be possible to completely avoid the generation of greenhouse gas emissions during construction (due to the need to consume energy and resources). Notwithstanding this, the volume of greenhouse emissions produced as a result of the proposal would be minimised through the application of standard mitigation measures, as outlined in Section 6.14.3. Overall, construction related greenhouse gas emissions associated with the proposal would be relatively minor and comparable with similar road upgrade projects.

Climate change risks

Climate change risks during the construction of the proposal would primarily be associated with the occurrence of severe weather events; for example, the increased frequency and severity of rainfall events placing increased pressure on erosion and sediment control measures and/or flooding of the work site.

The proposal is located outside of the flood extent for a 100 year Average Recurrence Interval (ARI) event and, therefore, is unlikely to be affected by flooding. Given the anticipated timing of construction, climate change risks are generally considered to be minor and would be readily manageable through the application of standard mitigation measures that have been adequately designed to respond to the potential occurrence of the increased frequency and severity of rainfall events.

Operation

Greenhouse gas emissions

Greenhouse gas emissions during the operation of the proposal would primarily be associated with maintenance activities and the operation of private motor vehicles on the road network. The volume of greenhouse gas emissions generated during operation of the proposal would depend on the frequency and intensity of maintenance activities and the volume of vehicles using the road network. These emissions are anticipated to be comparable with those emissions already occurring within the study area and would not be expected to significantly change as a result of the proposal (ie traffic volumes and/or maintenance frequencies would not be anticipated to change as a direct result of the proposal).

Climate change risks

Climate change risks during the operation of the proposal would primarily be associated with:

- Increases in average temperatures and heatwaves which may affect the integrity of pavement and other construction materials. Direct impacts could include more rapid deterioration of infrastructure, which may result in higher operational and maintenance costs. Indirectly, evaporative changes can result in changes to soil moisture content and soil instability, which may impact foundations of structures, cause cracking and/or softening of pavements and road rutting.
- The increased frequency and severity of rainfall events placing increased pressure on drainage infrastructure and/or resulting in flooding of the study area.

Given that the proposal comprises relatively minor upgrades of the Bells Line of Road/Grose Vale Road and March Street/Bosworth Street intersections, infrastructure established as part of the proposal would not likely be any more susceptible to climate change risks than that of the existing road network.

6.14.3 Safeguards and management measures

The proposed safeguards and management measures for greenhouse gas emissions and climate change are listed in Table 6-46.

Table 6-46 Safeguards and management measures for greenhouse gas emissions and climate change

Impact	Environmental safeguards	Responsibility	Timing
Construction greenhouse gas emissions	Plant and equipment would be switched off when not in use. Vehicles, plant and construction equipment would be appropriately sized for the task and properly maintained so as to achieve	Construction Contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	optimum fuel efficiency. Materials would be delivered with full loads and would come from local suppliers, where possible. The energy efficiency and related carbon emissions would be considered in the selection of vehicle and plant equipment.		

6.15 Cumulative environmental impacts

Cumulative impacts have the potential to arise from the interaction of individual elements within the proposal and the additive effects of the proposal with other external proposals. Roads and Maritime is required under clause 228 (2) of the Environmental Planning and Assessment Regulation 2000, to take into account potential cumulative impacts as a result of the proposal.

The following sections provide an assessment of the potential cumulative impacts that could arise due to the construction and operation of the proposal and other known developments, which include other preferred short-term solutions identified in the Richmond Bridge and Approaches strategy (ie the Kurrajong Road/Old Kurrajong Road intersection upgrade and the March Street/Bosworth Street intersection upgrade).

6.15.1 Methodology

Other locally occurring developments that could interact with the proposal were identified through a desktop review of publicly available information on the Department of Planning and Environment's major project register, Joint Regional Planning Panel Applications listed on Hawkesbury City Council's website and Hawkesbury City Council's online development application tracker. The desktop search was carried out on 9 July 2015. It is noted that minor developments (such as minor alterations to residential dwellings) have not been included as part of this assessment, due to the limited nature and extent of those developments and, therefore, minimal interaction with the current proposal.

6.15.2 Potential impacts

Other potential developments within the locality

Developments that have been approved, or are proposed to be carried out in the vicinity of the proposal are outlined in Table 6-47.

Table 6-47 Other potential developments occurring within the locality

Development	Location	Description	Timing	Status
Riverside Gardens	Beaumont Avenue, North Richmond	Over 55s retirement village.	December 2013 to unknown	Approved
Residential development	96 Grose Vale Road, North Richmond	Torrens title subdivision to create an additional 237 residential allotments.	Unknown	Approved
Richmond Bridge and Approaches	March Street/Bosworth Street	Remaining proposed intersection upgrade; as described in	2016	REF awaiting determinat

Development	Location	Description	Timing	Status
strategy	intersection	Section 1.1.2 of this REF.		ion by Roads and Maritime

Note 1: Stated timings of the remaining proposed intersection upgrade proposed as part of the preferred short-term solution for the Richmond Bridge and Approaches strategy are indicative only and are subject to change.

The significance of potential cumulative impacts has been assessed in consideration of the location and timing of the potential developments. Where the timing of a development was not known, the assessment assumed a worst-case scenario in that the proposal would coincide with that development.

Construction

The likely cumulative impacts associated with the concurrent construction of the proposal and other known developments within the locality (as listed in Table 6-47) are discussed in the following sections.

Increased construction traffic

Increased construction vehicle traffic on the existing road network (particularly March Street, Kurrajong Road and Bells Line of Road) has the potential to cause congestion and delays for other road users, as well as increased noise and air pollution for other sensitive receivers located along vehicle haulage routes.

The other known development having the largest potential for construction vehicle traffic to interact with the proposal is the residential development (comprising 237 allotments) at 96 Grose Vale Road, North Richmond.

The specific timing of this development is not known at the time of preparing this REF. Notwithstanding, it is anticipated that the greatest potential for cumulative construction traffic impacts would occur in situations where construction activities for the proposal would overlap with construction activities for the above developments. This would be due to the larger number of construction vehicles movements that would occur on the surrounding road network, relative to the number of vehicle movements that would occur if either of the projects were to be constructed in isolation.

While construction vehicle haulage routes for the residential development are currently unknown, given the location of the development, it would be reasonable to assume that a large portion of the construction traffic would travel through the Bells Line of Road/Grose Vale Road intersection. Therefore, construction vehicle movements for the proposal and the residential development are considered likely to overlap, increasing the potential for congestion and delays to be experienced by other road users.

The potential for cumulative traffic impacts with the residential development may be further increased by construction work for the proposal, which could delay construction vehicles associated with this development (in addition to other road users). The potential for such impacts would need to be managed by the Construction Contractor once the timing of other developments becomes known. The CEMP would need to include a process to review and update mitigation measures as new work begins or if complaints are received.

While potential cumulative traffic impacts could also occur in situations where construction of the proposal overlaps with the operational phases of the residential development, these impacts would be relatively minor. Operational traffic impacts associated with the residential development will need to be assessed and managed by the proponent of that development as part of their development application processes.

Increased travel delays

Increased travel delays could occur for motorists using the local road network due to the prolongation of roadwork within the locality. This would be particularly relevant for the remaining component of the Richmond Bridge and Approaches strategy, which would require construction work to be carried out at another key intersection on the road network.

Road users frequently travelling through both of the intersections at Bells Line of Road/Grose Vale Road and March Street/Bosworth Street would experience the greatest cumulative impacts on travel time.

Given the staged delivery of the proposed intersection upgrades at Bells Line of Road/Grose Vale Road and March Street/Bosworth Street, it is anticipated that potential cumulative travel delays could be readily managed through standard safeguards and management measures (eg the coordination of construction traffic management plans for each of the intersection locations). The potential for such impacts would need to be managed by the Construction Contractor.

Increased impacts on local amenity

Due to the separation distance between the proposal, the other proposed developments at North Richmond, and the proposed intersection upgrade at March Street/Bosworth Street Richmond, potential reductions in local amenity in the vicinity of Bells Line of Road and Grose Vale Road are not anticipated to be significant from concurrent construction of other projects. While there would be multiple construction sites, any local amenity impacts in the vicinity of the proposal would be unlikely to differ significantly from those already discussed in this REF.

Construction of the retirement village at Beaumont Avenue (refer Table 6-47) is already well advanced or near completion. Construction timing for the residential development at Grose Vale Road is currently unknown. Together, these developments are therefore considered unlikely to generate a level of construction activity or associated traffic and other disturbance that would cause a noticeable cumulative reduction in local amenity with the proposed intersection upgrade.

In the event that these (or other) developments do occur concurrently with the proposal, the potential for any such cumulative impacts would need to be considered and managed by the Construction Contractor once the timing of other developments becomes known. The CEMP would need to include a process to review and update mitigation measures as new work begins or if complaints are received.

Operation

No cumulative impacts would occur during the operational phases of the current proposal and other developments listed in Table 6-47.

The cumulative operational effects of the proposal, in conjunction with the other preferred short-term solutions for the Richmond Bridge and Approaches strategy (ie intersection upgrade works at Kurrajong Road/Old Kurrajong Road and March Street/Bosworth Street) would substantially improve travel conditions and road safety along the road corridor between Richmond and North Richmond (comprising Richmond Bridge and its approach roads).

Traffic modelling carried out for the Richmond Bridge and Approaches strategy (Roads and Maritime 2012d) identified the following cumulative improvements to existing road network performance on the above roads:

- Improved safety for turning movements for traffic in and out of Bells Line of Road, Kurrajong Road and March Street.
- Significant improvements in peak period travel speeds for westbound traffic on Kurrajong Road – from 17 kilometres per hour to 46 kilometres per hour. Improved safety and improved travel speeds are a result of providing a left turn slip lane from Old Kurrajong Road (northbound) to Kurrajong Road (westbound) and a westbound acceleration lane on Kurrajong Road.

- Improvements in peak period travel speeds for eastbound traffic on Kurrajong Road – from 48 kilometres per hour to 50 kilometres per hour.

In addition to the above benefits, the proposed extension of the eastbound merge on Bells Line of Road, east of Grose Vale Road/Terrace Road, is forecast to improve traffic flows on Grose Vale Road.

Section 6.7 discusses socio-economic benefits of the proposal. It is considered that the proposal would have an overall positive cumulative effect on the road environment within the study area.

6.15.3 Safeguards and management measures

The proposed safeguards and management measures for cumulative impacts are listed in Table 6-48.

Table 6-48 Safeguards and management measures for cumulative impacts

Impact	Environmental safeguards	Responsibility	Timing
Cumulative impacts from concurrent developments	The CEMP would be updated as required to incorporate potential cumulative impacts from surrounding development activities as they become known. This would include a process to review and update mitigation measures as new work begins or if complaints are received.	Construction Contractor	Pre-Construction, construction

6.16 Summary of beneficial effects

The proposal would improve eastbound and westbound traffic flows on Bells Line of Road and Kurrajong Road in the morning and evening peaks. Improvements to the local road network include:

- Improved safety for turning movements for traffic in and out of Bells Line of Road.
- Significant improvements in peak period travel speeds for westbound traffic on Kurrajong Road – from 17 kilometres per hour to 46 kilometres per hour.
- Improvements in peak period travel speeds for eastbound traffic on Kurrajong Road – from 48 kilometres per hour to 50 kilometres per hour.
- Improved traffic flows on Grose Vale Road due to the proposed extension of the eastbound merge on Bells Line of Road, east of Grose Vale Road/Terrace Road.

6.17 Summary of adverse effects

Adverse effects of the proposal include the following:

Temporary effects

- Temporary construction noise impacts that are predicted to greatly exceed the applicable noise management levels at the nearest noise sensitive receivers. Exceedances of the 'highly noise affected' construction noise management level of 75 dB(A) are predicted to occur at some receivers. As discussed in Section 6.1.4, the nature of some construction activities (e.g. pavement cutting, jackhammering) and their proximity to the nearest receivers makes these noise impacts difficult to mitigate other than through respite periods, restricting hours of work, and careful scheduling of high-noise activities in consultation with the affected receivers.
- Temporary disruptions to traffic flows and access due to traffic lane closures, the

implementation of roadwork speed limits and/or when manual traffic control is in operation to facilitate the movement of construction vehicles into and out of work areas.

- The temporary loss of on-street parking spaces during road widening work, potentially affecting the accessibility of surrounding residential properties and local businesses, particularly in situations where sufficient alternative parking provisions are not located nearby.
- A 'moderate to high' visual impact on residential properties fronting Grose Vale Road and Bells Line of Road (until new plantings become established) due to the removal of street trees and widening of the existing road pavement.

Permanent effects

- The permanent relocation of an existing bus stop (number 275455) from the northern kerb of Bells Line of Road east of Grose Vale Road, to a new kerbside location approximately 90 metres further to the east.
- The modification of one bus stop (number 275419) located on the southern kerb of Bells Line of Road, about 50 metres east of Grose Vale Road, to accommodate an additional dedicated northbound lane.
- The loss (during peak periods) of up to six time-restricted (15-minute) on-street parking spaces from Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods due to the provision of the proposed clearway.
- The permanent loss of up to 13 restricted (currently no parking 6.00 am – 6.00 pm Mon-Fri, 6.00 am – midday Sat) on-street parking spaces from Grose Vale Road (western kerb) due to the proposed road widening work.
- A 'moderate to high' impact on the existing landscape character of the area surrounding the Bells Line of Road/Grose Vale Road intersection due to the removal of six road trees from the northern corner of the intersection, up to five from Grose Vale Road as well as the removal of up to 11 visually prominent roadside trees within the existing traffic island on the westbound approach along Bells Line of Road.
- The permanent acquisition of about 575 square metres of privately owned land involving six properties and six separate land owners to accommodate the proposed road widening work. The majority of this land would comprise strips of residential land. The proposal would also require the acquisition of about 110 square metres of public land (Council-owned public reserve) on the northern corner of Bells Line of Road and Terrace Road. The proposal's land requirements include one full property acquisition, affecting a commercial property at 60 Bells Line of Road.
- Clearing of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection, as well as other planted native and exotic vegetation from the area surrounding the Bells Line of Road/Grose Vale Road intersection.
- Minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection. Threatened species assessments were undertaken for the Grey-headed Flying Fox, which are presented in Appendix C. These assessments concluded that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox.

7 Environmental management

7.1 Environmental management plan

A number of safeguards and management measures have been identified to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these management measures would be incorporated into the detailed design and applied during the construction and operation of the proposal.

A Construction Environmental Management Plan (CEMP) will be prepared to describe safeguards and management measures identified. This plan will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The plan will be prepared before construction of the proposal and must be reviewed and endorsed by the Roads and Maritime Services Environmental Officer before the start of any on-site work. The CEMP will be a working document, subject to ongoing change and updated as necessary to respond to specific requirements. The CEMP would be developed in accordance with the specifications set out in the QA Specification G36 – Environmental Protection (Management System), QA Specification G38 – Soil and Water Management (Soil and Water Plan) and the QA Specification G40 – Clearing and Grubbing.

7.2 Summary of safeguards and management measures

Environmental safeguards outlined in this document would be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards would minimise any potential adverse impacts arising from the proposed works on the surrounding environment. The safeguards and management measures are summarised in Table 7-1.

Table 7.1: Summary of site specific environmental safeguards

No.	Impact	Environmental safeguards	Responsibility	Timing
General				
1	General	All environmental safeguards must be incorporated within the following: • Detailed design stage • Contract specifications for the proposal • Contractor's Environmental Management Plan	Project manager	Pre-construction
2	General	A risk assessment must be carried out on the proposal in accordance with the Roads and Maritime Services Project Pack and PMS risk assessment procedures to determine an audit and inspection program for the work. The recommendations of the risk assessment are to be implemented. A review of the risk assessment must be carried out after the initial audit or inspection to evaluate is the level of risk chosen for the project is appropriate. Any work resulting from the proposal and as covered by the REF may be subject to environmental audit(s) and/or inspection(s) at any time during their duration.	Project manager and regional environmental staff	Pre-construction After first audit
3	General	The Roads and Maritime Services Project Manager must notify the Roads and Maritime Services Environmental Officer Western Sydney Region at least five days before work commencing.	Project manager	Pre-construction
4	General	All businesses and residences likely to be affected by the proposed work must be notified at least five working days before the start of the proposed activities.	Project manager	Pre-construction
5	General	Environmental awareness training must be provided, by the contractor, to all field personnel and subcontractors.	Contractor	Pre-construction and during construction as required.
Noise and vibration				

No.	Impact	Environmental safeguards	Responsibility	Timing
6	Construction noise	• Limit work to standard hours of construction and then daylight hours where possible. Consider implementing respite periods with low noise/vibration-producing construction activities where noisy works continue past 10 pm • Perform noisy work during less sensitive time periods.	Construction contractor	Construction
7	Construction noise	• Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner • Where possible, use quieter and less vibration emitting construction methods • Only have necessary equipment on-site and turn off when not in use • Where possible, concentrate noisy activities at one location and move to another as quickly as possible • Vehicle movements, including deliveries outside standard hours should be minimised and avoided where possible • Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices • Use only the necessary size and powered equipment for tasks • Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms • Where practicable, install enclosures around noisy mobile and stationary equipment as necessary • Locate noisy plant as far away from noise-sensitive plant as possible • Project info-line • Construction response/complaints telephone line	Construction contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
8	Construction noise	• Avoid simultaneous operation of two or more noisy plant close to receivers • The offset distance between noisy plant and sensitive receivers should be maximised • Plan traffic flow, parking and loading/unloading areas to minimise reversing movements • Delivery and loading / unloading of materials should occur as far as possible from sensitive receivers • Select site access points and roads as far as possible from sensitive receivers.	Construction contractor	Pre-construction
9	Construction noise	• Induct all employees, contractors and subcontractors on environmental details of the project including the following with respect to noise: – Standard hours of construction – Any limitations of the use of high-noise plant or equipment – Standard and additional noise mitigation measures to be applied – How to handle complaints or enquiries • Limit loud communications • Avoid dropping materials from height, throwing of metal items or slamming of doors which may generate unnecessary noise.	Construction contractor	Pre-construction
10	Construction noise	• Consult with the affected community prior to construction to identify times when they are less sensitive to noise, and determine whether they are prepared to accept a longer period of construction in exchange for greater restrictions on construction times and increased respite periods • Provide periodic updates on the progress of the project and upcoming works to surrounding receivers.	Construction contractor	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
11	Construction Noise	• A Construction Noise and Vibration Management Plan (CNVMP) would be prepared as part of the CEMP. This plan would include, but would not be limited to, the following: - A map indicating the locations of sensitive receivers including residential properties and vibration sensitive items - Procedures for prior notification of nearby residents in advance of high noise construction activities and work outside of standard hours - Procedure for notifying residents about the program of work, duration of works including high noise activities, noise management and mitigation methods, and complaints procedure - Management measures to minimise potential noise impacts from mobile, high noise construction activities such as concrete cutting - Mitigation measures to avoid noise and vibration impacts associated with truck movements during construction - A process for assessing the performance of the implemented mitigation measures, including a noise and vibration monitoring program for sensitive receivers - A process for documenting and resolving issues and complaints - A process for updating the plan when activities affecting construction noise and vibration change - Identify in toolbox talks where noise and vibration management is required - Implement EPA Interim Construction Noise Guidelines (DECCW 2009).	Construction contractor	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
12	Construction vibration	• Wherever possible, adhere to recommended safe setback distances as detailed in the CNS • Where these distances need to be encroached, conduct detailed inspections including the preparation of a written and photographic report to document the structural condition prior to and after the completion of the activities. Complete monitoring vibration monitoring during the works to verify that cosmetic building and human comfort criterion are not being exceeded • Scale back or suspend vibration-intensive works in response to vibration-related complaints until verification can be completed to determine whether criteria are being exceeded • Make good any vibration-related damages which arise during construction.	Construction contractor	During construction
13	Construction vibration	• Provide prior notification of any vibration-intensive works to surrounding receivers.	Construction contractor	Prior to and during construction
Construction noise: provisional measures				
14	Construction noise – during standard hours	At nearby residential receivers: • Noise verification measurements to determine actual noise levels at receivers against those predicted in this assessment • Provision of advanced warning notifications to potentially affected residences to advise them of potential disturbances at least five days prior to the commencement of works • Provision of additional respite periods • Targeted consultation with each potentially affected receiver.	Construction contractor	Construction – during standard hours

No.	Impact	Environmental safeguards	Responsibility	Timing
15	Construction noise – during standard hours	At nearby non-residential receivers: • Provision of advanced warning notifications to advise of potential disturbances at least five days prior to the commencement of works.	Construction contractor	Construction – during standard hours
16	Construction noise – outside standard hours	For receivers affected by out of hours work: • All of the measures detailed above • Provision of additional respite periods (if agreeable with the potentially affected receivers) • Provision of short-term accommodation for acutely affected receivers where verification measurements identify noise levels more than 25 dB(A) above night time NMLs.	Construction contractor	Construction – outside standard hours
Traffic, transport and access				
17	Construction traffic management	A detailed traffic management plan would be prepared in accordance with Traffic Control at Work Sites (Roads and Traffic Authority 2010) and QA Specification G10 Control of Traffic (Roads and Traffic Authority 2005) to provide a comprehensive and objective approach to minimise any potential impacts on road network operations during construction. The traffic management plan would include measures to minimise heavy vehicle usage on local roads. Where practicable, deliveries of plant and materials would be carried out outside of peak traffic periods.	Construction contractor	Pre-construction and Construction
18	Construction traffic management	The Construction Contractor would review the proposed timing of construction works at each of the intersection upgrade locations, with the objective of minimising the potential for cumulative traffic impacts.	Construction contractor	Pre-construction and Construction
19	Construction traffic management	Consultation would be carried out with emergency services. Emergency vehicle access would be maintained at all times for the duration of construction.	Construction contractor	Pre-construction and Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
20	Public transport	Access to bus stop locations would be maintained during construction wherever possible in consultation with bus operators (Busways).	Construction Contractor	Pre-construction and Construction
21	Public transport	The existing bus stop on Bells Line of Road (bus stop number 275455) would not be removed until a replacement stop has been established.	Construction Contractor	Pre-construction and Construction
22	Public transport	Updates on the location of temporary and permanent bus stops would be provided to the community during the construction period to ensure disruption is minimised.	Roads and Maritime and Construction Contractor	Pre-construction and Construction
23	Road user delay	The community would be kept informed about upcoming road construction activities. Notifications would include advertisements in the local media and prominently placed advisory notices and/or variable message signs.	Roads and Maritime	Construction
24	Pedestrian access	Safe pedestrian access around the worksite would be provided by the construction contractor (in consultation with Roads and Maritime and Hawkesbury City Council) and captured within the traffic management plan.	Construction Contractor	Pre-construction and Construction
25	Pedestrians and cyclists	Signage outlining pedestrian and cyclist diversion routes would be displayed during construction (where required).	Construction Contractor	Construction
26	Property access	Access to affected residential properties and businesses would be maintained during construction and temporary property access would be provided to residences and businesses where required. The management of property access would be considered by the construction contractor and detailed as part of the final staging plan for the proposal.	Construction Contractor	Pre-construction and Construction
27	On-street parking	The parking of light construction vehicles (eg staff vehicles) would be restricted to designated areas within proposed construction compounds, where possible to minimise the proposal's impact on the existing parking supply within the study area.	Construction Contractor	Construction
Aboriginal heritage				

No.	Impact	Environmental safeguards	Responsibility	Timing
28	Discovery/ disturbance of previously unrecorded Aboriginal sites	In the event of an unexpected find of Aboriginal cultural heritage, work will cease in the affected area and the Standard Management Procedure – Unexpected Archaeological Finds (Roads and Maritime 2012) will be implemented. This would include stopping all work in the vicinity of the find and contacting Roads and Maritime's Aboriginal Cultural Heritage Advisor or the relevant Roads and Maritime Environmental Officer immediately to identify the appropriate course of action. Work would not recommence until receipt of written approval from Roads and Maritime.	Construction Contractor	Construction
Landscape character and visual impact				
29	Visual amenity impact – sensitive receivers	Replacement tree planting (Viewpoints 1-5, 7-8, 10-13, 16-17, 19-22)	Construction Contractor	Construction
		Where required, lighting for night-time work is to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting) (Viewpoints 7-8, 10-19, 21-22).	RMS maintenance	Operation
30	Visual amenity impact – vegetation removal	Existing native roadside trees would be retained where possible to minimise the potential landscape character and visual impact of the work.	Construction Contractor	Construction
31	Visual amenity impact – vegetation removal	The landscaping plan is to incorporate planting for screening purposes where feasible.	Construction Contractor	Construction
32	Visual impacts of construction activities	The work site will be left in a tidy manner at the end of each work day.	Construction Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
33	Visual impacts of construction activities	Where appropriate, fencing with material attached (eg shade cloth) would be provided around the construction compound to screen views of the construction compounds from adjoining properties.	Construction Contractor	Construction
34	Visual impacts of construction activities	Where required, lighting for night-time work would be positioned to minimise light spill or disturbance to nearby residential receivers, and to minimise glare for motorists.	Construction Contractor	Construction
Topography, geology and soils				
35	Soil and Water Quality	An Erosion and sedimentation controls would be incorporated into the CEMP, in accordance with Landcom's (2004) *Managing Urban Stormwater: Soils and Construction*. Controls would include, but not be limited to: • Identify the site catchment, high risk areas and sensitive areas (eg ground disturbance areas). • Confirm the size of the above areas and catchments. • Proposed staging plans for the proposal to ensure appropriate erosion and sediment controls measures are possible. • The likely run-off from each worksite and direction of on and off site water flow. • Diversion of clean water around the work site. • A mapped plan identifying the above.	Construction Contractor	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
36	Soil and Water Quality	An Acid Sulphate Soil Management Plan would be prepared and incorporated into the CEMP. The plan would include, but not be limited to: • A summary of the available ASS information relevant to the project site. • Confirm the process for identification of ASS/PASS throughout construction. • Indicate the management measures to be implemented if ASS/PASS is identified. • Outline the monitoring requirements for ASS/PASS to confirm the surrounding area is being protected. • Confirm the treatment and disposal requirements for any ASS/PASS encountered. • Detail the reporting requirements.	Construction Contractor	Pre-Construction
Contaminated land				
37	Existing contamination	A limited site investigation of the project alignment should be completed to confirm the presence/absence of potential contaminants within the alignment. The limited site investigation would include as a minimum: • An investigation of soils to the maximum anticipated depth of excavation (including sampling and analysis) at locations identified as being potentially impacted. • A comparison of analytical results against appropriate guidelines. • Preparation of a factual report outlining the presence/absence of contaminants within the project alignment	Roads and Maritime	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
38	Potential exposure of contamination to site workers, public and environmental receptors	A Contamination Management Plan (CMP) would be prepared for the proposal in accordance with the Contaminated Land Management Act 1997 and relevant EPA guidelines. The CMP would include as a minimum: • Contaminated land legislation and guidelines. • Potential contamination sources that may be encountered at the site. • Procedures for the identification, management and reporting of contamination, including procedures for: – Finding unexpected contamination. – Handling and stockpiling of contaminated materials. – Dewatering and disposal of contaminated liquid waste. – Disposal of contaminated soils. • Incident management procedure and reporting procedure. • A process for reviewing and updating the plan	Construction Contractor	Pre-Construction
39	Exposure to contamination	The CMP would be sent to the Roads and Maritime Environmental Manager for review, before construction.	Construction contractor	Pre-Construction
Socio-economic				
40	Community consultation	A Communication Engagement Plan (CEP) will be prepared and included in the CEMP. The CEP will include (as a minimum): • Requirements to provide details and timing of proposed activities to affected residents. • Contact name and number for complaints. • Procedure to notify nearby land users for changed conditions during the construction period such as traffic, pedestrian and driveway access. The communications plan will be prepared in accordance with G36 requirements and Roads and Maritime Community Engagement and Communications Manual (2012).	Construction contractor	Pre-construction

No.	Impact	Environmental safeguards	Responsibility	Timing
41	Property access	During construction, access to properties within the proposal area will be maintained. Temporary property access will be provided to residences and businesses where required. Consultation will be undertaken with the North Richmond Seventh Day Adventist Church to ensure access is maintained for pedestrians and vehicles at this site.	Construction contractor	Construction
42	Emergency vehicle access	Access will be maintained for emergency vehicles near construction areas. Roads and Maritime will consult with emergency services throughout construction to ensure that potential impacts are identified and appropriately managed.	Construction contractor	Construction
Land use and property				
43	Direct land use and property impacts	Land directly affected during the establishment and operation of the construction compounds would be restored to its pre-construction condition.	Construction Contractor	Construction
44	Property acquisition	All land acquisitions would be undertaken in accordance with the provisions of the Land Acquisition (Just Terms) Compensation Act 1991.	Roads and Maritime	Pre-Construction
45	Leasing of private land	Land owner consent would be sought before the establishment of the construction compounds or any other ancillary facilities on private property. The construction compounds would not be established until a signed lease agreement has been received from the relevant land owner. Roads and Maritime Services would be consulted before contacting any land owners about the temporary leasing of their land.	Construction Contractor	Pre-Construction
Biodiversity				
46	Inductions	Environmental awareness training would include the locations of protected vegetation, and requirements and safeguards for biodiversity included in the CEMP.	Construction Contractor	Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
47	Clearing limits / Habitat trees	Clearing limits would be marked out by a surveyor prior to the commencement of works and would be clearly demarcated.	Construction contractor	Pre-Construction
48	Clearing limits / Habitat trees	All works are to comply with Roads and Maritime Biodiversity Guidelines – Protecting and managing biodiversity on RTA projects. This would include managing the spread of Phytophthora and Chytrid fungus.	Construction contractor	Construction
49	Clearing limits / Habitat trees	The removal of habitat trees (if they are found to be providing habitat) is to be staged in accordance with the RMS Biodiversity Guidelines procedure.	Construction contractor	Construction
50	Clearing limits / Habitat trees	A suitably qualified ecologist is to be present for the removal of any identified habitat trees. The ecologist is to be suitably vaccinated to handle bats.	Construction contractor	Construction
51	Noxious weeds	Develop and implement weed management measures including specific measures in accordance with the regulations set out under the Noxious Weeds Act 1993.	Construction contractor	Construction
52	Noxious weeds	A machinery hygiene procedure would be implemented to prevent spread of weeds.	Construction Contractor	Construction
53	Noxious weeds	Weeds are to be kept separate from general green waste and appropriately disposed of.	Construction Contractor	Construction
54	General	Locate temporary infrastructure (plant sites and offices etc.) in cleared areas away from vegetation, outside of the dripline of trees. Erect bunting around the dripline of trees to prevent stockpiling in tree protection zones.	Construction Contractor	Pre-construction
Water quality and hydrology				

No.	Impact	Environmental safeguards	Responsibility	Timing
55	Water quality management	Soil and water management measures will be included in the CEMP. The CEMP will also address the: • Roads and Maritime Code of Practice for Water Management (1999), the Roads and Maritime Erosion and Sedimentation Procedure. • The NSW Soils and Construction – Managing Urban Stormwater Volume 1 “The Blue Book” (Landcom, 2004) and Volume 2 (DECC, 2008). • Roads and Maritime Technical Guideline: Temporary Stormwater Drainage for Road Construction, 2011. • Roads and Maritime Technical Guideline: Environmental Management of Construction Site Dewatering, 2011. • Erosion and Sediment Management Procedures (P143P), Nov 2008.	Construction Contractor	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
56	Water quality management	Before the start of work, erosion and sedimentation controls are to be developed and implemented in accordance with the requirements of the Blue Book. The controls are to address the following as a minimum: • A process to routinely monitor the BOM weather forecast and identification of additional controls to be implemented ahead of rain. • A procedure for routine inspection and maintenance of erosion and sediment controls. • Nominated concrete washout areas away from watercourses and drainage. • Nominated spill kit locations. • Progressive stabilisation plan. • Stockpiles are to be restricted to the identified construction compounds, and managed in accordance with Roads and Maritime Stockpile Site Management Guideline, RMS Environmental Protection (Management System) QA Specification G36 and RMS Vegetation QA Specification R178. • Any dewatering required would be in accordance with Roads and Maritime Environmental Management of Construction Site Dewatering 2011. • Controls are to be implemented at exit points to minimise tracking soil and particulates onto pavement surfaces outside of the construction site area. • Any material transported onto pavements would be swept and removed at the end of each working shift and before rainfall.	Construction Contractor	Pre-Construction

No.	Impact	Environmental safeguards	Responsibility	Timing
57	Flood risk	A Flood preparedness plan would be incorporated within the CEMP and include measures to prepare the site for flood events. This is to include (but not be limited to): • Requirements to remove site plant and equipment outside of flood hazard areas • Stabilise disturbed areas • Maintain safe evacuation routes for the public and construction contractors and staff.	Construction contractor	Pre-construction
Air quality				
58	Dust and air quality management	Dust emissions during construction of the proposal would be minimised through the implementation of standard mitigation measures, which would include (but would not be limited to) the following: • Measures (including watering or covering exposed areas) are to be used to minimise or prevent air pollution and dust. • Work (including the spraying of paint and other materials) are not to be carried out during strong winds or in weather conditions where high levels of dust or air borne particulates are likely. • Vehicles transporting waste or other materials that may produce odours or dust are to be covered during transportation. • Stockpiles or areas that may generate dust are to be managed to suppress dust emissions in accordance with the Roads and Maritime Stockpile Site Management Guideline (2011). • Communications material such as the project website and community notification would include a contact person and phone number to enable complaints to be received and responded to. Erosion and sediment controls would be reviewed for adequacy in response to any dust complaints.	Construction contractor	Construction
Non-Aboriginal heritage				

No.	Impact	Environmental safeguards	Responsibility	Timing
59	Unexpected archaeological remains	If unexpected archaeological remains are uncovered during the works, all works must cease in the vicinity of the material/find and the steps in the Roads and Maritime Standard Management Procedure: Unexpected Archaeological Finds procedure must be followed. Roads and Maritime Senior Regional Environmental Officer must be contacted immediately.	Construction Contractor	Construction
60	Richmond-Kurrajong railway line	A pre-construction site specific archaeological assessment, by a suitably qualified person, is to be conducted where the former railway alignment is affected by proposed excavation or ground disturbance works. The assessment may make a recommendation for monitoring of any excavation works by a suitably qualified person, during construction. The assessment and monitoring would then (if required) support and inform an application for excavation permit under s.139 of the *Heritage Act*.	Construction Contractor	Pre-construction
61	Inductions	Environmental awareness is to include responsibilities under heritage legislation and the contractors EMP.	Construction Contractor	Pre-Construction
Resource use and waste				
62	Resource use and waste	The following resource management hierarchy principles are to be followed: • Avoid unnecessary resource consumption as a priority. • Avoidance is followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery). • Disposal is carried out as a last resort (in accordance with the Waste Avoidance & Resource Recovery Act 2001). All waste would be disposed of in accordance with the EPA waste classification guidelines at an appropriately licensed waste facility. Working areas are to be maintained, kept free of rubbish and cleaned up at the end of each working day. Procurement would endeavour to use materials and products with a recycled content where that material or product is cost and performance effective.	Construction Contractor	Construction
Greenhouse gas emissions and climate change				

No.	Impact	Environmental safeguards	Responsibility	Timing
63	Construction greenhouse gas emissions	• Plant and equipment would be switched off when not in use. • Vehicles, plant and construction equipment would be appropriately sized for the task and properly maintained so as to achieve optimum fuel efficiency. • Materials would be delivered with full loads and would come from local suppliers, where possible. • The energy efficiency and related carbon emissions would be considered in the selection of vehicle and plant equipment.	Construction Contractor	Construction
Cumulative environmental impacts				
64	Cumulative impacts from concurrent developments	The CEMP would be updated as required to incorporate potential cumulative impacts from surrounding development activities as they become known. This would include a process to review and update mitigation measures as new work begins or if complaints are received.	Construction Contractor	Pre-Construction, construction.

7.3 Licensing and approvals

A Road Occupancy Licence (ROL) will be required under Section 138 of the Roads Act, to enable to Contractor to occupy the road space to conduct the works.

A ROL allows the holder of that licence to use a specified road space at approved times, provided certain conditions are met. The licence applies to the occupation of the 'road space' only and does not imply permission or approval for the actual (physical) works being undertaken. It is up to the proponent to obtain the relevant approvals from other agencies, such as Water Board Authorities.

The ROL would be issued by Roads and Maritime and responsibility for compliance with the licence conditions would rest with the Contractor. The Contractor must apply for and receive the licence prior to the commencement of construction.

8 Conclusion

This chapter provides the justification for the proposal taking into account its biophysical, social and economic impacts, the suitability of the site and whether or not the proposal is in the public interest. The proposal is also considered in the context of the objectives of the EP&A Act, including the principles of ecologically sustainable development as defined in Schedule 2 of the Environmental Planning and Assessment Regulation 2000.

8.1 Justification

The proposal would improve eastbound and westbound traffic flows on March Street, Kurrajong Road and Bells Line of Road in the morning and evening peaks. Improvements to the local road network include:

- Improved safety for turning movements for traffic in and out of Bells Line of Road.
- Significant improvements in peak period travel speeds for westbound traffic on Kurrajong Road – from 17 kilometres per hour to 46 kilometres per hour. Improvements in peak period travel speeds for eastbound traffic on Kurrajong Road – from 48 kilometres per hour to 50 kilometres per hour.
- Improved traffic flows on Grose Vale Road due to the proposed extension of the eastbound merge on Bells Line of Road, east of Grose Vale Road/Terrace Road.

The following sections consider the justification of the proposal in relation to biophysical, social and economic factors and the public interest.

Biophysical

An assessment of the proposal's environmental impact is documented in Chapter 6 of this REF. Key biophysical impacts that would likely occur as a result of the proposal comprise the removal of roadside trees (including two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection) and temporary reductions in local air quality (primarily due to potential dust emissions during construction work). These impacts would not be significant and would be manageable through the application of the safeguards and management measures documented in Table 7-1. The proposal would not alter the biophysical environment during operation.

Social and economic

An assessment of the proposal's social and economic impact is documented in Section 6.7 of this REF. Adverse social impacts associated with the proposal would comprise the acquisition of about 575 square metres of privately owned land involving six properties and six separate landowners to accommodate the proposed road widening work. The proposal would also require the acquisition of about 110 square metres of public land (Council-owned public reserve) on the northern corner of Bells Line of Road and Terrace Road. The majority of this land would comprise strips of residential land. However, one full property acquisition, affecting a commercial property at 60 Bells Line of Road, would also be required. Socio-economic impacts associated with the acquisition of this land are described in Section 6.7.

Social and economic factors contributing to the justification of the proposal include reduced traffic congestion and improved connectivity and safety for motorists due to the provision of additional dedicated turn lanes, peak hour clearways and other intersection configuration changes at the Bells Line of Road/Grose Vale Road and March Street/Bosworth Street intersections. These intersection upgrades would improve the turning traffic performance and safety at the Bells Line of Road/Grose Vale Road and March Street/Bosworth Street intersections.

Public interest

The proposal would be in the public interest as it would contribute to improving the overall travel conditions and road safety along the road corridor between Richmond and North Richmond (comprising Richmond Bridge and its approach roads). On a local scale, the proposal would improve the turning traffic performance and safety at the Bells Line of Road/Grose Vale Road through the provision of additional dedicated turn lanes, peak hour clearways and other intersection configuration changes.

8.2 Objects of the EP&A Act

Table 8-1 provides a summary of the objects of the EP&A Act and outlines the proposal's consistency with these objects.

Table 8-1 The proposal's consistency with the objects of the EP&A Act

Object	Comment
5(a)(i) To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The proposal would comprise an intersection upgrade at Bells Line of Road/Grose Vale Road, which would generally involve the provision of dedicated through and turning lanes to improve traffic flow, reduce traffic congestion and improve safety on Richmond Bridge and its approach roads. Social and economic impacts are assessed in Section 6.7. The assessment includes management measures to avoid and/or minimise impacts.
5(a)(ii) To encourage the promotion and co-ordination of the orderly economic use and development of land.	The proposal would not impact on the economic use of land.
5(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.	As outlined in Section 3.5, preliminary investigations indicate that a number of utilities would require relocation or protection as part of the proposal. An outline of the public utility work required for the proposal is provided in Section 3.5. This work would be carried out in consultation with the relevant utility authorities.
5(a)(iv) To encourage the provision of land for public purposes.	The proposal would not permanently impact on land used for public purposes.
5(a)(v) To encourage the provision and co-ordination of community services and facilities.	The proposal is expected to alleviate traffic congestion on Richmond Bridge and its approach roads (until 2021) and would improve the safety of the environment through improvements to traffic flow and manoeuvring at the upgraded intersection.
5(a)(vi) To encourage the protection of	The proposal would be carried out in an

Object	Comment
the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	established urban environment and would have minimal biodiversity impacts.
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 8.2.1 – 8.2.4 below.
5(a)(viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the proposal.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the proposal.
5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	As outlined in Chapter 5, consultation activities focusing on the proposed intersection upgrade at Bells Line of Road/Grose Vale Road has been ongoing since 3 March 2015 and has involved a door knock campaign targeting residents and local businesses. Roads and Maritime will continue to consult the community and stakeholders during the proposal's development.

8.2.1 The precautionary principle

The precautionary principle deals with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

Alternative design options were considered and assessed to reduce the risk of serious and irreversible impacts on the environment, including avoiding significant environmental aspects, where feasible.

The detailed assessment of potential environmental impacts has sought to minimise impacts of the proposal on the environment. Where information has been lacking, a conservative approach has been adopted for the assessment. Safeguards have been proposed to minimise potential impacts. These safeguards would be implemented during construction and operation of the proposal. No safeguards have been postponed as a result of a lack of scientific certainty.

8.2.2 Intergenerational equity

Intergenerational equity provides that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The proposal would provide improved road infrastructure for future generations. Should the proposal not proceed, the principle of intergenerational equity may be compromised as future generations would inherit a lower level of service by the road transport network. Traffic congestion and associated travel times on Richmond Bridge and its approach roads could increase as a result of an increase in traffic volume over time.

The proposal would also benefit future generations by ensuring that road safety is improved, with this being a positive benefit for all road users.

8.2.3 Conservation of biological diversity and ecological integrity

The conservation of biological diversity and ecological integrity provides that the diversity of genes, species, populations and communities, as well as the ecosystems and habitats to which they belong, must be maintained and improved to ensure their survival.

An assessment of the existing local environment has been carried out to identify and manage any potential impact of the proposal on local biodiversity. The potential impacts of the proposal on biodiversity would be limited to the construction phase and would involve removal of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection, as well as other planted native and exotic vegetation from the area surrounding the proposal.

All vegetation and habitats that would be affected by the proposal are in very poor condition. Safeguards and management measures to minimise the extent of native vegetation clearing by the proposal are provided in Section 6.9.4.

The proposal would not significantly fragment or isolate any existing large patches of vegetation and would not compromise biological diversity or ecological integrity. No significant impacts to flora and fauna species were identified.

8.2.4 Improved valuation, pricing and incentive mechanisms

Improved valuation, pricing and incentive mechanisms provide that cost to the environment should be factored into the economic costs of a proposal. This REF has examined the environmental consequences of the proposal and identified mitigation measures for areas which have the potential to experience adverse impacts.

Requirements imposed in terms of implementation of these mitigation measures would result in an economic cost to Roads and Maritime. The implementation of mitigation measures would increase both the capital and operating costs of the proposal. This signifies that environmental resources have been given appropriate valuation.

8.3 Conclusion

The proposed intersection upgrade at Bells Line of Road and Grose Vale Road, North Richmond is subject to assessment under Part 5 of the EP&A Act. This REF has examined and taken into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the proposed activity. This has included consideration of conservation agreements and plans of management under the NPW Act, joint management and biobanking agreements under the TSC Act, wilderness areas, critical habitat, impacts on threatened species, populations and ecological communities and their habitats and other protected fauna and native plants.

A number of potential environmental impacts from the proposal have been avoided or reduced during the design development and options assessment. The proposal as described in this REF best meets the project objectives but would still result in some impacts including:

- Construction noise and vibration.
- Temporary disruptions to traffic flow and access during construction.
- The acquisition of about 575 square metres of privately owned land (affecting six properties and six separate landowners), as well as about 110 square metres of public reserve.
- The permanent loss of some kerbside on-street car parking.
- Unavoidable visual and landscape character impacts associated with the removal of prominent trees that define the intersection and approaches, and increasing the width of the

existing road pavement. However, the overall potential landscape character impact and visual impact of the proposed works to the intersection of Bells Line of Road with Grose Vale Road and Terrace Road in North Richmond has been assessed as ‘generally moderate’.

Mitigation measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal is also expected to alleviate traffic congestion on Richmond Bridge and its approach roads and would improve the safety of the environment through improvements to traffic flow and manoeuvring at the upgraded intersections. On balance, the proposal is considered justified.

The environmental impacts of the proposal are not likely to significantly affect the environment and therefore it is not necessary for an Environmental Impact Statement to be prepared and approval to be sought for the proposal from the Minister for Planning under Part 5.1 of the EP&A Act. The proposal is unlikely to affect threatened species, populations or ecological communities or their habitats, within the meaning of the TSC Act or Fisheries Management Act 1994 and therefore a Species Impact Statement is not required. The proposal is also unlikely to affect Commonwealth land or have an impact on any matters of national environmental significance.

9 Certification

This review of environmental factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Tim Colman
Senior Associate Environmental Planner
Jacobs
Date: 17 August 2016

I have examined this review of environmental factors and the certification by Tim Colman of Jacobs and accept the review of environmental factors on behalf of Roads and Maritime Services

Reviewed by:

Roads and Maritime Services
Date:

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Terms and acronyms used in this REF

ABS	Australian Bureau of Statistics
AHIMS	Aboriginal Heritage Information Management System
ARI	Average Recurrence Interval
ASRIS	Australian Soil Resource Information System
ASS	Acid Sulfate Soil
BOM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
CEP	Community Engagement Plan
CLM Act	*Contaminated Land Management Act 1977* (NSW)
CMP	Contaminated Management Plan
CNVMP	Construction Noise and Vibration Management Plan
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
dB	Decibel
dB(A)	A-weighted decibels
DECCW	NSW Department of Environment, Climate Change and Water (now the NSW Office of Environment and Heritage)
DNR	NSW Department of Natural Resources
DPE or DPI	NSW Department of Planning and Environment (formerly the Department of Planning and Infrastructure)
DUAP	NSW Department of Urban Affairs and Planning (now the NSW Department of Planning and Environment)
ENMM	Environmental Noise Management Manual
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW)
EPA	NSW Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPL	Environmental Protection Licence
ESCP	Erosion and Sediment Control Plan
FM Act	*Fisheries Management Act 1994* (NSW)
Hawkesbury LEP	*Hawkesbury Local Environmental Plan 2012*
Heritage Act	*Heritage Act 1977* (NSW)
Hz	Hertz
ICNG	Interim Construction Noise Guideline
ICOMOS	Australian International Council on Monuments and Sites
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LEP	Local Environmental Plan
LGA	Local Government Area
LoS	Level of Service. A qualitative measure describing operational

	conditions within a traffic stream and their perception by motorists and/or passengers.
LTTMP	NSW Long Term Transport Master Plan
m/s	Metres per second
mm/s	Millimetres per second
MP	Member of Parliament
NES	(Matters of) National Environmental Significance under the EPBC Act
NML	Noise Management Level
NO_2	Nitrogen dioxide
NOx	Oxides of nitrogen
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
NSW	New South Wales
O_3	Ozone
OEH	NSW Office of Environment and Heritage
PACHCI	Procedure for Aboriginal Heritage Consultation and Investigation
PASS	Potential Acid Sulfate Soil
PM_{10}	Particulate matter with equivalent aerodynamic diameter less than or equal to 10 micrometres
POEO Act	*Protection of the Environment Operations Act 1977*
Proposal	The 'proposal' refers to the work as generally described in Chapter 3 of this REF.
Proposal area	The area that would be potentially directly impacted by the proposal. The proposal includes those areas that would be potentially directly impacted during construction, including the location and access to the compound site, stockpile sites and storage of equipment and plant.
QA Specification	Specifications developed by Roads and Maritime for use with roadwork and bridgework contracts let by Roads and Maritime.
REF	Review of environmental factors
Roads and Maritime	NSW Roads and Maritime Services
RTA	Road and Traffic Authority (now Roads and Maritime Services)
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
SEPP No. 14	State Environmental Planning Policy No. 14 – Coastal Wetlands
SEPP No. 19	State Environmental Planning Policy No. 19 – Bushland in Urban Areas
SEPP No. 55	State Environmental Planning Policy No. 55 – Remediation of Land
SIS	State Infrastructure Strategy 2012-2032
SO_2	Sulfur dioxide

SREP 20	Sydney Regional Environmental Plan No. 20 – Hawkesbury-Nepean River
Study area	Encompasses the proposal area and the area that may be indirectly impacted by the proposal
SWMP	Soil and Water Management Plan
TMP	Traffic Management Plan
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
TSP	Total suspended particulates
VHT	Vehicle Hours Travelled
VKT	Vehicle Kilometres Travelled
WARR Strategy	NSW Waste Avoidance and Resource Recovery Strategy 2007

Appendix A

Consideration of clause 228(2) factors and matters of national environmental significance

Clause 228(2) Checklist

In addition to the requirements of the *Is an EIS required?* guideline as detailed in the REF, the following factors, listed in clause 228(2) of the *Environmental Planning and Assessment Regulation 2000*, have also been considered to assess the likely impacts of the proposal on the natural and built environment.

Factor	Impact
a. Any environmental impact on a community? Construction of the proposal would result in some short-term negative impacts, such as visual amenity impacts, traffic and access disruptions, in addition to potential noise and air emissions impacts. These issues could impact negatively on the local community as described in Sections 6.1 (noise and vibration), 6.2 (traffic, transport, and access), 6.4 (visual amenity) and 6.11 (air quality) of this REF. Potential visual amenity impacts during construction would include the placement and movement of construction vehicles within the proposal area and the removal of road side trees. Potential traffic impacts during construction would include an increase in the volume of heavy vehicles, interruption of traffic flows on the current road network and temporary changes in speed limit and/or implementation of contra-flow type lane configurations (where required) resulting in increased travel times for motorists on the highway. Impacts to access may also be experienced by residences, surrounding businesses and other sensitive receivers within the proposal area. Construction noise would be generated from construction plant and vehicles. Air quality impacts would result from dust, vehicle emissions and odour production. These impacts are likely to occur during the construction period.	Short-term, minor, negative
The primary long-term negative impact of the proposal would comprise the permanent acquisition of about 575 square metres of privately owned land involving six properties and six separate land owners to accommodate the proposed road widening work. It would also require the acquisition of about 110 square metres of public land (Council-owned public reserve) on the northern corner of Bells Line of Road and Terrace Road. The majority of this land would comprise strips of residential land. However, one full property acquisition, affecting a commercial property at 60 Bells Line of Road, would also be required. The proposal would also result in the permanent loss of up to six time-restricted (15-minute) on-street parking spaces from Bells Line of Road (northbound) between Pitt Lane and Grose Vale Road during peak periods due to the provision of the proposed clearway. The proposal would also require the removal of up to 13 unrestricted (outside of clearway times) on-street parking spaces from Grose Vale Road (western kerb) due to the proposed road widening work. The primary long-term positive impact of the proposal would include improved road safety through improved lane configurations and turning opportunities, resulting in a positive benefit to the community	Long-term, minor, negative

Factor	Impact
b. Any transformation of a locality? During construction, the proposal would result in temporary impacts to the existing locality, which would be predominantly through negative visual amenity impacts associated with the placement and movement of construction plant and equipment.	Short-term, minor, negative
The proposal would have a 'moderate to high' impact on the existing landscape character of the area surrounding the Bells Line of Road/Grose Vale Road intersection due to the removal of six road trees from the northern corner of the intersection, up to five from Grose Vale Road as well as the removal of up to 11 visually prominent roadside trees within the existing traffic island on the westbound approach along Bells Line of Road.	Long-term, moderate, negative
c. Any environmental impact on the ecosystems of the locality? The proposal would require the clearing of two Forest Red Gums from the north-western side of the Bells Line of Road/Grose Vale Road intersection, as well as other planted native and exotic vegetation from the area surrounding the Bells Line of Road/Grose Vale Road intersection. However, this would not have any significant impact on the ecosystems of the locality, as the proposal would not impact habitat or viability of any species, including any threated flora or fauna species. Biodiversity impacts are described further in Section 6.9 of this REF.	Long-term, minor, negative
d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? During construction, the proposal would have the potential to create a reduction in the overall aesthetic quality of the proposal area due to the equipment associated with the construction worksite, dust and noise generation as well as traffic and access disruption. The proposal also has the potential to result in temporary reductions in amenity for residents, businesses and workers located within the Richmond and North Richmond town centres. These impacts would be temporary, contained to a small area and minimised as far as practicable through the implementation of safeguards outlined in Section 7.2. No scientific qualities of the proposal area are anticipated to be impacted during the construction or operation of the proposal.	Short-term, minor, negative
e. Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? The proposal has the potential to indirectly impact three listed non-Aboriginal heritage items (comprising a place of worship and a former Police Station and residence in Bells Line of Road, and a house in Grose Vale Road) of local heritage significance due to the proposed road widening work. Overall, the level of impact on these heritage items would be relatively minor and would be reduced to an acceptable level through the implementation of the proposed mitigation measures	Long-term, minor, negative

Factor	Impact
f. Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act* 1974)? The proposal has the potential to result in the removal of two Forest Red Gums (*Eucalyptus tereticornis*) from the north-western side of the Bells Line of Road/Grose Vale Road intersection. These trees are a potential food resource for the Grey-headed Flying-fox; however, the removal of these trees is not likely to impact on the presence of the Grey-headed Flying-fox or affect their feeding regime and/or life cycle. The Grey-headed Flying-fox is expected to fly over the study area and may occasionally forage within the study area as they move to more productive habitats in the broader landscape. Threatened species assessments were undertaken for the Grey-headed Flying Fox, which are presented in Appendix H. These assessments concluded that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox as: no camps or other important habitat would be impacted; the proposal is unlikely to reduce the population size, or decrease the reproductive success, of this species.	Nil
g. Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The proposal would not endanger any species of animal, plant or other form of life, whether living on land, in water or in the air.	Nil
h. Any long-term effects on the environment? The proposal would comprise an intersection upgrade at Bells Line of Road/Grose Vale Road, which would generally involve the provision of dedicated through and turning lanes to improve traffic flow, reduce traffic congestion and improve safety on Richmond Bridge and its approach roads.	Long-term, major, positive
i. Any degradation of the quality of the environment? The proposal has the potential to degrade the quality of the environment through accidental spills and erosion and sediment during construction. A Soil and Water Management Plan would be implemented to mitigate these impacts (refer to Sections 6.5 and 6.10).	Short-term, minor, negative
j. Any risk to the safety of the environment? Construction of the proposal has the potential to temporarily decrease safety in the vicinity of the Bells Line of Road/Grose Vale Road intersection due to road work and the movement of construction plant. These risks are anticipated to be manageable through the application of standard mitigation measures.	Short-term, minor, negative
Operation of the proposal would improve the safety of the environment through improvements to traffic flow and manoeuvring.	Long-term, major, positive

Factor	Impact
k. Any reduction in the range of beneficial uses of the environment? The proposal would require the permanent acquisition of about 575 square metres of privately owned land involving six properties and six separate land owners. It would also require the acquisition of about 110 square metres of public land (Council-owned public reserve) on the northern corner of Bells Line of Road and Terrace Road. The majority of this land would comprise strips of residential land. However, one full property acquisition (affecting a commercial property at 60 Bells Line of Road) would also be required. Socio-economic impacts associated with the acquisition of this land are described in Section 6.7.	Long-term, minor, negative
l. Any pollution of the environment? There is the potential for accidental spills of chemicals during construction which could affect the surrounding land, surface water and groundwater. There is the potential for air quality and noise amenity to be reduced during construction activities.	Short-term, minor, negative
The proposal is expected to have a beneficial impact on air quality in the area. The proposed intersection upgrade at Bells Line of Road/Grose Vale Road is expected to alleviate traffic congestion on Richmond Bridge and its approach roads. Reduced congestion in the proposal area would result in shorter vehicle delays and a reduction in associated air emissions.	Long-term, minor, positive
m. Any environmental problems associated with the disposal of waste? Risks associated with the encountering of contaminated material (and its subsequent disposal) would be managed according to the safeguards outlined in Section 6.6.5. Contamination is discussed further in Section 6.5 of this REF; while discussion on the generation and disposal of waste is provided in Section 6.13.	Short-term, minor, negative
n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? The proposal would require resources such as fill, concrete and asphalt, which are common construction materials. The proposal would not create any significant demand on these resources. All other required resources for the proposal are considered to be readily available.	Nil
o. Any cumulative environmental effect with other existing or likely future activities? Construction of the proposal may overlap with other local development within the Hawkesbury City Council LGA. Given the nature of the proposal, cumulative impacts as a result of concurrent development is anticipated to be relatively minor and would be managed according to safeguards outlined in Section 6.15.	Nil
p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal is not located within a coastal area and would not result in any impact on coastal processes and coastal hazards.	Nil

Matters of National Environmental Significance

Under the environmental assessment provisions of the *Environment Protection and Biodiversity Conservation Act 1999*, the following matters of national environmental significance and impacts on Commonwealth land are required to be considered to assist in determining whether the proposal should be referred to the Australian Government Department of the Environment.

Factor	Impact
a. Any impact on a World Heritage property? The proposal would not have an impact on a World Heritage property.	Nil
b. Any impact on a National Heritage place? The proposal would not have an impact on a National Heritage place.	Nil
c. Any impact on a wetland of international importance? State whether the proposal would impact on a wetland of international importance. If impacts are likely, describe the nature and extent of the impacts.	Nil
d. Any impact on a listed threatened species or communities? A row of eight Forest Red Gums (*Eucalyptus tereticornis*) is located within the median of Bells Line of Road, to the east of the Bells Line of Road/ Grose Vale Road intersection, while an additional two Forest Red Gums are located on the north-western side of the Bells Line of Road/Grose Vale Road intersection. The proposal is likely to result in the removal of the two Forest Red Gums on the north-western side of the Bells Line of Road/Grose Vale Road intersection. While these Forest Red Gums are likely remnants of Cumberland Plain Woodland (listed as critically endangered under the EPBC Act), the proposal area has been highly modified and, therefore, vegetation to be removed by the proposal does not constitute an ecological community. There is a known Grey-headed Flying-fox (*Pteropus poliocephalus*; listed as Vulnerable under the EPBC Act) camp at Yarramundi, located about 5 kilometres from the study area. Forest Red Gums located within the median of Bells Line of Road, to the east of the Bells Line of Road/ Grose Vale Road intersection are a potential food resource for the Grey-headed Flying-fox. The Forest Red Gum is considered a significant food tree for this species with a high nectar production and good annual flowering reliability (Eby and Law 2008). While two of these Forest Red Gums are likely to be removed by the proposal, the loss of these trees is not likely to impact on the presence of the Grey-headed Flying-fox or affect their feeding regime and/or life cycle. Threatened species assessments were undertaken for the Grey-headed Flying Fox, which are presented in Appendix H. These assessments concluded that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox as: no camps or other important habitat would be impacted; the proposal is unlikely to reduce the population size, or decrease the reproductive success, of this species.	Nil

Factor	Impact
e. Any impacts on listed migratory species? The proposal would not impact any listed migratory species.	Nil
f. Any impact on a Commonwealth marine area? The proposal would not have an impact on a Commonwealth marine area.	Nil
g. Does the proposal involve a nuclear action (including uranium mining)? The proposal does not involve a nuclear action.	Nil
h. Water resource, in relation to coal seam gas development and large coal mining development? The proposal would not impact any water resources.	Nil
Additionally, any impact (direct or indirect) on Commonwealth land? The proposal would not have a direct or indirect impact on Commonwealth land.	Nil

Appendix B

Detailed design for the proposed Bells Line of Road/ Grose Vale Road intersection

HAWKESBURY CITY COUNCIL

RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST

MR184 - BELLS LINE OF ROAD

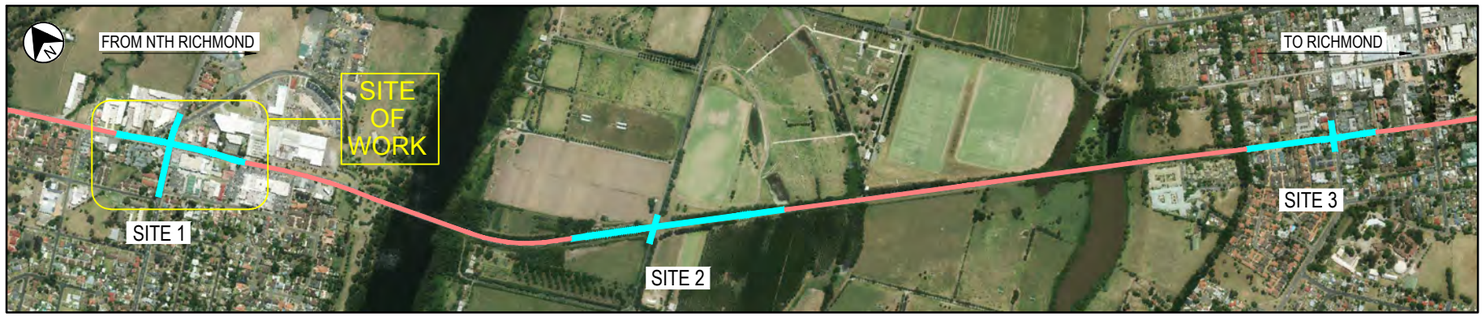
RICHMOND BRIDGE APPROACHES - SHORT TERM IMPROVEMENTS

FROM NORTH RICHMOND TO RICHMOND

DETAIL DESIGN

SITE 1

INTERSECTION WITH GROSE VALE ROAD



REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT: HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
COVER SHEET

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1001	E

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

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DRAWING No.	DRAWING TITLE
	GENERAL
NB00042-W010-DG-RD-1001	COVER SHEET
NB00042-W010-DG-RD-1002	INDEX SHEET
NB00042-W010-DG-RD-1003	GENERAL NOTES
NB00042-W010-DG-RD-1011	KEY PLAN
NB00042-W010-DG-RD-1021	TYPICAL CROSS SECTIONS
	ROADWORKS
NB00042-W010-DG-RD-1101	GENERAL ARRANGEMENT SHEET 1
NB00042-W010-DG-RD-1102	GENERAL ARRANGEMENT SHEET 2
NB00042-W010-DG-RD-1103	GENERAL ARRANGEMENT SHEET 3
NB00042-W010-DG-RD-1104	GENERAL ARRANGEMENT SHEET 4
NB00042-W010-DG-RD-1105	GENERAL ARRANGEMENT SHEET 5
NB00042-W010-DG-RD-1106	GENERAL ARRANGEMENT SHEET 6
NB00042-W010-DG-RD-1111	LONGSECTION - MC10 SHEET 1
NB00042-W010-DG-RD-1112	LONGSECTION - MC10 SHEET 2
NB00042-W010-DG-RD-1113	LONGSECTION - MC10 SHEET 3
NB00042-W010-DG-RD-1114	LONGSECTION - MC10 SHEET 4
NB00042-W010-DG-RD-1115	LONGSECTION - MC20 SHEET 1
NB00042-W010-DG-RD-1116	LONGSECTION - MC20 SHEET 2
NB00042-W010-DG-RD-1121	CROSS SECTION - MC10 SHEET 1
NB00042-W010-DG-RD-1122	CROSS SECTION - MC10 SHEET 2
NB00042-W010-DG-RD-1123	CROSS SECTION - MC10 SHEET 3
NB00042-W010-DG-RD-1124	CROSS SECTION - MC10 SHEET 4
NB00042-W010-DG-RD-1125	CROSS SECTION - MC10 SHEET 5
NB00042-W010-DG-RD-1126	CROSS SECTION - MC10 SHEET 6
NB00042-W010-DG-RD-1127	CROSS SECTION - MC10 SHEET 7
NB00042-W010-DG-RD-1128	CROSS SECTION - MC10 SHEET 8
NB00042-W010-DG-RD-1129	CROSS SECTION - MC10 SHEET 9
NB00042-W010-DG-RD-1131	CROSS SECTION - MC20 SHEET 1
NB00042-W010-DG-RD-1132	CROSS SECTION - MC20 SHEET 2
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NB00042-W010-DG-RD-1134	CROSS SECTION - MC20 SHEET 4
NB00042-W010-DG-RD-1135	CROSS SECTION - MC20 SHEET 5
	DRAINAGE
NB00042-W010-DG-DR-1101	DRAINAGE PLAN SHEET 1
NB00042-W010-DG-DR-1102	DRAINAGE PLAN SHEET 2
NB00042-W010-DG-DR-1103	DRAINAGE PLAN SHEET 3
NB00042-W010-DG-DR-1104	DRAINAGE PLAN SHEET 4
NB00042-W010-DG-DR-1105	DRAINAGE PLAN SHEET 5
NB00042-W010-DG-DR-1111	DRAINAGE LONGITUDINAL SECTIONS SHEET 1
NB00042-W010-DG-DR-1112	DRAINAGE LONGITUDINAL SECTIONS SHEET 2
NB00042-W010-DG-DR-1113	DRAINAGE LONGITUDINAL SECTIONS SHEET 3
NB00042-W010-DG-DR-1114	DRAINAGE LONGITUDINAL SECTIONS SHEET 4
NB00042-W010-DG-DR-1115	DRAINAGE LONGITUDINAL SECTIONS SHEET 5
NB00042-W010-DG-DR-1116	DRAINAGE LONGITUDINAL SECTIONS SHEET 6
NB00042-W010-DG-DR-1121	DRAINAGE PIT SCHEDULE
NB00042-W010-DG-DR-1141	UTILITIES CONFLICT SCHEDULE
NB00042-W010-DG-DR-1151	TYPICAL DRAINAGE DETAIL PIPE TO PIT CONNECTION
NB00042-W010-DG-DR-1171	STRUCTURAL DETAILS SPECIAL SA PIT WITH EXTENDED CHAMBER
NB00042-W010-DG-DR-1172	STRUCTURAL DETAILS PIT REINFORCEMENT DETAIL

DRAWING No.	DRAWING TITLE
	UTILITY COORDINATION
NB00042-W010-DG-UT-1101	UTILITY COORDINATION PLAN SHEET 1
NB00042-W010-DG-UT-1102	UTILITY COORDINATION PLAN SHEET 2
NB00042-W010-DG-UT-1103	UTILITY COORDINATION PLAN SHEET 3
NB00042-W010-DG-UT-1104	UTILITY COORDINATION PLAN SHEET 4
NB00042-W010-DG-UT-1105	UTILITY COORDINATION PLAN SHEET 5
	PAVEMENTS AND KERBS
NB00042-W010-DG-PV-1101	PAVEMENT PLAN SHEET 1
NB00042-W010-DG-PV-1102	PAVEMENT PLAN SHEET 2
NB00042-W010-DG-PV-1103	PAVEMENT PLAN SHEET 3
NB00042-W010-DG-PV-1104	PAVEMENT PLAN SHEET 4
NB00042-W010-DG-PV-1105	PAVEMENT PLAN SHEET 5
NB00042-W010-DG-PV-1106	PAVEMENT PLAN SHEET 6
NB00042-W010-DG-PV-1111	PAVEMENT PROFILES
NB00042-W010-DG-PV-1115	EDGE DETAILS SHEET 1
NB00042-W010-DG-PV-1116	EDGE DETAILS SHEET 2
NB00042-W010-DG-PV-1117	EDGE DETAILS SHEET 3
NB00042-W010-DG-PV-1118	INTERFACE DETAILS
NB00042-W010-DG-PV-1120	RIGID PAVEMENT DETAILS
NB00042-W010-DG-PV-1130	KERB DETAILS AND SCHEDULE
	PAVEMENT MARKING, SIGNS AND BARRIERS
NB00042-W010-DG-RS-1101	PAVEMENT MARKING, SIGNS AND BARRIERS SHEET 1
NB00042-W010-DG-RS-1102	PAVEMENT MARKING, SIGNS AND BARRIERS SHEET 2
NB00042-W010-DG-RS-1103	PAVEMENT MARKING, SIGNS AND BARRIERS SHEET 3
NB00042-W010-DG-RS-1104	PAVEMENT MARKING, SIGNS AND BARRIERS SHEET 4
NB00042-W010-DG-RS-1105	PAVEMENT MARKING, SIGNS AND BARRIERS SHEET 5
NB00042-W010-DG-RS-1106	PAVEMENT MARKING, SIGNS AND BARRIERS SHEET 6
	PROPERTY ADJUSTMENTS
NB00042-W010-DG-PA-1001	SP80355, 64 BELLS LINE OF ROAD SHEET 1
NB00042-W010-DG-PA-1011	SP38319, 8-10 GROSE VALE ROAD SHEET 1
NB00042-W010-DG-PA-1021	LOT 1, DP250109, 6 GROSE VALE ROAD SHEET 1
NB00042-W010-DG-PA-1031	LOT 2, DP161148, 4 GROSE VALE ROAD SHEET 1
NB00042-W010-DG-PA-1041	LOT 1, DP161148, 2 GROSE VALE ROAD SHEET 1
NB00042-W010-DG-PA-1051	LOT 1, DP537249, 50 BELLS LINE OF ROAD SHEET 1
NB00042-W010-DG-PA-1061	LOT 1, DP1183329, 1 TERRACE ROAD SHEET 1

DRAWING No.	DRAWING TITLE
	LANDSCAPING
NB00042-W010-DG-LS-1001	LANDSCAPE PLAN - SHEET 1 OF 4
NB00042-W010-DG-LS-1002	LANDSCAPE PLAN - SHEET 2 OF 4
NB00042-W010-DG-LS-1003	LANDSCAPE PLAN - SHEET 3 OF 4
NB00042-W010-DG-LS-1004	LANDSCAPE DETAILS - SHEET 4 OF 4

DRAWING No.	DRAWING TITLE
	EXTERNAL DRAWINGS
CASE NO. 141189PW	WATER MAIN ADJUSTMENT SHEET 1 OF 2
CASE NO. 141189PW	WATER MAIN ADJUSTMENT SHEET 2 OF 2
TELSTRA DESIGN	PROTECTION AND RELOCATION SOW CC NETWORK
TELSTRA DESIGN	PROTECTION AND RELOCATION SOW DA NETWORK
VV2303_10A	TRAFFIC SIGNALS - SHEET 10
L562A	LIGHTING DESIGN SHEET 1 OF 6
L562A	LIGHTING DESIGN SHEET 2 OF 6
L562A	LIGHTING DESIGN SHEET 3 OF 6
L562A	LIGHTING DESIGN SHEET 4 OF 6
L562A	LIGHTING DESIGN SHEET 5 OF 6
L562A	LIGHTING DESIGN SHEET 6 OF 6

RMS MODEL DRAWINGS - SUPPLEMENTARY DRAWING INDEX

DRAWING No.	DRAWING TITLE
	DRAINAGE
MD.R11.B01.A.1.PT1	GULLY PIT TYPE SA FOR PIPE DIA UP TO 450mm SHEET 1
MD.R11.B36.A.1	INSPECTION PIT WITH SINGLE OR DOUBLE CAST IRON FRAME AND COVER
	KERB AND GUTTER
MD.R15.A01.A.2	STANDARD KERB AND GUTTER SHAPES
MD.R15.A08.A.B	STANDARD VEHICULAR CHANNEL CROSSING FOR USE WITH TYPE SA KERB AND CHANNEL
	KERB RAMPS
MD.R173.B01.A.1 SHT 1	KERB RAMPS (SHEET 1)
MD.R173.B01.A.1 SHT 2	KERB RAMPS (SHEET 2)
MD.R173.B01.A.1 SHT 3	KERB RAMPS (SHEET 3)

SURVEY	
STANDARD SURVEY FEATURE NAMES	STANDARD FEATURE NAMES FOR RTA MX SURVEY, REVISED 2009

DESIGN MODELLING	
JACOBS DESIGN STRING NAMING CONVENTION	JACOBS NSW 2013 STRING NAMING CONVENTION

DATE: 17/03/2016 11:27:25 AM LOGIN NAME: SUTHERLAND, GRANT
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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
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0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
INDEX SHEET

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1002	E

GENERAL

1. ALL LOCATIONS, ORIENTATION AND LEVELS SHALL BE VERIFIED BEFORE COMMENCING ANY WORK. REFER ANY DISCREPANCIES TO THE PRINCIPAL. NATURAL SURFACE LEVELS ON THE DRAWINGS ARE INDICATIVE ONLY.

2. THESE NOTES SHALL BE READ IN CONJUNCTION WITH OTHER DRAWINGS, SPECIFICATIONS AND WRITTEN INSTRUCTIONS. ALWAYS REFER TO THE TECHNICAL SPECIFICATION FOR CLARIFICATION AND DETAILS.

3. LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (A.H.D.).

4. CO-ORDINATES ARE TO MAP GRID OF AUSTRALIA (MGA ZONE 56).

5. ALL DIMENSIONS ON DETAILED DRAWINGS ARE IN METRES UNLESS NOTED OTHERWISE.

6. SUPPLEMENTARY DRAWINGS HAVE BEEN PROVIDED AND ARE ATTACHED IN THE DETAIL DESIGN DRAWINGS.

ROADWORKS - NOTES

1. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH CURRENT RMS STANDARDS UNLESS OTHERWISE NOTED.

2. THE CONTRACTOR SHALL LOCATE AND DETERMINE THE LEVELS OF ALL EXISTING SERVICES PRIOR TO COMMENCING CONSTRUCTION AND PROTECT AND MAKE ARRANGEMENT WITH THE RELEVANT AUTHORITY TO RELOCATE AND/OR ADJUST IF NECESSARY. INFORMATION GIVEN ON THE DRAWING IN RESPECT TO SERVICES IS FOR GUIDANCE ONLY AND IS NOT GUARANTEED, COMPLETE NOR CORRECT.

3. THE LIMIT OF WORKS SHOWN ON THE PLANS REPRESENTS THE EXTENT OF PERMANENT ROAD WORKS (PAVEMENTS). OTHER DESIGN ELEMENTS MAY EXTEND BEYOND THE LIMIT OF WORKS AS DETAILED IN OTHER DRAWINGS.

4. ALL KERB RAMPS ARE TO BE IN ACCORDANCE WITH RMS MODEL DRAWING MD.R173.B01.A.1.

PAVEMENT

1. PAVEMENT TO BE CONSTRUCTED IN ACCORDANCE WITH RMS QA SPECIFICATIONS R71, R83 AND R116 UNLESS NOTED OTHERWISE.

2. DGB 20 MATERIAL TO BE IN ACCORDANCE WITH RMS QA SPECIFICATION 3051.

DRAINAGE - GENERAL

1. ANY DISCREPANCIES IN THE DRAWINGS AND/OR SPECIFICATIONS SHALL BE REFERRED TO THE JACOBS WORK PACKAGE MANAGER FOR CLARIFICATION BEFORE PROCEEDING.

2. THE CONTRACTOR IS RESPONSIBLE FOR THE PREPARATION OF TEMPORARY EROSION AND SEDIMENTATION CONTROL PLANS.

3. ANY PERMITS REQUIRED FOR DIVERSION WORKS SHALL BE OBTAINED BY CONTRACTOR.

4. WHERE CONNECTION IS TO BE MADE TO AN EXISTING DRAINAGE STRUCTURE OR OPEN DRAIN THE POSITION AND LEVEL OF THE EXISTING DRAINAGE STRUCTURE SHALL BE CONFIRMED PRIOR TO CONSTRUCTION.

DRAINAGE - STRUCTURES

1. U.N.O. ALL DRAINAGE PIPES SHALL BE CLASS 3 FOR LONGITUDINAL PIPES AND CLASS 4 FOR TRANSVERSE PIPES.

2. ALL PIPES ARE TO BE SPIGOT AND SOCKET WITH RUBBER RING JOINTS UNLESS OTHERWISE INDICATED.

3. ALL PROPOSED DRAINAGE PIT GRATINGS SHALL BE HEAVY DUTY CLASS D.

4. PROVIDE STEP IRONS TO ALL PROPOSED AND MODIFIED PITS DEEPER THAN 600mm.

5. CONCRETE AND STEEL REINFORCEMENT SHALL BE IN ACCORDANCE WITH RMS QA SPECIFICATION R53.

DRAINAGE - INSTALLATION

1. PAVEMENT DRAINAGE PIPES HAVE BEEN DESIGNED FOR TRENCH INSTALLATION CONDITION WITH TYPE HS3 SUPPORT UNLESS NOTED OTHERWISE.

2. TRANSVERSE DRAINAGE PIPES HAVE BEEN DESIGNED FOR EMBANKMENT POSITIVE PROJECTION CONDITIONS WITH TYPE HS3 SUPPORT UNLESS NOTED OTHERWISE.

3. CONNECTION BETWEEN PIPES AND STRUCTURES TO BE UNDERTAKEN IN ACCORDANCE WITH RMS QA SPECIFICATION R11 AND RMS STANDARD DRAWINGS UNLESS NOTED OTHERWISE.

DRAINAGE - DURABILITY

1. THE EXPOSURE CLASSIFICATION FOR DRAINAGE STRUCTURES SHALL BE "B1" IN ACCORDANCE WITH AUSTRALIAN STANDARD AS 5100.5 : 2005.

SUBSURFACE DRAINAGE

1. PAVEMENT SUBSURFACE DRAINAGE IS TO BE IN ACCORDANCE WITH RMS QA SPECIFICATION R33.

UTILITIES

1. UTILITIES SHOWN ARE INDICATIVE ONLY. THE CONTRACTOR SHALL CONFIRM THE LOCATION OF ALL UTILITIES PRIOR TO COMMENCING WORK. THE CONTRACTOR SHALL CARRY OUT THE FOLLOWING BEFORE COMMENCING ANY WORKS:

(I) DETERMINE THE EXTENT OF EXISTING UTILITY SURVEY INFORMATION.
(II) OBTAIN CURRENT DIAL BEFORE YOU DIG PLANS AND INFORMATION BY TELEPHONING 1100 OR FAX 1300 682 077 TO ASCERTAIN THE EXACT LOCATION OF UTILITIES;
(III) MAKE ANY OTHER ENQUIRIES AS THE CONTRACTOR CONSIDERS NECESSARY TO SATISFY ITSELF AS TO THE EXACT LOCATION OF UTILITY SERVICES; AND
(IV) ADOPT WORK METHODS TO AVOID DAMAGE TO UTILITIES.
(V) ALL "AS CONSTRUCTED" UTILITY INFORMATION OBTAINED FROM DIAL BEFORE YOU DIG OR OTHER SERVICES MUST BE CONFIRMED BY THE USE OF DETECTION DEVICES OR BY HAND EXCAVATION OR VACUUM EXCAVATION. CONSTRUCTION MUST NOT COMMENCE UNTIL POSITIONS HAVE BEEN CONFIRMED.

2. CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.

3. THE UTILITIES COORDINATION PLAN IS FOR INFORMATION ONLY AND DOES NOT FORM PART OF THE CONTRACT. ALL UTILITY RELOCATION AND INSTALLATION WORKS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH APPROVED UTILITY AUTHORITY PLANS ONLY.

4. UTILITIES ARE TO BE IN ACCORDANCE WITH LOCATIONS SPECIFIED BY THE NSW STREETS OPENING CONFERENCE, GUIDE TO CODES AND PRACTICES FOR STREETS OPENING UNLESS DETAILED OTHERWISE.

VEGETATION

1. VEGETATION AND LANDSCAPE PLANNING TO BE APPLIED IN ACCORDANCE WITH RMS QA SPECIFICATIONS R178 AND R179.

PAVEMENT MARKING

1. PAVEMENT MARKING SHALL BE APPLIED IN ACCORDANCE WITH RMS QA SPECIFICATION R145 AND RMS DELINEATION GUIDELINES.

2. RAISED PAVEMENT MARKERS SHALL BE PROVIDED ON ALL LANE, EDGE, CONTINUITY AND SEPARATION LINES. THE SPACING OF RAISED MARKERS SHALL BE IN ACCORDANCE WITH RMS QA SPECIFICATION R142.

SIGNPOSTING

1. BEFORE INSTALLING SIGN POSTS REFER TO UTILITIES FOR UNDERGROUND SERVICE LOCATIONS.

2. SIGN POSTS TO BE INSTALLED SUCH THAT THE OFFSET FROM THE EDGE OF THE SIGN FACE TO THE SHOULDER IS A MINIMUM OF 600mm AND CLEARLY VISIBLE BY APPROACHING TRAFFIC. POST SIZES AND SIGN HEIGHTS TO BE SELECTED IN ACCORDANCE WITH RMS QA SPECIFICATION R143 AND THE RMS INSTALLATION AND MAINTENANCE OF SIGN GUIDE.

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LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1003.dwg

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

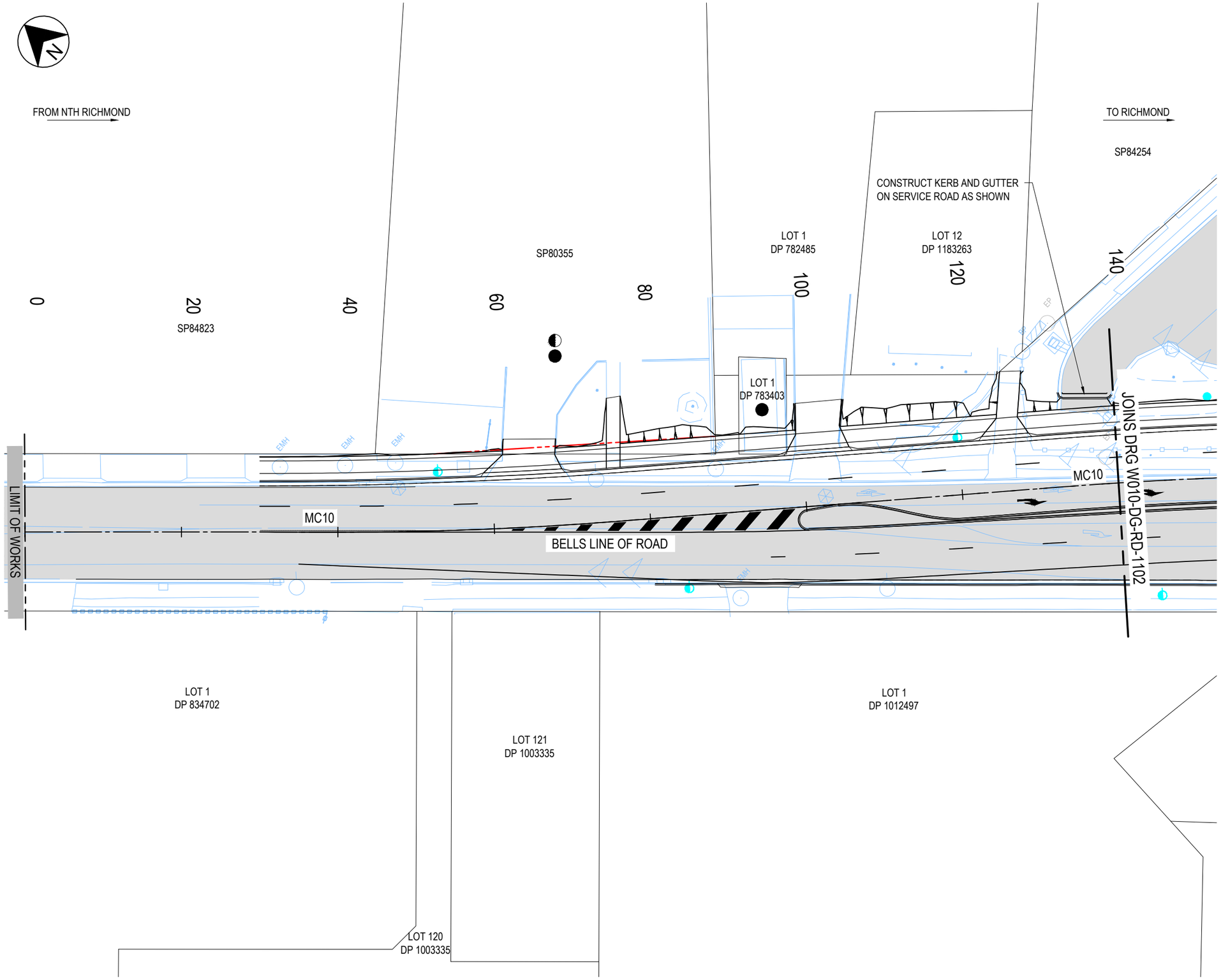
CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL NOTES

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1003	E



LEGEND

GENERAL - REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCE

ROAD GEOMETRY AND ALIGNMENT

- CONTROL LINE
- MC10 / MC20 — CONTROL STRING LABEL
- 200 — CONTROL STATIONS - MAIN CARRIAGEWAYS
- EARTHWORKS & GROUND INTERFACE
- PROPOSED BOUNDARY

PROPERTY WORKS - REFERENCE ONLY

- PROPERTY ACQUISITION
- PROPERTY ADJUSTMENT
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. FOR VEHICULAR CROSSING DETAILS REFER RMS MODEL DRAWING MD.R15.A08.B.
3. FOR KERB RAMP DETAILS REFER RMS MODEL DRAWING MD.R173.B01.A.1 (SHEETS 1 TO 3).
4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
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A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
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DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL ARRANGEMENT
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1101	E

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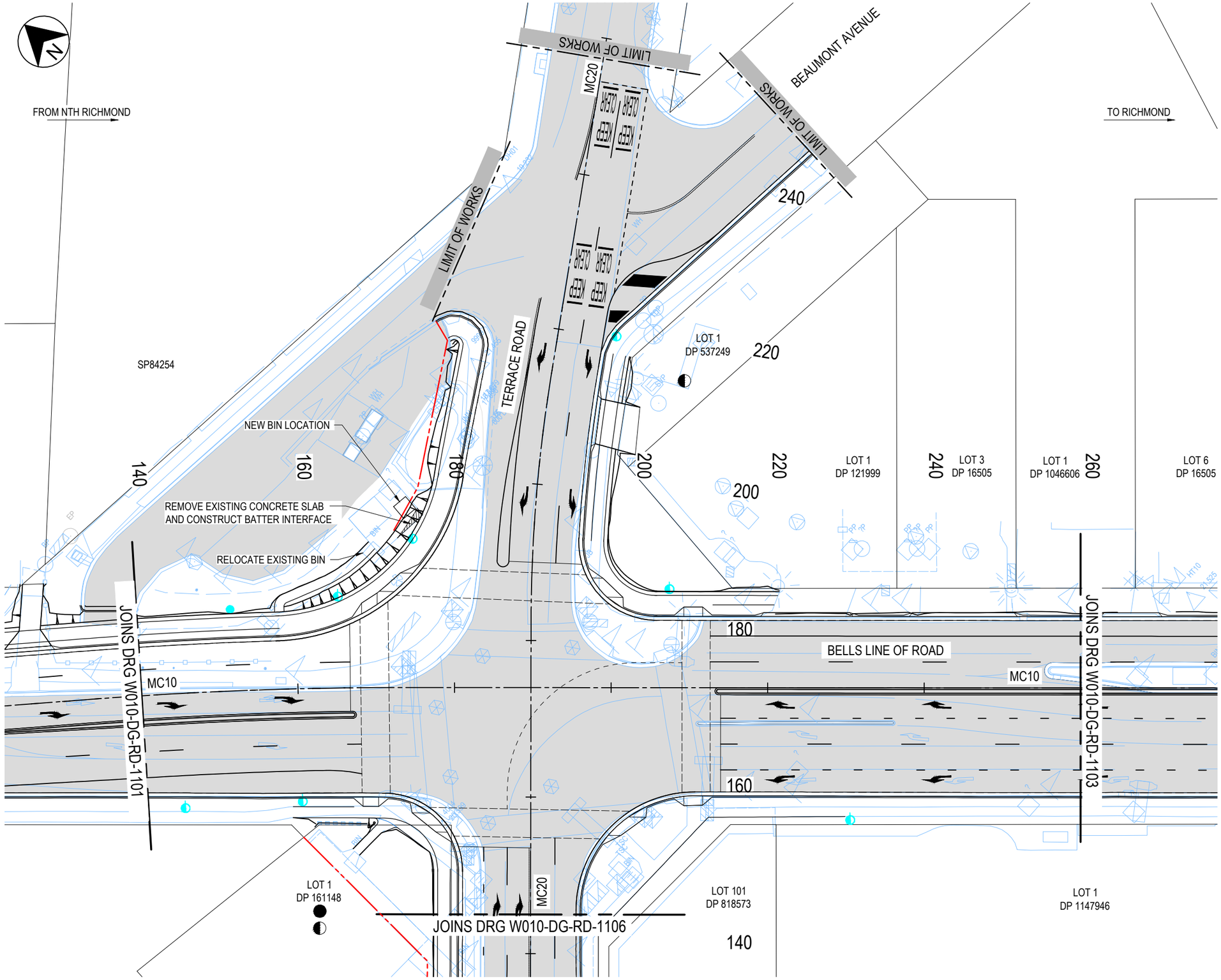

LEGEND

GENERAL - REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCE

ROAD GEOMETRY AND ALIGNMENT

- CONTROL LINE
- MC10 / MC20 — CONTROL STRING LABEL
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PROPERTY WORKS - REFERENCE ONLY

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- PROPOSED POWER POLE WITH LIGHT

NOTES

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DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 5 0 5 10 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL ARRANGEMENT
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1102	E

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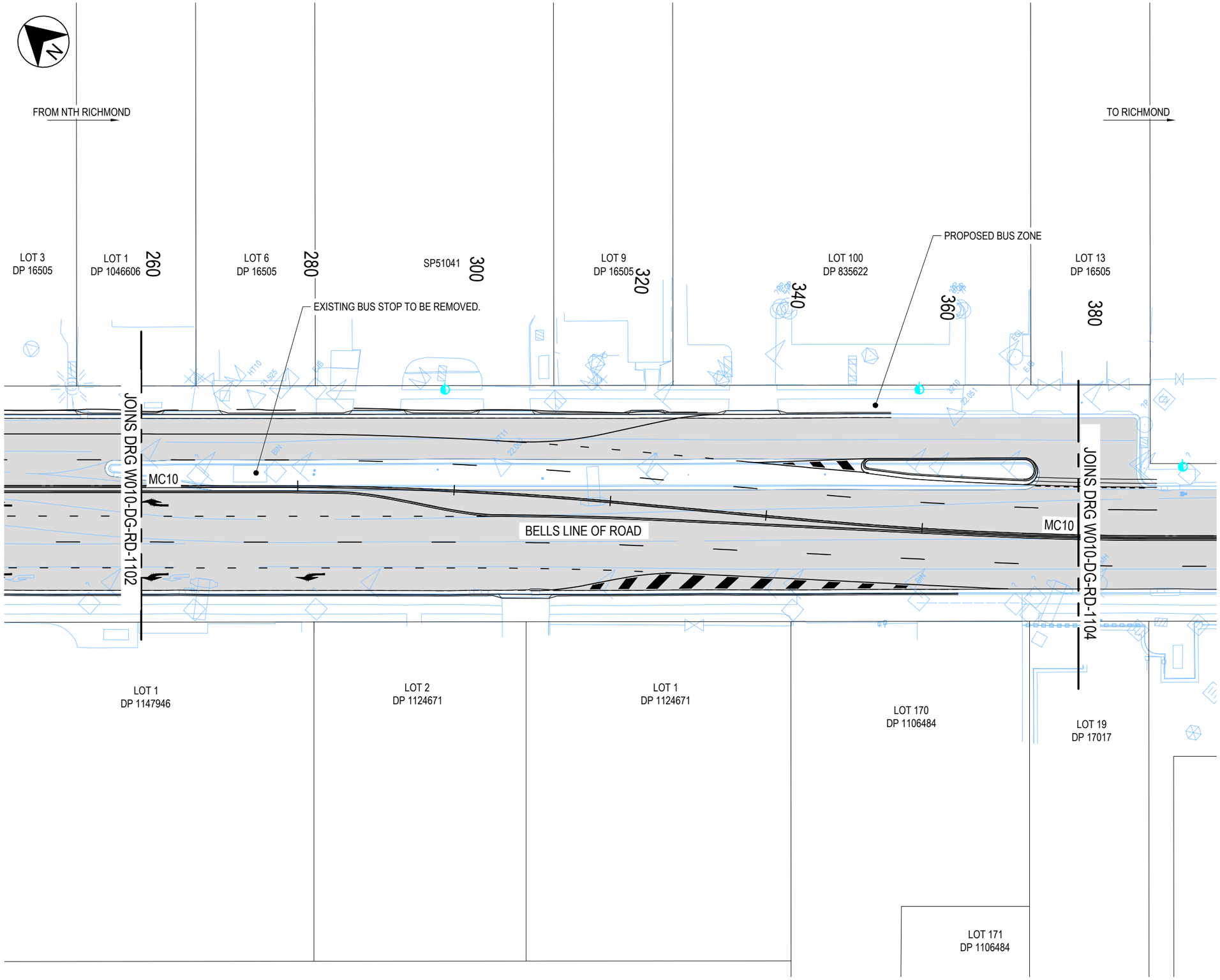

LEGEND

GENERAL - REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCE

ROAD GEOMETRY AND ALIGNMENT

- CONTROL LINE
- MC10 / MC20 — CONTROL STRING LABEL
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PROPERTY WORKS - REFERENCE ONLY

- PROPERTY ACQUISITION
- PROPERTY ADJUSTMENT
- EP — EXISTING POWER POLE
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NOTES

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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
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A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
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DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
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AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL ARRANGEMENT
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1103	E

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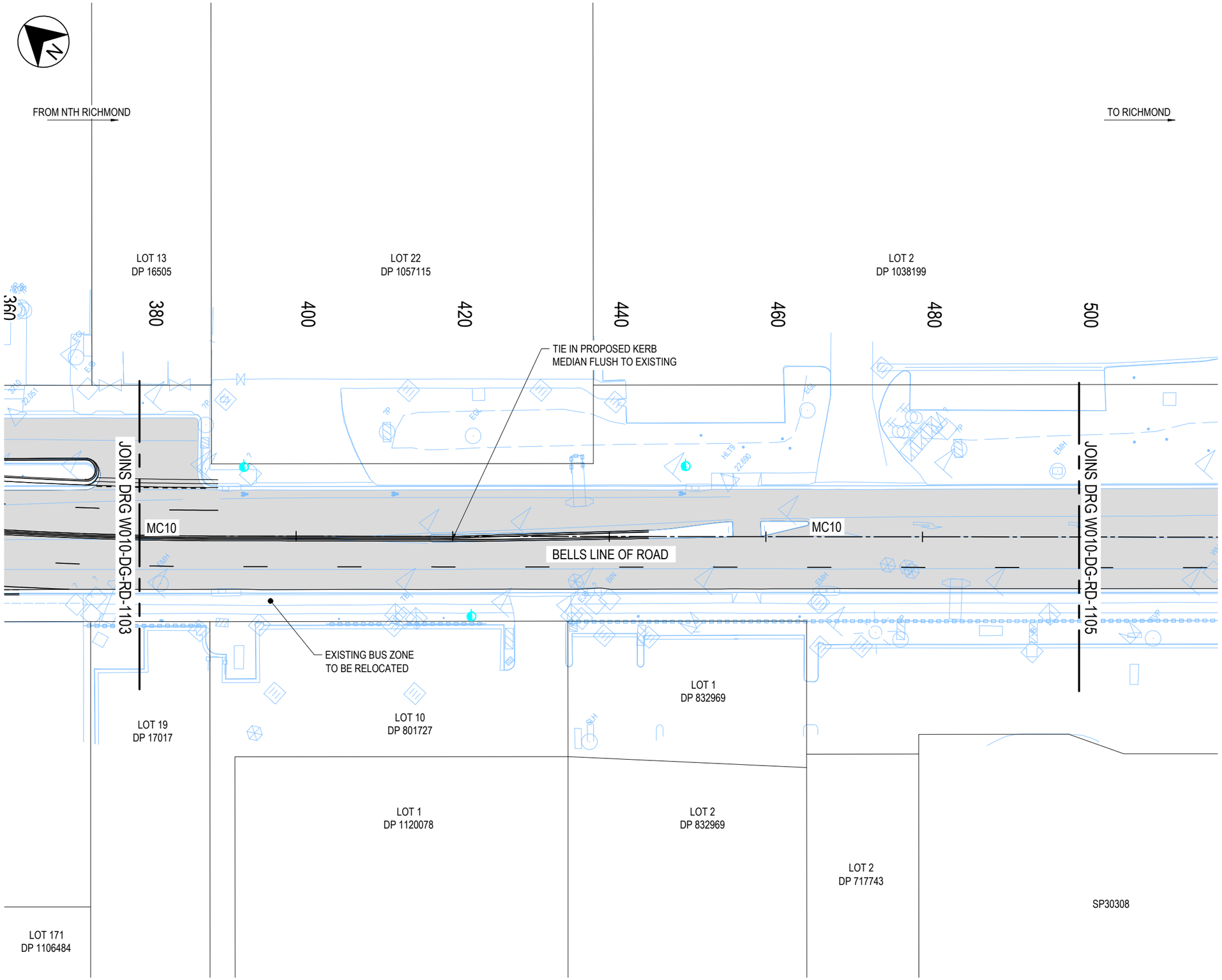

LEGEND

GENERAL - REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCE

ROAD GEOMETRY AND ALIGNMENT

- CONTROL LINE
- MC10 / MC20 — CONTROL STRING LABEL
- 200 — CONTROL STATIONS - MAIN CARRIAGEWAYS
- EARTHWORKS & GROUND INTERFACE
- PROPOSED BOUNDARY

PROPERTY WORKS - REFERENCE ONLY

- PROPERTY ACQUISITION
- PROPERTY ADJUSTMENT
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

NOTES

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2. FOR VEHICULAR CROSSING DETAILS REFER RMS MODEL DRAWING MD.R15.A08.B.
3. FOR KERB RAMP DETAILS REFER RMS MODEL DRAWING MD.R173.B01.A.1 (SHEETS 1 TO 3).
4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 5 0 5 10 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL ARRANGEMENT
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1104	E

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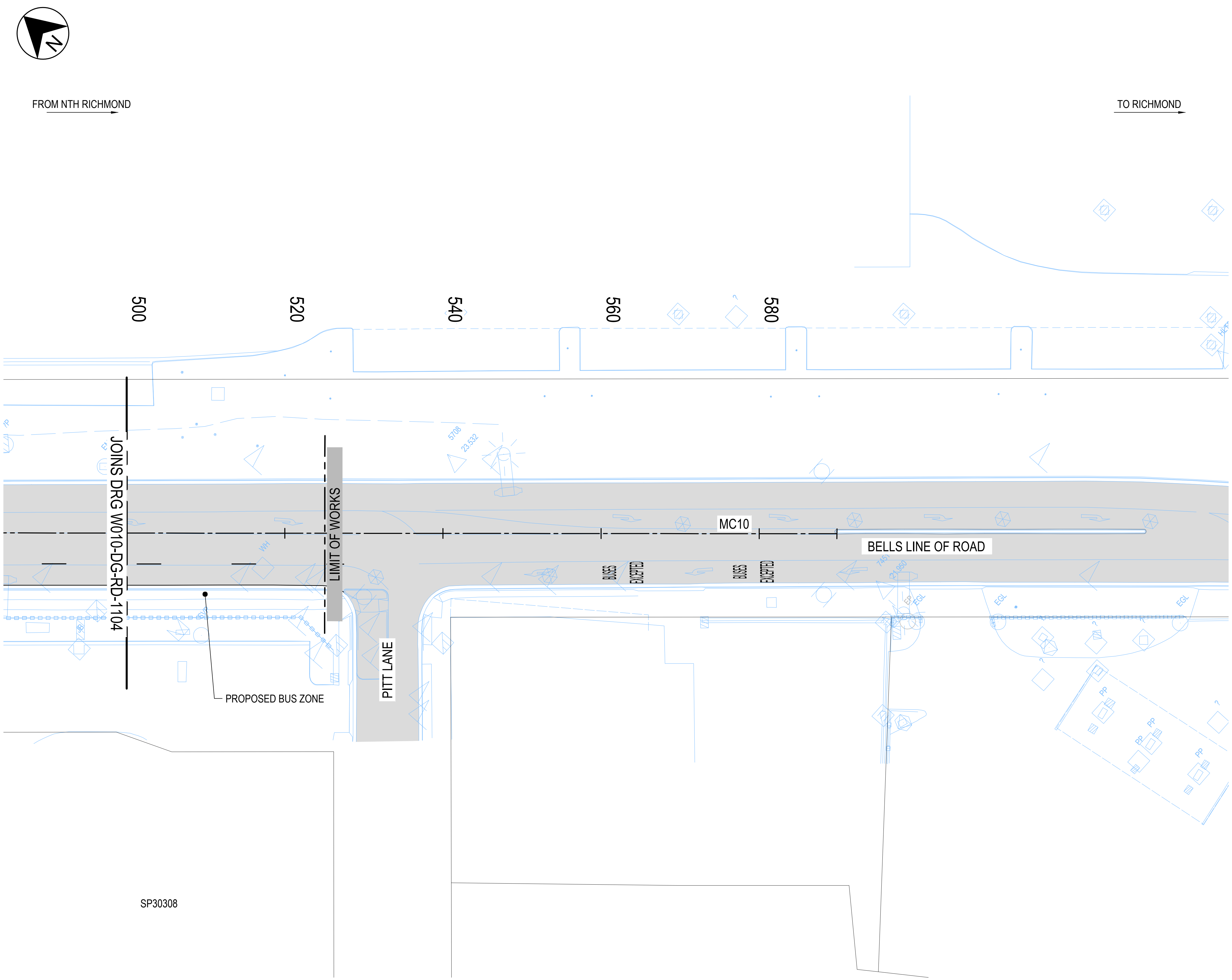
This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 12:34:09 PM
LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\IP\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1101-106.dwg



LEGEND

GENERAL - REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCE

ROAD GEOMETRY AND ALIGNMENT

- CONTROL LINE
- MC10 / MC20 — CONTROL STRING LABEL
- 200 — CONTROL STATIONS - MAIN CARRIAGEWAYS
- EARTHWORKS & GROUND INTERFACE
- PROPOSED BOUNDARY

PROPERTY WORKS - REFERENCE ONLY

- PROPERTY ACQUISITION
- PROPERTY ADJUSTMENT
- EP — EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. FOR VEHICULAR CROSSING DETAILS REFER RMS MODEL DRAWING MD.R15.A08.B.
3. FOR KERB RAMP DETAILS REFER RMS MODEL DRAWING MD.R173.B01.A.1 (SHEETS 1 TO 3).
4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

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LOCATION: I:\NBIF\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1101-1106.dwg

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
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DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10 AT A3)
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL ARRANGEMENT
SHEET 5

NOT FOR CONSTRUCTION

PHASE: FDD
RMS REGISTRATION No: DS2014/005514
STATUS: 80%
DRAWING No: NB00042-W010-DG-RD-1105
REV: C

FROM WILLIAM STREET

TO BELLS LINE OF ROAD

WILLIAM STREET

LIMIT OF WORKS

RIVERVIEW STREET

JOINS DRG W010-DG-RD-1102

GROSE VALE ROAD

MC20

MC20

LOT 4
DP 250109

No. 8 - 10
SP38319

LOT 1
DP 250109

LOT 2
DP 161148

LOT 1
DP 161148

LOT 1
DP 161148

LOT 1
DP 1127035

LOT 100
DP 818573

LOT 101
DP 818573

LOT 101
DP 818573

LOT 1
DP 1147946

0 20 40 60 80 100 120 140

LEGEND

GENERAL - REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- EXISTING FENCE

ROAD GEOMETRY AND ALIGNMENT

- CONTROL LINE
- MC10 / MC20 — CONTROL STRING LABEL
- 200 — CONTROL STATIONS - MAIN CARRIAGEWAYS
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PROPERTY WORKS - REFERENCE ONLY

- PROPERTY ACQUISITION
- PROPERTY ADJUSTMENT
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

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4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56

HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

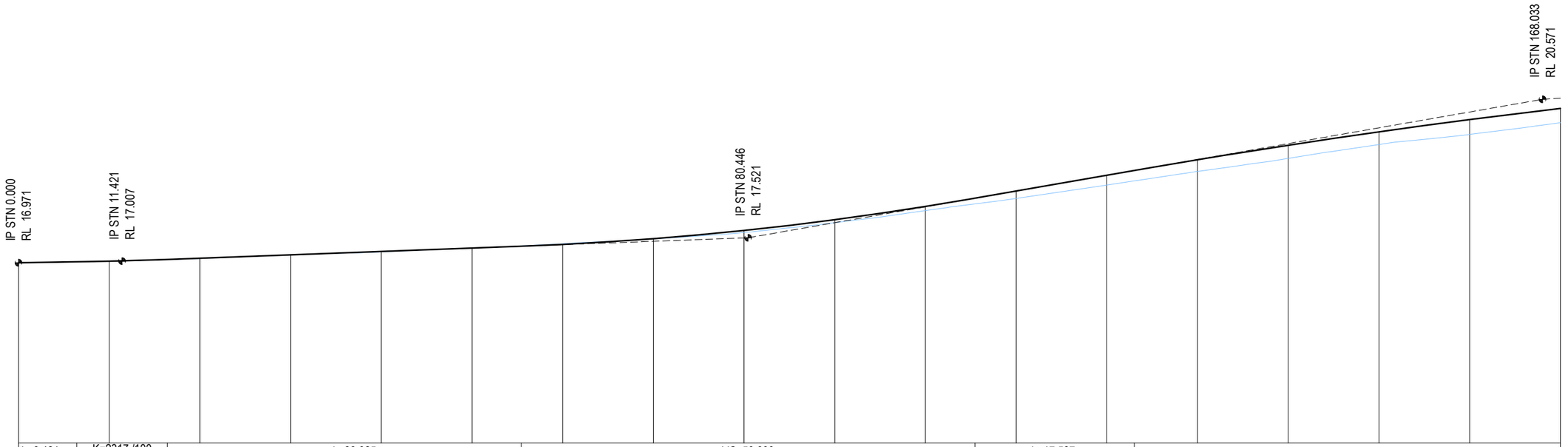
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT

HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
GENERAL ARRANGEMENT
SHEET 6

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1106	E



LONGITUDINAL SECTION BELLS LINE OF ROAD - MC10

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 5 0 5 10

VERT. 1:100 1 0 1 AT A3 2

CO-ORDINATE SYSTEM: MGA Zone 56

HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

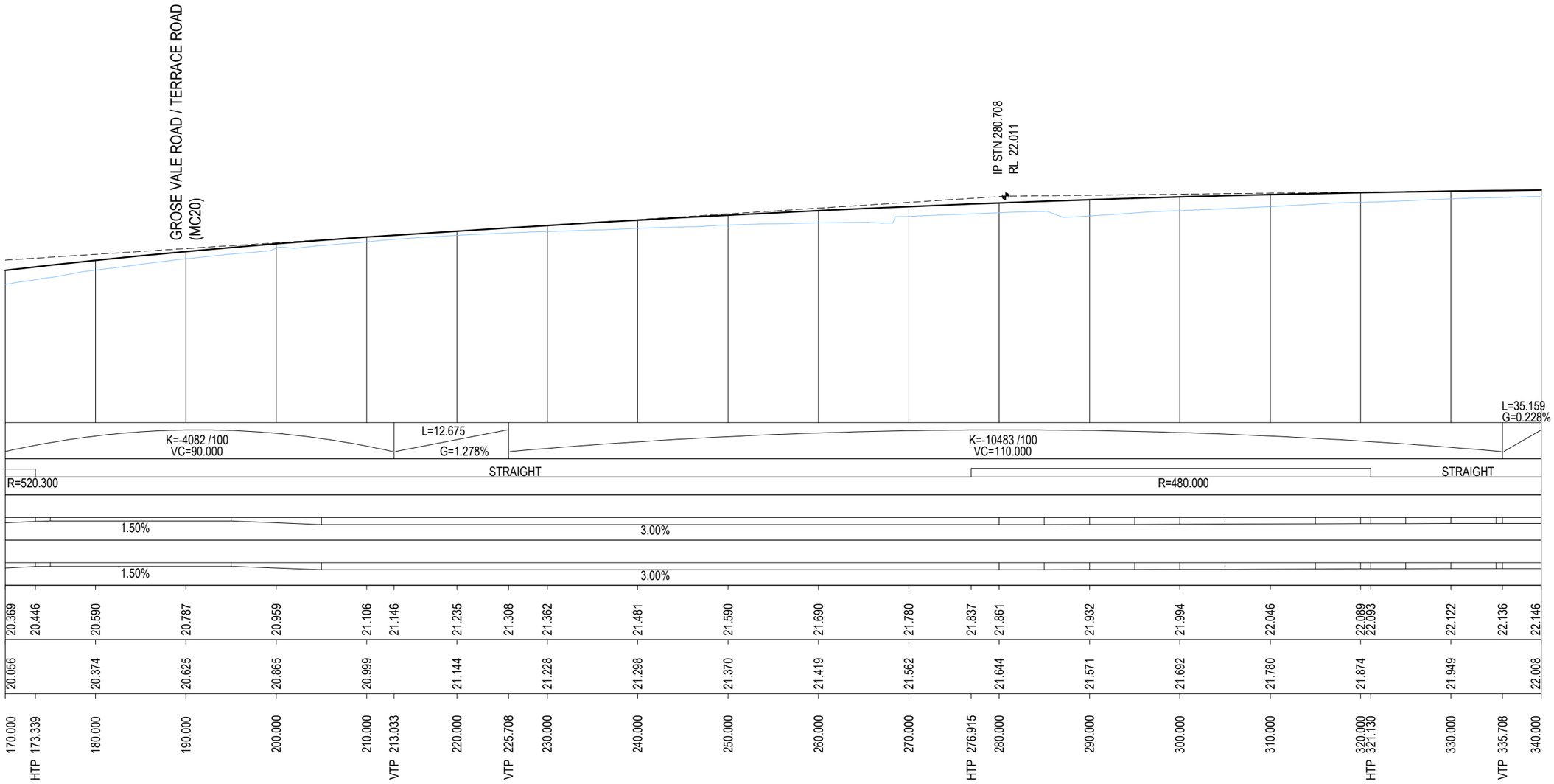
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
LONGSECTION - MC10
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1111	E

DATE: 17/03/2016 11:31:24 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwgs\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1111-116.dwg



LONGITUDINAL SECTION BELLS LINE OF ROAD - MC10

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 5 0 5 10

VERT. 1:100 1 0 1 AT A3 2

CO-ORDINATE SYSTEM: MGA Zone 56

HEIGHT DATUM: A.H.D.

CLIENT

Transport Roads & Maritime Services

CONTRACTOR

Downermouchel

DESIGNER

JACOBS

100 Christie Street
St Leonards, SYDNEY, NSW 2065
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Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

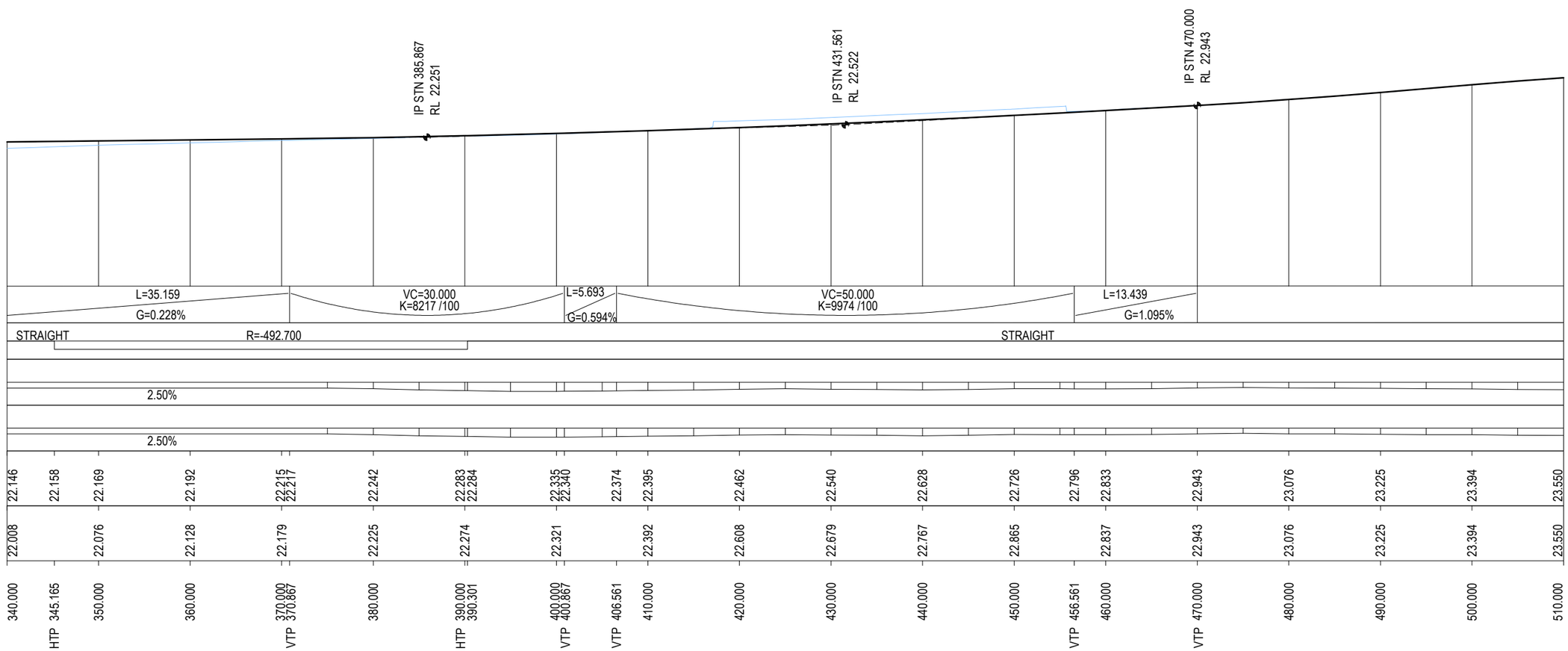
PROJECT

HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
LONGSECTION - MC10
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1112	E

DATE: 17/03/2016 11:31:29 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NBI\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwgs\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1111-1116.dwg



LONGITUDINAL SECTION BELLS LINE OF ROAD - MC10

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 5 0 5 10

VERT. 1:100 1 0 1 AT A3 2

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER:
JACOBS
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AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

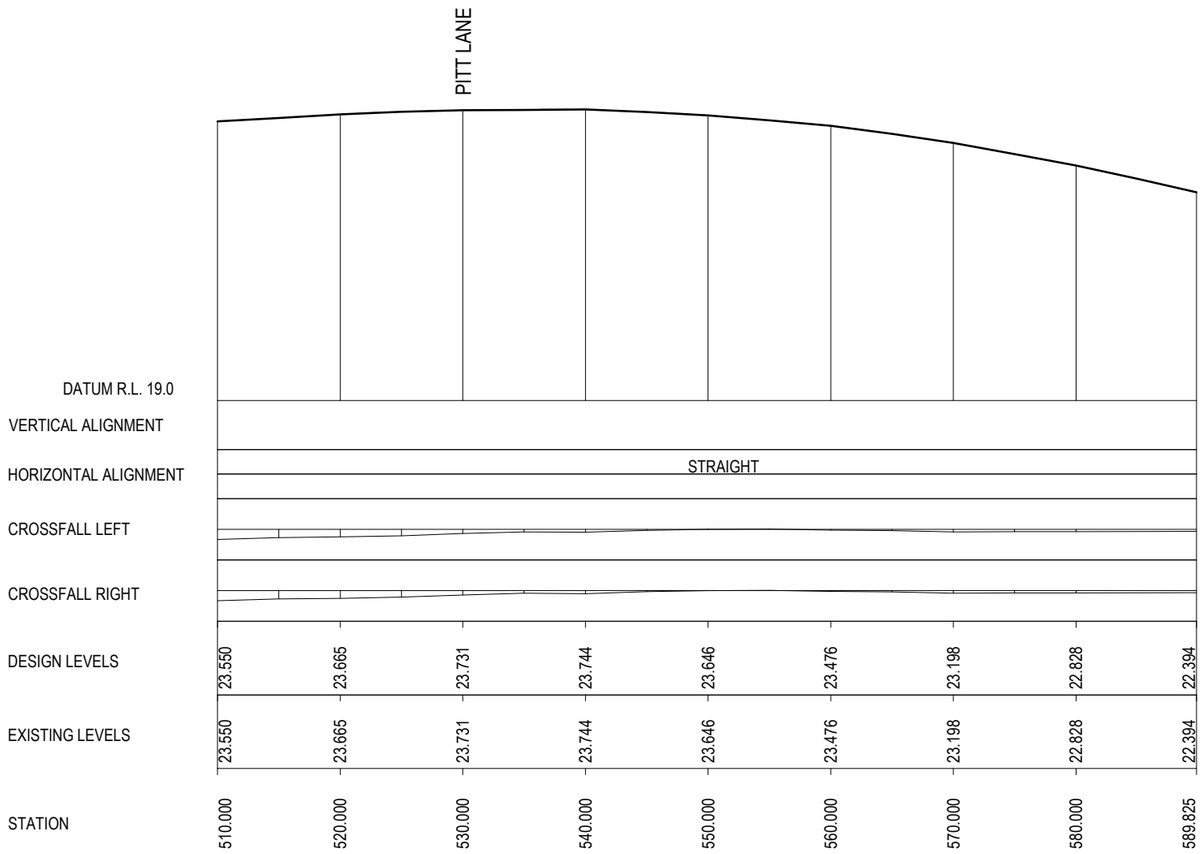
PROJECT:
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
LONGSECTION - MC10
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1113	E

0 5 10 15 20 25 mm ON A3 ORIGINAL

DATE: 17/03/2016 11:31:35 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1111-L



LONGITUDINAL SECTION BELLS LINE OF ROAD - MC10

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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 5 10 15 20 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
HORIZ. 1:500 5 0 5 10
VERT. 1:100 1 0 1 AT A3 2

CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT
NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR
Downermouchel

DESIGNER
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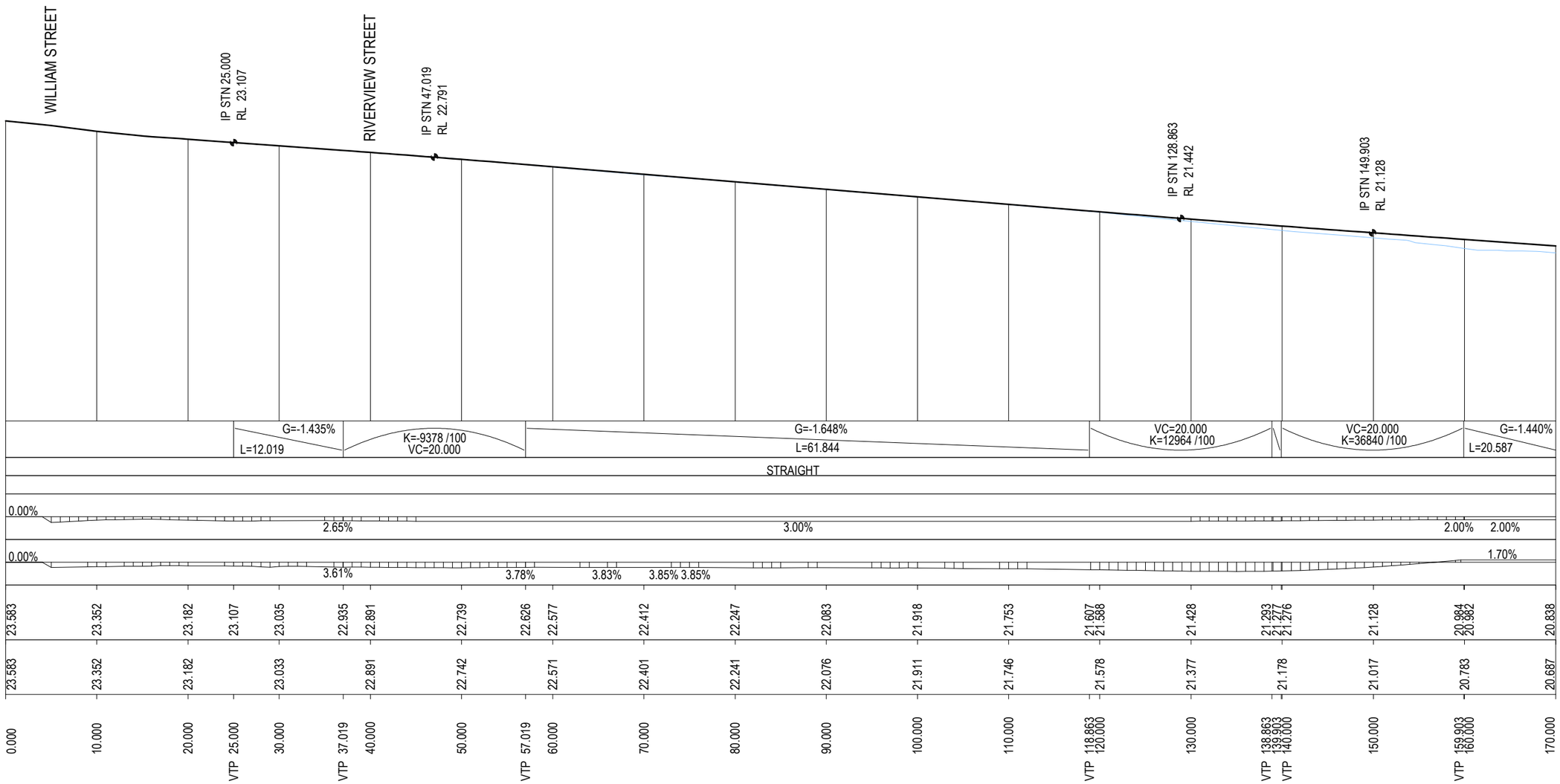
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
LONGSECTION - MC10
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1114	C



LONGITUDINAL SECTION GROSE VALE ROAD - MC20

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
HORIZ. 1:500
VERT. 1:100
5 0 5 10
1 0 1 AT A3 2
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

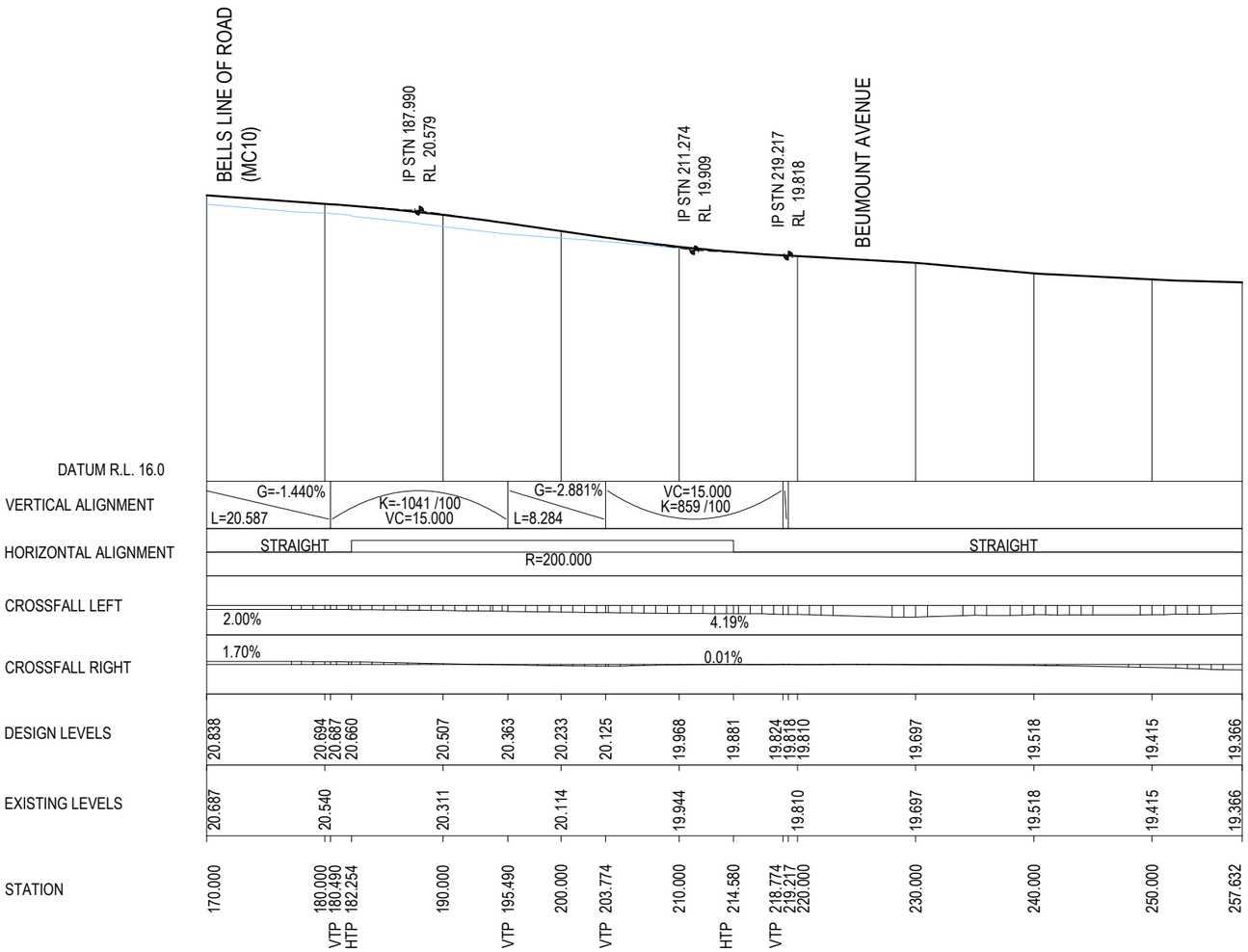
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
LONGSECTION - MC20
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1115	E

DATE: 17/03/2016 11:31:45 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1111-1115.dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL



LONGITUDINAL SECTION GROSE VALE ROAD - MC20

DATE: 17/03/2016 11:31:51 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1111-1116.dwg

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 5 0 5 10
VERT. 1:100 1 0 1 AT A3 2

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT
NSW GOVERNMENT Transport Roads & Maritime Services

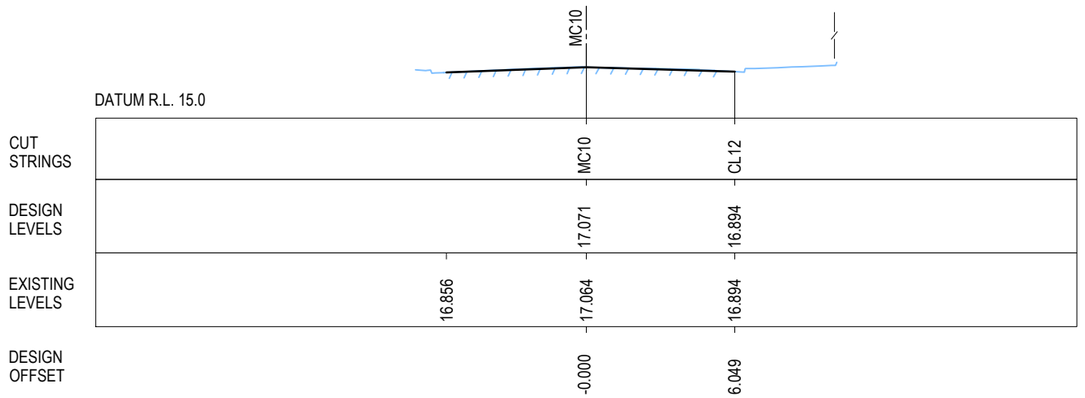
CONTRACTOR
DM Downermouchel

DESIGNER
JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
LONGSECTION - MC20
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1116	E



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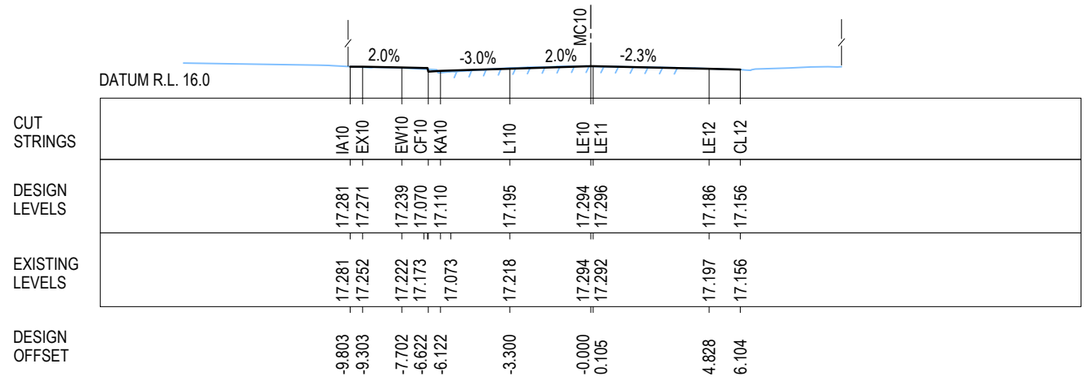

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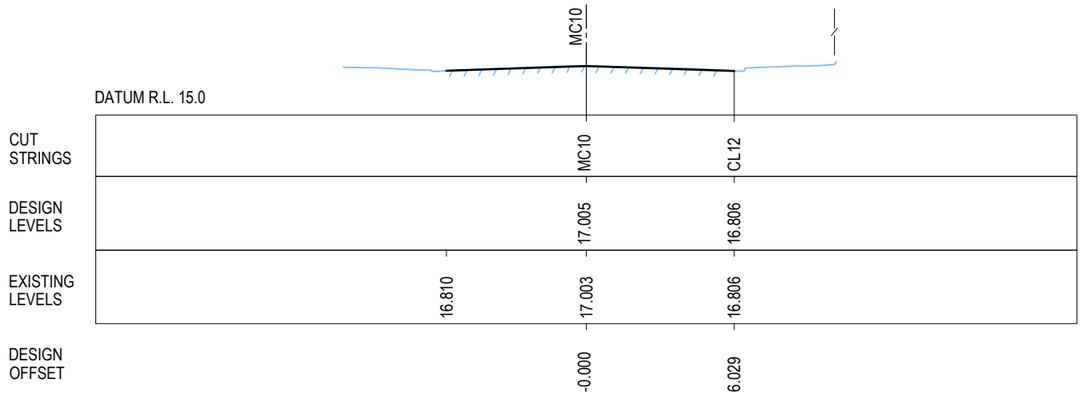

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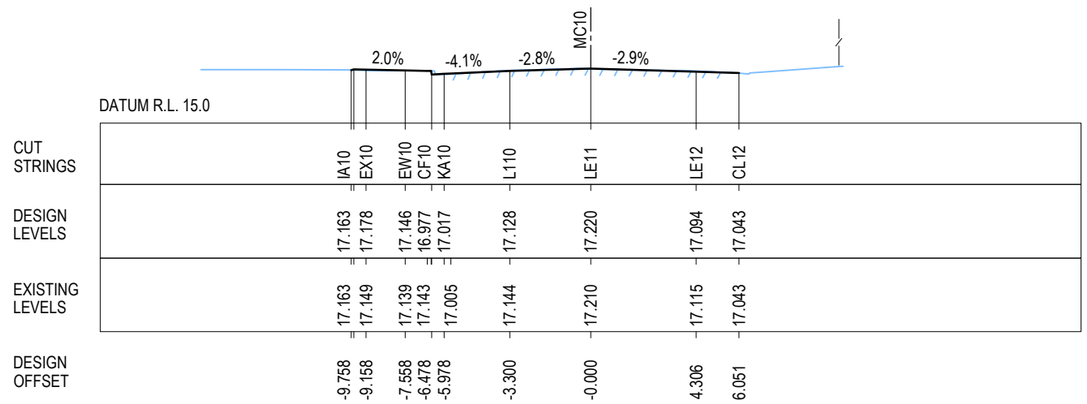

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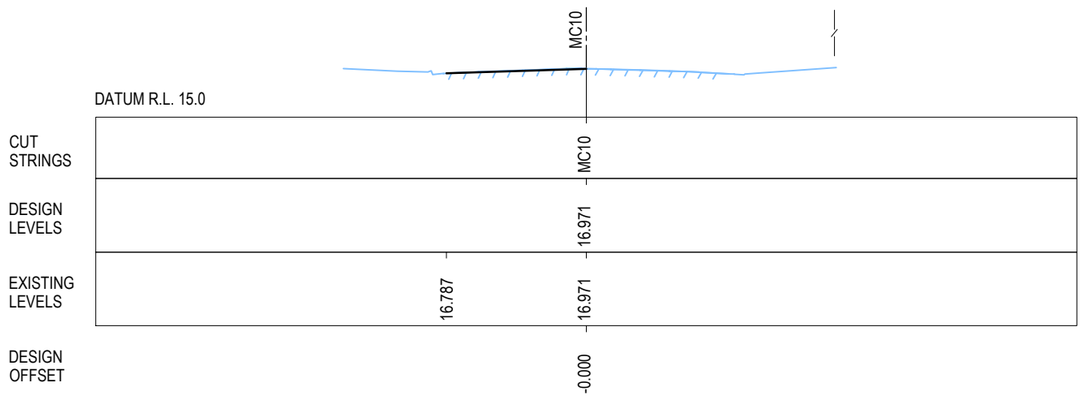

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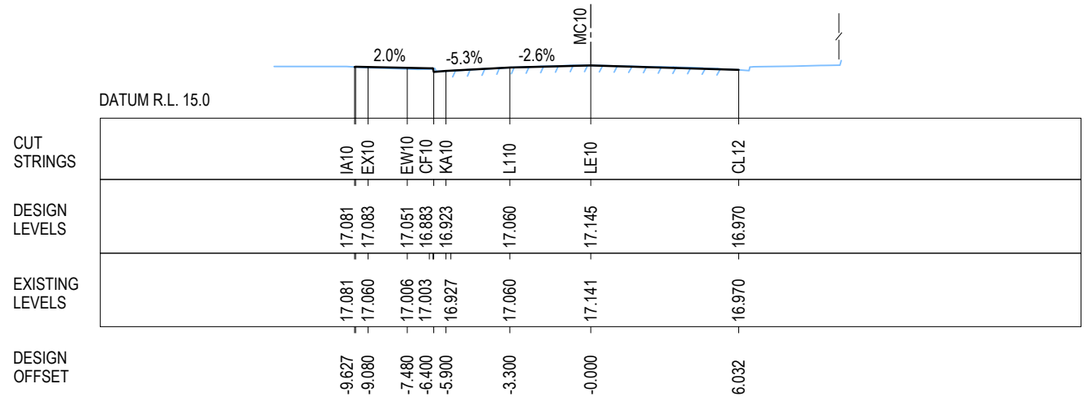


30

LEGEND

MC.xx CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

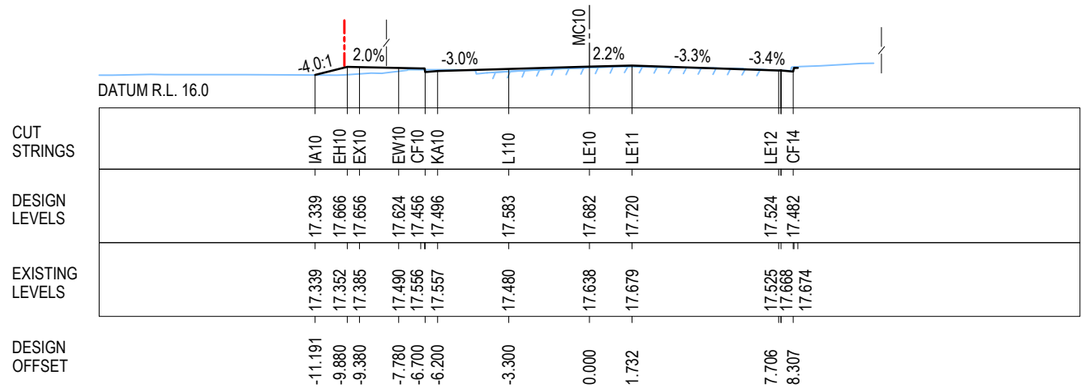
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1121	E

DATE: 17/03/2016 12:27:18 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL



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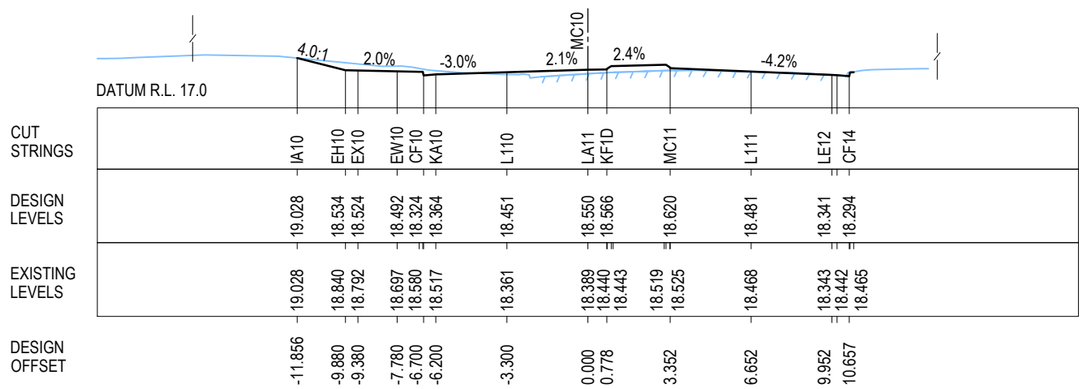

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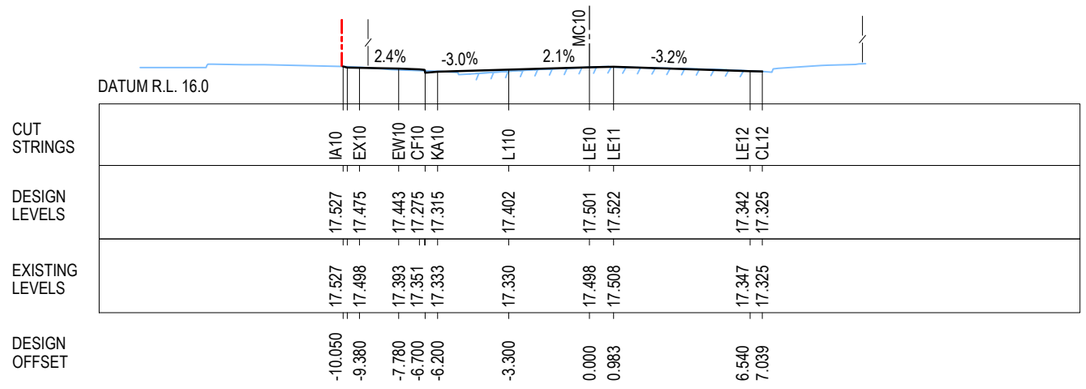

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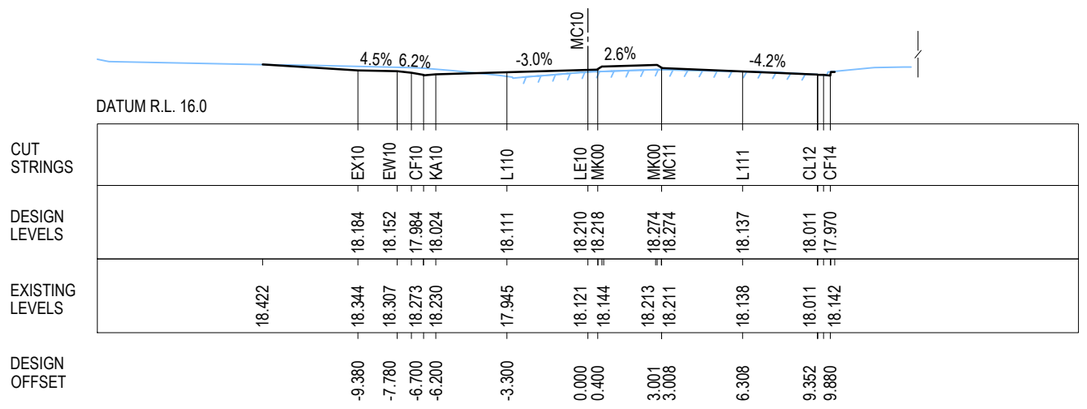

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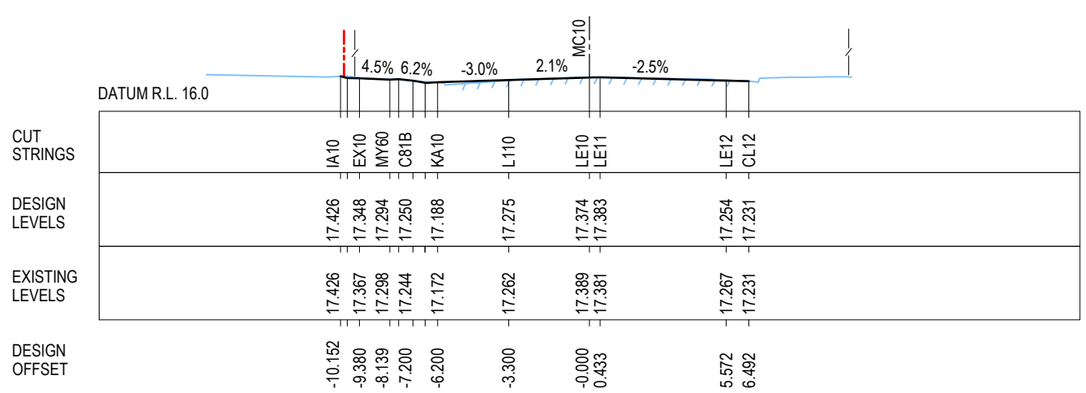

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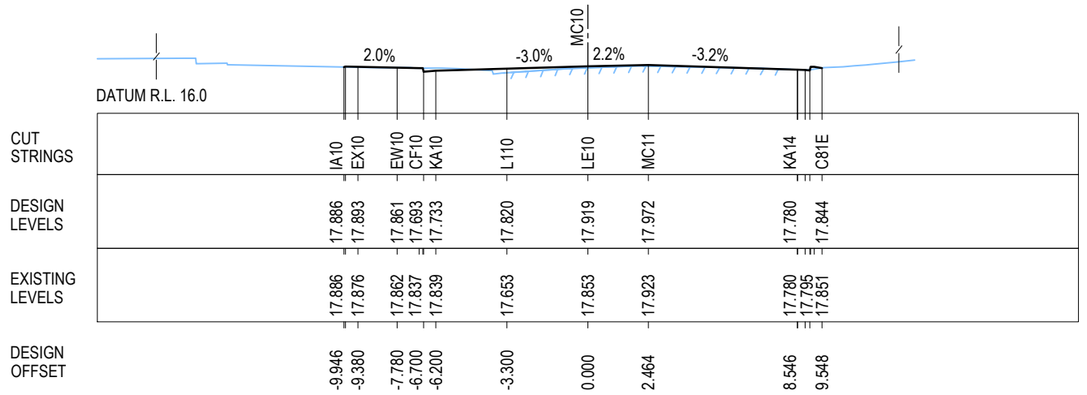

90

LEGEND

MC.xx CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1122	E

DATE: 17/03/2016 12:27:25 PM LOGIN NAME: SUTHERLAND, GRANT
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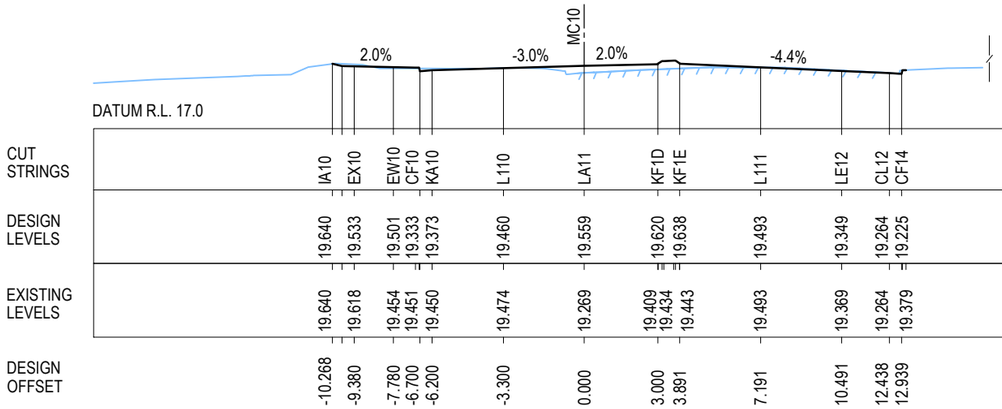
0 5 10 15 20 25 mm ON A3 ORIGINAL



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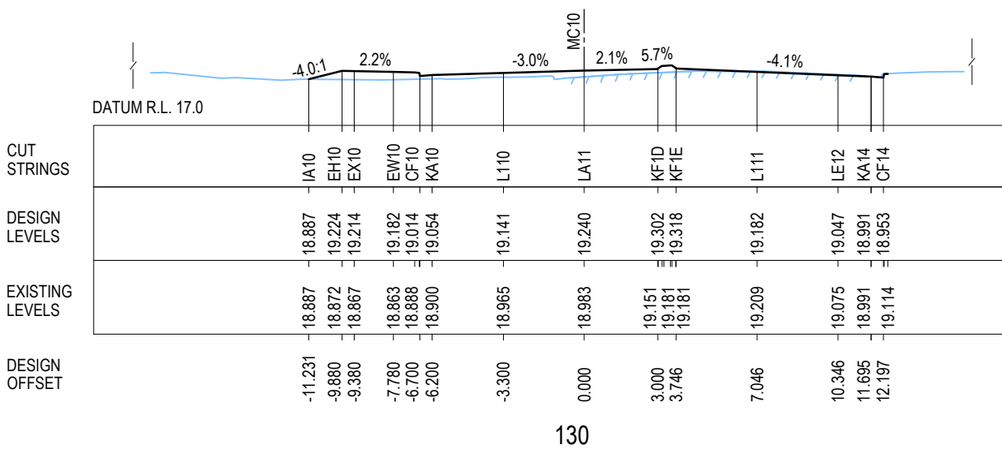

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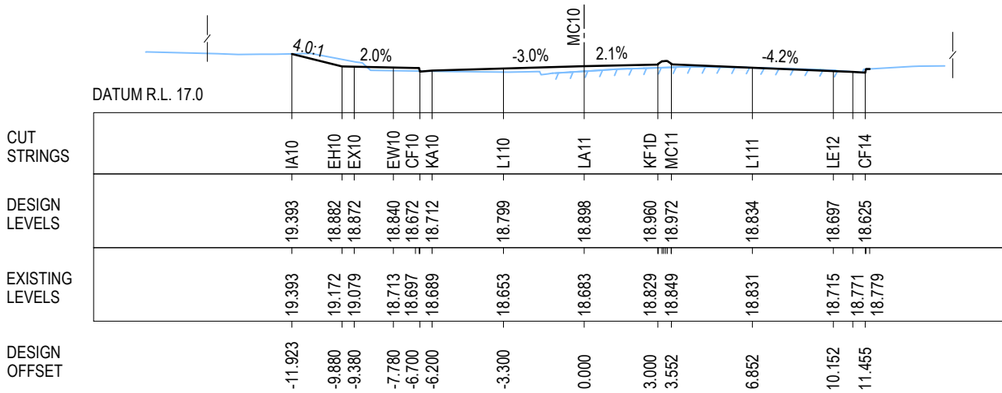

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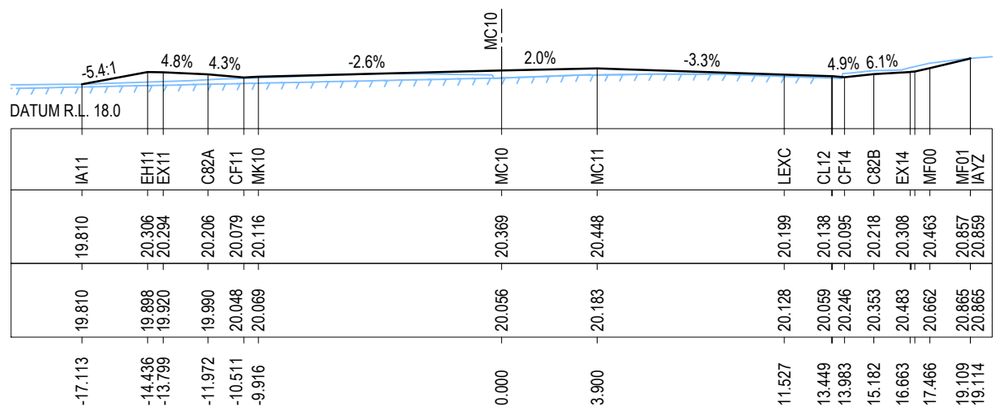

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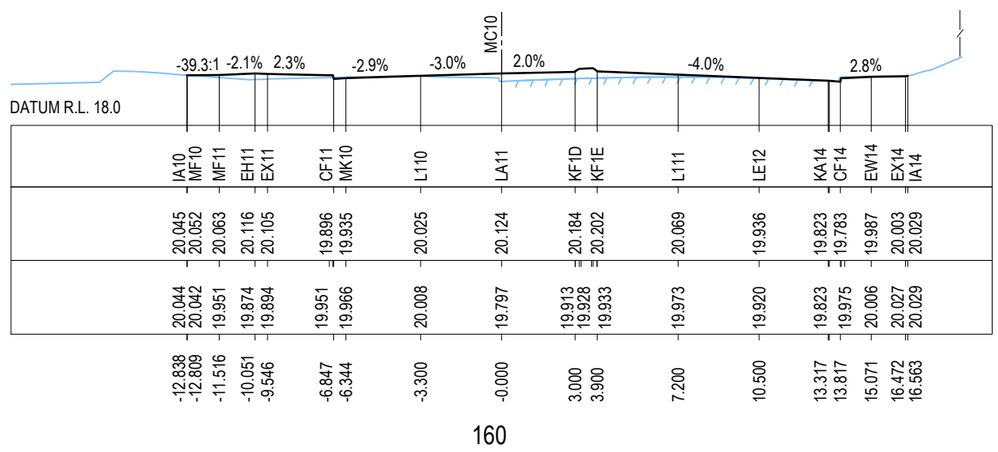

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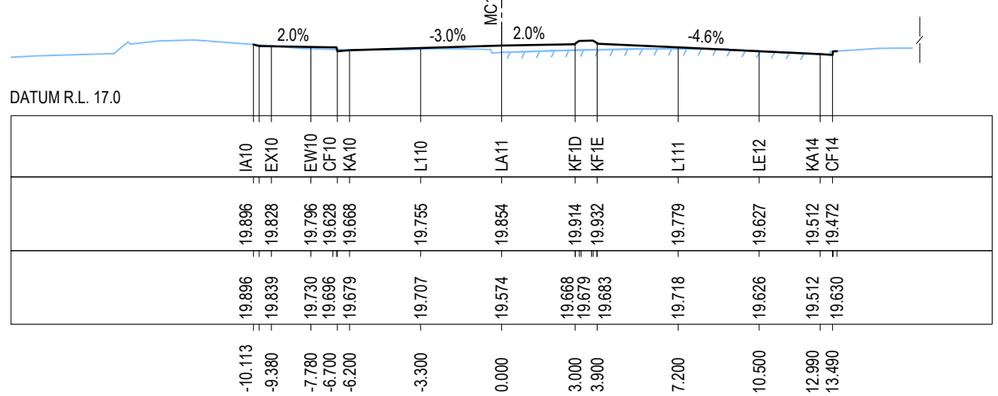


150

LEGEND

MC.xx CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

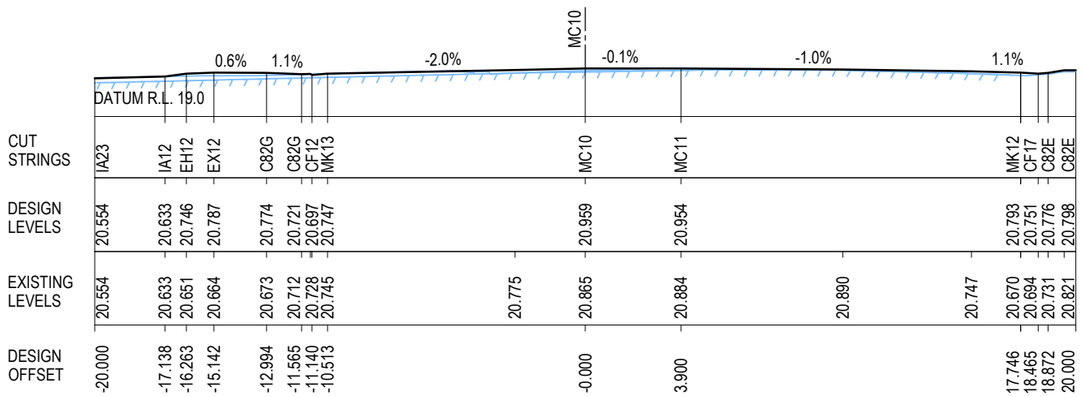
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1123	E

DATE: 17/03/2016 12:27:33 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL



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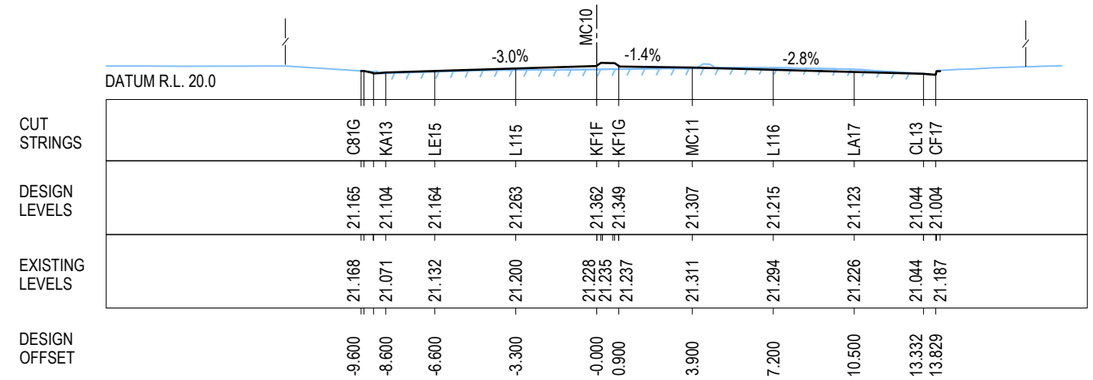

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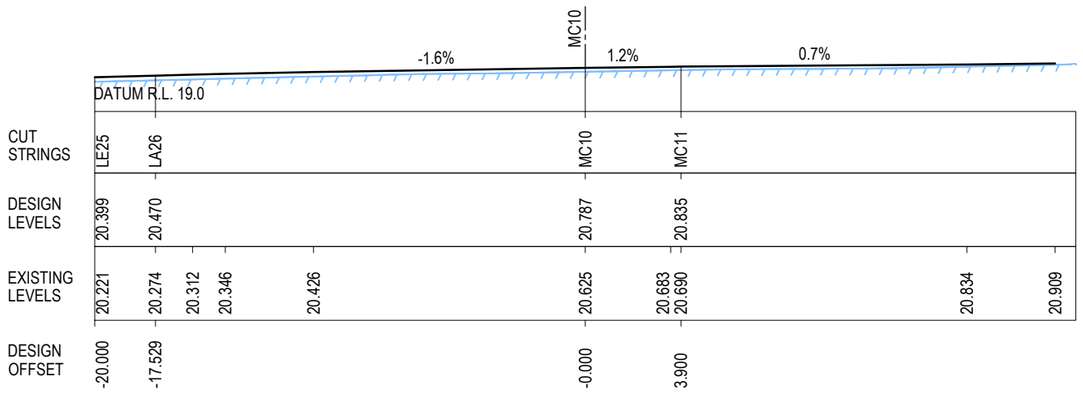

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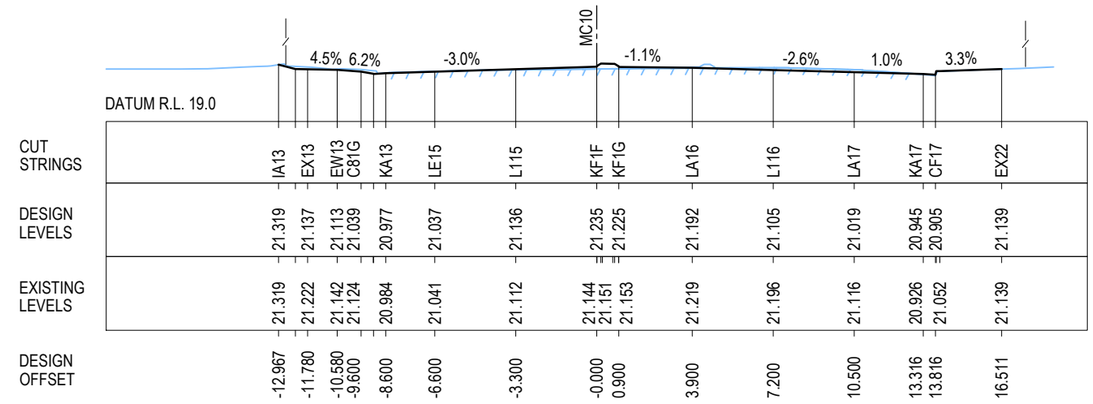

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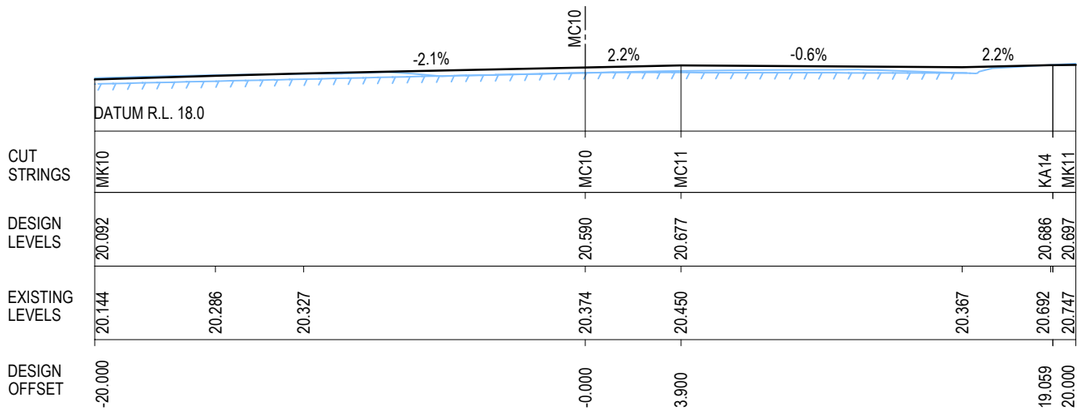

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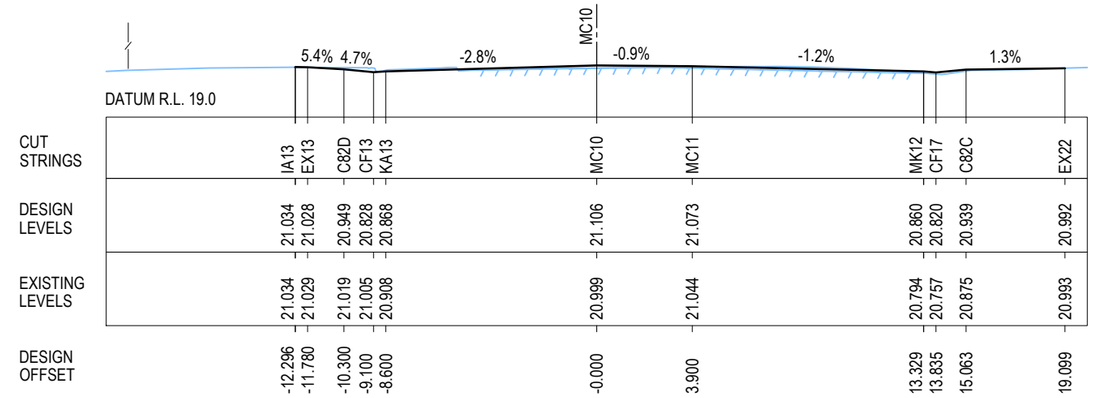


210

LEGEND

MC.xx CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5
AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

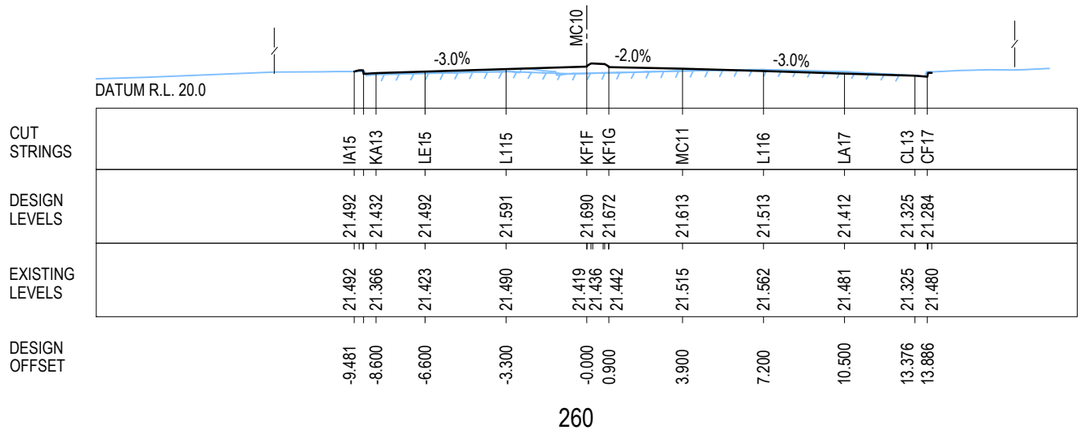
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1124	E

0 5 10 15 20 25 mm ON A3 ORIGINAL

DATE: 17/03/2016 12:27:39 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg



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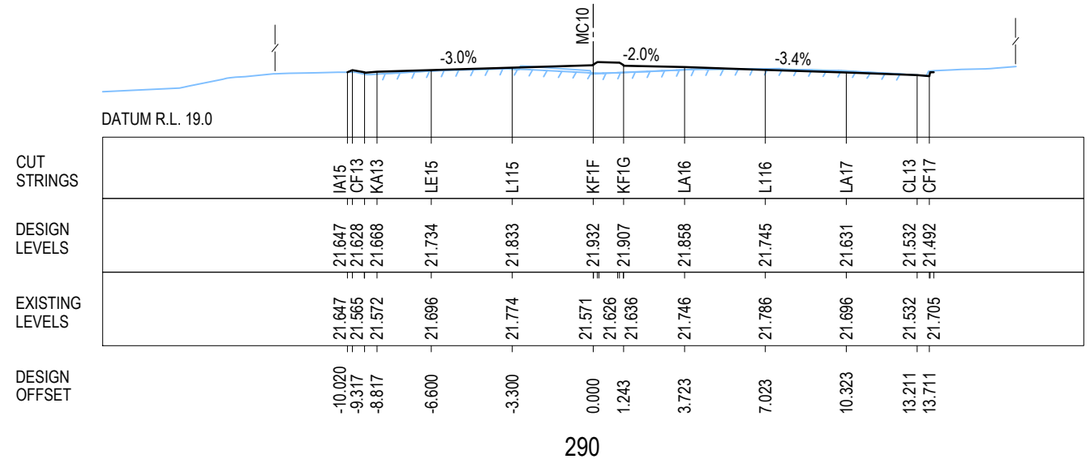

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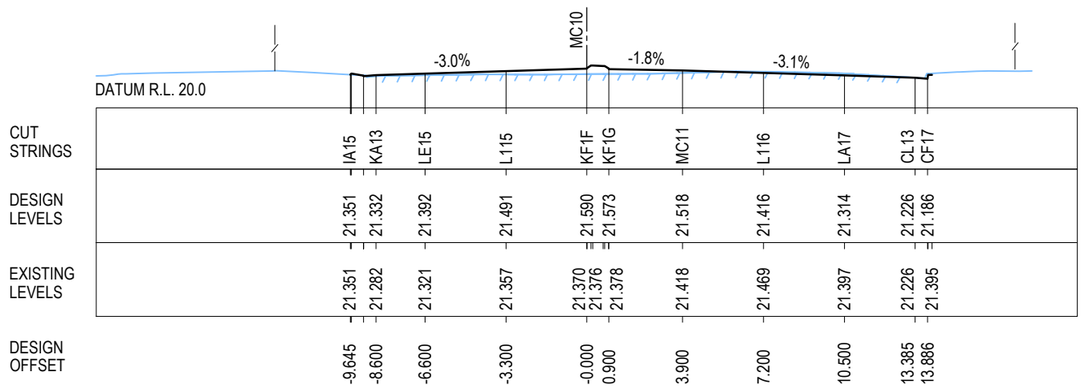

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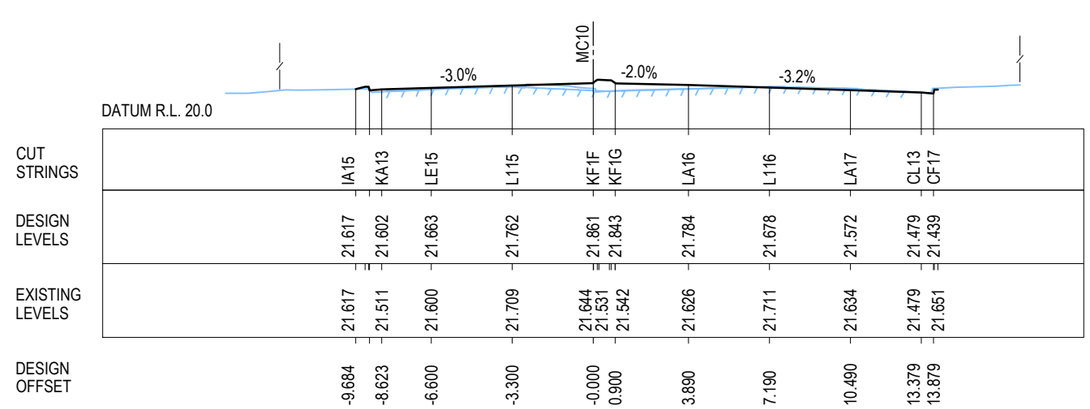

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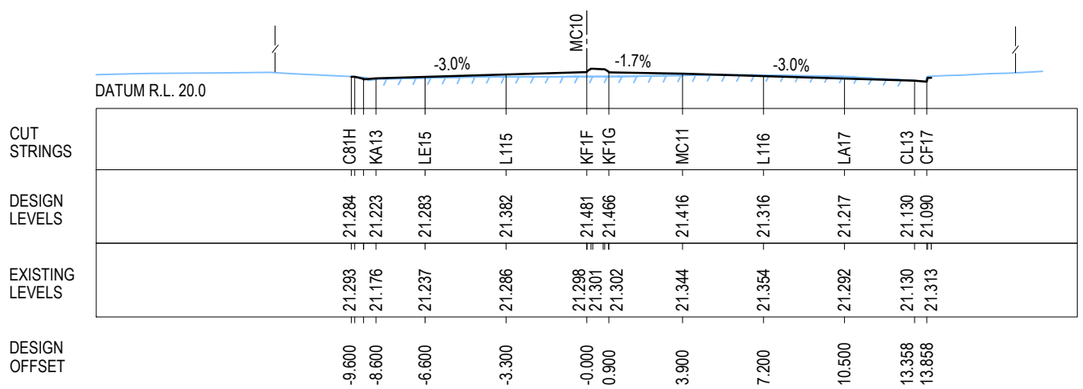

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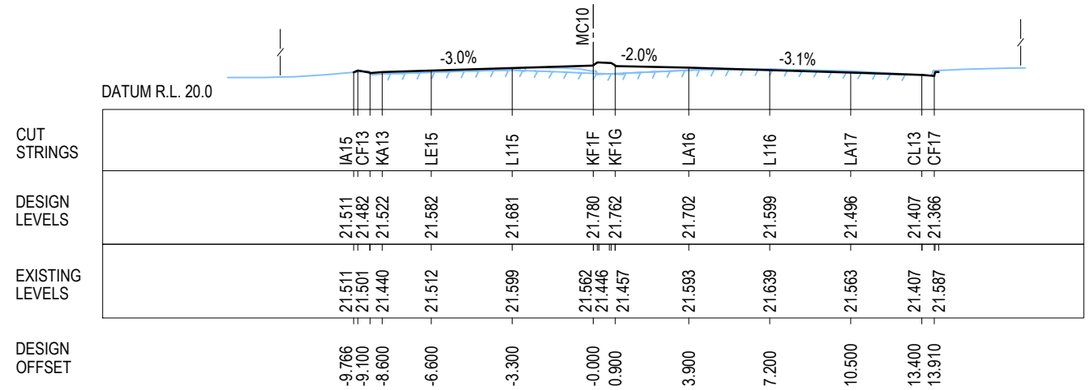

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LEGEND

MC XX CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:250 2.5 0 2.5 5 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

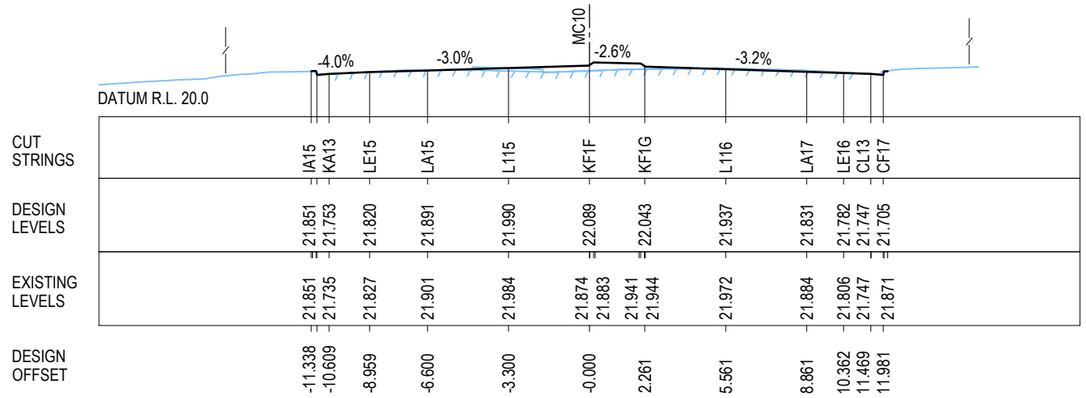
CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-RD-1125	E



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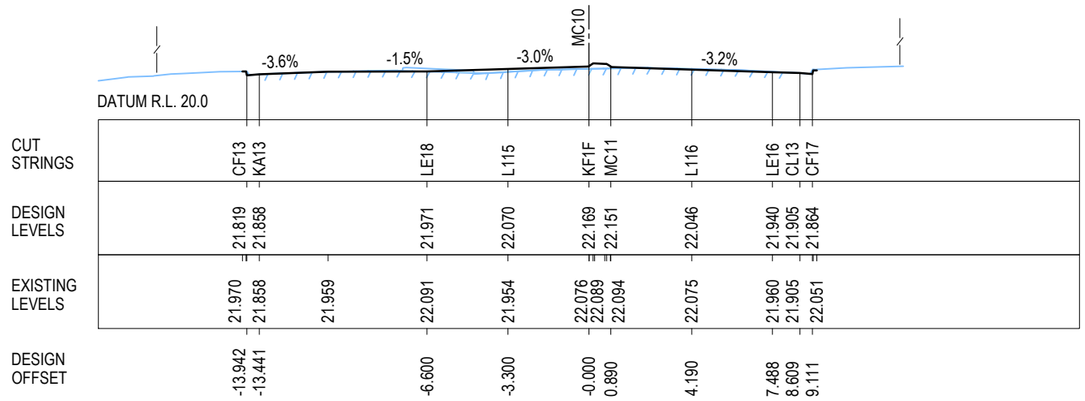

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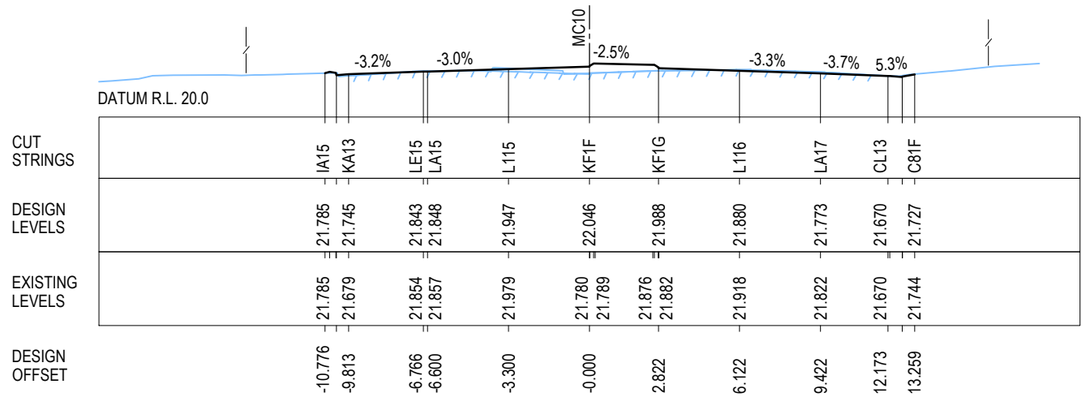

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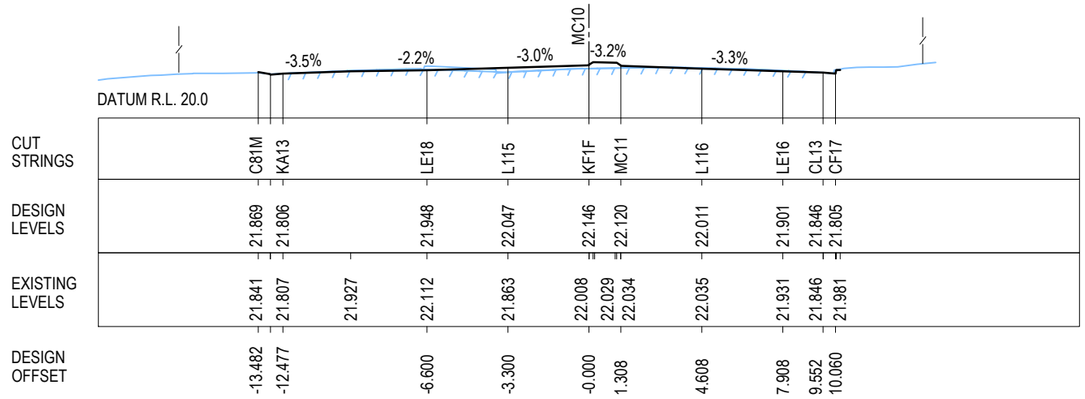

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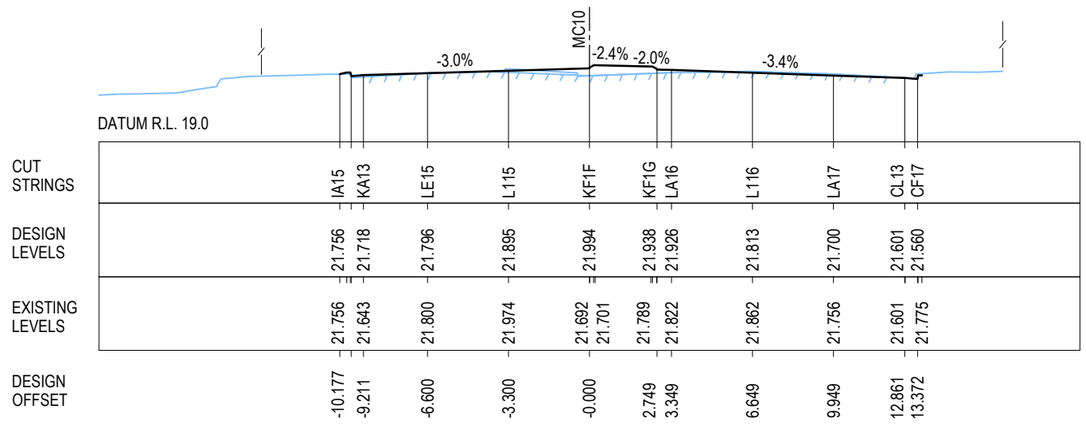

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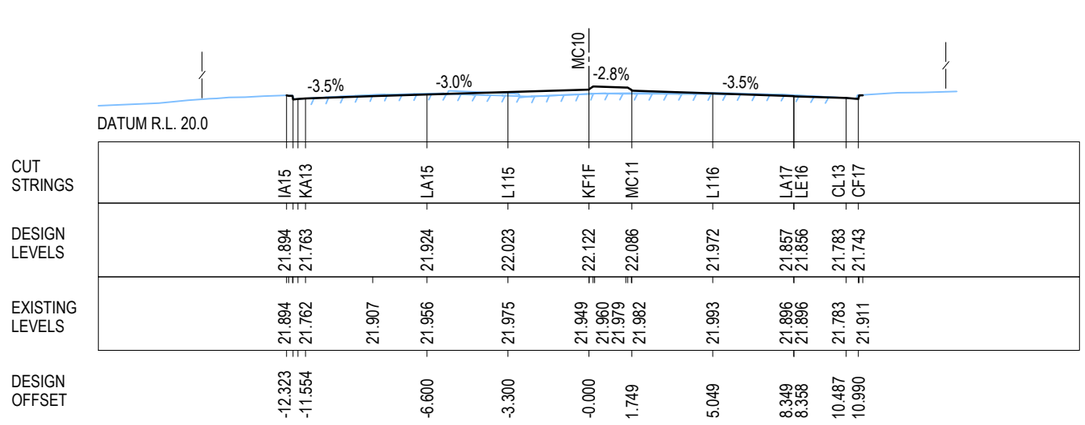


330

LEGEND

MC.xx — CONTROL LINE

EXISTING BOUNDARY

PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

	TITLE	INITIAL	DATE
DRAFTSPERSON		SG	18.03.16
DRAFTING CHECK		BDP	18.03.16
DESIGNER		PD	18.03.16
DESIGN CHECK		DV	18.03.16
PACKAGE MANAGER		BDP	18.03.16
PROJECT MANAGER		DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:250 2.5 0 2.5 5 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

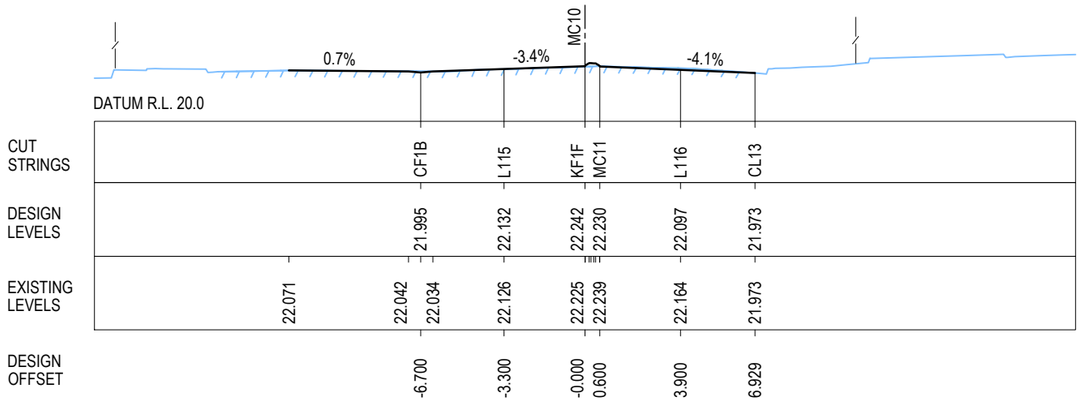
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 6

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-RD-1126	E

DATE: 17/03/2016 12:27:53 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-1(4).dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL



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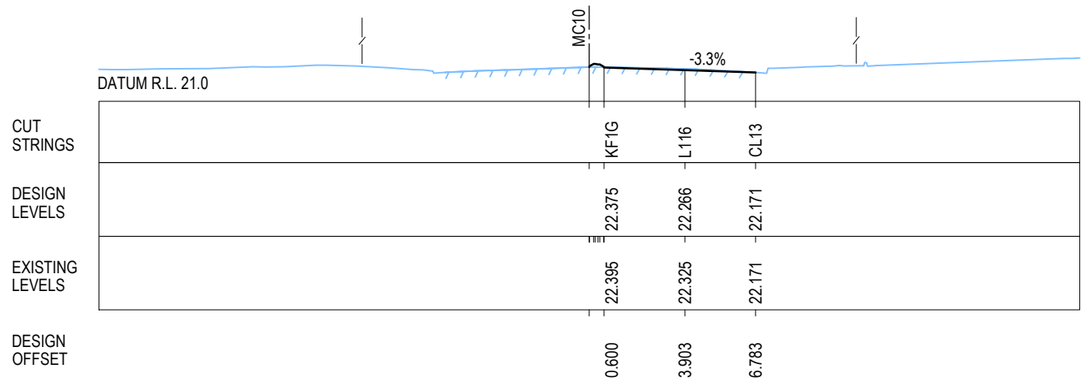

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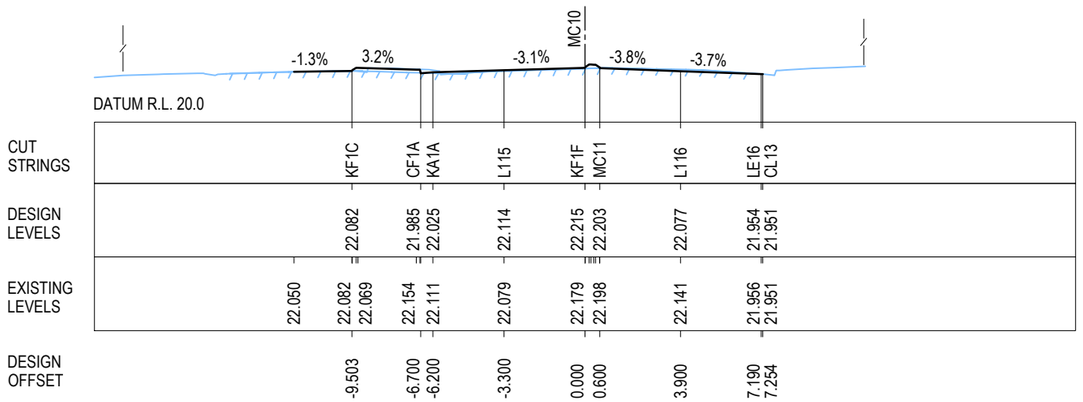

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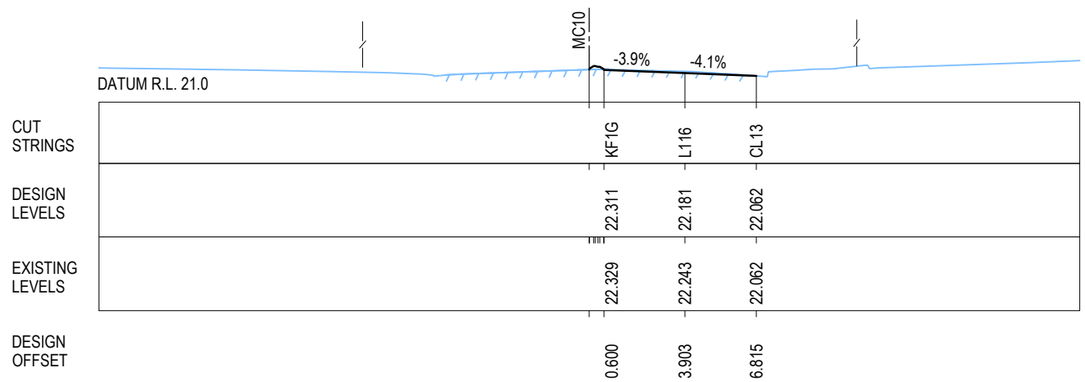

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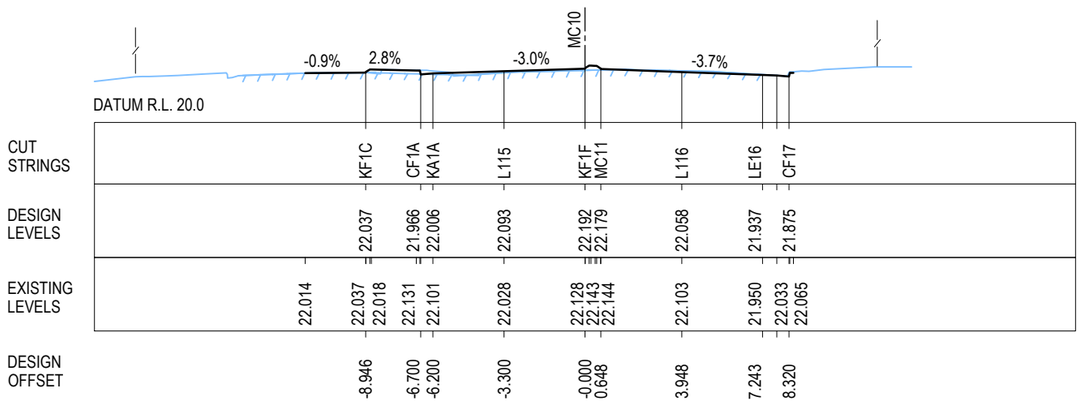

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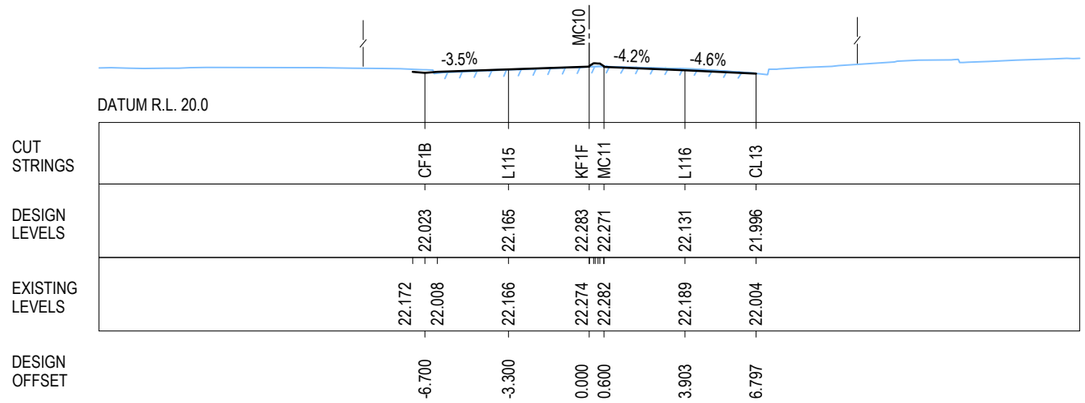


390

LEGEND

MC.XX CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

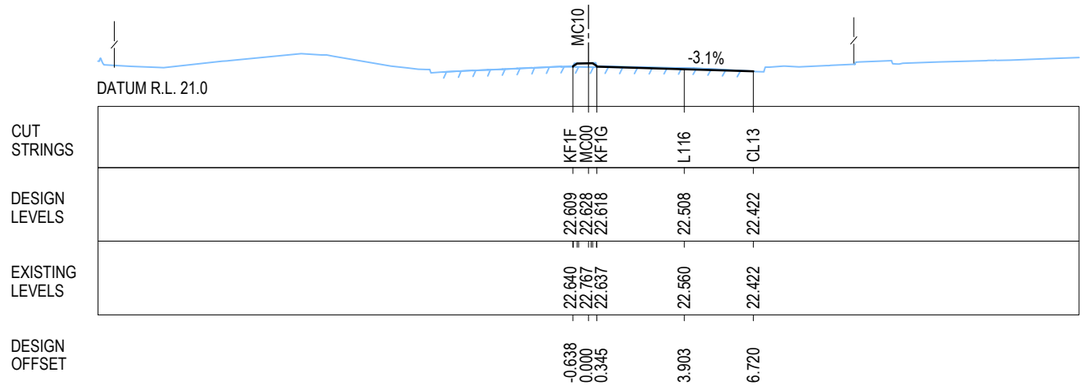
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 7

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1127	E

0 5 10 15 20 25 mm ON A3 ORIGINAL
This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 12:28:00 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg



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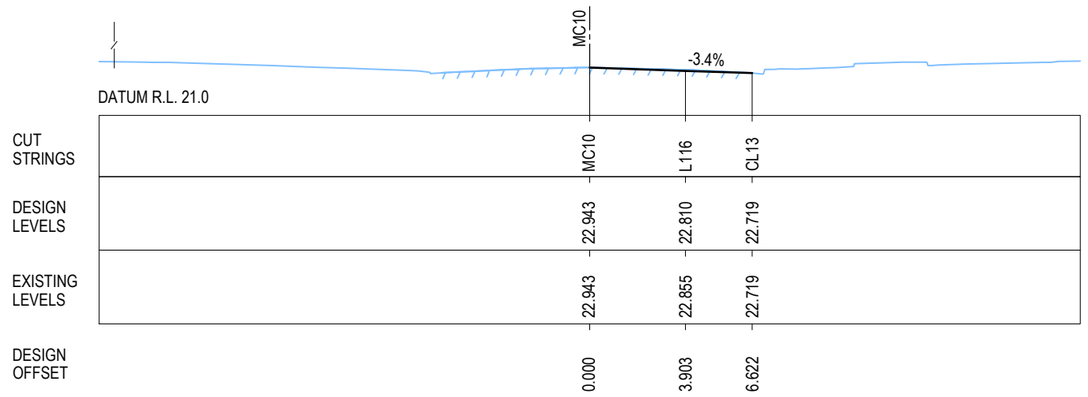

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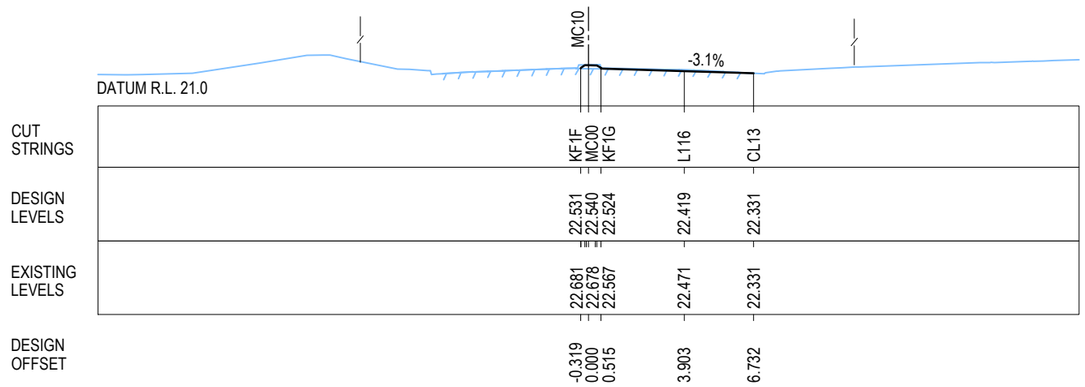

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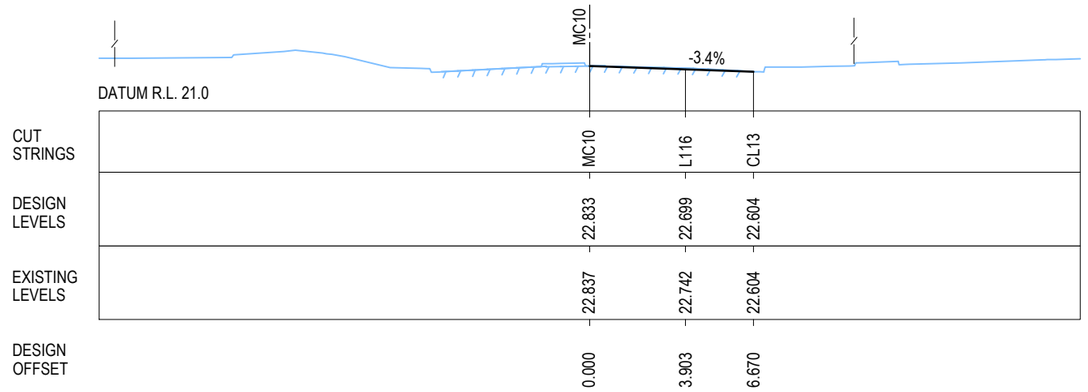

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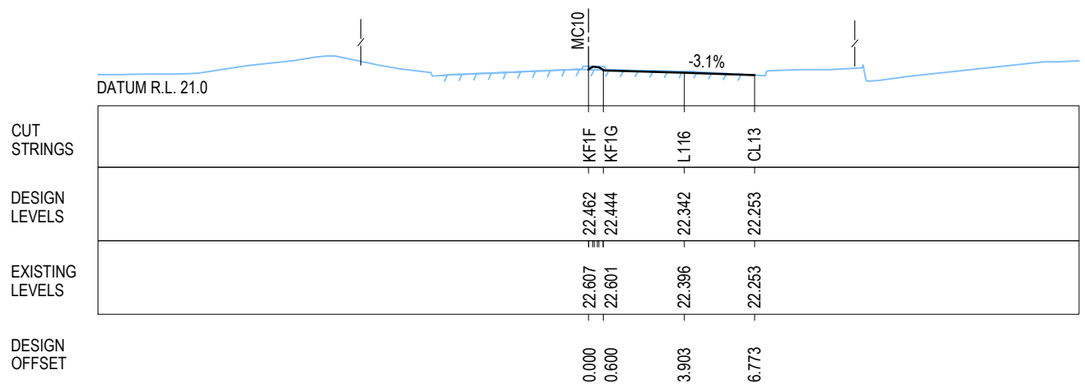

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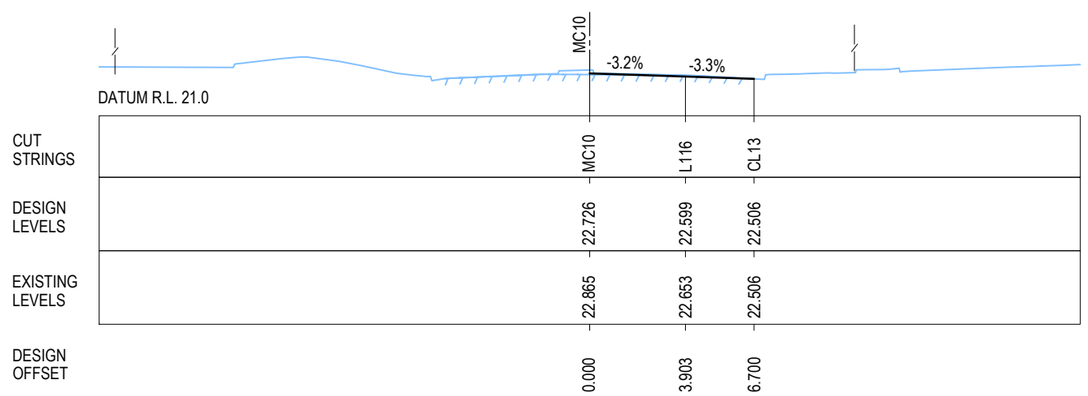


450

LEGEND

MC.xx — CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:250 2.5 0 2.5 5 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

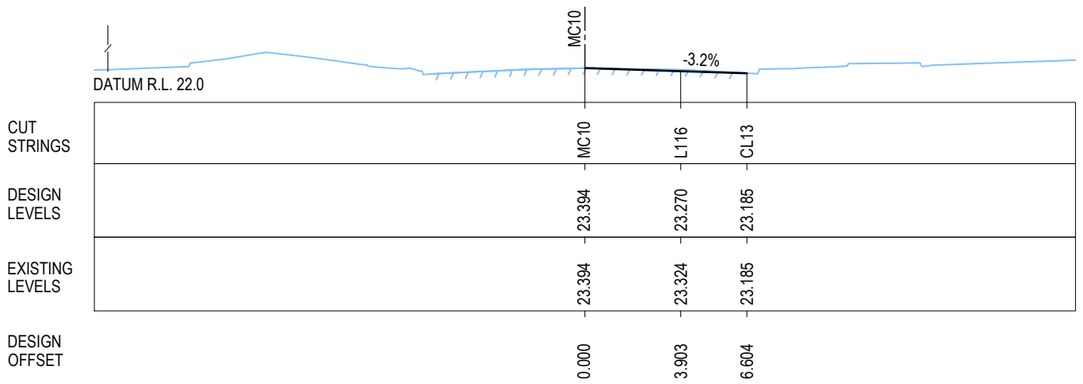
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 8

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1128	E

DATE: 17/03/2016 12:28:06 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg



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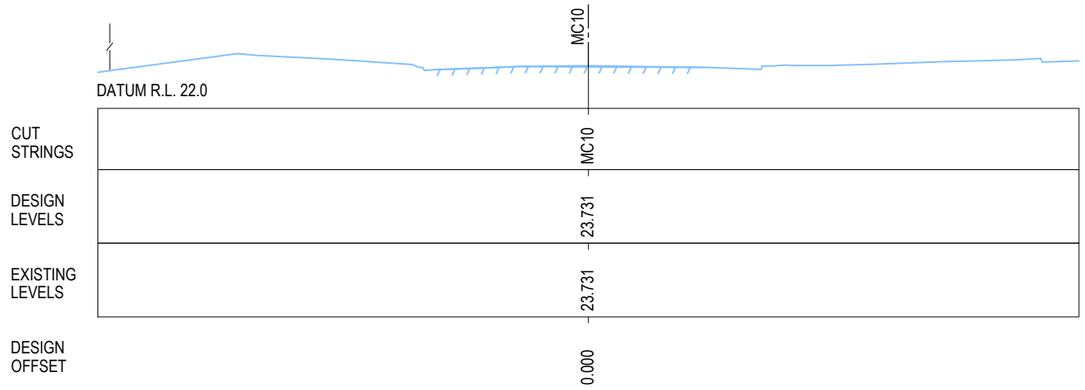

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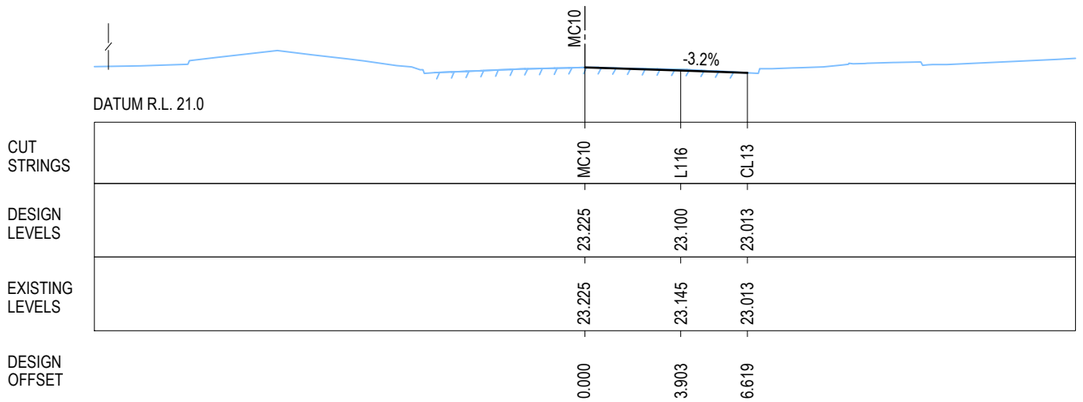

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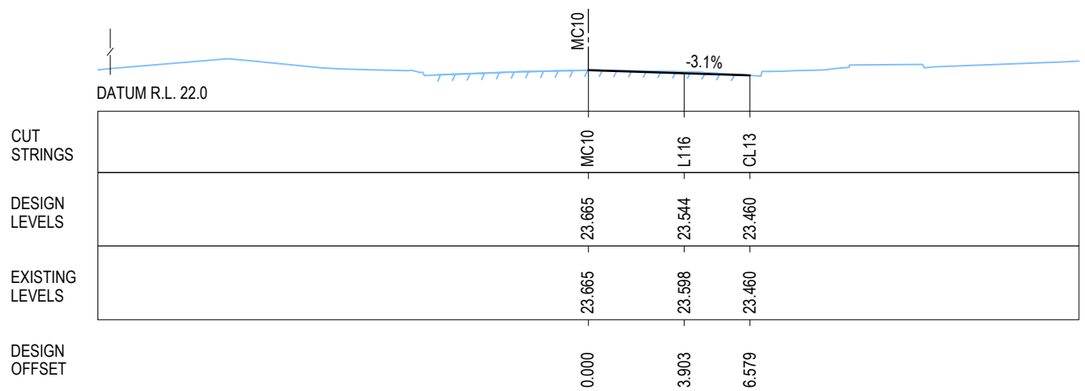

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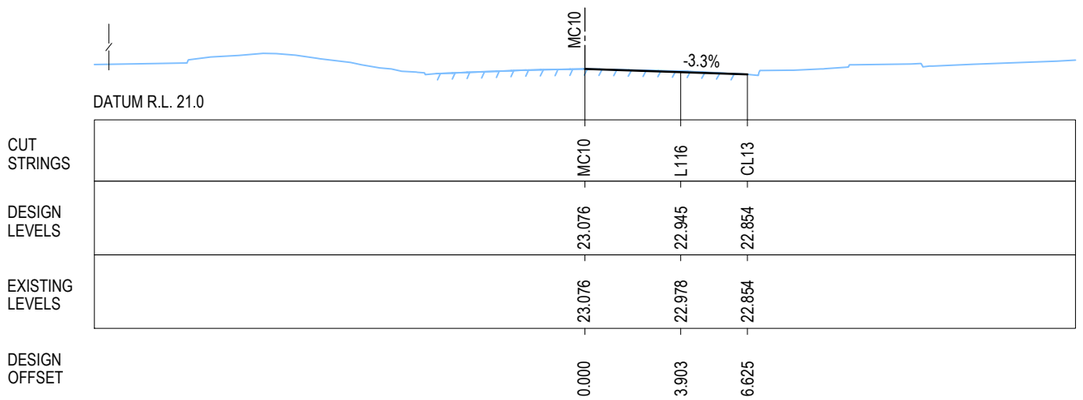

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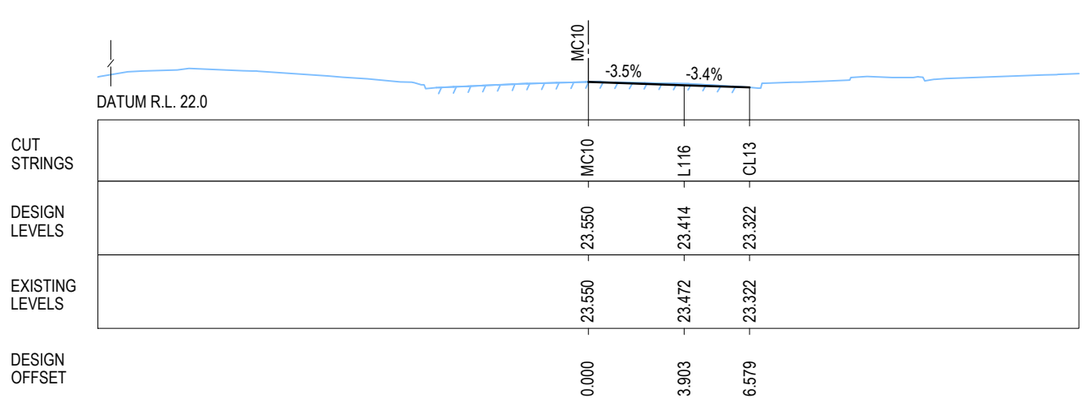

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LEGEND

MC XX — CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL — This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE — SCALE 1:250 (2.5 0 2.5 5) AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 — HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

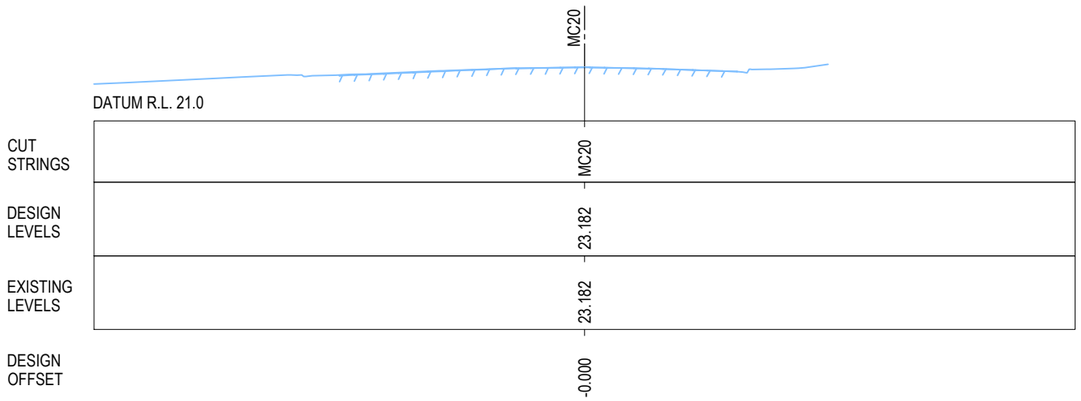
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC10
SHEET 9

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1129	E

DATE: 17/03/2016 12:28:12 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg



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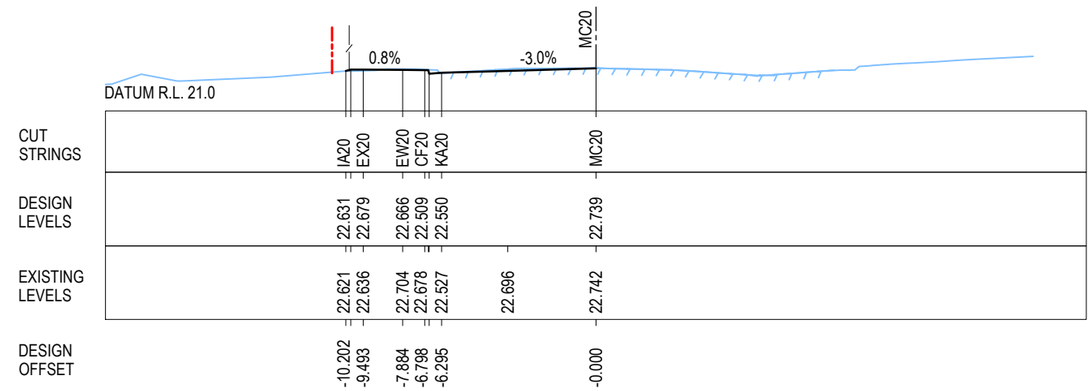

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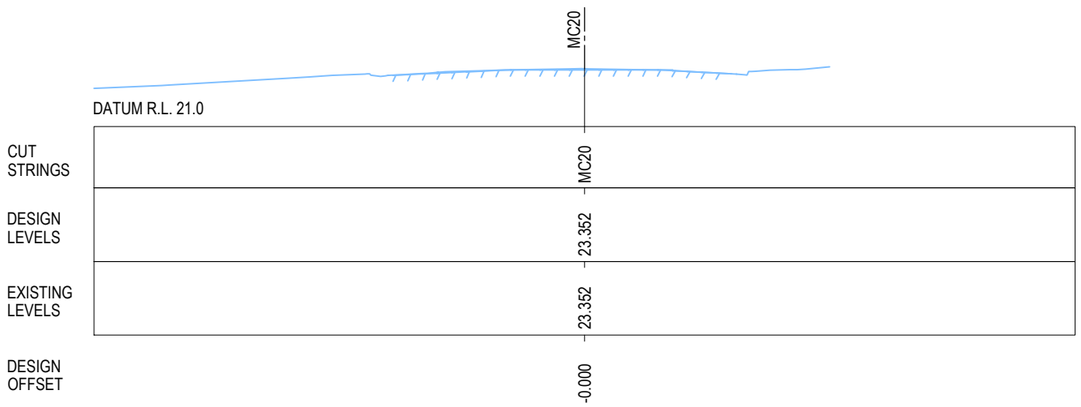

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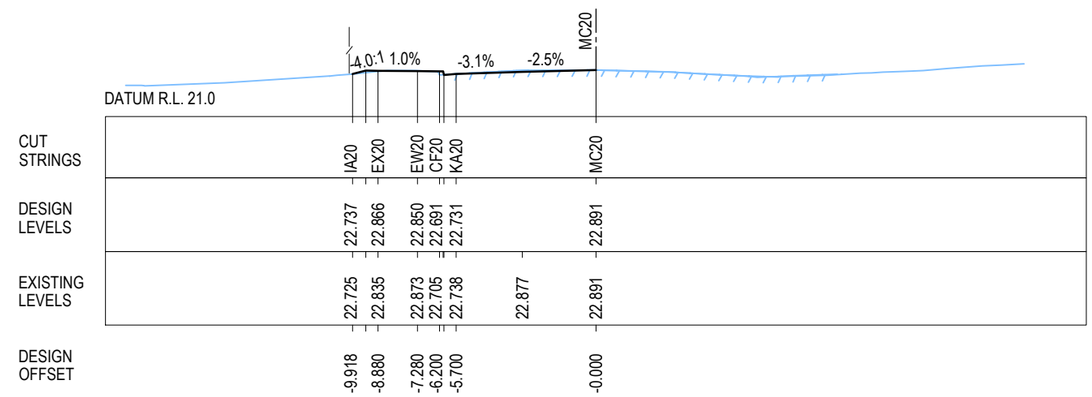

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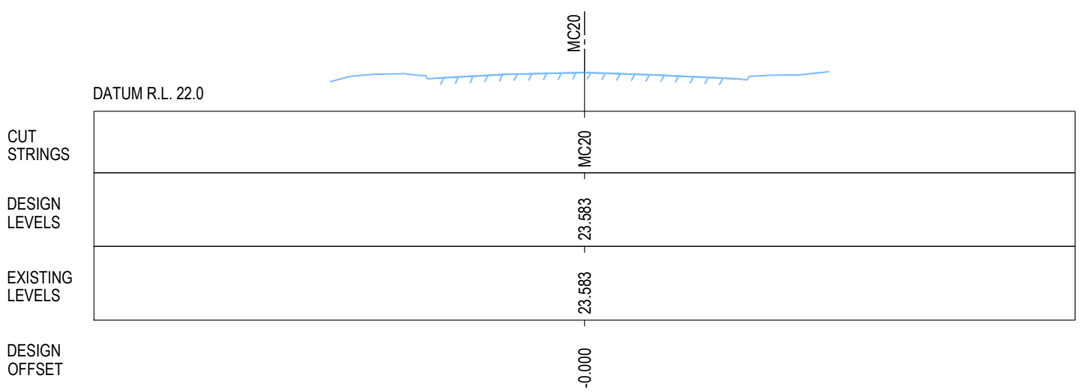

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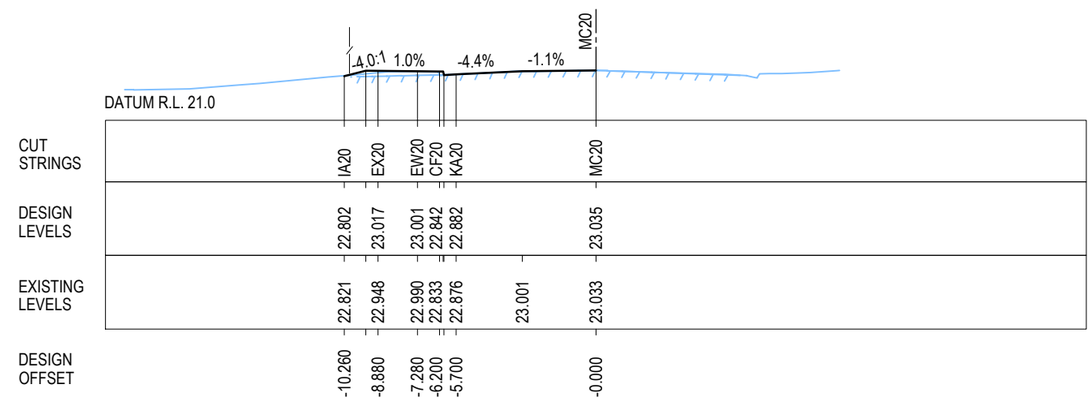

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LEGEND

MC XX — CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC20
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1131	E

DATE: 17/03/2016 12:28:19 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg

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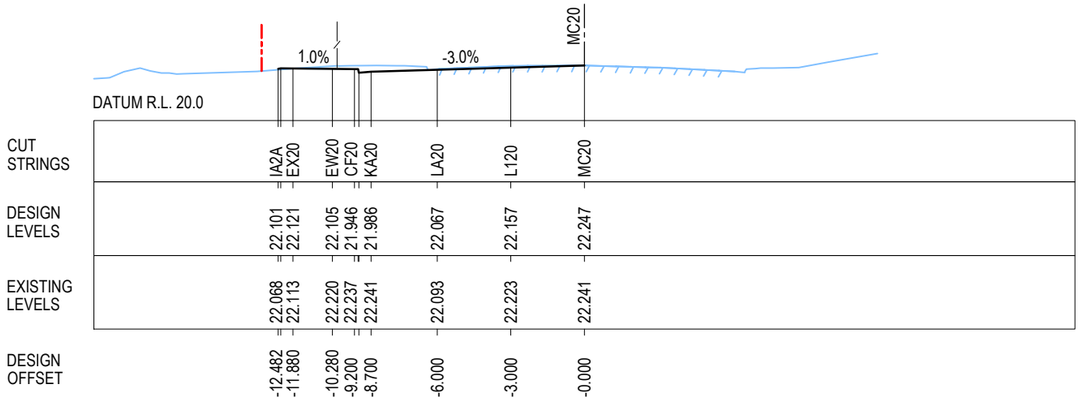

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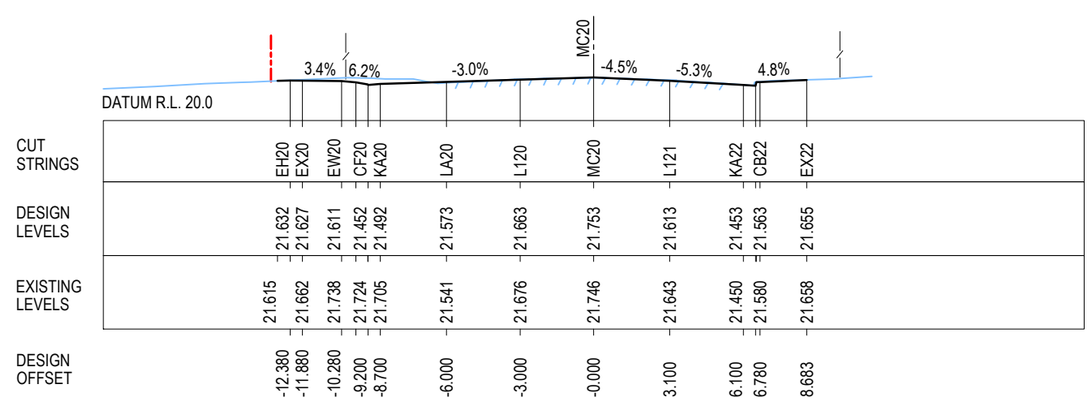

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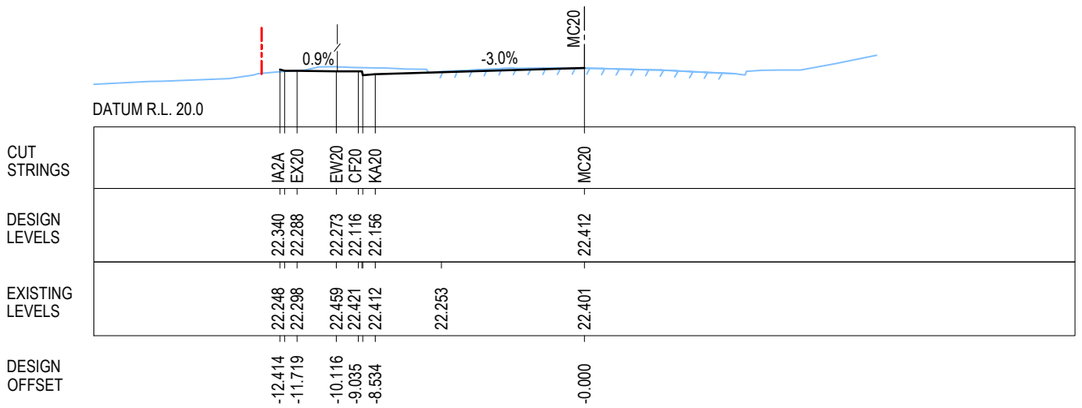

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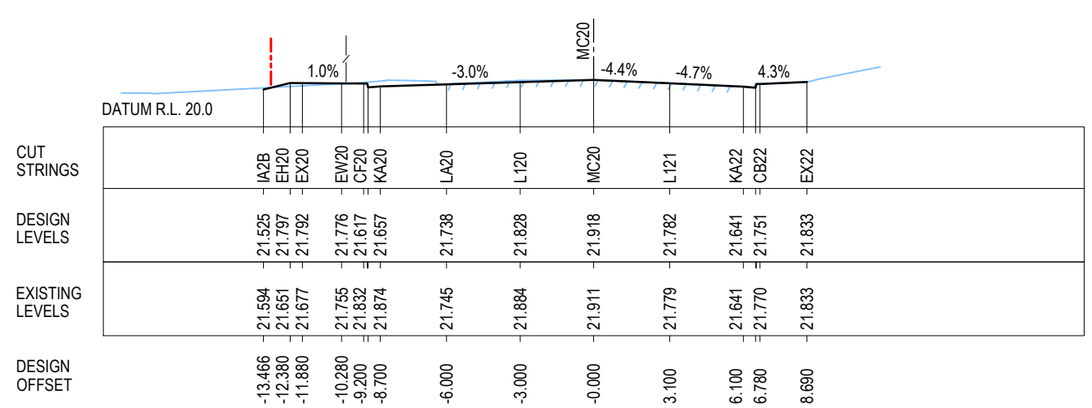

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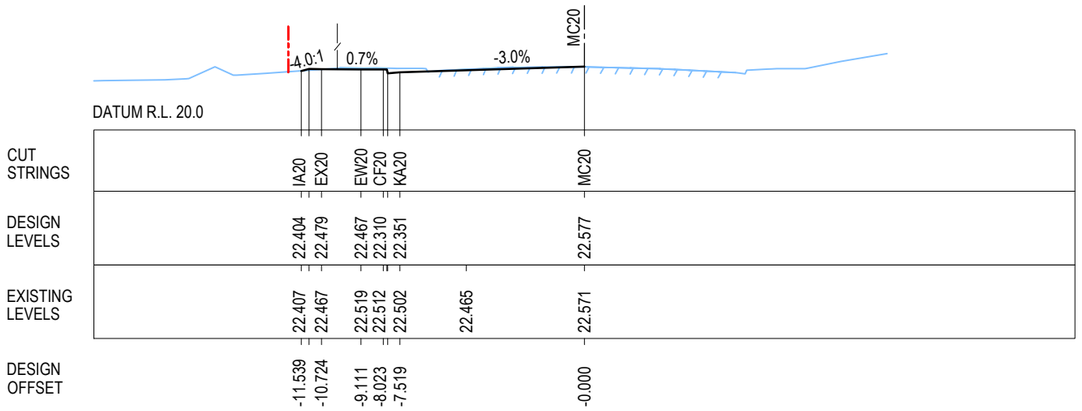

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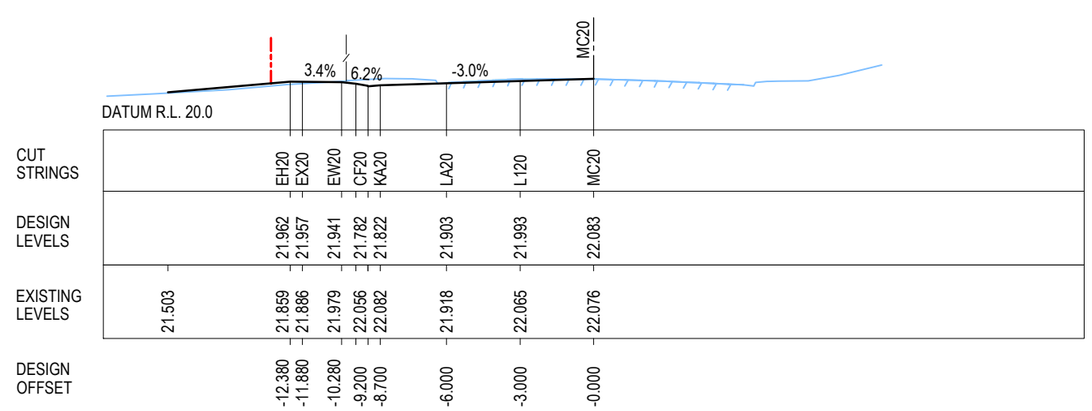


90

LEGEND

MC XX — CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5
AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

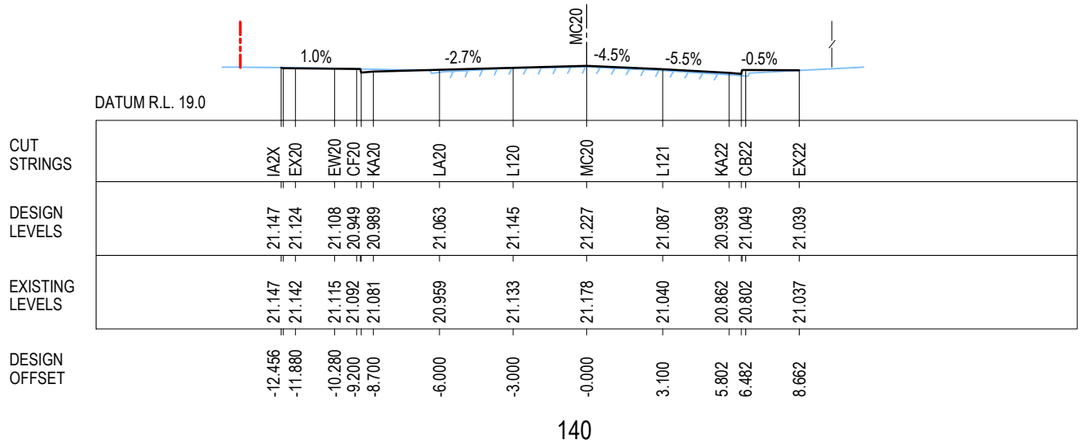
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC20
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1132	E

0 5 10 15 20 25 mm ON A3 ORIGINAL

DATE: 17/03/2016 12:28:26 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-1140.dwg



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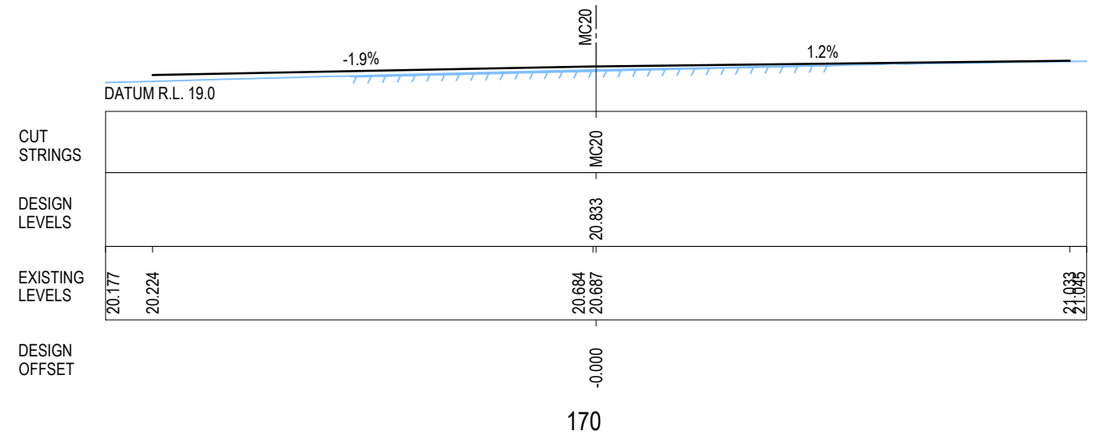

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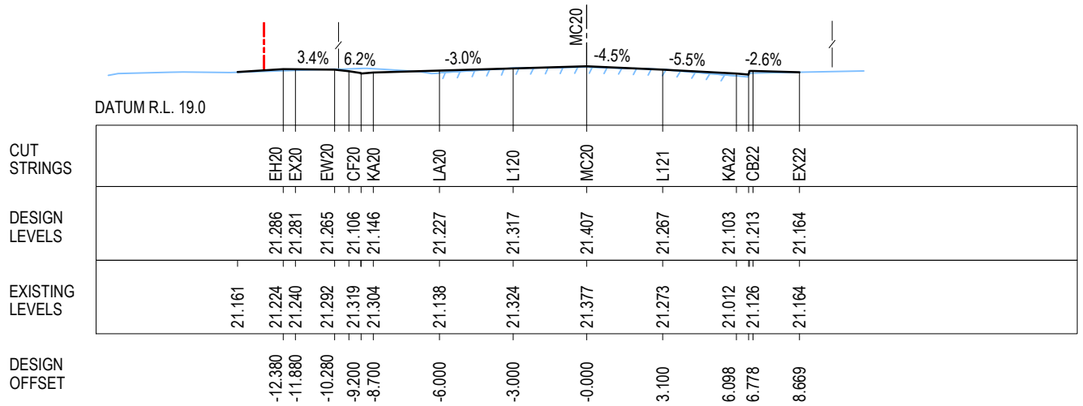

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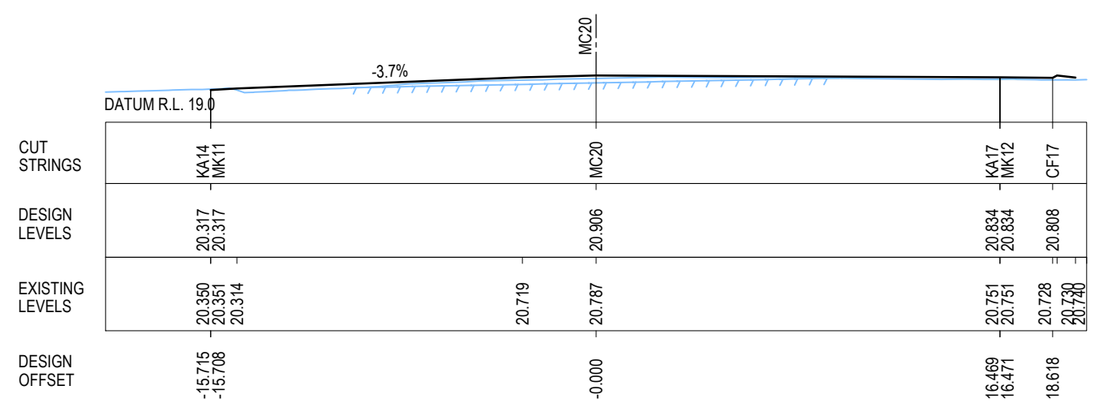

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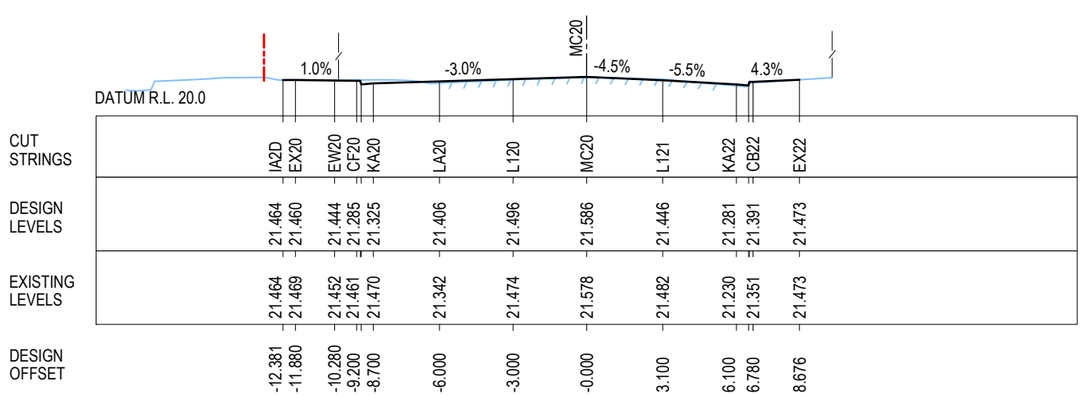

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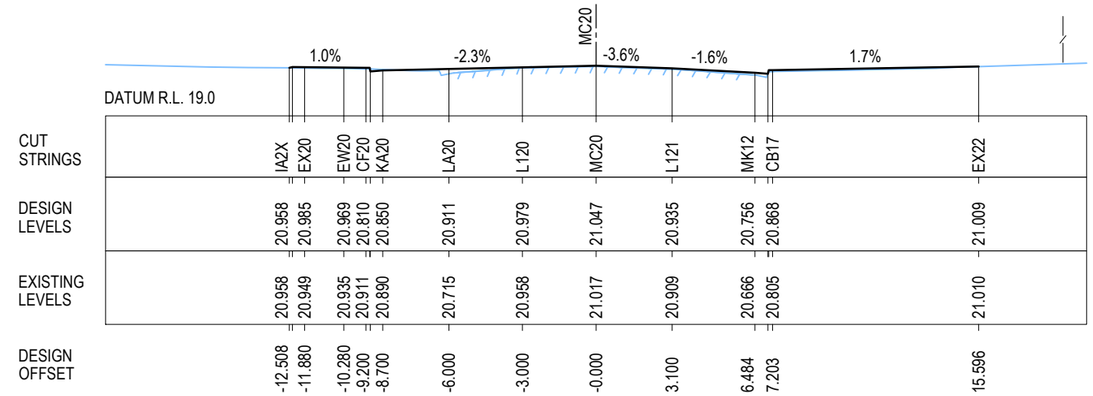


150

LEGEND

MC XX — CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

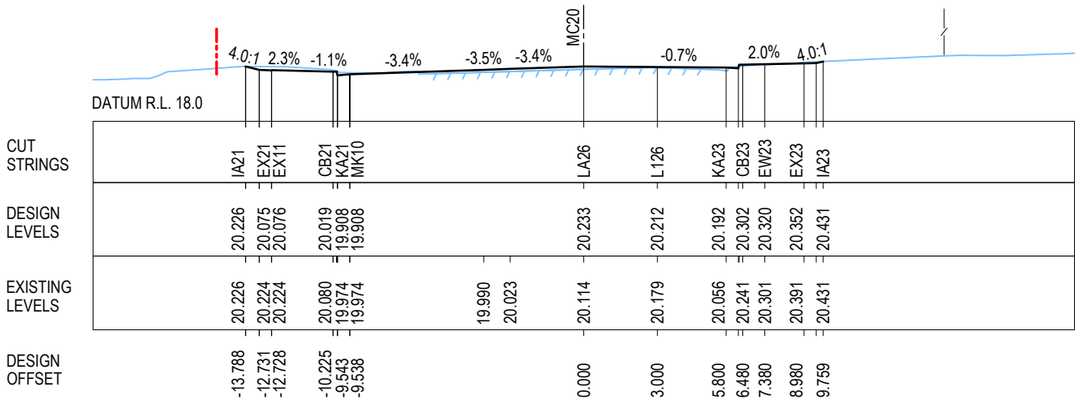
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC20
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1133	E

DATE: 17/03/2016 12:28:32 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RD-1121-140.dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL



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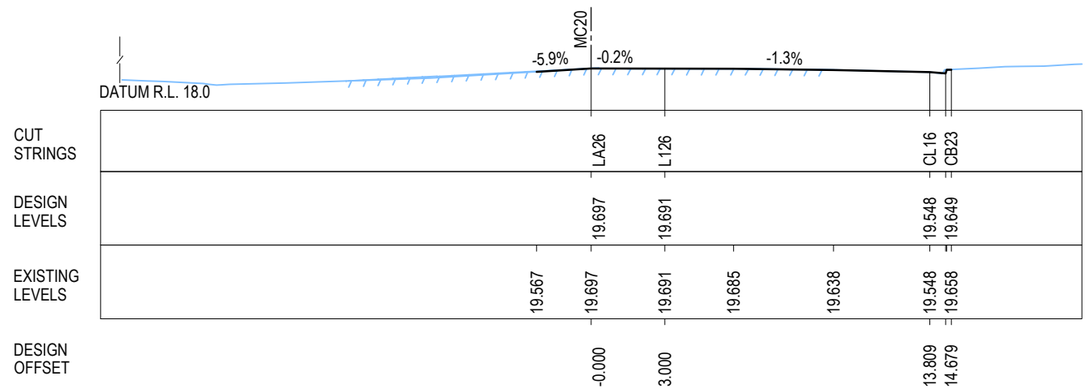

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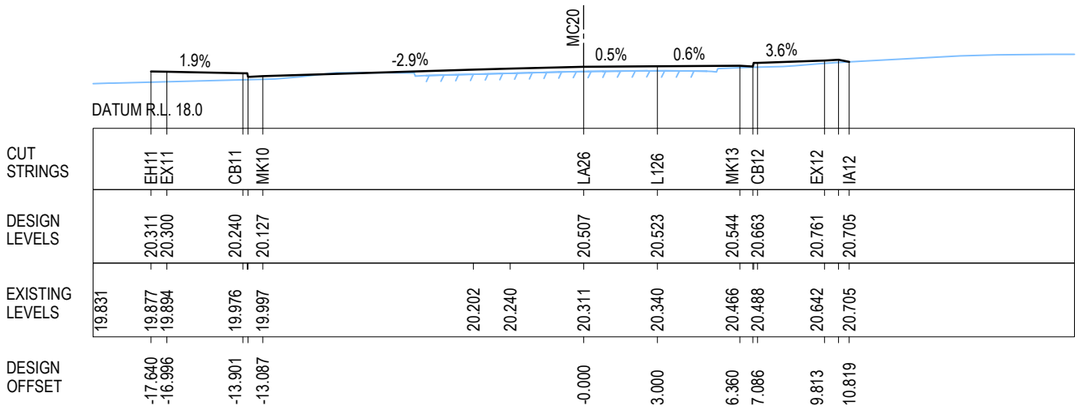

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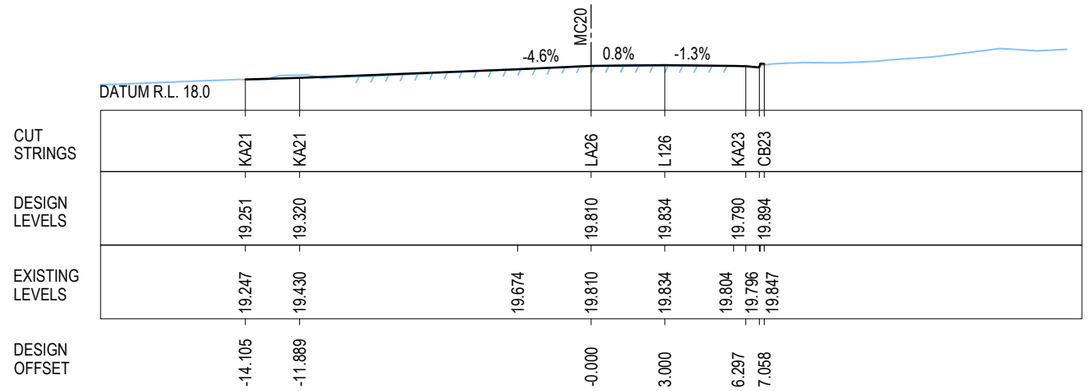

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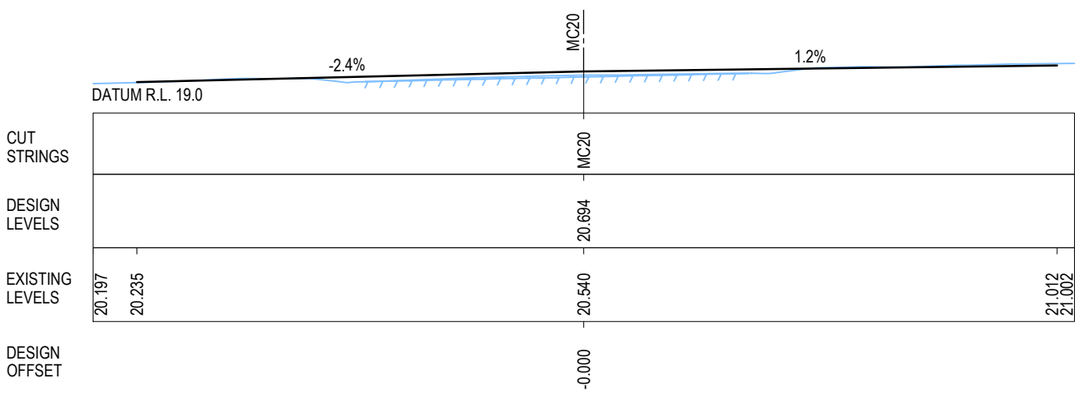

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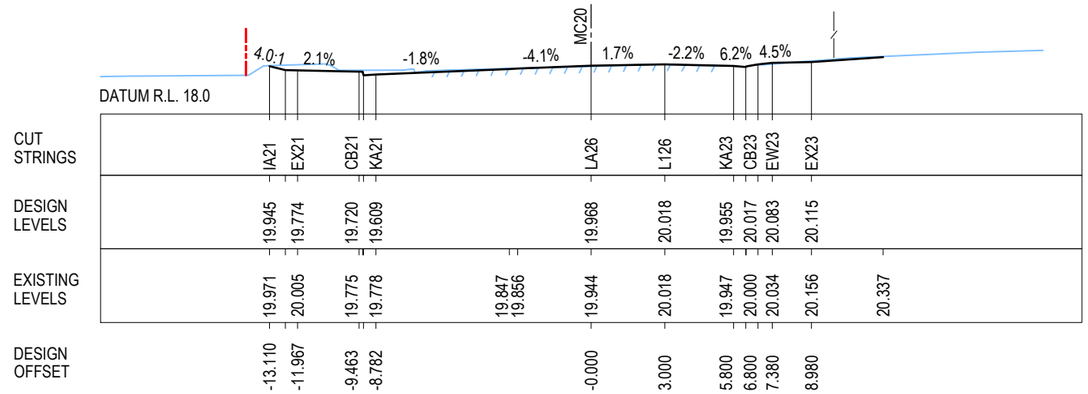

210

LEGEND

MC XX — CONTROL LINE

EXISTING BOUNDARY

PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:250 2.5 0 2.5 5 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: Transport Roads & Maritime Services NSW GOVERNMENT

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC20
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1134	E

DATE: 17/03/2016 12:28:39 PM LOGIN NAME: SUTHERLAND, GRANT
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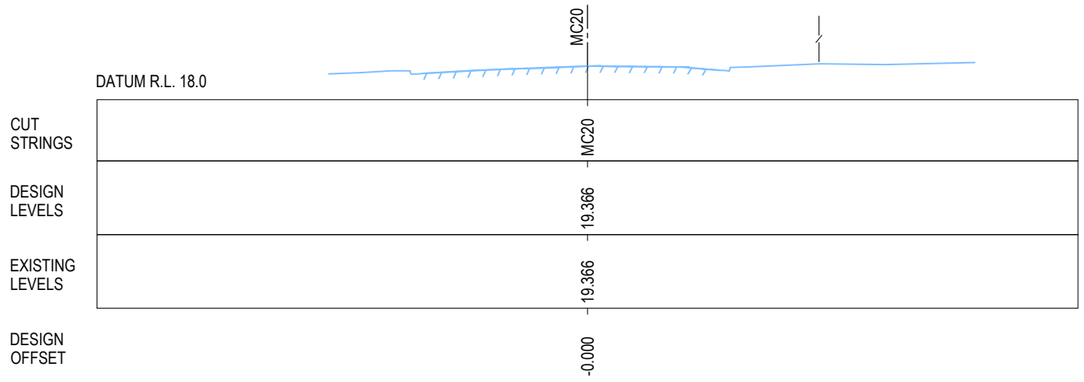

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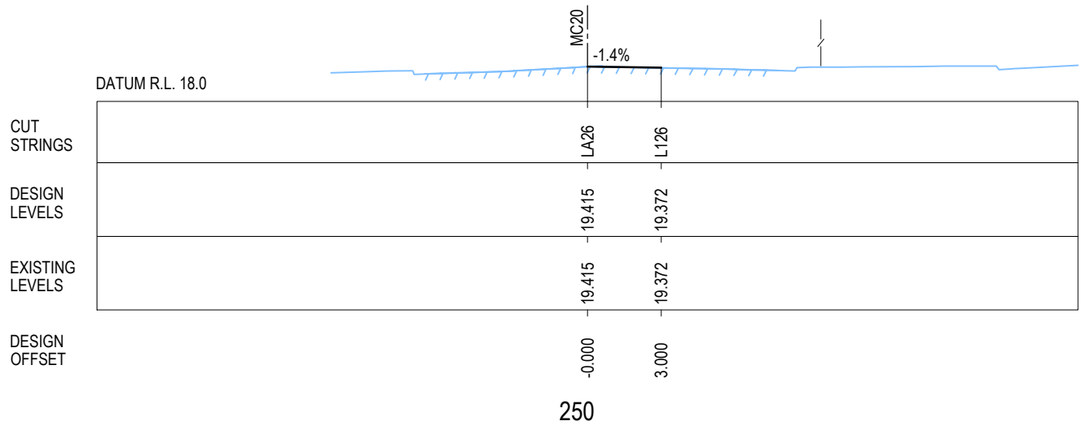

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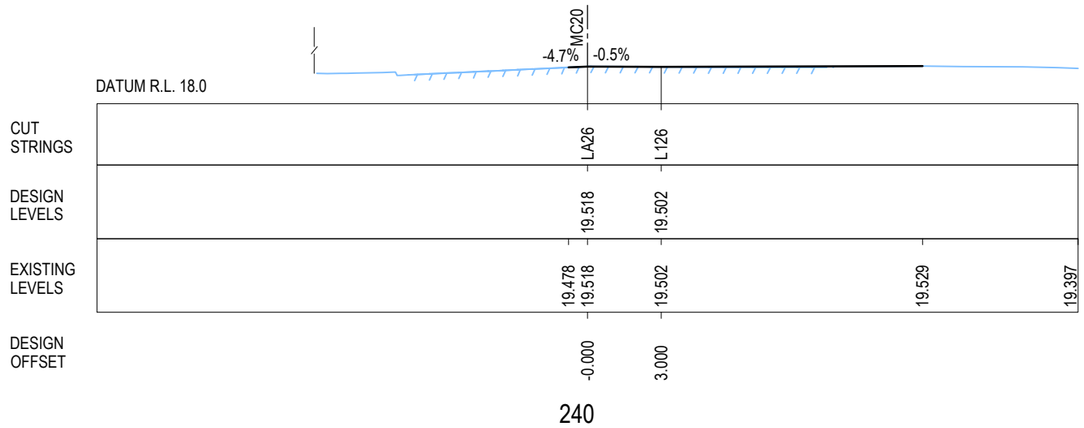

240

LEGEND

MC.xx — CONTROL LINE | EXISTING BOUNDARY | PROPOSED BOUNDARY

NOTES

1. FOR CUT STRING LABELS REFER TO 'JACOBS NSW 2013 STRING NAMING CONVENTION'

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	GD	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 2.5 0 2.5 5
AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
CROSS SECTION - MC20
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RD-1135	E

0 5 10 15 20 25 mm ON A3 ORIGINAL
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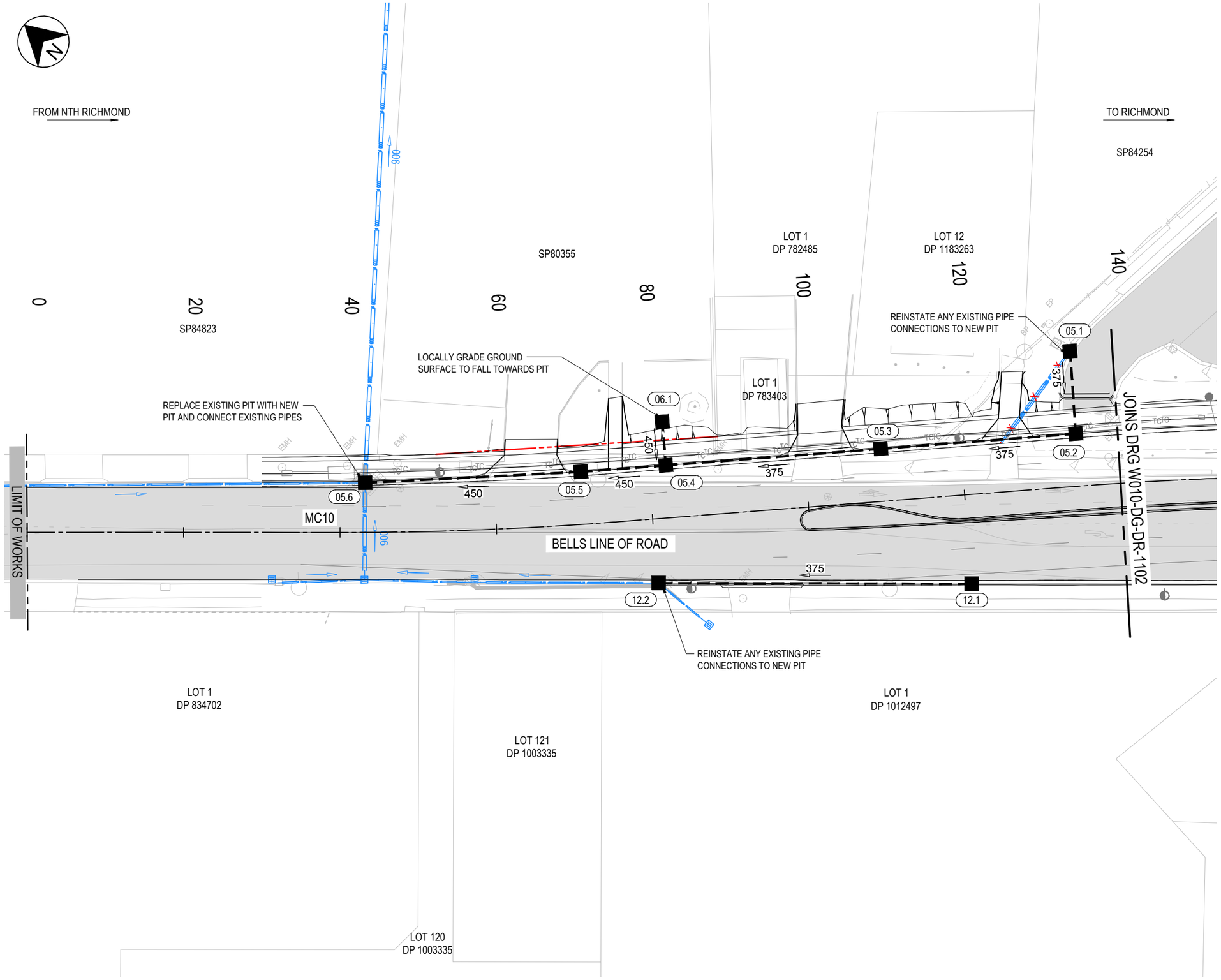

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER
- EXISTING FENCE
- PROPOSED BOUNDARY
- 20.00 — CONTOUR MAJOR INTERVAL 0.25m
- CONTOUR MINOR INTERVAL 0.05m
- EU(D) — UTILITY SERVICE (REFER TO UTILITIES PACKAGE)

DRAINAGE & WATER QUALITY

- EXISTING STORMWATER PIT
- EXISTING STORMWATER HEADWALL
- EXISTING STORMWATER PIPE TO REMAIN
- EXISTING STORMWATER TO BE REMOVED
- 450 — STORMWATER PIPE, SIZE & FLOW DIRECTION
- STORMWATER HEADWALL
- STORMWATER PIT
- 10.01 — STORMWATER PIT LABEL (REFER SCHEDULE) PIT NUMBER / DRAINAGE LINE
- ACO KLASIK DRAIN KS300 WITH CLASS 'D' HEELGUARD GRATE OR APPROVED EQUIVALENT TO OUTLET VIA UNIVERSAL JUNCTION PIT FROM ACO OR APPROVED EQUIVALENT.CONSTRUCT TO MANUFACTURERS SPECIFICATION.

NOTES:

1. FOR GENERAL NOTES & DRAINAGE NOTES REFER NB00042-W010-RD-DG-1003.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
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B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
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DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
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Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE PLAN
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1101	E

0 5 10 15 20 25 mm ON A3 ORIGINAL
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DATE: 17/03/2016 12:45:28 PM
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APRROXIMATE LOCATION OF GPT. TO BE RETAINED

LIMIT OF WORKS

LIMIT OF WORKS

LIMIT OF WORKS

MC20

KEEP CLEAR

KEEP CLEAR

BEAUMONT AVENUE

07.2

240

750

450

REPLACE EXISTING PIT WITH NEW PIT AND CONNECT EXISTING PIPE

CONSTRUCT NEW PIT WITH EXTENDED CHAMBER AND CONNECT EXISTING PIPES

SP84254

LOT 1 DP 537249

220

09.1

07.1

TERRACE ROAD

FROM NTH RICHMOND

04.10

140

160

180

200

CONSTRUCT NEW STORMWATER DRAINAGE PIPE PRIOR TO INSTALLATION OF TCS POLE

LOT 1 DP 121999

240

LOT 3 DP 16505

LOT 1 DP 1046606

260

LOT 6 DP 16505

200

UNKNOWN SERVICE FOUND. ASSUMED TO BE AN ABANDONED WATER MAIN.

600

TE-03

05.1

375

JOINS DRG W010-DG-DR-1101

05.2

375

MC10

04.8

04.9

600

180

600

600

04.7

04.6

TO RICHMOND

JOINS DRG W010-DG-DR-1103

04.5

MC10

BELLS LINE OF ROAD

02.5

600

160

600

600

600

01.9

01.8

01.7

01.6

01.5

750

600

03.1

01.10

600

02.4

MC20

LOT 1 DP 161148

LOT 101 DP 818573

LOT 1 DP 1147946

ONLY 70mm CLEARANCE BETWEEN EXISTING UNDERGROUND ELECTRICAL CABLE AND PROPOSED TRENCH DRAIN. MANUAL DIGGING SHALL BE USED DURING TRENCH DRAIN INSTALLATION.

ACO K200 KS2-00 TRENCH DRAIN WITH CLASS 'D' HEEL GUARD 18.5m LENGTH WITH MINIMUM 0.5% FALL IN BASE FROM OUTLET TO PIT 01.9 VIA UNIVERSAL JUNCTION PIT FROM ACO OR APPROVED EQUIVALENT.

JOINS DRG W010-DG-DR-1105

140

375

REPLACE EXISTING WITH NEW INSPECTION PIT

REPLACE EXISTING PIT WITH NEW PIT AND CONNECT EXISTING PIPES

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER
- EXISTING FENCE
- PROPOSED BOUNDARY
- 20.00 — CONTOUR MAJOR INTERVAL 0.25m
- CONTOUR MINOR INTERVAL 0.05m
- EU(D) — UTILITY SERVICE (REFER TO UTILITIES PACKAGE)

DRAINAGE & WATER QUALITY

- EXISTING STORMWATER PIT
- EXISTING STORMWATER HEADWALL
- EXISTING STORMWATER PIPE TO REMAIN
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NOTES:

1. FOR GENERAL NOTES & DRAINAGE NOTES REFER NB00042-W010-RD-DG-1003.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 — 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: Transport Roads & Maritime Services (NSW Government)

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT: HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE PLAN
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1102	E

FROM NTH RICHMOND

TO RICHMOND

LOT 3
DP 16505

LOT 1
DP 1046606

260

LOT 6
DP 16505

280

SP51041

300

LOT 9
DP 16505

320

LOT 100
DP 835622

340

360

LOT 13
DP 16505

380

600 TC TC 600 TC 600 TC TC 450 TC TC 450 TC TC TC TC TC

04.6 04.5 04.4 04.3 04.2 04.1

450

JOINS DRG W010-DG-DR-1102

JOINS DRG W010-DG-DR-1104

MC10

BELLS LINE OF ROAD

MC10

600 600 600 450 450

01.6 01.5 01.4 01.3 01.2 01.1

REINSTATE ANY EXISTING PIPE CONNECTIONS TOP NEW PIT

REINSTATE ANY EXISTING PIPE CONNECTIONS TOP NEW PIT

LOT 1
DP 1147946

LOT 2
DP 1124671

LOT 1
DP 1124671

LOT 170
DP 1106484

LOT 19
DP 17017

LOT 171
DP 1106484

LEGEND

REFERENCE ONLY

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- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
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- EXISTING FENCE
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DRAINAGE & WATER QUALITY

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NOTES:

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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

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TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE PLAN
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1103	E

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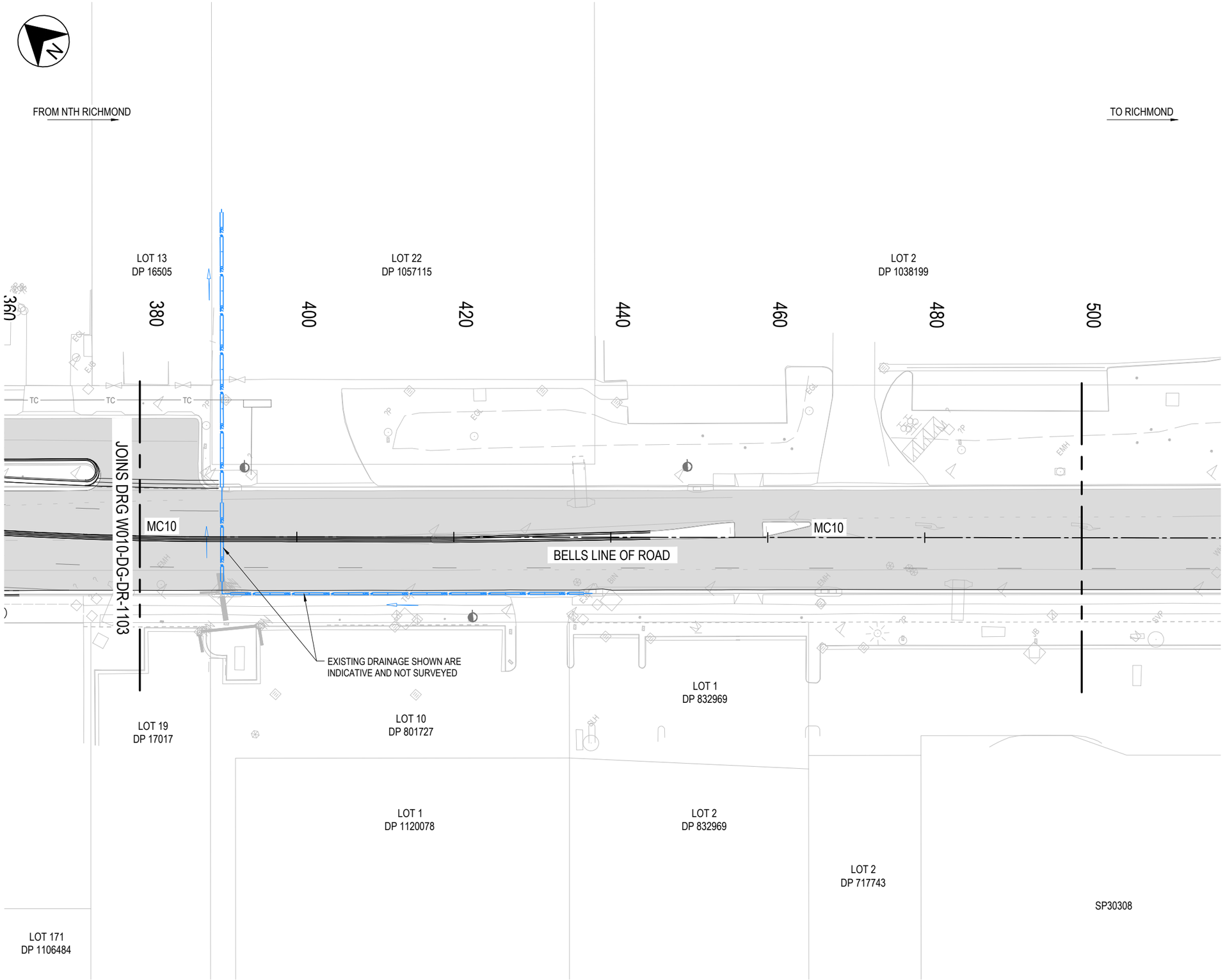

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
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- DP 782485 — DEPOSITED PLAN NUMBER
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NOTES:

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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
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TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
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DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE PLAN
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1104	E

DATE: 17/03/2016 12:45:49 PM LOGIN NAME: SUTHERLAND, GRANT
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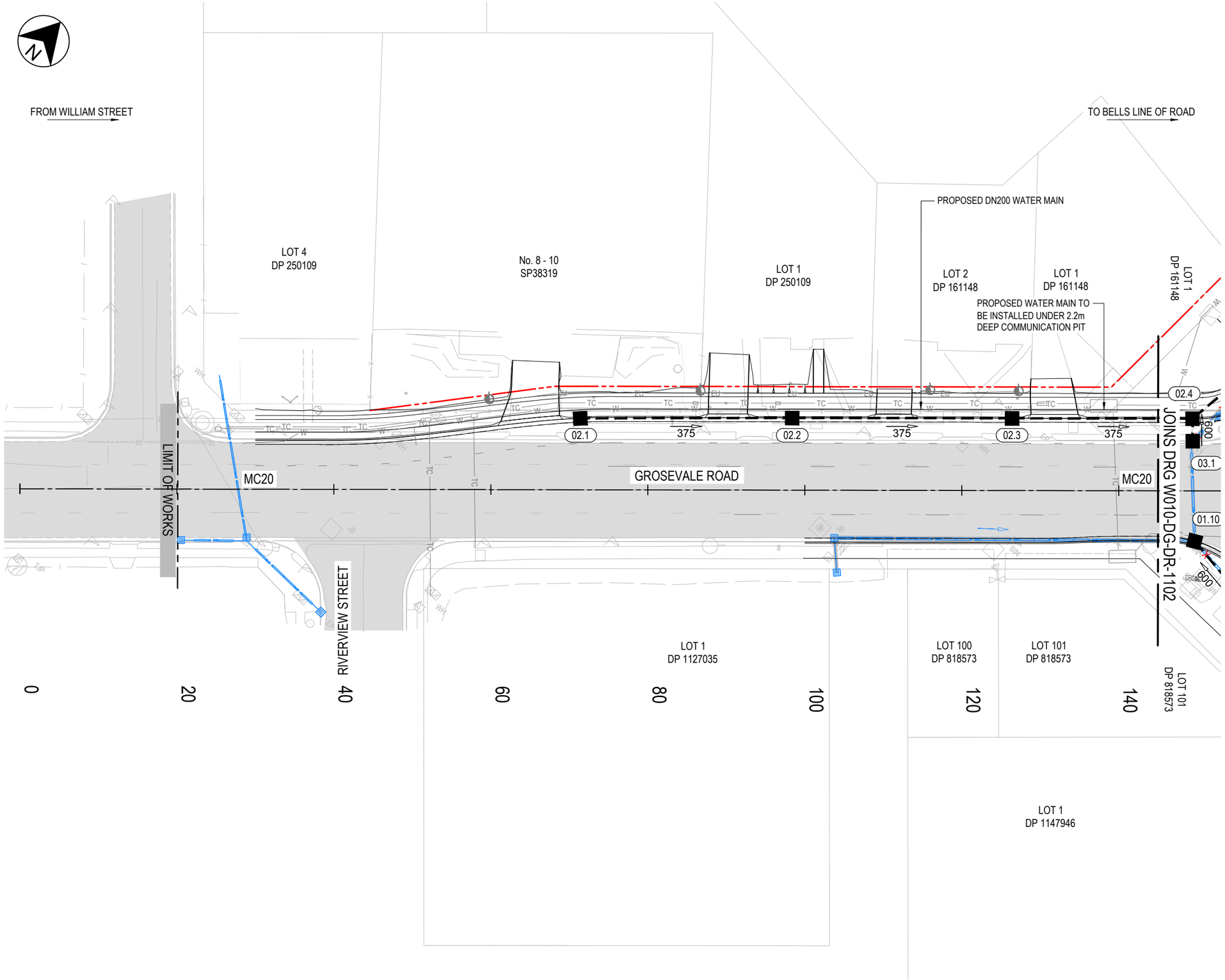
0 5 10 15 20 25 mm ON A3 ORIGINAL



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
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A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

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TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
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DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE PLAN
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1105	E

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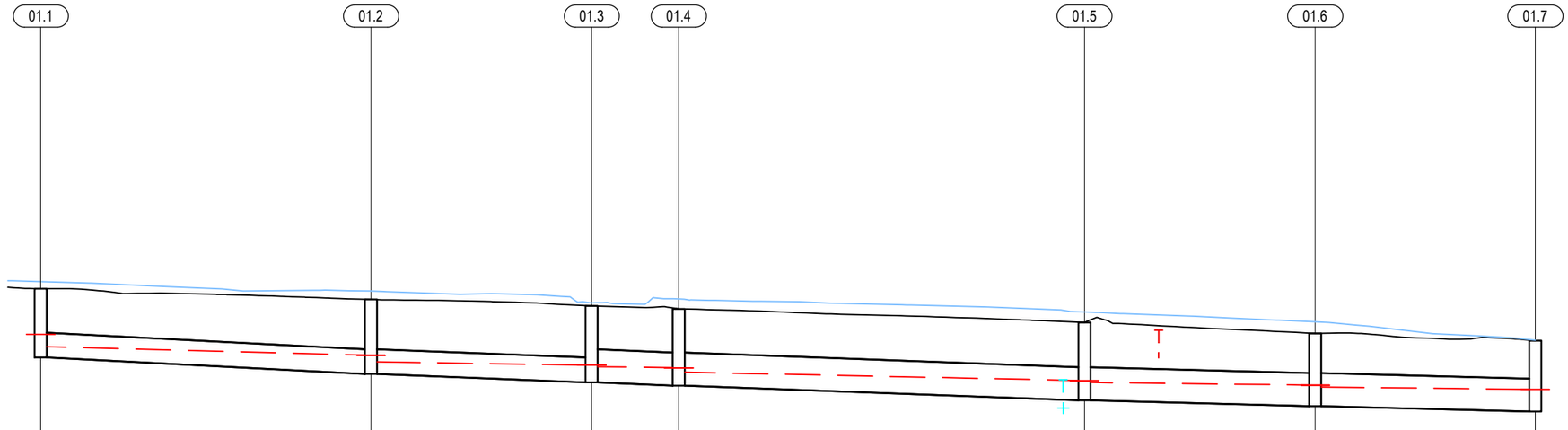


PIPE DIAMETER (mm)	450	450	600	600	600	600
PIPE CLASS	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 6
PIPE VELOCITY (m/s)	2.070	2.320	1.500	2.040	1.540	1.500
PIPE FLOW (m3/s)	0.139	0.180	0.198	0.219	0.240	0.253
PIPE GRADE (%)	1.00	0.75	0.75	0.73	0.50	0.50
DATUM R.L.	11.000					

HYDRAULIC GRADE LINE (10 YR ARI)	20.897		20.743	20.621		20.561	20.534	20.515	20.434		20.284	20.247		20.200	20.164		20.123
EXISTING SURFACE LEVELS	21.951		21.754			21.639		21.583			21.336			21.139			21.007
DESIGN SURFACE LEVELS	21.951		21.754			21.639		21.583			21.336			21.139			21.007
DEPTH TO INVERT	1.251		1.354	1.354		1.389	1.389	1.393	1.393		1.413	1.413		1.321	1.321		1.289
PIPE INVERT LEVELS	20.700		20.400	20.400		20.250	20.250	20.191	20.191		19.923	19.923		19.818	19.818		19.718
PIPE STATION	0.000		30.000			50.049		57.958			94.814			115.775			135.767

LINE 01

LEGEND

REFERENCE ONLY

- DESIGN SURFACE
- EXISTING SURFACE
- H.G.L
- 0 DRAINAGE PIT

EXISTING UTILITIES TO PRESERVE

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO ABANDON

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO REMOVE

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

UTILITY ADJUSTMENT

- T+ TELECOMMUNICATIONS
- W+ WATER MAIN
- SW+ STORM WATER
- E+ ELECTRICAL
- G+ GAS
- S+ SEWER
- TCS+ TRAFFIC CONTROL SYSTEMS

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
HORIZ. 1:500
VERT. 1:250
5 0 5 10
2.5 0 2.5 AT A3 5
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

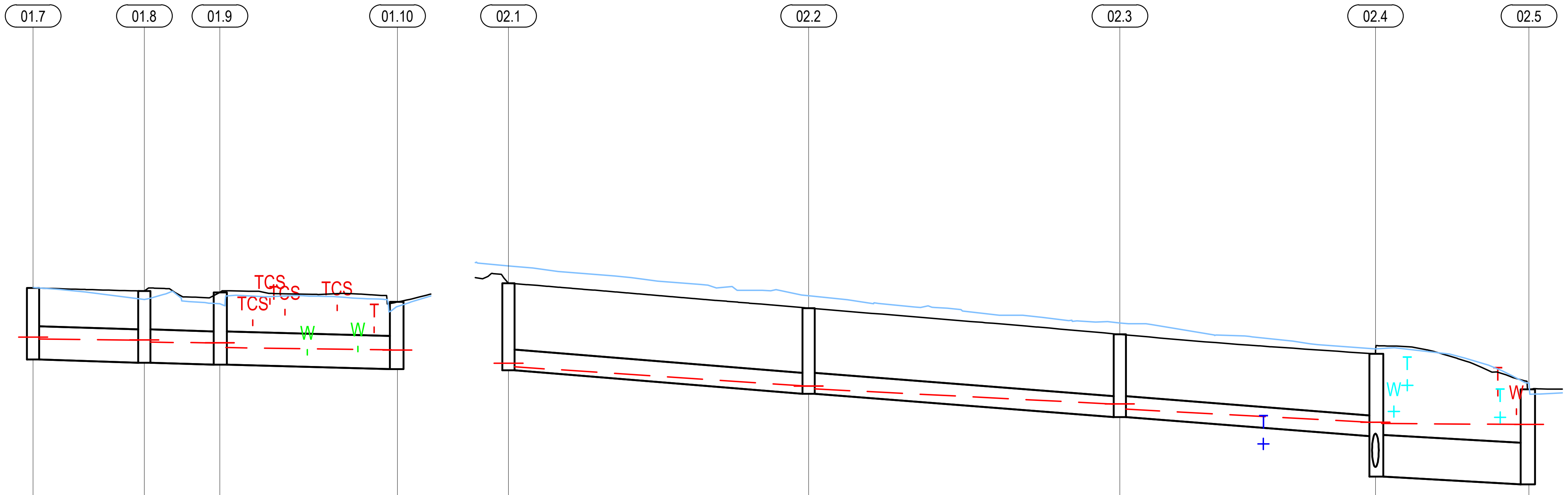
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE LONGITUDINAL SECTIONS
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1111	E

DATE: 17/03/2016 11:16:53 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1111-A1P.dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL



	Line 01: 01.7 – 01.8	Line 01: 01.8 – 01.9	Line 01: 01.9 – 01.10
PIPE DIAMETER (mm)	600	600	600
PIPE CLASS	CLASS 6	CLASS 6	CLASS 6
PIPE VELOCITY (m/s)	1.440	1.510	1.910
PIPE FLOW (m3/s)	0.264	0.277	0.280
PIPE GRADE (%)	0.58	0.51	0.51
DATUM R.L.	10.000		

	01.7	01.8	01.9	01.10
HYDRAULIC GRADE LINE (10 YR ARI)	20.123 / 20.088	20.068 / 20.031	20.017 / 19.934	19.892 / 19.892
EXISTING SURFACE LEVELS	21.007	20.951	20.925	20.755
DESIGN SURFACE LEVELS	21.007	20.951	20.925	20.755
DEPTH TO INVERT	1.289 / 1.289	1.291 / 1.291	1.300 / 1.300	1.211 / 1.211
PIPE INVERT LEVELS	19.718 / 19.718	19.660 / 19.660	19.625 / 19.625	19.544 / 19.544
PIPE STATION	135.767	145.767	152.562	168.540

LINE 01

	Line 02: 02.1 – 02.2	Line 02: 02.2 – 02.3	Line 02: 02.3 – 02.4	Line 02: 02.4 – 02.5
PIPE DIAMETER (mm)	375	375	375	750
PIPE CLASS	CLASS 4	CLASS 4	CLASS 4	CLASS 4
PIPE VELOCITY (m/s)	1.330	1.620	2.410	1.070
PIPE FLOW (m3/s)	0.017	0.031	0.095	0.471
PIPE GRADE (%)	1.56	1.50	1.50	1.00
DATUM R.L.	11.000			

	02.1	02.2	02.3	02.4	02.5
HYDRAULIC GRADE LINE (10 YR ARI)	20.587	20.245 / 20.190	19.916 / 19.827	19.590 / 19.567	19.550
EXISTING SURFACE LEVELS	22.091	21.644	21.171	20.819	20.180
DESIGN SURFACE LEVELS	22.091	21.644	21.171	20.819	20.180
DEPTH TO INVERT	1.568	1.541 / 1.541	1.489 / 1.489	1.482 / 2.208	1.707 / 1.707
PIPE INVERT LEVELS	20.523	20.103 / 20.103	19.683 / 19.682	19.337 / 18.611	18.473 / 18.473
PIPE STATION	0.000	27.001	55.001	78.001	91.815

LINE 02

LEGEND

REFERENCE ONLY
- DESIGN SURFACE
- EXISTING SURFACE
- H.G.L
- DRAINAGE PIT

EXISTING UTILITIES TO PRESERVE
- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO ABANDON
- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO REMOVE
- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

UTILITY ADJUSTMENT
- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
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REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
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TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
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DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
HORIZ. 1:500
VERT. 1:250
5 0 5 10
2.5 0 2.5 AT A3 5
CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL
This Drawing may have been prepared using colour and may be incomplete if copied

CLIENT: Transport Roads & Maritime Services (NSW Government)

CONTRACTOR: Downer mouchel

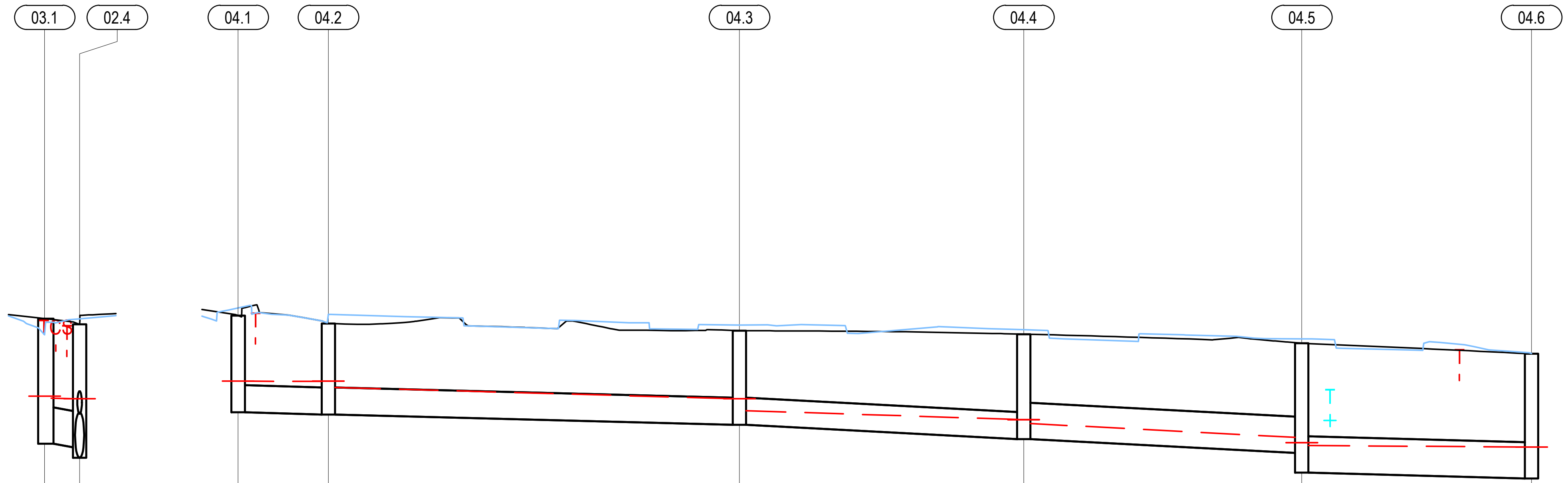
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE LONGITUDINAL SECTIONS
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1112	E

DATE: 17/03/2016 11:16:59 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NBIF\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1111-1116.dwg



LEGEND

REFERENCE ONLY

- DESIGN SURFACE
- EXISTING SURFACE
- H.G.L
- 0 DRAINAGE PIT

EXISTING UTILITIES TO PRESERVE

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO ABANDON

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO REMOVE

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

UTILITY ADJUSTMENT

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

LINE 03

	03.1	03.1 – 02.4	02.4
PIPE DIAMETER (mm)		600	
PIPE CLASS		CLASS 4	
PIPE VELOCITY (m/s)		1.350	
PIPE FLOW (m3/s)		0.381	
PIPE GRADE (%)		2.00	
DATUM R.L.		10.000	
HYDRAULIC GRADE LINE (10 YR ARI)	19.597		19.590 / 19.567
EXISTING SURFACE LEVELS	20.914		20.819
DESIGN SURFACE LEVELS	20.914		20.819
DEPTH TO INVERT	2.072		2.035 / 2.208
PIPE INVERT LEVELS	18.842		18.784 / 18.611
PIPE STATION	0.000		2.890

LINE 04

	04.1 – 04.2	04.2 – 04.3	04.3 – 04.4	04.4 – 04.5	04.5 – 04.6
PIPE DIAMETER (mm)	450	450	450	600	600
PIPE CLASS	CLASS 4	CLASS 4	CLASS 4	CLASS 4	CLASS 4
PIPE VELOCITY (m/s)	0.100	1.270	3.220	2.450	1.280
PIPE FLOW (m3/s)	0.016	0.199	0.271	0.283	0.290
PIPE GRADE (%)	0.50	0.50	1.00	1.00	0.50

DATUM R.L. 11.000

	04.1	04.2	04.3	04.4	04.5	04.6
HYDRAULIC GRADE LINE (10 YR ARI)	20.878	20.877 / 20.775	20.588 / 20.390	20.244 / 20.177	19.948 / 19.814	19.788
EXISTING SURFACE LEVELS	21.964	21.833	21.713	21.657	21.506	21.331
DESIGN SURFACE LEVELS	21.964	21.833	21.713	21.657	21.506	21.331
DEPTH TO INVERT	1.602	1.508 / 1.508	1.558 / 1.558	1.737 / 1.737	1.816 / 2.142	2.062
PIPE INVERT LEVELS	20.362	20.325 / 20.325	20.155 / 20.155	19.920 / 19.920	19.690 / 19.364	19.269
PIPE STATION	0.000	7.459	41.459	64.959	87.959	106.959

LOGIN NAME: SUTHERLAND, GRANT
DATE: 17/03/2016 11:17:04 AM
LOCATION: I:\NBIF\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1111-1116.dwg

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 5 10 15 20 25 mm ON A3 ORIGINAL — This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	CF	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

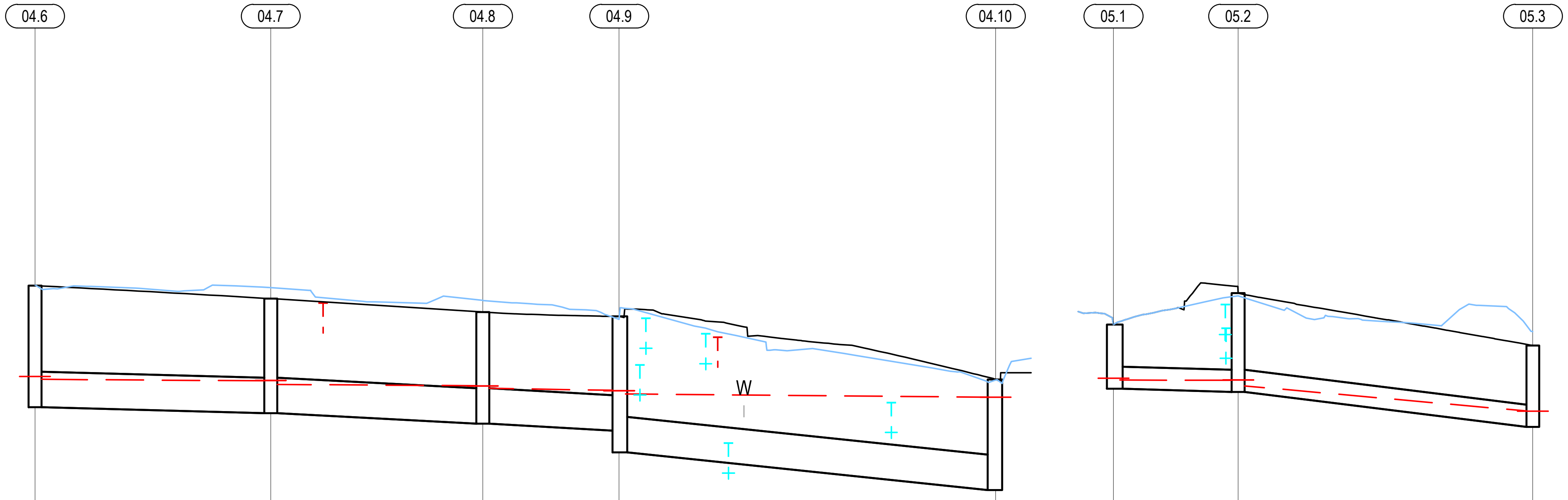
ORIGINAL DRAWING AT A3 SIZE
HORIZ. 1:500
VERT. 1:250
AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services
CONTRACTOR: Downer mouchel
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE LONGITUDINAL SECTIONS
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	**DRAWING No**	**REV**
80%	NB00042-W010-DG-DR-1113	C



LINE 04

	04.6 – 04.7	04.7 – 04.8	04.8 – 04.9	04.9 – 04.10
PIPE DIAMETER (mm)	600	600	600	600
PIPE CLASS	CLASS 4	CLASS 4	CLASS 4	CLASS 4
PIPE VELOCITY (m/s)	1.230	1.240	1.090	1.120
PIPE FLOW (m3/s)	0.294	0.302	0.310	0.317
PIPE GRADE (%)	0.50	1.00	1.00	2.00

DATUM R.L. 10.000

	04.6		04.7		04.8		04.9		04.10	
HYDRAULIC GRADE LINE (10 YR ARI)	19.788	19.742	19.716	19.653	19.634	19.589	19.555	19.493	19.437	19.437
EXISTING SURFACE LEVELS	21.331		21.110		20.883		20.811		19.739	
DESIGN SURFACE LEVELS	21.331		21.110		20.883		20.811		19.739	
DEPTH TO INVERT	2.062	2.062	1.941	1.941	1.894	1.894	1.938	2.307	1.873	1.873
PIPE INVERT LEVELS	19.269	19.269	19.169	19.169	18.989	18.989	18.873	18.504	17.865	17.865
PIPE STATION	106.959		126.959		144.959		156.523		188.467	

LINE 05

	05.1 – 05.2	05.2 – 05.3
PIPE DIAMETER (mm)	375	375
PIPE CLASS	CLASS 3	CLASS 4
PIPE VELOCITY (m/s)	0.490	2.190
PIPE FLOW (m3/s)	0.020	0.053
PIPE GRADE (%)	0.50	2.37

DATUM R.L. 8.000

	05.1		05.2		05.3
HYDRAULIC GRADE LINE (10 YR ARI)		17.729	17.726	17.630	17.204
EXISTING SURFACE LEVELS	18.671		19.205		18.315
DESIGN SURFACE LEVELS	18.671		19.205		18.315
DEPTH TO INVERT		1.090	1.677	1.677	1.379
PIPE INVERT LEVELS		17.581	17.528	17.528	16.936
PIPE STATION	0.000		10.581		35.581

LEGEND

REFERENCE ONLY

- DESIGN SURFACE
- EXISTING SURFACE
- H.G.L
- 0 DRAINAGE PIT

EXISTING UTILITIES TO PRESERVE

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO ABANDON

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO REMOVE

T	TELECOMMUNICATIONS
W	WATER MAIN
SW	STORM WATER
E	ELECTRICAL
G	GAS
S	SEWER
TCS	TRAFFIC CONTROL SYSTEMS

UTILITY ADJUSTMENT

T	TELECOMMUNICATIONS
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TCS	TRAFFIC CONTROL SYSTEMS

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

TITLE	INITIAL	DATE
DRAFTSPERSON	CF	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 — 5 0 5 10
VERT. 1:250 — 2.5 0 2.5 AT A3 5

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL — This Drawing may have been prepared using colour and may be incomplete if copied

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downer mouchel

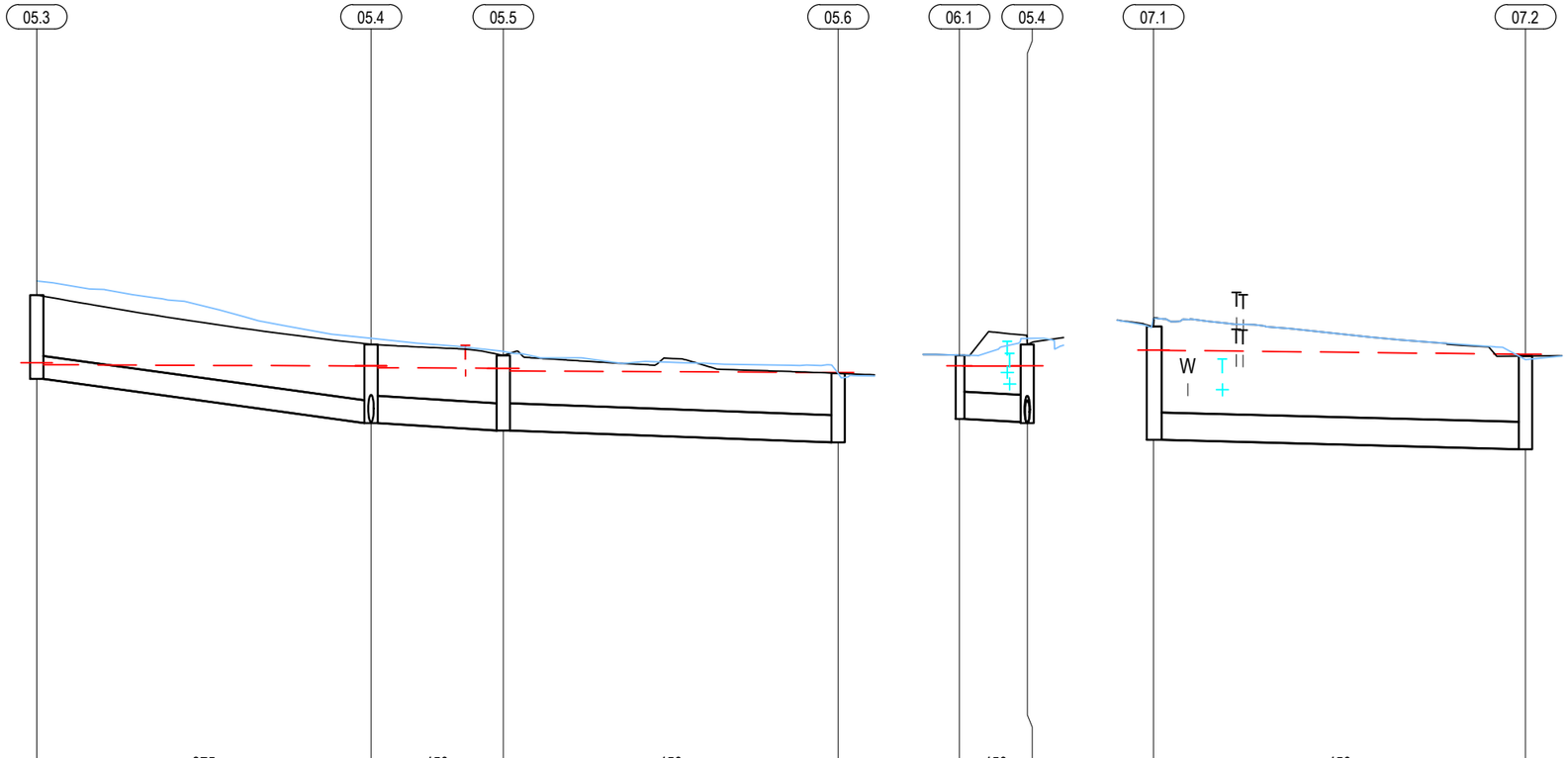
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE LONGITUDINAL SECTIONS
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1114	C

DATE: 17/03/2016 11:17:10 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NBIF\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1111-1116.dwg



PIPE DIAMETER (mm)	375	450	450	450	450
PIPE CLASS	CLASS 4	CLASS 4	CLASS 4	CLASS 3	CLASS 4
PIPE VELOCITY (m/s)	0.940	0.630	0.660	0.040	0.340
PIPE FLOW (m3/s)	0.067	0.100	0.105	0.006	0.054
PIPE GRADE (%)	2.64	1.14	0.71	0.92	0.50
DATUM R.L.	7.000			7.000	9.000
HYDRAULIC GRADE LINE (10 YR ARI)	17.204 / 17.169	17.147 / 17.119	17.110 / 17.066	17.040	17.147 / 17.147	17.119	19.407	19.342	19.342
EXISTING SURFACE LEVELS	18.315	17.504	17.319	17.026	17.326	17.504	19.798	19.311
DESIGN SURFACE LEVELS	18.315	17.504	17.319	17.026	17.326	17.504	19.798	19.311
DEPTH TO INVERT	1.379 / 1.379	1.296 / 1.296	1.236 / 1.236	1.138 / 1.138	1.052	1.281	1.296	1.868	1.534	1.534
PIPE INVERT LEVELS	16.936 / 16.936	16.207 / 16.207	16.083 / 16.083	15.888 / 15.888	16.274	16.223	16.207	17.930	17.777	17.777
PIPE STATION	35.581	63.142	74.038	101.639	0.000	5.592	0.000	30.665

LINE 05 LINE 06 LINE 07

LEGEND

REFERENCE ONLY

- DESIGN SURFACE
- EXISTING SURFACE
- H.G.L
- DRAINAGE PIT

EXISTING UTILITIES TO PRESERVE

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
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- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO ABANDON

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EXISTING UTILITIES TO REMOVE

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- SW STORM WATER
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UTILITY ADJUSTMENT

- T+ TELECOMMUNICATIONS
- W+ WATER MAIN
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- TCS+ TRAFFIC CONTROL SYSTEMS

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

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TITLE	INITIAL	DATE
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DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 5 0 5 10

VERT. 1:250 2.5 0 2.5 AT A3 5

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

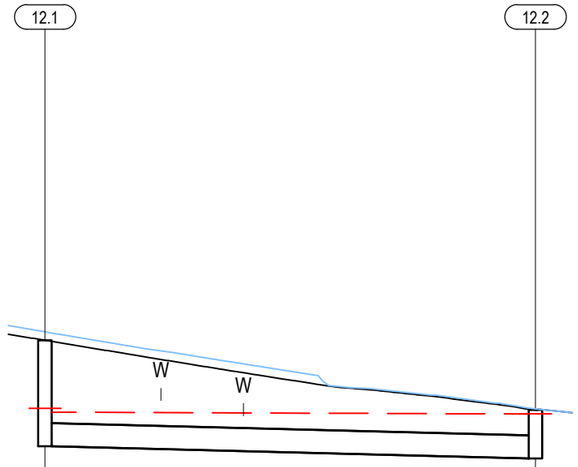
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE LONGITUDINAL SECTIONS
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1115	C

DATE: 17/03/2016 11:17:15 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1111-1115.dwg



PIPE DIAMETER (mm)	375	
PIPE CLASS	CLASS 6	
PIPE VELOCITY (m/s)	0.530	
PIPE FLOW (m3/s)	0.059	
PIPE GRADE (%)	0.50	
DATUM R.L.	8.000	
HYDRAULIC GRADE LINE (10 YR ARI)	17.458	17.428 17.428
EXISTING SURFACE LEVELS	18.630	17.493
DESIGN SURFACE LEVELS	18.630	17.493
DEPTH TO INVERT	1.727	0.790 0.790
PIPE INVERT LEVELS	16.903	16.703 16.703
PIPE STATION	0.000	40.000

LINE 12

LEGEND

REFERENCE ONLY

- DESIGN SURFACE
- EXISTING SURFACE
- H.G.L
- DRAINAGE PIT

EXISTING UTILITIES TO PRESERVE

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO ABANDON

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

EXISTING UTILITIES TO REMOVE

- T TELECOMMUNICATIONS
- W WATER MAIN
- SW STORM WATER
- E ELECTRICAL
- G GAS
- S SEWER
- TCS TRAFFIC CONTROL SYSTEMS

UTILITY ADJUSTMENT

- T+ TELECOMMUNICATIONS
- W+ WATER MAIN
- SW+ STORM WATER
- E+ ELECTRICAL
- G+ GAS
- S+ SEWER
- TCS+ TRAFFIC CONTROL SYSTEMS

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	CF	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 5 0 5 10

VERT. 1:250 2.5 0 2.5 AT A3 5

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

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PROJECT

HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE LONGITUDINAL SECTIONS
SHEET 6

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1116	C

DATE: 17/03/2016 11:17:21 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1111-1116.dwg

STRUCTURE			PIT LOCATION		LOCATION OFFSETS			INLET		OUTLET		PIPE CLASS	DRAWING REFERENCE	NOTES
No.	TYPE	SETOUT RL	EASTING	NORTHING	CTRL	STATION	OFFS	DIA	INV LEV	DIA	INV LEV			
DRAINAGE LINE 1														
01.1	SA3	21.926	288465.682	6281960.473	MC10	361.599	7.721			450	20.700	CLASS 4	MD.R11.B01.A.1.SHEET 1	
01.2	SA2	21.791	288445.655	6281982.815	MC10	331.985	10.288	450	20.400	450	20.400	CLASS 4	MD.R11.B01.A.1.SHEET 1	
01.3	SA1 GRATE ONLY	21.682	288432.359	6281997.753	MC10	331.837	12.027	450	20.250	600	20.250	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
01.4	SA2	21.624	288427.019	6282003.622	MC10	303.716	12.618	600	20.191	600	20.191	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
01.5	SA2	21.379	288402.475	6282031.127	MC10	266.133	13.369	600	19.923	600	19.923	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
01.6	SA2	21.179	288388.518	6282046.780	MC10	245.162	13.374	600	19.818	600	19.818	CLASS 6	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
01.7	SA2	20.991	288375.248	6282061.736	MC10	225.167	13.330	600	19.718	600	19.718	CLASS 6	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
01.8	SAS	20.895	288368.594	6282069.202	MC10	215.167	13.330	600	19.660	600	19.660	CLASS 6	MD.R11.B01.A.1.SHEET 2	FOR PITS NOTES REFER TO MODEL DRAWING MD.R11.B01.A.1 SHEET 1. FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
01.9	SA1 GRATE ONLY	20.944	288363.857	6282074.188	MC10	208.293	13.549	600	19.625	600	19.625	CLASS 6	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
01.10	SA2	20.899	288347.833	6282075.888	MC20	149.608	6.627	600	19.544	EXISTING			MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
DRAINAGE LINE 2														
02.1	SA2	22.131	288279.261	6282035.308	MC20	71.399	-8.610			375	20.523	CLASS 4	MD.R11.B01.A.1.SHEET 1	
02.2	SA2	21.684	288299.362	6282053.301	MC20	98.377	-8.700	375	20.103	375	20.103	CLASS 4	MD.R11.B01.A.1.SHEET 1	
02.3	SA2	21.224	288320.288	6282071.906	MC20	126.377	-8.700	375	19.683	375	19.682	CLASS 4	MD.R11.B01.A.1.SHEET 1	
02.4	SA2	20.938	288337.476	6282087.188	MC20	149.377	-8.700	375	19.337	750	18.611	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
02.5	SA1 GRATE ONLY	20.451	288339.657	6282101.536	MC10	171.734	13.417	750	18.473	EXISTING			MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
DRAINAGE LINE 3														
03.1	IP	20.840	288339.064	6282085.402	MC20	149.377	-6.310	EXISTING		600	18.842	CLASS 4	MD.R11.B36.A.1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
02.4	SA2	20.938	288337.476	6282087.188	MC20	149.377	-8.700	600	18.784				MD.R11.B01.A.1.SHEET 1	
DRAINAGE LINE 4														
04.1	SA2	22.021	288471.393	6281975.813	MC10	353.001	-6.201			450	20.362	CLASS 4	MD.R11.B01.A.1.SHEET 1	
04.2	SA3	21.873	288476.956	6281980.766	MC10	352.422	-13.628	450	20.325	450	20.325	CLASS 4	MD.R11.B01.A.1.SHEET 1	
04.3	SA2	21.737	288455.536	6282004.667	MC10	320.289	-10.640	450	20.164	450	20.164	CLASS 4	MD.R11.B01.A.1.SHEET 1	
04.4	SA2	21.613	288438.240	6282024.081	MC10	294.858	-8.984	450	20.034	600	19.869	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
04.5	SA2	21.470	288423.788	6282040.201	MC10	273.540	-8.579	600	19.761	600	19.364	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
04.6	SA2	21.305	288409.852	6282055.738	MC10	252.668	-8.513	600	19.259	600	19.259	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
04.7	SA2	21.063	288393.533	6282073.950	MC10	228.215	-8.447	600	19.137	600	19.137	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
04.8	SA2	20.769	288377.630	6282092.003	MC10	204.157	-8.586	600	18.897	600	18.504	CLASS 4	MD.R11.B01.A.1.SHEET 1	FOR PITS WITH DIAMETER GREATER THAN 450mm SEE MD.R11.B28.
04.9	SA2	19.799	288380.686	6282122.973	MC20	204.598	-8.029	600	17.865	EXISTING			MD.R11.B01.A.1.SHEET 1	CONSTRUCT NEW PIT OVER EXISTING PIPE AND CONNECT EXISTING PIPES. SPECIAL PIT DETAIL NB00042-W010-DG-DR-1171 & 1172. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
DRAINAGE LINE 5														
05.1	SA2	18.704	288336.043	6282149.526	MC10	134.789	-17.288			375	17.581	CLASS 4	MD.R11.B01.A.1.SHEET 1	REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
05.2	SA2	19.208	288328.296	6282141.593	MC10	134.736	-6.200	375	17.528	375	17.528	CLASS 4	MD.R11.B01.A.1.SHEET 1	
05.3	SA2	18.355	288310.268	6282158.913	MC10	109.758	-6.200	375	16.936	375	16.936	CLASS 4	MD.R11.B01.A.1.SHEET 1	
05.4	SA2	17.545	288290.390	6282178.004	MC10	82.196	-6.200	375	16.207	375	16.207	CLASS 4	MD.R11.B01.A.1.SHEET 1	
05.5	SA2	17.336	288282.545	6282185.570	MC10	71.243	-6.205	375	16.083	375	16.083	CLASS 4	MD.R11.B01.A.1.SHEET 1	
05.6	SA2	17.050	288263.278	6282205.361	MC10	43.237	-6.030	375	15.888	EXISTING			MD.R11.B01.A.1.SHEET 1	REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
DRAINAGE LINE 6														
06.1	IS 600x600	17.326	288294.610	6282182.398	MC10	82.196	-12.292			375	16.312	CLASS 3		
05.4	SA2	17.545	288290.390	6282178.004	MC10	82.196	-6.200	375	16.260				MD.R11.B01.A.1.SHEET 1	
DRAINAGE LINE 7														
07.1	SA2	19.832	288399.351	6282118.741	MC20	217.698	5.800			375	18.022	CLASS 4	MD.R11.B01.A.1.SHEET 1	
07.2	SA2	19.251	288430.226	6282116.434	MC20	242.536	24.283	375	17.777	EXISTING			MD.R11.B01.A.1.SHEET 1	REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
DRAINAGE LINE 9														
09.1	SA2	19.557	288390.882	6282128.709	MC20	215.884	-7.154	EXISTING					MD.R11.B01.A.1.SHEET 1	CONSTRUCT NEW PIT OVER EXISTING PIPE AND CONNECT EXISTING PIPES. SPECIAL PIT DETAIL NB00042-W010-DG-DR-1171 & 1172. REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151
DRAINAGE LINE 12														
12.1	SA2	18.665	288305.800	6282139.418	MC10	120.039	10.955			375	16.903	CLASS 6	MD.R11.B01.A.1.SHEET 1	
12.2	SA2	17.538	288279.213	6282169.301	MC10	80.164	7.819	375	16.703	EXISTING			MD.R11.B01.A.1.SHEET 1	REFER TO PIT TO PIPE CONNECTION DETAIL NB00042-W010-DG-DR-1151

NOTES:

1. X/Y SETOUT TO SETOUT STRING.
2. SETOUT LEVEL TO PIT COVER LEVEL.
3. SOME SETOUT X/Y OR Z LEVELS HAVE SPECIAL SETOUT DATA. SEE INDIVIDUAL MANHOLE REMARKS.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

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PROJECT
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RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
DRAINAGE PIT SCHEDULE

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1121	E

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

DATE: 17/03/2016 2:12:11 PM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1121.dwg

UTILITIES CONFLICT SCHEDULE FOR RICHMOND BRIDGE APPROACH SITE 1

ID	AUTHORITY	DESCRIPTION	POSITION	LOCATION	IMPACT BY	PROPOSED TREATMENT
TE-01	TELSTRA \ OPTUS \ NBN	COMMUNICATION CONDUITS	UNDERGROUND	BETWEEN STN. 30 AND STN. 395 ON THE EASTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON THE EASTBOUND OF BELLS LINE OF ROAD.	EXISTING COMMUNICATION CONDUITS WILL BE REMOVED. NEW COMMUNICATION CONDUITS WILL BE INSTALLED UNDER THE PROPOSED FOOTPATH BETWEEN STN.35 AND STN. 395 ON THE NORTHERN SIDE OF BELLS LINE OF ROAD. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.
TE-02	TELSTRA \ OPTUS \ NBN	COMMUNICATION CONDUITS	UNDERGROUND	BETWEEN STN. 110 AND STN. 260 ON THE EASTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON THE EASTBOUND OF BELLS LINE OF ROAD.	EXISTING COMMUNICATION CONDUITS WILL BE REMOVED. NEW COMMUNICATION CONDUITS WILL BE INSTALLED UNDER THE PROPOSED FOOTPATH BETWEEN STN. 110 AND STN. 260 ON THE NORTHERN SIDE OF BELLS LINE OF ROAD. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.
TE-03	TELSTRA \ OPTUS \ NBN	COMMUNICATION CONDUITS	UNDERGROUND	BETWEEN STN. 140 AND STN. 220 ON THE SOUTHBOUND OF TERRACE ROAD AND GROSEVALE ROAD.	ROAD WIDENING ON THE SOUTHBOUND OF TERRACE ROAD AND GROSEVALE ROAD.	EXISTING COMMUNICATION CONDUITS WILL BE REMOVED. NEW COMMUNICATION CONDUITS WILL BE INSTALLED UNDER THE PROPOSED FOOTPATH BETWEEN STN. 140 AND STN. 220 ON THE EASTERN SIDE OF TERRACE ROAD AND GROSEVALE ROAD. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.
TE-04	TELSTRA \ OPTUS \ NBN	COMMUNICATION CONDUITS	UNDERGROUND	BETWEEN STN. 25 AND STN. 175 ON THE NORTHBOUND OF GROSEVALE ROAD.	ROAD WIDENING ON THE NORTHBOUND OF GROSEVALE ROAD.	EXISTING COMMUNICATION CONDUITS WILL BE REMOVED. NEW COMMUNICATION CONDUITS WILL BE INSTALLED UNDER THE PROPOSED FOOTPATH BETWEEN STN. 25 AND STN. 175 ON THE WESTERN SIDE OF GROSEVALE ROAD. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.
TE-05	TELSTRA \ OPTUS \ NBN	COMMUNICATION CONDUITS	UNDERGROUND	AT STN. 50 ALONG THE GROSEVALE ROAD.	ROAD WIDENING ON THE NORTHBOUND OF GROSEVALE ROAD.	REPLACED BY THE NEW COMMUNICATION CONDUITS AT STN. 50 ALONG THE MC20 STRING. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.
TE-06	TELSTRA \ OPTUS \ NBN	COMMUNICATION CONDUITS	UNDERGROUND	AT STN. 260 ALONG THE BELLS LINE OF ROAD.	ROAD WIDENING ON THE EASTBOUND OF BELLS LINE OF ROAD.	EXISTING COMMUNICATION CONDUITS WILL BE REMOVED. NEW COMMUNICATION CONDUITS WILL BE INSTALLED AT STN. 260 ALONG THE BELLS LINE OF ROAD. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.
TCS-01	RMS	1X80 HD PVC CONDUITS	UNDERGROUND	AT THE INTERSECTION BETWEEN BELLS LINE OF ROAD AND TERRACE ROAD.	ROAD WIDENING AT THE INTERSECTION BETWEEN BELLS LINE OF ROAD AND TERRACE ROAD.	RELOCATE TCS CONDUITS AS PER NEW INTERSECTION ARRANGEMENT
WM-01	SYDNEY WATER	150mmPVC	UNDERGROUND	BETWEEN STN.155 AND STN. 175 ON THE WESTBOUND OF BELLS LINE OF ROAD.	PROPOSED FOOTPATH	REMOVE THE EXISTING WATER MAIN, AND THEN PROVIDE A NEW 200mm WATER MAIN ALONG THE NEW BOUNDARY AT THE SOUTHERN-WEST CORNER OF INTERSECTION. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH SYDNEY WATER REQUIREMENTS.
WM-02	SYDNEY WATER	200mm CICL	UNDERGROUND	BETWEEN STN. 25 AND STN. 160 ON THE NORTHBOUND OF GROSEVALE ROAD.	ROAD WIDENING AT THE NORTHBOUND OF GROSEVALE ROAD.	ABANDON THE EXISTING WATER MAIN. PROVIDE A NEW 200mm C.I.C.L WATER MAIN UNDER THE PROPOSED FOOTPATH ON THE WESTERN SIDE OF GROSEVALE ROAD. THE MINIMUM COVER AND CLEARANCE SHOULD BE IN ACCORDANCE WITH SYDNEY WATER REQUIREMENTS.
EU-01	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 35 ON WESTBOUND OF BELLS LINE OF ROAD.	PROPOSED STREET LIGHT DESIGN	REMOVED EXISTING POLE AND OVERHEAD POWER LINE.
EU-02	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 75 ON EASTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON EASTBOUND OF BELLS LINE OF ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE.
EU-03	ENDEAVOUR ENERGY	POLE AND UNDERGROUND POWER LINE	UNDERGROUND	"EXISTING POLE IS LOCATED AT STN. 110 ON THE WESTBOUND OF BELLS LINE OF ROAD. THE UNDERGROUND POWER LINE IS LOCATED BETWEEN STN. 100 AND STN. 115 ON THE WESTBOUND OF BELLS LINE OF ROAD."	PROPOSED ELECTRICAL RELOCATION DESIGN	REMOVED EXISTING POLE AND UNDERGROUND POWER LINE.
EU-04	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 145 ON EASTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON EASTBOUND OF BELLS LINE OF ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-05	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 150 ON EASTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON EASTBOUND OF BELLS LINE OF ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-06	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 175 ON WESTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON WESTBOUND OF BELLS LINE OF ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-07	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 210 ON EASTBOUND OF BELLS LINE OF ROAD.	ROAD WIDENING ON EASTBOUND OF BELLS LINE OF ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-08	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 125 ON NORTHBOUND OF GROSEVALE ROAD.	ROAD WIDENING ON NORTHBOUND OF GROSEVALE ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-09	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 85 ON NORTHBOUND OF GROSEVALE ROAD.	ROAD WIDENING ON NORTHBOUND OF GROSEVALE ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-10	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 100 ON THE NORTHERN SIDE OF PROPOSED FOOTPATH.	PROPOSED ELECTRICAL RELOCATION DESIGN	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-11	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 320 ON EASTBOUND OF BELLS LINE OF ROAD.	PROPOSED STREET LIGHT DESIGN	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-12	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 435 ON EASTBOUND OF BELLS LINE OF ROAD.	PROPOSED STREET LIGHT DESIGN	REMOVED EXISTING POLE AND OVERHEAD POWER LINE
EU-13	ENDEAVOUR ENERGY	POLE AND OVERHEAD POWER LINE	OVERHEAD	AT STN. 205 ON THE SOUTHBOUND OF TERRACE ROAD.	ROAD WIDENING ON SOUTHBOUND OF TERRACE ROAD.	REMOVED EXISTING POLE AND OVERHEAD POWER LINE

UTILITY TYPE	ID LABEL
WATER	WM
SEWER	SW
GAS	GM
TELECOM \ OPTICAL FIBRA	TE
ELECTRICAL	EU
TRAFFIC CONTROL SIGNAL	TCS

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government – Transport Roads & Maritime Services

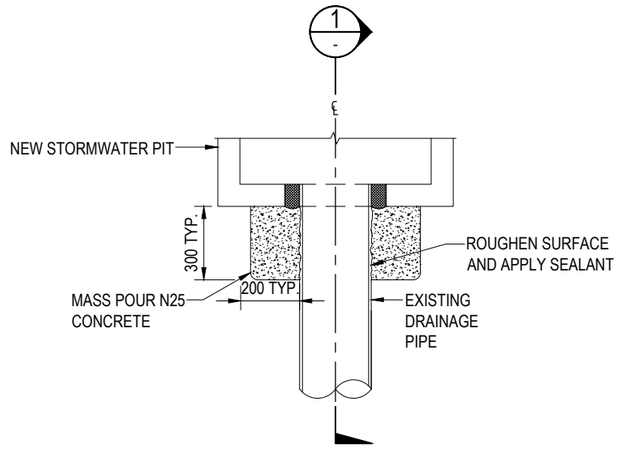
CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
UTILITIES CONFLICT SCHEDULE

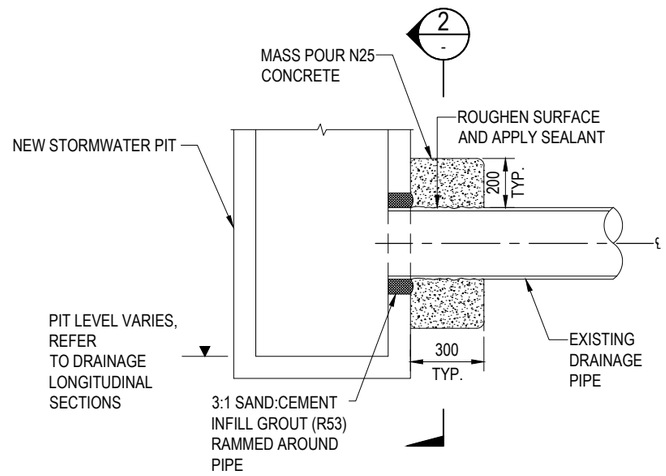
NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1141	C

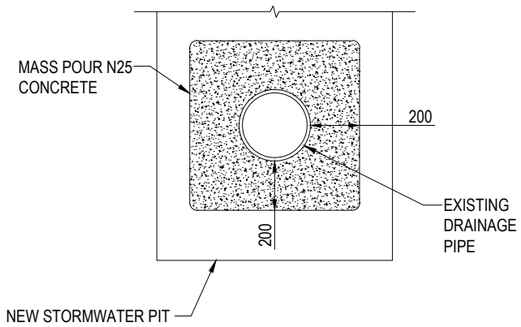


PLAN - PIPE TO PIT CONNECTION

SCALE 1:25



SECTION 1 - SCALE 1:25



SECTION 2 - SCALE 1:25

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B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

TITLE	INITIAL	DATE
DRAFTSPERSON	SG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

HORIZ. 1:500 VERT. 1:250 — 5 0 5 10 / 2.5 0 2.5 AT A3 5

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
TYPICAL DRAINAGE DETAIL
PIPE TO PIT CONNECTION

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005516	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1151	C

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

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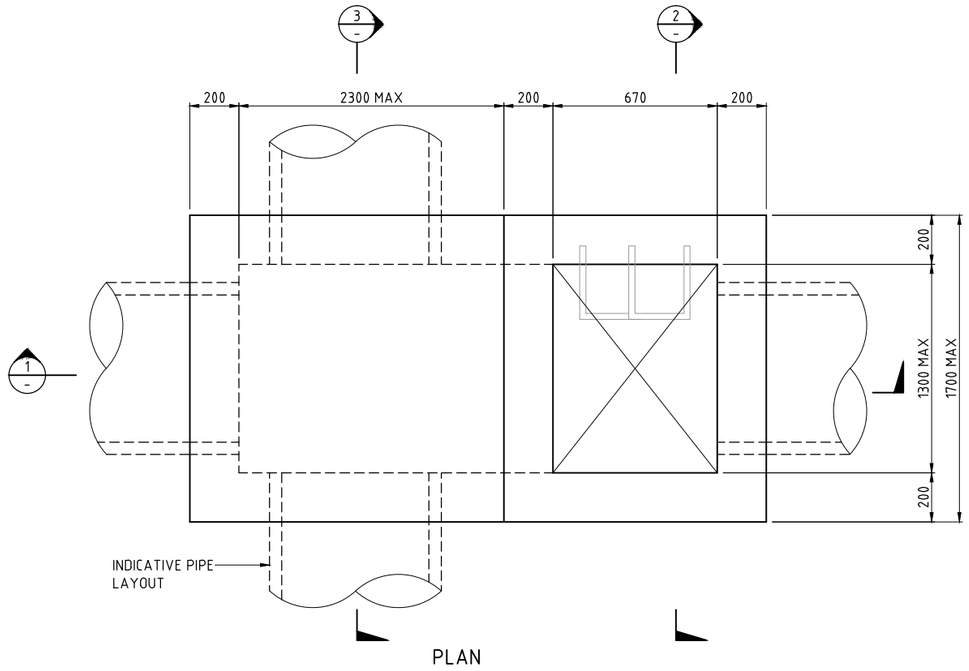
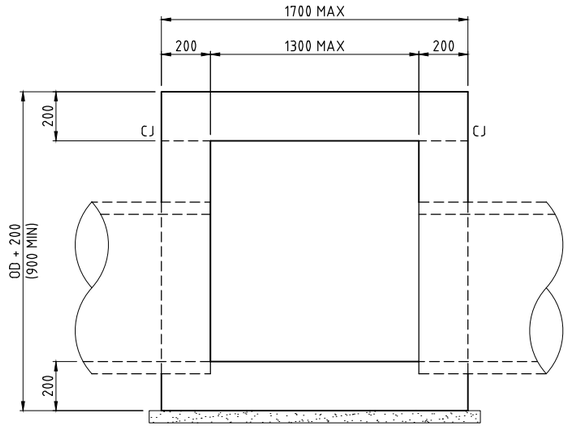
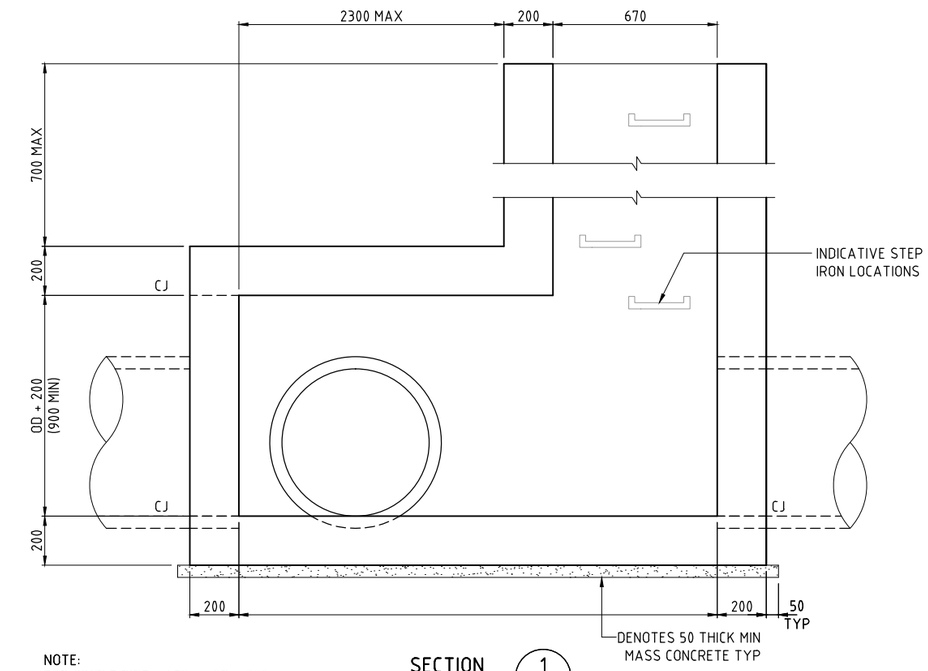


PLAN

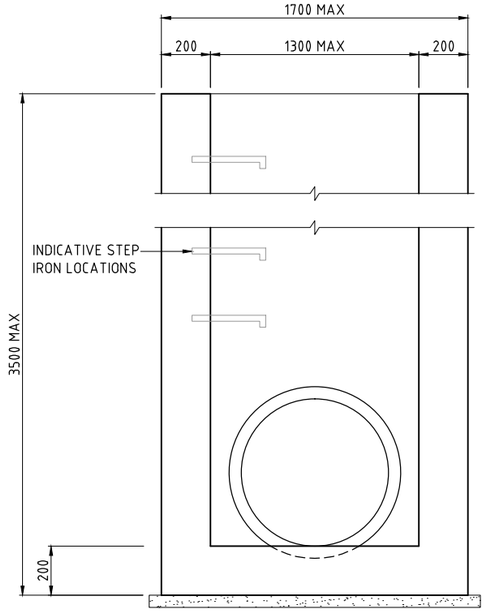


SECTION 3
SCALE 1 : 25



NOTE:
FOR SINGLE PIPE > 450 : = OD + 200
FOR MULTIPLE PIPE : = OD + (n-1) OD/2 + 200
WHERE n = NUMBER OF PIPES

SECTION 1
SCALE 1 : 25



SECTION 2
SCALE 1 : 25

GENERAL NOTES

ALL DIMENSIONS ARE IN MILLIMETRES
CONCRETE SHALL COMPLY WITH THE REQUIREMENTS OF THE RMS SPECIFICATION B80-CONCRETE WORKS FOR BRIDGE
FOR DRAINAGE PIT LAYOUT AND SETOUT DETAILS REFER TO NB00042-W010-DG-DR-1117
FOR PIT REINFORCEMENT DETAILS REFER TO NB00042-W010-DG-DR-1172
DEPTH OF PIT SHALL NOT EXCEED 3500
PITS DEEPER THAN 1200 TO BE FITTED WITH GALVANISED STEP IRONS. SEE MD.R11.B47.A
STEP IRONS TO BE FABRICATED, SUPPLIED AND LOCATED IN ACCORDANCE WITH RMS MODEL DRAWING MD.R11.B47.A.
WHERE PIPES ENTER PIT ON A SKEW OD = HORIZONTAL SKEW DIMENSION
SIDE DIMENSIONS WILL VARY WITH UNEQUAL PIPE SIZES IE SIDE DIMENSIONS DETERMINED BY LARGEST OUTSIDE PIPE DIMENSION PLUS 200.
MAXIMUM PIPE DIAMETER IS 900
MINIMUM 28 DAY COMPRESSIVE STRENGTH OF MASS CONCRETE SHALL BE 20MPa.
MINIMUM 28 DAY COMPRESSIVE STRENGTH FOR CAST-IN-SITU CONCRETE SHALL BE 40MPa.
CONCRETE EXPOSURE CLASSIFICATION B1 TO 5100.5-2004
EDGES SHALL BE CHAMFERED 20 x 20 AND RE-ENTRANT ANGLES FILLETED 20 x 20 UNLESS SPECIFIED OTHERWISE.
OD - DENOTES OUTSIDE DIAMETER

GEOTECHNICAL NOTES

PRIOR TO CONSTRUCTION OF THE CONCRETE SLAB, THE FOUNDATION CONDITIONS SHALL BE CONFIRMED ON SITE BY A QUALIFIED SITE GEOTECHNICAL ENGINEER USING THE RELEVANT TESTS AVAILABLE (EXAMPLES INCLUDE BUT NOT LIMITED TO TEST PITS / DCPTs / POCKET PENETROMETERS) AND AS DEEMED APPROPRIATE BY THE SITE GEOTECHNICAL ENGINEER
THE CONTRACTOR SHALL ENSURE THAT ANY NECESSARY FOUNDATION TREATMENT REQUIRED BY THE GEOTECHNICAL ENGINEER HAS BEEN COMPLETED PRIOR TO COMMENCING THE CONSTRUCTION OF THE CONCRETE BASE SLAB.
THE PLACING OF THE FILL SHALL BE IN ACCORDANCE WITH RMS R44 TABLE R44.9
THE DESIGN IS BASED ON A MINIMUM ALLOWABLE BEARING PRESSURE OF 150kPa AND SETTLEMENT PREDICTIONS LESS THAN 15mm.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
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A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	DG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:25 0.25 0 0.25 0.50 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
STRUCTURAL DETAILS
SPECIAL SA PIT WITH EXTENDED CHAMBER

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005516	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1171	C

DATE: 17/03/2016 11:39:06 AM LOGIN NAME: SUTHERLAND, GRANT
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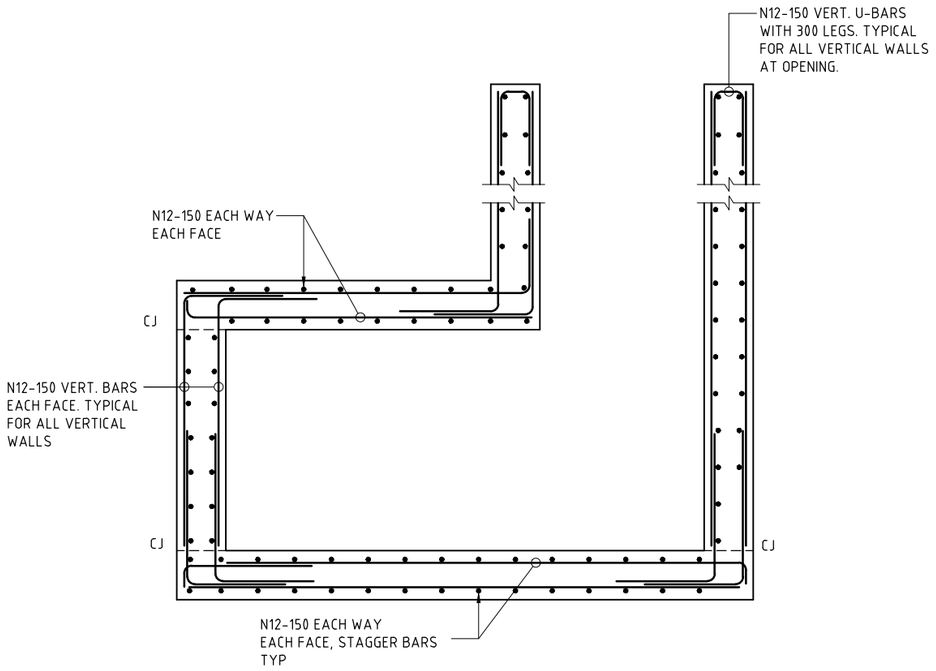
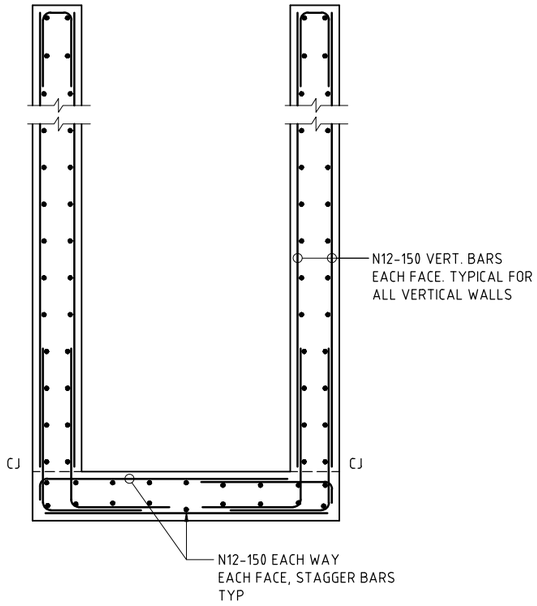
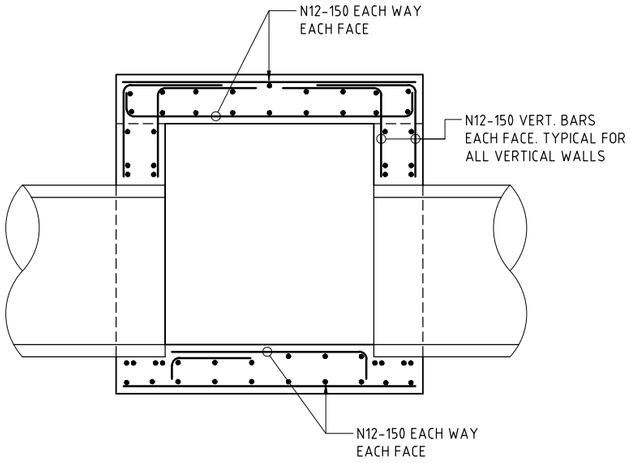


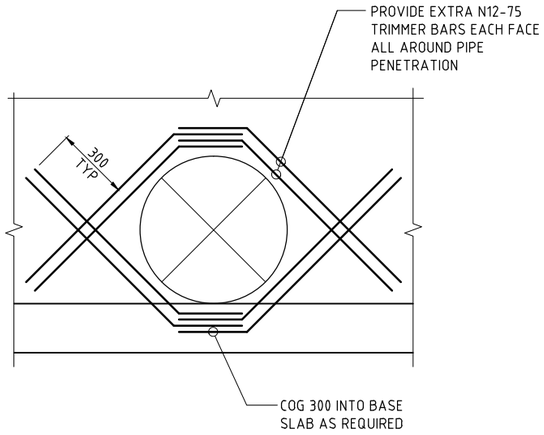
1 / - SECTION
SCALE 1 : 25



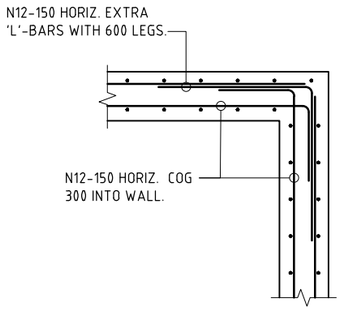
SECTION 2 / -
SCALE 1 : 25



SECTION 3 / -
SCALE 1 : 25



TYPICAL TRIMMER BARS AT PIPE PENETRATION
ELEVATION
SCALE 1:25



TYPICAL WALL CORNER DETAIL
PLAN
SCALE 1:50

GENERAL NOTES

REINFORCEMENT SHALL COMPLY WITH AS/NZS 4671 GRADE D500N (BARS)
UNLESS SPECIFIED OTHERWISE NOMINAL COVER TO REINFORCEMENT NEAREST TO THE CONCRETE SURFACE SHALL BE:
FORMED SURFACES (OR CAST ON MASS CONCRETE) = 40mm
CAST AGAINST GROUND =70mm
THE MINIMUM DEVELOPMENT LENGTHS AND LENGTHS OF LAP SPLICES SHALL BE AS FOLLOWS:

BAR SIZE	N12	N16	N20	N24	N28	N32	N36
ALL BARS	350	-	-	-	-	-	-

CJ DENOTES CONSTRUCTION JOINT.
EF DENOTES EACH FACE.
LV DENOTES LENGTH VARIES
REINFORCEMENT MAY BE DISPLACED SLIGHTLY TO CLEAR FIXINGS AND STARTER BARS.

DATE: 17/03/2016 11:39:12 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NBIP-Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-DR-1172.dwg

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 5 10 15 20 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	DG	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:25 0.25 0 0.25 0.50 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT
NSW GOVERNMENT Transport Roads & Maritime Services

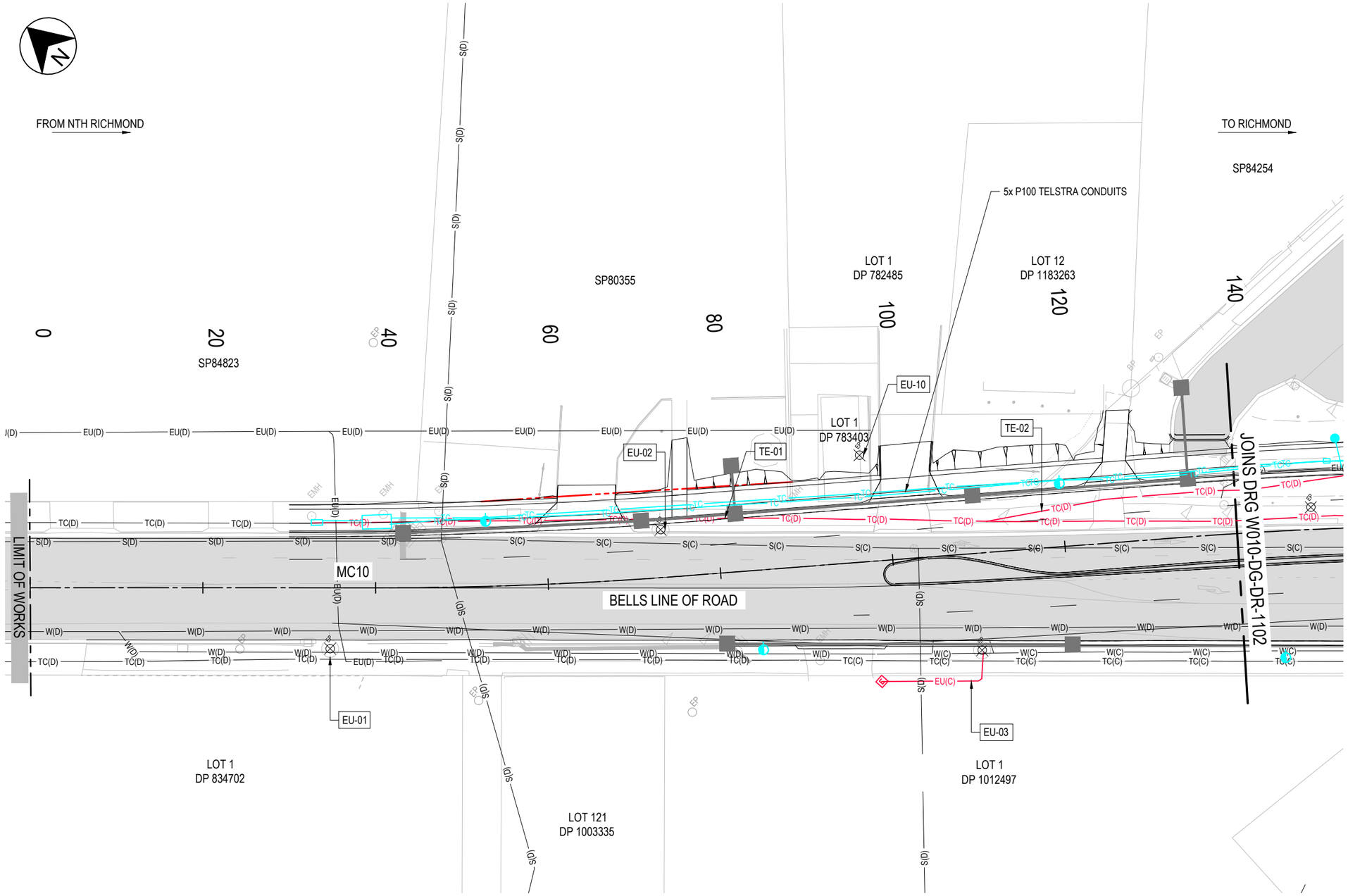
CONTRACTOR
Downermouchel

DESIGNER
JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
STRUCTURAL DETAILS
PIT REINFORCEMENT DETAIL

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005516	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-DR-1172	C



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER
- EXISTING FENCE
- PROPOSED BOUNDARY

UTILITY STATUS BY COLOUR

- EXISTING UTILITY TO PRESERVE
- EXISTING UTILITY TO ABANDON
- EXISTING UTILITY TO REMOVE
- UTILITY ADJUSTMENT

UTILITY TYPE

- EU-10 — UTILITY CONFLICT ID REFER TO DR-1141
- UTILITY TYPE (REFER LEGEND)
- EXISTING QUALITY LEVEL (REFER NOTE 2)
- TC(C) — TELEPHONE LINE (UNDERGROUND)
- W(C) — WATER MAIN
- S(D) — SEWER MAIN
- G(C) — GAS MAIN
- EU(D) — ELECTRICAL LINE (UNDERGROUND)
- TC(C) — TELECOM LINE (TELSTRA / OPTUS / NBN)
- OC(D) — OPTICAL FIBRE
- TCS(C) — TRAFFIC CONTROL SIGNAL
- SEWER MANHOLE
- EP — EXISTING POWER POLE
- COMMUNICATIONS
- TPL — TELEPHONE POLE
- WH — WATER HYDRANT
- POWER & COMMUNICATIONS POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT
- STAY CABLE AND ANCHOR
- PROPOSED COMMUNICATIONS PIT
- EXISTING POLE TO REMOVE
- E — ELECTRICAL PIT TO REMOVE
- PROPOSED TRAFFIC CONTROL SIGNAL (TCS)

DRAINAGE & WATER QUALITY

- STORMWATER PIT
- STORMWATER HEADWALL
- EXISTING STORMWATER PIPE
- NEW STORMWATER PIPE

NOTES:

1. FOR GENERAL NOTES REFER NB00042-W010-RD-DG-1003.
2. EXISTING UTILITY SPATIAL POSITION QUALITY LEVEL;
   (B) - ACCURATE TO 0.3m PLAN, 1.0m VERTICAL
   (C) - ACCURATE TO 1.0m PLAN, 1.0m VERTICAL
   (D) - SEVERAL METRES IN PLAN, NO VERTICAL (DIGITISED)
3. UTILITY LOCATION PLAN ARE INDICATIVE ONLY AND HAS BEEN DEVELOPED WITH THE EXISTING UTILITY SURVEY PROVIDED BY RMS AND DBYD PLANS.
4. OVERHEAD POWERLINES ARE NOT SHOWN FOR CLARITY.
5. UTILITY INFORMATION SHOWN ON PLANS DOES NOT DEPICT ANY MORE THAN THE PRESENCE OF A SERVICE, BASED ON AVAILABLE DOCUMENTARY EVIDENCE. THE PRESENCE OF A UTILITY SERVICE, ITS SIZE AND LOCATION SHOULD BE CONFIRMED BY FIELD INSPECTION, PRIOR TO THE COMMENCEMENT OF ROADWORKS AND THE RELEVANT UTILITY PLANS OBTAINED BY DIALLING PH 1100 OR FAX 1300652077 (DIAL BEFORE YOU DIG). CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.
6. PROPOSED ELECTRICAL LINES, POWER POLES AND LIGHT POLES SHOWN ON THIS DRAWING ARE INDICATIVE ONLY. PLEASE REFER TO APPROVED LEVEL 3 DESIGN DRAWING FOR THE FINAL DESIGN OF THE ELECTRICAL RELOCATION AND LIGHTING WORKS.
7. THE ALLOCATIONS OF UNDERGROUND UTILITIES MUST FOLLOW THE DESIGN GUIDE FROM NSW STREET OPENING CONFERENCE UNLESS NOTED OTHERWISE.
8. HOUSE CONNECTION UTILITIES ARE NOT SHOWN FOR CLARITY.
9. ALL ABANDONED SERVICES CAN BE REMOVED WHERE THESE SERVICES ARE IMPACTED BY THE PROPOSED DESIGN.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	CT
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	16.12.15	DETAIL DESIGN	CM	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

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TITLE	INITIAL	DATE
DRAFTSPERSON	CM	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
UTILITY COORDINATION PLAN
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-UT-1101	B

DATE: 17/03/2016 11:36:10 AM LOGIN NAME: SUTHERLAND, GRANT
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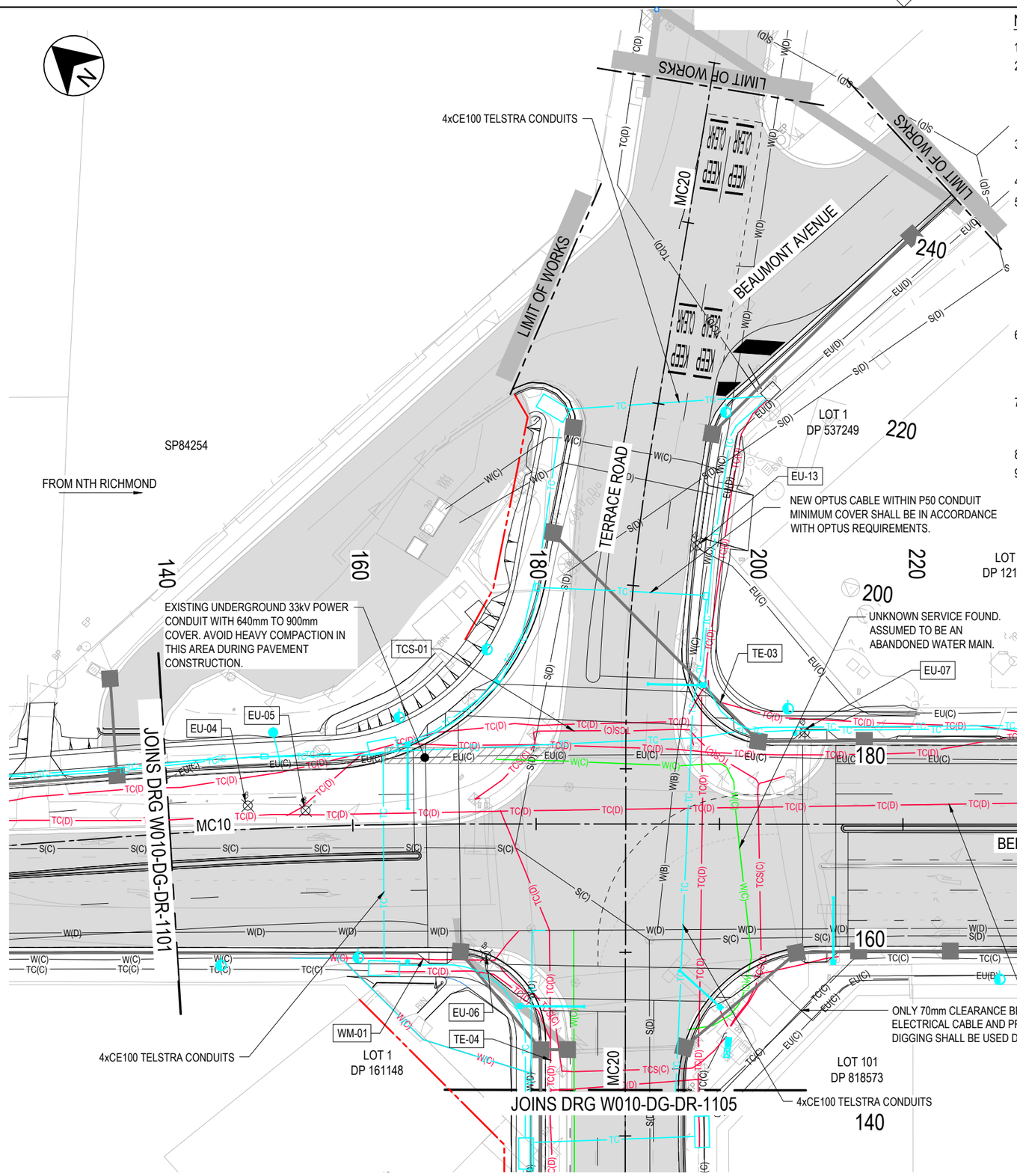

NOTES:

1. FOR GENERAL NOTES REFER NB00042-W010-RD-DG-1003.
2. EXISTING UTILITY SPATIAL POSITION QUALITY LEVEL;
   (B) - ACCURATE TO 0.3m PLAN, 1.0m VERTICAL
   (C) - ACCURATE TO 1.0m PLAN, 1.0m VERTICAL
   (D) - SEVERAL METRES IN PLAN, NO VERTICAL(DIGITISED)
3. UTILITY LOCATION PLAN ARE INDICATIVE ONLY AND HAS BEEN DEVELOPED WITH THE EXISTING UTILITY SURVEY PROVIDED BY RMS AND DBYD PLANS.
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6. PROPOSED ELECTRICAL LINES, POWER POLES AND LIGHT POLES SHOWN ON THIS DRAWING ARE INDICATIVE ONLY. PLEASE REFER TO APPROVED LEVEL 3 DESIGN DRAWING FOR THE FINAL DESIGN OF THE ELECTRICAL RELOCATION AND LIGHTING WORKS.
7. THE ALLOCATIONS OF UNDERGROUND UTILITIES MUST FOLLOW THE DESIGN GUIDE FROM NSW STREET OPENING CONFERENCE UNLESS NOTED OTHERWISE.
8. HOUSE CONNECTION UTILITIES ARE NOT SHOWN FOR CLARITY.
9. ALL ABANDONED SERVICES CAN BE REMOVED WHERE THESE SERVICES ARE IMPACTED BY THE PROPOSED DESIGN.

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER
- EXISTING FENCE
- PROPOSED BOUNDARY

UTILITY STATUS BY COLOUR

- EXISTING UTILITY TO PRESERVE
- EXISTING UTILITY TO ABANDON
- EXISTING UTILITY TO REMOVE
- UTILITY ADJUSTMENT

UTILITY TYPE

- EU-10 — UTILITY CONFLICT ID REFER TO DR-1141
- UTILITY TYPE (REFER LEGEND)
- EXISTING QUALITY LEVEL (REFER NOTE 2)
- TC(C) — TELEPHONE LINE (UNDERGROUND)
- W(C) — WATER MAIN
- S(D) — SEWER MAIN
- G(C) — GAS MAIN
- EU(D) — ELECTRICAL LINE (UNDERGROUND)
- TC(C) — TELECOM LINE (TELSTRA / OPTUS / NBN)
- OC(D) — OPTICAL FIBRE
- TCS(C) — TRAFFIC CONTROL SIGNAL
- SEWER MANHOLE
- EP — EXISTING POWER POLE
- COMMUNICATIONS
- TPL — TELEPHONE POLE
- WH — WATER HYDRANT
- POWER & COMMUNICATIONS POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT
- STAY CABLE AND ANCHOR
- PROPOSED COMMUNICATIONS PIT
- EXISTING POLE TO REMOVE
- E — ELECTRICAL PIT TO REMOVE
- PROPOSED TRAFFIC CONTROL SIGNAL (TCS)

DRAINAGE & WATER QUALITY

- STORMWATER PIT
- STORMWATER HEADWALL
- EXISTING STORMWATER PIPE
- NEW STORMWATER PIPE

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	CT
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	16.12.15	DETAIL DESIGN	CM	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	CM	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
UTILITY COORDINATION PLAN
SHEET 2

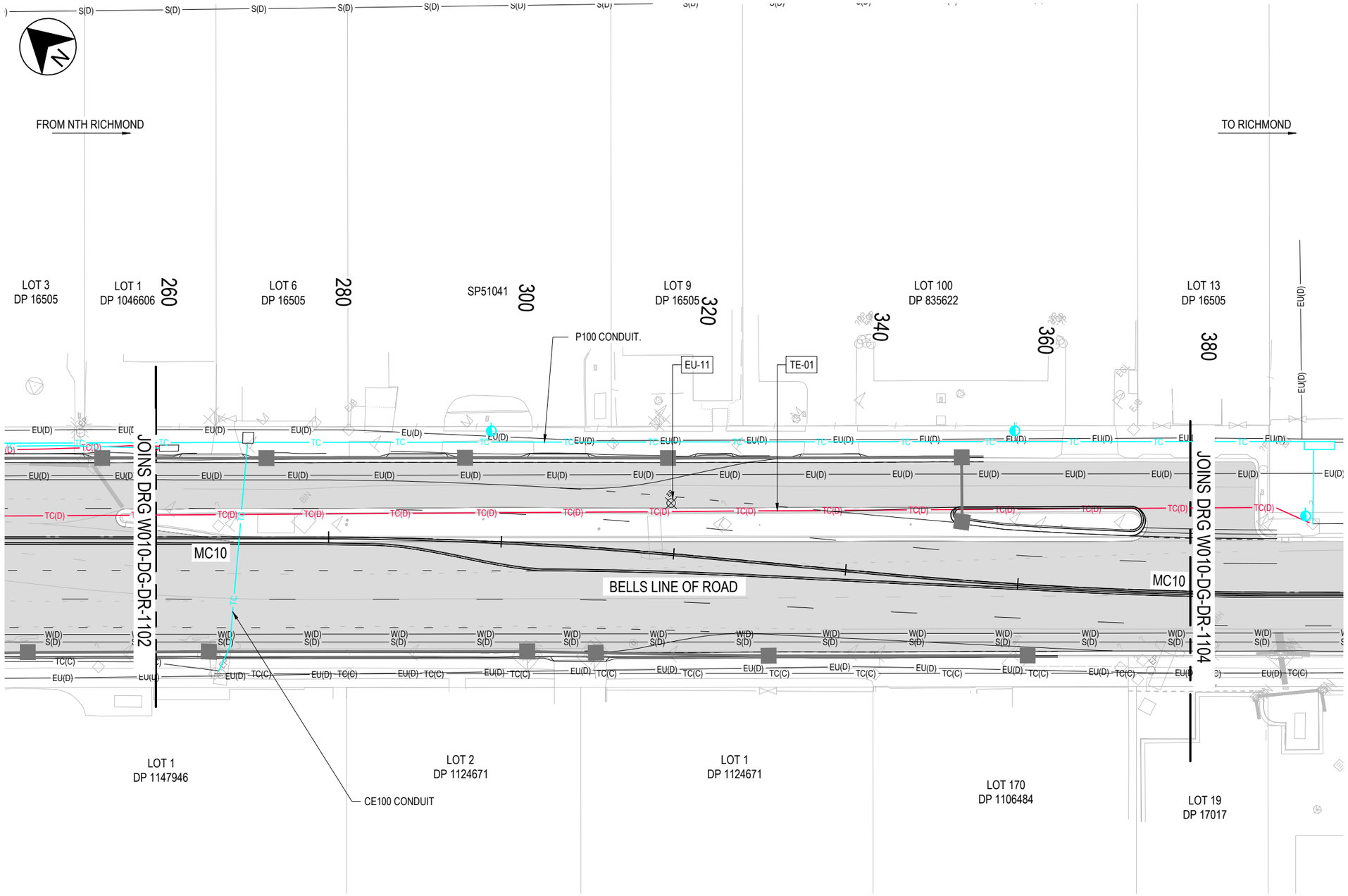
NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-UT-1102	B

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 11:36:17 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-UT-1101 - 1105.dwg



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER
- EXISTING FENCE
- PROPOSED BOUNDARY

UTILITY STATUS BY COLOUR

- EXISTING UTILITY TO PRESERVE
- EXISTING UTILITY TO ABANDON
- EXISTING UTILITY TO REMOVE
- UTILITY ADJUSTMENT

UTILITY TYPE

- EU-10 — UTILITY CONFLICT ID REFER TO DR-1141
- UTILITY TYPE (REFER LEGEND)
- EXISTING QUALITY LEVEL (REFER NOTE 2)
- TC(C) — TELEPHONE LINE (UNDERGROUND)
- W(C) — WATER MAIN
- S(D) — SEWER MAIN
- G(C) — GAS MAIN
- EU(D) — ELECTRICAL LINE (UNDERGROUND)
- TC(C) — TELECOM LINE (TELSTRA / OPTUS / NBN)
- OC(D) — OPTICAL FIBRE
- TCS(C) — TRAFFIC CONTROL SIGNAL
- SEWER MANHOLE
- EP — EXISTING POWER POLE
- COMMUNICATIONS
- TPL — TELEPHONE POLE
- WH — WATER HYDRANT
- POWER & COMMUNICATIONS POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT
- STAY CABLE AND ANCHOR
- PROPOSED COMMUNICATIONS PIT
- EXISTING POLE TO REMOVE
- E — ELECTRICAL PIT TO REMOVE
- PROPOSED TRAFFIC CONTROL SIGNAL (TCS)

DRAINAGE & WATER QUALITY

- STORMWATER PIT
- STORMWATER HEADWALL
- EXISTING STORMWATER PIPE
- NEW STORMWATER PIPE

NOTES:

1. FOR GENERAL NOTES REFER NB00042-W010-RD-DG-1003.
2. EXISTING UTILITY SPATIAL POSITION QUALITY LEVEL;
   (B) - ACCURATE TO 0.3m PLAN, 1.0m VERTICAL
   (C) - ACCURATE TO 1.0m PLAN, 1.0m VERTICAL
   (D) - SEVERAL METRES IN PLAN, NO VERTICAL (DIGITISED)
3. UTILITY LOCATION PLAN ARE INDICATIVE ONLY AND HAS BEEN DEVELOPED WITH THE EXISTING UTILITY SURVEY PROVIDED BY RMS AND DBYD PLANS.
4. OVERHEAD POWERLINES ARE NOT SHOWN FOR CLARITY.
5. UTILITY INFORMATION SHOWN ON PLANS DOES NOT DEPICT ANY MORE THAN THE PRESENCE OF A SERVICE, BASED ON AVAILABLE DOCUMENTARY EVIDENCE. THE PRESENCE OF A UTILITY SERVICE, ITS SIZE AND LOCATION SHOULD BE CONFIRMED BY FIELD INSPECTION, PRIOR TO THE COMMENCEMENT OF ROADWORKS AND THE RELEVANT UTILITY PLANS OBTAINED BY DIALLING PH 1100 OR FAX 1300652077 (DIAL BEFORE YOU DIG). CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES.
6. PROPOSED ELECTRICAL LINES, POWER POLES AND LIGHT POLES SHOWN ON THIS DRAWING ARE INDICATIVE ONLY. PLEASE REFER TO APPROVED LEVEL 3 DESIGN DRAWING FOR THE FINAL DESIGN OF THE ELECTRICAL RELOCATION AND LIGHTING WORKS.
7. THE ALLOCATIONS OF UNDERGROUND UTILITIES MUST FOLLOW THE DESIGN GUIDE FROM NSW STREET OPENING CONFERENCE UNLESS NOTED OTHERWISE.
8. HOUSE CONNECTION UTILITIES ARE NOT SHOWN FOR CLARITY.
9. ALL ABANDONED SERVICES CAN BE REMOVED WHERE THESE SERVICES ARE IMPACTED BY THE PROPOSED DESIGN.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	CT
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DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE — SCALE 1:500 — 5 0 5 10 — AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 — HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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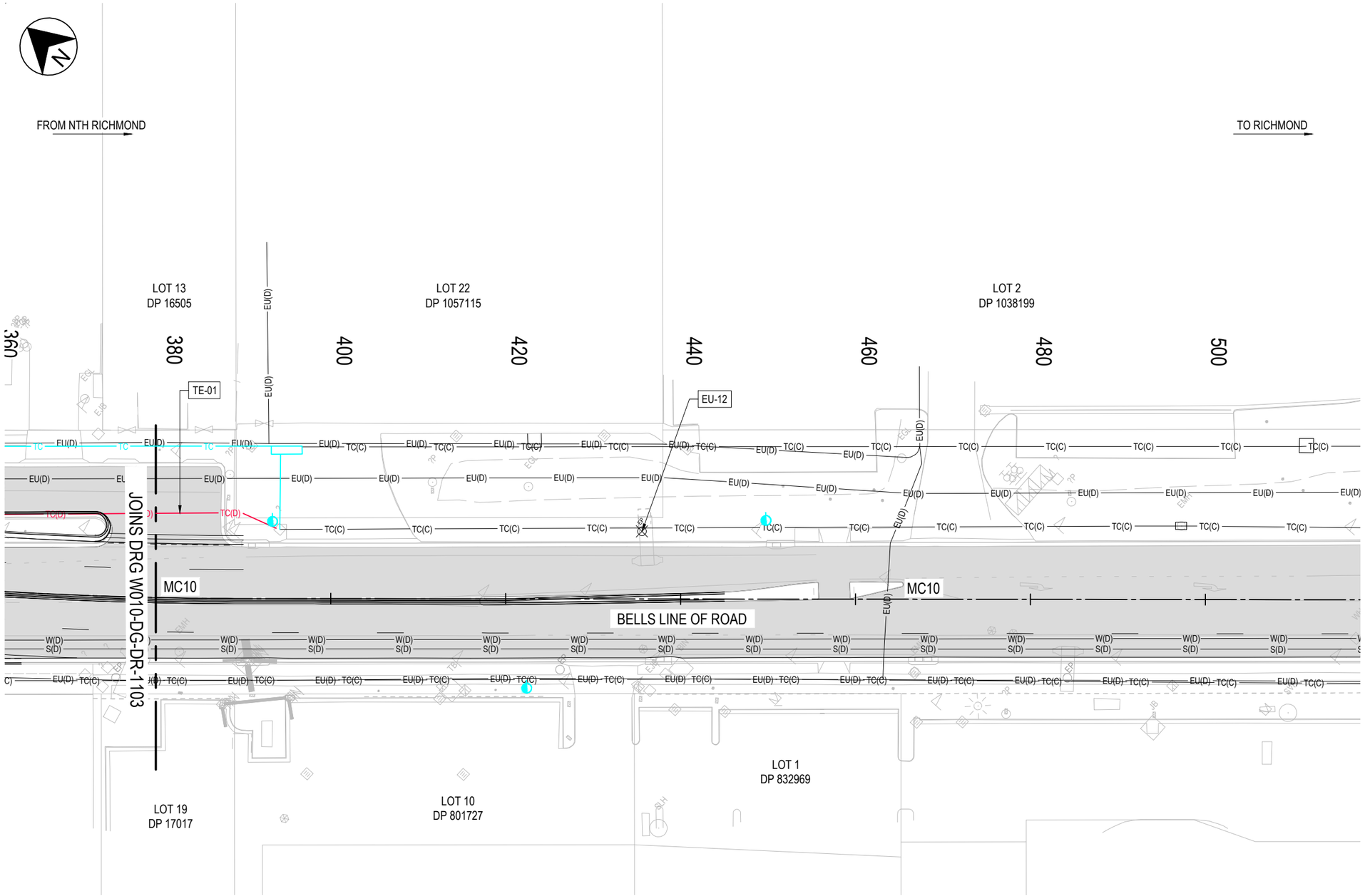
PROJECT: HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
UTILITY COORDINATION PLAN
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	B
STATUS: 80%	DRAWING No: NB00042-W010-DG-UT-1103	

0 5 10 15 20 25 mm ON A3 ORIGINAL — This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 11:36:24 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-UT-1101-105.dwg



NOTES:

1. FOR GENERAL NOTES REFER NB00042-W010-RD-DG-1003.
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LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER
- EXISTING FENCE
- PROPOSED BOUNDARY

UTILITY STATUS BY COLOUR

- EXISTING UTILITY TO PRESERVE
- EXISTING UTILITY TO ABANDON
- EXISTING UTILITY TO REMOVE
- UTILITY ADJUSTMENT

UTILITY TYPE

- EU-10 — UTILITY CONFLICT ID REFER TO DR-1141
- UTILITY TYPE (REFER LEGEND)
- EXISTING QUALITY LEVEL (REFER NOTE 2)
- TC(C) — TELEPHONE LINE (UNDERGROUND)
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- S(D) — SEWER MAIN
- G(C) — GAS MAIN
- EU(D) — ELECTRICAL LINE (UNDERGROUND)
- TC(C) — TELECOM LINE (TELSTRA / OPTUS / NBN)
- OC(D) — OPTICAL FIBRE
- TCS(C) — TRAFFIC CONTROL SIGNAL
- SEWER MANHOLE
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- TPL — TELEPHONE POLE
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- POWER & COMMUNICATIONS POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT
- STAY CABLE AND ANCHOR
- PROPOSED COMMUNICATIONS PIT
- EXISTING POLE TO REMOVE
- E — ELECTRICAL PIT TO REMOVE
- PROPOSED TRAFFIC CONTROL SIGNAL (TCS)

DRAINAGE & WATER QUALITY

- STORMWATER PIT
- STORMWATER HEADWALL
- EXISTING STORMWATER PIPE
- NEW STORMWATER PIPE

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	CT
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
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A	16.12.15	DETAIL DESIGN	CM	BDP	CT

	TITLE	INITIAL	DATE
DRAFTSPERSON		CM	18.03.16
DRAFTING CHECK		SG	18.03.16
DESIGNER		PD	18.03.16
DESIGN CHECK		DV	18.03.16
PACKAGE MANAGER		BDP	18.03.16
PROJECT MANAGER		DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

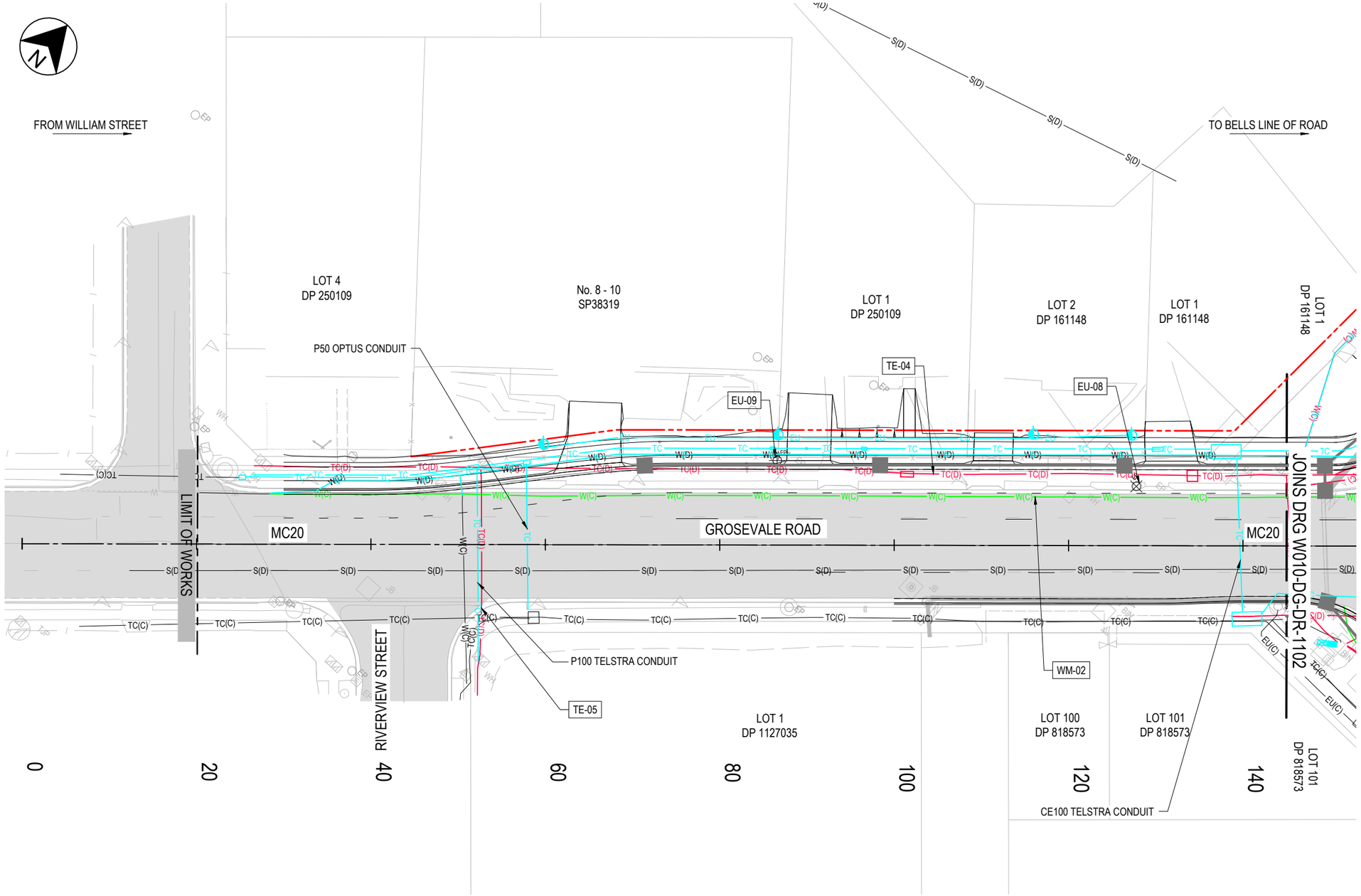
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
UTILITY COORDINATION PLAN
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-UT-1104	B

0 5 10 15 20 25 mm ON A3 ORIGINAL
This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 11:36:31 AM
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-UT-1101-1105.dwg
LOGIN NAME: SUTHERLAND, GRANT



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
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DRAINAGE & WATER QUALITY

- STORMWATER PIT
- STORMWATER HEADWALL
- EXISTING STORMWATER PIPE
- NEW STORMWATER PIPE

NOTES:

1. FOR GENERAL NOTES REFER NB00042-W010-RD-DG-1003.
2. EXISTING UTILITY SPATIAL POSITION QUALITY LEVEL;
   (B) - ACCURATE TO 0.3m PLAN, 1.0m VERTICAL
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8. HOUSE CONNECTION UTILITIES ARE NOT SHOWN FOR CLARITY.
9. ALL ABANDONED SERVICES CAN BE REMOVED WHERE THESE SERVICES ARE IMPACTED BY THE PROPOSED DESIGN.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	CT
C	20.10.15	DETAIL DESIGN	SG	BDP	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	DB
A	16.12.15	DETAIL DESIGN	CM	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	CM	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	PD	18.03.16
DESIGN CHECK	DV	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
UTILITY COORDINATION PLAN
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-UT-1105	B

DATE: 17/03/2016 11:36:38 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwgs\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-UT-1101-1105.dwg

FROM NTH RICHMOND

TO RICHMOND

SP84254

SP80355

SP84823

LOT 1
DP 782485

LOT 12
DP 1183263

LOT 1
DP 783403

0 20 40 60 80 100 120 140

TIE IN WITH EXISTING FOOTPATH

LIMIT OF WORKS

JOINS DRG W010-DG-PV-1102

BELLS LINE OF ROAD

MC10

KA10

KF00

KF1D

KF1E

KA14.A

D2 1115

D4 1116

D5 1116

D11 1117

P1 1118

LOT 1
DP 834702

LOT 121
DP 1003335

LOT 120
DP 1003335

LOT 1
DP 1012497

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER

PAVEMENTS AND KERBS

- PAVEMENT TYPE 1 - WIDENING PAVEMENT
- PAVEMENT TYPE 2 - LEVEL CORRECTION
- PAVEMENT TYPE 3 - HEAVY PATCH
- PAVEMENT TYPE 4 - RAISED MEDIAN
- PAVEMENT TYPE 5 - FOOTPATH
- PAVEMENT TYPE 6 - RESIDENTIAL DRIVEWAY
- PAVEMENT TYPE 7 - COMMERCIAL DRIVEWAY
- (1) PAVEMENT TYPE LABEL (REFER NB00042-W010-DG-PV-1111)
- DX - PAVEMENT EDGE DETAIL (REFER NB00042-W010-DG-PV-1115-1116)
- PX - PAVEMENT INTERFACE DETAIL (REFER NB00042-W010-DG-PV-1117)
- KXXX — KERB AND GUTTER LABEL (REFER NB00042-W010-DG-PV-1130)
- KERB AND GUTTER STRING START/END (REFER NB00042-W010-DG-PV-1130)

SUBSURFACE DRAINAGE

- TRENCH DRAIN
- NO FINE CONCRETE BOX DRAIN
- CARRIER PIPE
- STORMWATER PIT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. FOR VEHICULAR CROSSING DETAILS REFER RMS MODEL DRAWING MD.R15.A08.B.
3. FOR KERB RAMP DETAILS REFER RMS MODEL DRAWING MD.R173.B01.A.1 (SHEETS 1 TO 3).
4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
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AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PLAN
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-PV-1101	E

0 5 10 15 20 25 mm ON A3 ORIGINAL This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 11:24:34 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1101-1102.dwg

FROM NTH RICHMOND

TO RICHMOND

LIMIT OF WORKS

LIMIT OF WORKS

LIMIT OF WORKS

BEAUMONT AVENUE

TERRACE ROAD

JOINS DRG W010-DG-PV-1101

JOINS DRG W010-DG-PV-1103

JOINS DRG W010-DG-PV-1106

BELLS LINE OF ROAD

SP84254

LOT 1 DP 537249

LOT 1 DP 121999

LOT 3 DP 16505

LOT 1 DP 1046606

LOT 6 DP 16505

LOT 1 DP 161148

LOT 101 DP 818573

LOT 1 DP 1147946

TIE IN WITH EXISTING FOOTPATH

TIE IN WITH EXISTING FOOTPATH

REFER NOTE 5

MC20

MC10

MC10

MC20

KA10 KA11 KA12 KA13 KA13.A KA14 KA14.A KA17 KA20 KA21 KA22 KA23

KF1D KF1E KF1F KF1G KF18 KF19

P1 1118

P2 1118

P2 1118

P3 1118

P3 1118

D1 1115

D2 1115

D2 1115

D4 1115

D4 1115

D5 1116

D5 1116

D5 1116

D10 1116

D11 1117

D11 1117

D12 1117

140 160 180 200 220 240 260

200 220 240 180 160 140

LEGEND

REFERENCE ONLY

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- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER

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- PX - PAVEMENT INTERFACE DETAIL (REFER NB00042-W010-DG-PV-1117)
- KXXX — KERB AND GUTTER LABEL (REFER NB00042-W010-DG-PV-1130)
- KERB AND GUTTER STRING START/END (REFER NB00042-W010-DG-PV-1130)

SUBSURFACE DRAINAGE

- TRENCH DRAIN
- NO FINE CONCRETE BOX DRAIN
- CARRIER PIPE
- STORMWATER PIT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. FOR VEHICULAR CROSSING DETAILS REFER RMS MODEL DRAWING MD.R15.A08.B.
3. FOR KERB RAMP DETAILS REFER RMS MODEL DRAWING MD.R173.B01.A.1 (SHEETS 1 TO 3).
4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.
5. ONLY 640mm TO 900mm COVER ON TOP OF THE EXISTING UNDERGROUND 33kV POWER LINE WITH CONCRETE ENCASEMENT. PLEASE AVOID USING HEAVY COMPACTION IN THIS HATCH AREA DURING PAVEMENT CONSTRUCTION.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 (5 0 5 10) AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

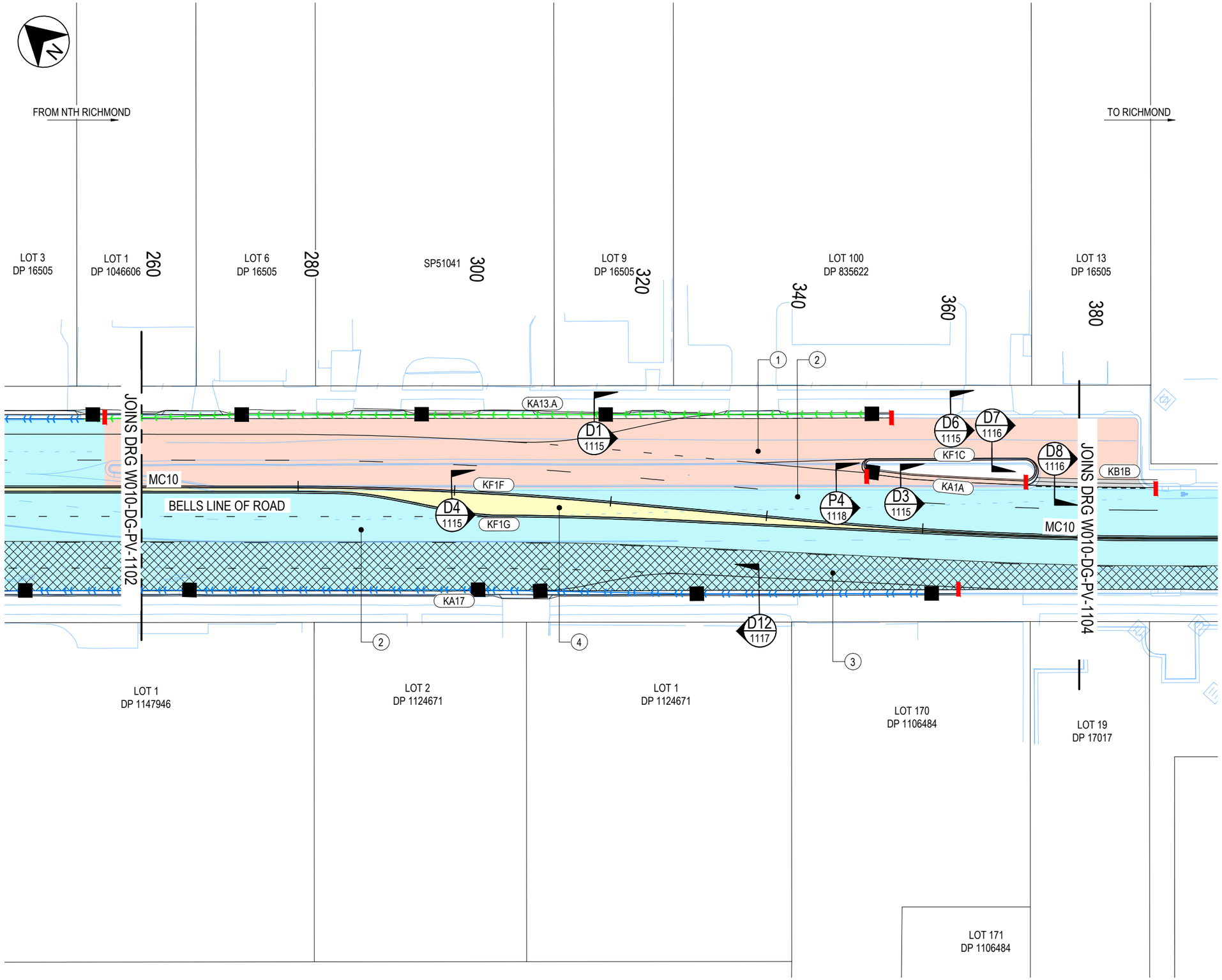
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PLAN
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1102	E

0 5 10 15 20 25 mm ON A3 ORIGINAL

DATE: 17/03/2016 11:24:40 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1101 - 1106.dwg



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER

PAVEMENTS AND KERBS

- PAVEMENT TYPE 1 - WIDENING PAVEMENT
- PAVEMENT TYPE 2 - LEVEL CORRECTION
- PAVEMENT TYPE 3 - HEAVY PATCH
- PAVEMENT TYPE 4 - RAISED MEDIAN
- PAVEMENT TYPE 5 - FOOTPATH
- PAVEMENT TYPE 6 - RESIDENTIAL DRIVEWAY
- PAVEMENT TYPE 7 - COMMERCIAL DRIVEWAY
- (1) — PAVEMENT TYPE LABEL (REFER NB00042-W010-DG-PV-1111)
- DX - PAVEMENT EDGE DETAIL (REFER NB00042-W010-DG-PV-1115-1116)
- PX - PAVEMENT INTERFACE DETAIL (REFER NB00042-W010-DG-PV-1117)
- KXXX — KERB AND GUTTER LABEL (REFER NB00042-W010-DG-PV-1130)
- KERB AND GUTTER STRING START/END (REFER NB00042-W010-DG-PV-1130)

SUBSURFACE DRAINAGE

- TRENCH DRAIN
- NO FINE CONCRETE BOX DRAIN
- CARRIER PIPE
- STORMWATER PIT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. FOR VEHICULAR CROSSING DETAILS REFER RMS MODEL DRAWING MD.R15.A08.B.
3. FOR KERB RAMP DETAILS REFER RMS MODEL DRAWING MD.R173.B01.A.1 (SHEETS 1 TO 3).
4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 (5 0 5 10) AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PLAN
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1103	E

DATE: 17/03/2016 11:24:46 AM LOGIN NAME: SUTHERLAND, GRANT
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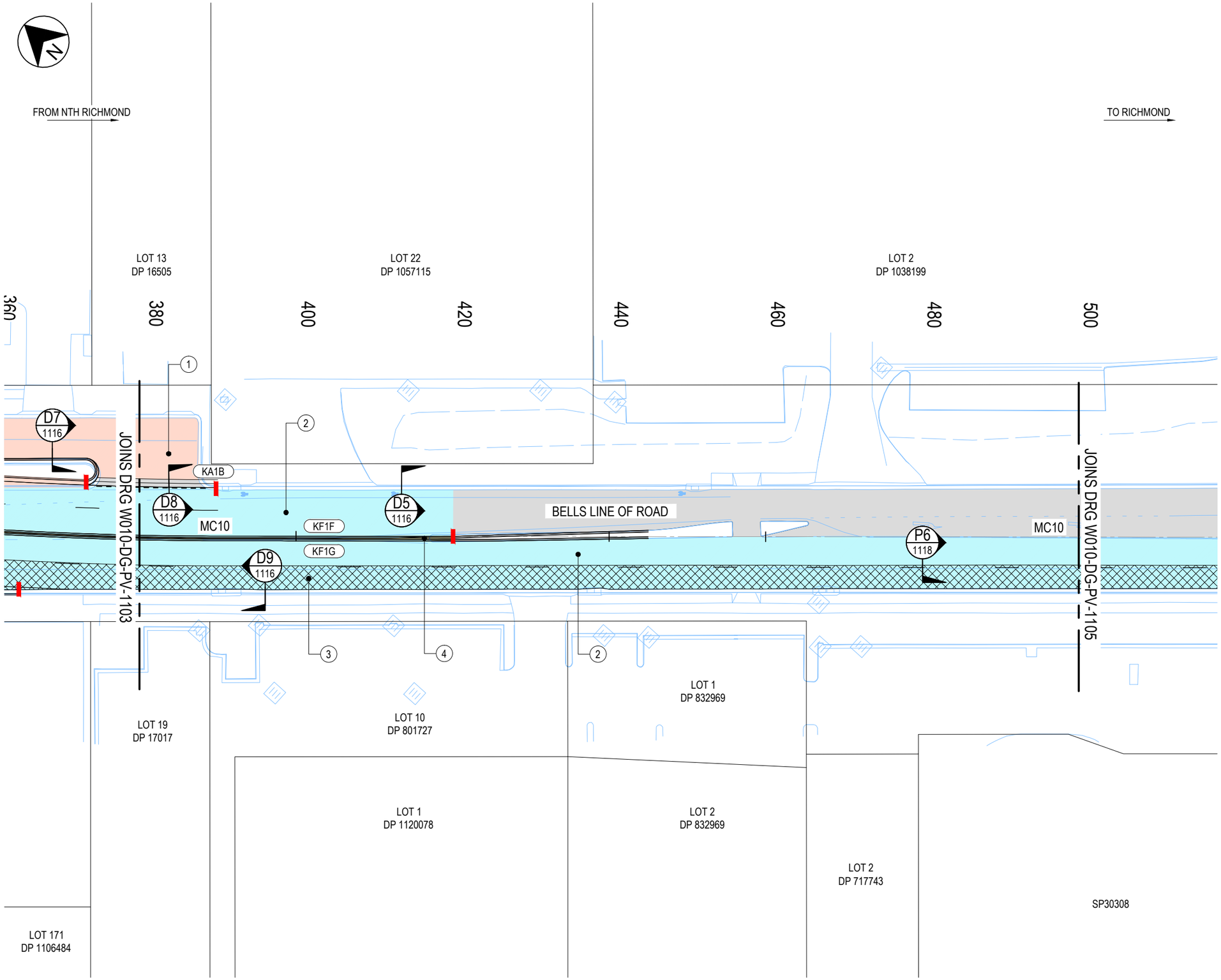

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER

PAVEMENTS AND KERBS

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- PX - PAVEMENT INTERFACE DETAIL (REFER NB00042-W010-DG-PV-1117)
- KXXX — KERB AND GUTTER LABEL (REFER NB00042-W010-DG-PV-1130)
- KERB AND GUTTER STRING START/END (REFER NB00042-W010-DG-PV-1130)

SUBSURFACE DRAINAGE

- TRENCH DRAIN
- NO FINE CONCRETE BOX DRAIN
- CARRIER PIPE
- STORMWATER PIT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
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4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

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TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 — 5 0 5 10 — AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PLAN
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-PV-1104	E

DATE: 17/03/2016 11:24:52 AM
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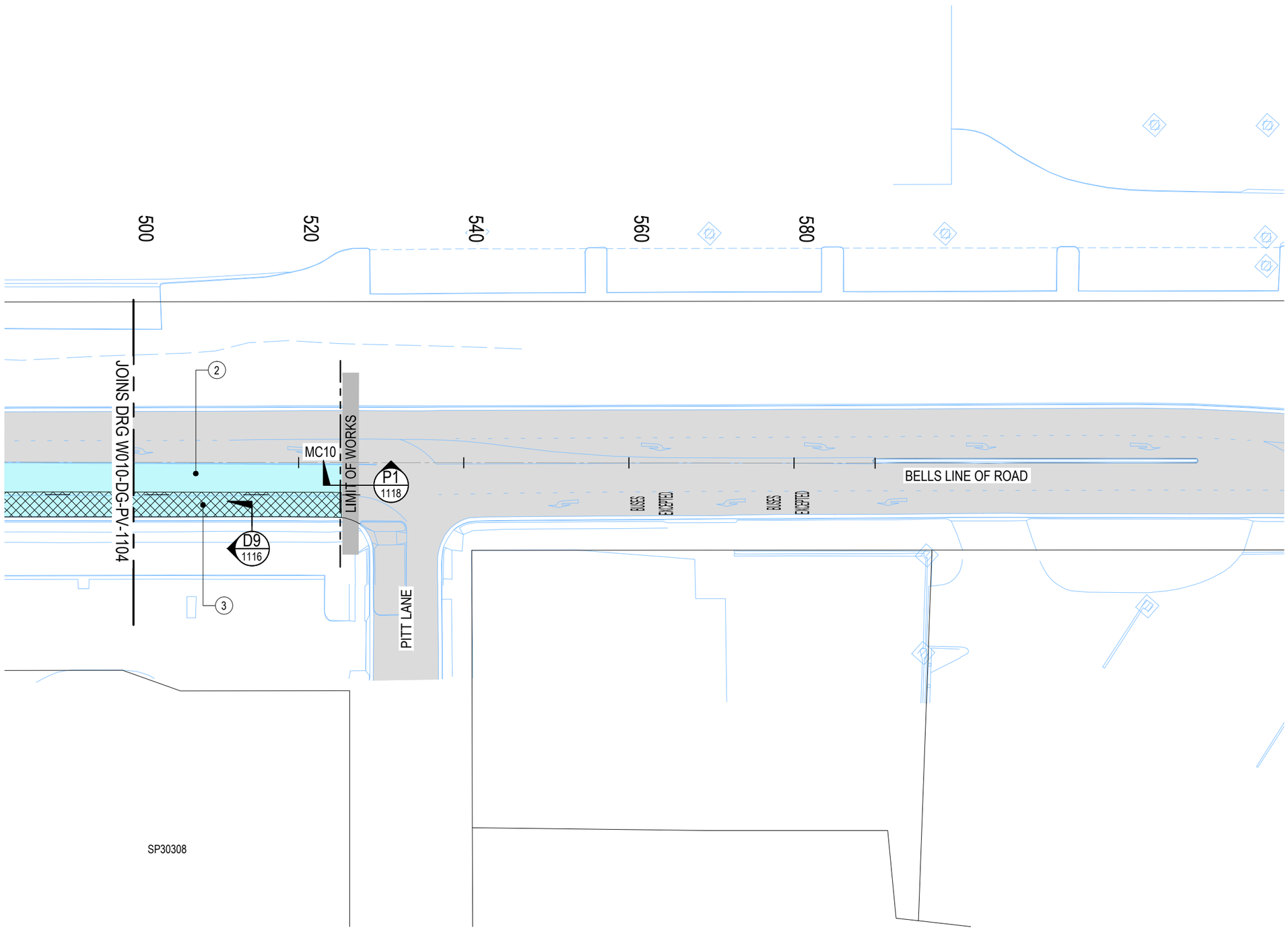

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER

PAVEMENTS AND KERBS

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- KERB AND GUTTER STRING START/END (REFER NB00042-W010-DG-PV-1130)

SUBSURFACE DRAINAGE

- TRENCH DRAIN
- NO FINE CONCRETE BOX DRAIN
- CARRIER PIPE
- STORMWATER PIT

NOTES

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
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4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PLAN
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1105	E

0 5 10 15 20 25 mm ON A3 ORIGINAL

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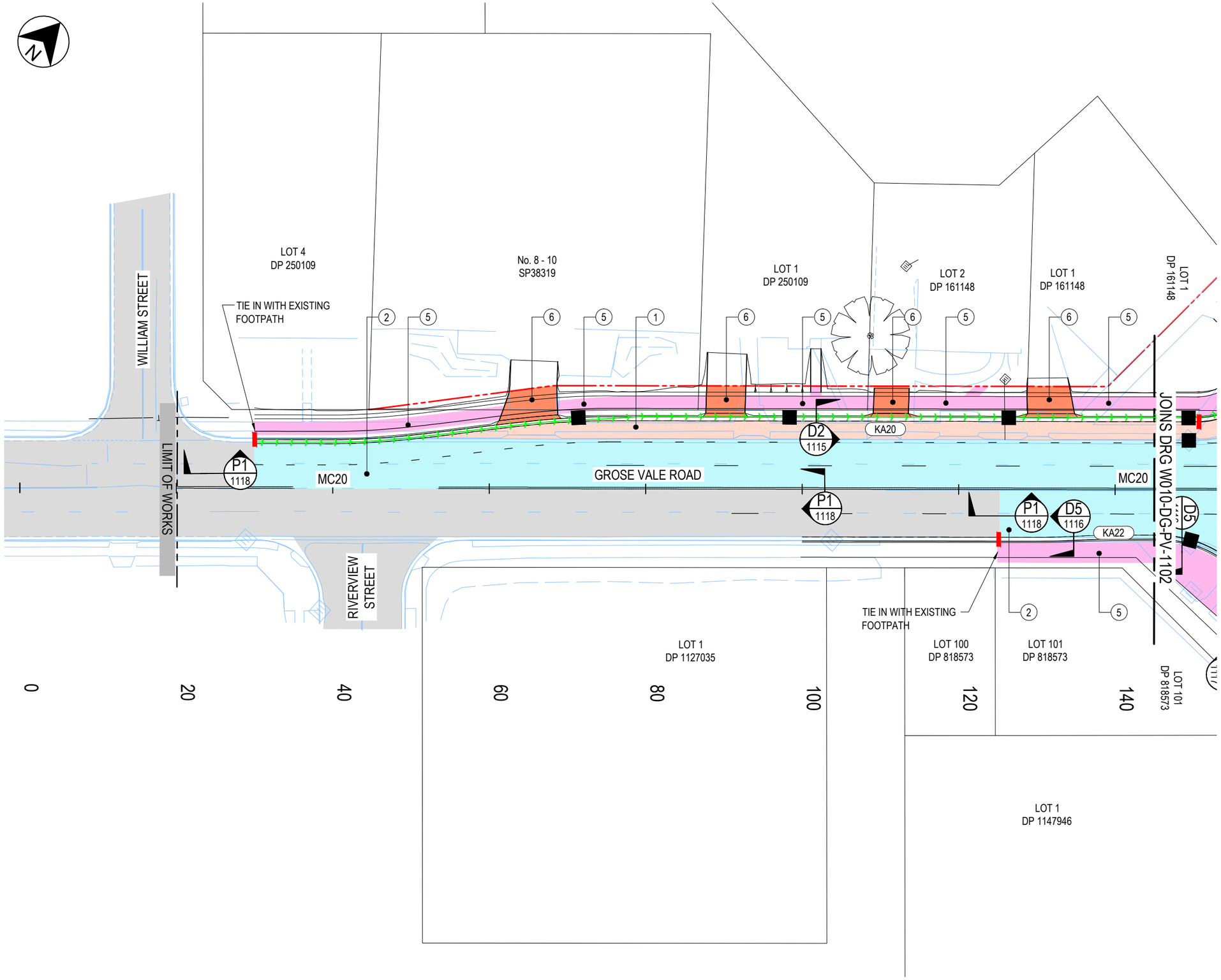

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- LOT 1 — CADASTRAL LOT NUMBER
- DP 782485 — DEPOSITED PLAN NUMBER

PAVEMENTS AND KERBS

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- PX - PAVEMENT INTERFACE DETAIL (REFER NB00042-W010-DG-PV-1117)
- KXXX — KERB AND GUTTER LABEL (REFER NB00042-W010-DG-PV-1130)
- KERB AND GUTTER STRING START/END (REFER NB00042-W010-DG-PV-1130)

SUBSURFACE DRAINAGE

- TRENCH DRAIN
- NO FINE CONCRETE BOX DRAIN
- CARRIER PIPE
- STORMWATER PIT

NOTES

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4. FOR LANDSCAPE DETAILS REFER DRAWING NB00042-W010-DG-LS-1001-1004.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PLAN
SHEET 6

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-PV-1106	E

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This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 11:25:04 AM LOGIN NAME: SUTHERLAND, GRANT
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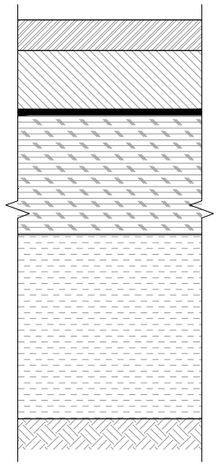


50mm DGA AC14 (AR450)

100mm DGA AC20 (AR450)

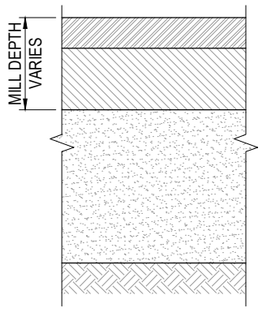
7mm LOW CUTTER

200mm DGB20

300mm SELECTED MATERIAL ZONE (CBR ≥ 30%)

SUBGRADE (CBR ≥ 3%)

PAVEMENT TYPE 1
WIDENING PAVEMENT



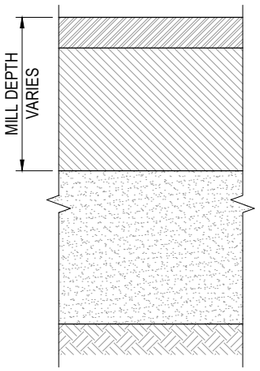
50mm DGA AC14 (AR450)
TO SUIT NEW LEVELS

60-283mm DGA AC20 (AR450)
WHERE REQUIRED (REFER NOTE 2)

EXISTING PAVEMENT

SUBGRADE

PAVEMENT TYPE 2
LEVEL CORRECTION



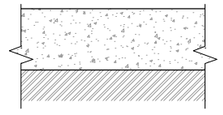
50mm DGA AC14 (AR450)
TO SUIT NEW LEVEL

150mm DGA AC20 (AR450)

EXISTING PAVEMENT

SUBGRADE

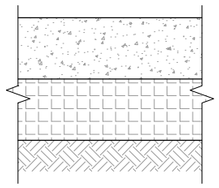
PAVEMENT TYPE 3
HEAVY PATCH



130mm 20MPa CONCRETE

ASPHALT

PAVEMENT TYPE 4
RAISED MEDIAN

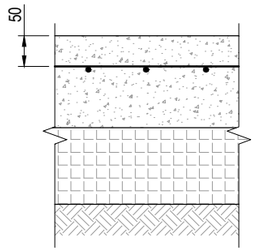


100mm 20MPa CONCRETE

100mm DGS20

SUBGRADE

PAVEMENT TYPE 5
FOOTPATH

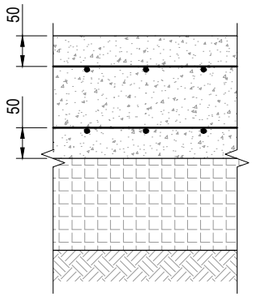


150mm 25MPa CONCRETE WITH SL72 MESH (50mm COVER)

125mm DGS20

SUBGRADE

PAVEMENT TYPE 6
RESIDENTIAL DRIVEWAY



200mm 32MPa CONCRETE WITH SL82 MESH (50mm COVER TOP AND BOTTOM)

150mm DGS20

SUBGRADE

PAVEMENT TYPE 7
COMMERCIAL DRIVEWAY

NOTES:

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. INTRODUCE AC20 CORRECTION COURSE WHEN DESIGN SURFACE LEVEL IS GREATER THAN 50 MILLIMETRES ABOVE EXISTING SURFACE LEVEL.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
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A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:10 0.1 0 0.1 0.2 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT PROFILES

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1111	E

0 5 10 15 20 25 mm ON A3 ORIGINAL
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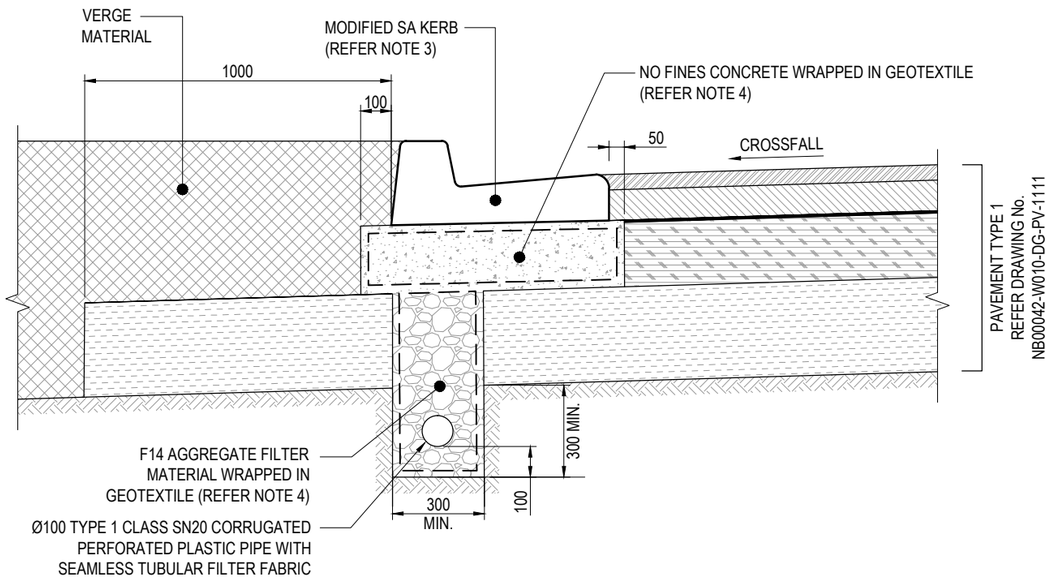
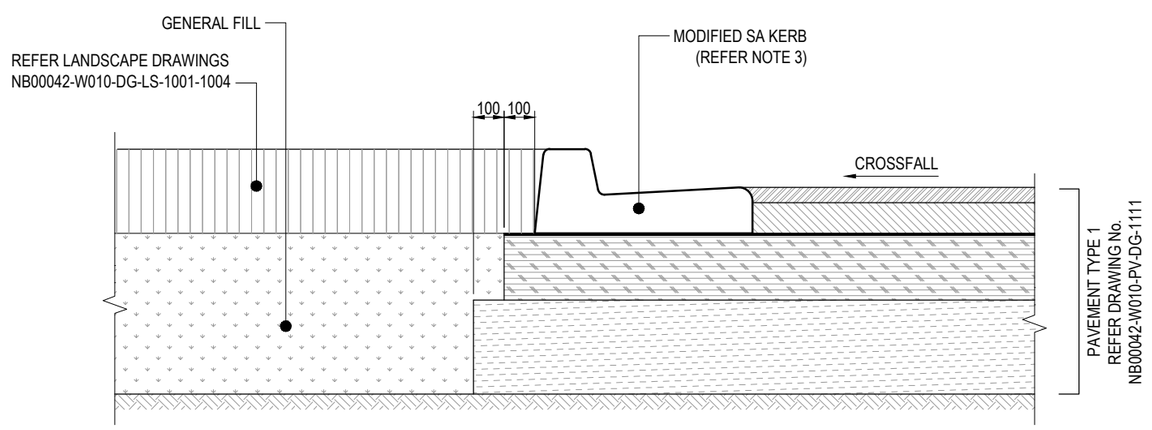
DATE: 17/03/2016 11:25:44 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1(30).dwg



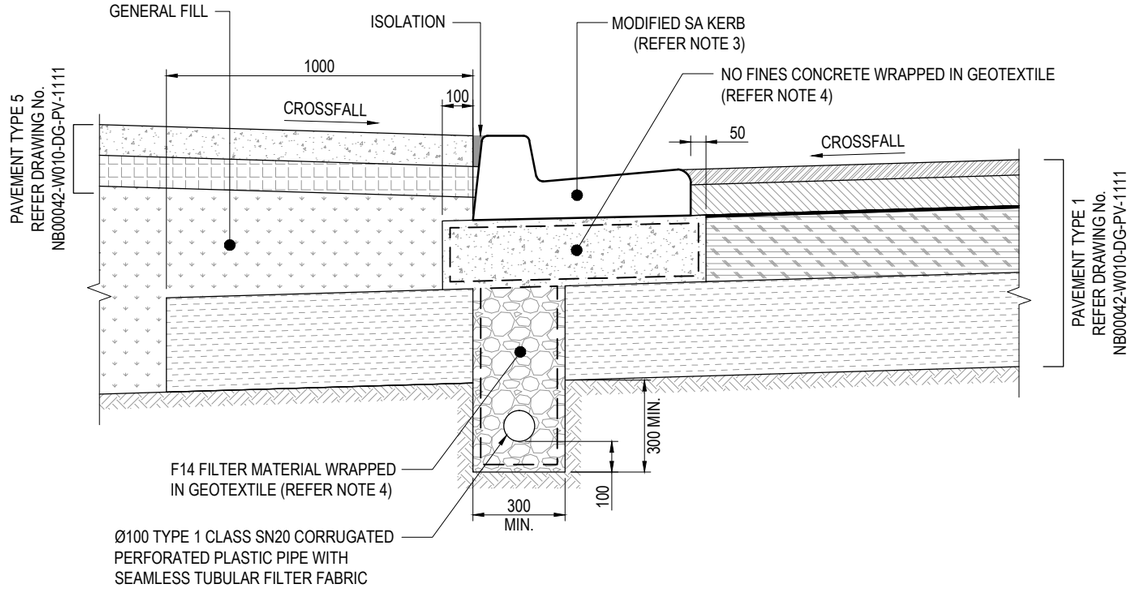
TYPICAL TRENCH DRAIN UNDER LOW MODIFIED SA KERB ON TYPE 1 PAVEMENT

DETAIL D1 (SCALE 1:20)



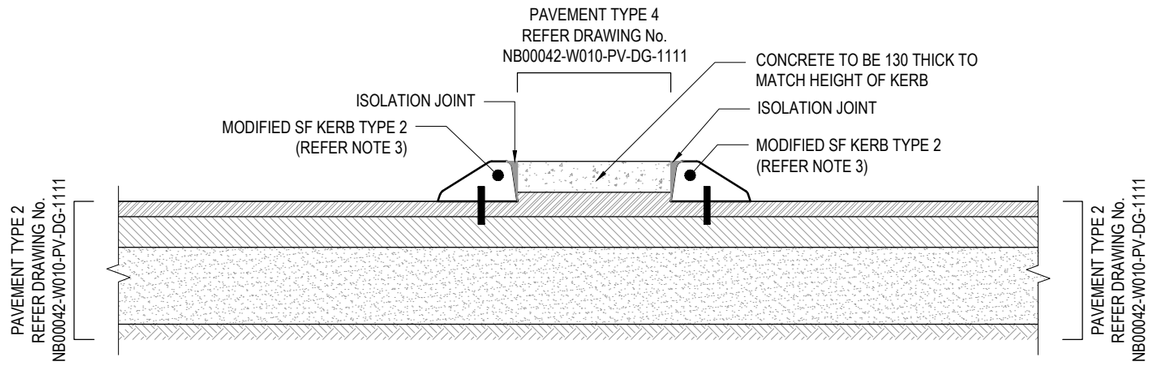
TYPICAL MODIFIED SA KERB ON TYPE 1 PAVEMENT WITH LANDSCAPE ZONE

DETAIL D3 (SCALE 1:20)



TYPICAL TRENCH DRAIN UNDER LOW MODIFIED SA KERB ON TYPE 1 PAVEMENT WITH FOOTPATH

DETAIL D2 (SCALE 1:20)



TYPICAL MODIFIED SF KERB ON TYPE 2 PAVEMENT WITH RAISED MEDIAN

DETAIL D4 (SCALE 1:20)

NOTES:

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. FOR MODIFIED KERB DETAILS REFER DRAWING NB00042-W010-DG-PV-1130.
4. GEOTEXTILE TO BE WRAPPED OUTSIDE NO FINES CONCRETE AND FILTER MATERIAL.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	03.04.15	DETAIL DESIGN	SWH	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:20 0.2 0 0.2 0.4 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

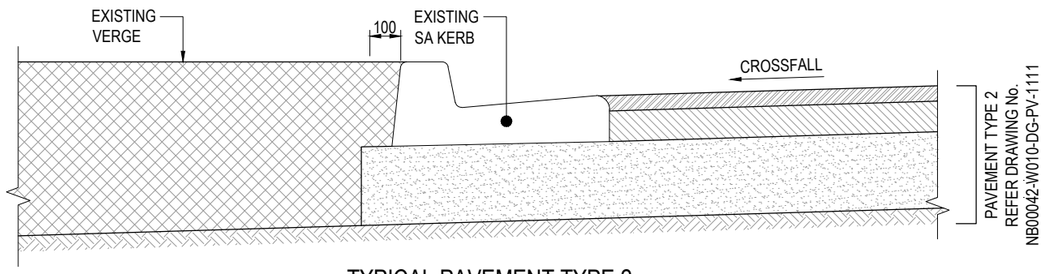
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
EDGE DETAILS
SHEET 1

NOT FOR CONSTRUCTION

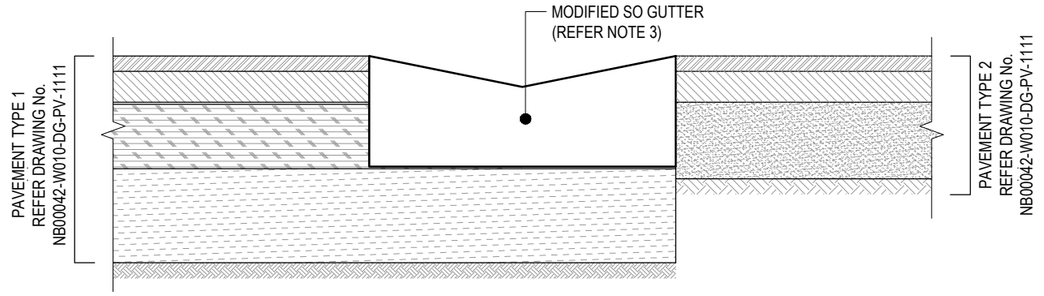
PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1115	E

DATE: 17/03/2016 11:25:50 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1130.dwg



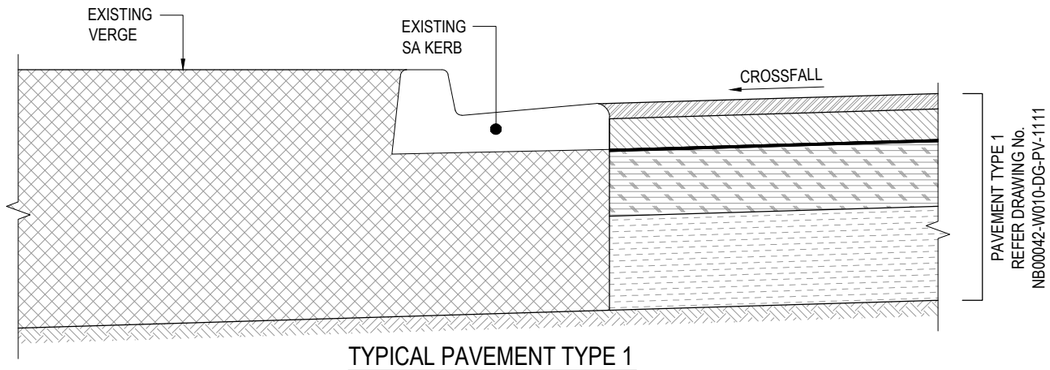
TYPICAL PAVEMENT TYPE 2
TIE-IN TO EXISTING SA KERB

DETAIL D5
SCALE 1:20 -



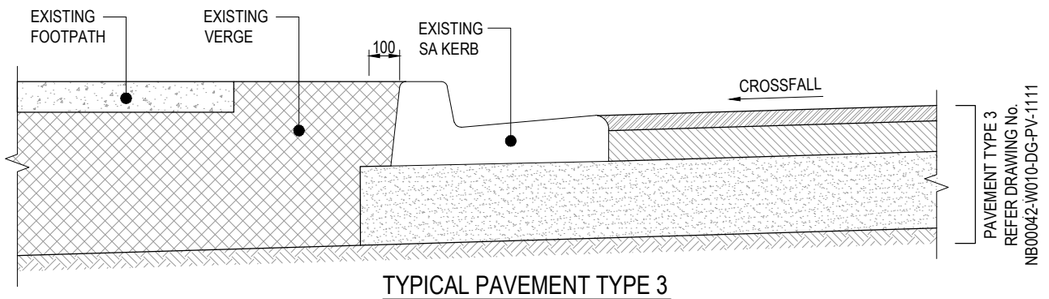
TYPICAL MODIFIED SO GUTTER ON
TYPE 1 PAVEMENT

DETAIL D8
SCALE 1:20 -



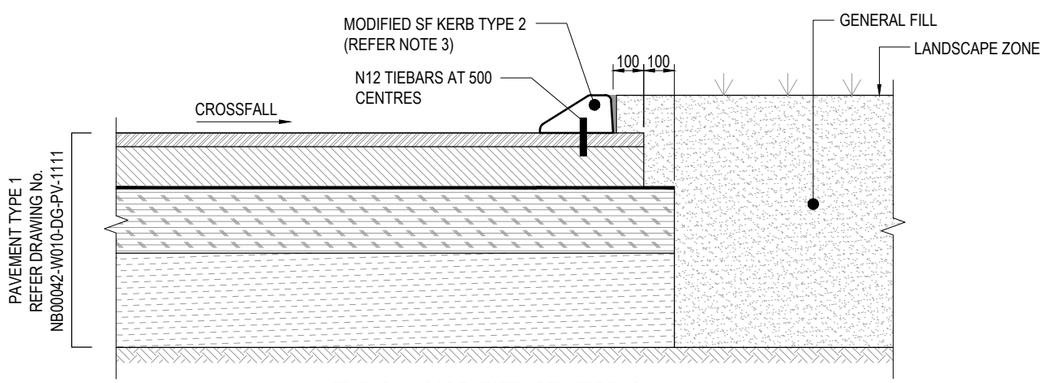
TYPICAL PAVEMENT TYPE 1
TIE-IN TO EXISTING SA KERB

DETAIL D6
SCALE 1:20 -



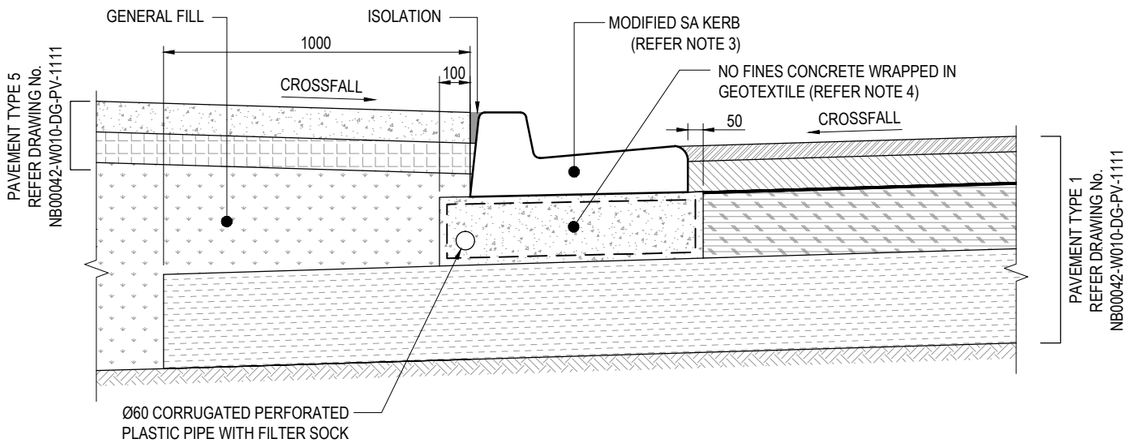
TYPICAL PAVEMENT TYPE 3
TIE-IN TO EXISTING KERB

DETAIL D9
SCALE 1:20 -



TYPICAL MODIFIED SF KERB ON
TYPE 1 PAVEMENT WITH LANDSCAPE ZONE

DETAIL D7
SCALE 1:20 -



TYPICAL EDGE DRAIN UNDER LOW MODIFIED SA
KERB ON TYPE 1 PAVEMENT WITH FOOTPATH

DETAIL D10
SCALE 1:20 -

NOTES:

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. FOR MODIFIED KERB DETAILS REFER DRAWING NB00042-W010-DG-PV-1130.
4. GEOTEXTILE TO BE WRAPPED OUTSIDE NO FINES CONCRETE AND FILTER MATERIAL.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	SM	DB
A	13.07.15	DETAIL DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:20 0.2 0 0.2 0.4 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

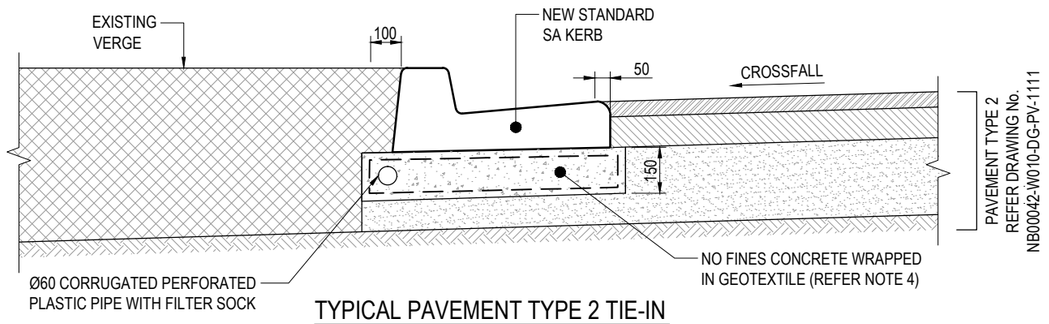
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
EDGE DETAILS
SHEET 2

NOT FOR CONSTRUCTION

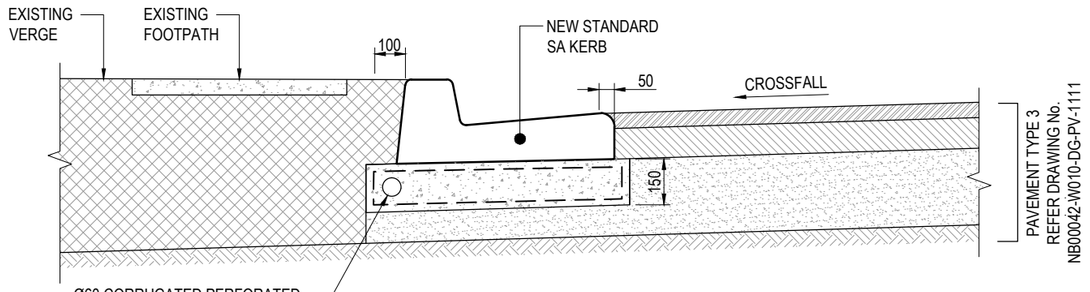
PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1116	C

DATE: 17/03/2016 11:25:55 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1130.dwg



TYPICAL PAVEMENT TYPE 2 TIE-IN TO NEW STANDARD SA KERB WITH NO FINE CONCRETE BOX DRAIN

DETAIL D11
SCALE 1:20 -



TYPICAL PAVEMENT TYPE 3 TIE-IN TO NEW STANDARD SA KERB WITH NO FINE CONCRETE BOX DRAIN

DETAIL D12
SCALE 1:20 -

NOTES:

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. FOR MODIFIED KERB DETAILS REFER DRAWING NB00042-W010-DG-PV-1130.
4. GEOTEXTILE TO BE WRAPPED OUTSIDE NO FINES CONCRETE AND FILTER MATERIAL.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	SM	DB
A	13.07.15	DETAIL DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:20 0.2 0 0.2 0.4 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

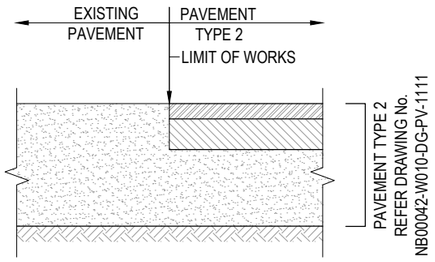
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
EDGE DETAILS
SHEET 3

NOT FOR CONSTRUCTION

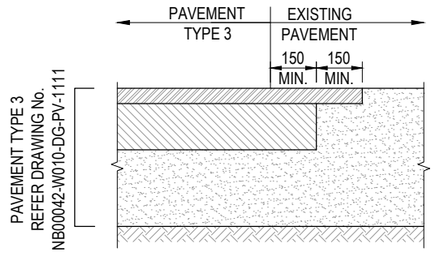
PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-PV-1117	C

DATE: 17/03/2016 11:26:01 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\FPProjects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1130.dwg



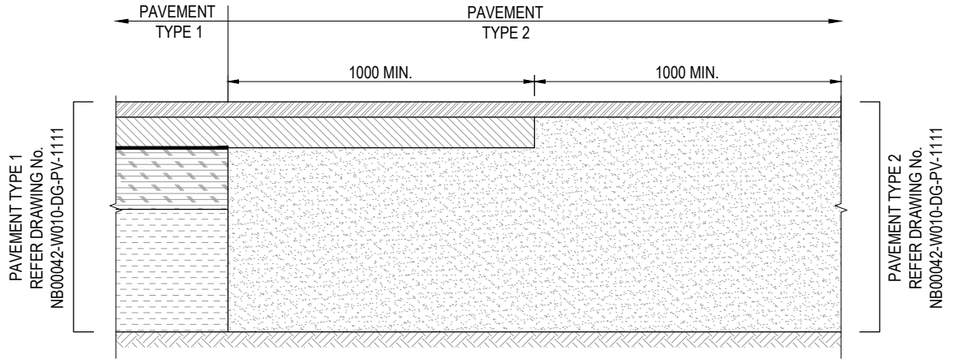
PAVEMENT TYPE 2 TRAVERSE / LONGITUDINAL INTERFACE WITH EXISTING

DETAIL P1 SCALE 1:20 -



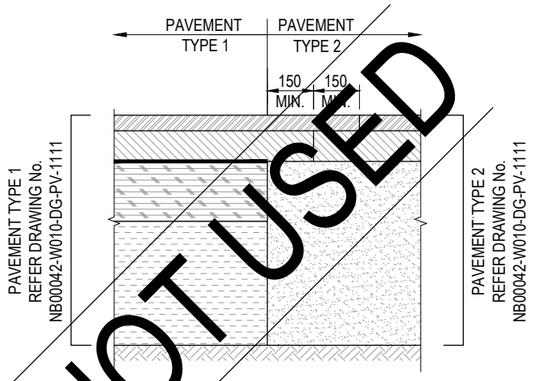
PAVEMENT TYPE 3 TRAVERSE / LONGITUDINAL INTERFACE WITH EXISTING

DETAIL P2 SCALE 1:20 -



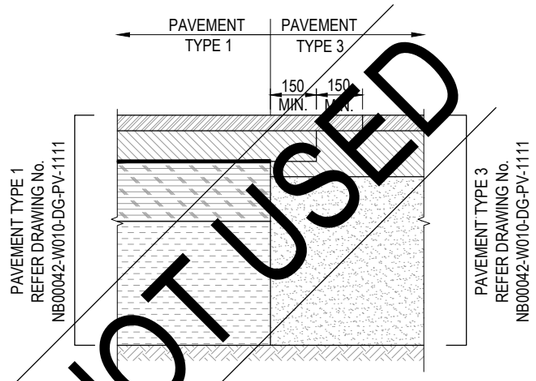
PAVEMENT TYPE 1 TRAVERSE INTERFACE WITH PAVEMENT TYPE 2

DETAIL P3 SCALE 1:20 -



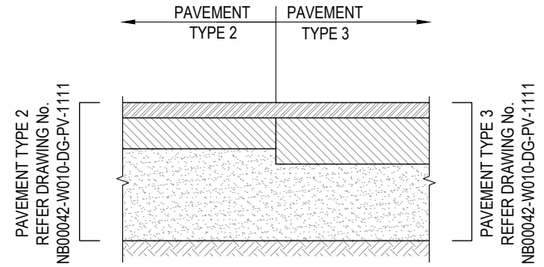
PAVEMENT TYPE 1 LONGITUDINAL INTERFACE WITH PAVEMENT TYPE 2

DETAIL P4 SCALE 1:20 -



PAVEMENT TYPE 1 LONGITUDINAL INTERFACE WITH PAVEMENT TYPE 3

DETAIL P5 SCALE 1:20 -



PAVEMENT TYPE 2 LONGITUDINAL INTERFACE WITH PAVEMENT TYPE 3

DETAIL P6 SCALE 1:20 -

NOTES:

1. FOR GENERAL NOTES REFER DRAWING NB00042-W010-DG-RD-1003.
2. DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:20 0.2 0 0.2 0.4 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

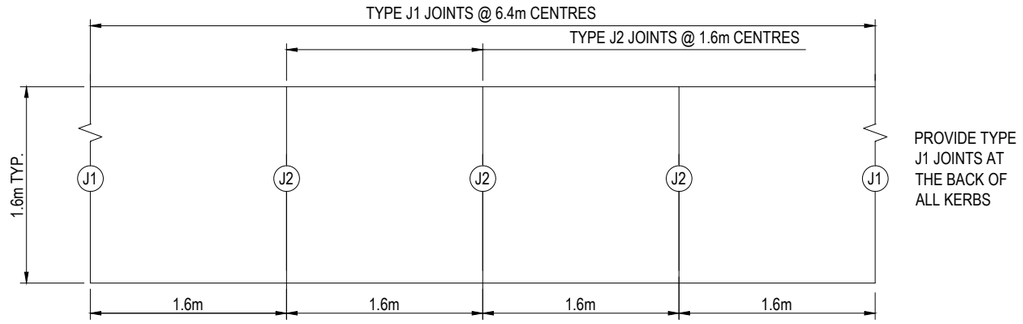
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
INTERFACE DETAILS

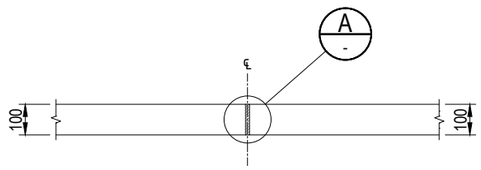
NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-PV-1118	C

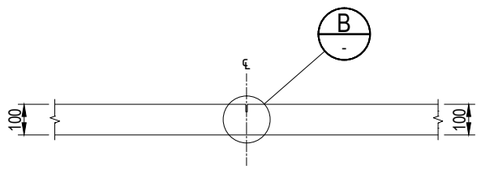
DATE: 17/03/2016 11:26:07 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NBIP\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwgs\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1430.dwg



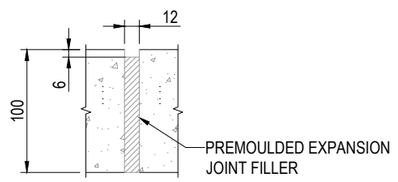
PAVEMENT TYPE 5 TYPICAL JOINT LAYOUT
SCALE 1:50



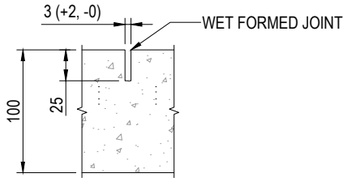
JOINT TYPE (J1)
PAVEMENT TYPE 5 EXPANSION JOINT
SCALE 1:20



JOINT TYPE (J2)
PAVEMENT TYPE 5 FORMED CONTRACTION JOINT
SCALE 1:20



DETAIL A
SCALE 1:5



DETAIL B
SCALE 1:5

NOTES:

1. FOR GENERAL NOTES REFER DRAWING No. NB00042-W010-DG-RD-1003.
2. DIMENSIONS SHOWN ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. PROVIDE TYPE J1 JOINTS AROUND ALL ABUTTING STRUCTURES SUCH AS PITS, UTILITY SERVICE INFRASTRUCTURE, POWER POLES, KERBS, KERB RAMPS AND ADJACENT CONCRETE PAVEMENTS.
4. TYPE J1 JOINTS CAN BE CONSTRUCTED AS FORMED JOINTS BY CHEQUERBOARD PAVING SEQUENCE OR BY FULL DEPTH SAW CUT.
5. SAW CUTS SHOULD BE MADE WITHIN 12 HOURS OF CONCRETE PLACEMENT OR AS SOON AS THE CONCRETE IS STRONG ENOUGH TO SUPPORT THE SAWING EQUIPMENT.
6. TRANSVERSE SLAB JOINTS MUST BE ALIGNED SQUARE TO THE LONGITUDINAL EDGE WITH A TOLERANCE OF ±5 DEGREES.
7. FOR PAVEMENT TYPE 6 AND 7 JOINT DETAILS REFER PROPERTY ADJUSTMENT DRAWINGS NB00042-W010-DG-PA-1001-1005.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	03.04.15	DETAILED DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:5 — 0.05 0 0.05 0.10 — AT A3
SCALE 1:20 — 0.2 0 0.2 0.4 — AT A3
SCALE 1:50 — 0.5 0 0.5 1 — AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

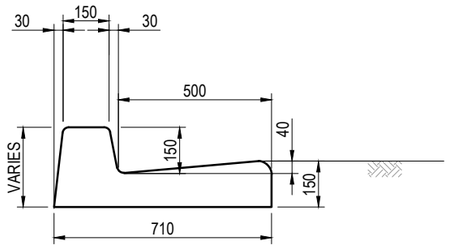
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
RIGID PAVEMENT DETAILS

NOT FOR CONSTRUCTION

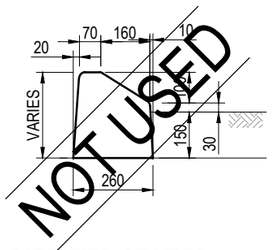
PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1120	E

DATE: 17/03/2016 11:26:12 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NBI\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1130.dwg

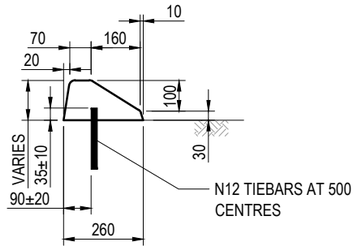
0 5 10 15 20 25 mm ON A3 ORIGINAL This Drawing may have been prepared using colour and may be incomplete if copied



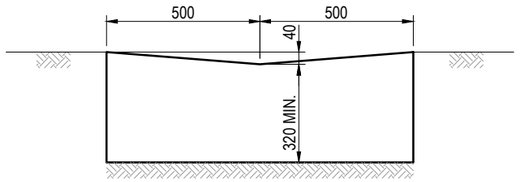
MODIFIED SA KERB



MODIFIED SF KERB
TYPE 1



MODIFIED SF KERB
TYPE 2



MODIFIED SB GUTTER

KERB/GUTTER SCHEDULE

TAG	TYPE	KERB START LOCATION			KERB END LOCATION			LENGTH *
		CARRIAGEWAY	CONTROL LINE	START STATION	CARRIAGEWAY	CONTROL LINE	END STATION	
KA10	MODIFIED SA	EASTBOUND	MC10	30.000	EASTBOUND	MC10	158.977	128.853
KA11	MODIFIED SA	EASTBOUND	MC10	158.977	NORTHBOUND	MC20	199.623	33.922
KA12	MODIFIED SA	EASTBOUND	MC10	205.546	SOUTHBOUND	MC20	193.307	16.270
KA13	STANDARD SA	EASTBOUND	MC10	205.546	EASTBOUND	MC10	250.000	45.265
KA13.A	MODIFIED SA	EASTBOUND	MC10	250.000	EASTBOUND	MC10	355.000	105.000
KA14	STANDARD SA	WESTBOUND	MC10	170.000	NORTHBOUND	MC20	150.868	16.013
KA14.A	STANDARD SA	WESTBOUND	MC10	80.000	WESTBOUND	MC10	170.000	90.000
KA17	STANDARD SA	WESTBOUND	MC10	365.000	SOUTHBOUND	MC20	146.068	117.115
KA1A	MODIFIED SA	EASTBOUND	MC10	352.600	EASTBOUND	MC10	372.778	19.924
KA20	MODIFIED SA	NORTHBOUND	MC20	30.000	NORTHBOUND	MC20	150.868	121.038
KA21	MODIFIED SA	NORTHBOUND	MC20	199.623	NORTHBOUND	MC20	220.524	29.209
KA22	STANDARD SA	SOUTHBOUND	MC20	125.000	SOUTHBOUND	MC20	146.068	21.071
KA23	MODIFIED SA	SOUTHBOUND	MC20	193.307	SOUTHBOUND	MC20	218.774	25.183
KB1B	MODIFIED SO	EASTBOUND	MC10	372.995	EASTBOUND	MC10	390.000	17.005
KF00	MODIFIED SF TYPE 2	MEDIAN	MC10	100.070	MEDIAN	MC10	104.079	8.020
KF18	MODIFIED SF TYPE 2	MEDIAN	MC10	166.982	MEDIAN	MC10	166.982	1.411
KF19	MODIFIED SF TYPE 2	MEDIAN	MC10	213.720	MEDIAN	MC10	213.720	1.411
KF1C	MODIFIED SF TYPE 2	MEDIAN	MC10	352.600	MEDIAN	MC10	372.779	27.181
KF1D	MODIFIED SF TYPE 2	MEDIAN	MC10	104.079	MEDIAN	MC10	166.982	63.092
KF1E	MODIFIED SF TYPE 2	MEDIAN	MC10	100.070	MEDIAN	MC10	166.982	66.702
KF1F	MODIFIED SF TYPE 2	MEDIAN	MC10	213.720	MEDIAN	MC10	420.000	206.289
KF1G	MODIFIED SF TYPE 2	MEDIAN	MC10	213.720	MEDIAN	MC10	420.000	206.363

* REFER NOTE 2.

NOTES:

1. FOR GENERAL NOTES REFER DRAWING No. NB00042-W010-DG-RD-1003.
2. KERB LENGTHS INCLUDE ALL VEHICULAR CROSSING AND KERB RAMPS. THE CONTRACTOR MUST DEDUCT THE LENGTH OF VEHICULAR CROSSING AND KERB RAMPS USING THE DESIGN 3D MODEL PROVIDED.
3. FOR STANDARD SA KERB DETAILS REFER RMS MODEL DRAWING No. MD.R15.A01.A.2.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	20.10.15	DETAIL DESIGN	SG	SM	DB
B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	03.04.15	DETAILED DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	CW	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:10 0.1 0 0.1 0.2 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
KERB DETAILS AND SCHEDULE

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PV-1130	E

DATE: 17/03/2016 11:26:17 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PV-1111-1130.dwg

0 5 10 15 20 25 mm ON A3 ORIGINAL

FROM NTH RICHMOND

TO RICHMOND

0 20 40 60 80 100 120 140

SP84823

SP80355

SP84254

LOT 1 DP 782485

LOT 12 DP 1183263

LOT 1 DP 783403

LOT 1 DP 834702

LOT 121 DP 1003335

LOT 120 DP 1003335

LOT 1 DP 1012497

NO STOPPING
R5-400(LR) (RETAINED)

NO STOPPING
R5-400(LR) (RELOCATED)

R4-1(60) (RELOCATED)

NO STOPPING
R5-400(LR) (RELOCATED)

G9-57 (RELOCATED)

WATCH FOR
HERITAGE PARK BEAUMONT AVE

NO STOPPING
R5-400(LR) (RELOCATED)

AR3(R)
15m SPACINGS

BB L1 E5 C1 E6

EMH EMH EMH EMH

BP EP

3.4 3.3 3.0 3.3 3.3 2.1

MC10

MC10

BELLS LINE OF ROAD

JOINS DRG W010-DG-RS-1102

LIMIT OF WORKS

E1 E5 L1 E1 E6

R5-400(LR) (RETAINED)

R4-1(60) (RELOCATED)

R4-1(60) (RELOCATED)

R5-400(LR) (RELOCATED)

FORM 1 LANE G9-15

R5-400(LR) (RELOCATED)

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- EXISTING FENCE
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

DELINEATION AND SIGNPOSTING

- E2 — PAVEMENT MARKING LABEL
- AR3(R) — PAVEMENT MARKING ARROW LABEL
- NEW BASIC SUPPORT FRANGIBLE SIGNPOST (NUMBER OF POSTS VARIES)
- NEW BASIC SUPPORT NON-FRANGIBLE SIGNPOST (NUMBER OF POSTS VARIES)
- 60 / R4-1 — EXISTING SIGN (RETAINED / RELOCATED)
- 60 / R4-1 — NEW SIGN
- R4-1 — SIGN NUMBER
- EXISTING SIGN

NOTES

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B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	SF	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW GOVERNMENT Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT MARKING, SIGNS AND BARRIERS
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RS-1101	E

0 5 10 15 20 25 mm ON A3 ORIGINAL This Drawing may have been prepared using colour and may be incomplete if copied

DATE: 17/03/2016 11:34:46 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RS-1101-1106.dwg

FROM NTH RICHMOND

TO RICHMOND

LIMIT OF WORKS

BEAUMONT AVENUE

LIMIT OF WORKS

TERRACE ROAD

BELLS LINE OF ROAD

JOINS DRG W010-DG-RS-1101

JOINS DRG W010-DG-RS-1103

JOINS DRG W010-DG-RS-1106

MC10

MC20

MC10

SP84254

(RELOCATED TO NEW TCS POST)

Freemans Reach Wilberforce

TERRACE ROAD

(RELOCATED TO NEW TCS POST)

AR3(R) 20m SPACINGS

AR3(L) 20m SPACINGS

AR3(R) 15m SPACINGS

AR3(R) 20m SPACINGS

AR3(L) 20m SPACINGS

R5-400(L) (RELOCATED)

R5-400(LR) (RELOCATED)

R5-400(LR) (RELOCATED)

R5-400(LR) (RETAINED)

R5-400(LR) (RETAINED)

R5-400(LR) (RELOCATED)

R5-400(R)

R5-400(R)

R5-400(R) (RETAINED)

R1-4A (RELOCATED TO NEW TCS POST)

R1-4A (RELOCATED TO NEW TCS POST)

R1-4A (RELOCATED TO NEW TCS POST)

R1-4A (RELOCATED TO NEW TCS POST)

R4-1B(60)

R2-3AA(L) KEEP LEFT

R2-9A(L) (RETAINED)

R1-2A

STREET SIGN (RELOCATED)

STREET SIGN (RELOCATED)

RELOCATE EXISTING BANNER POLE

LOT 1 DP 537249

LOT 1 DP 121999

LOT 3 DP 16505

LOT 1 DP 1046606

LOT 6 DP 16505

LOT 101 DP 818573

LOT 1 DP 1147946

Windsor B59

Lithgow B59

GROSE VALE RD Grose Vale Bowen Mtn

LEFT LANE MUST TURN LEFT

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- EXISTING FENCE
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

DELINEATION AND SIGNPOSTING

- E2 — PAVEMENT MARKING LABEL
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- NEW BASIC SUPPORT FRANGIBLE SIGNPOST (NUMBER OF POSTS VARIES)
- NEW BASIC SUPPORT NON-FRANGIBLE SIGNPOST (NUMBER OF POSTS VARIES)
- EXISTING SIGN (RETAINED / RELOCATED) — R4-1
- NEW SIGN — R4-1 — SIGN NUMBER
- EXISTING SIGN

NOTES

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B	30.04.15	DETAIL DESIGN	SG	BDP	EDA
A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	SF	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT MARKING, SIGNS AND BARRIERS
SHEET 2

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RS-1102	E

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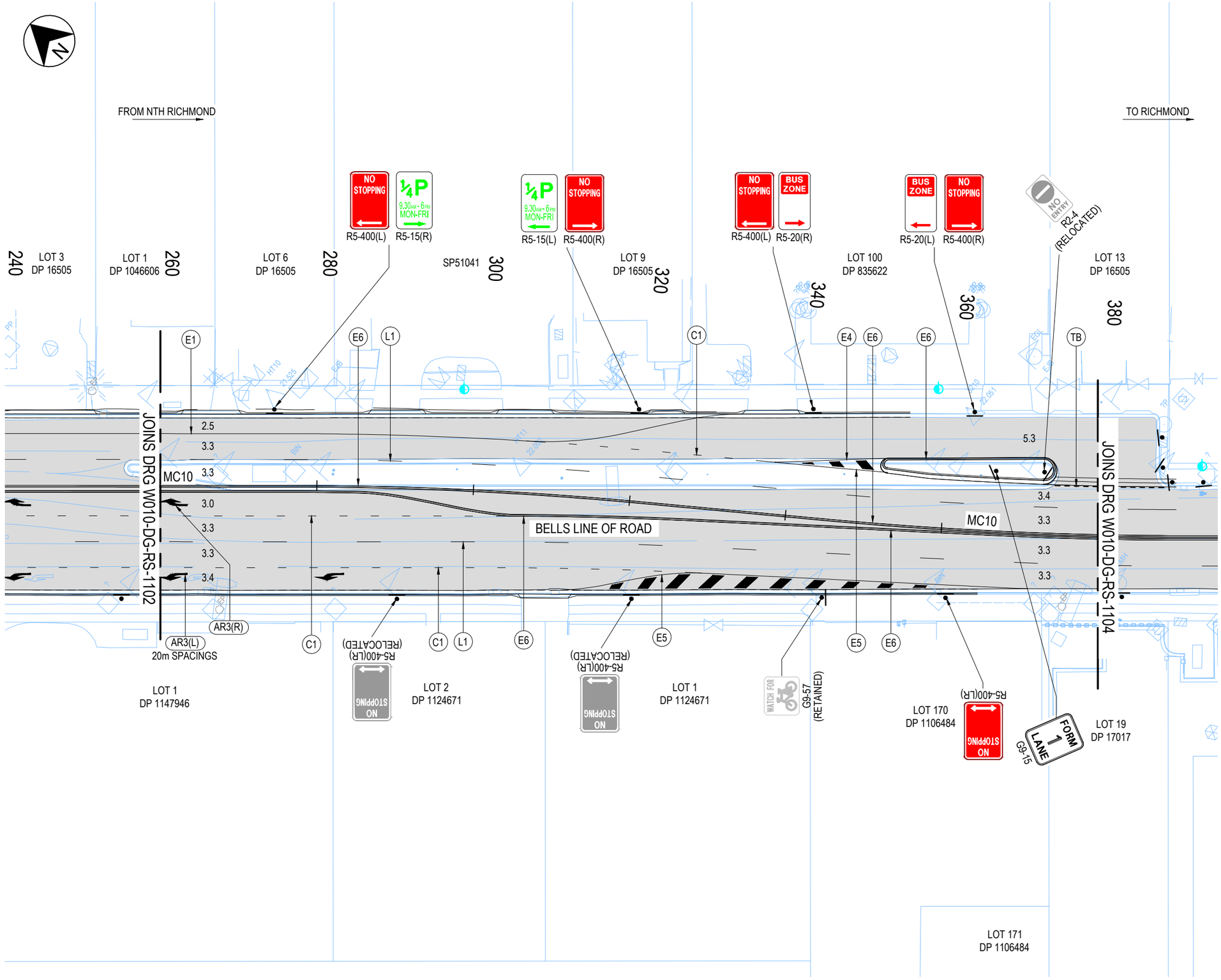

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- EXISTING FENCE
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

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DRAFTSPERSON	SWH	18.03.16
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DESIGNER	SF	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT MARKING, SIGNS AND BARRIERS
SHEET 3

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RS-1103	E

0 5 10 15 20 25 mm ON A3 ORIGINAL

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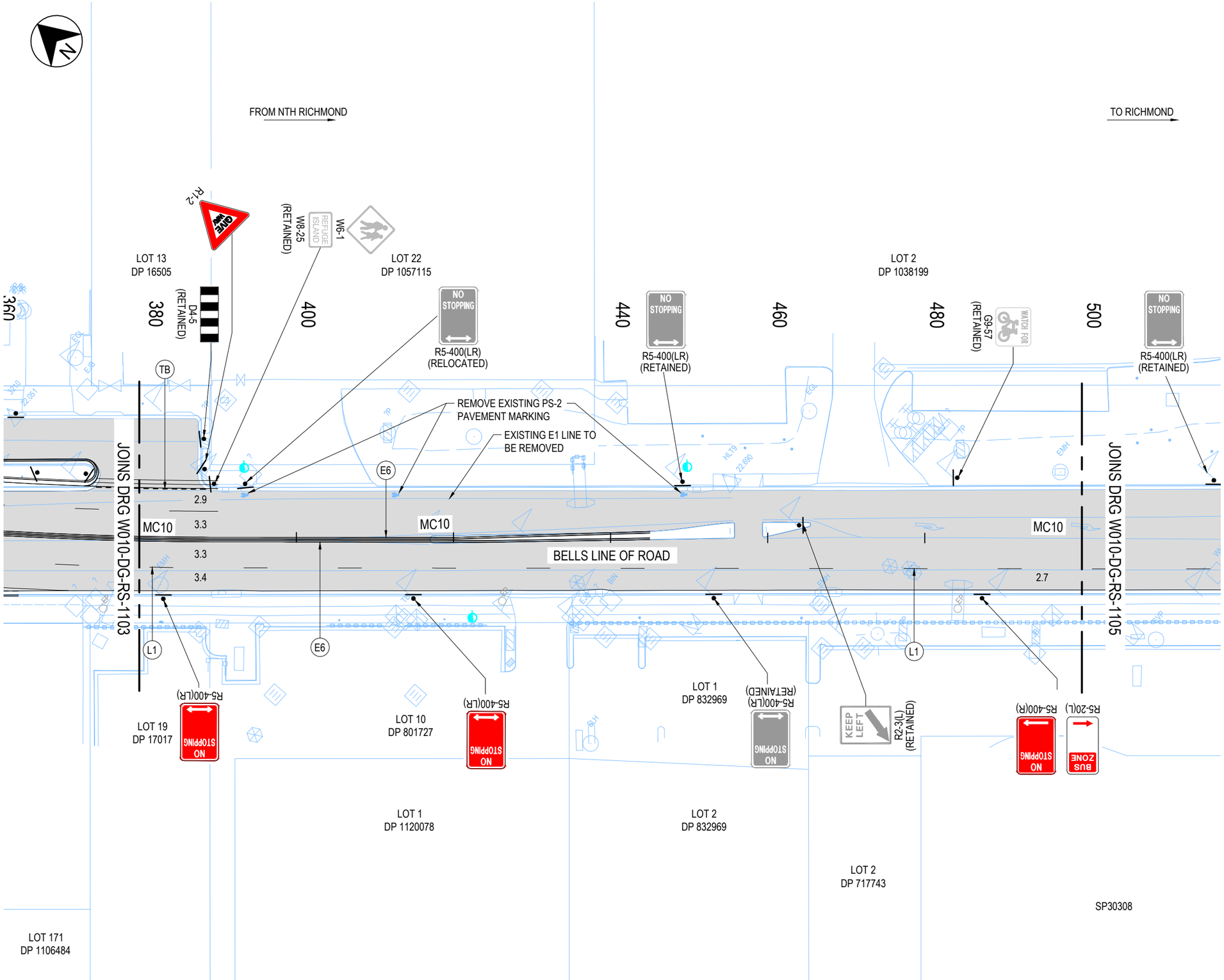

LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
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DELINEATION AND SIGNPOSTING

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TITLE	INITIAL	DATE
DRAFTSPERSON	SWH	18.03.16
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DESIGNER	SF	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

0 5 10 15 20 25 mm ON A3 ORIGINAL
This Drawing may have been prepared using colour and may be incomplete if copied

CONTRACTOR: Downermouchel

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AUSTRALIA
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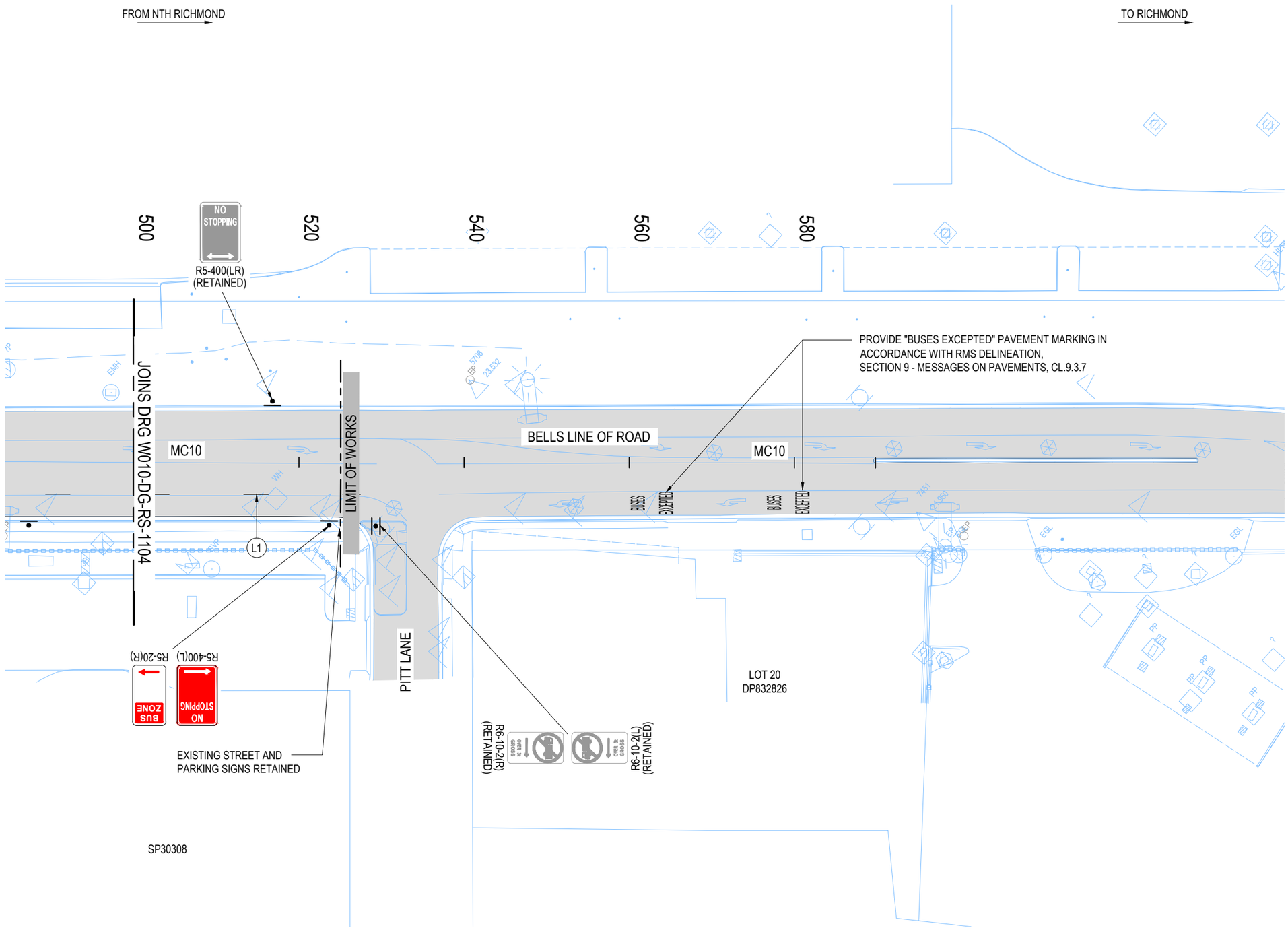
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT MARKING, SIGNS AND BARRIERS
SHEET 4

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RS-1104	E

DATE: 17/03/2016 11:35:08 AM
LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwgs\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RS-1101-1106.dwg



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
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- EXISTING POWER POLE
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A	19.12.14	CONCEPT DESIGN	SWH	BDP	CT

TITLE	INITIAL	DATE
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DESIGNER	SF	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:500 (5 0 5 10) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

0 5 10 15 20 25 mm ON A3 ORIGINAL
This Drawing may have been prepared using colour and may be incomplete if copied

CONTRACTOR: Downermouchel

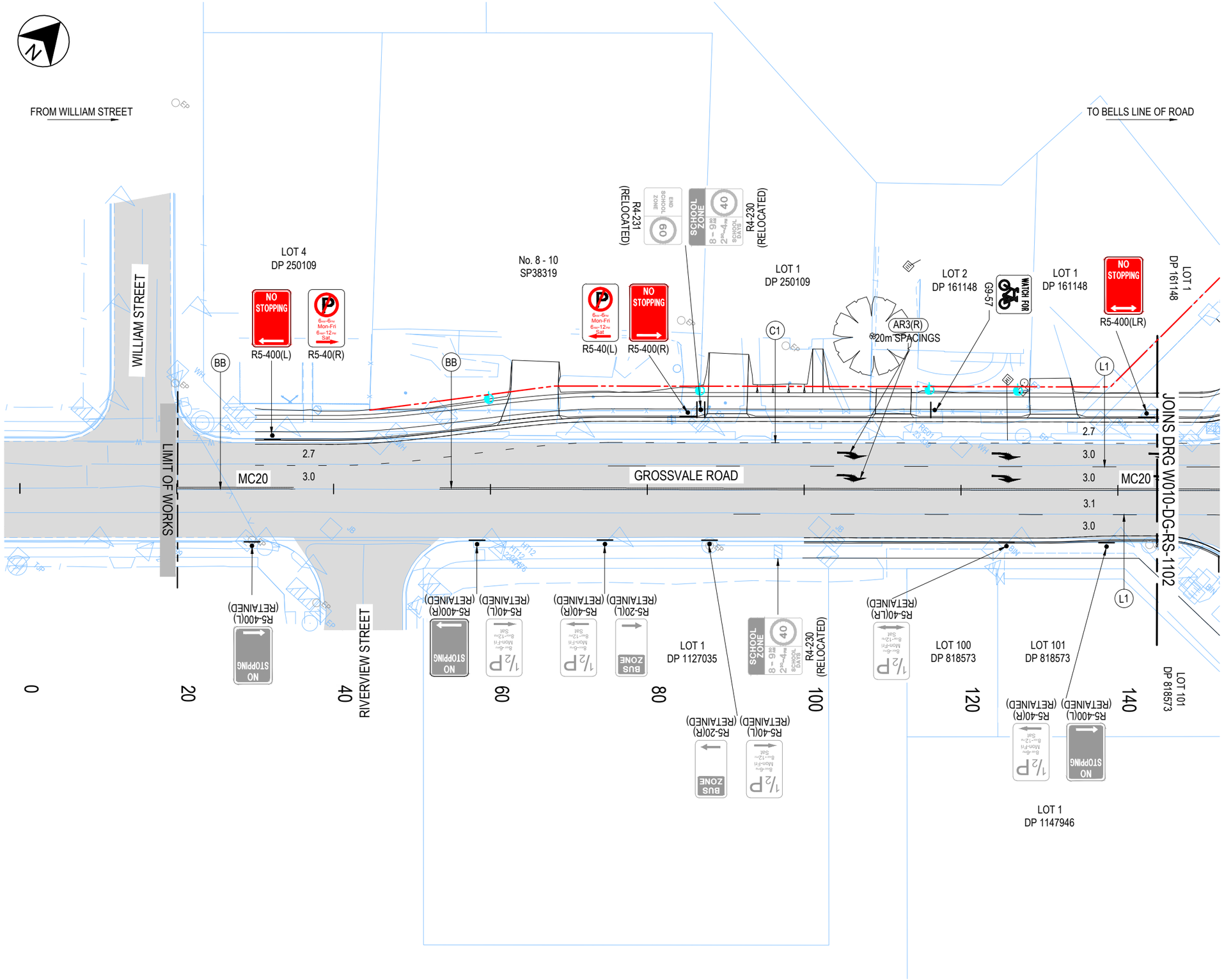
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT MARKING, SIGNS AND BARRIERS
SHEET 5

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RS-1105	E

DATE: 17/03/2016 11:35:15 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RS-1101-1106.dwg



LEGEND

REFERENCE ONLY

- EXISTING PAVEMENT
- EXISTING CADASTRAL BOUNDARY
- PROPOSED BOUNDARY
- EXISTING FENCE
- EXISTING POWER POLE
- PROPOSED POWER POLE
- PROPOSED POWER POLE WITH LIGHT

DELINEATION AND SIGNPOSTING

- E2 — PAVEMENT MARKING LABEL
- AR3(R) — PAVEMENT MARKING ARROW LABEL
- NEW BASIC SUPPORT FRANGIBLE SIGNPOST (NUMBER OF POSTS VARIES)
- NEW BASIC SUPPORT NON-FRANGIBLE SIGNPOST (NUMBER OF POSTS VARIES)
- 60 / R4-1 — EXISTING SIGN (RETAINED / RELOCATED)
- 60 / R4-1 — NEW SIGN
- R4-1 — SIGN NUMBER
- EXISTING SIGN

NOTES

1. SIGN LOCATIONS SHOWN ARE INDICATIVE ONLY.
2. SIGNFACES ARE NOT TO SCALE.
3. EXISTING SIGNS WITHIN BOUNDARY OF PROJECT WORKS TO BE REMOVED UNLESS OTHERWISE SPECIFIED
4. ADDITIONAL NO RIGHT TURN SIGNS TO BE ATTACHED TO TRAFFIC LIGHT MAST ARMS AS SHOWN IN TCS PLAN NO.2595.
5. ONLY OFFICERS WITH DELEGATION UNDER 5.9 OF THE RMS DELEGATIONS MANUAL ARE AUTHORISED TO APPROVE INSTALLATION OF ALL REGULATORY SIGNPOSTING AND LINE MARKING ILLUSTRATED ON THIS PLAN. REGULATORY SIGNPOSTING AND LINE MARKING SHOWN ON THESE PLANS ARE NOT APPROVED FOR INSTALLATION WITHOUT WRITTEN AUTHORISATION FROM RMS NETWORK AND SAFETY SERVICES.

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	16.12.15	DETAIL DESIGN	CM	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	BDP	DB
A	17.07.15	DETAIL DESIGN	IR	BDP	CT

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

TITLE	INITIAL	DATE
DRAFTSPERSON	IR	18.03.16
DRAFTING CHECK	IR	18.03.16
DESIGNER	SF	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE

SCALE 1:500 — 5 0 5 10 AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

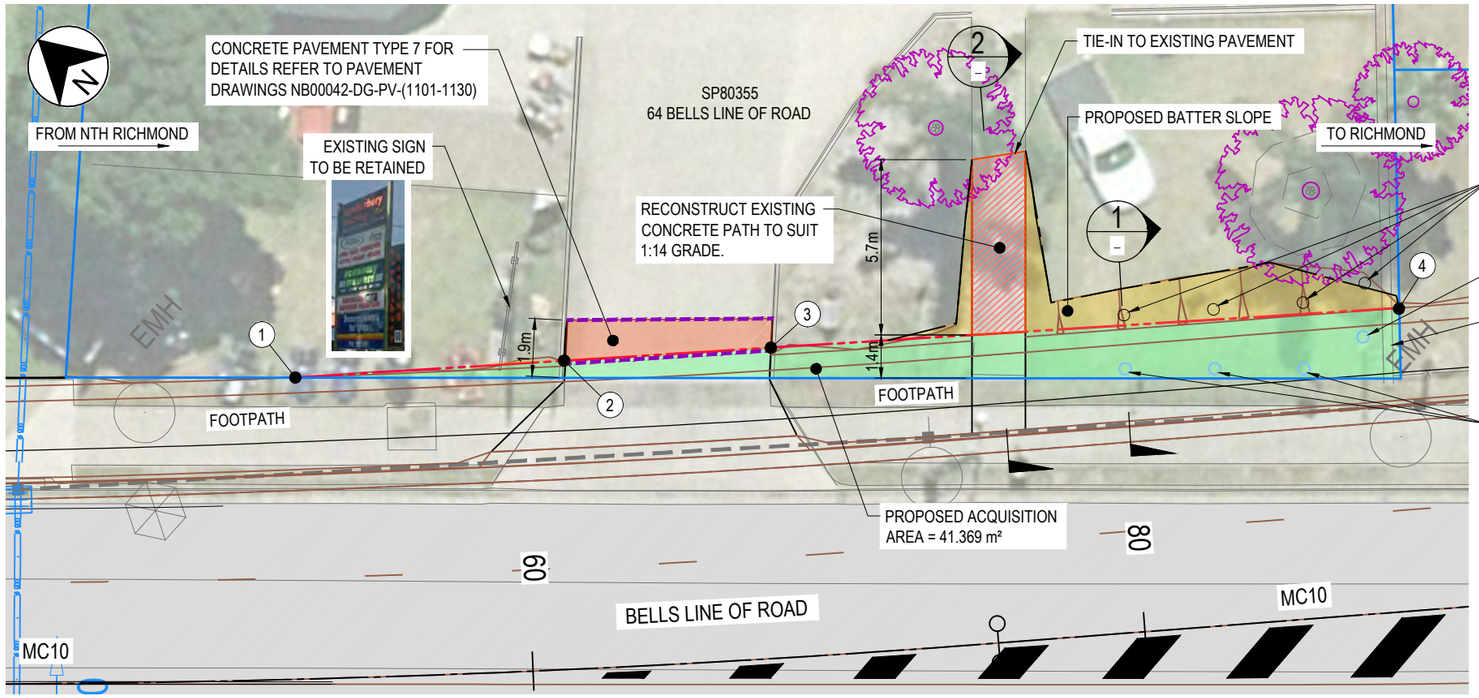
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
SITE 1 – BELLS LINE OF ROAD / GROSE VALE ROAD
PAVEMENT MARKING, SIGNS AND BARRIERS
SHEET 6

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-RS-1106	E

DATE: 17/03/2016 11:35:21 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwgs\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-RS-1101-1106.dwg



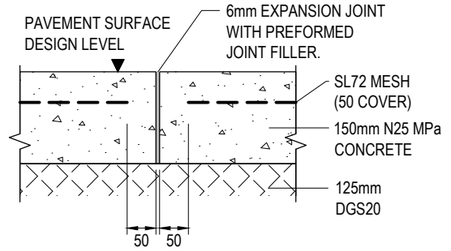
PROPOSED POLES LOCATION

RELOCATE POLE WITHIN PROPOSED BOUNDARY

CUT OFF SECTION OF EXISTING BRICKWALL WITHIN PROPOSED FOOTWAY AREA AND MAKE GOOD.

RELOCATE THREE FLAG POLES WITHIN PROPOSED BOUNDARY

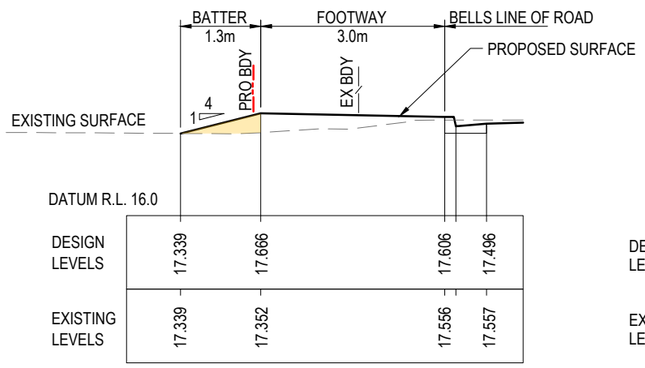
PLAN
PROPERTY ADJUSTMENTS
SCALE 1:200



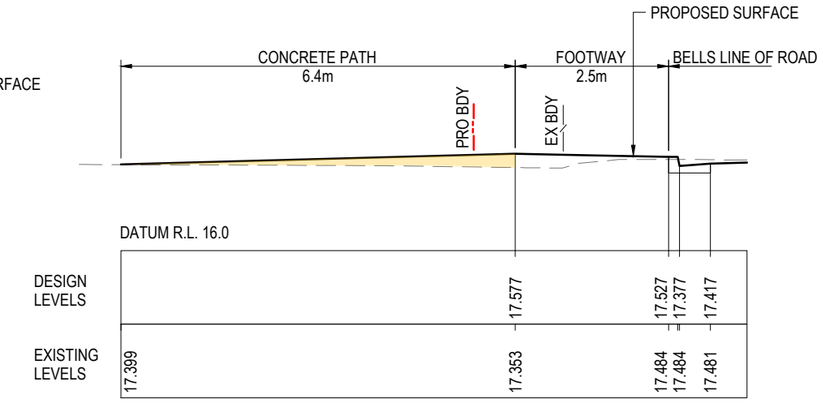
PAVEMENT EXPANSION JOINT
SCALE 1:10

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-1003.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH RMS PROPERTY ADJUSTMENT SPECIFICATION R204. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DESIGN DRAWINGS AND ALL DISCREPANCIES REFERRED TO THE PRINCIPAL FOR DECISION BEFORE PROCEEDING WITH THE WORK.
3. ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTOR BEFORE CONSTRUCTION AND FABRICATION IS COMMENCED.
4. IF SITE CONDITIONS ENCOUNTERED APPEAR TO DIFFER SUBSTANTIALLY FROM THE CONDITIONS DEPICTED ON THESE PLANS, THE PRINCIPAL SHALL BE NOTIFIED IMMEDIATELY.
5. CONSTRUCT BATTER SLOPE TO TIE-IN WITH EXISTING GROUND LEVEL.
6. RELOCATE UTILITIES AS REQUIRED. REFER UTILITIES COORDINATION PLANS FOR DETAILS.
7. TEMPORARY CONSTRUCTION DISTURBANCE TO BE LIMITED TO WITHIN 2m OF PERMANENT WORKS SHOWN. ERECT TEMPORARY FENCING AND OPEN CHANNELS IN THIS SPACE IF REQUIRED. REINSTATE EXISTING LANDSCAPE ON COMPLETION OF WORKS.
8. MAKE GOOD ANY DISTURBANCE CAUSED DURING THE ADJUSTMENT WORK.
9. CLEAN UP AND REMOVE BUILDERS WASTE FROM SITE GENERATED DURING THE ADJUSTMENT WORK.



SECTION 1
SCALE 1:100



SECTION 2
SCALE 1:100

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- 1 — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
- MC00 — CONTROL LINE
- PROPOSED BOUNDARY
- EXISTING BOUNDARY

SETOUT CO-ORDINATES

POINT	EASTING	NORTHING
1	288272.241	6282201.247
2	288278.491	6282195.072
3	288283.300	6282190.320
4	288297.904	6282175.889

PROPERTY ADDRESS: 64 BELLS LINE OF STREET, NORTH RICHMOND

LOT / DP: SP80355

OWNERS NAME: THE OWNERS - STRATA PLAN No. 80355

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
C	16.12.15	DETAIL DESIGN	CM	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	BDP	DB
A	03.04.15	DETAIL DESIGN	NA	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	NA	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:200 2 0 2 4 AT A3
SCALE 1:100 1 0 1 2 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

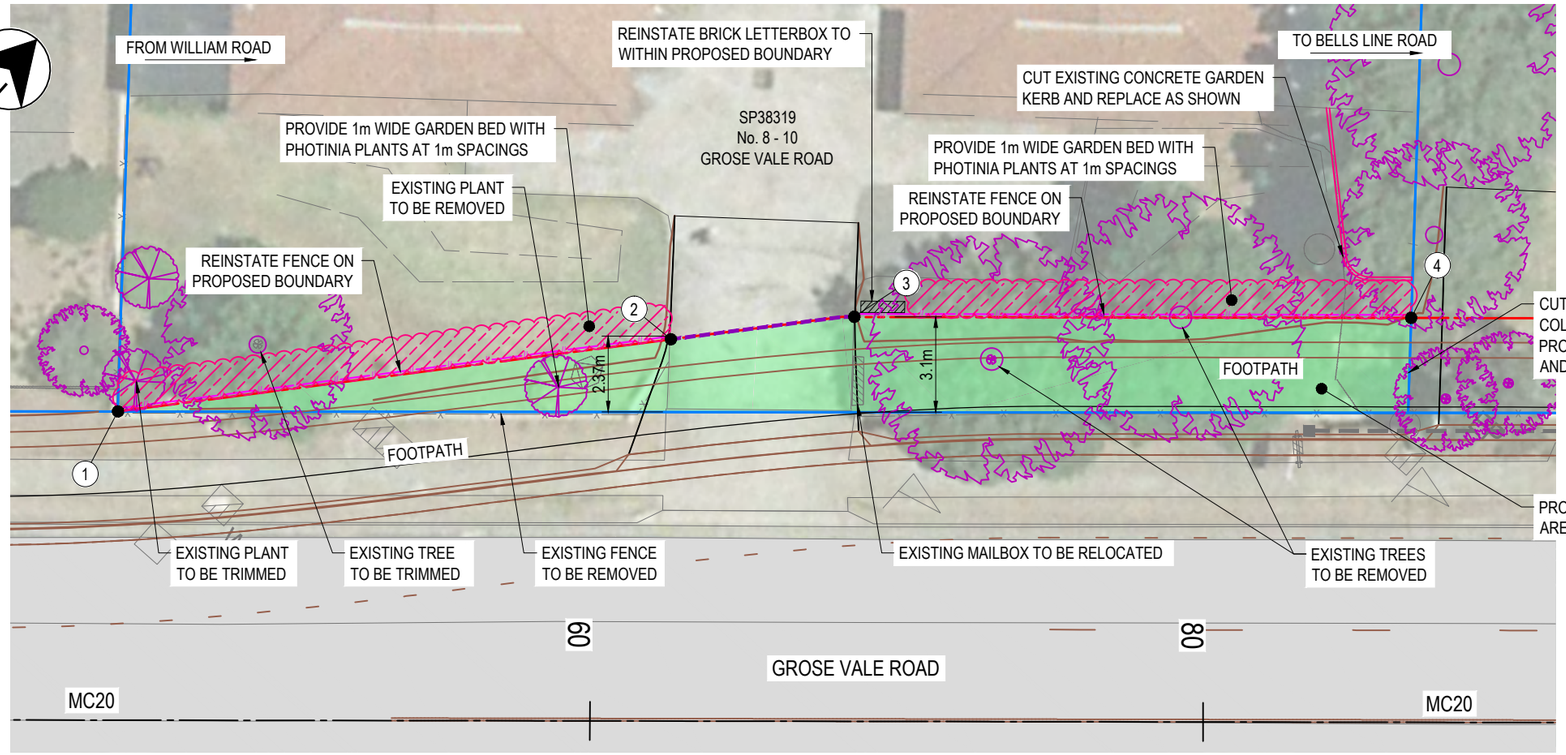
PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
SP80355, 64 BELLS LINE OF ROAD
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS 80%	DRAWING No NB00042-W010-DG-PA-1001	D

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

DATE: 17/03/2016 11:19:38 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PA-1001.dwg



PLAN
PROPERTY ADJUSTMENTS
SCALE 1:200

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-1003.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH RMS PROPERTY ADJUSTMENT SPECIFICATION R204. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DESIGN DRAWINGS AND ALL DISCREPANCIES REFERRED TO THE PRINCIPAL FOR DECISION BEFORE PROCEEDING WITH THE WORK.
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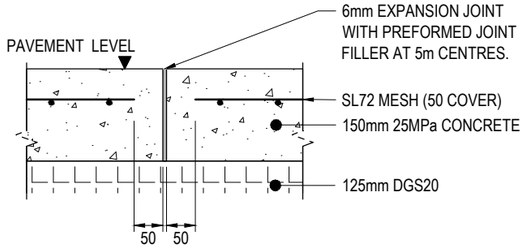
8. MAKE GOOD ANY DISTURBANCE CAUSED DURING THE ADJUSTMENT WORK.
9. CLEAN UP AND REMOVE BUILDERS WASTE FROM SITE GENERATED DURING THE ADJUSTMENT WORK.



PAVEMENT EXPANSION JOINT
SCALE 1:10

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- 1 — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
- MC00 — CONTROL LINE
- PROPOSED BOUNDARY
- EXISTING BOUNDARY

SETOUT CO-ORDINATES

POINT	EASTING	NORTHING
1	288258.260	6282018.574
2	288270.154	6282032.338
3	288274.133	6282036.864
4	288287.710	6282048.935

PROPERTY ADDRESS: No. 8 - 10 GROSE VALE ROAD NORTH RICHMOND

LOT / DP: SP38319

OWNERS NAME: THE OWNERS STRATA PLAN No. 38319

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

.....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
C	16.12.15	DETAIL DESIGN	CM	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	BDP	DB
A	03.04.15	DETAIL DESIGN	NA	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	NA	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:200 2 0 2 4 AT A3
SCALE 1:10 0.1 0 0.1 0.2 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
SP38319, 8-10 GROSE VALE ROAD
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS 80%	DRAWING No NB00042-W010-DG-PA-1011	D

0 5 10 15 20 25 mm ON A3 ORIGINAL

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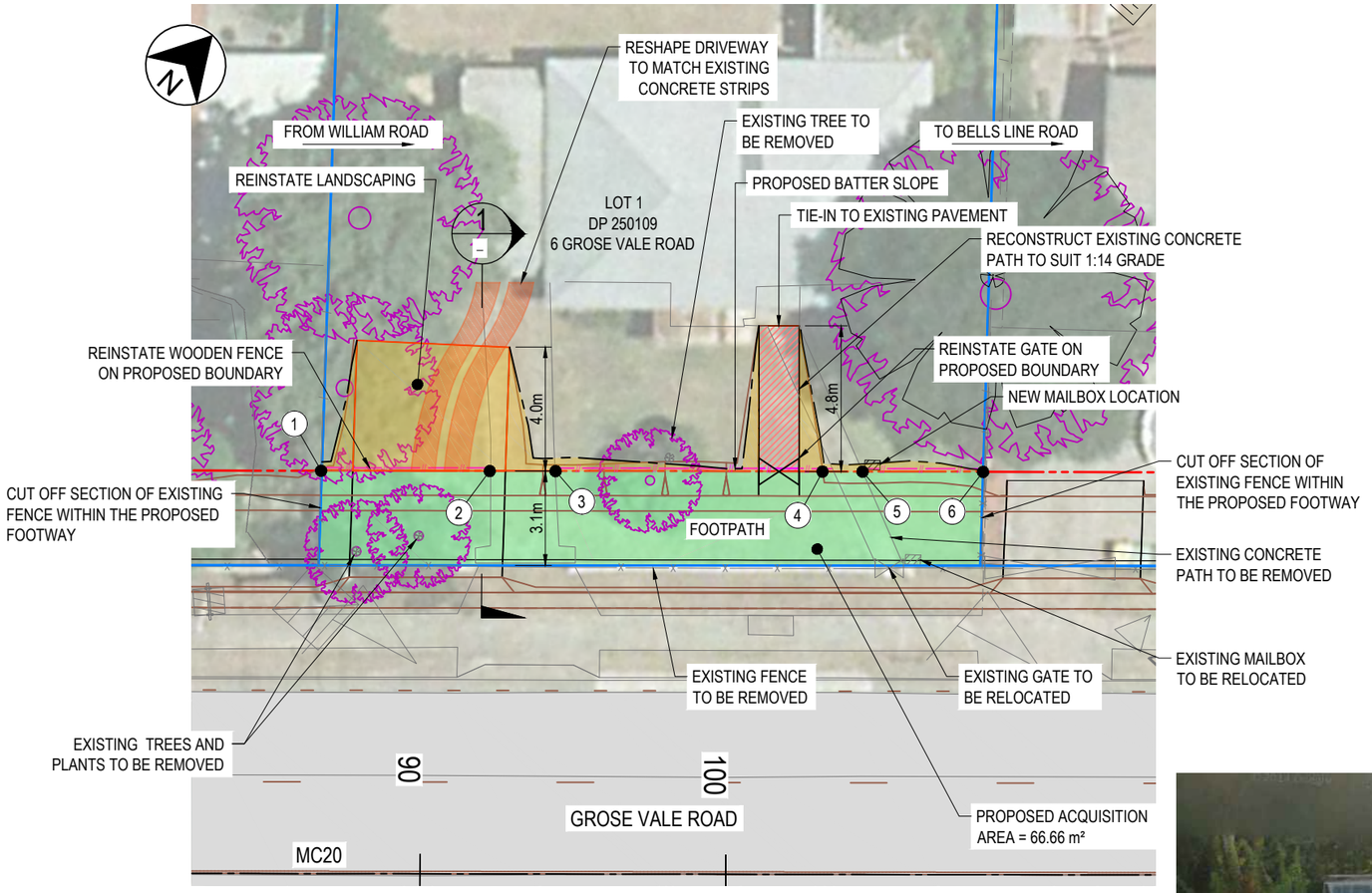
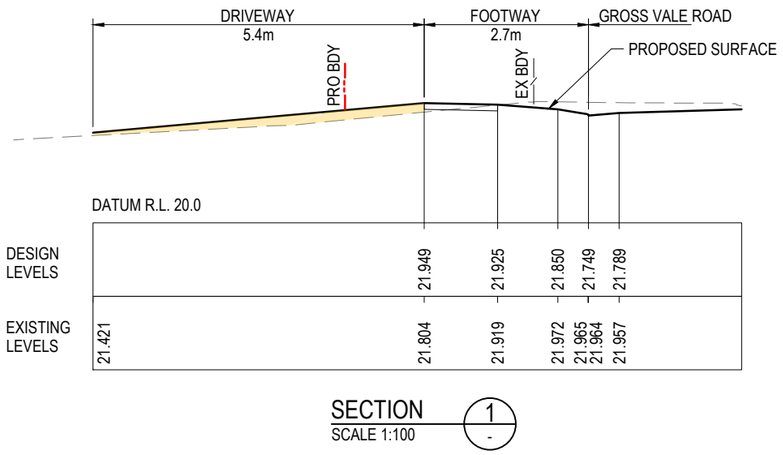


PLAN
PROPERTY ADJUSTMENT
SCALE 1:200



SECTION 1
SCALE 1:100

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-1003.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH RMS PROPERTY ADJUSTMENT SPECIFICATION R204. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DESIGN DRAWINGS AND ALL DISCREPANCIES REFERRED TO THE PRINCIPAL FOR DECISION BEFORE PROCEEDING WITH THE WORK.
3. ALL DIMENSIONS RELEVANT TO SETTING OUT AND OFF-SITE WORK SHALL BE VERIFIED BY THE CONTRACTOR BEFORE CONSTRUCTION AND FABRICATION IS COMMENCED.
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5. CONSTRUCT BATTER SLOPE TO TIE-IN WITH EXISTING GROUND LEVEL.
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8. MAKE GOOD ANY DISTURBANCE CAUSED DURING THE ADJUSTMENT WORK.
9. CLEAN UP AND REMOVE BUILDERS WASTE FROM SITE GENERATED DURING THE ADJUSTMENT WORK.

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- 1 — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
- MC00 — CONTROL LINE
- PROPOSED BOUNDARY
- EXISTING BOUNDARY

SETOUT CO-ORDINATES

POINT	EASTING	NORTHING
1	288287.710	6282048.935
2	288291.813	6282052.584
3	288293.426	6282054.018
4	288299.950	6282059.818
5	288300.930	6282060.689
6	288303.877	6282063.309

PROPERTY ADDRESS: 6 GROSE VALE ROAD NORTH RICHMOND

LOT / DP: DP250109

OWNERS NAME: GODWIN GESMOND XIBERRA

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
C	16.12.15	DETAIL DESIGN	CM	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	BDP	DB
A	03.04.15	DETAIL DESIGN	NA	BDP	CT

0 5 10 15 20 25 mm ON A3 ORIGINAL — This Drawing may have been prepared using colour and may be incomplete if copied

TITLE	INITIAL	DATE
DRAFTSPERSON	NA	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:200 — 2 0 2 4 — AT A3
SCALE 1:100 — 1 0 1 2 — AT A3
SCALE 1:10 — 0.1 0 0.1 0.2 — AT A3
CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

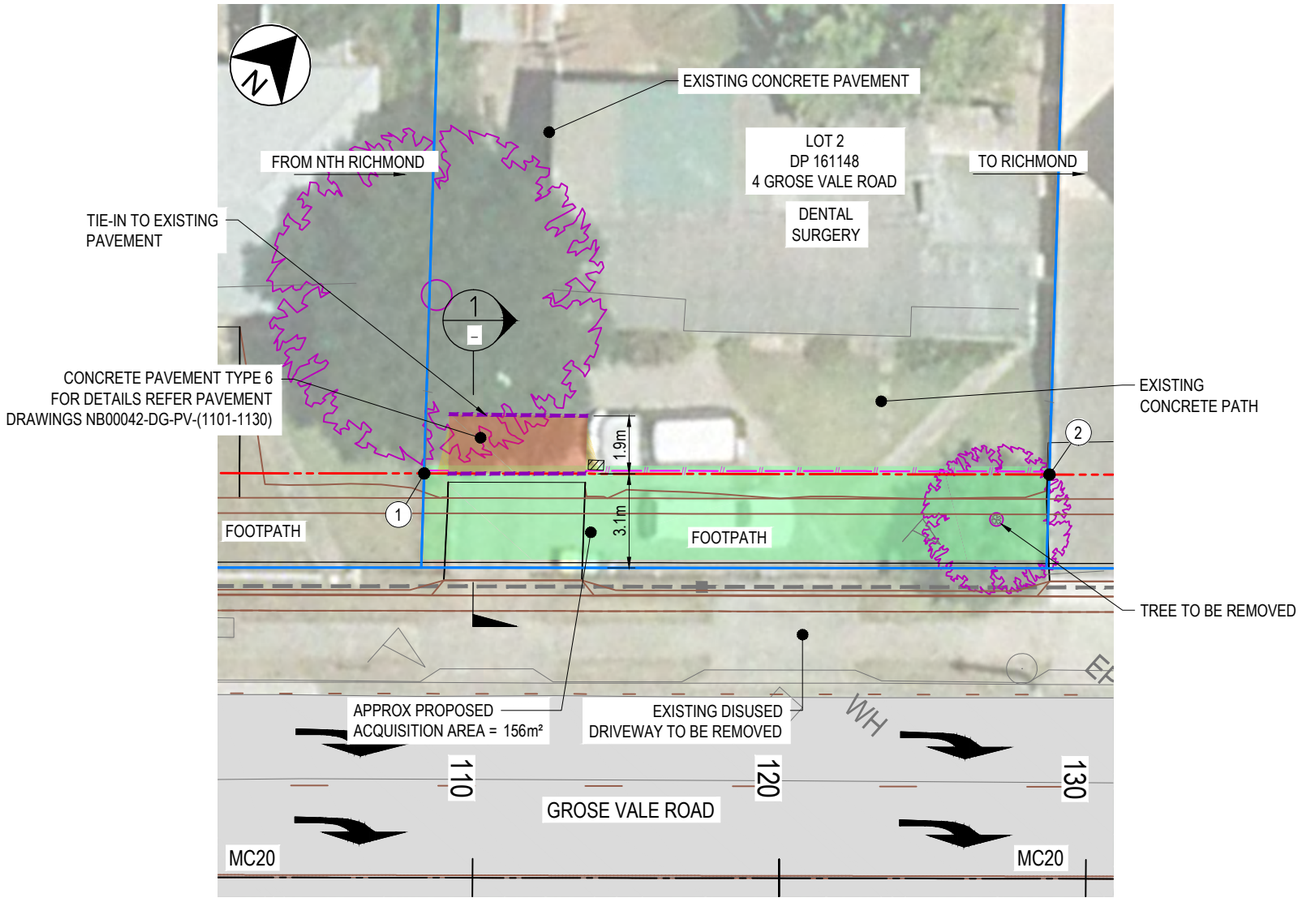
DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
LOT 1, DP250109, 6 GROSE VALE ROAD
SHEET 1

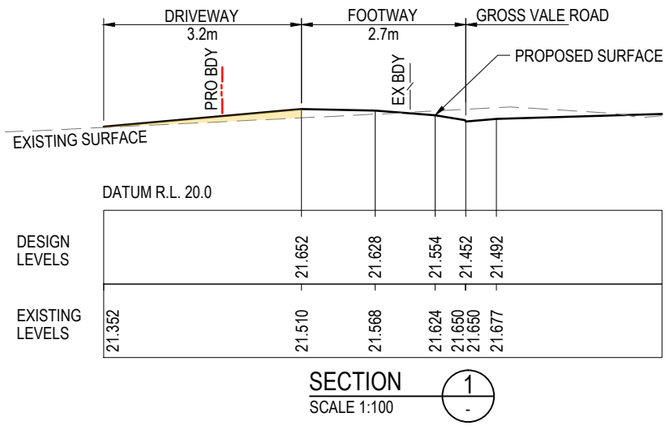
NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS	DRAWING No	
80%	NB00042-W010-DG-PA-1021	D

DATE: 17/03/2016 11:21:15 AM LOGIN NAME: SUTHERLAND, GRANT
LOCATION: I:\NB\Projects\NB00042\Work Packages\10. Richmond Bridge Approaches\Deliverables\Drawings\Civil\Dwg\SITE 1 - GROSEVALE ROAD\NB00042-W010-DG-PA-1021.dwg



PLAN
PROPERTY ADJUSTMENTS
SCALE 1:200



SECTION 1-1
SCALE 1:100

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-1003.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH RMS PROPERTY ADJUSTMENT SPECIFICATION R204. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DESIGN DRAWINGS AND ALL DISCREPANCIES REFERRED TO THE PRINCIPAL FOR DECISION BEFORE PROCEEDING WITH THE WORK.
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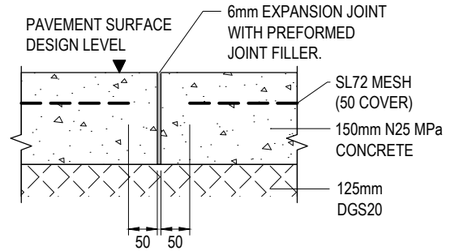
5. CONSTRUCT BATTER SLOPE TO TIE-IN WITH EXISTING GROUND LEVEL.
6. RELOCATE UTILITIES AS REQUIRED. REFER UTILITIES COORDINATION PLANS FOR DETAILS.
7. TEMPORARY CONSTRUCTION DISTURBANCE TO BE LIMITED TO WITHIN 2m OF PERMANENT WORKS SHOWN. ERECT TEMPORARY FENCING AND OPEN CHANNELS IN THIS SPACE IF REQUIRED. REINSTATE EXISTING LANDSCAPE ON COMPLETION OF WORKS.
8. MAKE GOOD ANY DISTURBANCE CAUSED DURING THE ADJUSTMENT WORK.
9. CLEAN UP AND REMOVE BUILDERS WASTE FROM SITE GENERATED DURING THE ADJUSTMENT WORK.



PAVEMENT EXPANSION JOINT
SCALE 1:10

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- (1) — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
- MC00 — CONTROL LINE
- PROPOSED BOUNDARY
- EXISTING BOUNDARY

SETOUT CO-ORDINATES

POINT	EASTING	NORTHING
1	288303.877	6282063.309
2	288319.113	6282076.856

PROPERTY ADDRESS:	No. 4 GROSE VALE ROAD NORTH RICHMOND
LOT / DP:	LOT 2 / DP161148
OWNERS NAME:	FARIS ZAKAULLAH KIRMANI

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

.....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
E	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
D	16.12.15	DETAIL DESIGN	CM	BDP	DB
C	30.10.15	DETAIL DESIGN W/ NEW DEVELOPMENT	SG	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	BDP	DB
A	03.04.15	DETAIL DESIGN	NA	BDP	CT

	INITIAL	DATE
DRAFTSPERSON	NA	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:200 (2 0 2 4) AT A3
SCALE 1:100 (1 0 1 2) AT A3
SCALE 1:10 (0.1 0 0.1 0.2) AT A3
CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
LOT 2, DP161148, 4 GROSE VALE ROAD
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	REV
FDD	DS2014/005514	
STATUS 80%	DRAWING No NB00042-W010-DG-PA-1031	E

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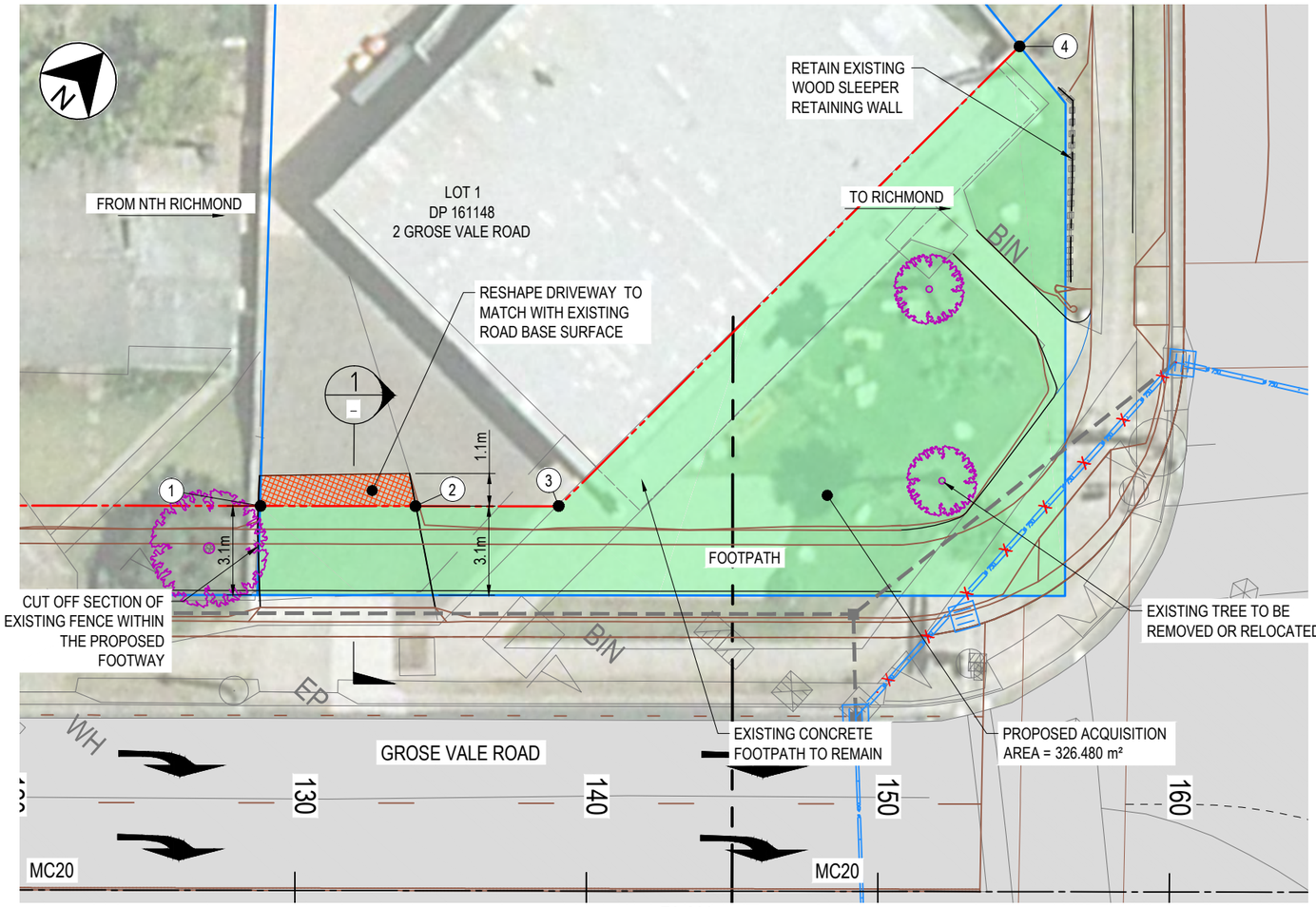
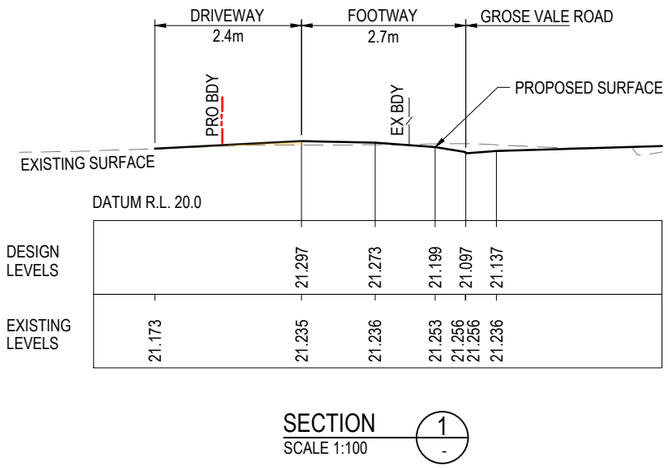


PLAN
PROPERTY ADJUSTMENTS
SCALE 1:200



SECTION 1
SCALE 1:100

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-1003.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH RMS PROPERTY ADJUSTMENT SPECIFICATION R204. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DESIGN DRAWINGS AND ALL DISCREPANCIES REFERRED TO THE PRINCIPAL FOR DECISION BEFORE PROCEEDING WITH THE WORK.
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8. MAKE GOOD ANY DISTURBANCE CAUSED DURING THE ADJUSTMENT WORK.
9. CLEAN UP AND REMOVE BUILDERS WASTE FROM SITE GENERATED DURING THE ADJUSTMENT WORK.

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- 1 — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
- MC00 CONTROL LINE
- PROPOSED BOUNDARY
- EXISTING BOUNDARY

SETOUT CO-ORDINATES

POINT	EASTING	NORTHING
1	288319.069	6282076.817
2	288323.094	6282080.395
3	288326.769	6282083.663
4	288328.059	6282105.962

PROPERTY ADDRESS: 2 GROSE VALE ROAD
NORTH RICHMOND

LOT / DP: LOT 1 / DP161148

OWNERS NAME: JOSEPH PAUL TANTI

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
D	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
C	16.12.15	DETAIL DESIGN	CM	BDP	DB
B	20.10.15	DETAIL DESIGN	SG	BDP	DB
A	03.04.15	DETAIL DESIGN	NA	BDP	CT

TITLE	INITIAL	DATE
DRAFTSPERSON	NA	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:200 2 0 2 4 AT A3
CO-ORDINATE SYSTEM: MGA Zone 56
HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: DM Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
LOT 1, DP161148, 2 GROSE VALE ROAD
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PA-1041	D

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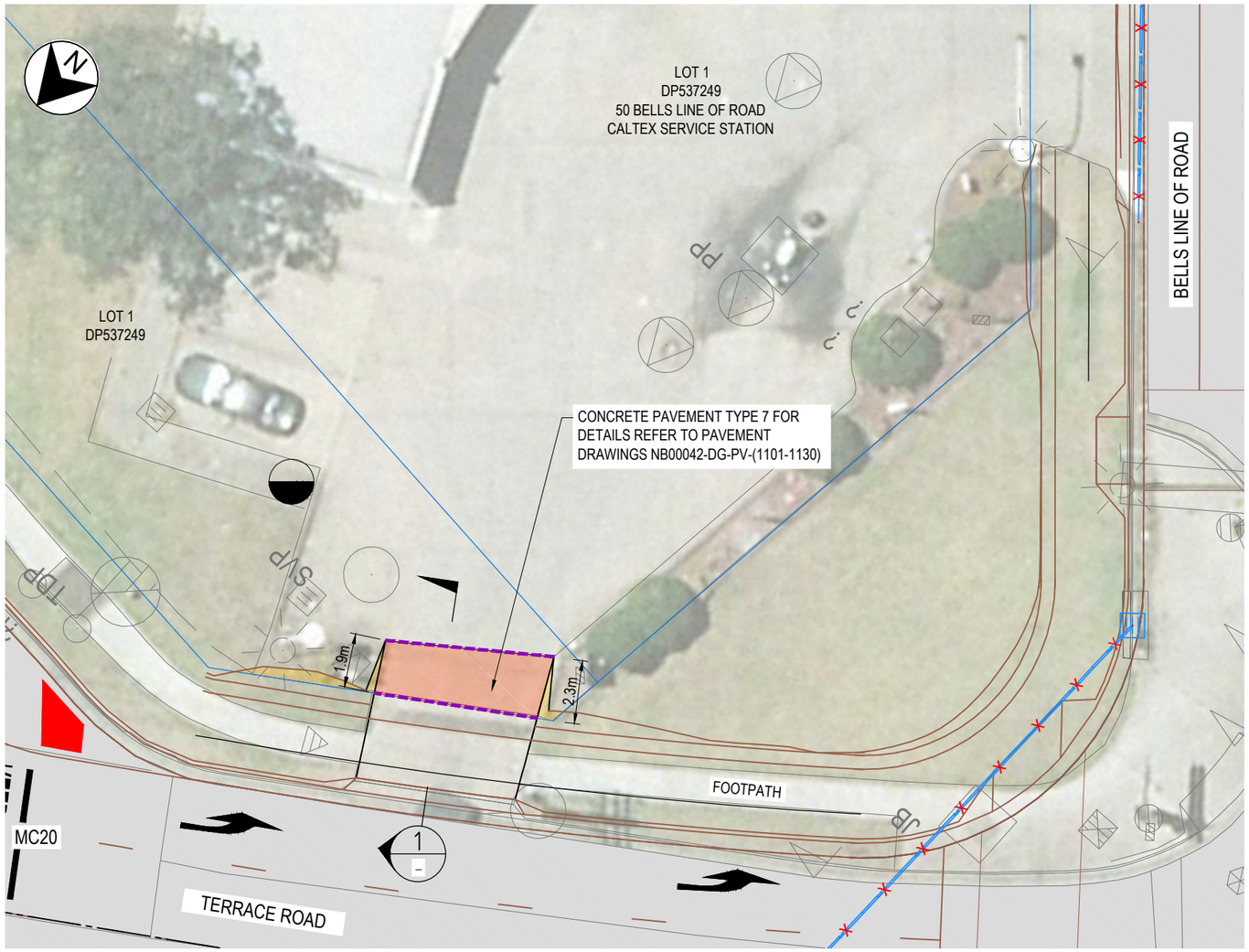
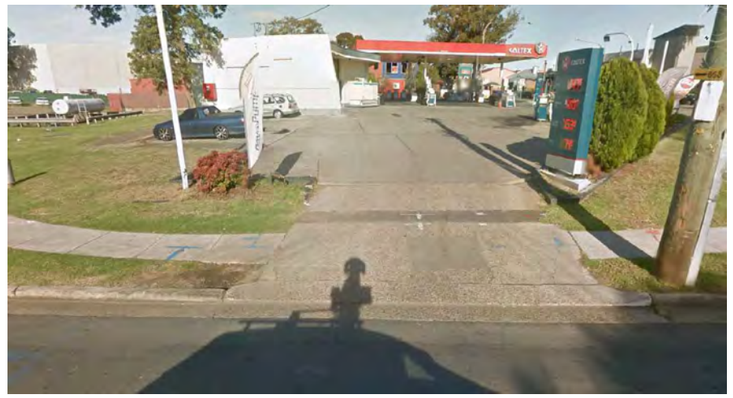
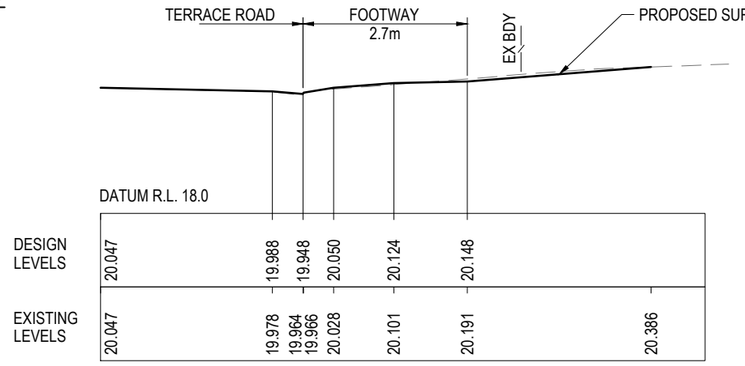


PLAN
PROPERTY ADJUSTMENTS
SCALE 1:200





SECTION 1
SCALE 1:100

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-1003.
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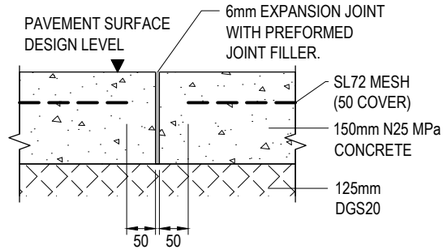

PAVEMENT EXPANSION JOINT
SCALE 1:10

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- 1 — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
- MC00 — CONTROL LINE
- PROPOSED BOUNDARY
- EXISTING BOUNDARY

PROPERTY ADDRESS:	50 BELLS LINE OF ROAD NORTH RICHMOND
LOT / DP:	LOT 1 / DP537249
OWNERS NAME:	CALTEX PETROLEUM PTY LTD

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

.....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
C	18.03.16	FINAL DETAIL DESIGN	ST	BDP	DB
B	16.12.15	DETAIL DESIGN	CM	BDP	DB
A	20.10.15	DETAIL DESIGN	SG	BDP	DB

TITLE	INITIAL	DATE
DRAFTSPERSON	CM	18.03.16
DRAFTING CHECK	SG	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	PC	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE — SCALE 1:200 — 2 0 2 4 — AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 — HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
St Leonards, SYDNEY, NSW 2065
AUSTRALIA
Tel: (02) 9928 2100 Fax (02) 9928 2500
Web: www.jacobs.com

PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
LOT 1, DP537249, 50 BELLS LINE OF ROAD
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PA-1051	C

0 | 5 | 10 | 15 | 20 | 25 mm ON A3 ORIGINAL

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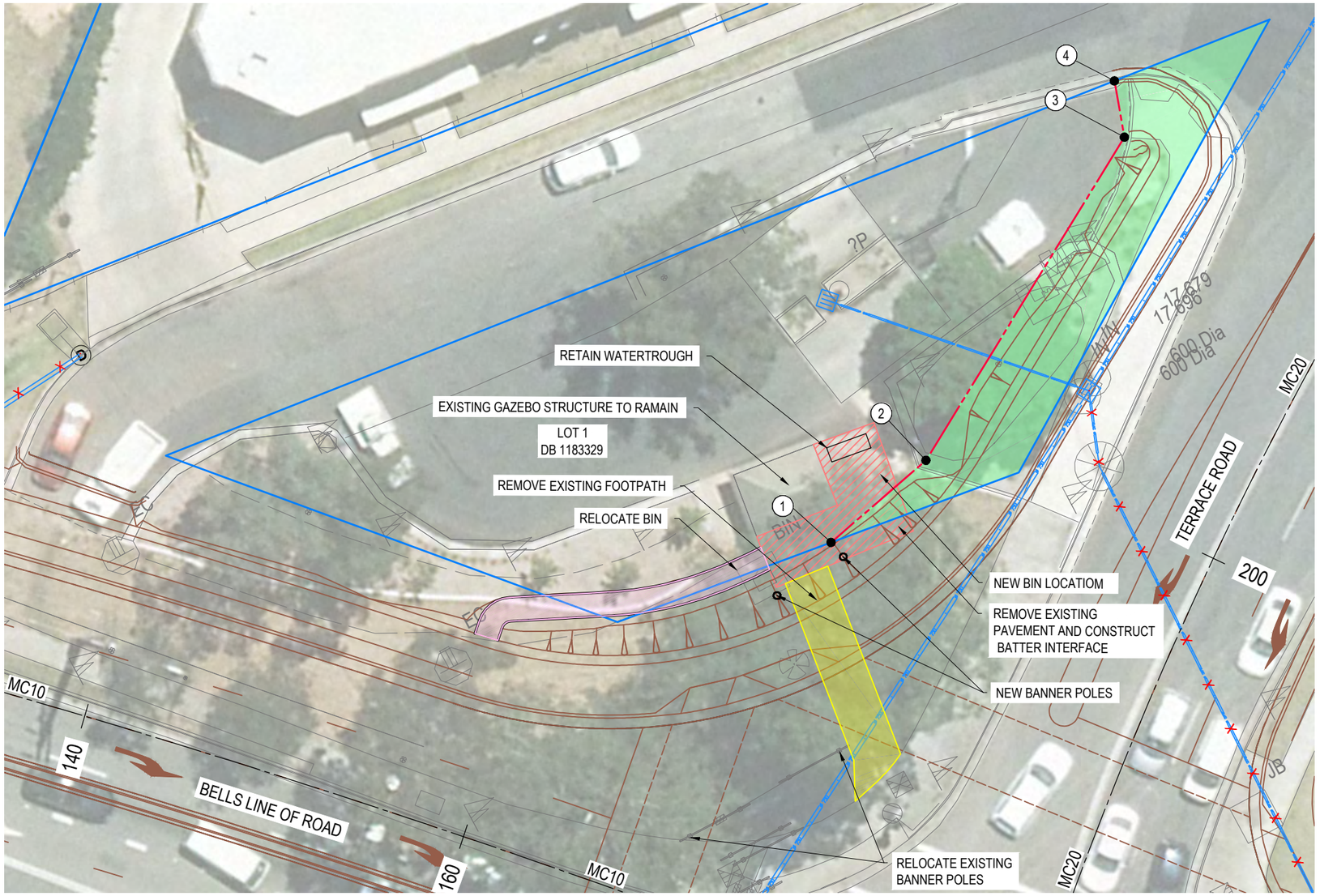

PLAN
PROPERTY ADJUSTMENT

SCALE 1:250

NOTES

1. FOR GENERAL NOTES REFER NB00042-W010-DG-RD-3003.
2. ALL WORK TO BE CARRIED OUT IN ACCORDANCE WITH RMS PROPERTY ADJUSTMENT SPECIFICATION R204. THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH OTHER DESIGN DRAWINGS AND ALL DISCREPANCIES REFERRED TO THE PRINCIPAL FOR DECISION BEFORE PROCEEDING WITH THE WORK.
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8. MAKE GOOD ANY DISTURBANCE CAUSED DURING THE ADJUSTMENT WORK.
9. CLEAN UP AND REMOVE BUILDERS WASTE FROM SITE GENERATED DURING THE ADJUSTMENT WORK.
10. MAINTAIN ACCESS TO PROPERTIES AT ALL TIMES.

LEGEND

GENERAL
- EXISTING PAVEMENT
- EXISTING BOUNDARY
- PROPOSED BOUNDARY

ALIGNMENT AND EARTHWORKS
- CONTROL LINE - MAIN ROAD
- MC00 — CONTROL STRING LABEL - MAIN ROAD
- 200 — CONTROL STATIONS - MAIN ROAD
- EARTHWORKS & GROUND INTERFACE

DRAINAGE AND WATER QUALITY - REFERENCE ONLY
- EXISTING STORMWATER PIPE
- STORMWATER PIPE, PIT AND HEADWALL

PROPERTY ADJUSTMENTS
- LOT 53 — LOT NUMBER
- DP 613620 — DEPOSITED PLAN NUMBER
- FENCE TO MATCH EXISTING
- EXISTING FENCE TO BE RETAINED
- EXISTING FENCE TO BE REMOVED
- GATE
- EXISTING GATE
- CONCRETE DRIVEWAY INSIDE PROPERTY
- EARTHWORKS DESIGN INSIDE PROPERTY
- PROPOSED ACQUISITION AREA
- ROAD BASE DRIVEWAY INSIDE PROPERTY
- FOOTWAY INSIDE PROPERTY
- NEW CONCRETE FOOTPATH
- EXPANSION JOINT
- EXISTING FOOTPATH

SETOUT
- 1 — SETOUT POINT AND LABEL

CROSS SECTION SYMBOLS
MC00 — CONTROL LINE | PROPOSED BOUNDARY | EXISTING BOUNDARY

SETOUT CO-ORDINATES

POINT	EASTING	NORTHING
1	288319.069	6282076.817
2	288323.094	6282080.395
3	288326.769	6282083.663
4	288328.059	6282105.962

PROPERTY ADDRESS: 1 TERRACE ROAD
NORTH RICHMOND, NSW 2754

LOT / DP: DB 1183329

OWNERS NAME:

The proposed property adjustments detailed in these plans are acceptable to me/us and I/we authorise the RMS and its agents to enter onto the property for the purpose of carrying out these works. The future maintenance of all completed adjustments within the property will be my responsibility.

PROPERTY OWNERS NAME .....

SIGNED .....

WITNESS ..... DATE .....

WITNESS NAME .....

REV	DATE	DESCRIPTION	DRAWN	REVIEWED	APPROVAL
B	18.03.16	FINAL DETAIL DESIGN	GS	BDP	DB
A	19.02.16	DETAIL DESIGN	GS	BDP	EDA

TITLE	INITIAL	DATE
DRAFTSPERSON	GS	18.03.16
DRAFTING CHECK	BDP	18.03.16
DESIGNER	DH	18.03.16
DESIGN CHECK	MJ	18.03.16
PACKAGE MANAGER	BDP	18.03.16
PROJECT MANAGER	DB	18.03.16

ORIGINAL DRAWING AT A3 SIZE
SCALE 1:250 — 2.5 0 2.5 5 — AT A3

CO-ORDINATE SYSTEM: MGA Zone 56 | HEIGHT DATUM: A.H.D.

CLIENT: NSW Government — Transport Roads & Maritime Services

CONTRACTOR: Downermouchel

DESIGNER: JACOBS
100 Christie Street
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AUSTRALIA
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PROJECT
HAWKESBURY CITY COUNCIL
RMS STEWARDSHIP MAINTENANCE CONTRACT - SYDNEY WEST
RICHMOND BRIDGE APPROACHES
PROPERTY ADJUSTMENT PLANS AND DETAILS
LOT 1, DP1183329, 1 TERRACE ROAD
SHEET 1

NOT FOR CONSTRUCTION

PHASE	RMS REGISTRATION No	
FDD	DS2014/005514	
STATUS	DRAWING No	REV
80%	NB00042-W010-DG-PA-1061	B

0 5 10 15 20 25 mm ON A3 ORIGINAL

This Drawing may have been prepared using colour and may be incomplete if copied

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Appendix C

Biodiversity assessment report, and threatened species assessment for the Grey-headed Flying Fox

RMS Maintenance Stewardship Contract, Richmond Approaches

ROADS AND MARITIME AUTHORITY

Biodiversity assessment

Final

8 July 2015

Document history and status

Revision	Date	Description	By	Review	Approved
Draft	28/07/2014	Draft Report No.1	J.Carr	S.Hudson	

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments

JACOBS

RMS Maintenance Stewardship Contract, Richmond Approaches

Project no:	NB00042.10
Document title:	Biodiversity assessment
Document no:	V.1
Revision:	Draft
Date:	28 July 2014
Client name:	Roads and Maritime Authority
Client no:	Client Reference
Project manager:	Chris Turnbull
Author:	Jonathan Carr
File name:	E:\SKM\WORKING\Richmond Bridge_NB00042.10\Report\Review_SH\NB00042 10_biodiversity_report_DRAFT_28072014_JC - SHReview 28Jul14.docx

Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
100 Christie Street
St Leonards NSW 2065 Australia
PO Box 164 St Leonards NSW 2065 Australia
T +61 2 9928 2100
F +61 2 9928 2500
www.jacobs.com

Contents

Appendix A. Threatened subject species assessment

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to identify biodiversity values of conservation significance as a specialist component of the Review of Environmental Factors (REF) and assess the impacts of the proposal on terrestrial and aquatic flora and fauna and advise ameliorative actions to avoid or minimise impacts on biodiversity in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

The list of flora and fauna species recorded from this study should not be seen to be fully comprehensive, but an indication of the species present at the time of the surveys. A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year for short periods (e.g. orchids or migratory birds) and require specific weather conditions for optimum detection (e.g. frogs and reptiles). The conclusions of this report have therefore based upon available data and the field surveys and are indicative of the environmental condition of the site at the time of the surveys.

The survey methods used were tailored to the site conditions, in particular the fauna surveys were opportunistic and focused on identifying the condition and suitability of the habitat for threatened fauna species known from the locality and predicted to occur. As the majority of surveyed vegetation was in close proximity to rural and residential properties, this restricted the types of equipment that could be used in terms of use of mammal traps or spotlighting for nocturnal fauna. For example, nocturnal call playback surveys and spotlight surveys were not deemed to be effective, especially due to the lack of hollow bearing trees on site. To address this limitation a precautionary approach was adopted whereby a species presence was assumed based on the presence of suitable habitat. Aquatic fish and macroinvertebrate surveys were not conducted, as suitable habitats were not present.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Background

The Richmond Bridge and Approaches congestion study was undertaken by RMS in order to investigate and recommend short term and long term solutions to address congestion.

The traffic analysis indicated that the Richmond Bridge is close to saturation traffic levels and is reaching the current capacity of the corridor. During morning and afternoon peak periods, the operation of Richmond Bridge is adversely affected by some of the turning movements on key approach intersections on Bells Line of Road.

1.2 Project description

Short term improvement of the travel conditions between Richmond and North Richmond through:

- Upgrade the Bells Line of Road/Grose Vale Road intersection;
- Upgrade the Kurrajong/Old Kurrajong Road intersection;
- Upgrade the Kurrajong/Bosworth Street intersection;
- Improve safety;
- Improve travel times in peak periods.

The proposed works include:

- At the Bells Line of Road/Grose Vale Road intersection:
  - Providing two dedicated right turn lanes from Grose Vale Road into Bells Line of Road (northbound and eastbound);
  - Providing a dedicated left turn lane from Bells Line of Road into Grose Vale Road;
  - Provision of two westbound through lanes on Bells Line of Road;
  - Extending the eastbound merge on Bells Line of Road;
  - Imposing a clearway on Bells Line of Road between Pitt Lane and Grose Vale Road during peak periods.
- At Kurrajong Road/Old Kurrajong:
  - Widening of the intersection to provide an exclusive right turn bay for eastbound and southbound movements for Kurrajong Road into Yarramundi Lane;
  - Providing a left slip lane out of Yarramundi Lane with a westbound acceleration lane on Kurrajong Road.
- At Kurrajong Road/Bosworth Street Intersection:
  - Widening the intersection to provide and exclusive eastbound right turn bay from Kurrajong Road to Bosworth Street;
  - Banning right turn movements from March Street to Bosworth Street North;
  - Providing a clearway on Kurrajong Road between Chapel Street and Bosworth Street during peak periods.

1.3 Study area

This report has assessed the potential biodiversity impacts within a ‘proposed works’ area. The proposed works is the extent of land that may be directly or indirectly affected by the upgrade and encompasses:

- The proposed three intersection upgrade.
- Indirect areas in the study area.

An overview of the proposed works has been shown in **Figure 1-1**.

The term 'study locality' has been used to define the ten kilometre area surrounding the proposed works that was used in database searches and desktop assessments (refer to **Section 2.2**).

1.4 Legislative context

The information presented in this report assesses the potential impacts on threatened species, populations, or ecological communities or their habitats in relation to State and Commonwealth environmental and threatened species legislation, namely the:

- NSW Environmental Planning and Assessment Act 1979 (EP&A Act);
- NSW Threatened Species Conservation 1995 (TSC Act);
- NSW Fisheries Management Act 1994 (FM Act);
- The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

1.4.1 Environmental Planning and Assessment Act 1979

Under Part 5 of the EP&A Act (section 111 and section 112), all proposals must include an assessment of threatened flora and fauna and their habitats that are likely to occur within the area of the activity or that may be indirectly affected by the construction and operation of an activity. The assessment must address whether the proposed activity 'is likely to have a significant effect' on the threatened biodiversity identified. In order to make this decision, a determining authority must consider the effect of an activity on:

- Threatened species, populations and ecological communities, and their habitats (listed under the TSC Act or FM Act) and whether there is likely to be a significant effect on these (as assessed under Part 5 of the EP&A Act);
- Critical habitat (listed under the TSC Act or FM Act);
- Any other protected fauna or protected native plants within the meaning of the NPW Act.

Section 5A of the EP&A Act outlines the seven factors that must be taken into account when deciding whether a proposal would be likely to have a significant impact on threatened species, populations or communities or their habitats (significance assessments).

1.4.2 Threatened Species Conservation Act, 1995

The TSC Act identifies threatened species, populations and ecological communities, as listed under Schedules 1, 1A and 2 that are to be identified as potential subject species and therefore require a significance assessment under section 5A of the EP&A Act. The TSC Act also lists Key Threatening Processes comprising matters that threaten the survival or evolutionary development of a species, population or ecological community.

1.4.3 Fisheries Management Act, 1994

The FM Act establishes provisions for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. This Act also covers the identification and management of key threatening processes which affect threatened species or could cause other species to become threatened.

The Minister for Fisheries would need to be notified of any proposed dredging or reclamation works (Part 7 Division of the FM Act), associated with the proposed upgrade in accordance with Section 199 of the Act.

1.4.4 State Environmental Planning Policy No. 14 – Coastal wetlands

The *State environmental planning policy no. 14 – Coastal wetlands* (SEPP 14) is a regulation which identifies significant wetlands in NSW which provide important ecosystem services and are valued by local communities. This regulation helps protect wetland habitat and wetland species. If a development requests the clearing, draining, filling or leveeing within a mapped SEPP 14 wetland, an environmental impact statements would need to be prepared and usually require wetland restoration works.

1.4.5 Environment Protection and Biodiversity Conservation Act 1999

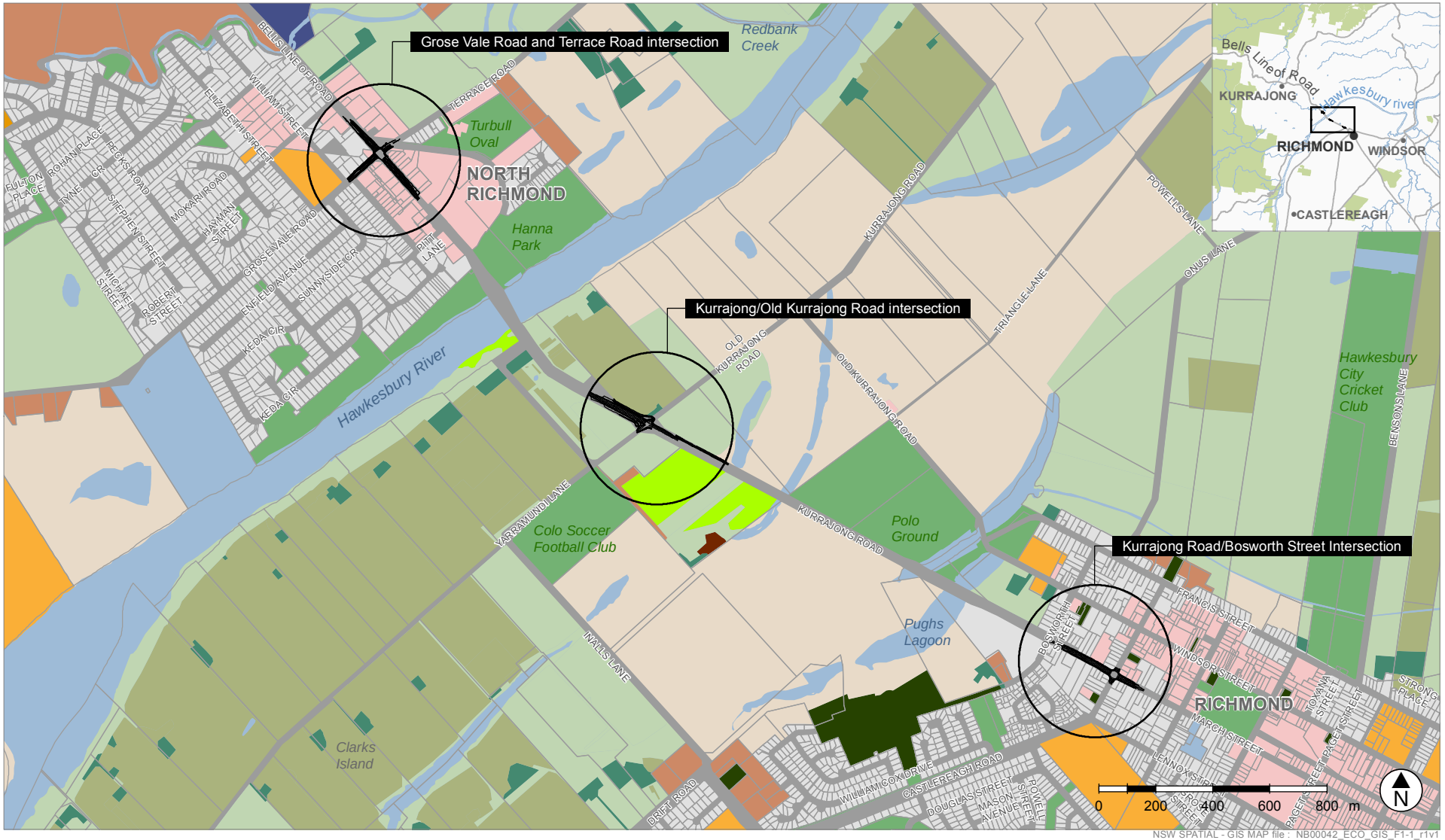
The EPBC Act objective is to protect the environment, particularly matters of national environmental significance (Matters of NES), and to provide an environmental assessment pathway for the development on Commonwealth land. It streamlines the national environmental assessment and approvals process, protects Australian biodiversity and integrates management of important natural and cultural places. The EPBC Act identifies nine Matters of NES:

- World Heritage properties;
- National heritage places;
- Wetlands of international importance (Ramsar wetlands);
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas;
- Nuclear actions (including uranium mining);
- Great Barrier Reef;
- Protection of water resources from coal seam gas development or large coal mining development.

The EPBC Act is triggered by actions that would be likely to have a significant impact upon Matters of NES. Under the EPBC Act, such actions require approval from the Commonwealth Environment Minister and should be referred to the Commonwealth Department of Environment (DoE) for consideration. Actions deemed by DoE to require Commonwealth approval would be 'controlled actions' which require an environmental assessment. The EPBC Act also lists Key Threatening Processes comprising matters that threaten the survival or evolutionary development of a native species or ecological community.

1.5 Study aims

This biodiversity assessment has been prepared as a specialist component of the Review of Environmental Factors (REF) to identify and assess the impacts of the proposal on terrestrial and aquatic flora and fauna and advise ameliorative actions to avoid or minimise impacts on biodiversity.



Land use

Conservation Area	Horticulture	Power Generation	Sewage disposal ponds
Farm Infrastructure	Industrial/commercial	Residential	Transport
Government and private facilities	Intensive Animal Production	River & Drainage System	Tree & Shrub Cover
Grazing	Landfill (garbage)	Rural residential	Urban recreation

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Figure 1-1
Project locality

2. Methodology

2.1 Personnel

Ecological surveys for the assessment were conducted under the (NSW) National Parks and Wildlife Act 1974 (NPW Act) (Scientific Research Permit SL100044) and Animal Research Authority (TRIM09/1895) maintained by the Principal Ecologist. The qualifications and role of personnel involved in the field assessments and reporting are provided in **Table 2-1**.

Table 2-1 Qualifications and role of key personnel

Personnel	Qualifications	Project tasks
Jonathan Carr	BEnvScMgt	Biodiversity assessment report, flora and fauna surveys
Simon Hudson	PhD (ecology) BSc(Hons) Certified Environmental Practitioner	Practice review

2.2 Database searches and literature review

A review of available ecological data and information sources was conducted as a preliminary assessment to identify and describe vegetation and habitat characteristics and spatial distributions of potential threatened species, populations and ecological communities listed under the TSC Act and EPBC Act.

2.2.1 Database search

The list of records of threatened biodiversity with potential to occur within the study area were reviewed for direct relevance to the proposed works by taking the present condition of habitat types into consideration in relation to the broader study area. A review of existing government databases was undertaken as the first stage of investigation. The following information was reviewed:

- Office of Environment and Heritage (OEH) Atlas of NSW Wildlife Database (post 1980 records) (OEH 2014a);
- OEH Threatened Species Profile Search (OEH 2014b);
- OEH Spatial Data Online Access (OEH 2014c);
- Department of Environment (DoE) Protected Matters Search Tool (PMST) (DoE 2014a);
- DoE online species profiles and threats database (DoE 2013b);
- DPI Noxious weed declarations for relevant LGAs (DPI 2013).

Existing ecological reports

- *Native vegetation of southeast NSW* (Tozer et al 2010);
- *The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities* (Tozer, 2003);
- *The Natural Vegetation of the Penrith 1:100 000 map sheet* (Benson, 1992).

2.3 Field survey and effort

A site visit was undertaken by a Jacobs ecologist on the 2 June 2014 to complement the background review and ground truth existing ecological constraints in relation to the proposed works. Field activities included:

- General traverses along the roadside to assess the presence of threatened ecological communities as listed under the TSC Act and EPBC Act.
- Opportunistic sightings of fauna including assessment of the value of the habitat for threatened fauna.
- Identification of fauna habitat such as hollow-bearing trees and nectar producing plants.

3. Existing Environment

3.1 Landscape context

The proposed works would upgrade three intersections from Richmond along Kurrajong Road and across the Hawkesbury River to North Richmond along Bells Line of Road.

The study area is wholly within the Sydney Basin Bioregion (Thackway and Creswell 1995; National Parks and Wildlife Service, 2003) and is within the Hawkesbury-Nepean Catchment Management Area. The bioregion consists of the Cumberland sub-region and is present in a landscape made up of low rolling hills and wide valleys in a rain shadow area below the Blue Mountains. At least three terrace levels are evident in the gravel splays, volcanics from low hills in the shale landscapes, and swamps and lagoons on the floodplain of the Nepean River (NPWS 2003). The variety of rock types, topography and climate provide one of the most species diverse bioregions in Australia.

The north of the study area (Cumberland sub region) is characteristic of low shale hills and loamy floodplains of the Nepean River. Shale soils support eucalypt woodlands of Grey Box (Eucalyptus moluccana), Forest Red Gum (*E. tereticornis*) and Narrow-leaved Ironbark (*E. crebra*) with occurrences of Spotted Gum (*Corymbia maculata*).

A statewide map of landscapes (Mitchell, 2003) includes classification of ecosystems, land features and existing natural resources for the Sydney Basin Bioregion. These are summarised in **Table 3-1** and includes an estimated proportion of cleared land for these landscapes as reported in CMA & OEH (2007).

Table 3-1 NSW landscapes in the Sydney Bioregion

Mitchell (2003) ecosystems	Landscape characteristics (geomorphic, pedologic and vegetation)	Percentage cleared (CMA & OEH, 2007)
Cumberland	**Hawkesbury - Nepean Terrace Gravels**: Three levels of river terrace dating into the Tertiary. General elevation 20 to 45m, local relief 10m. Planar, poorly drained terraces with harsh texture-contrast soils and heavy clays in swamps and cut-off meanders. In places deep sands of crevasse splays support scribbly gum *(Eucalyptus sclerophylla*), narrow-leaved apple (*Angophora bakeri*) and old man banksia (*Banksia serrata*) on podsols with adjacent sedgelands. Most clay-based soils (harsh texture contrast profiles) are very gravelly and carry broad-leaved ironbark *(Eucalyptus fibrosa* ssp.*fibrosa*) and narrow-leaved ironbark *(Eucalyptus crebra*), grey box *(Eucalyptus moluccana*), paperbarks (*Melaleuca* sp.) and drooping red gum *(Eucalyptus parramattensis*). Several vegetation communities are now rare especially that on the Pliocene/Pleistocene sand body with podsol soil profiles at Agnes Banks.	67

Mitchell (2003) ecosystems	Landscape characteristics (geomorphic, pedologic and vegetation)	Percentage cleared (CMA & OEH, 2007)
	Hawkesbury - Nepean Channels and Floodplains: Meandering channel and moderately wide floodplain of the Hawkesbury and Nepean rivers on Quaternary sand and gravel. Sand is dominant upstream of the Warragamba River junction, general elevation 0 to 20m, local relief <10m. Undifferentiated alluvial sand to poorly structured gradation profiles of sandy loam or clay loam. Forests on the river flats include blue box *(Eucalyptus baueriana*), broad-leaved apple (*Angophora subvelutina*), manna gum *(Eucalyptus viminalis*), river peppermint *(Eucalyptus elata*) in upstream sectors and dominated by river oak (*Casuarina cunninghamiana*) possibly originally with rainforest species such as white cedar (*Melia azedarach*) in the lower sectors. Common reed (*Phragmites australis*), cumbungi (*Typha orientalis*) and other aquatic plants are found in the river. Deep organic loams and loamy sands on floodplain with river flat forest of Sydney blue gum *(Eucalyptus saligna*), round-leaved gum *(Eucalyptus deanei*), forest red gum *(Eucalyptus tereticornis*), cabbage gum *(Eucalyptus amplifolia*), broad-leaved apple, rough barked apple (*Angophora floribunda*) and river oak. Water gum (*Tristaniopsis laurina*) in protected channel sections. Large swamps and lagoons on the floodplain and in tributary streams below Richmond dammed by levees on the main stream support tall spike rush (*Eleocharis sphacelata*), *Juncus* sp., *Melaleuca* sp., and *Lepidosperma* sp. Below Pitt Town the river is tidal and swamp oak (*Casuarina glauca*), common reed, river mangrove (*Aegiceras corniculatum*), grey mangrove (*Avicennia marina*) and limited salt marsh are found on the muddy sands of the inter-tidal zone.	79

3.2 Landuse

The project traverses the Hawkesbury City Council Local Government Area (LGA). The majority of the study area is located within developed and disturbed land in the form of residential and agriculture.

3.3 Vegetation communities and habitat

Literature review

A review of spatial vegetation data and reports within a 2 kilometres of the study area reveals the potential presence of six native vegetation communities. Five are listed under the TSC Act and EPBC Act (refer to **Table 3-2**).

Table 3-2 Summary of native vegetation communities known within and surrounding the study area

Tozer et al (2010)	Benson (1992)	Biometric Vegetation Type (OEH 2012)	Conservation status	Percentage cleared (%) up to 2010 (Tozer)
Cumberland River Flat Forest (FoW p33)	River-flat Forest (9f)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	*River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions* listed as endangered under the TSC Act	80-95

Cumberland Shale Sandstone Transition Forest (GW p2)	N/A	Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin	*Shale/Sandstone Transition Forest* listed as critically endangered under both TSC Act and EPBC Act.	60-80
Cumberland Shale Plains Woodland (G Wp29)	Grey Box Woodland (10c)	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	*Cumberland Plain Woodland in the Sydney Basin Bioregion* listed as critically endangered under TSC Act *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* listed as critically endangered under EPBC Act	75-95
Castlereagh Shale-Gravel Transition Forest (p502)	Shale/Gravel Transition Forest (9d)	Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin	*Shale Gravel Transition Forest in the Sydney Basin Bioregion* listed as critically endangered under TSC Act *Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* listed as critically endangered under EPBC Act	65-75
Coastal Freshwater Lagoon (p313)	Freshwater Reed Swamps (28a)	Coastal freshwater lagoons of the Sydney Basin and South East Corner	*Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* listed as endangered under the TSC Act	30-70
Sydney Hinterland Transition Woodland (p146)	N/A	Red Bloodwood - Grey Gum woodland on the edges of the Cumberland Plain, Sydney Basin	Not listed	20-40

Field survey

A site visit verified the type, extent, condition and conservation status of vegetation in the study area. Native vegetation is scarce and habitat has been highly modified from land clearing for agriculture and urban development. Vegetation and habitat for all intersection locations are described below.

Kurrajong Road/Bosworth Street Intersection

The Kurrajong Road/Bosworth Street Intersection consists of mixed plantings of exotic and native trees such as Crepe Myrtle (*Lagerstroemia indica*), Broad leaved Paperbark (*Melaleuca quinquenervia*) and Milk-flower Cotoneaster (*Cotoneaster coriaceus*) on roadsides and has maintained gardens on footpath and in residential lots (refer to **Figure 3-1**). No important wildlife habitat resources were observed.

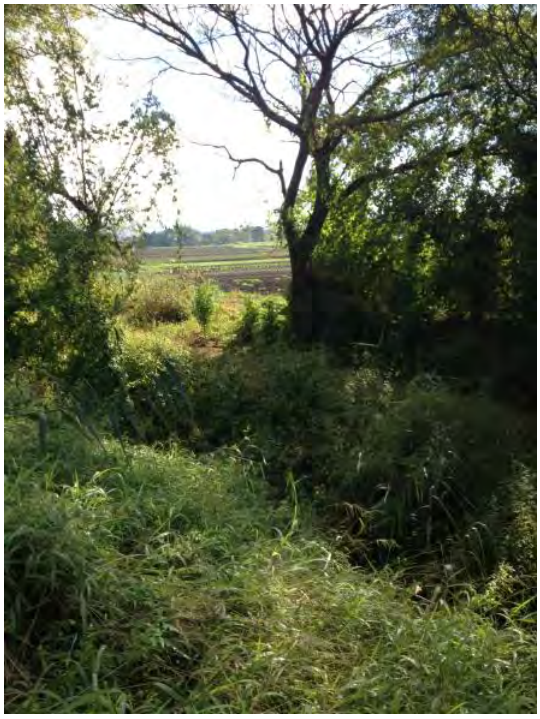
Kurrajong/Old Kurrajong Road intersection

This intersection is dominated by planted and introduced exotic vegetation adjacent to farmland and a Paulownia plantation on the floodplain. On the eastern side, planted rows of deciduous Alder (*Alnus* sp.) and Elm trees (*Ulmus* sp.) line the roadside with a regularly maintained groundcover of exotic grasses and herbs such as Vazey grass (*Paspalum urvillei*), Plantago (*Plantago lanceolata*), Catsear (*Hypochaeris radicata*) and Cobbler's Pegs (*Bidens Pilosa*). There have also been some recent plantings of native trees such as Tallowwood (*Eucalyptus microcorys*) and Magenta Lilly Pilly (*Syzygium paniculatum*) which is listed as endangered under the TSC Act and vulnerable under the EPBC Act. However this species is outside of its natural habitat.

Exotic weeds dominate on the west side of the intersection. Species include Large leaved privet (*Ligustrum lucidum*), African lovegrass (*Eragrostis curvula*), Balloon Vine (*Cardiospermum grandiflorum*), Moth Vine (*Araujia sericifera*) Wall Fumitory (*Fumaria muralis*) and Lantana (*Lantana camara*). A drainage line runs parallel to the road which consists of the native Common Reed (*Phragmites australis*) and Coast Myall (*Acacia binervia*) and introduced Kikuyu (*Pennisetum clandestinum*) (refer to **Plate 1**)

There are a number of remnant Swamp Oak (*Casuarina glauca*) trees around the intersection; one tree in particular contains 8 small medium sized hollows (refer to **Plate 2** and **Figure 3-2**) and may provide roosting habitat for native wildlife, particularly microchiropteran bats. These trees also have a high abundance of parasitic mistletoe (*Amyema* sp.) which provides a good nectar resource for nectar feeding birds and mammals. There were no native fauna observed on site, a high abundance of pest species Common Starling (*Sturnus vulgaris*) and Indian Myna (*Acridotheres tristis*) were observed and may occupy these Swamp Oak hollows.

This location was probably once River-flat Eucalypt Forest interlinking with freshwater wetlands prior to land clearing. This is indicated by some remaining native species such as Swamp Oak, Coast Myall and Native Raspberry (*Rubus parvifolius*).



- **Plate 1. Disturbed drainage line adjacent to Kurrajong Road.**

- **Plate 2. Single remnant hollow bearing Swamp Oak on Old Kurrajong Road.**

Bells Line of Road/Grose Vale Road intersection

Remnant trees and planted exotic and native trees occur at this intersection. On the North West side, two remnant Forest Red Gums (*Eucalyptus tereticornis*) grow close to the road (refer to **Plate 3**), Narrow leaved Ironbark (*Eucalyptus crebra*) and a planted Lemon scented Gum (*Corymbia citriodora*) also occur in the area. Exotic trees include Jacaranda (*Jacaranda mimosifolia*) and Crepe Myrtle. Along the Bells Line of Road further east of the intersection, there is a row of eight remnant Forest Red Gums within the median strip (refer to **Figure 3-3**).

The Forest Red Gums and Narrow leaved Ironbarks are likely remnants of Cumberland Plain Woodland (listed as critically endangered under the TSC Act and EPBC Act), however the area has been highly modified and does not constitute an ecological community. These trees have conservation value as 'stepping stones' for maintaining wildlife habitat connectivity in the landscape and as a genetic resource for recovery of the Cumberland Plain Woodland.

- **Plate 3. Two remnant Forest Red Gums proposed for removal at the Bells Line of Road/Grose Vale Road intersection.**

3.4 Threatened Ecological Communities

Although the Kurrajong/Old Kurrajong Road intersection and Bells Line of Road/Grose Vale Road intersection were once part of River-flat Eucalypt Forest and Cumberland Plain Woodland, the condition of these ecological communities has become highly degraded and replaced with urban sprawl and agricultural landscapes. Therefore, all intersection areas do not constitute as viable threatened ecological communities. There are however three known threatened ecological communities within 1 kilometre of the proposed works. These include:

- *Cumberland Plain Woodland in the Sydney Basin Bioregion* (listed as critically endangered under the TSC Act).
- *Shale/Sandstone Transition Forest* (listed as endangered under the TSC Act).
- *Freshwater wetlands on coastal floodplains of the Sydney Basin Bioregion* (listed as endangered under the TSC Act).

Figure 3-1
Vegetation at Kurrajong Road/Bosworth Street Intersection

Figure 3-2
Vegetation and biodiversity values at Kurrajong/Old Kurrajong Road intersection

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Proposed project design - Intersection with Grose Vale Road and Terrace Road

Vegetation communities

Exotic plantings

Native vegetation

Habitat trees

Remnant tree

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Figure 3-3
Vegetation and biodiversity values at Grose Vale Road and Terrace Road intersection

3.5 Threatened species and endangered populations

3.5.1 Threatened flora

A total of 31 threatened flora species have been previously recorded within 10 kilometres of the study area. These species and an assessment of their likely presence in the proposed works area are provided in **Table A-2** in Appendix A. Of these 31 species identified in the background review the assessment has revealed that all species are considered to have a low potential or are unlikely to occur based on these species being non-cryptic species that were not identified during the field surveys or the absence of suitable habitat for these species.

3.5.1 Threatened fauna

A total of 55 threatened terrestrial and aquatic fauna species have been recorded from a 10 kilometre radius of the study area or have been identified as potentially occurring, and these are listed in **Table A-3** in Appendix A. These 59 species include 32 bird species, 17 mammals, five amphibians, one reptile, two fish species and two invertebrate. The majority of the species are considered unlikely or have a low potential to occur (54 species) and 1 species are considered to have a moderate potential to occur based on the habitats present and their condition.

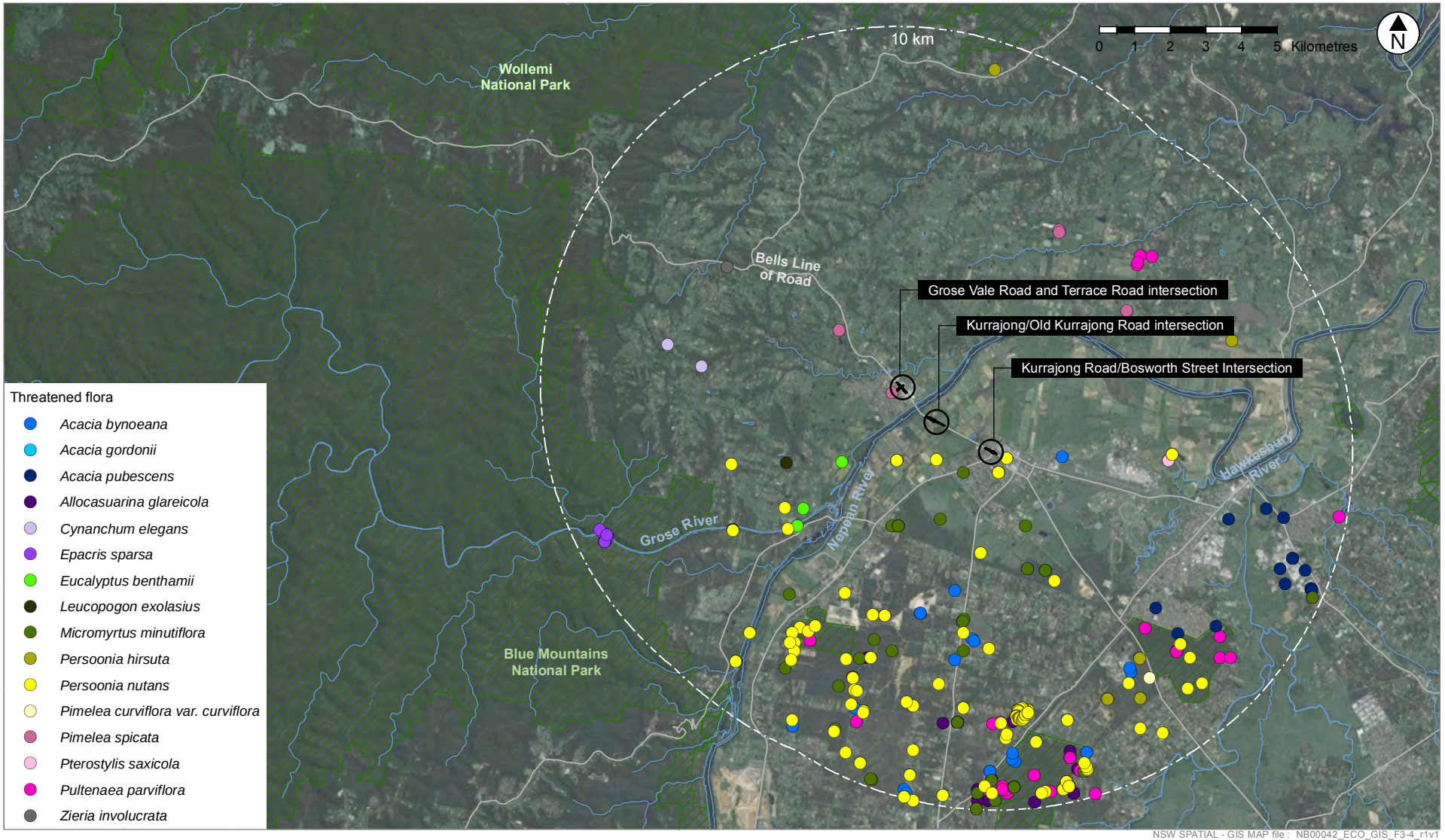
There is a known Grey-Headed Flying-Fox (*Pteropus poliocephalus*) camp at Yarramundi, approximately 6 kilometres from the study area. Although there is a known Grey-headed Flying-fox camp at Yarramundi, the study area provides minimal feeding habitat for the Grey-headed Flying-fox listed as vulnerable (TSC Act and EPBC Act). Forest Red Gums and a high abundance of mistletoe on one Swamp Oak in the study area are potential food resources for this species. The Forest Red Gum is considered a significant food tree species with a high nectar production and good annual flowering reliability (Eby and Law 2008). Individuals are expected to occasionally fly over study area at dawn and dusk. Threatened species assessments were undertaken for this species as outlined under Section 5A of the EP&A Act (known as the 7-part test) and in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (SIG 1.1) (DoE 2013). These assessments concluded the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox (*Pteropus poliocephalus*) (Appendix B and Appendix C).

3.6 Migratory and marine species

A total of 15 migratory species were identified from the background searches. The list of these species is detailed in **Table A-4** of Appendix A.

3.7 Wildlife connectivity

There are no major wildlife corridors within the proposed works. The Hawkesbury River would act as an important connection for a variety of fish and birds; however it is outside the area of proposed works.



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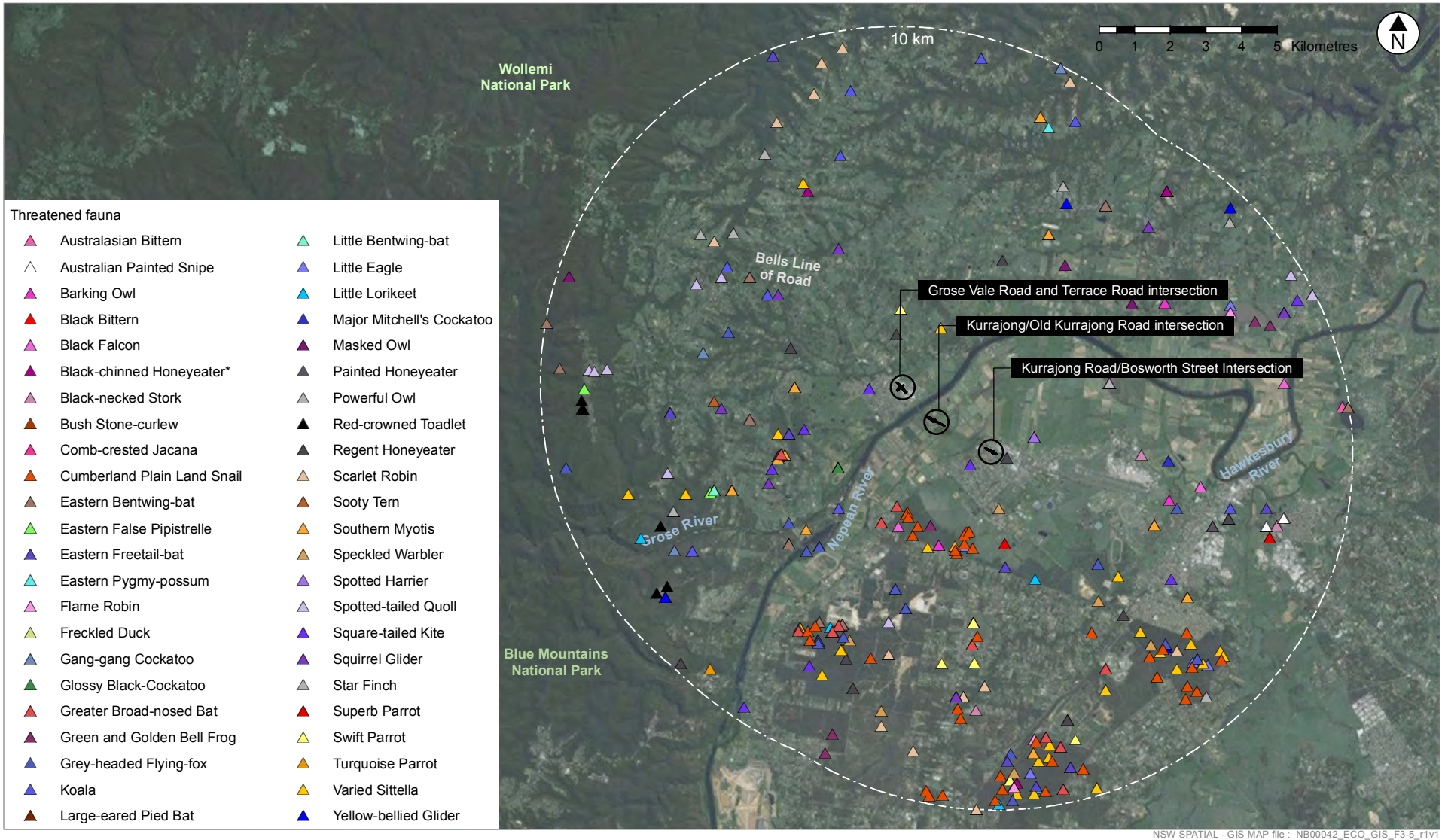
Source: Atlas of NSW Wildlife - Office of Environment & Heritage 2014

Figure 3-4
Threatened flora records in the study locality



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* eastern subspecie
Source: Atlas of NSW Wildlife - Office of Environment & Heritage 2014

Figure 3-5
Threatened fauna records in the study locality

4. Potential impacts

4.1 Loss of vegetation/habitat

All vegetation and habitats are in very poor condition and there would be minor clearing of existing native vegetation. There would be no clearing of vegetation at Kurrajong Road/Bosworth Street Intersection. Exotic vegetation is likely to be removed at the Kurrajong/Old Kurrajong Road intersection. The proposed works are likely to remove two mature Forest Red Gum trees at the Bells Line of Road/Grose Vale Road intersection. Existing habitat such as hollow bearing trees and vegetation cover are not expected to provide important resources for threatened fauna species in the region. No hollow bearing trees would be removed as part of the proposed works.

Indirect impacts to adjacent vegetation and habitats such as TEC's are not expected as the proposed works would be minor and any sediment runoff or weed invasion would be mitigated with controls (refer to section 5).

The Magenta Lilly Pilly trees are located outside of the proposed works. Due to the fact that this species are planted and do not naturally occur in this location the proposal would not impose a significant impact and there is no requirement for assessment of significance under the EP&A Act or the EPBC Act.

Grey-headed Flying Fox habitat

The proposal would result in minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of the two Forest Red Gums (*Eucalyptus tereticornis*) from the north-western side of the Bells Line of Road/Grose Vale Road intersection. Considering the presence of a Grey-headed Flying-fox camp at Yarramundi (6 kilometres from study area), threatened species assessments were undertaken as outlined under Section 5A of the EP&A Act (known as the 7-part test) and in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (SIG 1.1) (DoE 2013) and are presented in Appendix B and Appendix C. Forest Red Gums and a high abundance of mistletoe on one Swamp Oak in the study area are potential food resources for this species. The proposed works would not require the removal of the Swamp Oak with high densities of mistletoe and hollows. However two Forest Red Gums are likely to be removed. The loss of these trees is not likely to impact on the presence of the Grey-headed Flying-fox or affect their feeding regime and/or life cycle. No camps or other important habitat will be impacted. The Grey-headed Flying-fox is expected to fly over the study area and may occasionally forage within the study area as they move to more productive habitats in the broader landscape. Assessments of significance concluded that the proposal is unlikely to have a significant impact on this species.

4.2 Wildlife connectivity and habitat fragmentation

The study area does not include any land identified that forms part of a regional biodiversity corridor. The study area is already highly fragmented; the removal of two remnant trees and exotic vegetation would not significantly increase habitat fragmentation.

4.3 Injury and mortality

Given the lack of fauna observed across the study area, together with the mobility of the species that may exist in the area, it is unlikely that species would suffer injury and mortality as a result of the proposed works.

4.4 Weeds

There was a high abundance of weeds recorded in the study area, four of which are declared noxious in the Hawkesbury City Council LGA and are listed in **Table 4-1**.

Table 4-1 Noxious weed species declared in the Hawkesbury City Council LGA

Species	Prevalence on site	Noxious class and control requirements
African Boxthorn *Lycium ferocissimum*	Recorded in moderate-high abundance within numerous patches of native remnant vegetation.	Class 4: The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed. Weed of national significance.
Blackberry *Rubus fruticosus* aggregate species	High abundance throughout the study area. Common and Widespread.	Class 4: The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed. Weed of national significance.
Bridal Creeper *Asparagus asparagoides*	Moderate abundance, mostly in Riparian Woodland	Class 4: The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed. Weed of national significance.
Lantana *Lantana camara*	High abundance throughout the study area. Widespread.	Class 4: The growth of the plant must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction and the plant must not be sold propagated or knowingly distributed. Weed of national significance.

4.5 Pests and pathogens

There were 3 pest species recorded in the study area including Indian Myna, Common Starling and House Sparrow (*Passer domesticus*). These species are not expected to further increase in abundance as a result of this project. Several pathogens known from NSW have potential to impact on biodiversity as a result of their movement and infection during earthworks on construction projects. Of these, three are listed as a key threatening process under either the EPBC Act and/or TSC Act including:

- Dieback caused by Phytophthora (Root Rot; EPBC Act and TSC Act).
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and TSC Act).
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (TSC Act).

The Phytophthora (*Phytophthora cinnamomi*) root rot fungus is known to occur in Castlereagh Nature Reserve approximately 8 kilometres from study area. However, Windsor Downs Nature Reserve and Agnes Banks Nature Reserve, approximately 5 kilometres from the study area have negative results for the pathogen (Hawkesbury-Nepean Catchment Management Authority, 2008).

4.6 Changed hydrology

The proposed works are unlikely to significantly alter hydrology such that it impacts upon native biodiversity at all sites.

4.7 Groundwater dependent ecosystems

Groundwater is likely to support exotic vegetation at the Kurrajong/Old Kurrajong Road intersection. The proposed works are unlikely to alter or impede groundwater dependent ecosystems.

There are two SEPP 14 wetland areas in the study locality. Pughs Lagoon (approximately 750 metres east of study area) and the Hawkesbury River (approximately 350 metres west of the study area) are obligate GDEs and occur in close proximity to the study area. The project is unlikely to alter the hydrology regime associated with groundwater. There is potential for surface water sedimentation and contamination as a result of construction in adjacent drainage lines. However this would be minor and mitigation measures would be implemented to ensure that contaminated surface water is not transported into sensitive ecosystems.

4.8 Aquatic impacts

Aquatic environments in the form of wetlands and the Hawkesbury River occur east and west of Kurrajong/Old Kurrajong Road intersection. The proposed works would be minor and any sediment runoff would be mitigated with controls (refer to Section 5).

4.9 Noise, vibration and light

Given the low habitat potential of the study area it is unlikely that noise, vibration or light associated with the proposed works will have an adverse impact on the surrounding flora and fauna. Should microchiropteran bats move into any of the hollows in the Swamp Oak at Kurrajong/Old Kurrajong Road intersection, the noise, vibration and light would not change as a result of the proposed works.

4.10 Impact on relevant key threatening processes

The proposal would be associated with two key threatening processes listed under the TSC Act and one listed under the EPBC Act:

1) Clearing of native vegetation (this would be restricted to remnant Forest Red Gum trees at Bells Line of Road/Grose Vale Road intersection.

2) Invasion of native plant communities by exotic perennial grasses.

   The proposal has the potential to increase the risk of invasion and spread of the weeds within the study area. African lovegrass (*Eragrostis curvula*) is an exotic perennial grass in the study area which readily colonises overgrazed and disturbed sites such as roadsides and railway lines. It can form dense monocultures, increase fuel loads and limit native species regeneration. Works would physically remove vegetation from the construction corridor and disturb the soil. If left unmanaged there would be a high potential for these works corridors to become sites for invasion and spread of perennial grasses.

4.11 Cumulative impacts

The proposed works are minor and require minimal vegetation removal in a degraded landscape. The project is not likely to contribute to a significant impact when combined with other developments in the area.

4.12 Coastal wetlands

The Hawkesbury River and other associated freshwater wetlands such as Pughs lagoon and floodplain wetlands (SEPP 14 wetlands) are present within the vicinity Kurrajong/Old Kurrajong Road intersection. There is potential for surface water sedimentation and contamination as a result of construction in adjacent drainage lines. However this would be minor and mitigation measures would be implemented to ensure that contaminated surface water is not transported into sensitive ecosystems. Changes to the current hydrology regime would be minor and are unlikely to affect associated aquatic habitats (floodplain wetlands) and would not impose a significant impact. Refer to **Table 5-1** and Guide 10 (RTA 2010) for measures to minimise impacts.

5. Mitigation measures

The RMS Corporate Plan: Blueprint Update (2011) states RMS 'will reduce the impact of road projects on the natural and social environment'. The RMS Biodiversity Guidelines (RTA 2011) respond to the RMS' corporate commitments by addressing biodiversity management. In managing biodiversity, RMS aims to:

- **Avoid** and minimise impacts first.
- **Mitigate** impacts where avoidance is not possible.
- **Offset** where residual impacts cannot be avoided.

The following mitigation measures have been recommended for implementation during the construction and operation of the proposed works (**Table 5-1**). Measures to be adopted are in accordance with the *Biodiversity Guidelines Protecting and managing biodiversity on RTA projects* (RTA 2011).

Table 5-1 Recommended mitigation measures during construction and operation

Item	Timing	Mitigation measure
Site personnel induction	Pre-construction	Ensure that all staff working on the proposal have an awareness of the ecological sensitivity of the site by educating staff at the induction phase on items such as: • Potential for the presence of fauna in hollows of trees requiring removal and small reptiles under logs and rocks requiring removal. • Proposed site environmental procedures (pre-clearing fauna checks, appropriate branch lopping to manage hollows, vegetation management, sediment and erosion control, protective fencing, noxious weed management). • What to do in case of emergency (chemical spills, fire, injured fauna). • Key contacts in case of environmental emergency.
Site planning	Pre-construction	• Locate temporary infrastructure (plant sites and offices etc.) in cleared areas away from vegetation, outside of the dripline of trees. Erect bunting around the dripline of trees to prevent access. • Where possible locate infrastructure in a manner which minimises the removal of mature trees.
Identification of clearing limits (Guide 2)	Pre-construction	• Accurately and clearly mark out the limits of clearing and native trees/vegetation to be retained in the construction zone. • Install protective fencing (para-web fencing or similar) through native vegetated sections of the proposal footprint to minimise the potential for accidental incursion.
Pre-clearing fauna survey (Guide 1 and 9)	Pre-construction	• Once construction areas have been surveyed and marked, a suitably qualified fauna ecologist should undertake a pre-clearing survey to identify the presence of hollow-bearing trees and habitat trees within the work area and mark these trees with spray paint. • An ecologist should be present during the clearing of these habitat trees to handle and relocate any injured fauna. • WIRES should be consulted if any injured fauna are encountered.
Management of erosion and sediment control (Guide 10)	Pre and during construction	• Provide sediment and erosion controls to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways, vegetation and fauna habitat. • Clearly identify stockpile and storage locations and provide erosion and sediment controls around stockpiles.
Management of fauna habitat (Guide 5)	Construction	• Fallen logs encountered within the works corridor should be retained and scattered throughout the remaining habitats at the site. This should be conducted using the most sensitive manner possible (i.e. not piled up in a heap at the edge of the road or shoved into the woodland with a bulldozer). • Timber felled for clearing should be retained on the ground as cover for terrestrial fauna.

Item	Timing	Mitigation measure
Clearing of native vegetation (Guide 4)	Construction	• Avoid the removal of trees with hollows (alive or dead) where practicable. Where removal cannot be avoided for WH&S reasons, maintain the tree intact (as far as possible) and place it on the ground in adjoining vegetation. • Topsoil collected during excavation should be stockpiled for later use in order to retain the soil seed bank.
Weed management (Guide 6)	Pre and during construction	• Establish a weed management protocol] • All weeds which are cleared as part of the proposal must be disposed of appropriately. • Implement inspection/maintenance procedures to reduce the carriage of weed material on machinery. • If root rot fungus is identified in the study area, implement basic hygiene protocols to reduce the risk of spreading pathogens and invasive plants.
Rehabilitation (Guide 3)	During and post construction	• With the removal of remnant trees, these should be replaced and regrown in an adjacent reserve or regional park using the same seed source to maintain genetic resources. • Rehabilitate disturbed areas to the previous land-use. Exotic pasture should be returned to exotic pasture, while areas of native vegetation should be rehabilitated with locally indigenous species, not exotic lawn grass seed.

6. Conclusion

6.1 Key findings of the assessment

The study area supports a disturbed landscape with very poor condition vegetation, dominated by exotic vegetation and some native remnant trees. The vegetation and habitat is not at an adequate level of condition to be considered threatened ecological communities. The study area is unlikely to support threatened flora species. There would be removal of two remnant Forest Red Gum trees at Bells Line of Road/Grose Vale Road intersection, which represent suitable foraging habitat for the Grey-headed Flying Fox (*Pteropus poliocephalus*) listed as vulnerable (TSC Act and EPBC Act). Assessments of significance concluded the proposal is unlikely to result in a significant impact to this species. The Swamp Oak hollow bearing tree at Kurrajong/Old Kurrajong Road intersection will not be impacted by the proposed works. As the surrounding native vegetation and habitat is generally absent there would be no impact on threatened ecological communities.

The proposed works to upgrade the road edge at intersection locations is not likely to significantly impact upon the biodiversity of the study area. However, it will be necessary to avoid, minimise and mitigate the impacts of the project on potential habitats and remnant vegetation. Wherever possible, the project would aim to avoid impacting natural vegetation cover, removing only those trees in direct contact with the design process. It is also advised to follow the ecological mitigation measures when removing/altering native trees and implementing sediment and erosion controls to manage potential contaminated surface water runoff into drainage lines during construction. If mitigation measures are followed correctly there will be a reduced risk of indirect impacts affecting adjacent waterways and wetlands.

7. References

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Appendix A. Threatened subject species assessment

The following assessment identifies the list of threatened flora and fauna species recorded from a 10 km radius of the project and compares the preferred habitat of these species with the habitats identified in the study area to make an assessment of the likelihood of the species being present in the project study area (ie. subject species). The criteria used in the assessment are detailed in **Table A-1**.

Table A-1 Likelihood of occurrence includes one or more of the following criteria

Likelihood of occurrence	Criteria
Unlikely	• Species highly restricted to certain geographical areas not within the Project area • Specific habitat requirements are not present in the study area
Low	• Species not recorded during field surveys and fit one or more of the following criteria: • Have not been recorded previously in the study area/surrounds and for which the study area is beyond the current distribution range • Use specific habitats or resources not present in the study area • Are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded
Moderate	• Species not recorded during the field surveys that fit one or more of the following criteria: • Have infrequently been recorded previously in the study area/surrounds • Use specific habitats or resources present in the study area but in a poor or modified condition • Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration • Are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded
High	• Species recorded during the field surveys or species not recorded that fit one or more of the following criteria: • Have frequently been recorded previously in the study area/surrounds • Use habitat types or resources that are present in the study area that are abundance and/or in good condition within the study area • Are known or likely to maintain resident populations surrounding the study area • Are known or likely to visit the site during regular seasonal movements or migration

Table A-2 Threatened flora potentially occurring in the study area

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Acacia bynoeana	E	V	Low	28 OEH, PMST	Found in central eastern NSW, from the Hunter District south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra. Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*Eucalyptus haemastoma*), Drooping Red Gum (*E. parramattensis*), Old Man Banksia (*Banksia serrata*) and Small-leaved Apple (*Angophora bakeri*).
Acacia gordonii	E	E	Low	2 OEH	Restricted to north-west Sydney occurring in the lower Blue Mountains to Maroota/Glenorie area. 2000 individuals are thought to occur. Grows in dry sclerophyll forest and heathlands around sandstone rock outcrops.
Acacia pubescens	V	V	Low	6 OEH, PMST	Concentrated around the Bankstown-Fairfield-Rookwood area and the Pitt Town area, with outliers occurring at Barden Ridge, Oakdale and Mountain Lagoon. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland. Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone.
Allocasuarina glareicola	E	E	Unlikely	15 OEH, PMST	Primarily restricted to the Richmond (NW Cumberland Plain) district, but with an outlier population found at Voyager Point, Liverpool. Grows in Castlereagh woodland on lateritic soil. Found in open woodland with *Eucalyptus parramattensis*, *Eucalyptus fibrosa*, *Angophora bakeri*, *Eucalyptus sclerophylla* and *Melaleuca decora*. Common associated understorey species include *Melaleuca nodosa*, *Hakea dactyloides*, *Hakea sericea*, *Dillwynia tenuifolia*, *Micromyrtus minutiflora*, *Acacia elongata*, *Acacia brownei*, *Themeda australis* and *Xanthorrhoea minor*.
Cryptostylis hunteriana (Leafless Tongue-orchid)	V	V	Unlikely	PMST	
Cynanchum elegans	E	E	Unlikely	2 OEH, PMST	Occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*) – Coastal Banksia (*Banksia integrifolia* subsp. *integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum (*Corymbia maculata*) aligned open forest and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Dillwynia tenuifolia	V	V	Low	261 OEH	Core distribution is the Cumberland Plain from Windsor to Penrith east to Deans Park. Other populations in Western Sydney are recorded at Voyger Point and Kemps Creek in the Liverpool LGA, Luddenham in the Penrith LGA and South Maroota in the Baulkham Hills Shire. Disjunct localities include the Bulga Mountains at Yengo in the north, and Kurrajong Heights and Woodford in the Lower Blue Mountains. In western Sydney, it may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. At Yengo, is reported to occur in disturbed escarpment woodland on Narrabeen sandstone.
Epacris sparsa	V	V	Unlikely	4 OEH	Restricted to the lower Grose River, within the Hawkesbury and Blue Mountains LGAs. Grows in Riparian Sandstone Scrub, where it grows on the base of cliffs or rock faces, on rocky ledges or amongst rocks in the riparian zone. Generally grows in association with rocky sites in scrub vegetation dominated by *Tristaniopsis laurina, Leptospermum trinervium, Allocasuarina littoralis, Acacia longifolia, Grevillea sericea* and *Lomandra fluviatilis*.
Eucalyptus benthamii	V	V	Unlikely	4 OEH	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. A further 18 trees are scattered along the Nepean River, south to The Oaks. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Occurs in open forest. Associated species at the Bents Basin site include *Eucalyptus elata*, *E. baueriana*, *E. amplifolia*, *E. deanei* and *Angophora subvelutina*. Understorey species include *Bursaria spinosa*, *Pteridium esculentum* and a wide variety of agricultural weeds. The Kedumba Valley site lists *E. crebra*, *E. deanei*, *E. punctata*, *Leptospermum flavescens*, *Acacia filicifolia* and *Pteridium esculentum* among its associated species.
Genoplesium baueri (Bauer's Midge Orchid)	E	E	Unlikely	PMST	Recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the several conservation reserves including Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Found in sparse sclerophyll forest and moss gardens over sandstone

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Grevillea juniperina subsp. *juniperina*	V	-	Low	15 OEH	Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest.
Haloragis exalata subsp. *exalata*	V	V	Low	PMST	Square Raspwort occurs in 4 widely scattered localities in eastern NSW. It is disjunct distributed in the Central Coast, South Coast and North Western Slopes botanical subdivisions of NSW. Square Raspwort appears to require protected and shaded damp situations in riparian habitats. Flowering specimens in NSW are recorded from November to January.
Leucopogon exolasius	V	V	Unlikely	1 OEH	Woronora Beard-heath is found along the upper Georges River area and in Heathcote National Park. The plant occurs in woodland on sandstone. Flowering occurs in August and September.
Leucopogon fletcheri subsp. *fletcheri*	E	-	Unlikely	2 OEH	Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs.
Melaleuca deanei (Weeping Paperbark)	-	E	Unlikely	PMST	
Micromyrtus minutiflora	E	V	Unlikely	34 OEH, PMST	Restricted between Richmond and Penrith of western Sydney. Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest and open forest on tertiary alluvium.
Olearia cordata	V	V	Unlikely	PMST	It generally restricted to the south-western hunter Plateau, eastern Colo Plateau and the far north Hornsby Plateau of which most of the population occurs within conservation reserves. Populations are small and scattered growing in dry open forest and open shrubland, including on sandstone ridges.
Persoonia hirsuta	E	E	Unlikely	8 OEH	The Hairy Geebung has been recorded in the Sydney coastal area, the Blue Mountains area and the Southern Highlands. Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone.
Persoonia nutans	E	E	Unlikely	112 OEH, PMST	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Core distribution occurs within the Penrith, and to a lesser extent, Hawkesbury LGAs, with isolated and relatively small populations also occurring in the Liverpool, Campbelltown, Bankstown and Blacktown LGAs. Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Pelargonium sp. G.W. Carr 10345 (Omeo Storksbill)	E	E	Unlikely	PMST	Known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. A population at a fourth known site on the Monaro has not been seen in recent years. The only other known population is at Lake Omeo, Victoria. It occurs at altitudes between 680 to 1030 m. It is known to occur in the local government areas of Goulburn-Mulwaree, Cooma-Monaro, and Snowy River, but may occur in other areas with suitable habitat; these may include Bombala, Eurobodalla, Palerang, Tumbarumba, Tumut, Upper Lachlan, and Yass Valley local government areas. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities. It sometimes colonises exposed lake beds during dry periods.
Pimelea curviflora var. *curviflora*	V	V	Unlikely	1 OEH, PMST	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Former range extended south to the Parramatta River and Port Jackson region including Five Dock, Bellevue Hill and Manly. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.
Pimelea spicata	E	E	Unlikely	5 OEH PMST	Broad distribution in western Sydney, occurring on the Cumberland Plain (Narellan, Marayong, Prospect Reservoir areas). Another smaller population is recorded in districts (Landsdowne to Shellharbour to northern Kiama) Illawarra. It grows on well-structured clay soils. On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark. In the coastal Illawarra it occurs commonly in Coastal Banksia open woodland with a more well developed shrub and grass understorey.
Pomaderris brunnea	E	V	Unlikely	PMST	Found in a very limited area around the Nepean and Hawkesbury Rivers, including the Bargo area. It also occurs at Walcha on the New England tablelands and in far eastern Gippsland in Victoria. Grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines.
Pterostylis gibbosa	E	E	Unlikely	PMST	Known from a small number of populations in the Hunter region (Milbrodale), the Illawarra region (Albion Park and Yallah) and the Shoalhaven region (near Nowra). It is apparently extinct in western Sydney which is the area where it was first collected (1803).
Pterostylis saxicola	E	E	Unlikely	4 OEH, PMST	Restricted to western Sydney between Freemans Reach in the north and Picton in the south. There are very few known populations and they are all very small and isolated. Only one population occurs within a conservation reserve at Georges River National Park. Most commonly found growing in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. The vegetation communities above the shelves where it occurs are sclerophyll forest or woodland on shale/sandstone transition soils or shale soils.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Pultenaea parviflora	E	E	Unlikely	21 OEH, PMST	Endemic to the Cumberland Plain the core distribution is from Windsor to Penrith and east to Dean Park. Outlier populations are recorded from Kemps Creek and Wilberforce. May be locally abundant, particularly within scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland. *Eucalyptus fibrosa* is usually the dominant canopy species. *Eucalyptus globoidea*, *E. longifolia*, *E. parramattensis*, *E. sclerophylla* and *E. sideroxylon* may also be present or co-dominant, with Melaleuca decora frequently forming a secondary canopy layer. Associated species may include *Allocasuarina littoralis*, *Angophora bakeri*, Aristida spp., *Banksia spinulosa*, Cryptandra spp., *Daviesia ulicifolia*, *Entolasia stricta*, *Hakea sericea*, *Lissanthe strigosa*, *Melaleuca nodosa*, *Ozothamnus diosmifolius* and *Themeda australis*.
Rhizanthella slateri	V	E	Unlikely	PMST	*Rhizanthella slateri* is restricted to New South Wales where it is currently known from 14 populations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. Apparently prefers sclerophyll forest with a reasonably deep layer of organic litter although little else is known about the habitat of this species. The ecology of *Rhizanthella slateri* is poorly known given that it grows almost completely below the soil surface, with flower heads being the only part of the plant that can occur above ground. Therefore plants are usually located only when the soil is disturbed.
Streblus pendulinus	-	E	Unlikely	PMST	Occurs from Cape York Peninsula to Milton, south-east New South Wales (NSW), as well as Norfolk Island. Found in warmer rainforests, chiefly along watercourses. On the Australian mainland, Siah's Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well-developed rainforest, gallery forest and drier, more seasonal rainforest.
Tetratheca glandulosa	V	-	Unlikely	3 OEH	Endemic to NSW, with around about 150 populations from Yengo National Park to Lane Cove National Park. Associates in areas with shale cappings over sandstone. Occurs in heath, scrublands to woodlands and open forest. Common woodland tree species include: *Corymbia gummifera*, *C. eximia*, *Eucalyptus haemastoma*, *E. punctata*, *E. racemosa*, and/or *E. sparsifolia*, with an understorey dominated by species from the families Proteaceae, Fabaceae, and Ericaceae.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Thesium australe (Austral Toadflax)	V	V	Unlikely	PMST	Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (*Themeda australis*).
Zieria involucrata	E	V	Unlikely	1 OEH	It has a disjunct distribution north and west of Sydney, in the Baulkham Hills, Hawkesbury, Hornsby and Blue Mountains local government areas. It occurs primarily on Hawkesbury sandstone and also on Narrabeen Group sandstone and on Quaternary alluvium. Found primarily in sheltered forests on mid- to lower slopes and valleys, e.g. in or adjacent to gullies which support sheltered forest, although some populations extend upslope into drier vegetation. Also known from at least two atypical ridgetop locations. The canopy typically includes *Syncarpia glomulifera* subsp. *glomulifera* (Turpentine), *Angophora costata* (Smooth-barked Apple), *Eucalyptus agglomerata* (Blue-leaved Stringybark) and *Allocasuarina torulosa* (Forest Oak).

V=Vulnerable, E=Endangered, CE=Critically Endangered

Table A-3 Threatened fauna potentially occurring in the study area

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
BIRDS					
Anthochaera phrygia (Regent Honeyeater)	CE	E	Unlikely	14 OEH, PMST	Temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks.
Botaurus poiciloptilus (Australasian Bittern)	E	E	Unlikely	7 OEH, PMST	Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats.
Burhinus grallarius (Bush Stone-curlew)	E	-	Unlikely	6 OEH	Open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.
Callocephalon fimbriatum (Gang-Gang Cockatoo)	V	-	Low	4 OEH	In summer, occupies tall montane forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. Also occur in subalpine Snow Gum woodland and occasionally in temperate or regenerating forest. In winter, occurs at lower altitudes in drier, more open eucalypt forests and

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
					woodlands, particularly in box ironbark assemblages, or in dry forest in coastal areas. It requires tree hollows in which to breed.
Calyptorhynchus lathami (Glossy Black Cockatoo)	V	-	Unlikely	4 OEH	The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, *Allocasuarina diminuta*, and *A. gymnanthera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (Casuarina cristata).
Chthonicola sagittata (Speckled Warbler)	V	-	Unlikely	13 OEH	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area.
Circus assimilis (Spotted Harrier)	V	-	Low	7 OEH	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.
Daphoenositta chrysoptera (Varied Sittella)	V	-	Low	36 OEH	The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy.
Ephippiorhynchus asiaticus (Black-necked Stork)	E	-	Low	6 OEH	In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
					Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat).
Falco subniger (Black Falcon)	V	-	Low	6 OEH	Widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referrable to the Brown Falcon. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling hundreds of kilometres (Marchant & Higgins 1993). The Black Falcon occurs as solitary individuals, in pairs, or in family groups of parents and offspring.
Glossopsitta pusilla (Little Lorikeet)	V	-	Low	7 OEH	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (angophora sp.), paperbarks (melaleuca sp.) and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species.
Grantiella picta (Painted Honeyeater)	V	-	Unlikely	2 OEH	The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema.
Hieraaetus morphnoides (Little Eagle)	V	-	Low	18 OEH	The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used.
Irediparra gallinacean (Comb-crested Jacana)	V	-	Unlikely	3 OEH	Occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW, with stragglers recorded in south-eastern NSW (possibly in response to unfavourable conditions further north). Inhabit permanent freshwater wetlands,

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
					either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation.
Ixobrychus flavicollis (Black Bittern)	V	-	Unlikely	1 OEH	The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water.
Lathamus discolor (Swift Parrot)	E	E	Low	17 OEH, PMST	On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta),* Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Red Ironbark (*E. sideroxylon*), and White Box (*E. albens*).
Lophoictinia isura (Square-Tailed Kite)	V	-	Low	7 OEH	Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs.
Melithreptus gularis gularis (Black-Chinned Honeyeater)	V	-	Unlikely	6 OEH	Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees.
Neochmia ruficauda (Star Finch)	PE	E	Unlikely	1 OEH	The Star Finch has been presumed extinct in NSW. This species is thought to exist as two subspecies (i.e. eastern and southern). It is accepted that both subspecies occur from central Queensland to (formerly) NSW. When observed in 1865 at Namoi River in NSW it occurred on the sloping river bank covered with grass and herbs, amongst beds of rushes alongside of the river.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Neophema pulchella (Turquoise Parrot)	V	-	Unlikely	1 OEH	Range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland.
Ninox connivens (Barking Owl)	V	-	Unlikely	4 OEH	Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas.
Ninox strenua (Powerful Owl)	V	-	Unlikely	1 OEH	In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species.
Onychoprion fuscata (Sooty Tern)	V	-	Unlikely	1 OEH	The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW only known to breed at Lord Howe Island. Occasionally seen along coastal NSW, especially after cyclones. Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. Breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands.
Petroica boodang (Scarlet Robin)	V	-	Unlikely	11 OEH	The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps.
Petroica phoenicea (Flame Robin)	V	-	Unlikely	3 OEH	The Flame Robin is endemic to south eastern Australia, and ranges from near the Queensland border to south east South Australia and also in Tasmania. In NSW, it breeds in upland areas and in winter, many birds move to the inland slopes and plains. It is likely that there are two separate populations in NSW, one in the Northern Tablelands, and another ranging from the Central to Southern Tablelands. Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
					shrub layer may be either sparse or dense. Occasionally occurs in temperate rainforest, and also in herbfields, heathlands, shrublands and sedgelands at high altitudes.
Polytelis swainsonii (Superb Parrot)	V	V	Unlikely	2 OEH	Found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box. Nest in small colonies, often with more than one nest in a single tree.
Rostratula australis (Australian Painted Snipe)	E	E	Low	8 OEH, PMST	Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds.
Stagonopleura guttata (Diamond Firetail)	V	-	Unlikely	1 OEH	Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland.
Stictonetta naevosa (Freckled Duck)	V	-	Low	5 OEH	Prefer permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds.
Tyto novaehollandiae (Masked Owl)	V	-	Unlikely	3 OEH	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting.
MAMMALS					
Cercartetus nanus (Eastern Pygmy-possum)	V	-	Unlikely	1 OEH	Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred.
Chalinolobus dwyeri (Large-Eared Pied Bat)	V	V	Unlikely	1 OEH, PMST	Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves.
Dasyurus maculatus (Spotted-Tailed	V	E	Unlikely	8 OEH, PMST	Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Quoll)					with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.
Falsistrellus tasmaniensis (Eastern False Pipistrelle)	V	-	Low	5 OEH	Prefers moist habitats, with trees taller than 20 m. Generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings.
Miniopterus australis (Little Bentwing-bat)	V	-	Unlikely	1 OEH	East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.
Miniopterus schreibersii oceanensis (Eastern Bentwing-Bat)	V	-	Low	14 OEH	Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures.
Mormopterus norfolkensis (Eastern Freetail-Bat)	V	-	Low	24 OEH	Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures.
Myotis macropus (Southern Myotis)	V	-	Low	16 OEH	Generally roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish.
Petaurus australis (Yellow-bellied Glider)	V	-	Unlikely	14 OEH	Found along the eastern coast to the western slopes of the Great Dividing Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar.
Petaurus norfolcensis (Squirrel Glider)	V	-	Unlikely	6 OEH	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey.
Petrogale penicillata (Brush-Tailed Rock Wallaby)	E	V	Unlikely	PMST	Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.
Phascolarctos cinereus (Koala)	V	V	Unlikely	8 OEH, PMST	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
					Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.
Potorous tridactylus tridactylus (Long-Nosed Potoroo)	V	V	Unlikely	PMST	The long-nosed potoroo is found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. Inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. The fruit-bodies of hypogeous (underground-fruiting) fungi are a large component of the diet of the Long-nosed Potoroo. They also eat roots, tubers, insects and their larvae and other soft-bodied animals in the soil.
Pseudomys novaehollandiae (New Holland Mouse)	-	V	Unlikely	PMST	Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes.
Pteropus poliocephalus (Grey-Headed Flying-Fox)	V	V	Moderate	31 OEH, PMST	Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young.
Scoteanax rueppellii (Greater Broad-Nosed Bat)	V	-	Low	11 OEH	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.
AMPHIBIANS					
Heleioporus australiacus (Giant Burrowing Frog)	V	V	Unlikely	PMST	The Giant Burrowing Frog is distributed in south eastern NSW and Victoria, and appears to exist as two distinct populations: a northern population largely confined to the sandstone geology of the Sydney Basin and extending as far south as Ulladulla, and a southern population occurring from north of Narooma through to Walhalla, Victoria. Found in heath, woodland and open dry sclerophyll forest on a variety of soil types except those that are clay based. Spends more than 95% of its time in non-breeding habitat in areas up to 300 m from breeding sites. Whilst in non-breeding habitat it burrows below the soil surface or in the leaf litter. Individual frogs occupy a series of burrow sites, some of which are used repeatedly. The home ranges of both sexes appear to be non-overlapping suggesting exclusivity of non-breeding habitat. Home ranges are approximately 0.04 ha in size.

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Litoria aurea (Green and Golden Bell Frog)	E	V	Unlikely	1 OEH, PMST	Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish.
Litoria littlejohni (Littlejohn's Tree Frog)	V	V	Unlikely	PMST	Distribution includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria. This species breeds in the upper reaches of permanent streams and in perched swamps. Non-breeding habitat is heath based forests and woodlands where it shelters under leaf litter and low vegetation, and hunts for invertebrate prey either in shrubs or on the ground.
Mixophyes balbus (Stuttering Frog)	E	V	Unlikely	PMST	Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor.
Pseudophryne australis (Red-crowned Toadlet)	V	-	Unlikely	4 OEH	It has restricted distribution from Pokolbin to Nowra and west to Mt Victoria. Occurs in open forests and wet drainage lines below sandstone ridges that often have shale lenses or cappings in the Hawkesbury and Narrabeen Sandstones.
REPTILES					
Hoplocephalus bungaroides (Broad-headed Snake)	E	V	Unlikely	PMST	Shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer.
FISH					
Macquaria australasica (Macquarie Perch)	FM Act	E	Unlikely	PMST	The Murray-Darling form of the Macquarie Perch is still known to exist in waterways of Victoria, NSW and the ACT. The eastern form is confined to the Hawkesbury-Nepean and Shoalhaven river systems including a number of Sydney's water supply reservoirs. The Macquarie Perch is a riverine, schooling species. It prefers clear water and deep, rocky holes with lots of cover. As well as aquatic vegetation, additional cover may comprise of large boulders, debris and overhanging banks.
Prototroctes maraena (Australian Grayling)	FM Act	V	Unlikely	PMST	The Australian Grayling has been recorded within the upper reaches of the Hawkesbury-Nepean River Catchment. It inhabits clear, flowing waters.
INVERTEBRATES					

Species	Status		Potential likelihood to occur in the study area	No. of records and source	Distribution and habitat
	TSC Act	EPBC Act			
Meridolum corneovirens (Cumberland Plain Land Snail)	E	-	Low	31 OEH	Primarily inhabits Cumberland Plain Woodland (an endangered ecological community). This community is grassy, open woodland with occasional dense patches of shrubs. Lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.
Pommerhelix duralensis	-	E	Low	PMST	The Dural land snail is endemic to New South Wales. The species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringe of the Cumberland Plain on shale-sandstone transitional landscapes. The species has been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.

V=Vulnerable, E=Endangered, CE=Critically Endangered, PE=Presumed Extinct

Table A-4 Migratory species potentially occurring in the study area

Species	EPBC Act	No. of records and source	Distribution and habitat
Apus pacificus (Fork-Tailed Swift)	Migratory (CAMBA, JAMBA, ROKAMBA)	1 OEH, PMST	Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.
Ardea alba or *Ardea modesta* (Great Egret)	Marine, Migratory (CAMBA, JAMBA)	PMST	Widespread in Australia. Reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial).
Ardea ibis (Cattle Egret)	Marine, Migratory (CAMBA, JAMBA)	28 OEH, PMST	Widespread and common according to migration movements and breeding localities surveys. Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands.
Gallinago hardwickii (Latham's Snipe, Japanese Snipe)	Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	2 OEH, PMST	Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level.
Haliaeetus leucogaster (White-Bellied Sea Eagle)	Migratory (CAMBA)	12 OEH, PMST	Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea).
Hirundapus caudacutus (White-throated Needletail)	Marine, Migratory (CAMBA, JAMBA, ROKAMBA)	1 OEH, PMST	Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps.
Hydroprogne caspia (Caspian Tern)	Marine, Migratory (CAMBA, JAMBA)	1 OEH	Within Australia, the Caspian Tern has a widespread occurrence and can be found in both coastal and inland habitat. The Caspian Tern breeds on variable types of sites including low islands, cays, spits, banks, ridges, beaches of sand or shell, terrestrial wetlands and stony or rocky islets or banks. This species usually forages in open wetlands, including lakes and rivers.
Merops ornatus (Rainbow Bee-Eater)	Migratory (JAMBA)	1 OEH, PMST	Distributed across much of mainland Australia, and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation.

Monarcha melanopsis (Black-faced Monarch)	Migratory (Bonn)	PMST	Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest.
Monarcha trivirgatus (Spectacled Monarch)	Marine, Migratory (Bonn)	PMST	Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges.
Myiagra cyanoleuca (Satin Flycatcher)	Migratory (Bonn)	PMST	Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.
Pandion haliaetus or *Pandion cristatus* (Osprey)	Marine, Migratory (Bonn)	PMST	The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water.
Rhipidura rufifrons (Rufus Fantail)	Migratory (Bonn)	PMST	Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (Eucalyptus microcorys), Mountain Grey Gum (E. cypellocarpa), Narrow-leaved Peppermint (E. radiata), Mountain Ash (E. regnans), Alpine Ash (E. delegatensis), Blackbutt (E. pilularis) or Red Mahogany (E. resinifera); usually with a dense shrubby understorey often including ferns.
Tringa nebularia (Common Greenshank)	Marine, Migratory (Bonn, CAMBA, JAMBA, ROKAMBA)	1 OEH	The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia.

Appendix B. Assessment of Significance – NSW EP&A Act 1979

For threatened biodiversity listed under the TSC Act the threatened species assessment was undertaken as outlined under Section 5A of the EP&A Act (known as the 7-part test). The document *Threatened Species Assessment Guidelines: The Assessment of Significance* (Department of Environment and Climate Change 2007) outlines a set of guidelines to help applicants/proponents of a development or activity with interpreting and applying the factors of assessment in the 7-part test. The guidance provided by the Department of Environment and Climate Change (2007) has been used in this report.

B.1 Grey-headed Flying-fox (*Pteropus poliocephalus*)

While the Grey-headed Flying-fox (Pteropus poliocephalus) was not recorded in the study area during the field survey due to the diurnal nature of the survey, it is considered likely to occur based on the presence of suitable foraging habitat and the nearby location of roosting camps at Yarramundi, Emu Plains, Parramatta Park, Clyde and Cabramatta.

The factors to be considered when determining whether an action, development or activity is likely to significantly affect threatened species or their habitats are outlined below.

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

The Grey-headed Flying-fox (*Pteropus poliocephalus*) occurs in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 kilometres of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Annual mating commences in January and conception occurs in April or May; a single young is born in October or November.

There were no roost camps located in the study area and at the time of this assessment and the proposal would not directly impact on any known breeding / maternity site. The closest camp is at Yarramundi on the Hawkesbury River approximately six kilometres south west of the proposal. A further six camps are located within 50 kilometres of the proposal. As such, the impacts of the proposal to the Grey-headed Flying-fox (*Pteropus poliocephalus*) will be limited to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase.

The proposal would result in minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of the two Forest Red Gums (*Eucalyptus tereticornis*) from the north-western side of the Bells Line of Road/Grose Vale Road intersection. The affected area of foraging habitat would represent a very small percentage of the total extent of important foraging vegetation types present within the locality. The study area is not considered important habitat for these species and much of it is made up of planted roadside vegetation. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of the camps located near the study area, the project is not expected to significantly affect the life cycle of the species.

The draft recovery plan for the Grey-headed Flying-fox (DECCW, 2009) identifies critical foraging habitat for this species. One of the criteria is if the area is known to support populations of greater than 30,000 individuals within a 50 kilometre radius of the site. Considering the presence of numerous camps within a 50 kilometre radius, habitats in the study area are likely to be classed as critical foraging habitat. Additionally Forest Red Gum (*Eucalyptus tereticornis*) is relatively common and is a known food source during winter and spring. The large majority of foraging habitat for this species will be retained within the study area.

Considering the above factors the proposal is unlikely to reduce the population size of the Grey-headed Flying-fox (*Pteropus poliocephalus*) or decrease the reproductive success of this species.

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

N/A

(c) In the case of an endangered ecological community, whether the action proposed:

- *is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or*
- *is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.*

N/A

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

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

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

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

The potential habitat of the Grey-headed Flying-fox (*Pteropus poliocephalus*) within the study area is limited to foraging habitat and includes all fruiting and flowering trees and shrubs. The extent of habitat for the Grey-headed Flying-fox (*Pteropus poliocephalus*) will be reduced by two Forest Red Gum (*Eucalyptus tereticornis*) trees. This amount of habitat removal is very small when the amount of available foraging habitat in the locality is considered.

Importantly, the proposal will not result in fragmentation of habitat for the Grey-headed Flying-fox (*Pteropus poliocephalus*). This species is highly mobile and will freely fly long distances (up to 50 kilometres) over open areas including urbanised city centres to move between roost camps and foraging sites. The proposal will not affect the movement of the Grey-headed Flying-fox (*Pteropus poliocephalus*) between habitat patches.

The proposal will not impact on the most important habitats for Grey-headed Flying-fox (*Pteropus poliocephalus*) within the locality. The most important habitats for the local Grey-headed Flying-fox (*Pteropus poliocephalus*) sub-populations are the roosting camps at Yarramundi, Emu Plains, Parramatta Park, Clyde and Cabramatta. These camps will not be affected by the proposal. Foraging habitat within the study area is classed as critical foraging habitat considering the close proximity of several roost camps and is likely to form part of an overall foraging range of these sub-populations. The foraging habitat within the study area is unlikely to be of importance for the survival of the Grey-headed Flying-fox (*Pteropus poliocephalus*) within the locality.

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

Critical habitat refers only to those areas of land listed in the Register of Critical Habitat kept by the NSW Office of Environment and Heritage (OEH). This question is not applicable as no critical habitat has been listed for the Grey-headed Flying-fox (*Pteropus poliocephalus*).

(f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threatened abatement plan

The *Draft National Recovery Plan for the Grey-headed Flying-fox* (*Pteropus poliocephalus*) (Department of Environment, Climate Change and Water NSW, 2009) outlines the following actions:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan

A targeted strategy for managing threatened species is also being developed under the OEH Saving Our Species program. OEH is currently developing a targeted approach for managing threatened species. The Grey-headed Flying-fox (*Pteropus poliocephalus*) has been assigned to the Landscape species management stream under the OEH Saving our Species program.

The recovery actions listed above, and those identified in the Saving Our Species program, that have been identified by the OEH to help recover the Grey-headed Flying-fox (*Pteropus poliocephalus*) are largely not applicable to the proposal as they are actions for the OEH to complete and focus on priority conservation lands which are outside of the study area. The proposal will not interfere with the recovery of the Grey-headed Flying-fox (*Pteropus poliocephalus*).

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

A Key Threatening Process (KTP) is a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, population or ecological community. Key threatening processes are listed under the TSC Act and at the present there are currently 38 listed KTPs. Broadly, the KTPs include threats to threatened species and other plants and animals in NSW including:

- Pest animals that can compete with or prey upon native animals. They can also damage native plants and degrade natural habitats.
- Weeds that compete with native plants for resources such as light and nutrients. They can aggressively invade areas, displacing native plants and animals.
- Diseases, those exotic fungal infections, viruses and other pathogens can weaken and kill native species.
- Habitat loss or change (e.g. through large-scale land clearing).

Of the 38 listed KTPs under the TSC Act, the only KTP relevant to the Grey-headed Flying-fox (*Pteropus poliocephalus*) that will be increased by the proposal is clearing of native vegetation. The main threats to the Grey-headed Flying-fox (*Pteropus poliocephalus*) include:

- Loss and disturbance of roosting sites.
- Unregulated shooting.
- Electrocution on powerlines, entanglement in netting and on barbed-wire.
- Competition with Black Flying-foxes.
- Negative public attitudes and conflict with humans.
- Impacts from climate change.
- Disease.

The proposal will not increase any of the above threats.

Conclusion

The Grey-headed Flying-fox (*Pteropus poliocephalus*) will suffer a very small reduction in extent of suitable foraging habitat (i.e. two Forest Red Gum trees) from the proposal. No camps or other important habitat will be impacted. The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox (*Pteropus poliocephalus*) or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Grey-headed Flying-fox (*Pteropus poliocephalus*) and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox (*Pteropus poliocephalus*).

Appendix C. Assessment of Significance – Commonwealth EPBC Act 1999

For threatened biodiversity listed under the EPBC Act significance assessments have been completed in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (SIG 1.1) (DoE 2013).

Vulnerable Fauna

C.1 Grey-headed Flying-fox (*Pteropus poliocephalus*)

While the Grey-headed Flying-fox (*Pteropus poliocephalus*) was not recorded in the study area during the field survey it is considered likely to occur based on the presence of suitable foraging habitat and the nearby location of roosting camps at Yarramundi, Emu Plains, Parramatta Park, Clyde and Cabramatta.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

Lead to a long-term decrease in the size of an important population

There have been no roost camps identified in the project boundary to date and at the time of the REF the project would not directly impact on any known breeding / maternity site. Therefore it is likely that the impacts of construction and operation of the project would be confined to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase.

The proposal would result in minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of the two Forest Red Gums (*Eucalyptus tereticornis*) from the north-western side of the Bells Line of Road/Grose Vale Road intersection. This area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the project boundary. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the project is not expected to lead to a long-term decrease in the size of an important population.

Reduce the area of occupancy of the species

The proposal would result in minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of the two Forest Red Gums (*Eucalyptus tereticornis*) from the north-western side of the Bells Line of Road/Grose Vale Road intersection. This area of habitat may be defined as a portion of the potential area of occupancy for feeding life-cycle attributes of the population. The project will reduce the area of habitat available to the species; however, the area occupied by this species will remain the same.

Fragment an existing important population into two or more populations

There is currently a high degree of habitat fragmentation across the study area. Highly mobile species such as bats are expected to be less impacted by fragmentation and the grey-headed flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. The project would not fragment an important population of the Grey-headed Flying-fox.

Adversely affect habitat critical to the survival of the species

Habitat critical to the survival of a species refers to areas that are necessary for activities such as:

- Foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species.

The proposed area of habitat loss represents a small percentage of the potential foraging habitat for the Grey-headed Flying-fox within a 50 kilometre radius of the project boundary and known roost camps in the region. This species typically exhibits very large home ranges and Grey-headed Flying-fox are known to travel distances of at least 50 kilometres from roost sites to access seasonal foraging resources (Eby, 1996). No evidence of a camp site has been identified from the footprint of the proposal.

The draft recovery plan for the Grey-headed Flying-fox (DECCW, 2009) identifies critical foraging habitat for this species as:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals, within an area of 50 kilometre radius
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)
- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- Known to be continuously occupied as a camp site.

The proposal would result in minor clearing of potential food resources for the Grey-headed Flying-fox, due to the removal of the two Forest Red Gums (*Eucalyptus tereticornis*) from the north-western side of the Bells Line of Road/Grose Vale Road intersection. Considering the close proximity of several roost camps and presence of important feed trees the habitats are consistent with the classification for critical foraging habitat (DECCW, 2009). The affected area of foraging habitat would represent a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the project boundary. Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the project is not expected to adversely affect habitat critical to the survival of the species.

Disrupt the breeding cycle of an important population

As stated above there would be a minor impact on foraging habitat identified as important during the breeding cycle of the species. The upgrade would not directly impact on a known roost camp / breeding or maternity site.

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

No evidence of a roost camp has been identified from the study area. Further, there would be a relatively minor impact on critical foraging habitat. This impact is not expected to lead to a decline in the species in this region.

Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat

The potential for weed invasion was considered possible with a project of this nature and appropriate controls are required during construction and operation of the road to reduce this threat. The management of invasive species would be managed under the construction environmental management plan and during operation of the highway using best practice methods as outlined in RTA (2011).

Introduce disease that may cause the species to decline

There are no known disease issues affecting this species in relation to the project. The project would be unlikely to increase feral animal abundance or the potential for significant disease vectors to affect local populations.

Interferes substantially with the recovery of the species

The *Draft National Recovery Plan for the Grey-headed Flying-fox* (*Pteropus poliocephalus*) (Department of Environment, Climate Change and Water NSW. 2009) outlines the following actions:

- Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range
- Enhance winter and spring foraging habitat for Grey-headed Flying-foxes
- Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes
- Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture
- Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps
- Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions
- Monitor population trends for the Grey-headed Flying-fox
- Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts
- Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox
- Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan

The recovery actions listed above are largely not applicable to the proposal as they focus on priority conservation lands which are outside of the study area.

Given the relative widespread nature of similar planted vegetation in the locality and abundance of higher quality foraging habitat within the feeding range of regional populations, the project is not expected to interfere substantially with the recovery of the species.

Conclusion

The Grey-headed Flying-fox (*Pteropus poliocephalus*) will suffer a small reduction in extent of suitable foraging habitat from the proposal. No breeding camps or other important habitat will be impacted. The proposal is unlikely to reduce the population size of the Grey-headed Flying-fox (*Pteropus poliocephalus*) or decrease the reproductive success of this species. The proposal will not interfere with the recovery of the Grey-headed Flying-fox (*Pteropus poliocephalus*) and will not contribute to the key threats to this species. After consideration of the factors above, an overall conclusion has been made that the proposal is unlikely to result in a significant impact to the Grey-headed Flying-fox (*Pteropus poliocephalus*).

Appendix D

Non-Aboriginal heritage assessment

Richmond Bridge Approaches - Short Term Improvements

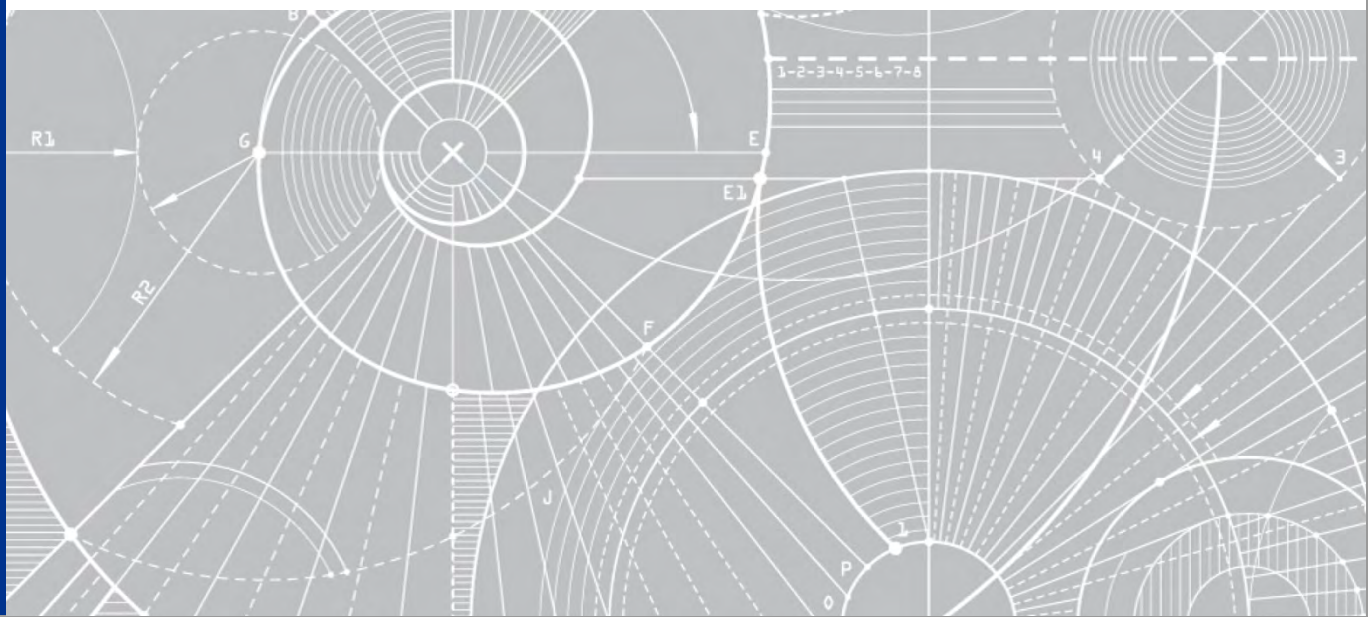
DOWNER MOUCHEL

Non-Aboriginal Heritage Assessment

NB00042.10 | Final

Work Package 10, RMS T/06487

16 July 2015



JACOBS

Richmond Bridge Approaches - Short Term Improvements

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Document no:	NB00042.10
Revision:	Final
Date:	16 July 2015
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Document history and status

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V1	24 June 2014	Compliance and quality	V Edmonds	Practice	24 June 2014
V2	28 August 2014	Client review comments addressed	K Murphy	-	-
Final	16 October 2014	Report finalised	K Murphy	-	-

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Executive Summary

As an outcome of the *Richmond Bridge and Approaches Congestion Study*, NSW Roads and Maritime Services (Roads and Maritime) proposes works to improve travel conditions between Richmond and North Richmond, NSW, through the implementation of three preferred short term upgrade options.

Jacobs was commissioned by Downer Mouchel on behalf of Roads and Maritime to undertake an assessment of the potential environmental impacts of the proposal, and prepare a review of environmental factors (REF) in accordance with the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

As part of preparing the REF, this non-Aboriginal heritage impact assessment identifies the non-Aboriginal heritage items within and immediately adjacent to the proposed works areas, assesses the potential impacts on the heritage items from the proposed project activities, and develops measures to address impacts. The non-Aboriginal heritage impact assessment addresses archaeology, heritage items and conservation areas, in accordance with NSW Heritage Branch guidelines, and the Australia ICOMOS Charter for Places of Cultural Significance (Burra Charter).

The scope of works proposed by Roads and Maritime and to be undertaken by Downer Mouchel include the implementation of three short term upgrades as follows:

- At the Bells Line of Road/Grose Vale Road intersection, North Richmond:
  - Providing two dedicated right turn lanes from Grose Vale Road into Bells Line of Road (northbound and eastbound)
  - Providing a dedicated left turn lane from Bells Line of Road into Grose Vale Road
  - Provision of two westbound through lanes on Bells Line of Road
  - Extending the eastbound merge on Bells Line of Road
  - Imposing a clearway on Bells Line of Road between Pitt Lane and Grose Vale Road during peak periods
- At Kurrajong Road/Old Kurrajong Road intersection, Richmond:
  - Widening of the intersection to provide an exclusive right turn bay for eastbound and southbound movements for Kurrajong Road into Yarramundi Lane
  - Providing a left slip lane out of Yarramundi Lane with a westbound acceleration lane on Kurrajong Road
- At Kurrajong Road/Bosworth Street intersection, Richmond:
  - Widening the intersection to provide and exclusive eastbound right turn bay from Kurrajong Road to Bosworth Street
  - Banning right turn movements from March Street to Bosworth Street North
  - Providing a clearway on Kurrajong Road between Chapel Street and Bosworth Street during peak periods
- The strategic design plans on which this assessment is based are presented in Appendix A.

A search of all available non-Aboriginal heritage registers was undertaken to identify heritage places within or immediately adjacent to the proposed works areas. A total of 10 heritage items were identified; nine listed on the Hawkesbury Local Environmental Plan (LEP) and one on the State Heritage Register (SHR). A site inspection of all identified heritage items was undertaken to identify and assess potential impacts. The inspection did not reveal any heritage items or areas of archaeological potential that were previously unidentified within or adjacent to the proposed works areas. Subsequent information from Roads and Maritime Services indicated the potential for the remains of the Kurrajong to Richmond Railway Line to exist beneath the current road surface of Kurrajong Road – bringing the total to 11 heritage items.

-

Table 1 presents the 11 heritage items, the potential impacts of the proposed works, the mitigation measures to minimise the impacts and the statutory requirements for proceeding with the proposed works. Overall, the level of impact on non-Aboriginal heritage items by the proposed works is minor. The implementation of the site-specific mitigation measures listed in Table 1 and the general mitigation measures (including mapping of heritage items, heritage awareness training and protocols for unexpected finds of heritage items) in Section 7.2 would minimise impacts on non-Aboriginal heritage to an acceptable level to proceed with the proposal as assessed.

Table 1 : Non-Aboriginal heritage items within or adjacent to proposed works areas, potential impacts, mitigation measures and statutory requirements.

Heritage item name	Number	Potential impacts	Mitigation measures	Statutory requirements
Seventh Day Adventist Church, 54 Bells Line of Road	I407	No impact.	None required.	None required.
House, 15 Grose Vale Road	I495	No impact.	None required.	None required.
Former Police Station and Residence, 39 Bells Line of Road	I406	No impact.	None required.	None required.
Avenue of Trees (East and West Side of Street), Chapel Street	I18	No impact.	None required.	None required.
Former House, 190 March Street	I72	No impact.	None required.	None required.
House, 35 Bosworth Street	I4	No impact.	None required.	None required.
House, 162 March Street	I483	Works within the LEP heritage boundary, but no impact on significance.	None required.	None required.
House, 160 March Street	I482	Works within the LEP heritage boundary, but no impact on significance.	None required.	None required.
Rutherglen, 158 March Street	I69	Potential impact on significance of main Rutherglen house as the house location reflects the 1820 siting requirements for the layout of Richmond.	Detailed design must avoid reduction of the existing boundary in front of the main Rutherglen house, as far as practical.	If the existing boundary of Rutherglen is reduced consultation with Hawkesbury City Council must be undertaken under Clause 14 of the ISEPP. ISEPP requires that a notification and a copy of a heritage impact assessment be submitted to the council and take into consideration any response to the notice that is received from the council within 21 days after the notice is given.

Heritage item name	Number	Potential impacts	Mitigation measures	Statutory requirements
		Potential for physical damage to front brick fence of main Rutherglen house from construction works due to the close proximity of work.	Detailed design must avoid impact on front brick fence, as far as practical. The fence does appear to be of modern construction, so while the presence of the fence in delineating the original boundary is significant, the actual physical material of the fence itself is not significant.	If the existing boundary of Rutherglen is reduced consultation with Hawkesbury City Council must be undertaken under Clause 14 of the ISEPP. ISEPP requires that a notification and a copy of a heritage impact assessment be submitted to the council and take into consideration any response to the notice that is received from the council within 21 days after the notice is given.
House, 155 March Street	I71	Potential physical damage to front hedge from construction works due to close proximity of work, but hedge is not of significance having replaced an earlier picket fence and wrought iron gate. Works within LEP heritage boundary but no impact on significance.	None required.	None required.
Kurrajong to Richmond Railway Line, Kurrajong Road	n/a	Potential for physical damage to potential remains of railway line beneath the current road surface in the eastbound lane of Kurrajong Road.	Should any remains possibly related to the Kurrajong to Richmond Railway Line, such as tracks, sleepers, fixtures or ballast, be discovered during construction the 'Discovery of non-Aboriginal heritage materials, features or deposits' measure (Section 7.2.1) must be implemented.	As early infrastructure falls under the definition of 'works' rather than 'relics' under the Heritage Act, there is no requirement to report to the Heritage Branch, however Roads and Maritime policy indicates that their *Standard Management Procedure: Unexpected Heritage Items* (2013) be implemented.

Abbreviations

the Act	*Heritage Act* 1977
AHC Act	*Australian Heritage Council Act* 2003
CHL	Commonwealth Heritage List
DCP	Development Control Plan
DP&I	Department of Planning and Infrastructure
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Act* 1999
HCA	Heritage Conservation Area
ICOMOS	International Council on Monuments and Sites
ISEPP	*State Environmental Planning Policy (Infrastructure)* 2007
LEP	Local Environmental Plan
NHL	National Heritage List
OEH	Office of Environment and Heritage
REF	Review of Environmental Factors
Roads and Maritime	NSW Roads and Maritime Services
RNE	Register of the National Estate
SHR	State Heritage Register
SOHI	Statement of Heritage Impact

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to assess potential impacts on non-Aboriginal heritage in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

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1. Introduction

1.1 Project background

As an outcome of the *Richmond Bridge and Approaches Congestion Study*, NSW Roads and Maritime Services (Roads and Maritime) proposes works to improve travel conditions between Richmond and North Richmond, NSW, through the implementation of three preferred short term upgrade options.

Jacobs was commissioned by Downer Mouchel on behalf of Roads and Maritime to undertake an assessment of the potential environmental impacts of the proposal, and prepare a review of environmental factors (REF) in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act).

1.2 Aim and scope of assessment

As part of preparing the REF, this non-Aboriginal heritage impact assessment identifies the non-Aboriginal heritage items within and immediately adjacent to the proposed works areas, assesses the potential impacts on the heritage items from the proposed project activities, and develops measures to address impacts. The non-Aboriginal heritage impact assessment addresses archaeology, heritage items and conservation areas, in accordance with NSW Heritage Branch guidelines, and the Australia ICOMOS Charter for Places of Cultural Significance (Burra Charter).

1.3 Authorship of report

This report has been prepared by Dr Karen Murphy (Historical Archaeologist, Jacobs). Mapping was prepared by Ana Ouriques (Spatial Analyst, Jacobs). A quality review was undertaken by Vanessa Edmonds (Practice Leader – Cultural Heritage Assessments, Jacobs).

2. Legislative framework

2.1 State legislation

2.1.1 *Environmental Planning and Assessment Act* 1979

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) requires that environmental impacts are considered in land-use planning, including impacts on Aboriginal and non-Aboriginal heritage. Part 5 of the EP&A Act is designed to ensure public authorities fully consider environmental issues before they undertake or approve activities that do not require development consent.

2.1.2 *State Environmental Planning Policy (Infrastructure)* 2007

The *State Environmental Planning Policy (Infrastructure)* 2007 (ISEPP) aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of the ISEPP permits development on any land for the purpose of road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. The proposal can therefore be assessed under Part 5 of the EP&A Act by Roads and Maritime as both the proponent and the determining authority. Development consent from the Hawkesbury City Council is not required.

There are several divisions and clauses in the ISEPP that refer to heritage matters. Clause 14 states that where a development may be carried out without consent (determined by Clause 94), and that development is likely to have an impact that is not minor or inconsequential on a local heritage item (other than a local heritage item that is also a State heritage item) or a heritage conservation area then:

'(2) A public authority, or a person acting on behalf of a public authority, must not carry out development to which this clause applies unless the authority or the person has:
(a) had an assessment of the impact prepared, and
(b) given written notice of the intention to carry out the development, with a copy of the assessment, to the council for the area in which the heritage item or heritage conservation area (or the relevant part of such an area) is located, and
(c) taken into consideration any response to the notice that is received from the council within 21 days after the notice is given.'

As a public authority, this clause applies to Roads and Maritime. A heritage impact assessment report would fulfil the requirement under subclause (2)(a). ISEPP requires that a notification and a copy of a heritage impact assessment be submitted to the council(s) within which any potentially impacted local heritage items are located, and take into consideration any response to the notice that is received from the council within 21 days after the notice is given.

2.1.3 *Heritage Act* (NSW) 1977

The *Heritage Act* 1977 (the Act) provides a number of mechanisms by which items and places of heritage significance may be protected. The Act is designed to protect both listed heritage items, such as standing structures, and potential archaeological remains or relics. Different parts of the Act deal with these different situations.

2.1.3.1 State Heritage Register

The Heritage Council of NSW maintains the State Heritage Register (SHR). Only those items which are of state-level heritage significance in NSW are listed on the SHR. Listing on the SHR controls activities such as alteration, damage, demolition and development. When a place is listed on the SHR, the approval of the Heritage Council of NSW is required for any major work, including the following:

- Demolishing the building or work
- Carrying out any development in relation to the land on which the building, work or relic is situated, the land that comprises the place, or land within the precinct

- Altering the building, work, relic or moveable object

An application under section 60 of the Act must be made to the Heritage Council in order to carry out such activities.

In some circumstances a section 60 permit may not be required if works are undertaken in accordance with the Standard Exemptions for Works Requiring Heritage Council Approval (NSW Heritage Council 2009). For example, Standard Exemption 7 covers works that would have little or no adverse impact on the heritage significance of the heritage item. An Exemption Notification Form (s57(2) NSW *Heritage Act*) is required to be submitted to the NSW Heritage Branch with appropriate supporting information (such as this heritage assessment).

2.1.3.2 Archaeological relics

Part 6 Division 9 of the Act protects archaeological 'relics' from being 'exposed, moved, damaged or destroyed' by the disturbance or excavation of land. This protection extends to the situation where a person has 'reasonable cause to suspect' that archaeological remains may be affected by the disturbance or excavation of the land. It applies to all land in NSW that is not included in the SHR. A 'relic' is defined by the Act as:

Any deposit, object of material evidence which relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and has local or state significance.

Section 139 of the Act requires any person who knows or has reasonable cause to suspect that their proposed works will expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to section 140), unless there is an applicable exception (pursuant to section 139(4)). If there is an exception, an Excavation Permit Exception Notification Form must be submitted and endorsed by the Director of Heritage Branch for places not listed on the SHR.

In some circumstances a section 140 permit may not be required when excavating land in NSW. In accordance with the NSW Government Gazette (no 110, 5 September 2008) Schedule of Exceptions to subsection 139 (1) and (2) of the *Heritage Act* 1977, made under subsection 139 (4):

Excavation or disturbance of land of the kind specified below does not require an excavation permit under section 139 of the Heritage Act, provided that the Director-General is satisfied that [certain criteria] have been met and the person proposing to undertake the excavation or disturbance of land has received a notice advising that the Director-General is satisfied that:

(c) a statement describing the proposed excavation demonstrates that evidence relating to the history or nature of the site, such as its level of disturbance, indicates that the site has little or no archaeological research potential.

An Excavation Permit Exception Notification Form is required to be submitted to the NSW Heritage Branch with appropriate supporting information (such as this heritage assessment). If the Director of the Heritage Branch is satisfied of the relevant matters relating to the proposal, a copy of the form will be endorsed by the Heritage Branch and returned to the applicant.

Section 146 of the Act requires any person who is aware or believes that they have discovered or located a relic must notify the Heritage Council of NSW providing details of the location and other information required.

2.1.3.3 Works

The Heritage Act identifies 'works' as a category separate to relics. 'Works' refer to past evidence of infrastructure which may even be buried, and so therefore 'archaeological' in nature and with the potential to provide information that contributes to our knowledge. Exposure of a 'work' does not trigger reporting obligations under the Heritage Act. However, good environmental practice recognises the archaeological potential of such discoveries and the need to balance these against the requirements of development. Roads and Maritime uses its *Standard Management Procedure: Unexpected Heritage Items* (Roads and Maritime Services 2013) to manage the discovery of such items. This provides guidance for the way such finds are to be managed when uncovered during construction and other activities.

2.1.3.4 Section 170 Heritage and Conservation Registers

Government agencies have responsibilities under section 170 of the *Heritage Act* 1977. Section 170 requires agencies to identify, conserve and manage heritage assets owned, occupied or managed by that agency. Section 170 requires government agencies to keep a Register of heritage items, which is called a Heritage and Conservation Register or more commonly, a s170 Register. The Act obliges government agencies to maintain their assets with due diligence in accordance with State-Owned Heritage Management Principles approved by the Minister on the advice of the Heritage Council and notified by the Minister to government instrumentalities from time to time.

2.2 Commonwealth heritage legislation

2.2.1 *Environment Protection and Biodiversity Conservation Act* 1999

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) includes 'national heritage' as a matter of National Environmental Significance and protects listed places to the fullest extent under the Constitution. It also establishes the National Heritage List (NHL) and the Commonwealth Heritage List (CHL).

The following is a description of each of the Heritage Lists and the protection afforded places listed on them.

2.2.1.1 National Heritage List

The NHL is a list of places with outstanding heritage value to Australia, including places overseas. This means that a person cannot take an action that has, will have, or is likely to have, a significant impact on the national heritage values of a national heritage place without the approval of the Commonwealth Minister for the Environment, Heritage and the Arts. The person appointed with the responsibility for a proposed action needs to undertake a 'self-assessment' to decide whether or not a proposed action is likely to have a 'significant' adverse impact on the National Heritage values of the place. If so, that action must be referred to the Minister for a decision.

2.2.1.2 Commonwealth Heritage List

The CHL is a list of places managed or owned by the Australian Government. A person cannot take an action that has, will have, or is likely to have, a significant impact on the Commonwealth heritage values of a Commonwealth heritage place without the approval of the Commonwealth Minister for the Environment, Heritage and the Arts. The person appointed with the responsibility for a proposed action needs to undertake a 'self-assessment' to decide whether or not a proposed action is likely to have an adverse or 'significant' impact on the Commonwealth Heritage values of the place. That action must be referred to the Minister for a decision.

2.2.1.3 Register of the National Estate

The Australian Heritage Council compiled and maintained the Register of the National Estate (RNE) under the *Australian Heritage Council Act* 2003 (AHC Act). Places on the RNE that are in Commonwealth areas, or subject to actions by the Australian Government, are protected under the EPBC Act by the same provisions that protect Commonwealth Heritage places (see above). Following amendments to the AHC Act, the RNE was frozen on 19 February 2007, which means that no new places could be added, or removed. From February 2012 all references to the RNE were removed from the EPBC Act and the AHC Act. The RNE is maintained on a non-statutory basis as a publicly available archive.

3. Background

3.1 Historical context

Following initial British settlement in the Sydney region in January 1788, the Hawkesbury region was taken up by small farmers as early as the 1790s, growing wheat and maize and shipping it to Sydney on the Hawkesbury River. Governor Macquarie founded an urban base for this small farming community including the towns of Wilberforce, Pitt Town, Windsor, Green Hills, Castlereagh and Richmond (NSW Heritage Office and Department of Urban Affairs and Planning 1996:24). The towns were established on high ground to provide flood-free residences for the flood-prone district. By 1810, the Hawkesbury's population had exceeded that of Parramatta and remained so throughout the period of Macquarie's governance, and beyond (Stubbs 2000).

The first access between the Hawkesbury region and Sydney was by river, with river boats providing a relatively cheap and easy method of moving produce until the establishment of the railway in 1864 (Stubbs 2000). During the 1850s various routes were considered for the proposed railway between Sydney and Bathurst, over the Blue Mountains. Two of the proposals considered routes via Richmond (the Grose River Valley and Kurrajong along Bells Line of Road to Mount Wilson). They were abandoned due to the high costs and the Penrith route was chosen. The railway line was extended from Blacktown to Richmond in 1864 (Nichols 2003).

Macquarie introduced a system of tollways as a means of upgrading the road network He listed in his 1822 report to Earl Bathurst a number of 'Turnpike roads' stating of these 'On all the roads specified to be Turnpike Ones good brick Toll-houses (for the Toll-keepers) and strong Turnpike Gates have been erected' (Stubbs 2000).

The Hawkesbury River was crossed at North Richmond by a punt, from around 1821, close to the site of today's Richmond Bridge. In 1857 the Richmond Bridge Company was formed to replace the punt with a bridge. A wooden bridge was built, the first over the Hawkesbury River, and opened in 1860. Continual floods weakened the bridge and a new bridge was planned in the early 1900s with construction commencing in 1904. In 1926 additions took place to the bridge to allow the Richmond Kurrajong railway line access across the river (Nichols 2003).

The Hawkesbury region continued into the 1860s as an area of small farming communities, before adding dairying to its industries (NSW Heritage Office and Department of Urban Affairs and Planning 1996:24), and remained substantially rural into the 20th century.

During World War I the Richmond airfield was established on Ham Common as a NSW Government Flying School. In 1925, the first Air Force element in NSW, No 3 Squadron, was formed at Richmond. RAAF Base Richmond was the first Air Force base to be established in NSW and the second within Australia. From 1923 to 1936, RAAF Base Richmond was also used as a supplementary airport for Sydney, with Sir Charles Kingsford-Smith landing the Southern Cross here after his trans-Pacific flight in 1928, and Miss Jean Batten landing after her solo flight from England in 1935 (Royal Australian Air Force 2009; 2012).

At the outbreak of World War II, Nos 3, 6, 9 and 22 Squadrons were based at Richmond, together with No 2 Aircraft Depot. No 8 Squadron formed on 11 September 1939 and No 11 Squadron two weeks later. During World War II, Richmond developed into a base of major importance to Australia's defence, and has since evolved from a combat centre to become the home of Air Lift Group. As such, the base is now the hub of logistics support for the Australian Defence Force (Royal Australian Air Force 2009; 2012).

Today, with a population of around 65,000, the Hawkesbury region is still an important agricultural area which continues to play a vital role in defining the character and landscape of the district. Since the beginning of the 20th century the defence force has also maintained a significant presence in the Hawkesbury with the RAAF bases continuing to be a major contributor to the local economy (Hawkesbury City Council 2012).

3.2 Heritage context

3.2.1 Previous heritage assessments

Two key broad-scale heritage assessments, both dating to the 1980s, appear to have been undertaken in the region and likely informed the heritage items listed on the Hawkesbury LEP. More recent heritage studies or reviews of heritage items in the Hawkesbury were not able to be identified for this assessment. A substantial number of other heritage assessments within the Richmond area all focussed on specific heritage places rather than broadly identifying and assessing heritage places across the region. The two key broad-scale assessments are outlined below.

Howard Tanner and Associates (1984) prepared the *Heritage Study of the North Western Sector of Sydney* for the NSW Department of Environment and Planning to inform a Regional Environmental Plan for the area. The study area included Hawkesbury Shire, among others. The study prepared a thematic history of the region, and included field survey to identify heritage places which formed an inventory listing of potential heritage items in the North West Sector. The study included identification of archaeological sites representative of the historic themes of the region. In North Richmond, 17 heritage items were identified, including the following within or near the proposed works areas for the current assessment:

- Former Police Station, Bells Line of Road (H/NR-3)
- 51 Bells Line of Road (H/NR-4)
- 54 Bells Line of Road (H/NR-5)
- Seventh Day Adventist Church (H/NR-6)
- 15 Grose Vale Road (H/NR-12)

In Richmond, Howard Tanner and Associates' study identified 163 heritage places and four heritage precincts, including the following in or near the proposed works areas for the current assessment:

- 31 Bosworth Street (H/R-7)
- Avenue of London Plane Trees, approach to 'Hobartville' (H/R-20)
- 150 March Street (H/R-80)
- 155-157 March Street (H/R-81)
- 158 March Street ('Rutherglen') (H/R-82)
- 160 March Street (H/R-83)
- 162 March Street (H/R-84)
- Kindergarten, 190 March Street (H/R-85)

Shellshear (1986) prepared the *Richmond NSW Townscape Study* for the Hawkesbury Shire Council. The study focussed on the original centre of the town of Richmond to assess the character of the area. The study made an assessment of every building in the study area including architectural merit, dominant characteristics of buildings, and each building's role in the current streetscape. A schedule of buildings with significant architectural, historical and streetscape values was identified including the following within or adjacent to the proposed works areas for the current assessment:

- 156 March Street ('Rutherglen')
- 155 March Street
- 35 Bosworth Street

3.2.2 Historical heritage register search results

A search of all available non-Aboriginal heritage registers was undertaken to identify heritage places within or immediately adjacent to the proposed works areas. The following registers were searched using a combination of online databases and where available using spatial data in Global Information System format by Karen Murphy on 26 May 2014 and updated by Rebecca Andrews (Project Archaeologist, Jacobs) on 14 July 2015:

- NSW State Heritage Register
- Roads and Maritime Section 170 Heritage and Conservation Register
- Hawkesbury LEP 2012
- Commonwealth Heritage List
- National Heritage List
- World Heritage List
- Register of the National Estate
-
- A list of heritage items located within or immediately adjacent to the proposed works areas is presented in Table 3.1. The heritage items considered as part of this impact assessment are mapped in Figure 3.1 and Figure 3.2[1]. There were no heritage places on the Roads and Maritime Section 170 register, CHL, NHL, or WHL within or adjacent to the proposed works areas.

Table 3.1 : Registered heritage items within and adjacent to proposed works areas.

Heritage item name	Register	Number	Significance	Location
Seventh Day Adventist Church	LEP	I407	Local	54 Bells Line of Road, North Richmond
House	LEP	I495	Local	15 Grose Vale Road, North Richmond
Former Police Station and Residence	LEP	I406	Local	39 Bells Line of Road, North Richmond
Avenue of Trees (East and West Side of Street)	LEP	I18	Local	Chapel Street, Richmond
Former House	LEP RNE	I72 14167	Local	190 March Street, Richmond
House	LEP	I4	Local	35 Bosworth Street, Richmond
House	LEP	I483	Local	162 March Street, Richmond
House	LEP	I482	Local	160 March Street, Richmond
Rutherglen	LEP RNE	I69 14165	Local	158 March Street, Richmond
House	LEP RNE	I71 14166	Local	155 March Street, Richmond

[1] While Figures 3.1 and 3.2 display all heritage items within the entire extent of the map, only those heritage items within or adjacent to the proposed works areas are itemised and discussed in this assessment.

3.2.3 Summary

Of the significant heritage items identified in the two 1980s heritage assessments, all are now listed on the Hawkesbury LEP, or else are no longer standing and have been replaced by modern structures. Despite there being no more recent heritage studies or reviews, Howard Tanner and Associates (1984) and Shellshear (1986) were systematic in their approach and assessment and there are unlikely to be any previously unidentified heritage items in the current assessment area.

NSW SPATIAL - GIS MAP file : NB00042_HER_GIS_F3-1_r1v1

Proposed project design - Intersection with Grose Vale Road and Terrace Road

Hawkesbury LEP heritage data

NSW State Heritage Register data

* Standard Instrument Local Environmental Plan (SILEP) - Office of Environment & Heritage 2014

Figure 3.1
Non-Aboriginal heritage items at Bells Line of Road/Grose Vale Road intersection

NSW SPATIAL - GIS MAP file : NB00042_HER_GIS_F3-2_r1v1

Proposed project design - Intersection with MR570 Bosworth Street

Hawkesbury LEP heritage data

NSW State Heritage Register data

JACOBS

* Standard Instrument Local Environmental Plan (SILEP) - Office of Environment & Heritage 2014

Figure 3.2
Non-Aboriginal heritage items at Kurrajong Road/Bosworth Street intersection

4. Site inspection

4.1 Aim and method

The aim of the site inspection was to confirm and record known non-Aboriginal heritage items, identify any previously unidentified heritage items and assess the potential of archaeological resources within and immediately adjacent to the proposed works areas.

The proposed works areas including known heritage items was inspected on foot as to their current nature and condition. All proposed works areas were also inspected for previously unidentified heritage items and the potential for archaeological resources not previously identified. Potential impacts of the proposed works were considered during the site inspection. Photographs were taken of known heritage items. Notes were made regarding relevant description and condition details and potential impacts of the proposed works. The field survey was carried out by Karen Murphy on 30 May 2014.

4.2 Results

4.2.1 Known heritage items

Ten known heritage items were assessed using the above methodology. Photographs and descriptions of each heritage item is presented in Table 5.1.

4.2.2 Previously unidentified heritage items and areas of archaeological potential

No heritage items or areas of archaeological potential that were previously unknown were identified during the site inspection.

Information received from Roads and Maritime Services, indicates that there is potential for the remains of the railway line which ran from Kurrajong to Richmond to still be present under the road surface of the eastbound lane of Kurrajong Road where the railway line ran from the Richmond Bridge to East Market Street. No evidence of the presence of the railway line was detected during the site inspection. It is uncertain whether the railway line has been removed during previous works.

5. Cultural heritage significance

The concept of cultural heritage significance helps in estimating the value of places. Places which are likely to be significant are those which 'help an understanding of the past or enrich the present, and which will be of value to future generations' (Australia ICOMOS 2000:12). In Australia, the significance of a place is generally assessed according to the following values:

- Aesthetic value
- Historic value
- Scientific value
- Social value

The NSW Heritage Council has adopted specific criteria for heritage assessment, which have been gazetted pursuant to the *Heritage Act* 1977. The seven criteria upon which the assessment of significance is based are outlined below:

Criterion (a) an item is important in the course, or pattern, of NSW cultural or natural history.

Criterion (b) an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW cultural or natural history.

Criterion (c) an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW.

Criterion (d) an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons.

Criterion (e) an item has potential to yield information that will contribute to an understanding of NSW cultural or natural history.

Criterion (f) an item possesses uncommon, rare or endangered aspects of NSW cultural or natural history.

Criterion (g) an item is important in demonstrating the principal characteristics of a class of NSW cultural or natural places or cultural or natural environments.

There appears to be no systematic significance assessment for any of the identified heritage items listed on either the LEP or the SHR. The preparation of detailed significance assessment is outside the scope of this report. Brief description and aspects of significance which exists for these heritage items is presented in Table 5.1 based on information from the RNE, Shellshear (1986) and information and photographs obtained during the site inspection.

Table 5.1 : Description and significance of heritage items within or immediately adjacent to proposed works areas.

Heritage item	Description and photograph	Significance
Seventh Day Adventist Church	A Methodist Church was established in North Richmond (originally known as Enfield) in 1857. Known as the Enfield Chapel, Reverend Watkin took the opening service there on 12 January 1857. He described the building as '…a strong but plain structure large enough for the worshippers of the place and a great improvement on the former one' (Nichols 2003). The current Seventh Day Adventist Church comprises a brick church building (Enfield Chapel) with a timber hall building to the rear of the church.  Figure 5.1 : South elevation of Seventh Day Adventist Church, perpendicular to Bells Line of Road.	Historical significance as an early church in North Richmond.

Heritage item	Description and photograph	Significance
House, 15 Grose Vale Road	The house is a early to mid-Victorian timber weatherboard structure with bull-nosed verandah roof.  Figure 5.2 : North elevation of 15 Grose Vale Road, fronting Grose Vale Road.	Historical significance as an early example of residence in North Richmond.

Heritage item	Description and photograph	Significance
Former Police Station and Residence	While the brick former police station appears to be Victorian in style, a 'new' North Richmond police station was being constructed in 1911 on almost an acre of land near the turn-off to Grose Vale (Windsor and Richmond Gazette, 4 February 1911). This building is situated near the corner of Grose Vale Road, so is likely the 1911 building referred to. The North Richmond police station was closed in 1933, with policing responsibilities taken over by Richmond Police Station some three miles away. The residence continued to be used for police housing until at least 1935 (Windsor and Richmond Gazette, 30 August 1935).  Figure 5.3 : North east elevation of Former Police Station and Residence, fronting Bells Line of Road.	Historical significance as an early government building in North Richmond.

Heritage item	Description and photograph	Significance
Avenue of Trees (East and West Side of Street), Chapel Street	The Avenue comprises large plane trees (also known as sycamores, *Platanus* sp.) on both sides of Chapel Street, between Francis Street to just south of Kurrajong Road. The Avenue leads to the entrance of 'Hobartville' at the south end of Chapel Street.  Figure 5.4 : Avenue of Trees on Chapel Street, north of Kurrajong Road, facing north.	The Avenue is significant as the entry avenue into the State heritage listed 'Hobartville', an intact early colonial homestead group significant for its association with the Cox family and Francis Greenway. Its original grant boundaries determined the extent of the 1810 grid layout of Richmond township (SHR).

Heritage item	Description and photograph	Significance
Former House, 190 March Street	A single storey symmetrical brick cottage having hipped iron main and verandah roofs, with verandah supported on cast iron columns with decorative friezes and trim. Shuttered French windows open onto the verandah (RNE).  Figure 5.5 : North elevation of 190 March Street, fronting Kurrajong Road.	A good example of an elegant late Victorian country cottage which is a valuable addition to the townscape of Windsor (RNE).

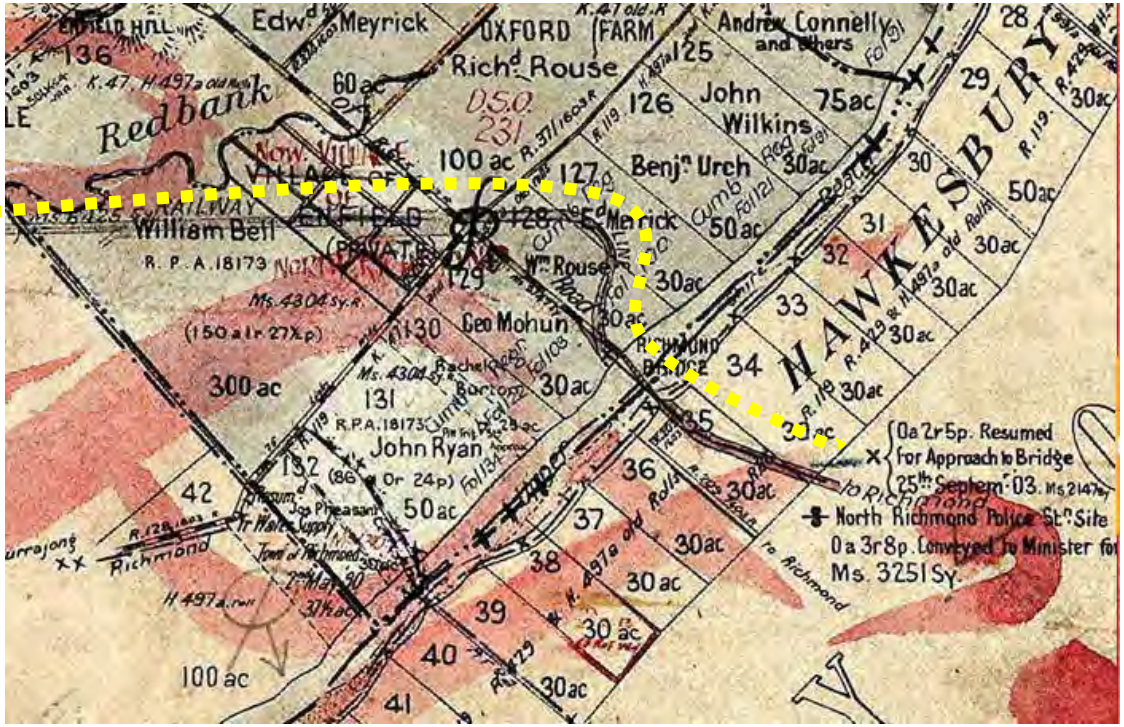
Heritage item	Description and photograph	Significance
House, 35 Bosworth Street	Constructed in around 1925. Bungalow style cottage of rectangular plan with large terracotta tiled gable roof. Face brick construction with gable ends sheeted and battened to the lower half and shingled to the upper half into the apex of the gable. Wide eaves overhang. Large gable roofed verandah off front side matching main gable details and supported on triple timber posts over brick piers. Verandah enclosed by low brick dwarf wall. Nicely detailed shallow oriel windows with diamond lead light glazing. House set in large grounds and now used for commercial purposes (Shellshear 1986).  Figure 5.6 : East elevation of 35 Bosworth Street, with vacant alotment at left, on corner of Bosworth Street and Kurrajong Road.	Architectural, historical and streetscape (aesthetic) significance (Shellshear 1986).

Heritage item	Description and photograph	Significance
House, 162 March Street	Single storey timber Victorian house with brick and stone verandah and timber picket fence along street front.  Figure 5.7 : North elevation of 162 March Street, fronting March Street.	Historical significance as an early example of residence in Richmond. Contribution to streetscape.

Heritage item	Description and photograph	Significance
House, 160 March Street	Single storey timber weatherboard Victorian cottage situated adjacent to Rutherglen. with timber picket fence and hedge along street front.  Figure 5.8 : North elevation of 160 March Street, fronting March Street.	Historical significance as an early example of residence in Richmond. Contribution to streetscape.

Heritage item	Description and photograph	Significance
Rutherglen, 158 March Street	Constructed in 1830, Rutherglen, formerly Grimwood House, is a simple rectangular two storey sandstock brick house of six bays with slightly irregular spacing of the windows. The windows are all 12-pane sash windows with stone sills. The lower windows are larger than the upper storey windows. There is a main hipped iron roof and a simple hipped iron verandah roof supported on colonial vernacular style stop chamfered timber posts (eight sided), which rest on a dressed stone base. The verandah is decorated with an undulating scalloped timber facia and has a tongue and groove board lining to the soffit. There is an excellent stone flagging floor to the verandah. On either side of the main roof are double brick chimneys and an external brick chimney to the rear brick skillion addition. The whole front facade is painted. The setback of the house has been influenced by the 1829 siting regulations, but there is extensive land to the rear of the property (RNE).  Figure 5.9 : North elevation of Rutherglen, 158 March Street, fronting March Street.	One of Richmond's best known Georgian houses this superb example has been restored to original condition. Rutherglen is a characteristic Georgian townhouse of high quality. It is an important component of the historic townscape of Richmond and is a significant element in the entrance to Richmond along March Street (RNE).

Heritage item	Description and photograph	Significance
House, 155 March Street	Dating to 1875, the house (now professional offices) is a substantial single storey Victorian house of fine tuckpointed Flemish bond brick with hipped iron roof and bellcast iron verandah. The facade is symmetrical with original four-paned windows and four-panelled door. Verandah has cast iron lace trims and supports and original shutters. There are four stuccoed chimneys. Setting is enhanced by a large tree (RNE). A picket fence in poor condition and wrought iron gates described in the RNE entry is no longer present, instead replaced with a hedge.  Figure 5.10 : South elevation of 155 March Street, fronting March Street.	This house, together with Rutherglen opposite, forms an important townscape element at the entrance to Richmond along March Street and is a reminder of the earlier character of the area (RNE).
Kurrajong to Richmond Railway, Kurrajong Road	The Richmond line extended from Blacktown to the north west of Sydney, ending at Richmond. From 1926 until 1952, it was extended to the township of Kurrajong, however the section was not profitable and after the line was damage in floods it was closed (Bozier 2000). Parish maps dating to 1915 and 1916 indicate that the railway line ran along what is now Kurrajong Road from the Richmond Bridge to the Richmond Railway Station, East Market Street in Richmond (Currency Parish map 1916, Ham Common Parish map 1915). No evidence of the existence of the railway line remaining under the road surface was noted during the site inspection (such as subsidence or visible ridges in the road surface) however there is still the potential that the rails, sleepers or other remains of the line are present. Further documentary research may provide further indication of the presence or absence of archaeological remains during previous works on Kurrajong Road.	Significance not assessed, but likely to be of local significance.

Heritage item	Description and photograph	Significance
	 Figure 5.11 : Alignment of Kurrajong to Richmond railway line, indicated to south of yellow dashed line (Currency Parish map, 1916, NSW Government).	

Heritage item	Description and photograph	Significance
	 Figure 5.12 : Alignment of Kurrajong to Richmond railway line, indicated to the south of the yellow dashed line (Ham Common Parish map, 1915, NSW Government).	

6. Impact assessment

6.1 Proposed works

The scope of works proposed by Roads and Maritime and to be undertaken by Downer Mouchel include the implementation of three short term upgrades as follows:

- At the Bells Line of Road/Grose Vale Road intersection, North Richmond:
  - Providing two dedicated right turn lanes from Grose Vale Road into Bells Line of Road (northbound and eastbound)
  - Providing a dedicated left turn lane from Bells Line of Road into Grose Vale Road
  - Provision of two westbound through lanes on Bells Line of Road
  - Extending the eastbound merge on Bells Line of Road
  - Imposing a clearway on Bells Line of Road between Pitt Lane and Grose Vale Road during peak periods
- At Kurrajong Road/Old Kurrajong Road intersection, Richmond:
  - Widening of the intersection to provide an exclusive right turn bay for eastbound and southbound movements for Kurrajong Road into Yarramundi Lane
  - Providing a left slip lane out of Yarramundi Lane with a westbound acceleration lane on Kurrajong Road
- At Kurrajong Road/Bosworth Street intersection, Richmond:
  - Widening the intersection to provide and exclusive eastbound right turn bay from Kurrajong Road to Bosworth Street
  - Banning right turn movements from March Street to Bosworth Street North
  - Providing a clearway on Kurrajong Road between Chapel Street and Bosworth Street during peak periods
- The strategic design plans on which this assessment is based are presented in Appendix A.

6.1.1 Potential impacts

The proposed activities within or adjacent to each heritage item identified for this assessment and the potential impacts of these activities is presented in Table 6.1.

Table 6.1 : Potential impacts from proposed works for each heritage item.

Heritage item name	Number	Proposed activities	Potential impacts
Seventh Day Adventist Church, 54 Bells Line of Road	I407	Reduction in existing footpath in front of Church to accommodate two westbound lanes on Bells Line of Road. Works outside LEP heritage boundary.	No impact.
House, 15 Grose Vale Road	I495	End of works approximately 20 m north of LEP heritage boundary of House.	No impact.
Former Police Station and Residence, 39 Bells Line of Road	I406	Increase of existing footpath in front of Former Police Station to accommodate dedicated left turn lane into Gros Vale Road. Works outside LEP heritage boundary.	No impact.

Heritage item name	Number	Proposed activities	Potential impacts
Avenue of Trees (East and West Side of Street), Chapel Street	I18	End of works approximately 15 m east of LEP heritage boundary of Avenue of Trees.	No impact.
Former House, 190 March Street	I72	Realignment of lanes on opposite side of road to Former House. No works immediately adjacent to Former House. Works outside LEP heritage boundary.	No impact.
House, 35 Bosworth Street	I4	Alteration of kerbing at corner adjacent to House. Works outside LEP heritage boundary.	No impact.
House, 162 March Street	I483	Realignment of lane and footpath in front of House, encroaching into LEP heritage boundary.	Potential physical damage to front picket fence from construction works due to the close proximity of the work, but fence is of recent construction and not of significance.
House, 160 March Street	I482	Realignment of lane and footpath in front of House, encroaching into LEP heritage boundary.	Potential physical damage to front picket fence from construction works due to the close proximity of the work, but fence is of recent construction and not of significance.
Rutherglen, 158 March Street	I69	Realignment of lane and footpath in front of Rutherglen house, encroaching into LEP heritage boundary.	Potential impact on significance of Rutherglen house as the house location reflects the 1820 siting requirements for the layout of Richmond. Potential for physical damage to front brick fence of Rutherglen house from construction works due to the close proximity of work.
House, 155 March Street	I71	Realignment of lane and footpath in front of House, encroaching into LEP heritage boundary for House.	Potential physical damage to front hedge from construction works due to close proximity of work, but hedge is not of significance having replaced an earlier picket fence and wrought iron gate. No impact on significance.
Kurrajong to Richmond Railway Line, Kurrajong Road	n/a	Excavation works beneath the current road surface at Kurrajong Road/Old Kurrajong Road intersection. Excavation works beneath the current road surface at Kurrajong Road/Bosworth Street intersection.	Potential for physical damage to remains of railway line which may exist beneath the current road surface in the eastbound lane of Kurrajong Road.

7. Conclusion

7.1 Site-specific mitigation measures and statutory requirements

Overall, the level of impact on non-Aboriginal heritage items by the proposed project works is relatively minor. The implementation of the general and site-specific mitigation measures listed below (Table 7.1, Section 0) would minimise impacts on non-Aboriginal heritage to an acceptable level to proceed with the proposal as assessed.

Table 7.1 : Mitigation measures and statutory requirements for heritage items.

Heritage item name	Number	Potential impacts	Mitigation measures	Statutory requirements
Seventh Day Adventist Church, 54 Bells Line of Road	I407	No impact.	None required.	None required.
House, 15 Grose Vale Road	I495	No impact.	None required.	None required.
Former Police Station and Residence, 39 Bells Line of Road	I406	No impact.	None required.	None required.
Avenue of Trees (East and West Side of Street), Chapel Street	I18	No impact.	None required.	None required.
Former House, 190 March Street	I72	No impact.	None required.	None required.
House, 35 Bosworth Street	I4	No impact.	None required.	None required.
House, 162 March Street	I483	Works within the LEP heritage boundary, but no impact on significance.	None required.	None required.
House, 160 March Street	I482	Works within the LEP heritage boundary, but no impact on significance.	None required.	None required.
Rutherglen, 158 March Street	I69	Potential impact on significance of Rutherglen house as the house location reflects the 1820 siting requirements for the layout of Richmond.	Detailed design must avoid reduction of the existing boundary in front of the main Rutherglen house, as far as practical.	If the existing boundary of Rutherglen is reduced consultation with Hawkesbury City Council must be undertaken under Clause 14 of the ISEPP. ISEPP requires that a notification and a copy of a heritage impact assessment be submitted to the council and take into consideration any response to the notice that is received from the council within 21 days after the notice is given.

Heritage item name	Number	Potential impacts	Mitigation measures	Statutory requirements
		Potential for physical damage to front brick fence of Rutherglen house from construction works due to the close proximity of work.	Detailed design must avoid impact on front brick fence, as far as practical. The fence does appear to be of modern construction, so while the presence of the fence in delineating the original boundary is significant, the actual physical material of the fence itself is not significant.	If the existing boundary of Rutherglen is reduced consultation with Hawkesbury City Council must be undertaken under Clause 14 of the ISEPP. ISEPP requires that a notification and a copy of a heritage impact assessment be submitted to the council and take into consideration any response to the notice that is received from the council within 21 days after the notice is given.
House, 155 March Street	I71	Potential physical damage to front hedge from construction works due to close proximity of work, but hedge is not of significance having replaced an earlier picket fence and wrought iron gate. Works within LEP heritage boundary but no impact on significance.	None required.	None required.
Kurrajong to Richmond Railway Line, Kurrajong Road	n/a	Potential for physical damage to potential remains of railway line beneath the current road surface in the eastbound lane of Kurrajong Road.	Should any remains possibly related to the Kurrajong to Richmond Railway Line, such as tracks, sleepers, fixtures or ballast, be discovered during construction the 'Discovery of non-Aboriginal heritage materials, features or deposits' measure (Section 7.2.1) must be implemented.	As early infrastructure falls under the definition of 'works' rather than 'relics' under the Heritage Act, there is no requirement to report to the Heritage Branch, however Roads and Maritime policy indicates that their *Standard Management Procedure: Unexpected Heritage Items* (2013) be implemented.

7.2 General management measures

7.2.1 Discovery of non-Aboriginal heritage materials, features or deposits

If at any time during construction of the project, non-Aboriginal heritage materials, features and/or deposits are found and are not covered by an issued approval (generally s139 excavation permit, exception or s60 approval or exemption) then the Roads and Maritime *Standard Management Procedure: Unexpected Heritage Items* (Roads and Maritime Services 2013) must be followed:

1) Stop work, protect item and inform Roads and Maritime environment staff
2) Contact and engage an archaeologist or heritage consultant
3) Undertake preliminary assessment and recording of the find
4) Prepare an archaeological or heritage management plan
5) Notify the Heritage Division of Office of Environment and Heritage (OEH), if required in the management plan

6) Implement the archaeological or heritage management plan
7) Review and update the project's Construction Environment Management Plan (CEMP) and any approval conditions resulting from the management plan
8) Resume work
9)

7.2.2 Discovery of human remains

In the event that construction of the project reveals possible human skeletal material (remains) the following procedure must be implemented:

- As soon as remains are exposed, all construction must halt at that location immediately and the on-site supervisor must be immediately notified to allow assessment and management
- The on-site supervisor must notify the Environmental Representative, Roads and Maritime Project Manager and Roads and Maritime Senior Environmental Officer
- Initial photographs would be supplied to Roads and Maritime heritage specialists to determine whether they are human or animal. If identification as animal is confirmed they will advise on site supervisor to proceed with caution, and manage the find as an unexpected find. A determination of human or uncertain will trigger the remainder of this protocol.
- The on-site supervisor must contact police
- The on-site supervisor must contact OEH's Environment Line on 131 555 and the Heritage Division of OEH on (02) 9873 8500
- A physical or forensic anthropologist must inspect the remains in situ (organised by the police unless otherwise directed by the police) and make a determination of ancestry (Aboriginal or non-Aboriginal) and antiquity (pre-contact, historic or forensic)
- If the remains are identified as forensic, the area would be deemed a crime scene
- If the remains are identified as Aboriginal, the site would be secured and OEH and all Aboriginal stakeholders would be notified in writing
- If the remains are identified as non-Aboriginal (historical) remains, the site would be secured and the Heritage Branch of OEH would be contacted.

The above process functions only to appropriately identify the remains and secure the site. From this time, the management of the area and remains would be determined through one of the following means:

- If the remains are identified as a forensic matter, management of the area must be determined through liaison with the police
- If the remains are identified as Aboriginal, management of the area must be determined through liaison with Roads and Maritime, OEH, the Department of Planning and Infrastructure (DP&I) and registered Aboriginal stakeholders
- If the remains are identified as non-Aboriginal (historical), management of the area must be determined through liaison with Roads and Maritime, the Heritage Branch of OEH and the DP&I
- If the remains are identified as not being human, then work would recommence once the appropriate clearances have been given.

7.2.3 Mapping of heritage items

The location of all non-Aboriginal heritage items identified in this assessment must be included on construction drawings and plans so that all contractors and personnel involved with the construction works are aware of their location.

7.2.4 Heritage awareness training

Non-Aboriginal heritage awareness training must be provided for all contractors and personnel prior to commencement of construction works to ensure understanding of potential heritage buildings, features and artefacts that may be impacted during the project, and the procedure required to be undertaken in the event of discovery of non-Aboriginal heritage materials, features or deposits, or the discovery of human remains.

8. References

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Appendix A. Strategic design plans

NOT FOR CONSTRUCTION - 22/10/12

Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd.

From KURRAJONG

(MR184)

BELLS LINE OF ROAD

RIGHT TURN BAY

ZIP MERGE

DUAL WESTBOUND LANES
(LENGTH: 90m)

TERRACE

ROAD

BEAUMONT AVENUE

RIGHT TURN BAY

BUS STOP

LEGEND

— — PROPOSED BOUNDARY

N

GROSE VALE ROAD

RIGHT TURN BAY

LEFT TURN LANE

DUAL RIGHT
TURN LANES

ZIP MERGE

WILLIAM STREET

RIVERVIEW STREET

To RICHMOND

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Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D.

Transport Roads & Maritime Services

DESIGNED. . . . . .

REVIEWED. . . . . .

ROADS AND MARITIME SERVICES

HAWKESBURY COUNCIL
MR184 BELLS LINE OF ROAD, NORTH RICHMOND
INTERSECTION WITH GROSE VALE ROAD AND TERRACE ROAD
STRATEGIC DESIGN - INTERSECTION UPGRADE
DESIGN LAYOUT

FILE No.	DRAWING	PRINTED DATE	SHEET No.
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REGISTRATION NUMBER
DS2012/001118

NOT FOR CONSTRUCTION - 22/10/12

Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd

RIGHT TURN BAY
(LENGTH: 40m STORAGE
PLUS DECELERATION)

3m WIDE MERGE
RUNOFF AREA
(LENGTH: 30m)

LEFT TURN LANE
WITH ACCELERATION
(LENGTH: 125m)

PAVEMENT WIDENING TO
FACILITATE RIGHT TURN MOVEMENTS
BY SEMITRAILERS

FROM NORTH RICHMOND

TO RICHMOND

MR184 KURRAJONG ROAD

OLD KURRAJONG ROAD

TO YARRAMUNDI LANE

600mm
600mm
150mm
150mm
150mm
50mm
150mm
150mm
2X100mm
2X100mm
2X100mm
375mm
100mm
450mm
100mm
WZ
WC
TZ
E

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Transport Roads & Maritime Services
NSW GOVERNMENT

DESIGNED. . . . . .
REVIEWED. . . . . .

ROADS AND MARITIME SERVICES

HAWKESBURY COUNCIL
MR184 KURRAJONG ROAD
INTERSECTION WITH OLD KURRAJONG ROAD, RICHMOND
STRATEGIC DESIGN - INTERIM INTERSECTION UPGRADE
DESIGN LAYOUT

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REGISTRATION NUMBER
DS2012/001119

NOT FOR CONSTRUCTION - 22/10/12

Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd

LEGEND

— — PROPOSED BOUNDARY

PARKING TO BE BANNED FROM CHAPEL STREET TO BOSWORTH STREET

RIGHT TURN BAY (LENGTH: 145m)

PARKING TO BE BANNED FROM BOSWORTH STREET TO 120m EAST

PARKING TO BE BANNED FROM BOSWORTH STREET TO 210m WEST

PARKING TO BE BANNED FROM BOSWORTH STREET TO 100m EAST

MARCH STREET TO BOSWORTH STREET RIGHT TURN BAN

STREET

From NORTH RICHMOND

To WINDSOR

MR 184 KURRAJONG ROAD

MARCH STREET

CHAPEL STREET

MR 570 BOSWORTH STREET

BOSWORTH STREET

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SCALES

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Transport Roads & Maritime Services NSW GOVERNMENT

DESIGNED. . . . . .

REVIEWED. . . . . .

ROADS AND MARITIME SERVICES

HAWKESBURY COUNCIL
MR184 KURRAJONG ROAD AND MARCH STREET
INTERSECTION WITH MR570 BOSWORTH STREET, RICHMOND
STRATEGIC DESIGN - INTERSECTION UPGRADE
DESIGN LAYOUT

FILE No.	DRAWING	PRINTED DATE	SHEET No.
SF2012/040309	01_Bosworth_St.dgn	22/10/2012	01

REGISTRATION NUMBER

DS2012/001120

Appendix E

Aboriginal heritage due diligence assessment report and PACHCI clearance letter

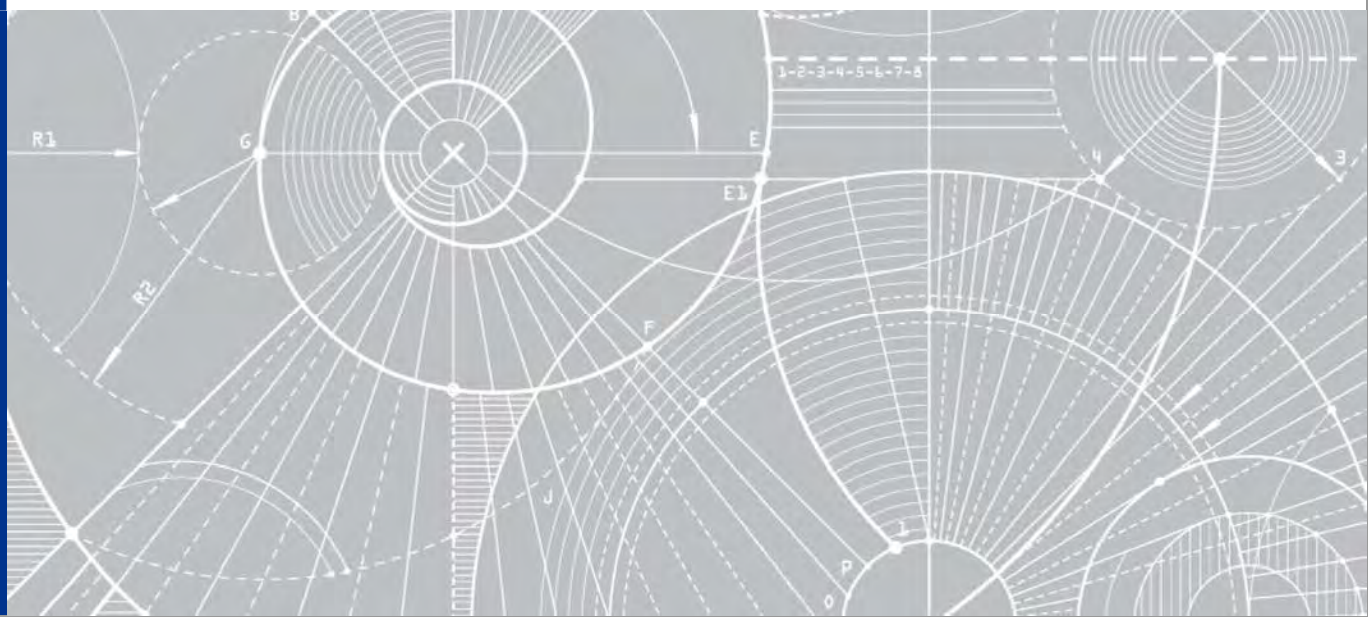
Richmond Bridge Approaches - Short Term Improvements Work Package 10, RMS Project Number T/06487

DOWNER MOUCHEL

Aboriginal Due Diligence Assessment Report

NB00042.10 |v1

28 September 2015



JACOBS

Richmond Bridge Approaches - Short Term Improvements Work Package 10, RMS Project Number T/06487

Project no:	NB00042.10
Document title:	Aboriginal Due Diligence Assessment Report
Document no:	NB00042.10
Revision:	V5
Date:	28 September 2015
Client name:	Downer Mouchel
Client no:	Client Reference
Project manager:	Andrew Costello
Author:	David Collard
File name:	I:\VWES\Admin\Cultural Heritage\Projects\NSW\Richmond Bridge Updates\Aboriginal\Richmond Bridge Approaches NSW Due Diligence_V5.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
1	24/06/14	Draft Aboriginal Due Diligence Assessment Report	Rani Attwood	Andrew Costello	

Contents

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Executive Summary

As an outcome of the *Richmond Bridge and Approaches Congestion Study*, Roads and Maritime Services (Roads and Maritime) proposes works to improve travel conditions between Richmond and North Richmond, NSW, through the implementation of three preferred short term upgrade options.

Jacobs was commissioned by Downer Mouchel on behalf of Roads and Maritime to undertake an assessment of the potential environmental impacts of the proposal, and prepare a review of environmental factors (REF) in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act).

As part of preparing the REF, this Aboriginal heritage due diligence assessment has been undertaken in accordance with the Office of Environment and Heritage (OEH) (formerly Department of Environment, Climate Change and Water, DECCW) Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, September 2010).

The purpose of the assessment is to determining whether the proposal may harm any Aboriginal objects and to satisfy the requirements of Due Diligence. Specifically, this due diligence assessment will investigate whether Aboriginal sites are located within, or immediately adjacent to, the works areas; determine the likelihood of impact to these sites and consequently, whether an Aboriginal Heritage Impact Permit (AHIP) application is required for the proposed works.

The scope of works proposed by Roads and Maritime and to be undertaken by Downer Mouchel includes the implementation of three short term upgrades as follows:

- At the Bells Line of Road/Grose Vale Road intersection, North Richmond:
  - Providing two dedicated right turn lanes from Grose Vale Road into Bells Line of Road (northbound and eastbound)
  - Providing a dedicated left turn lane from Bells Line of Road into Grose Vale Road
  - Provision of two westbound through lanes on Bells Line of Road
  - Extending the eastbound merge on Bells Line of Road
  - Imposing a clearway on Bells Line of Road between Pitt Lane and Grose Vale Road during peak periods
- At Kurrajong Road/Old Kurrajong Road intersection, Richmond:
  - Widening of the intersection to provide an exclusive right turn bay for eastbound and southbound movements for Kurrajong Road into Yarramundi Lane
  - Providing a left slip lane out of Yarramundi Lane with a westbound acceleration lane on Kurrajong Road
  - Installation of a site compound comprising 2 site offices, lunchroom, ablutions and 2 shipping containers
- At Kurrajong Road/Bosworth Street intersection, Richmond:
  - Widening the intersection to provide and exclusive eastbound right turn bay from Kurrajong Road to Bosworth Street
  - Banning right turn movements from March Street to Bosworth Street North
  - Providing a clearway on Kurrajong Road between Chapel Street and Bosworth Street during peak periods

A search of the Aboriginal Heritage Information System (AHIMS) register was undertaken on 28 May 2014 to identify heritage places within, or immediately adjacent to, the proposed works areas. A total of five Aboriginal sites were identified within 1.5 km of the proposed works areas (Table 1.1), comprising three stone artefact scatters (including one isolated stone artefact), a rock-shelter containing artwork and one stone axe grinding groove site.

The proposed works areas are not located within 200 m of known AHIMS sites or sensitive landforms. As the study area is situated within a high density area, comprising existing roads and road reserves however, a substantial degree of previous ground disturbance is assumed to have occurred in association with past and present land use activities. Therefore it is considered unlikely that in-situ sub-surface Aboriginal objects are present within the study area. Consequently no further recommendations are provided for this package of works for the Project.

As no Aboriginal cultural heritage objects or PAD areas were identified during this assessment, an AHIP application is **not** required to be submitted to OEH for the proposed works.

Table 1.1 : Summary details of Aboriginal site types recorded within 1.5 km of the study area

Site type	Frequency of site types	Percentage of total site types
Artefact scatter	3	60%
Art	1	20%
Axe grinding groove	1	20%
Total	5	100 %

Abbreviations

AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
CHL	Commonwealth Heritage List
DP&I	Department of Planning and Infrastructure
Due Diligence Code	Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales
EP&A Act	*Environmental Planning and Assessment Act* 1979
EPBC Act	*Environment Protection and Biodiversity Act* 1999
ICOMOS	International Council on Monuments and Sites
LEP	Local Environmental Plan
NHL	National Heritage List
OEH	Office of Environment and Heritage
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services
RNE	Register of the National Estate
SHR	State Heritage Register
WHL	World Heritage List

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to undertake an Aboriginal due diligence assessment in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

This report has been prepared on behalf of, and for the exclusive use of, Jacobs's Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Project background

As an outcome of the *Richmond Bridge and Approaches Congestion Study*, Roads and Maritime Services (Roads and Maritime) proposes works to improve travel conditions between Richmond and North Richmond, NSW, through the implementation of three preferred short term upgrade options.

Jacobs was commissioned by Downer Mouchel on behalf of Roads and Maritime to undertake an assessment of the potential environmental impacts of the proposal, and prepare a review of environmental factors (REF) in accordance with the Environmental Planning and Assessment Act 1979 (EP&A Act).

1.2 Project location

The Project study area is located approximately 63 kilometres (km) north-west of the Sydney CBD, and 48 km north-west of the Liverpool CBD, within the suburbs of North Richmond and Richmond. The precinct is bound by Grose Vale Road to the north-west and March Street to the south-east and is primarily situated along Bells Line of Road and Kurrajong Road, between these extents. The Project study area is located within the Hawkesbury Local Government Area (LGA) (Figure1.1).

1.3 Aim and scope of assessment

This Aboriginal heritage due diligence assessment has been undertaken in accordance with the Office of Environment and Heritage (OEH) (formerly Department of Environment, Climate Change and Water, DECCW) Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, September 2010).

The purpose of the assessment is to determining whether the proposal may harm any Aboriginal objects and to satisfy the requirements of Due Diligence. Specifically, the Due Diligence aims to:

1) Identify whether or not Aboriginal objects are, or are likely to be, present in the project area,

2) Determine whether or not the project is likely to harm Aboriginal objects (if present), and

3) Determine whether an AHIP application is required.

If Aboriginal objects are present or likely to be present and an activity will harm those objects, then an AHIP application will be required.

1.4 Assessment process

To satisfy the requirements of the Due Diligence Code the scope of this assessment included:

- A desktop review of previous studies and reports relevant to the study area
- A search of AHIMS maintained by the Office of Environment and Heritage (OEH) to identify known Aboriginal objects and sites within the study area

A search of the World Heritage List (WHL), Commonwealth Heritage List (CHL), National Heritage List (NHL), Register of the National Estate (RNE), State Heritage Register (SHR) and the Local Environmental Plan Heritage Schedules was undertaken during the non-Aboriginal assessment undertaken by Murphy (2014) to identify known non-Aboriginal (historical) objects and sites within the study area.

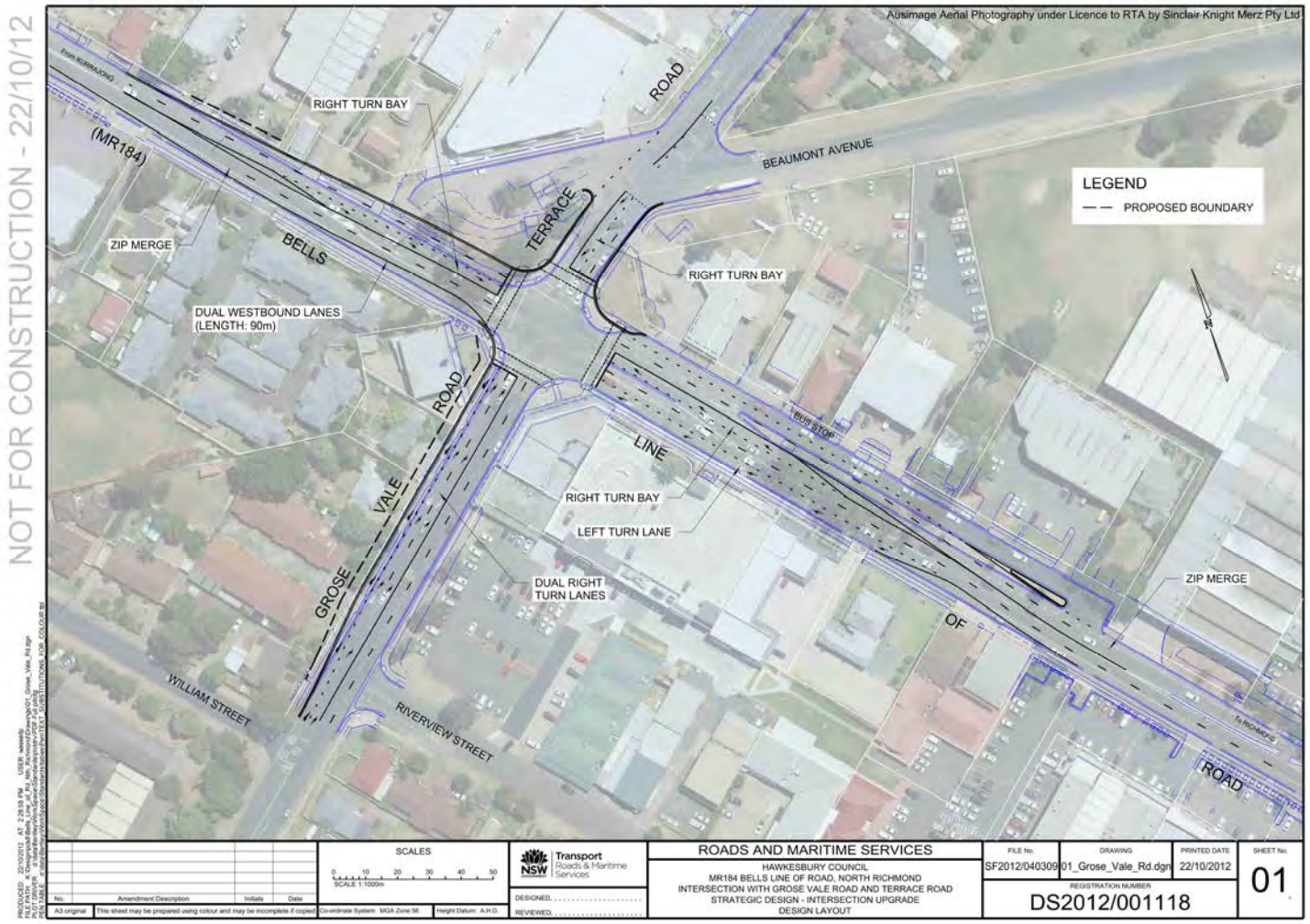


Figure 1.1: Richmond Bridge Approaches study area location, Bells Line of Road/Grose Vale Road intersection

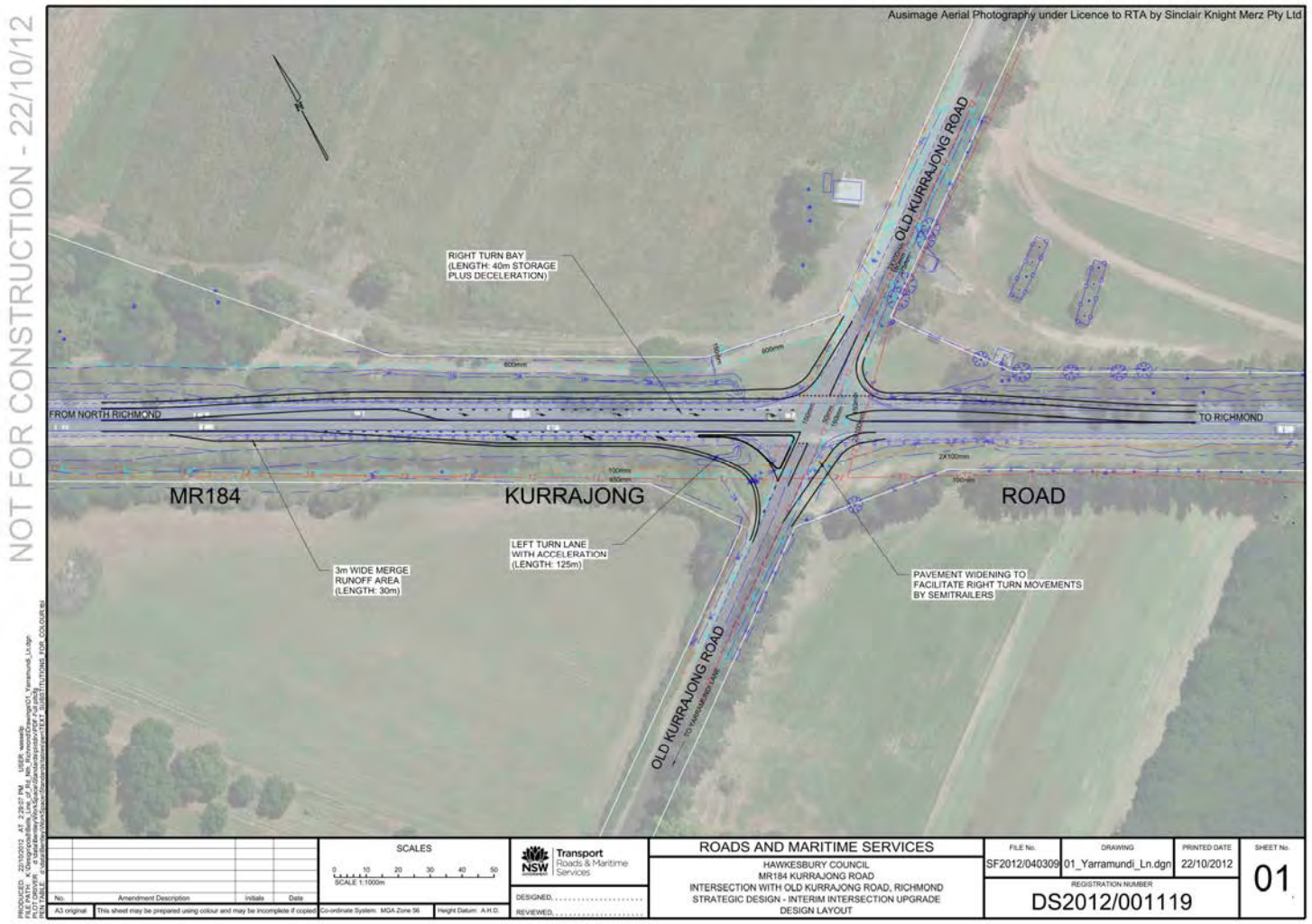


Figure 1.2: Richmond Bridge Approaches study area location, Kurrajong Road/Old Kurrajong

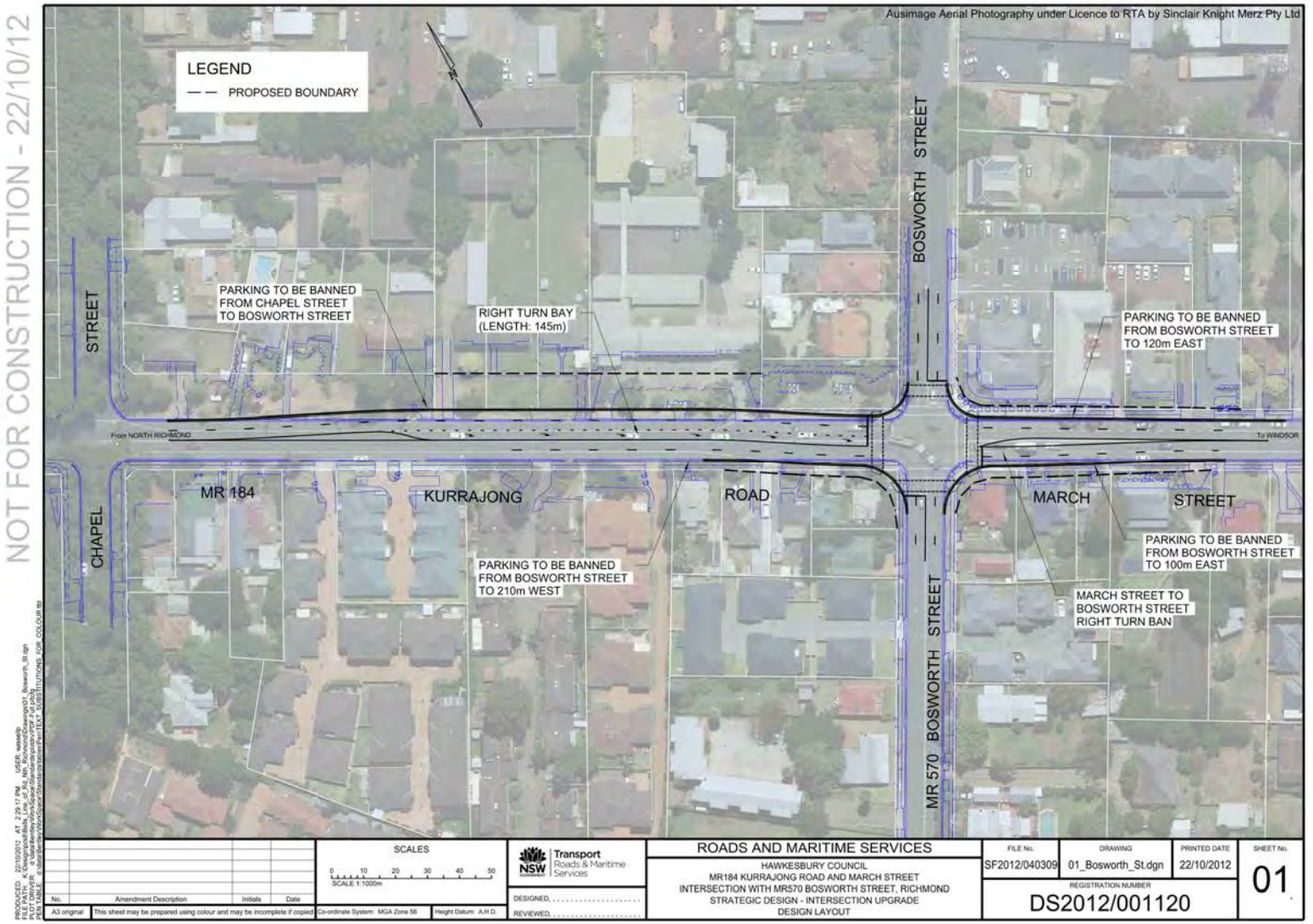


Figure 1.3: Richmond Bridge Approaches study area location, Kurrajong Road/Bosworth Street Intersection

2. Due Diligence assessment

1) *Will the activity disturb the ground surface or any culturally modified trees?*

The proposal involves ground surface disturbance during construction. Construction activities would include:

At the Bells Line of Road/Grose Vale Road intersection:

- Providing two dedicated right turn lanes from Grose Vale Road into Bells Line of Road (northbound and eastbound)
- Providing a dedicated left turn lane from Bells Line of Road into Grose Vale Road
- Provision of two westbound through lanes on Bells Line of Road
- Extending the eastbound merge on Bells Line of Road
- Imposing a clearway on Bells Line of Road between Pitt Lane and Grose Vale Road during peak periods

At Kurrajong Road/Old Kurrajong:

- Widening of the intersection to provide an exclusive right turn bay for eastbound and southbound movements for Kurrajong Road into Yarramundi Lane
- Providing a left slip lane out of Yarramundi Lane with a westbound acceleration lane on Kurrajong Road
- Installation of a site compound comprising 2 site offices, lunchroom, ablutions and 2 shipping containers

At Kurrajong Road/Bosworth Street Intersection:

- Widening the intersection to provide and exclusive eastbound right turn bay from Kurrajong Road to Bosworth Street
- Banning right turn movements from March Street to Bosworth Street North
- Providing a clearway on Kurrajong Road between Chapel Street and Bosworth Street during peak periods

A detailed description of the proposed project including construction methods is presented in the REF. As the proposal would disturb the ground surface it is considered to have the potential to impact on Aboriginal heritage items that may be present.

2) *Are there any relevant confirmed site records or other associated landscape feature information on AHIMS and or any landscape features that are likely to indicate presence of Aboriginal objects?*

The AHIMS database is operated by OEH, and regulated under section 90Q of the *National Parks and Wildlife Act 1974*. An extensive search of the AHIMS database was undertaken on 28 May 2014 using a shape file of the proposed works, including a 50 m search buffer to identify any registered (known) Aboriginal sites or declared Aboriginal places within or adjacent to the study area (Figure 1.3). It should be noted that the AHIMS database only contains records of Aboriginal sites that have been officially recorded and included on the list, which mainly represents areas of NSW that have been subject to systematic archaeological survey. As such, the AHIMS database may not provide a complete list of all Aboriginal cultural heritage within the landscape, and on its own is not an entirely accurate representation of where sites may be found. The results of these searches are summarised in Table 2.1 and illustrated in Figure 2.1. Details of theses Aboriginal sites are provided in Appendix A.

A search of AHIMS was conducted 28 May 2014 to identify registered (known) Aboriginal sites or declared Aboriginal places within, or adjacent to, the study area.

A total of five AHIMS sites were identified within 1.5 km of the proposed construction sites (Figure 2.1), representing five site types, as two of the site types contain more than one site component (Table 2.1). Three of these sites are artefact scatters (AHIMS # 45-5-2478, # 45-5-1062, # 45-5-2740), including one isolated stone artefact (AHIMS # 45-5-2740). All of the stone artefact scatter sites are manufactured from chert, silcrete and

mudstone raw materials. One site comprises two components; a sandstone rock shelter (AHIMS # 52-2-0851) containing Aboriginal artwork on three of the shelter walls. The remaining site consists of a stone axe grinding groove (AHIMS # 45-5-0259). All of these sites are open sites.

Table 2.1 : Summary details of Aboriginal site types recorded within 1.5 km of the study area

Site type	Frequency of site types	Percentage of total site types
Artefact scatter	3	60%
Art	1	20%
Axe Grinding groove	1	20%
Total	5	100 %

The most frequent site types recorded in the study area are artefact scatters and isolated finds which account for 60 per cent of the registered site types. Artefact scatters have been recorded across all environmental landscapes of the Cumberland Plain, however within the study area specifically they are recorded more frequently in close proximity to waterways such as the Hawkesbury River, and minor waterways further east and south-east, where the procurement of preferable stone resources were available for the manufacture of stone artefacts.

There are no registered Aboriginal sites located within 50 m of the proposed road infrastructure works. Consequently, no known Aboriginal sites will be impacted by the Project works.

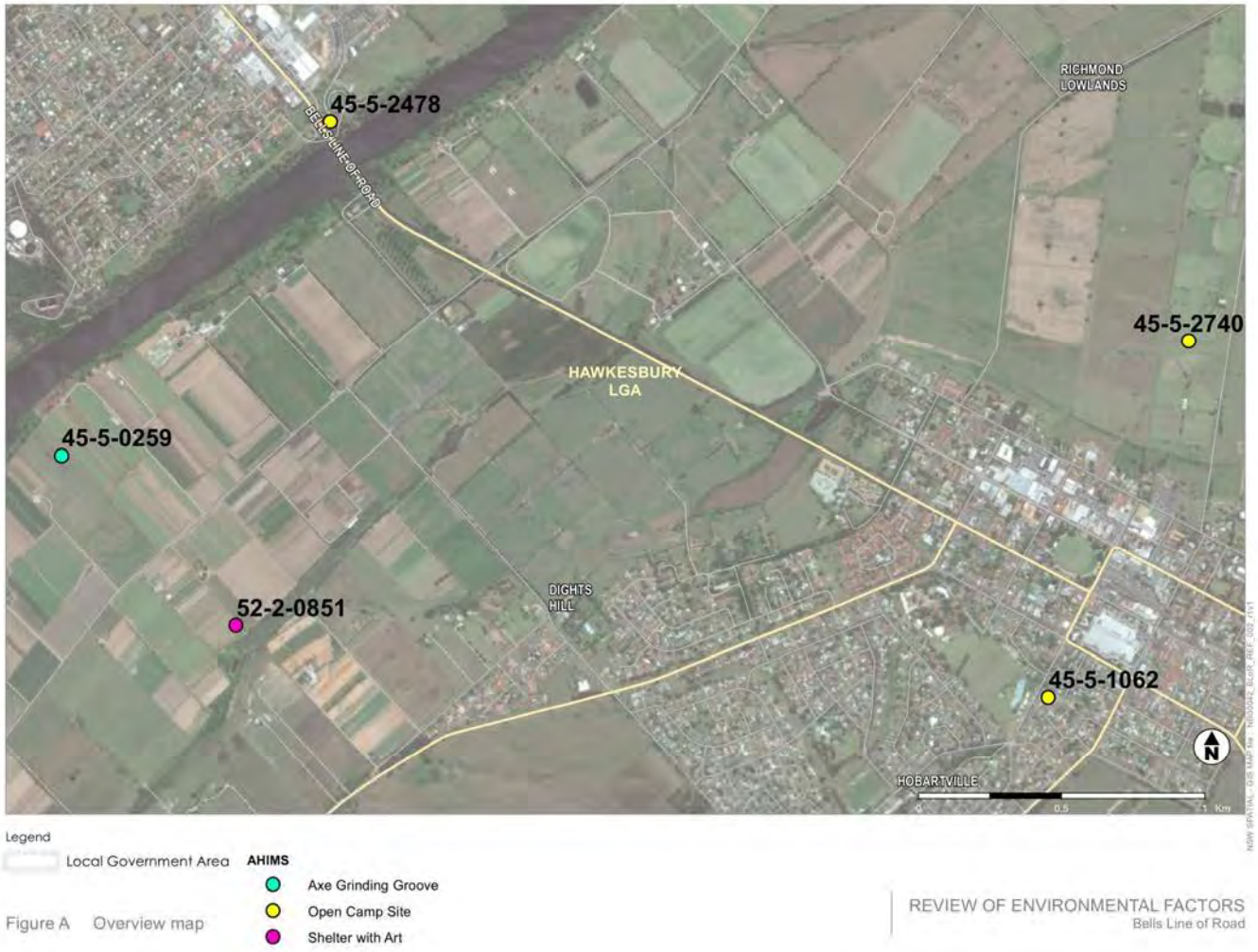


Figure 2.1: Project location in relation to AHIMS site locations

3. Previous Archaeological investigations

A number of previous investigations have been undertaken within the surrounding project area. The most relevant of these to the current study area have been summarised below in order to inform the background archaeological review.

Author/Year	Results
Dallas 1982	Dallas(1982) was engaged by the Land Commission of NSW to undertake an archaeological survey assessment for a proposed mine at Riverstone, Schofields and Quakers Hill NSW, approximately 17 km, 19 km and 23 km south-east of the Project area respectively. During the survey assessment a total of 50 stone artefacts were identified within a seven meter area, comprising predominately of cores, flakes and debitage manufactured from silcrete, chert, quartz, petrified wood and chalcedony raw materials. Dallas (1982) provides the following predictive statements regarding the archaeological potential of the wider Richmond NSW region: • Aboriginal Places will be concentrated within 200 m of waterways and other semi-permanent water sources • Sites will include stone artefact scatters and scarred trees • The potential for Aboriginal sites will depend on the degree of previous ground disturbance • Raised landforms such as hills and terraces have a higher potential for the presence of Aboriginal Places than lower lying landforms, as they were preferred occupation areas
McDonald1986	McDonald (1986) was engaged by the NSW Metropolitan Land Waste Authority to undertake an archaeological survey and sub-surface excavation assessment for a proposed regional waste disposal depot at Schofields in Plumpton NSW, approximately 20 km south-east of the Project area. During the survey assessment, McDonald (1986) identified 12 artefacts scatters and eight isolated stone artefacts. The sub-surface assessment resulted in the identification of extensive sub-surface deposits, containing silcrete stone artefacts at five of the previously identified Aboriginal stone artefact sites. McDonald (1986) concluded that gullies and spur lines were of greater sensitivity than ridgelines and consequently contained the greatest density of stone artefacts across the area. Within the test excavation areas, stratigraphy was found to be substantially disturbed due to past and present land use activities. McDonald (1986) provides the following predictive statements for the greater Plumpton region: • Stone artefact scatters and quarries are the most likely site types to be found within the region; • Stone artefact scatters will primarily be low density (<10 m^2) in nature on the ground surface however may be extensive within shallow sub-surface deposits • Artefact scatters will predominantly be manufactured from silcrete materials, with mudstone, chert, quartz and petrified wood utilized in lower frequencies • Artefact scatters on the surface will be located along raised areas including ridges and terraces • Quarries may be situated below ridge lines and within gullies; • Formal tool types will include cores, flakes and micro-blades, however flaked pieces (debitage) will comprise the majority of stone artefact type s • Sites are most likely to occur within or around 200 m of waterways

3.1.1 Summary

No registered Aboriginal sites are located within the study area. Five registered sites are located within 1.5 km of the study area (AHIMS # 45-5-2478, # 45-5-1062, # 45-5-2740, # 52-2-0851, # 45-5-0259), comprising three stone artefact scatter sites (including one isolated stone artefact), an artwork site located within a sandstone rock-shelter and a stone axe grinding groove site. None of these sites will be impacted by the proposed road works, as they are all situated at least 500 m outside the works areas (Figure 2.1).

3.2 Predictive Model

Predictive modelling was developed in conjunction with existing data sets to provide statements about the archaeological sensitivity of the study area for Aboriginal cultural heritage. The predictive model used to identify areas of archaeological sensitivity for this desktop assessment was based on a 'land system' or 'archaeological

landscape' model of site location. These types of models enable the prediction of site location based on known patterns of site distribution in similar landforms or archaeological landscapes. Predictions were based on:

- The most prominent Aboriginal archaeological site types within the study area will be stone artefacts, ranging from isolated finds to extensive scatters and quarries
- Most areas contain sub-surface archaeological deposits regardless of the density of visible stone material
- The most common raw materials utilized for the manufacture of stone artefacts would be primarily locally sourced silcrete and fine grained rocks derived from gravels and stone exposures, including, chert and mudstone raw materials, with quartz and petrified wood in lower occurrences
- Most sites which include stone artefacts will be located in landscape contexts which are well drained, predominantly on a locally elevated landform adjacent to a water source
- Artefact density will be greatest in the top 300 mm of the soil profile (plough zone)
- Knapping floors located within the plough zone may be still relatively intact
- Sites will mainly be located in close proximity (5 m - 300 m) to natural water sources
- Major streamline confluences are prime site locations, and may represent larger occupation or activity sites than sites located on ephemeral or temporary water lines
- Terraces, ridge lines and spur lines of higher elevation near water sources will be the most sensitive landforms for Aboriginal cultural heritage however quarry sites may occur within gullies
- The presence of Aboriginal sites within the study area will be dependent on the degree of previous ground disturbance associated with past and present land use practices

Sensitivity ratings for the predictive model shown in Table 3.1 reflect the likelihood for cultural and archaeological sites to occur within each category, as well as an indicator of the potential significance of the sites. For example, a high rating indicates that the areas with these specific landscape characteristics (called landforms) are predicted to have a high potential for the discovery of archaeological and cultural sites and these sites are more likely to be of higher significance.

Table 3.1: Predictive model based on landscape units for the identification of areas of high, moderate and low archaeological sensitivity in the study area

Broad archaeological landscape units	Specific landscape characteristics within the broad landscape units	Sensitivity rating	Issues relating to assigning sensitivity ratings.
Floodplain	Low lying areas.	Low	Previous flooding, damp soils. Sites are recorded within this landform unit.
Terraces, rises, spur lines	Raised areas within floodplain, such as terraces, spur lines and ridge lines.	High	Many known sites are recorded within this landform unit, however only limited examples of this landform are found within the study area.
Swamps	Low lying areas	Low	Previous flooding, damp soils
Low ridgelines and gentle slopes	Level to gently sloping crests of ridgelines particularly those between adjacent to swamps. Upper slopes of spur lines greater than 100 m from water.	High Low	Sites are recorded within this landform unit however deposits are likely to be of shallow nature. Known sites of low significance located in these areas.

4. Consultation

In accordance with the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (OEH) Aboriginal community consultation was undertaken. The aims of the consultation process are to:

- Provide an opportunity for Aboriginal people who hold cultural knowledge relevant to determining the significance of Aboriginal objects(s) and/or place(s) in the area of the Project to be involved in consultation
- Provide Aboriginal people who hold cultural knowledge relevant to determining the significance of Aboriginal objects (s) and/or place(s) in the area of the Project with the opportunity to participate in decision making regarding the management of their cultural heritage by providing proponents information regarding cultural significance and inputting into management options

The consultation process has been initiated under the Project.

5. Conclusion and recommendations

The proposed works areas are not located within 200 m of known AHIMS sites or sensitive landforms. As the study areas are situated within built up, residential areas comprising of existing roads and road reserves, a substantial degree of previous ground disturbance is assumed to have occurred within the study area associated with past and present land use activities. Therefore it is considered unlikely that in-situ sub-surface Aboriginal objects are present within the study area. Consequently no further recommendations are provided for this package of works for the Project.

As no Aboriginal cultural heritage objects or PAD areas were identified during this assessment, an AHIP application is **not** required to be submitted to OEH for the proposed works.

6. References

Dallas, M. 1982. *An Archaeological Survey at Riverstone, Schofields and Quakers Hill, NSW*. Report prepared for the Land Commission of NSW, Blacktown City Council and the Department of Environment and Planning

McDonald, J. 1986. *Preliminary Archaeological Reconnaissance of the Proposed Schofields Regional Depot Plumpton, NSW.* Report prepared for the Metropolitan Waste Disposal Authority, Sydney NSW.

Murphy, K. 2014 *Richmond Bridge Approaches – Short Term Improvements Work Package 10, Number T/06487: Non-Aboriginal Due Diligence Assessment Report*. Report prepared for Downer Mouchel.

Appendix A. Previously recorded Aboriginal sites (AHIMS search results)

Site Id#	Site name	Datum	Zone	Easing	Northing	Site features
45-5-2740	ISF	AGD	56	291750	6280900	Isolated find
45-5-1062	Richmond Markerplace 1;RM 1;	AGD	56	291260	6279650	Artefact scatter
45-5-2478	Beaumont Ave (BA-OS-1)	AGD	56	288750	6281670	Artefact scatter
52-5-0851	Wilton Allens Creek Bridge Site 8	AGD	56	288420	6279900	Art site
45-5-0259	North Richmond	AGD	56	287811	6280496	Axe grinding groove

Appendix B. AHIMS search results

Office of Environment & Heritage

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : Richmond Brudge Update
Client Service ID : 192306

Jacobs Group (Australia) Pty Ltd - Melbourne
PO Box 312 Flinders Lane
Melbourne Victoria 8009
Attention: David Collard

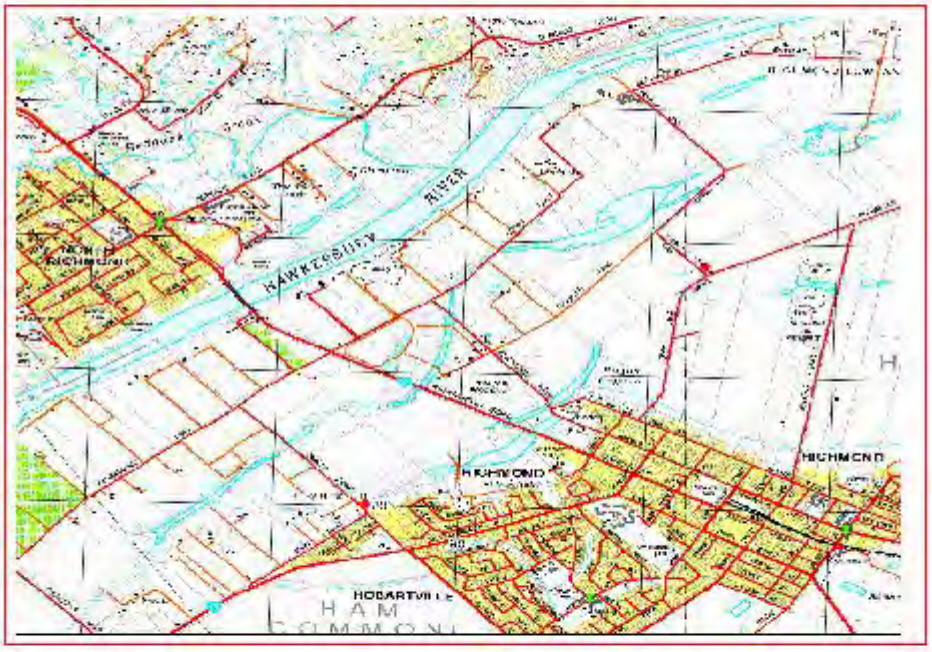
Email: dcollard@globalskm.com

Date: 28 September 2015

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -33.6026, 150.7118 - Lat, Long To : -33.571, 150.7619 with a Buffer of 50 meters, Additional Info : Due diligence for REF, conducted by David Collard on 28 September 2015.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.



A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

5	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

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Office of Environment & Heritage

AHIMS Web Services (AWS)

Extensive search - Site list report

Purchase Order/Reference : Richmond Brudge Update

Client Service ID : 192306

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-2478	Beaumont Ave (BA-OS-1)	AGD	56	288750	6281670	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Mr.Phil Hunt					Permits		
52-2-0851	Wilton Allens Creek Bridge Site 8	AGD	56	288420	6279900	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	384,1738
	Contact	Recorders	Mary Dallas Consulting Archaeologists					Permits		
45-5-1062	Richmond Markerplace 1;RM 1;	AGD	56	291260	6279650	Open site	Valid	Artefact : -	Open Camp Site	
	Contact	Recorders	Doctor.Jo McDonald					Permits	838,963	
45-5-2740	ISF	AGD	56	291750	6280900	Open site	Valid	Artefact : -		3327
	Contact	Recorders	Ms.Alison Nightingale					Permits		
45-5-0259	North Richmond	AGD	56	287811	6280496	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	260,1018
	Contact	Recorders	Charles.D Power					Permits		

Report generated by AHIMS Web Service on 28/09/2015 for David Collard for the following area at Lat, Long From : -33.6026, 150.7118 - Lat, Long To : -33.571, 150.7619 with a Buffer of 50 meters. Additional Info : Due diligence for REF. Number of Aboriginal sites and Aboriginal objects found is 5

Transport
Roads & Maritime
Services

9 September 2015

Elizabeth Sim
Project/Contract Manager
Roads & Maritime Services
Argyle Street
PARRAMATTA NSW 2150

Dear Elizabeth,

Preliminary assessment results for Intersection Upgrade at Bells Line of Road/Grose Vale Road & March Street/Bosworth Street based on Stage 1 of the *Procedure for Aboriginal cultural heritage consultation and investigation* (the procedure).

The project, as described in the Project REF, was assessed as being unlikely to have an impact on Aboriginal cultural heritage.

The assessment is based on the following due diligence considerations:

- The project is unlikely to harm known Aboriginal objects or places.
- The AHIMS search did not indicate moderate to high concentrations of Aboriginal objects or places in the study area.
- The study area does not contain landscape features that indicate the presence of Aboriginal objects, based on the Office of Environment and Heritage's *Due diligence Code of Practice for the Protection of Aboriginal objects in NSW* and the Roads and Maritime Services' procedure.
- The cultural heritage potential of the study area appears to be reduced due to past disturbance.
- There is an absence of sandstone rock outcrops likely to contain Aboriginal art.

Your project may proceed in accordance with the environmental impact assessment process, as relevant, and all other relevant approvals.

If the scope of your project changes, you must contact me and your regional environmental staff Jennifer Warren (Ext 82875) to reassess any potential impacts on Aboriginal cultural heritage.

If any potential Aboriginal objects (including skeletal remains) are discovered during the course of the project, all works in the vicinity of the find must cease. Follow the steps outlined in the Roads and Maritime Services' *Unexpected Archaeological Finds Procedure*.

For further assistance in this matter and do not hesitate to contact me.

Yours sincerely,

Andrew Whitton
A/Senior Advisor Aboriginal Cultural Heritage

Appendix F

Community and stakeholder consultation report

Appendix F – Community and Stakeholder consultation report:

To be issued separately

Appendix G

Noise and vibration assessment report

RMS Stewardship Maintenance Contract

DOWNER MOUCHEL

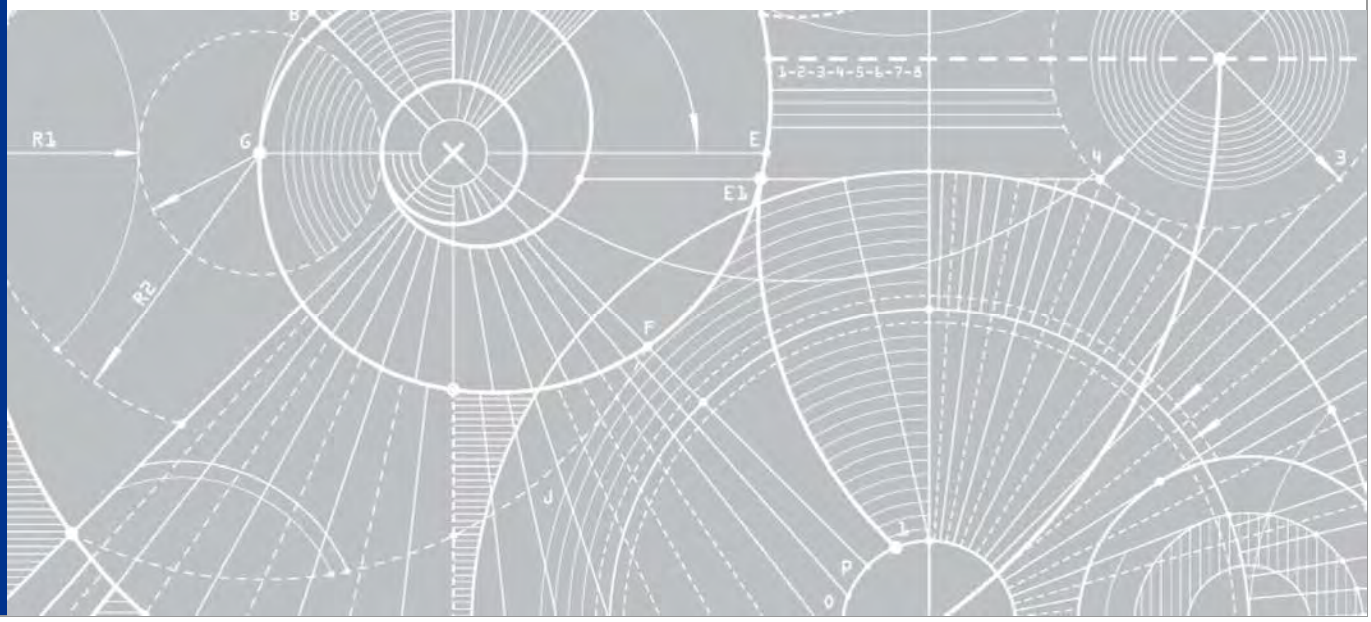
Work Package 10, RMS Project Number T/06487

Richmond Bridge Approaches – Short-Term Improvements

CONSTRUCTION NOISE AND VIBRATION AND ROAD NOISE IMPACT ASSESSMENT REPORT

Final 1 | 0

15 July 2014



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Work Package 10, RMS Project Number t/06487

Project no:	NB00042.10
Document title:	Work Package 10, RMS Project Number T/06487 Richmond Bridge Approaches – Short Term Improvements Construction Noise and Vibration and Road Noise Impact Assessment Report
Document no:	Draft 1
Revision:	1
Date:	15 July 2014
Client name:	Downer Mouchel
Client no:	
Project manager:	Chris Turnbull
Author:	Luke Spencer
File name:	C:\Users\lspencer\Desktop\Projects\Richmond Bridge\EN04467_Jacobs_HRL AQ_Draftv0.docx

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Document history and status

Revision	Date	Description	By	Review	Approved
D1v0	03/07/2014	Draft assessment report	L. Spencer	J. Hutchison	
D1v1	15/07/2014	Draft assessment report addressing practice review edits	L. Spencer	S. Hughes	
F1v0	15/07/2014	Final	L. Spencer		J. Hutchison

Contents

Executive Summary

The purpose of this study was to assess potential construction noise and vibration and operational road traffic noise impacts associated with the upgrade of three key road intersections at Bells Line of Road and Grose Vale Road North Richmond, Kurrajong Road and Old Kurrajong Road Richmond and Richmond, Kurrajong Road and Bosworth Street Richmond. This involved:

- Identification of noise sensitive receivers.
- Installation of noise logging equipment and long-term measurement to determine background noise conditions.
- Establishment of construction noise management levels.
- Prediction of construction noise and vibration levels at nearby sensitive receivers.
- Evaluation of changes in road noise levels at sensitive receivers.
- Identification of noise management and mitigation measures where predictions indicated that criteria may be exceeded during the works.

The assessment identified that there is potential for construction activities at all three work areas to exceed noise management levels established for the project. Management and mitigation measures were identified in line with RMS guidance documentation including additional mitigation measures in line with the CNS for out of hour's works.

Where vibration-intensive plant is used in closer proximity to residential and heritage-listed properties (10 m or closer to the closest façade) it is possible that the lowest values (for 1 to 10 Hz) for building damage; and human comfort criteria could be exceeded and mitigation may be required. Management and mitigation measures were recommended in accordance with RMS guidance documentation.

Calculations were completed to assess road noise impacts arising from proposed changes to road alignments. Based on the preliminary information available, predictions indicated that road noise levels at the nearest receivers would not increase by 2 dB(A) or more as a result of the upgrade work, relative to existing conditions.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to assess potential construction noise and vibration and operational road traffic noise impacts associated with the upgrade of three key road intersections at Bells Line of Road and Grose Vale Road North Richmond, Kurrajong Road and Old Kurrajong Road Richmond and Richmond, Kurrajong Road and Bosworth Street Richmond in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

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1. Introduction

1.1 Background

Jacobs has been engaged by DownerMouchel (DM) to provide environmental services for the projects delivered under the NSW Roads and Maritime Services (RMS) Stewardship Maintenance Contracts, Sydney West and Sydney North zones. The 'Richmond Bridge Approaches – Short-term Improvements' project forms part of this package of works. The project involves upgrade works to be undertaken at the following intersections:

- Bells Line of Road and Grose Vale Road, North Richmond;
- Kurrajong Road and Old Kurrajong Road, Richmond; and
- Kurrajong Road and Bosworth Street; Richmond.

Jacobs has been engaged by DM to prepare a *Review of Environmental Factors* (REF) to assess potential environmental impacts arising from the works. This *Construction Noise and Vibration and Road Noise Impact Assessment Report* (CNVRNIA) forms part of the *Review of Environmental Factors* (REF) for the works and assesses acoustic and vibration-related impacts of the proposed upgrade on sensitive receivers.

The CNVRNIA has been undertaken with consideration to the following documentation:

- *Richmond Bridge and Approaches Congestion Study: Preferred short-term and long-term options report*, (NSW RMS, February 2013);
- *Richmond Bridge and Approaches Congestion Study: Stage 1 summary report*, (NSW RMS, July 2012);
- *Interim Construction Noise Guidelines* [ICNG], (former NSW Department of Environment and Climate Change [DECC], July 2009);
- *NSW Industrial Noise Policy* [INP], (NSW Environment Protection Authority, January 2000);
- *NSW Road Noise Policy* [RNP], (former NSW Department of Environment, Climate Change and Water NSW [DECCW], March 2011);
- *RTA Environmental Noise Management Manual* [ENMM], (former NSW Roads and Traffic Authority [RTA], December 2001).
- *Australian Standard 1055.1 – 1997: Acoustics – Description and measurement of environmental noise* [AS 1055.1 – 1997], (Committee AV/5 Acoustics, Community, Noise, August 1997).
- *Construction Noise Strategy 7TP-ST-157/2.0* [CNS], (former Transport for NSW [TfNSW], April 2012).
- *Assessing Vibration: a technical guideline,* (former NSW Department of Environment and Conservation [DEC], February 2006).

1.2 Project Description

1.2.1 Scope or works

The purpose of the proposed works is to improve travel conditions across Richmond Bridge between Richmond and North Richmond by providing short-term relief to local traffic congestion issues.

The scope of works at each of the three locations is described below. Preliminary design drawings for each of the three proposed work locations are provided in Appendix A.

Bells Line of Road and Grose Vale Road, North Richmond:

- Two dedicated right turn lanes from Grose Vale Road into Bells Line of Road (northbound and eastbound).
- Dedicated left turn lane from Bells Line of Road into Grose Vale Road.
- Two westbound through lanes on Bells Line of Road.
- Extension of eastbound merge on Bells Line of Road.
- Establishment of a clearway on Bells Line of Road between Pitt Lane and Grose Vale Road during peak periods.

Kurrajong Road and Old Kurrajong Road, Richmond:

- Widening of the intersection including an exclusive right turn bay for eastbound and southbound movements for Kurrajong Road into Yarramundi Lane.
- Left slip lane out of Yarramundi Lane with a westbound acceleration lane on Kurrajong Road.

Kurrajong Road and Bosworth Street; Richmond:

- Widening of the intersection to allowing an exclusive right turn bay from Kurrajong Road to Bosworth Street.
- Prohibition of right turn movements from March Street to Bosworth Street.
- Establishment of a clearway on Kurrajong Road between Chapel Street and Bosworth Street during peak periods.

1.2.2 Program

A staged delivery of the three intersection upgrades is proposed. Upgrade of the Bells Line of Road and Grose Vale Road intersection is planned to take place from late 2014 to mid-2015, with the Kurrajong Road and Old Kurrajong Road intersection to be completed by June 2016 and the Kurrajong Road and Bosworth Street intersection by June 2017. Each upgrade is expected to take several months.

Construction work is anticipated to be carried out during standard day time hours whenever possible and practical; although there may be some works which are required to be undertaken outside standard hours in order to maintain public safety and minimise traffic disturbances and delays.

1.3 Scope of assessment

The scope of the CNVRNIA consists of the following tasks:

- Identification of noise sensitive receivers.
- Installation of noise logging equipment and long-term measurement for a period of 7 days of ambient noise conditions within the vicinity of the proposed upgrade sites.
- Determination of rating background levels (RBLs) in accordance with the INP.
- Establish construction noise management levels (NMLs) with consideration to the ICNG.
- Predict construction noise and vibration levels at nearby sensitive receivers and compare against established NMLs and vibration criteria.
- Evaluate change in road noise levels at sensitive receivers and assess whether there is any significant impacts associated with the proposed upgrades.
- Provide noise management and mitigation measures if predictions indicate the criteria are likely to be exceeded.

2. Existing environment

2.1 Sensitive receivers

The proposed road upgrades are located around three intersections at:

- Bells Line of Road and Grose Vale Road, North Richmond (work area 1);
- Kurrajong Road and Old Kurrajong Road, Richmond (work area 2); and
- Kurrajong Road and Bosworth Street; Richmond (work area 3).

Receivers are the residential, commercial, educational, places of worship and recreational land uses located within the vicinity of each of these locations. At work areas 1 and 3, the nearest receivers are located directly adjacent to the proposed works. At work area 2 the closest receiver is the Colo Football Club fields located approximately 200 m southwest, with residential receivers set 380 m or more away.

2.2 Background noise

2.2.1 Measurement

Long-term continuous noise monitoring was undertaken to establish the existing level of background noise and identify dominant noise sources within the work locations. The data would be used to determine construction and operational noise assessment criteria.

Monitoring was completed at two receiver locations within work areas 1 and 3 from Friday 20 to Friday 27 June 2014. Continuous results were recorded for each 24-hour period of monitoring, recording 15 minute noise statistics. An audio recording of the ambient noise was obtained for the purposes of noise source identification.

Monitoring was carried out using Type 1 Ngara noise loggers set up in accordance with AS 1055.1 – 1997. One noise logger (logger no. 8780 AA) was installed at the residential premises at 1/8-10 Grose Vale Road, North Richmond to measure background noise conditions around work area 1, and the second noise logger was installed at 162 March Street, Richmond (logger no. 8780 A5) to measure background noise conditions within the vicinity of work area 3. Both loggers were installed at 1 m from the building façade. Figures 2-1 and 2-2 below show the approximate location where both noise loggers were installed, as well as nearby sensitive receivers.

2.2.2 Results

The ICNG and RNP consider different statistical noise parameters for assessing construction and road noise.

Statistical noise results collected for standard hours of construction and outside standard hours of construction are presented in Table 2-1 and Table 2-2 from both monitoring locations. The statistics exclude measurements affected by high winds. Background noise level plots for both locations are included in Appendix B.

Table 2-1 Statistical noise monitoring results – work area 1

Time of Day	$L_{A10\ 15min\ 50th\ percentile}$ dB	$L_{A90\ 15min\ 10th\ percentile}$ dB	$L_{Aeq\ 15min}$ dB
Day	65	53	63
Evening	64	45	61
Night	57	30	57

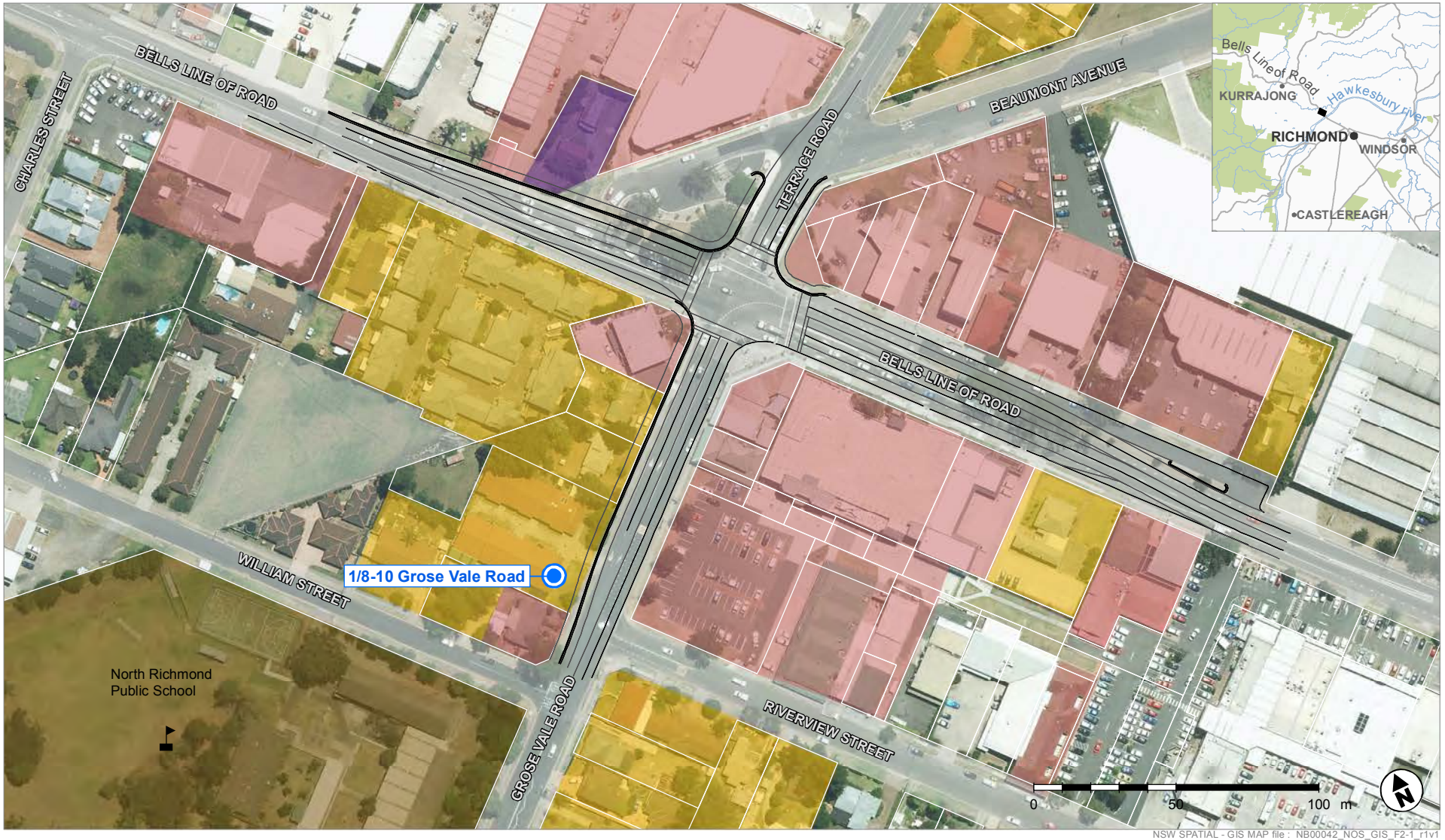

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Figure 2-1
Bells Line of Road and Grose Vale Road sensitive receiver locations

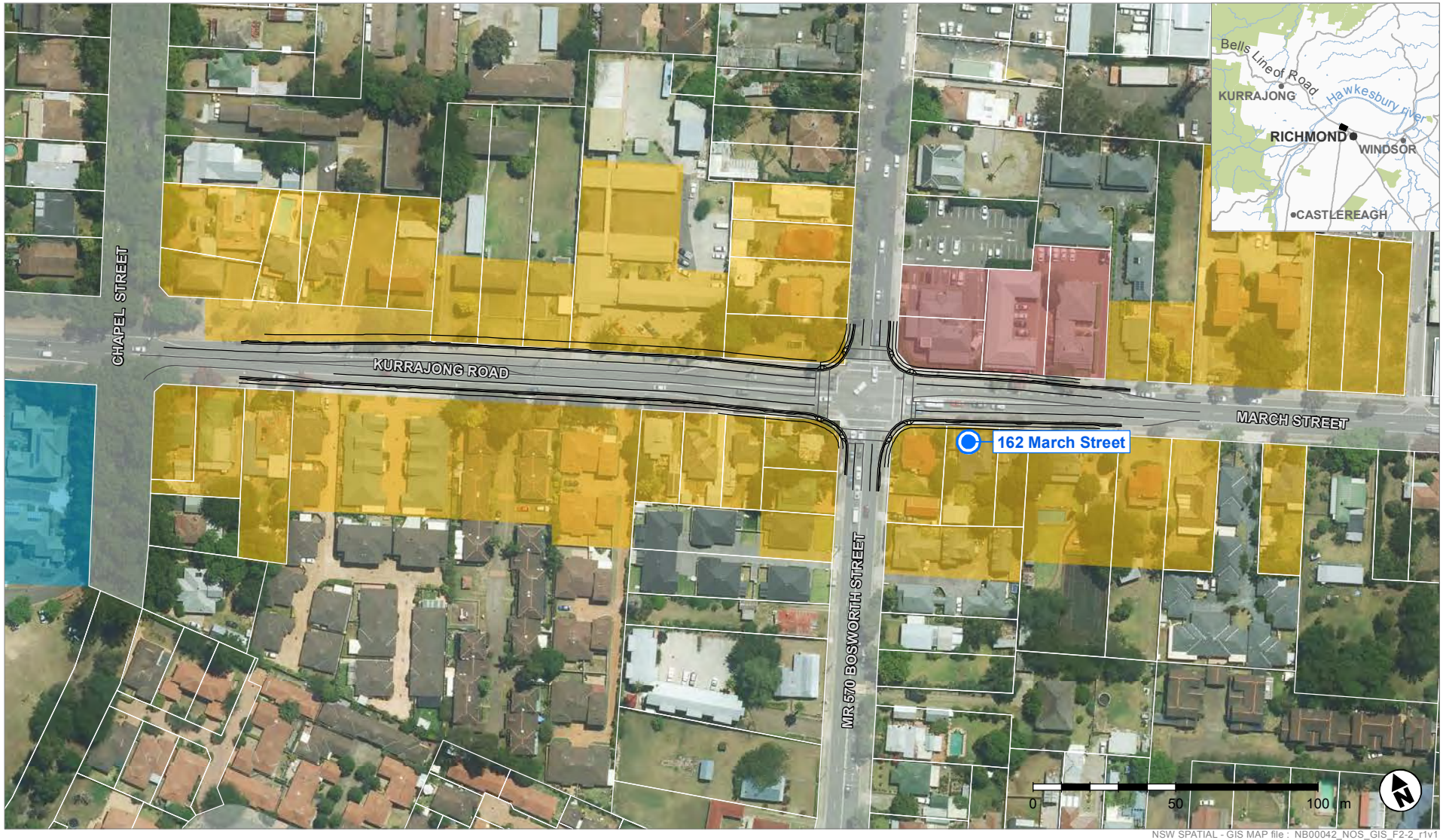

Figure 2-2
Kurrajong Road and Bosworth Street sensitive receiver locations

Table 2-2 Statistical noise monitoring results – work area 3

Time of Day	$L_{A10\ 15min\ 50th\ percentile}$ dB	$L_{A90\ 15min\ 10th\ percentile}$ dB	$L_{Aeq\ 15min}$ dB
Day	70	56	67
Evening	67	50	64
Night	61	33	62

During deployment and collection of the noise loggers it was observed that background noise at both locations was dominated by traffic noise from local roads.

For work area 2, noise measurements undertaken on Old Kurrajong Road at distances of about 30 and 230 from Kurrajong Road were used to estimate background noise levels for the two nearest receivers. The attended noise survey was undertaken for two consecutive 15 minute periods at each location during the daytime period on 4 September 2014. Figure 2-3 shows the approximate location where both noise loggers were installed, as well as nearby sensitive receivers.

The measured daytime levels have been used to approximate evening and night time levels based on expected traffic movements between Richmond and North Richmond. The L_{A90} noise levels used in the assessment of impacts are presented in Table 2-3.

Table 2-3 Measured background noise levels work area 2

Receiver address	$L_{A90\ 15min}$ dB(A)		
	Day	Evening	Night
170 Old Kurrajong Road	52	50	30
148 Old Kurrajong Road	49	45	30

For traffic noise assessments, the RNP divides the day into two periods, day and night as follows:

- Day – 7am to 10pm.
- Night – 10 pm to 7am.

As part of the RNP road noise assessment procedure, projected traffic emissions are compared against $L_{Aeq\ (15\ hr)}$ and $L_{Aeq\ (9\ hr)}$ noise management criteria. Table 2-4 presents the results for measured traffic noise levels for the day and night period.

Table 2-4 RNP traffic noise monitoring results

Location	Day – $L_{Aeq\ (15\ hr)}$	Night – $L_{Aeq\ (9\ hr)}$
Work area 1	63	57
Work area 3	66	62

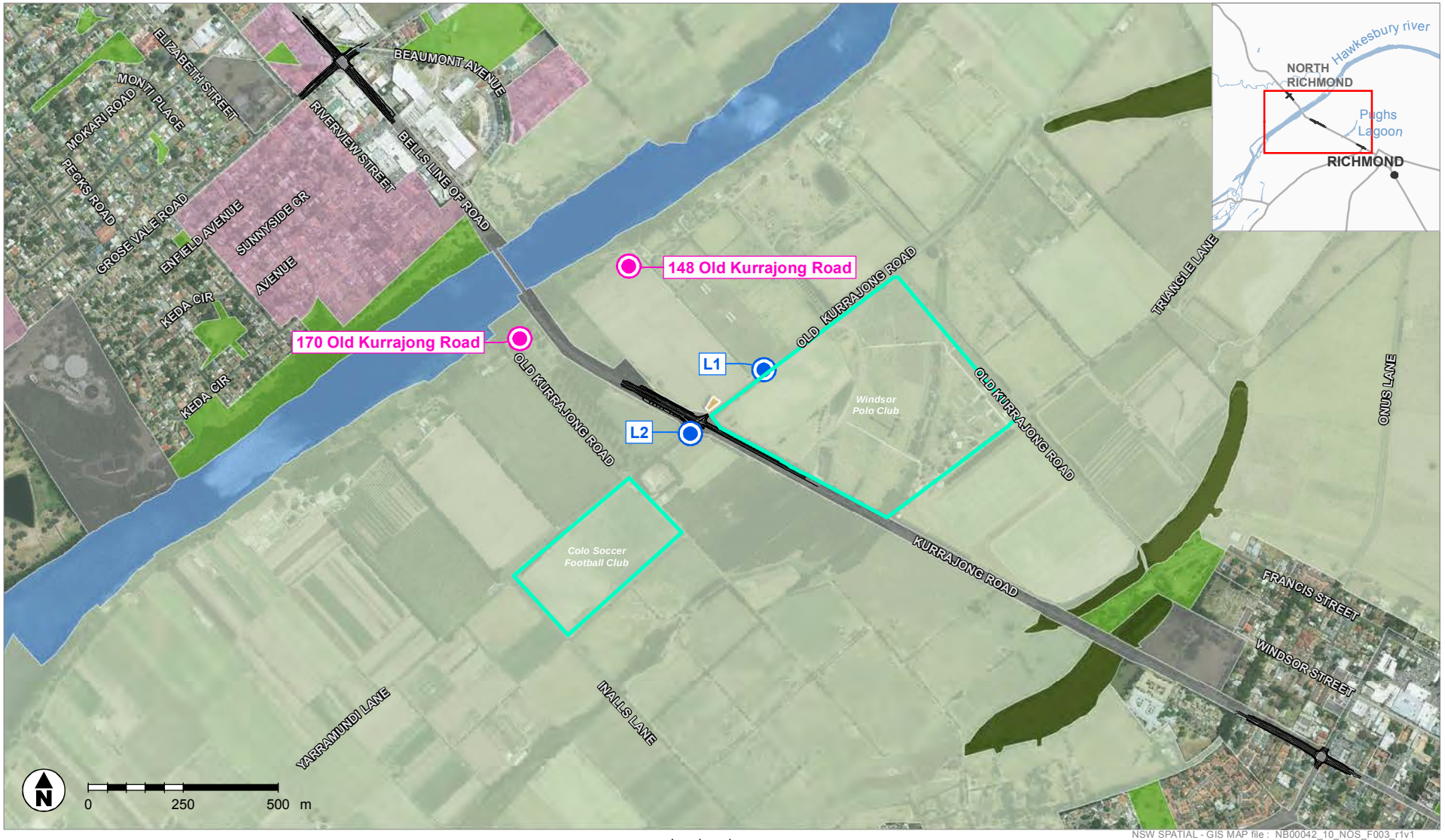

Figure 2-3
Background noise monitoring locations and nearest sensitive receivers

3. Noise and vibration criteria

3.1 Construction noise

Construction noise impacts in NSW are managed under the *Interim Construction Noise Guideline* (ICNG, DECC 2009). The guideline has been developed to assist with the management of noise impacts, rather than to present strict numeric noise criteria for construction activities.

The ICNG recommends standard hours for construction:

- Monday to Friday 7 am to 6 pm.
- Saturday 8 am to 1 pm.
- No work on Sundays or public holidays.

The ICNG describes two methods of assessing noise impacts from construction activities: the quantitative method, which is suited to major and complex construction projects; and the qualitative method, suited to short-term (less than three weeks) works undertaken during standard construction hours.

The proposed upgrade requires assessment using the quantitative method owing to the anticipated duration of the works and the potential for activities to be undertaken outside standard construction hours.

The ICNG recommends establishing NMLs at receiver locations adjacent to the works, using information on the existing background noise level at these locations. Where the NML may be exceeded as a result of the proposed works and there is potential for adverse noise impacts to occur, appropriate management measures should be implemented.

Table 3-1 details the method for determining NMLs for residential receivers potentially affected by the proposed upgrade. Often works that may cause inconvenience within the community (e.g. traffic congestion) or safety concerns are done outside standard hours. NMLs during these periods are presented in the table for works ‘Outside recommended standard hours’.

Table 3-1 Construction NMLs residential receivers (ICNG, DECC 2009)

Time of Day	Management level (NML) L_{Aeq} (15 min)*	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected (RBL + 10 dB)	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and the duration, as well as contact details.
	Highly noise affected (75 dB(A))	The highly noise affected level represents the point above which there may be strong community reaction to noise. Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected (RBL + 5 dB)	A strong justification would typically be required for works outside the recommended standard hours The proponent should apply all feasible and reasonable work practices to meet the noise affected level Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community For guidance on negotiating agreements see Section 7.2.2 of the ICNG (DECC, 2009).

As noted in Section 2.1, there are a range of non-residential receivers within the vicinity of the works. Relevant NMLs for each are summarised below in Table 3-2.

Table 3-2 Construction NMLs non-residential receivers (ICNG, DECC 2009)

Land use (when in use)	NML dB(A)
Classrooms at schools and other educational institutions (internal)	45 L_{Aeq}(15 minute)
Places of worship (internal)	45 L_{Aeq}(15 minute)
Active recreation	65 L_{Aeq}(15 minute)
Commercial premises	70 L_{Aeq}(15 minute)

Considering the background noise data in Section 2.2.2 and guidance from the ICNG in Table 3-1, construction NMLs have been established and are presented in Table 3-3 for residential receivers.

Table 3-3 Project residential receiver NMLs

Location	RBL dB(A)			NML, $L_{Aeq,\ 15\ minute}$ [dB(A)]			
	Day	Evening	Night	Day (RBL + 10)	Evening (RBL + 5)	Night (RBL + 5)	Highly noise affected
Work area 1	53	45	30	63	50	35	75
170 Old Kurrajong Road	52	50	30	62	55	35	75
148 Old Kurrajong Road	49	45	30	59	50	35	75
Work area 3	56	50	33	66	55	38	75

3.2 Construction vibration

Construction vibration is considered where it can impact on people (human comfort) and where there may be physical impacts on buildings (building damage). These two influences have different criteria levels, with the effects of vibration on people having the lowest threshold.

3.2.1 Buildings and structures

Guidance for limiting vibration levels during construction in Australia is presently informed by the German Standard *DIN 4150-3 Structural Vibration Part 3: Effects of vibration on structures [DIN4150-3],* (Building and Civil Engineering Standards Committee, February 1999). The following guideline values are provided in DIN 4150-3 for evaluating the effect of short-term vibration on structures. It is noted that 12xceedance of the values listed below '*…does not necessarily lead to damage; should they be significantly exceeded, however further investigations are necessary*'.

Table 3-4 Guideline values for evaluation of short-term vibration on structures, (DIN4150-3)

Line vibration level	Type of structure	Guidance values for velocity (mm/s)		
		1 to 10 Hz	10 to 50 Hz	50 to 100 Hz*
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10
*At frequencies above 100 Hz, the values listed in the 50 Hz to 100 Hz column may be used as minimum values				

3.2.2 Human Comfort

To establish human comfort criteria, *Assessing Vibration: a technical guideline,* (DEC, February 2006) was considered. Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 3-5 for different types of sensitive receivers.

Table 3-4 Acceptable vibration dose values for intermittent vibration (m/s$^{1.75}$), (BS 6427-2008)

Receiver type	Period	Intermittent vibration dose value (m/s$^{1.75}$)	
		Preferred value	Maximum value
Residential	Day	0.2	0.4
	Night	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8
Workshops	When in use	0.8	1.6

3.3 Road traffic noise

The proposed upgrade is not classed as a new road or redevelopment of an existing road, but instead is considered to be a safety project primarily involving lane widening, minor realignment and turning lanes, which should not result in significant increases in road traffic noise impacts.

The RNP recommends that where the noise level is predicted to increase by more than 2 dB(A) as a result of the works, and predicted noise levels are higher than the guidelines for existing roads, noise treatments should still be considered. Additionally, at some locations where existing noise levels are already very high, minimising noise impacts should be considered even when the increases in noise levels will be 2 dB(A) or less.

The roads, subject to this assessment, are 'arterial/sub-arterial' in the context of the RNP. Hence, criteria outlined in Table 3-5 are applicable.

Table 3-5 RNP noise assessment criteria, (DECCW, 2011)

Road category	Type of project/land use	Assessment criteria dB(A)	
		Day (7am to 10 pm)	Night (10pm to 7am)
Freeway/arterial/sub-arterial roads	Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	$L_{Aeq(15\ hr)}$ 60 (external)	$L_{Aeq\ (9\ hr)}$ 55 (external)

Since preliminary monitoring indicated that these criteria are exceeded under existing conditions at work areas 1 and 3 (refer to Table 2-4), they would also be exceeded once works have been completed. As such, the increase of 2 dB(A) is the principle assessment criterion.

If increases of 2 dB(A) or more are predicted at non-residential receivers, assessment will be made against applicable criteria in Table 4 of the RNP.

4. Construction noise assessment

4.1 Construction noise sources

As described in Section 1.2.3, where possible construction work will be carried out during recommended standard hours; however some works may need to be undertaken outside standard hours in order to maintain public safety and minimise disturbance to local traffic.

Table 4-1 lists typical construction activities and associated plant and equipment likely to be required for each stage of the proposed intersection works. Lighting towers and additional traffic control plant would also be expected during out of hour's works. Typical sound power levels have been estimated using values presented in the CNS or have been estimated from Jacobs' databases and previous studies. All equipment is assumed to operate concurrently, a conservative assumption.

The sound power levels of equipment in reality will depend on equipment selected, operating conditions and driver behaviour. Actual construction activities may vary from those outlined; however these provide a suitable indication of the potential for noise impacts. A 5 dB(A) penalty has been applied to the equipment denoted with an asterisk (*) to account for tonal effects. A lower estimated SWL has been applied for preliminary works at work area 2, since limited concrete removal and asphalt milling are anticipated at this location.

Table 4-1 Proposed typical construction activities

Construction phase	Details	Typical plant/equipment anticipated	Typical SWL dB(A)	Estimated usage factor (%)	Overall estimated activity SWL dB(A)
1. Preliminary works	Removal of existing concrete road furnishings, redundant signage. Pavement and redundant line markings	Jackhammer* Excavator Dump truck Elevated working platform Hand tools Asphalt milling machine* Line marking removal plant	111 107 101 89 94 101 100	0.1 0.2 0.2 0.3 0.2 0.2 0.4	108 (103)
2. Earthworks	Earthworks and pavement sub-grade preparation	Excavator Dump truck Water cart Grader Roller* Wacker packer	107 101 100 100 105 108	0.4 0.3 0.4 0.4 0.4 0.2	109
3. Pavement	Pavement, road furnishings, kerb and drainage	Paver Asphalt truck Roller Spray sealing equipment Road sweeper	112 93 105 109 100	0.7 0.4 0.4 0.4 0.3	112

Construction phase	Details	Typical plant/equipment anticipated	Typical SWL dB(A)	Estimated usage factor (%)	Overall estimated activity SWL dB(A)
4. Final detailing	Line marking and signage installation	Line marking plant Elevated working platform Mobile crane Concrete truck	93 89 101 103	0.4 0.3 0.4 0.3	101

4.2 Predicted construction noise levels

4.2.1 Prediction method

Construction noise impacts were predicted at the nearest sensitive receivers at each of the three upgrade locations. Potential impacts were calculated based on the distance between source and receiver. Attenuation factors such as air and ground absorption have been neglected and no correction for topographical or structural screening has been given. Hence results are conservative.

Results are presented for selected receivers in work area 1 (Table 4-2), work area 2 (Table 4-3) and work area 3 (Table 4-4).

Table 4-2 Estimated SPL at nearby sensitive receivers around work area 1

Receiver (Type)	Approximate distance to closest works (m)	NML			Estimated SPL at nearest receiver based on distance $L_{Aeq(15min)}$ dB			
		Day	Evening	Night	1.Preliminary works (SWL = 108 dB[A])	2.Earthworks (SWL = 109 dB[A])	3.Pavement (SWL = 112 dB[A])	4.Final detailing (SWL = 101 dB[A])
13 Grose Vale Road (Residential)	10 m	63	50	35	80	81	84	73
1/8-10 Grose Vale Road (Residential)	10 m	63	50	35	80	81	84	73
12 Grose Vale Road (Commercial)	10 m	70	70	70	80	81	84	73
4 Grose Vale Road (Residential)	8 m	63	50	35	82	83	86	75
35 Riverview Street (Commercial)	60 m	70	70	70	64	65	68	57
77 Bells Line of Road (Residential)	23 m	63	50	35	73	74	77	66
56 Bells Line of Road (North Richmond Seventh Day Adventist Church)	10 m	45	45	45	80	81	84	73
41 Bells Line of Road (Residential)	12 m	63	50	35	78	79	82	71
14 Grose Vale Road (Richmond North Public School)	45 m	45	45	45	67	68	71	60
46 Bells Line of Road (Commercial)	12 m	70	70	70	78	79	82	71

Table 4-3 Estimated SPL at nearby sensitive receivers around Kurrajong Road and Old Kurrajong Road intersection

Receiver (Type)	Approximate distance to closest works (m)	NML dB(A)			Estimated SPL at nearest receiver based on distance $L_{Aeq(15min)}$ dB			
		Day	Evening	Night	1.Preliminary works (SWL = 103 dB[A])	2.Earthworks (SWL = 109 dB[A])	3.Pavement (SWL = 112 dB[A])	4.Final detailing (SWL = 101 dB[A])
170 Old Kurrajong Road (Residential)	380 m	62	55	35	43	49	52	41
148 Old Kurrajong Road (Residential)	380 m	59	50	35	43	49	52	41
Windsor Polo Club*	100 m	65	65	65	55	61	64	53
Colo Soccer Football Club*	220 m	65	65	65	48	54	57	46

*Denotes an area of active recreation. Criteria only apply when facilities are in use.

Table 4-4 Estimated SPL at nearby sensitive receivers around Kurrajong Road and Bosworth Street intersection

Receiver (Type)	Approximate distance to closest works (m)	NML			Estimated SPL at nearest receiver based on distance $L_{Aeq(15min)}$ dB			
		Day	Evening	Night	1.Preliminary works (SWL = 108 dB[A])	2.Earthworks (SWL = 109 dB[A])	3.Pavement (SWL = 112 dB[A])	4.Final detailing (SWL = 101 dB[A])
162 March Street (Residential)	5 m	66	55	38	86	87	90	79
164 March Street (Residential)	7 m	66	55	38	84	85	88	76
39 Bosworth Street (Residential)	5 m	66	55	38	86	87	90	79
165 Kurrajong Road (Residential)	15 m	66	55	38	76	77	80	69
184 Kurrajong Road (Residential)	18 m	66	55	38	75	76	79	68
155A March Street (Commercial)	5 m	66	55	38	86	87	90	79

Receiver (Type)	Approximate distance to closest works (m)	NML			Estimated SPL at nearest receiver based on distance $L_{Aeq(15min)}$ dB			
		Day	Evening	Night	1.Preliminary works (SWL = 108 dB[A])	2.Earthworks (SWL = 109 dB[A])	3.Pavement (SWL = 112 dB[A])	4.Final detailing (SWL = 101 dB[A])
34 Chapel Street (Residential)	15 m	63	50	35	76	77	80	69
190 Kurrajong Road (Residential)	10 m	63	50	35	80	81	84	73
25 Chapel Street (UnitingCare Hawkesbury Village)	55 m	63	50	35	65	66	69	58

4.2.2 Predicted results

4.2.2.1 Work area 1

Receivers in work area 1 are very close to construction activity and are likely to experience noise levels in excess of the NMLs and may be highly noise affected from time to time. The noisiest activities are likely to be during earthworks and pavement works when works are closest to premises.

4.2.2.2 Work area 2

Since residential receivers are further from construction activity, the impacts are expected to be lower than in the other work areas. Only minor exceedances of NMLs would be anticipated during the works due the existing influence of road traffic noise from Kurrajong Road and the large separation distances to the closest receivers.

There are areas of active recreation identified for this work area that may be impacted by construction activities. The noise guidelines for these locations are only applicable when the respective facilities are in use.

The predicted noise levels for these locations are below the guideline levels and therefore no specific mitigation measures are recommended for the proposal however the Clubs should be included in any community notifications or updates prior to the commencement of works.

4.2.2.3 Work area 3

Receivers in work area 3 are very close to construction activity and are likely to experience noise levels in excess of the NMLs and may be highly noise affected from time to time. The noisiest activities are likely to be during earthworks and pavement works when works are closest to premises.

4.3 Noise mitigation

The assessment of construction noise impacts indicates that there is potential for construction activities at all three work areas to exceed the project NMLs at the nearest sensitive receivers. All reasonable and feasible measures should be implemented to minimise construction noise impacts.

Where actual activities vary significantly from those considered in this report, more detailed design of noise control measures may be necessary after specific plant/equipment and construction methods have been confirmed and assessed on-site.

4.3.1 ENMM standard management measures

A Construction Noise and Vibration Management Plan (CNVMP) should be developed for the works and should consider the noise mitigation measures presented Table 4-5, which are derived from section 5 of the ENMM and Section 6.1 of the CNS.

Table 4-5 ENMM and CNS standard noise and vibration management measures

Control measure	Details
Time constraints	• Limit work to daylight hours where possible. Consider implementing respite periods with low noise/vibration-producing construction activities where noisy works continue past 11 pm.
Scheduling	• Perform noisy work during less sensitive time periods.
Equipment restrictions	• Select low-noise plant and equipment. Ensure equipment mufflers operate in a proper and efficient manner.

Control measure	Details
Substitute methods	• Where possible, use quieter and less vibration emitting construction methods.
Limit equipment use	• Only have necessary equipment on-site and turn off when not in use.
Limit activity duration	• Where possible, concentrate noisy activities at one location and move to another as quickly as possible.
Site access	• Vehicle movements, including deliveries outside standard hours should be minimised and avoided where possible.
Equipment maintenance	• Ensure all plant and equipment is well maintained and where possible, fitted with silencing devices.
Reduce equipment power	• Use only the necessary size and powered equipment for tasks.
Quieter working practices	• Implement training to induct staff on noise sensitivities
Reversing alarms	• Where possible, consider the application of less intrusive alternatives to reverse beepers such as 'squawker' or 'broadband' alarms.
Noise barriers	• Consider the installation of temporary construction noise barriers.
Enclosures	• Where practicable, install enclosures around noisy mobile and stationary equipment as necessary.
Increased distance	• Locate noisy plant as far away from noise-sensitive plant as possible.
Community consultation	• Periodic notification (monthly letterbox drop or equivalent) • Project info-line. • Construction response/complaints telephone line.
Use and siting of plant	• Avoid simultaneous operation of two or more noisy plant close to receivers. • The offset distance between noisy plant and sensitive receivers should be maximised.
Plan work sites and activities to minimise noise and vibration	• Plan traffic flow, parking and loading/unloading areas to minimise reversing movements.
Monitoring	• Community noise measurements should be undertaken at nearest sensitive receivers at representative times during the works. Where noise levels are found to exceed NMLs, activities should be reviewed for further noise reductions.
Emission restrictions	• Conduct monitoring of equipment to ensure that they remain within limits specified in Section 6.2 of the CNS.
Minimise disturbance arising from delivery of goods to construction sites	• Delivery and loading / unloading of materials should occur as far as possible from sensitive receivers. • Select site access points and roads as far as possible from sensitive receivers.

4.3.2 TfNSW additional mitigation measures

Should works be scheduled to be undertaken outside standard hours, the CNS provides additional mitigation measures for various levels of noise in excess of the RBLs, including notifications, monitoring, respite and alternative accommodation in extreme circumstances. The thresholds at which these measures are recommended are summarised in Table 4-6.

Table 4-6 CNS additional mitigation measures, (TfNSW, April 2012)

Time period		**Mitigation measures**			
		L_{Aeq}(15 minute) noise level above background RBL (Qualitative assessment)			
		0 to 10 dB(A) (Noticeable)	**10 to 20 dB(A) (Clearly audible)**	**20 to 30 dB(A) (Moderately intrusive)**	**> 30 dB(A) (Highly intrusive)**
Standard	Mon-Fri (7am-6pm)	-	-	LB,M	LB,M
	Sat (8am-1pm)				
	Sun/Pub Hol (Nil)				
OOHW Period 1	Mon-Fri (6pm-10pm)	-	LB	M,LB	M,IB,LB,RO,PC,SN
	Sat (7am-8am)				
	Sun/Pub Hol (8am-6pm)				
OOHW Period 2	Mon-Fri (10pm-7am)	LB	M,LB	M,IB,LB,PC,SN	AA,M,IB,LB,PC,SN
	Sat (10pm-8am)				
	Sun/Pub Hol (6pm-7am)				

Key

LB – Letterbox drop
M – Monitoring
IB – Individual briefings
RO – project specific respite offer
PC – Phone calls
SN – Special notification
AA – alternative accommodation

Note: the mitigation measures in Table 4-6 are based on noise in excess of the RBL rather than the NML, which are the assessment criteria for this study. For quick comparison, subtract 10 dB(A) for standard time and 5 dB(A) for OOHW periods.

5. Construction vibration assessment

5.1 Vibration sources

Typical vibration levels for various construction plant items are presented in Table 5-1. These have been taken from the ENMM (RTA, 2001) or Jacobs' databases.

Table 5-1 ENMM typical vibration levels for construction equipment

Plant/Equipment	Vibration level (mm/s)			
	5 m	10 m	25 m	50 m
Vibratory roller (3-8 tonne)[2]	7	3	0.7	0.3
Vibratory roller (8-13 tonne)[2]	19	9	2	1
Vibratory roller (13-18 tonne)[2]	22	10	3	1
Vibratory roller (>18 tonne)[2]	28	13	4	1
Hydraulic hammer	6	2	0.5	0.2
Jackhammer (hand held)	2	0.8	0.2	<0.1

1 - Calculated in accordance with BS5228 – Code of practice for noise and vibration control on construction and open sites (95% confidence) / FTA Guidance Manual for Transit Noise and Vibration Impact Assessment

2 - Mid amplitude setting

5.2 Predicted vibration impacts

The magnitude of impact from vibration-intensive activities is largely dependent on the distance from source to receiver for any given ground type. A summary of receiver distances from the nearest proposed upgrade works is summarised in Table 5-2.

Table 5-2 Proximity of sensitive receivers to construction activity

Work area	Proximity of receivers to construction activity
1	Residential and commercial receivers at around 8 to 15 m or further (including some heritage-listed locations). Place of worship at around 10 m.
2	Farm shed at around 50 m. Colo Soccer Football Association Clubhouse at around 220 m.
3	Residential receivers at 5 m to 15 m (including some heritage-listed locations). Commercial receivers at around 5 m. Aged care facility at 55 m.

Considering the typical vibration levels in Section 5.1, in conjunction with distances to receivers, the human comfort criteria listed in Section 3.2.2 are likely to be exceeded by vibration-intensive activity at some locations around work areas 1 and 3.

With regard to building damage criteria in Section 3.2.1, it is unlikely that the lowest values (for 1 to 10 Hz) for commercial premises would be exceeded during the works. Where vibration-intensive equipment is used in closer proximity to residential and heritage-listed properties (10 m or closer to closest façade) it is possible that the lowest values (for 1 to 10 Hz) for building damage could be exceeded. Particular care will need to be undertaken when working near the local heritage-listed locations (refer to Figures 3-1 and 3-2 of the non-Aboriginal Heritage Assessment).

5.3 Vibration mitigation

Noting the potential for adverse impacts on human comfort and even building damage at close proximity, vibration management measures including safe setback distances, community consultation and monitoring and auditing should be applied during the works.

Where vibration intensive plant or equipment is to be used during the proposed upgrade works, the safe setback distances recommended in the CNS should be implemented.

It is noted that human response safe working distance values are derived from continuous vibration activities. For most construction activities, vibration emissions are intermittent and higher vibration levels over shorter periods are acceptable. Additional assessment should be undertaken where the human response criteria are exceeded.

Table 5-3 Recommended safe working distances for vibration intensive plant, (TfNSW, April 2012)

Plant item	Rating/description	Safe working distance	
		Cosmetic damage (British Std 7385)	Human response (DECCW)
Vibratory roller	<50 kN (typically 1-2 t) <100 kN (typically 2-4 t) <200 kN (typically 4-6 t) <300 kN (typically 7-13 t) >300 kN (typically 13-18 t) >300 kN (> 18 t)	5 m 6 m 12 m 15 m 20 m 25 m	15 m to 20 m 20 m 40 m 100 m 100 m 100 m
Small hydraulic hammer	300 kg – 5 to 12 t excavator	2 m	7 m
Medium hydraulic hammer	900 kg – 12 to 18t excavator	7 m	23 m
Large hydraulic hammer	1600 kg – 18 to 34 t excavator	22 m	73 m
Vibratory pile driver	Sheet piles	2 m to 20 m	20 m
Pile boring	≤800 mm	2 m	n/a
Jackhammer	Hand held	1 m	Avoid contact with structure

When vibration-intensive plant such as rollers, compactors and pavement breaking equipment, or when excavators or graders are to be used within 20 m of the nearest façade of a residential premise, school or place of worship, prior warning and explanation should be provided to the affected receiver. Prior notification of the works should be provided several days prior to the intended works. During notification, residents should be informed of the project information line and construction response/complaints telephone line to enable them to seek further information or voice concerns during the works.

If a complaint relating to vibration is received, attended monitoring should be undertaken to assess whether criteria are being met. If monitoring identifies that criteria are being exceeded then works are to be scaled back until an acceptable vibration level can be reached in consultation with the affected resident.

Initial vibration monitoring should also be completed at commencement for each type of equipment and plant to verify that vibration levels are consistent with, and not significantly higher the typical levels above.

6. Road traffic noise assessment

6.1 Assessment methodology

The calculation method for road traffic noise presented in *Calculation of Road Traffic Noise [CoRTN],* (UK Department of Transport, 1988) is the accepted method used in Australia. The algorithm considers input variables including traffic flow, percentage heavy vehicles, traffic speed, road gradient, road surface type, propagation pathway from road source to receiver including, terrain barrier and shielding effects to determine noise levels arising from road traffic at receivers.

Assessments typically review current and projected noise arising from the existing road alignment if proposed upgrades were not to occur and compare against noise projected from the proposed alignment soon after completion, and at timeframes further into the future.

Based in the information available in the two recently completed congestion studies (NSW RMS, 2012 and 2013), the only CoRTN model input expected to markedly change as a result of the proposed upgrade works is the distance between traffic flow and receivers at some locations owing to lane and intersection re-alignments and widening works. For a traffic source, the resulting change in sound pressure level, Lp difference, can be estimated using the equation:

$$L_p\ difference = 10log\left(\frac{proposed\ source\ to\ receiver\ distance}{existing\ source\ to\ receiver\ distance}\right)$$

6.2 Results

The change in distance between the existing road alignment and the proposed upgrade alignment for each receiver around the around works area 1 and work area 3 has been estimated from the preliminary design drawings included in Appendix A. The resulting change in SPL was estimated using the equation above. Results are shown in Table 6-1. Although turning lanes, slip lanes and clearways may result in some traffic moving closer to receivers, only changes to the balance of traffic flow have been considered.

Owing to the considerable distance to the nearest receivers from work area 2, the overall change in noise levels arising from road traffic was deemed to be negligible, and as such have not been assessed below.

As shown below in Table 6-1, noise levels arising from road traffic are not expected to increase by 2 dB(A) relative to existing noise levels at any of the nearest residential receivers as a result of the proposed upgrades.

The road noise assessment criteria for a place of worship in the RNP is $L_{Aeq(1\ hr)}$ = 40 (internal) when in use. It appears that the most exposed façade is masonry with a corrugated steel roof. Considering a conservative transmission loss estimate through the façade to the internal space of 30 dB(A), the resulting internal noise levels would be below the recommended internal level.

Table 6-1 Estimated change in SPL arising from change in distance to traffic flow from receivers

Work area	Address	Existing distance (m) from receiver to main traffic flow	Proposed distance (m) from receiver to main traffic flow	Resulting change in SPL at address dB(A)
1	12 Grose Vale Road	10	10	0
	13 Grose Vale Road	10	10	0
	8-10 Grose Vale Road	10	10	0
	6 Grose Vale Road	10	10	0

Work area	Address	Existing distance (m) from receiver to main traffic flow	Proposed distance (m) from receiver to main traffic flow	Resulting change in SPL at address dB(A)
	4 Grose Vale Road	8	6	+1.2
	77 Bells Line of Road	23	23	0
	63 Bells Line of Road	12	12	0
	56 Bells Line of Road (Place of worship)	15	10	+1.8
	41 Bells Line of Road	13	12	+0.3
	36 Bells Line or Road	21	19	+0.4
3	192 Kurrajong Road	14	14	0
	190 Kurrajong Road	10	10	0
	188 Kurrajong Road	12	12	0
	182 Kurrajong Road	10	10	0
	178-180 Kurrajong Road	18	18	0
	176 Kurrajong Road	15	15	0
	174 Kurrajong Road	9	9	0
	172 Kurrajong Road	12	12	0
	170 Kurrajong Road	15	12	+1.0
	34 Chapel Street	20	20	0
	179 Kurrajong Road	27	27	0
	177 Kurrajong Road	28	25	+0.5
	175 Kurrajong Road	25	20	+1.0
	173 Kurrajong Road	27	22	+0.9
	171 Kurrajong Road	27	22	+0.9
	169 Kurrajong Road	27	22	+0.9
	167 Kurrajong Road	27	22	+0.9
	165 Kurrajong Road	24	18	+1.2
	39 Bosworth Street	10	8	+1.0
	164 March Street	8	6	+1.2
	162 March Street	7	6	+0.7
	158 March Street	8	8	0
	26-30 Bosworth Street	10	9	+0.5
	153 March Street	15	15	0
	151 March Street	16	16	0

6.3 Mitigation measures

Predictions indicate that road noise levels at nearby receivers would not increase by more than about 1.2 dB(A) at any residential receiver as a result of the upgrade works, no road noise mitigation measures would be required.

This assessment has been undertaken based on the preliminary design, and that the requirement for mitigation measures may change subject to the final detailed design, or further detailed traffic information becoming available.

7. Conclusion

Jacobs has completed an assessment of construction noise and vibration; and road traffic noise arising from the proposed upgrade of the three intersections Bells Line of Road and Grose Vale Road, Kurrajong Road and Old Kurrajong Road and Richmond, Kurrajong Road and Bosworth Street, which are intended to provide short-term relief to local traffic congestion issues.

With regards to the three elements of the assessment (construction noise, construction vibration and operational road traffic noise) the outcomes of each are summarised below.

7.1 Construction noise

- The assessment of construction noise impacts indicates that there is a potential for construction activities at all three work areas to generate noise levels that exceed the project NMLs at the nearest sensitive receivers.
- Mitigation measures were proposed in line with RMS guidance documentation including additional mitigation measures in line with the CNS for out of hours works.

7.2 Construction vibration

- Vibration levels at some locations around the three work areas may be of the magnitude which could result in complaints, but could be managed through effective community consultation.
- Vibration management measures consistent with RMS documentation including safe setback distances, community consultation and monitoring and auditing should be applied as necessary during the works.

7.3 Road traffic noise

- Increases in road traffic noise of 2 dB(A) or more are not predicted at the closest sensitive receivers at any of the three work areas.

Appendix A. Preliminary intersection upgrade designs

NOT FOR CONSTRUCTION - 22/10/12

Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd.

From KURRAJONG

(MR184)

BELLS LINE OF ROAD

RIGHT TURN BAY

ZIP MERGE

DUAL WESTBOUND LANES
(LENGTH: 90m)

TERRACE

ROAD

BEAUMONT AVENUE

RIGHT TURN BAY

BUS STOP

LEGEND

— — PROPOSED BOUNDARY

N

GROSE VALE ROAD

RIGHT TURN BAY

LEFT TURN LANE

DUAL RIGHT
TURN LANES

ZIP MERGE

WILLIAM STREET

RIVERVIEW STREET

To RICHMOND

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SCALE 1:1000m

Co-ordinate System: MGA Zone 56 | Height Datum: A.H.D.

Transport Roads & Maritime Services

DESIGNED. . . . . .

REVIEWED. . . . . .

ROADS AND MARITIME SERVICES

HAWKESBURY COUNCIL
MR184 BELLS LINE OF ROAD, NORTH RICHMOND
INTERSECTION WITH GROSE VALE ROAD AND TERRACE ROAD
STRATEGIC DESIGN - INTERSECTION UPGRADE
DESIGN LAYOUT

FILE No.	DRAWING	PRINTED DATE	SHEET No.
SF2012/040309	01_Grose_Vale_Rd.dgn	22/10/2012	01

REGISTRATION NUMBER
DS2012/001118

NOT FOR CONSTRUCTION - 22/10/12

Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd

RIGHT TURN BAY
(LENGTH: 40m STORAGE
PLUS DECELERATION)

3m WIDE MERGE
RUNOFF AREA
(LENGTH: 30m)

LEFT TURN LANE
WITH ACCELERATION
(LENGTH: 125m)

PAVEMENT WIDENING TO
FACILITATE RIGHT TURN MOVEMENTS
BY SEMITRAILERS

FROM NORTH RICHMOND

TO RICHMOND

MR184 KURRAJONG ROAD

OLD KURRAJONG ROAD

TO YARRAMUNDI LANE

600mm
600mm
150mm
150mm
150mm
50mm
150mm
150mm
2X100mm
2X100mm
2X100mm
375mm
100mm
450mm
100mm
WZ
WC
TZ
E

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SCALE 1:1000m

Transport Roads & Maritime Services
NSW GOVERNMENT

DESIGNED. . . . . .
REVIEWED. . . . . .

ROADS AND MARITIME SERVICES

HAWKESBURY COUNCIL
MR184 KURRAJONG ROAD
INTERSECTION WITH OLD KURRAJONG ROAD, RICHMOND
STRATEGIC DESIGN - INTERIM INTERSECTION UPGRADE
DESIGN LAYOUT

FILE No.	DRAWING	PRINTED DATE	SHEET No.
SF2012/040309	01_Yarramundi_Ln.dgn	22/10/2012	01

REGISTRATION NUMBER
DS2012/001119

NOT FOR CONSTRUCTION - 22/10/12

Ausimage Aerial Photography under Licence to RTA by Sinclair Knight Merz Pty Ltd

LEGEND

— — PROPOSED BOUNDARY

PARKING TO BE BANNED FROM CHAPEL STREET TO BOSWORTH STREET

RIGHT TURN BAY (LENGTH: 145m)

PARKING TO BE BANNED FROM BOSWORTH STREET TO 120m EAST

PARKING TO BE BANNED FROM BOSWORTH STREET TO 210m WEST

PARKING TO BE BANNED FROM BOSWORTH STREET TO 100m EAST

MARCH STREET TO BOSWORTH STREET RIGHT TURN BAN

STREET

From NORTH RICHMOND

To WINDSOR

MR 184 KURRAJONG ROAD

MARCH STREET

CHAPEL STREET

MR 570 BOSWORTH STREET

BOSWORTH STREET

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SCALES

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SCALE 1:1000m

Transport Roads & Maritime Services NSW GOVERNMENT

DESIGNED. . . . . .

REVIEWED. . . . . .

ROADS AND MARITIME SERVICES

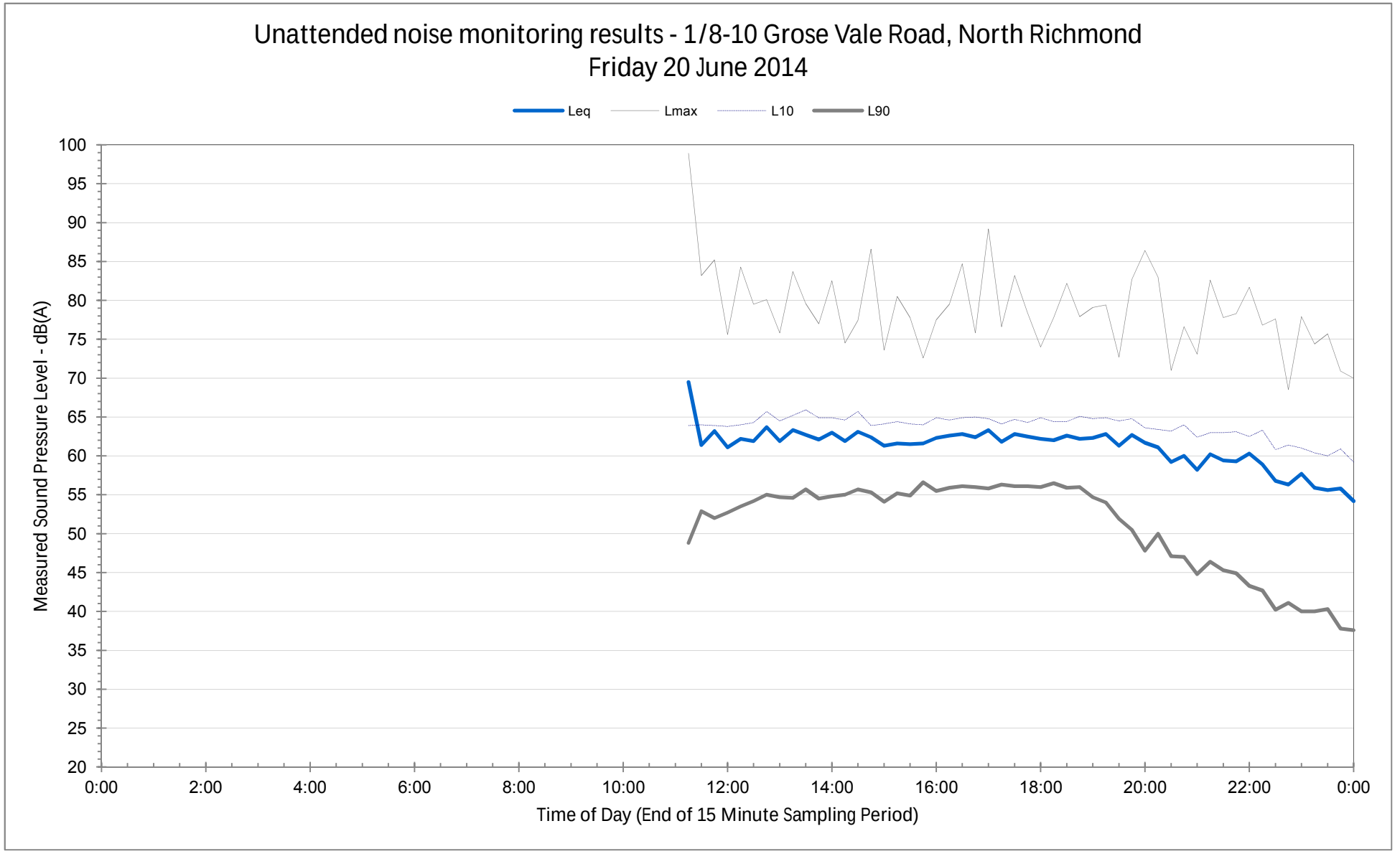
HAWKESBURY COUNCIL
MR184 KURRAJONG ROAD AND MARCH STREET
INTERSECTION WITH MR570 BOSWORTH STREET, RICHMOND
STRATEGIC DESIGN - INTERSECTION UPGRADE
DESIGN LAYOUT

FILE No.	DRAWING	PRINTED DATE	SHEET No.
SF2012/040309	01_Bosworth_St.dgn	22/10/2012	01

REGISTRATION NUMBER

DS2012/001120

Appendix B. Noise monitoring results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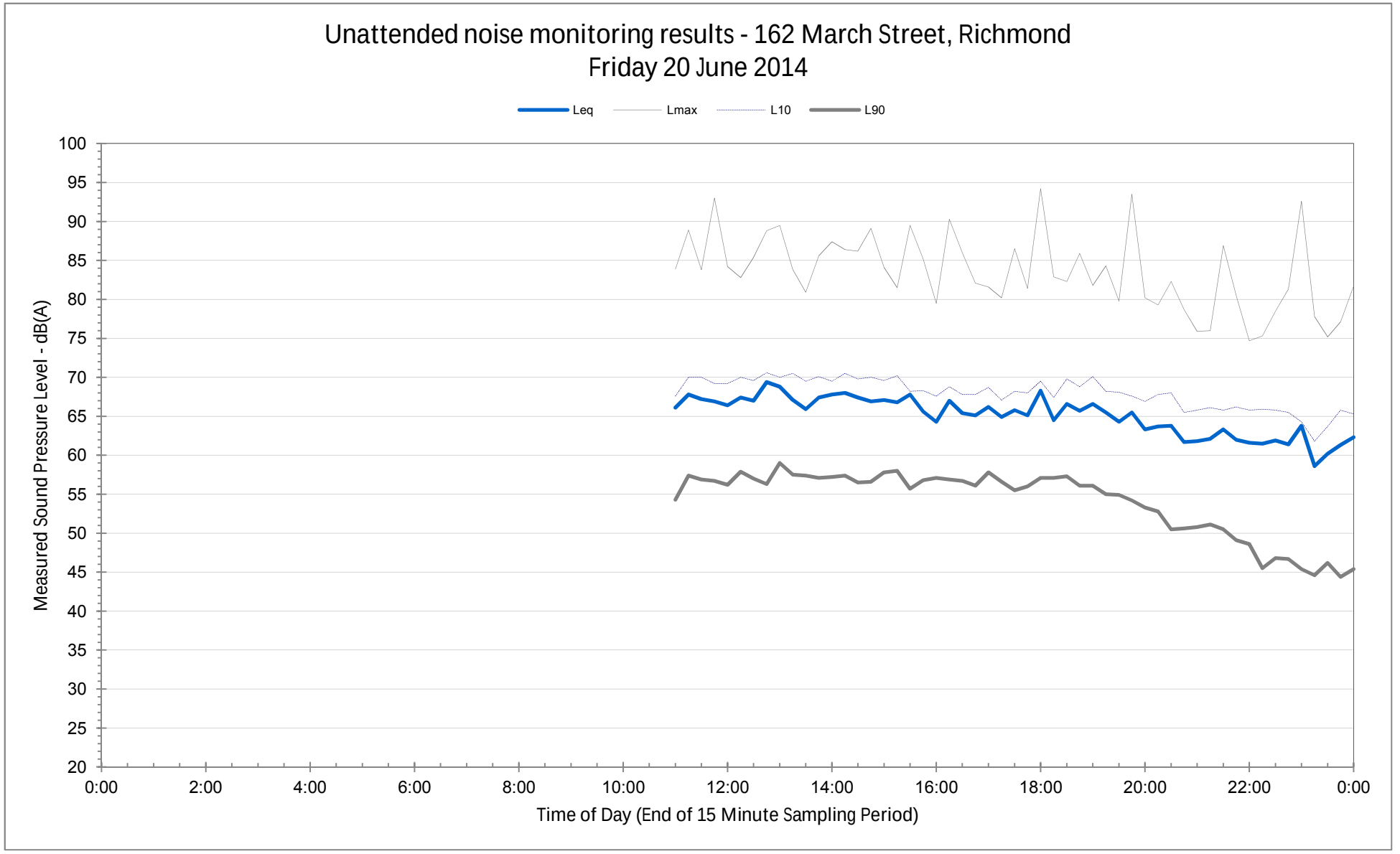
Friday 20 June 2014
Leq
Lmax
L10
L90
Measured Sound Pressure Level - dB(A)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sampling Period)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Friday 20 June 2014
Leq
Lmax
L10
L90
Measured Sound Pressure Level - dB(A)
100
95
90
85
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75
70
65
60
55
50
45
40
35
30
25
20
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sampling Period)

Appendix H

Landscape character and visual assessment report, and proposed landscape plan

Table H-1 Summary of visual impact assessment for key representative viewpoints

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
Bells Line of Road/Grose Vale Road intersection						
Viewpoint 1: Motorists travelling north-west along Bells Line of Road	Low – Motorists travelling at 60km/h distinguish intersection from about 300m away. Total view time of about 18 seconds.	High – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. The duration of views of this work may be increased due to the implementation of traffic controls, which could slow vehicle speeds through the area.	High – Removal of roadside trees and increase in carriageway width from 4 to 6 lanes.	Moderate	Moderate	Construction – General measures listed in Table 6-25. Operation Tree planting where appropriate along road corridor.
Viewpoint 2: Motorists travelling south-east along Bells Line of Road	Low – Motorists travelling at 60km/h distinguish intersection from about 200m away. Total view time of about 12 seconds.	Moderate – Views of construction activities associated with removal of roadside vegetation and establishment of an additional verge. The duration of views of this work may be increased due to the implementation of traffic controls, which could slow vehicle speeds through the area.	Moderate – Removal of mature roadside tree and additional verge adjoining dual westbound lanes north of intersection.	Moderate to Low	Moderate to Low	Construction General measures listed in Table 6-25. Operation Tree planting to replace trees that would be removed on northern corner of intersection.
Viewpoint 3: Motorists	Low – Motorists travelling at	Low – Views of construction activities	Low – Carriageway width increased	Low	Low	Construction General measures listed in

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
travelling north-east along Grose Vale Road	60km/h distinguish intersection from about 250m away. Total view time of about 15 seconds.	associated with widening the existing carriageway. The duration of views of this work may be increased due to the implementation of traffic controls, which could slow vehicle speeds through the area.	from 4 to 5 lanes.			Table 6-25. Operation Tree planting adjoining new turning lane along north-western edge of Grose Vale Road.
Viewpoint 4: Motorists travelling south-west along Terrace Road	Low – Motorists travelling at 60km/h distinguish intersection from about 175m away. Total view time of about 11 seconds.	Low – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. The duration of views of this work may be increased due to the implementation of traffic controls, which could slow vehicle speeds through the area.	Low – Minor increase in carriageway width, removal of mature roadside tree.	Low	Low	Construction General measures listed in Table 6-25. Operation Tree planting to replace trees that would be removed on northern corner of intersection.
Viewpoint 5: Motorists travelling west along Beaumont Avenue	Low – Motorists travelling at 60km/h distinguish intersection from about 200m away. Total view time of about 12	Low – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. The duration of views of this work may be increased due to the	Negligible – Minor views to removal of roadside trees along Bells Line of Road.	Low	Negligible	Construction General measures listed in Table 6-25. Operation Tree planting to replace trees that would be removed on northern corner of intersection.

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
	seconds.	implementation of traffic controls, which could slow vehicle speeds through the area.				
Viewpoint 6: North Richmond Village shopping centre	Low – Employees and customers	Low – Opportunities for views of construction activities associated with removal of roadside vegetation and widening the existing carriageway.	Negligible – Minor changes to line marking.	Low	Negligible	Construction General measures listed in Table 6-25. Operation None required.
Viewpoint 7: Shops fronting Bells Line of Road	Low – Employees and customers	Moderate – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	Moderate – Removal of roadside trees and increase in carriageway width from 4 to 6 lanes.	Moderate to Low	Moderate to Low	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting at location of new verge and in front of industrial development along north-eastern edge of Bells Line of Road.
Viewpoint 8: Large commercial centre with five shops fronting intersection	Low – Employees and customers	High – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of	High – Removal of roadside trees and increase in intersection footprint.	Moderate	Moderate	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
		portable lighting during night work (if required to minimise traffic impacts associated with the proposal).				in Table 6-25. Operation Tree planting to replace trees to be removed on northern corner of intersection and in front of industrial development along north-eastern edge of Bells Line of Road.
Viewpoint 9: Small shopping centre setback about 60m from Grose Vale Road	Low – Employees and customers	Negligible – Shopping centre frontage setback from road edge, minimal opportunities for views of construction activities.	Negligible – Shopping centre frontage setback from road edge.	Negligible	Negligible	None required.
Viewpoint 10: Two residences fronting internal driveway	Moderate – Residents	Moderate – Views of construction activities associated with widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	Low – Road widening for turning lane.	Moderate	Moderate to Low	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting adjoining new turning lane along north-western edge of Grose Vale Road.
Viewpoint	High –	Moderate – Views of	Moderate – Road	Moderate to	Moderate	Construction

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
11: Two residences fronting Grose Vale Road	Residents	construction activities associated with widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	widening for turning lane and potential tree removal.	High	to High	Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting adjoining new turning lane along north-western edge of Grose Vale Road.
Viewpoint 12: Shops fronting intersection	Low – Employees and customers	High – Views of construction activities associated with the removal of roadside trees widening the existing intersection footprint. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	High – Removal of roadside trees and increase in intersection footprint.	Moderate	Moderate	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting adjoining new turning lane along north-western edge of Grose Vale Road.
Viewpoint 13: Residential developmen t with driveway access to	Moderate – Views from double storey residences over boundary wall	High – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of	High – Tree removal and road widening	Moderate to High	Moderate to High	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
Bells Line of Road		portable lighting during night work (if required to minimise traffic impacts associated with the proposal).				in Table 6-25. Operation Tree planting to replace trees that would be removed on northern corner of intersection.
Viewpoint 14: Service station fronting Bells Line of Road	Low – Employees and customers	Low – Opportunities for views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	Negligible – Minor changes to kerb alignment and line marking.	Low	Negligible	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25 Operation None required.
Viewpoint 15 Light industrial developmen t fronting Bells Line of Road	Low – Employees and customers	Low – Opportunities for views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	Negligible – Minor changes to kerb alignment and line marking.	Low	Negligible	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation None required.
Viewpoint	Moderate –	Moderate – Views of	Low – Minor	Moderate	Moderate	Construction

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
16: Church fronting Bells Line of Road	Church attendees	construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	increase in carriageway width, removal of mature roadside tree.		to Low	Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting to replace trees that would be removed along northern edge of Bells Line of Road and on northern corner of intersection.
Viewpoint 17: Commercial developmen t fronting intersection	Low – Employees and customers	High – Views of construction activities associated with the removal of roadside trees widening the existing intersection footprint. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	High – Removal of roadside trees and increase in intersection footprint.	Moderate	Moderate	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting to replace trees that would be removed on northern corner of intersection.
Viewpoint 18: Residence fronting Terrace Road	High – Residents	Low – Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the	Negligible – Vegetation in private property blocking views of intersection.	Moderate	Negligible	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
		proposal).				lighting). General measures listed in Table 6-25. Operation None required.
Viewpoint 19: Service Station fronting Bells Line of Road intersection	Low – Employees and customers	High – Views of construction activities associated with the removal of roadside trees widening the existing intersection footprint. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	High – Removal of roadside trees and increase in intersection footprint.	Moderate	Moderate	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting to service station fronting and to replace trees to be removed on northern corner of intersection and in front of industrial development along north-eastern edge of Bells Line of Road.
Viewpoint 20: Post office	Low – Employees and customers	High – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway.	High – Removal of roadside trees and increase in carriageway width from 4 to 6 lanes.	Moderate	Moderate	Construction General measures listed in Table 6-25. Operation Tree planting to replace trees that would be removed on northern corner of intersection and in front of industrial development along north-eastern edge of Bells Line of

Viewpoint	Sensitivity of the viewer	Magnitude of visual change due to the proposal		Potential visual impact		Measures to reduce potential visual impact
		Construction	Operation	Construct-ion	Operation	
						Road.
Viewpoint 21: Commercial and industrial developmen t fronting Bells Line of Road	Low – Employees and customers	High – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	High – Removal of roadside trees and increase in carriageway width from 4 to 6 lanes.	Moderate	Moderate	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting to replace trees to be removed along north-eastern edge of Bells Line of Road.
Viewpoint 22: Industrial developmen t fronting Bells Line of Road	Low – Employees and customers setback from road	High – Views of construction activities associated with removal of roadside vegetation and widening the existing carriageway. Potential for light spill from the use of portable lighting during night work (if required to minimise traffic impacts associated with the proposal).	High – Removal of roadside trees and increase in carriageway width from 4 to 6 lanes.	Moderate	Moderate	Construction Where required, lighting for night-time work to comply with relevant Australian Standards, including AS4282- 1997 (Control of the obtrusive effects of outdoor lighting). General measures listed in Table 6-25. Operation Tree planting to replace trees to be removed along north-eastern edge of Bells Line of Road.

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