Roads & Maritime

Upgrade of Parramatta Road and Great North Road Intersection

Review of environmental factors

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Approval and authorisation

Title	Upgrade of Parramatta Road and Great North Road Intersection Review of Environmental Factors
Accepted on behalf of NSW Roads and Maritime Services by:	Robin Ferdous RMS Project Manager Easing Sydney's Congestion Program Office
Signed:	
Dated:	29/11/2016

Executive summary

The proposal

Roads and Maritime Services (Roads and Maritime) proposes to upgrade the intersection of Parramatta Road and Great North Road, Five Dock. The general features of the Proposal include:

- Duplicating the right turn from Parramatta Road westbound to Great North Road
- Pavement widening on the north side of Parramatta Road between Great North Road and around 70 metres east of Dobroyd Parade
- Removal of around 40 metres of parking space on Great North Road to be changed to "No Stopping"
- Widening of the bridge over Iron Cove Creek (Dobroyd Canal)
- New footpaths, medians and kerbs
- Relocation of traffic control signal infrastructure
- Signage and line marking adjustments
- Drainage and utility adjustments
- Property adjustments
- Relocation of a bus shelter on Parramatta Road
- Tree trimming and removal.

Need for the proposal

The Parramatta Road corridor is a critical transport link between the Sydney and Parramatta Central Business Districts, the western suburbs and beyond to the Blue Mountains. Great North Road provides direct access to the suburbs of Five Dock, Wareemba and Abbotsford. There are capacity constraints along Parramatta Road, resulting in slow travel times especially for movements east in the morning and west in the evening. Incidental congestion impacts include noise, amenity, safety, which also impact on the attractiveness of walking and cycling.

As part of the NSW Government's Pinch Point Program which targets peak hour traffic hotspots and investigates ways to relieve traffic congestion, Roads and Maritime identified Parramatta Road as a Pinch Point Corridor, with improvements to key intersections anticipated to provide better travel time for the entire corridor. Duplicating the right turn bay on Parramatta Road into Great North Road would provide considerable improvement to the operational performance of not only that intersection, but the overall corridor. In addition, a reduction in the frequency and severity of crashes reported on Parramatta Road, on approach to the intersection with Great North Road was anticipated.

Proposal objectives

The Proposal aims to:

- Improve traffic congestion on Parramatta Road, at the intersection with Great North Road, for the outbound (i.e. westbound) direction
- Increase the physical capacity of the right turn movement from Parramatta Road to Great North Road
- Improve safety on approach to Parramatta Road and Great North Road intersection
- Minimise environmental impact.

Options considered

Two options were considered during the development of the Proposal:

- Option 1 (Upgrade Parramatta Road and Great North Road intersection): This option comprises upgrading Parramatta Road and Great North Road intersection by duplicating and extending

the right hand turn bay and associated pavement widening, utility, drainage, signalling, signage and line marking adjustments

- Option 2 (Do nothing): This option would result in the current intersection arrangements remaining in place.

Option 1 is the preferred option as it fulfils the Proposal objectives and contributes to meeting the strategic objectives for the Parramatta Road Corridor.

Statutory and planning framework

This Review of Environmental Factors (REF) has been prepared by SNC-Lavalin Australia Pty Ltd for the Ventia Boral Amey Joint Venture (VBA) on behalf of Roads and Maritime. The potential environmental impacts of the proposal identified through this REF would be assessed by Roads and Maritime under Part 5 of the *Environmental Planning & Assessment Act 1979* (EP&A Act).

Clause 94 of the State Environmental Planning Policy Infrastructure 2007 (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.

In assessing the proposal, Roads and Maritime will consider Sections 111 and 112 of EP&A Act and Clause 228 of the Environmental Planning and Assessment Regulation 2000 (refer to Appendix A).

Community and stakeholder consultation

Stakeholder engagement regarding the Pinch Point Program has been ongoing for almost a decade, since its inception. Consultation directly relating to the proposal began in 2014 with discussions with WestConnex representatives and following a media release announcing the start of work on the proposal in March 2015, consultation with local residents and businesses was undertaken by VBA in October 2015 for the investigation phase.

Roads and Maritime has prepared a Community and Stakeholder Engagement Plan for the proposal that outlines the approach to communication and engagement that will be implemented throughout the design phase.

This REF will be displayed for community and stakeholder comment. Roads and Maritime will consider and address all comments in a submissions report, which will be made publicly available on Roads and Maritime's website.

Environmental impacts

Traffic and access

Construction would run over a period of about 10 months, during which time there would be additional traffic accessing the study area.

Day-time construction works would occur under road barrier so as to maintain traffic flow along Parramatta Road. It is unlikely that lane closures would be required for day-time works. During night-time works, lane closure and contra flow would be employed as required to reduce potential risks to safety of construction personnel and motorists. In the event that Parramatta Road needs to be closed (e.g. for a large crane lift) a detour would be established with prior approval under a Road Occupancy Licence for the works.

Vehicular access to adjacent commercial premises and fast food restaurants would be maintained throughout the construction period. Alternative access for pedestrians would be provided, where required.

The provision of a dual lane right turn bay would result in less queuing of right turning traffic from Parramatta Road into Great North Road which in turn would improve westbound traffic flow on Parramatta Road. The Proposal would result in the reduction in the frequency and severity of rear end, side swipe and lane change crashes reported on Parramatta Road, on approach to the intersection with Great North Road.

The proposed works would have an overall positive impact on operational traffic conditions both in the vicinity of the site and along the Parramatta Road corridor in general.

Noise and vibration

Noise emission from day-time, evening and night-time construction works associated with the proposed intersection upgrade were predicted to potentially exceed the applicable noise management levels at the nearest affected receivers and the residential receivers may also potentially be highly noise affected. Furthermore, maximum noise levels, for the assessment of sleep disturbance may exceed the applicable sleep disturbance upper limit at the nearest affected residences.

Potential vibration impacts of varying degrees were predicted at receivers based on the anticipated combination of equipment needed for the construction.

The proposed installation of piles in the breakwater and the north east abutment of the Iron Cove Creek Bridge would provide minimal clearance to the canal structure, which is a heritage item and thus more stringent structural damage criteria is applicable (in the absence of a dilapidation study or structural assessment of the canal). There is a very high risk of structure damage from piling works and vibration monitoring would be conducted on site prior to the works to determine vibration through the local ground type and appropriate buffer distances.

Noise modelling was completed residential locations potentially worst affected by the operation of the proposed upgrade. These locations typically represent residences within the first row of properties where Parramatta Road has moved closer; that is, residences north of Parramatta Road. The predicted noise levels show a minor increase of up to 0.5dB(A) for the worst affected residential receivers, which is well within the 2dB(A) increase allowance presented in the relevant guideline. This assessment determines that no noise mitigation measures for operation are required.

Roads and Maritime standard safeguards and acoustic assessment recommended safeguards have been provided to limit the potential impact of noise and vibration generated by construction activities to acceptable levels. In addition, buffer distances for vibration compliance have been also provided as guidance, which would be determined in more detail prior to the start of construction works through on site measurements of vibration.

Water quality

The waterway within the study area is Dobroyd Canal, beneath Parramatta Road. The canal is a tidally influenced open concrete channel and is heavily influenced by urban runoff and associated pollutant inflows.

Construction of the Parramatta Road bridge extension over Dobroyd Canal would pose a risk to water quality. Earthworks required for construction of new road pavement, pedestrian paths and utility adjustments could potentially impact water quality. It is considered that the risks to water quality during construction can be readily mitigated with standard construction site management measures.

Non-Aboriginal heritage

The only listed heritage item within the study area is Dobroyd Stormwater Channel No 53 (Sydney Water's Section 170 register). The listing includes the channel beds, walls and coping. The open

channel sections extend approximately 3.4 kilometres upstream of the discharge point at Iron Cove to the intersection of Carshalton and Norton Street.

The site inspection identified the bridge spanning the Dobroyd Canal Stormwater Channel as partially intact and containing some of the original 1930s fabric. This item meets the local significance threshold for its historical significance only and is not listed on any heritage registers.

The proposed works do not involve direct impacts to the Dobroyd Canal Stormwater Channel. There is the potential that this item could be impacted indirectly from the construction works (and in particular vibration from piling) given its proximity to the works. Recommendations to mitigate potential impacts include establishing an exclusion zone to protect the Dobroyd Canal, undertake vibration monitoring, and archival recording prior to construction impacts to the 1930 bridge.

Biodiversity

The site is highly modified, and no natural habitat for endemic flora is present. Vegetation within the subject site does not conform to any listed threatened communities. Urban native and exotic vegetation would be trimmed or removed as part of the proposed upgrade, resulting in minor impacts to flora species.

Limited potential habitat for native fauna species, including arboreal mammals, bats, and birds, is present on the subject site. Roosting habitat is potentially present for microbats, including threatened species, within sections of the bridge containing crevices and cracks.

One threatened fauna species, the Eastern Bentwing-bat was recorded within the subject site during targeted surveys via ultrasonic call detection and likely utilises habitat within the bridge for roosting habitat and/or the fringing vegetation along Iron Cove Creek as a flyway for foraging purposes. Three other threatened fauna species may also use trees and the bridge structure as foraging and/or roosting habitat. Assessments of significance of potential impacts were undertaken for all species and it was determined that the proposed upgrade is unlikely to result in a significant impact on any of them.

Hazardous materials and contamination

Potentially contaminating land uses along the length of the proposed works were identified, but no registered contaminated sites occur within or adjacent to the Proposal area.

Construction activities have the potential to expose and liberate unidentified contaminants contained within soil or fill material. Exposure to contaminated media or hazardous materials that may be present in building materials could pose a risk to human health and the environment. Safeguards have been developed to avoid or mitigate this risk. This includes further assessment of potential contaminants prior to undertaking ground disturbing activities in the vicinity of the potentially contaminating land uses. Hazardous material inspection would also be undertaken prior to commencement of any demolition works.

Socio-economic

The area is highly urbanised, with a mix of residential and commercial premises occurring along the various sections of the Proposal.

The current design requires property acquisition and adjustments to at least three properties, and impacts seven driveway accesses to commercial properties. Vehicular access to adjacent commercial premises and fast food restaurants would be maintained throughout the construction period. During construction, the community would experience temporary traffic delays and noise, air quality and visual amenity impacts.

During construction and operation, land use would be altered for certain properties that require acquisition. This would have a minor impact on the beneficial uses of the local environment with these businesses either terminating there use or altering the frontage of the businesses.

There is potential for positive, short-term business impacts during the construction phase, including increased trade for food outlets and service stations.

There would be positive long term impacts during operation of the Proposal including improved traffic flow and safety for motorists.

Justification and conclusion

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. The proposed intersection upgrade meets the proposal objectives to provide improved safety and congestion of the intersection and increase capacity and performance of the intersection. The Proposal also meets the objectives of the Pinch Point Program.

The proposal would result in some impacts including noise and vibration impacts, temporary disruptions to traffic flow and access, and property acquisition impacts. 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 would not have a significant impact on 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

1 Introduction

1.1 Proposal identification

The Parramatta Road corridor is a critical transport link between the Sydney and Parramatta Central Business Districts (CBD), the western suburbs and beyond to the Blue Mountains. Great North Road provides direct access to the suburbs of Five Dock, Wareemba and Abbotsford. Roads and Maritime Services NSW (Roads and Maritime) identified Parramatta Road as a Pinch Point Corridor, with improvements to key intersections anticipated to provide better travel time for the entire corridor.

As part of the NSW Government's Pinch Point Program which targets peak hour traffic hotspots and investigates ways to relieve traffic congestion, Roads and Maritime proposes to upgrade the intersection of Parramatta Road and Great North Road, Five Dock. Key features of the proposal would include (see also section 3.1 and Figure 3-1):

- Duplicating an existing right turn bay westbound from Parramatta Road to Great North Road
- Widening of the bridge over Iron Cove Creek (also known as Dobroyd Canal)
- Widening of the north side of Parramatta Road between Great North Road and around 70 metres east of Dobroyd Parade.

The proposed works would provide improved capacity along Parramatta Road at the right turn into Great North Road, assist in relieving existing traffic congestion, and improve safety for road users.

The northern portion of the Proposal (from Arlington Street to Henley Marine Drive) is located within the City of Canada Bay Local Government Area (LGA). The southern portion of the Proposal (Dobroyd Parade to Wolseley Street) and works on the western side of Parramatta Road are located within the Inner West Council LGA. A mix of residential and commercial premises occurs along the various sections of the Proposal. The location of the proposal is shown in Figure 1-1.

The proposal length is approximately 270 metres along Parramatta Road, with proposed works extending about 40 metres into Great North Road, about 25 metres into Dobroyd Parade, and about 20 metres into Henley Marine Drive. The total area of proposed new pavement and median is approximately 6280 m^2. Chapter 3 describes the proposal in more detail.

The works are proposed to commence in the first half of 2018 and continue for about 10 months.

1.2 Purpose of the report

This review of environmental factors (REF) has been prepared by SNC-Lavalin Australia Pty Ltd for the Ventia Boral Amey Joint Venture (VBA) on behalf of Roads and Maritime. For the purposes of these works, Roads and Maritime is the proponent and the determining authority under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The purpose of the 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 undertaken in the context of clause 228 of the Environmental Planning and Assessment Regulation 2000, the factors in Is an EIS Required? Best Practice Guidelines for Part 5 of the *Environmental Planning and Assessment Act 1979* (Is an EIS required? guidelines) (DUAP, 1995/1996), 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).

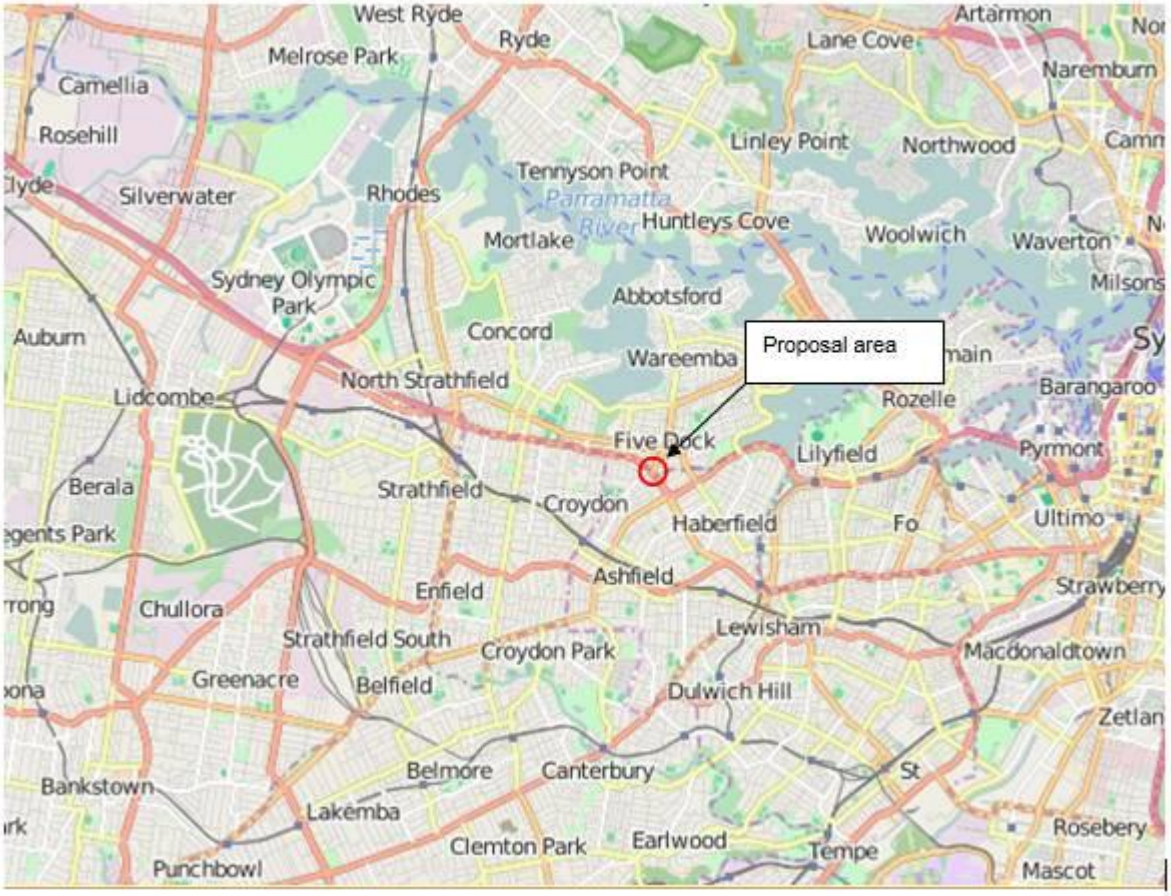


Figure 1-1: Location of the proposal (VBA 2016)

In doing so, the REF helps to fulfil 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 the REF would be considered when assessing:

- Whether the proposal is likely to have a significant impact on the environment and therefore the necessity for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act
- The significance of any impact on threatened species as defined by the TSC Act and/or FM Act, in section 5A of the EP&A Act and therefore the requirement for a Species Impact Statement
- The significance of any impact on nationally listed biodiversity matters under the EPBC Act, including whether there is a real possibility that the activity may threaten long-term survival of these matters, and whether offsets are required and able to be secured
- The potential for the proposal to significantly impact any other matters of national environmental significance or Commonwealth land and the need, subject to the EPBC Act strategic assessment approval, to make a referral to the Australian Government Department of the 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

2.1 Strategic need for the proposal

The Parramatta Road Corridor between the Sydney and Parramatta CBDs is one of the most important growth corridors in Sydney. The 22 kilometre stretch includes major road and rail infrastructure; major employment and research hubs; smaller, localised centres; residential neighbourhoods; and public open spaces (Transport for NSW (TfNSW) 2015).

There are capacity constraints along Parramatta Road, resulting in slow travel times especially for movements east in the morning and west in the evening. Incidental congestion impacts include noise, amenity, safety, which also impact on the attractiveness of walking and cycling. While a range of transport modes are available, private vehicles (light and heavy) typically account for the majority of all weekday trips within the corridor (TfNSW 2015).

The proposal is needed to improve capacity along Parramatta Road at the right turn into Great North Road, assist in relieving existing traffic congestion, and improve safety for road users.

The proposal would also address objectives for Sydney's important urban roads and the Parramatta Road corridor outlined in:

- NSW 2021: A plan to make NSW Number One
- NSW State Infrastructure Strategy
- NSW Long Term Transport Master Plan
- Parramatta Road Urban Transformation Program
- Pinch Point Program.

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

2.1.1 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, quality services and infrastructure, improved environment and communities and more government accountability throughout NSW. NSW 2021 places emphasis on investing in and delivering an efficient and effective transport system that will relieve congestion, improve safety and expand capacity on road corridors.

The proposal directly addresses two of the objectives relating to transport and infrastructure identified in the NSW 2021 Plan:

- Goal 7 – reduce travel times by delivering upgraded road infrastructure to relieve congestion, improve safety and enhance and expand capacity
- Goal 10 – improve road safety by cutting congestion at the intersection.

2.1.2 NSW State Infrastructure Strategy

In November 2014 the Government released Rebuilding NSW: State Infrastructure Strategy 2014 (NSW Government, 2014), a plan to invest $20 billion in new productive infrastructure, which adopts the recommendations from Infrastructure NSW that are set out in the State Infrastructure Strategy-Update 2014 (Infrastructure NSW, 2015).

The Strategy recognises the costs of congestion and includes an allocation of $300 million to address pinch points on Sydney's roads. The proposal falls within the $22 million budget identified specifically for Parramatta Road, between Strathfield and Leichardt.

2.1.3 NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan (TfNSW 2012) establishes the framework to deliver an integrated, modern transport system by identifying NSW's transport actions and investment priorities over the next 20 years. The Plan has identified a number of challenges and actions relevant to the proposal including keeping the city's most important transport corridors moving.

The Parramatta Road corridor was considered highly constrained in meeting travel demand. Volume demand for vehicles at Dobroyd Parade was found to exceed capacity by 24 percent in 2011, which would increase to 36 percent if nothing was done to address the congestion. The proposal responds to the growing pressure on the road network by addresses congestion / pinch point along this important road corridor.

2.1.4 Parramatta Road Urban Transformation Program

The Parramatta Road Urban Transformation Program was established by the NSW Government in 2013 as an integrated, cross-agency project to explore, capture and deliver on opportunities for urban transformation along the Parramatta Road Corridor resulting from WestConnex. WestConnex is a transport and integrated urban revitalisation project that brings together a number of important road projects which together form a vital link in Sydney's Orbital Motorway Network. WestConnex will substantially change the traffic environment along different parts of Parramatta Road, particularly in peak periods, and facilitate the Parramatta Road Urban Transformation Program (UrbanGrowth NSW 2015).

Key deliverables of the Parramatta Road Urban Transformation Program are the:

- UrbanGrowth NSW 2015 Draft Parramatta Road Urban Transformation Strategy, which will guide renewal of the Parramatta Road Corridor over the next 30 years under the New Parramatta Rd Project
- TfNSW 2015 Sydney CBD to Parramatta Strategic Transport Plan, which brings existing major land use and transport initiatives together into one document, setting out the clear strategic context for integrated transport and land use planning in the Parramatta Road Corridor
- Precinct Transport Plans Report, which aims to establish a strategic transport framework and an indicative infrastructure plan to guide development of the selected precincts along the Parramatta Road Corridor.

Sydney CBD to Parramatta Strategic Transport Plan

The Sydney CBD to Parramatta Strategic Transport Plan fits within a larger context of other NSW Government plans and policies including the State Infrastructure Strategy Update 2014, the NSW Long Term Transport Master Plan, A Plan for Growing Sydney and the NSW Freight and Ports Strategy (TfNSW 2015).

Included in the short term and medium term initiatives of the Sydney CBD to Parramatta Strategic Transport Plan is Roads and Maritime's Pinch Point Program.

Precinct Transport Plans Report

The Precinct Transport Plans Report provides a framework to achieve sustainable, targeted, social and economic outcomes for all stakeholders. Precinct planning has been informed by Sydney CBD to Parramatta Strategic Transport Plan and Draft Parramatta Road Urban Transformation Strategy.

Investigation of an additional westbound right turn bay from Parramatta Road into Great North Road was nominated as an opportunity to enhance road capacity in the short term.

2.1.5 Pinch Point Program

The Pinch Point Program aims to reduce traffic delays, manage congestion and maintain travel times on Sydney's major roads, particularly during weekday peak periods (Roads and Maritime 2015a). The original five year program started in 1 July 2007 and has been extended to 30 June

2017. The Pinch Point Program is being delivered by the Roads and Maritime Easing Sydney's Congestion Program Office.

Parramatta Road, from the M4 to Liverpool Road / Hume Highway was identified as a Pinch Point Corridor in 2008 and five key congestion points at peak periods were tested (using a paramics model) as potential improvement projects. Duplicating the right turn bay on Parramatta Road into Great North Road was found to provide considerable improvement to the operational performance of not only that intersection, but the overall corridor. In addition, a reduction in the frequency and severity of rear end, side swipe and lane change crashes reported on Parramatta Road, on approach to the intersection with Great North Road is anticipated (Roads and Maritime 2015b).

Further work to identify congestion points and determine improvement initiatives for a section of Parramatta Road from Concord Road at Strathfield to Crystal Street at Leichhardt was completed in 2009 by the then Roads and Traffic Authority (RTA). The Parramatta Road / Great North Road intersection, Five Dock was confirmed as having insufficient capacity in the westbound right turn bay from Parramatta Road to Great North Road, hence queuing out and affecting westbound through traffic on Parramatta Road. The proposed improvement initiative was to either lengthen the westbound right turn bay from Parramatta Road to Great North Road or duplicate the existing right turn bay.

Conditions at the Parramatta Road / Great North Road intersection were again assessed in 2012, confirming large volumes of traffic travelled along Parramatta Road at most times and Great North Road functioned as a major collector road. The upgrade of the Parramatta Road / Great North Road intersection was included in an assessment of future traffic conditions. Results indicated that proposed improvements would have a positive impact on traffic conditions (SKM 2012; cited in Positive Traffic 2015).

2.2 Existing infrastructure

Parramatta Road is a key east-west arterial road carrying large volumes of traffic at most times (between 55,000 and 85,000 vehicles per day). In the vicinity of the intersection with Great North Road, Parramatta Road includes three travel lanes in each direction. A right turn bay from Parramatta Road into Great North Road is provided at a length of approximately 100 metres.

The three way intersection with Great North Road is signalised. Each direction of Parramatta Road is divided by a concrete median strip and has a footpath on both sides of the road. Lane widths are about 2.5 to 2.8 metres and the shoulders have varying widths. The speed limit is 60 kilometres per hour (km/hr).

Parramatta Road has clearway restrictions that operate from 6am to 6pmMonday to Friday and 8am to 8pm Saturdays and Sundays in both the eastbound and westbound directions. Outside the hours of the clearway restrictions, no stopping and no parking restrictions exist. Bus stop number 204511 is situated on Parramatta Road eastbound between Henley Marine Drive and Dobroyd Parade.

Great North Road is a major collector road (carrying approximately 10,000 vehicles per day) linking Parramatta Road in the south with the Five Dock Town Centre in the north. It includes two travel lanes in each direction at its intersection with Parramatta Road. To the north, the road includes a single travel lane in each direction with restricted / unrestricted parallel parking on either side of the street. Lane widths are about 2.5 to 3.5 metres. The speed limit is 60 km/hr.

Dobroyd Parade and Henley Marine Drive are local roads. The T-intersections of Parramatta Road and both Dobroyd Parade and Henley Marine Drive are unsignalised and restricted to left in / left out. The speed limit is 50 km/hr.

Pedestrians are able to cross at the intersection of Great North Road with Parramatta Road using signalised and unsignalised pedestrian crossings. No pedestrian crossings occur at the intersection of Parramatta Road with Dobroyd Parade or Henley Marine Drive. Concrete pedestrian paths are provided along both sides of the road on all roads. No cycling lanes are provided.

Iron Cove Creek is a concrete lined open channel (also known as Dobroyd Canal) that bisects the proposed works. Parramatta Road crosses the Creek via a bridge and a small box culvert with a combined length of approximately 17 metres.

Utilities and services in the vicinity of the proposed works include Roads and Maritime intelligent transport system (ITS) infrastructure, Telstra and Optus telecommunications, Ausgrid electricity and Jemena gas, Sydney Water's water mains and Council stormwater. Refer to section 3.5 for more details on utilities in the area.

2.3 Proposal objectives

The Proposal aims to:

- Improve traffic congestion on Parramatta Road, at the intersection with Great North Road, for the outbound (i.e. westbound) direction
- Increase the physical capacity of the right turn movement from Parramatta Road to Great North Road
- Improve safety on approach to Parramatta Road and Great North Road intersection
- Minimise environment impact.

2.4 Alternatives and options considered

2.4.1 Methodology for selection of preferred option

Two options are provided below for the provision of relieving the pinch point at Parramatta Road and Great North Road. Selection of the preferred option was based on meeting the project objectives as well as structural / engineering, environmental, and surrounding land use planning considerations.

Options were assessed against the Proposal objectives presented in Section 2.3. Options were also assessed against the ability to meet broader strategic objectives outlined in Section 2.1.

The Ecologically Sustainable Development (ESD) principle of 'intergenerational equity', as identified in the *Protection of Environmental Administration Act 1991*, was used in the decision making process. The principle states that decision making processes should effectively integrate both long-term and short-term economic, environmental, social and equitable considerations. In developing and selecting options, Roads and Maritime considered existing and future traffic volumes, including anticipated impacts of WestConnex on the Parramatta Road Corridor, as well as engineering, environmental, and surrounding land use planning considerations.

2.4.2 Identified options

Option 1: Upgrade Parramatta Road and Great North Road intersection

This option comprises upgrading Parramatta Road and Great North Road intersection by duplicating and extending the right hand turn bay and associated pavement widening, utility, drainage, signalling, signage and line marking adjustments.

Option 2: Do nothing

This option would result in the current intersection arrangements remaining in place.

2.4.3 Analysis of options

Option 1 – Upgrade Parramatta Road and Great North Road intersection

This option consists of upgrading Parramatta Road and Great North Road intersection by duplicating and extending the right hand turn bay. This would also involve widening the bridge over Iron Cove Creek and widening the north side of Parramatta Road between Great North Road and around 70 metres east of Dobroyd Parade to improve congestion and safety.

This would result in:

- Improved safety of outbound approach to intersection as it will reduce the potential of rear end accident as vehicles turning right will not be stopped in through lane
- Increase the physical capacity of the right hand turn bay.by increasing the length of the right hand turn lane
- Improve traffic congestion on Parramatta Road for the outbound direction by improving the capacity of the right turn lane and minimising the potential of the through lane to be blocked by vehicles overflowing from the right turn lane.

Option 1 would meet the objectives of the Pinch Point Program as it would reduce delay for road users, improve the intersection performance, improve safety and maintain consistent travel times. This option meets all the objectives for this proposal.

Option 2 – Do nothing

Retaining the current arrangements (the do-nothing option) would result in the intersection continuing to operate at or above capacity, particularly during peak periods.

Option 2 would not fulfil the Proposal objectives or contribute to strategic planning outcomes. In particular, it would:

- Not assist in reducing traffic congestion or improving traffic flow
- Not increase capacity of the right-turn movement from Parramatta Road into Great North Road
- Not address safety risks for motorists on approach to the intersection

Option 2 would not meet the objectives of the Pinch Point Program as it would not reduce delay for road users, improve the intersection performance, improve safety or maintain consistent travel times.

2.5 Preferred option

Option 1 is the preferred option as it responds to the principles of ESD fulfils the Proposal objectives, and contributes to meeting the strategic objectives for the Parramatta Road Corridor.

3 Description of the proposal

3.1 The proposal

Roads and Maritime proposes to upgrade the intersection of Parramatta Road and Great North Road, Five Dock (Figure 1-1 shows the proposal location). The main features of the proposal are shown in Figure 3-1 and Figure 3-2 and include:

- Duplicating the right turn from Parramatta Road westbound to Great North Road
- Pavement widening on the north side of Parramatta Road Great North Road and about 70 metres east of Dobroyd Parade
- Widening of the bridge over Iron Cove Creek (Dobroyd Canal)
- Construction of new footpaths
- Demolition and construction of medians and kerbs to accommodate the new intersection layout
- Relocation of traffic control signal infrastructure to suit the new intersection layout
- Signage and line marking adjustments
- Removal of around 40 metres of parking space on Great North Road to be changed to “No Stopping”
- Utility relocation and protection
- Modifications to stormwater drainage infrastructure
- Installation of new street lighting
- Property acquisition on the northern side of Parramatta Road
- Reinstatement of driveway accesses
- Relocation of a bus shelter on Parramatta Road
- Tree removal on Parramatta Road, inbound between Henley Marine Drive and Dobroyd Parade
- Tree trimming on Parramatta road outbound adjacent to Iron Cove Creek bridge.

The proposal requires the existing location of Parramatta Road to be moved closer to sensitive receivers on the northern side by around six metres. The Proposal length is about 270 metres along Parramatta Road, with proposed works extending about 40 metres into Great North Road, about 25 metres into Dobroyd Parade, and about 20 metres into Henley Marine Drive. The total area of proposed new pavement and median is approximately 6280 m^2.

3.2 Design

Extensive design work has been undertaken to refine the concept, which is assessed in this REF. The detailed design is provided in Appendix B. It is noted that this design may be further refined during this design phase.

3.2.1 Design criteria

The design has been developed in accordance with current Austroads road design guidelines, which reference Australian Standards, and applicable Roads and Maritime supplements to the Austroads Guide, including:

- Austroads Guide to Road Design (Austroads 2009) and Roads and Maritime supplements to the Austroads Guide
- Austroads Guide to Road Safety (Part 6: Road Safety Audit) (Austroads 2002)
- Roads and Maritime Road Design Guide (Roads and Maritime undated)
- Roads and Maritime Delineation Guidelines (Roads and Maritime undated).

The design also reflects the following considerations:

- The need to minimise environmental impacts by developing a design that requires minimal vegetation removal and complements the existing streetscape
- The need to minimise land acquisition and disruption to residents and businesses.

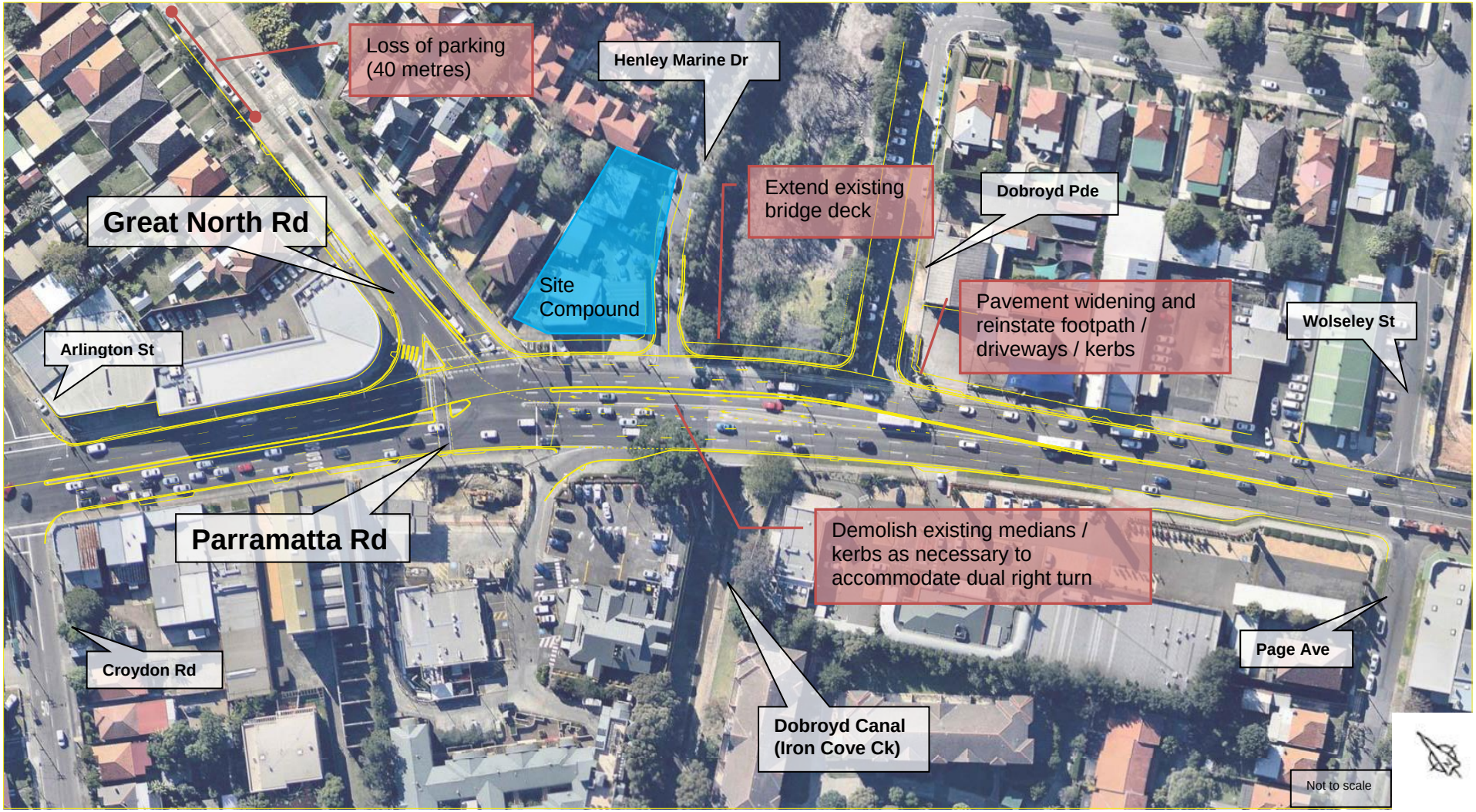


Figure 3-1: Key features of the proposal (VBA 2016)

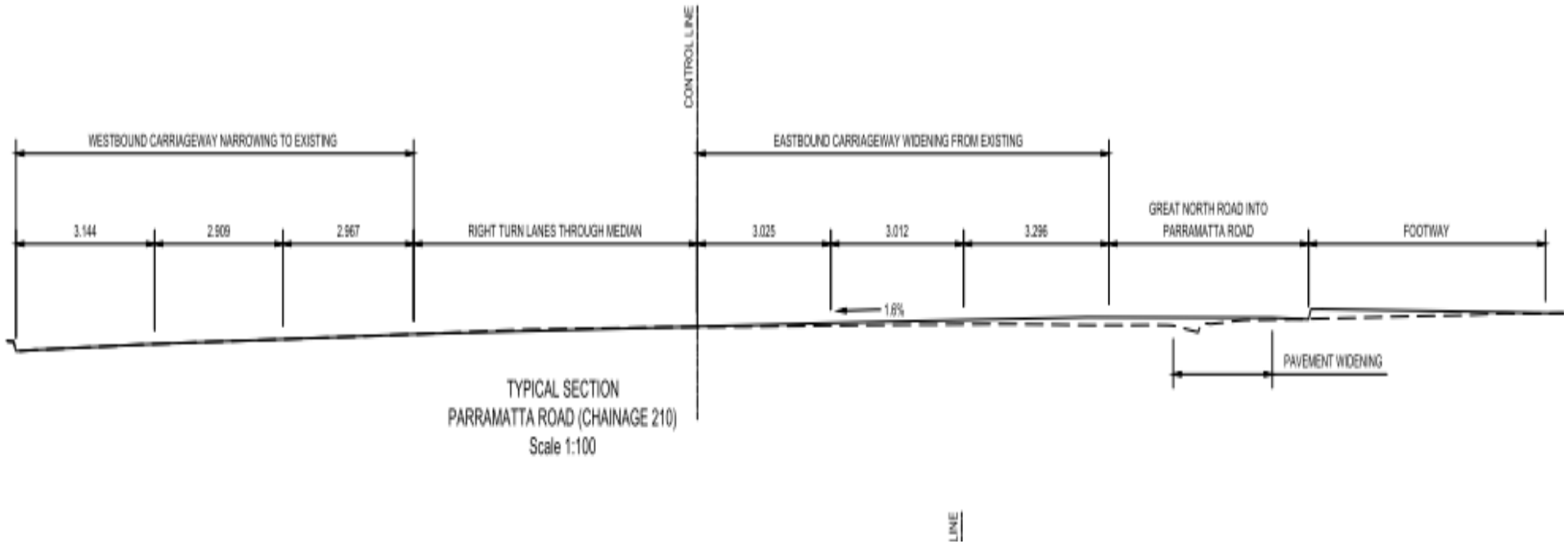


Figure 3-2: View of a typical cross section showing the proposed road design on Parramatta Road at the intersection with Great North Road (VBA 2016)

Design criteria are as follows:

Requirement	Criteria
Design speed	Design speed on Parramatta Road – 70 km/h
Posted speed	Posted speed on Parramatta Road – 60 km/h
Lane width	Lane widths: 3 m for middle lanes and 3.2 m for outside lanes (adjacent to the kerb) Turning lanes width: 3 m
Tie-ins	Provided at each interface of the Proposal with the road network.
Property access	All to be reinstated (excluding acquired properties)
Footpath	Footpath width approximately 1.5 m

3.2.2 Engineering constraints

Roads and Maritime has identified a number of engineering issues and constraints for the design and construction of the proposal. The main issues and constraints are:

- Maintaining traffic flows: Given the importance of the Parramatta Road corridor to the road network, approval to close lanes during construction is considered limited, particularly during the AM and PM peaks. The construction methodology would require a combination of day-time works under road barrier and night-time works under lane closure. The constructability review would need to be cognisant of impacts to traffic flow and adjacent residential and commercial properties.
- Utility adjustments and protection: Early engagement of utility providers would be necessary to facilitate approvals and adjustments/protections in a coordinated and timely manner.

3.2.3 Major design features

Road widening

To facilitate the additional turning lane, the northern side of Parramatta Road (i.e. eastbound) would be widened from Great North Road for a total distance of approximately 200 metres to just before Wolseley Street (Figure 3-1). The total area of proposed new pavement and median is approximately 6280 m^2.

Widening would generally be within the road reserve, with some overlap into privately owned land. Refer to Figure 3-3 to Figure 3-5 for maps of properties to be acquired to allow widening of Parramatta Road. The proposal would not result in any substantial change to the stormwater drainage system within the study area.

Tie-ins to existing pavement would occur at Parramatta Road, Great North Road, Dobroyd Parade and Henley Marine Drive. The tie-ins to the proposal at these locations would be adjusted to accommodate intersection amendments, road widening and difference in slope.

The proposed works would also include the removal of around 40 metres of parking space on the eastern side of Great North Road. This is to allow for the two lanes turning right from Parramatta Road onto Great North Road westbound to merge safely to one lane on Great North Road. Refer to Figure 3-1 for the location of the parking space to be removed. The parking space would be replaced with “No Stopping” signage.

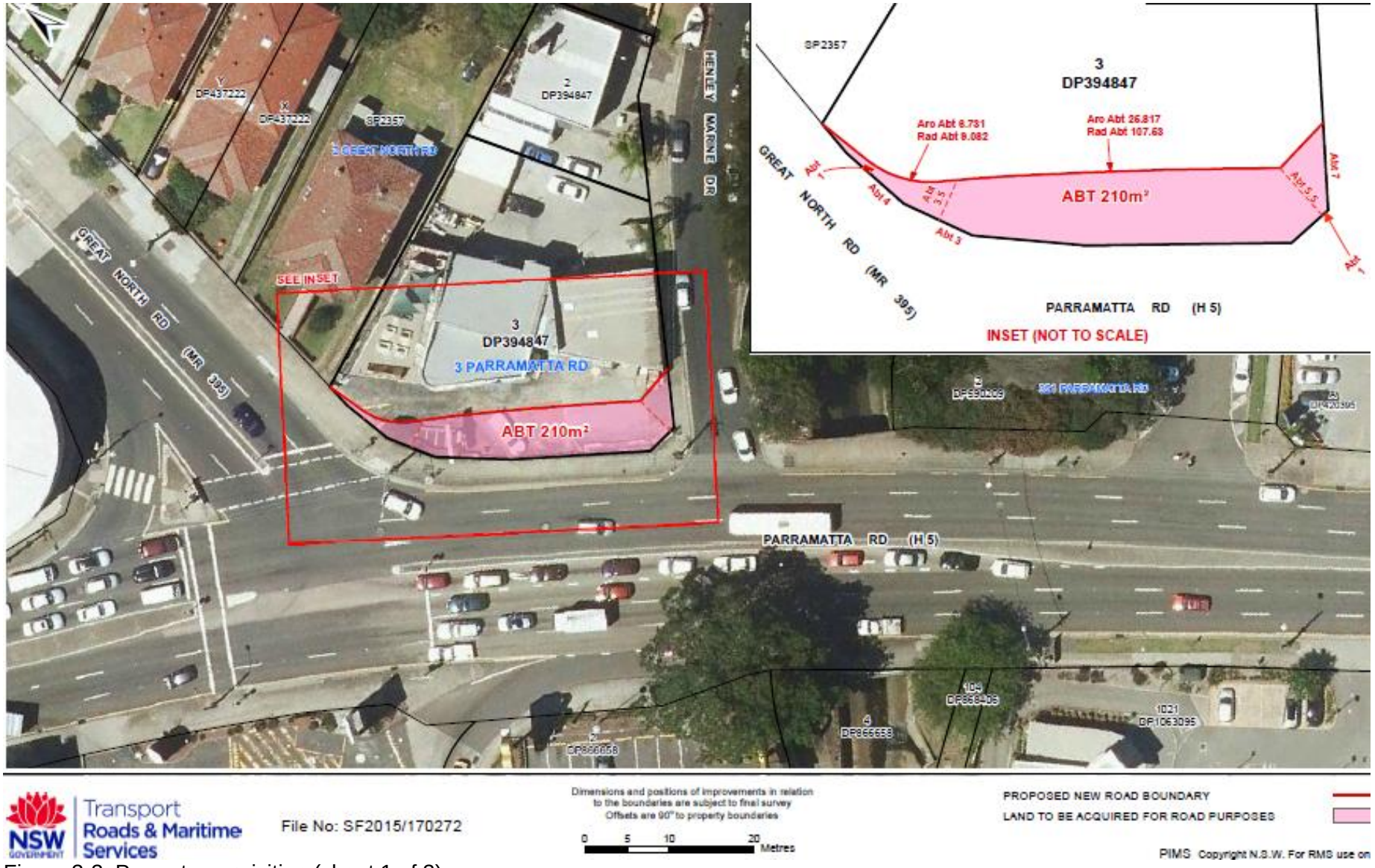


Figure 3-3: Property acquisition (sheet 1 of 3)

Figure 3-4: Property acquisition (sheet 2 of 3)

Figure 3-5: Property acquisition (sheet 3 of 3)

Bridge over Iron Cove Creek

Both precast bridge elements and in-situ reinforced concrete elements would be utilised for the widening of the bridge over Iron Cove Creek (Dobroyd Canal). The widening would be on the north side of Parramatta Road and the bridge widening would be approximately 12 meters wide. The Bridge design does not impact the stormwater canal. Piles would be required to be installed into the middle of the central breakwater and behind the wing wall on the northeast corner of the bridge. This would be confirmed in detailed design.

Refer to Figure 3-6 for a plan view of the proposed bridge widening and Figure 3-7 for the typical cross section.

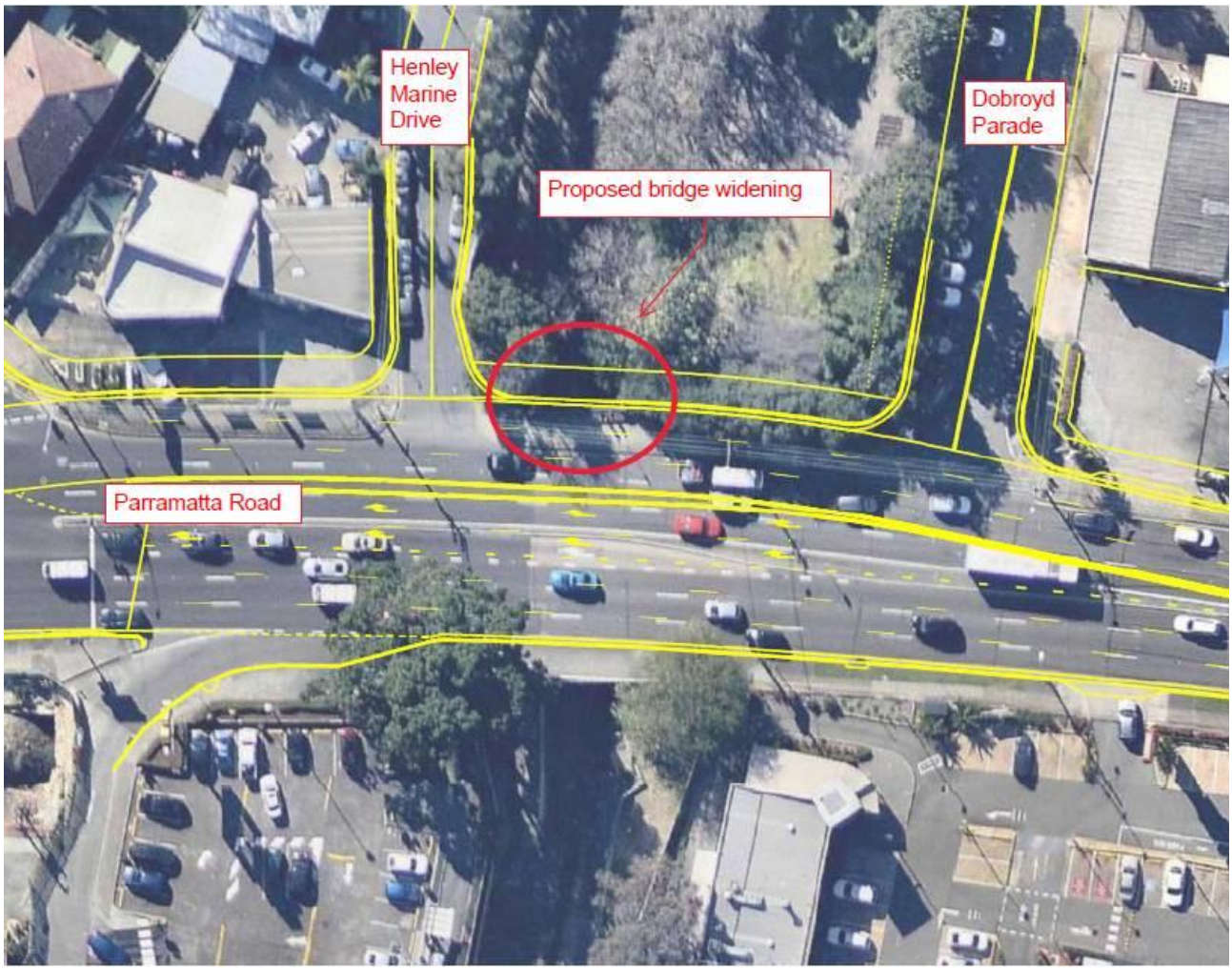


Figure 3-6: Plan view showing the proposed Iron Cove Creek bridge widening on Parramatta Road at the intersection with Henley Marine Drive (VBA 2016)

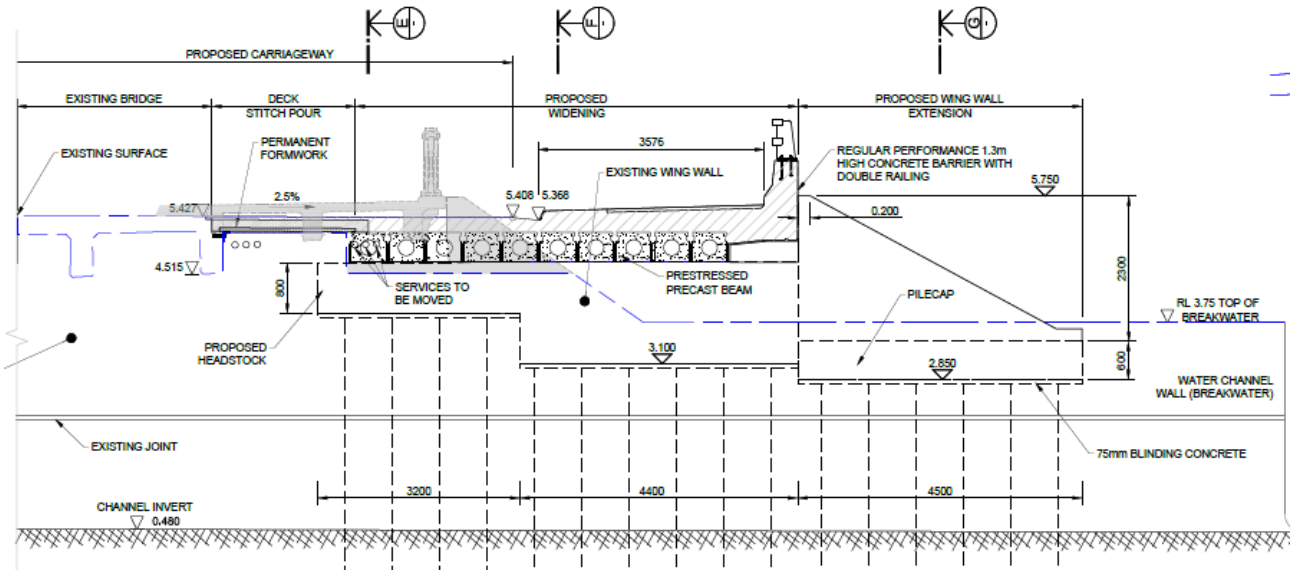


Figure 3-7: View of a typical cross section showing the proposed Iron Cove Creek bridge design on Parramatta Road at the intersection with Henley Marine Drive (VBA 2016)

3.2.4 General construction activities

Construction of the proposal has been broadly grouped into phases as follows:

Phase	Construction Activities
Pre-construction	Property acquisition and adjustment
Phase 1	Preliminary works including: • Utility investigation including survey and potholing • Survey set out • Saw cutting the kerbs and concrete paths • Identifying the trees to be removed and then removal of trees using equipment such as chain saws. Establishment of site compound • Preliminary property adjustment works
Phase 2	Utility adjustment along Parramatta and Great North Roads would include excavation, saw cutting of concrete and jackhammering works. The utilities that need to be adjusted include: • Relocate underground and overhead electrical asset • Relocate Telstra and Optus telecom asset • Relocate/protect Sydney Water asset
Phase 3	Bridge works including: • Excavation for implementation of bridge piers and abutments. • Piling for bridge piers and abutments • Formwork and concrete works to construct piers, abutments and bridge deck. • Installation of guard rails and other road safety infrastructure (eg signs)

Phase 4	Widening of road, which includes excavation of footpath and road area on north side of Parramatta Road. The widening works include: • Saw cutting • Excavation • Jack hammering • Installing stormwater drainage pipes and pits • Placing select material zone (SMZ) which entails placing material and compacting the material under the concrete layer • Placing lean mix concrete (LMC) along the widening section, then test and cure • Building base concrete, tie in to existing and align transverse joints with existing, test and cure • Building SA kerb and gutter (where not integral) and subsoil drain • Constructing median on Parramatta Rd Traffic control signal adjustments / works to be completed during widening works
Phase 5	Finishing works including: • Asphalt removal which includes milling. Then placing asphalt for the wearing course which includes resheet and correction courses • Reinstate lane configuration including line making line mark to new configuration and sign posting • Landscaping

3.2.5 Construction hours and duration

Day-time construction is proposed where safety barriers can be established to allow construction work to safely be completed away from traffic. Below is an outline of the standard works out and out of hours:

- Standard Work hours: 7am to 6pm Mondays to Fridays, and 8am to 1pm on Saturdays.
- Out of hours works: 6pm to 7am (Mon to Fri)
- No works on Sundays or Public Holidays.

The majority of the proposed works would require a traffic lane closure and posted speed reduction to 40 km/hr to ensure the work crew have a sufficient work area and a safe clearance from live traffic. Parramatta Road is a key transport corridor for motorists, freight and public transport and connects Sydney CBD with Parramatta. Traffic volumes in the day peak at 2362 vehicles per hour which reduces to 1794 vehicles per hour at night. Consequently, to minimise disruption to traffic and potential safety risks to construction personnel and road users it would be necessary to carry out the majority of work outside standard work hours. Proposed works outside normal hours are 8pm to 5am Sundays to Fridays.

Many activities would require consecutive nights of work in order to complete the task. For example, utility connections are required to be completed over consecutive nights to reduce disruption to the service and reduce safety hazards such as open utility pits or trenches. Works that are sufficiently set back from live traffic and do not require multiple truck movement would be completed during the day, for example landscaping, property adjustment, fencing, pavement construction and bridge widening works.

Extensive consultation would be carried out with residences predicted to experience high construction noise levels to establish reasonable and feasible mitigation measures for night-time construction.

Construction is expected to commence in first half of 2018 and be completed during January 2019, subject to approval and weather permitting.

3.2.6 Plant and equipment

A variety of plant and equipment would be required for the Proposal. The final plant and equipment will be determined during detailed design, with an indicative list as follows:

Surveying equipment	Hydraulic jack
Concrete agitator	Excavator
Concrete pump	Truck
Concrete saw	Loader
Roller	Milling machine
Bobcat	Asphalt paver
Profiler	Road saw cutter
Kerb extruder	Dewatering pumps and equipment
Day maker	Crane
Water cart	Line marking equipment
Chainsaw	Elevated working platform
Tree mulcher	Hand-held tools
Piling rig	Vacuum truck

3.2.7 Earthworks

The extent of earthworks required for the Proposal is expected to be low. It is anticipated that the following quantities of material will be removed:

- Excavation for drainage – 456m^3
- Excavation for pavement construction – 867m^3
- Excavation for footpath construction – 170m^3
- Milling of existing asphalt – 240m^3

3.2.8 Source and quantity of materials

Materials required for the proposed works include steel and concrete, precast stormwater and pits and precast bridge elements. The source of materials would be confirmed during detailed design and in future pre-construction planning activities.

3.2.9 Traffic management and access

Although detailed traffic management planning has not taken place, the following preliminary traffic management and access will be required during construction of the proposal.

Pedestrians and cyclists

A temporary pedestrian footpath would be construction to divert pedestrians away from the work site. Where this is not possible due to insufficient width, pedestrians would be managed by traffic control in accordance with a pedestrian movement plan during working hours and the existing pedestrian path reinstated at the end of each shift for public use.

Cyclists would be managed by traffic control in accordance with the vehicle movement plan during working hours and cycle routes would be reinstated at the end of each shift for public use.

Construction plant and vehicles

Associated truck movements are expected to be minimal during construction, however this would vary dependent upon the activity being completed. Construction plant and vehicles (including trucks) would enter and exit the site into the closed traffic lanes under traffic control in accordance with a vehicle movement plan.

Plant and vehicles will enter and exit the site compound via one access on Henley Marine Drive.

Vehicular access to adjacent commercial premises and fast food restaurants would be maintained throughout the construction period.

3.3 Ancillary facilities

A construction compound would be required for the duration of works. The compound would be used for site offices and construction personnel amenities, temporary stockpiling of construction materials, storage of precast stormwater and precast bridge elements, storage of plant and equipment and chemical/fuel storage.

Where practicable, plant and equipment would be stored at the compound, but may also be parked within the traffic closures within the proposal site.

One location has been nominated for potential use as a compound site for the proposal and is shown in Figure 3-1. The lot is located at the corner of Great North Road and Parramatta Road, Five Dock. This compound site is also proposed for use by a separate Roads and Maritime project, Parramatta Road and Shaftesbury intersection upgrade. The potential cumulative impacts of this are assessed in section 6.14.

The proposed site compound area was selected given its proximity to the proposal site and considering it will be acquired for the widening of Parramatta Road. It provides direct access to the proposal site thereby reducing construction traffic on surrounding streets and reducing potential safety hazards to motorists.

3.4 Public utility adjustment

As a result of the proposed works, the following utilities shown in Table 3-1 are expected to be impacted and require adjustment.

Table 3-1 Public utility adjustment requirements

Utility Type	Provider	Location	Details of adjustment
Electricity	Ausgrid	The asset extends east on the northern side of Parramatta Road from the intersection with Great North Road for a length of 200 metres	• Five power poles to be relocated • Overhead powerlines to be relocated • Underground powerlines to be relocated • Electricity asset to be relocated to the new proposed footpath location
Telecommunication	Optus and Telstra	The asset extends east on the northern side of Parramatta Road from the intersection with Great North Road for a length of 200 metres	• Underground asset to be relocated to new proposed footpath location
Water	Sydney Water	The asset extends east on the northern side of Parramatta Road from the intersection with Great North Road for a length of 200 metres	• Underground asset to be relocated to new proposed footpath location
Traffic Control Signals	Roads and Maritime	Traffic control signals are currently located at the intersection of Parramatta	• Existing 10 traffic control signal posts will be replaced with new posts to

Utility Type	Provider	Location	Details of adjustment
		Road and Great North Road	accommodate for the proposed widening and modification to the median • One new traffic control signal post will be installed on Parramatta Road westbound, opposite Great North Road • Associated ducting and cabling works would be required in conjunction with the new post installations
Stormwater	Council		• The stormwater drainage design has not yet been developed

Further utility surveys are being conducted and any necessary adjustments would be planned in consultation with utility providers during detailed design.

3.5 Property acquisition

The Proposal would require full or partial acquisition of three properties as indicated in Table 3-2. Plans showing the location of these properties are provided in Figure 3-3 to Figure 3-5. Full acquisition is required for Lot 2 and 3 DP394847, 3 Parramatta Road, Five Dock. For all properties, the area to be acquired is to be confirmed in detailed design.

Acquisition notices would be provided within the timeframe as specified in *Land Acquisition (Just Terms Compensation) Act 1991*.

Table 3-2: Proposed property acquisition

Property Address	Lot	Plan	LGA	Zoning
315-319 Parramatta Road, Haberfield	A	DP420395	Inner West	B6 Enterprise Corridor
321 Parramatta Road, Haberfield	2	DP590209		RE1 Public Recreation
3 Parramatta Road, Five Dock	2 & 3	DP394847	Canada Bay	B6 Enterprise Corridor

4 Statutory and planning framework

4.1 Environmental Planning and Assessment Act 1979

4.1.1 State Environmental Planning Policies

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 on behalf of Roads and Maritime, it can be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. Development consent from 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 prior to the commencement of certain types of development. Consultation, including consultation as required by ISEPP (where applicable), is discussed in chapter 5 of this REF.

State Environmental Planning Policy No 19—Bushland in Urban Areas

Pursuant to Schedule 1 of State Environmental Planning Policy No—Bushland in Urban Areas (SEPP 19), this policy applies to the Inner West (formerly Ashfield) and Canada Bay (formerly Drummoyne and Concord) LGAs. SEPP 19 protects and preserves bushland within certain urban areas as part of the natural heritage or for recreational, educational and scientific purposes. Road construction is permissible under this policy, provided the proposal is consistent with the aims and objectives of the policy.

The aims and objectives of this SEPP generally relate to the preservation of bushland due to its value as a recreational, educational and scientific resource, value to the community as part of the natural heritage and aesthetic value. As no such bushland occurs within the proposal site, SEPP 19 is not applicable to the Proposal.

4.1.2 Local Environmental Plans

Canada Bay Local Environment Plan 2013

The northern portion of the Proposal (from Arlington Street to Henley Marine Drive) is located within the City of Canada Bay LGA. The Proposal traverses land zoned B6 Enterprise Corridor, SP2 Infrastructure and RE1 Public Recreation under the Canada Bay Local Environment Plan (LEP) 2013. Under the Canada Bay LEP, development for the purposes of roads within these zones is permitted with consent. However, the provisions of the ISEPP remove the requirement for development consent from City of Canada Bay Council.

Ashfield Local Environment Plan 2013

The southern portion of the Proposal (from Dobroyd Parade to Wolseley Street) and the western side of Parramatta Road are located within the Inner West Council LGA. The Proposal traverses land zoned B6 Enterprise Corridor, SP2 Infrastructure and RE1 Public Recreation under the

Ashfield LEP 2013. Under the Ashfield LEP, development for the purposes of roads within zones B6 and RE1 is permitted with consent, and no consent is required in land zoned SP2. However, the provisions of the ISEPP remove the requirement for development consent from Inner West Council.

4.2 Other relevant NSW legislation

4.2.1 Threatened Species Conservation Act 1995

The purpose of the *Threatened Species Conservation Act 1995* (TSC Act) is to protect and conserve threatened, endangered and vulnerable species, populations and ecological communities listed under the Act. Potential impacts to listed species, populations and their habitat or communities require an Assessment of Significance under Section 5A of the EP&A Act. If there is likelihood for a significant impact on threatened species, populations and their habitat or on ecological communities then a Species Impact Statement is required.

No threatened flora species or listed ecological communities were recorded in the Proposal area. One threatened fauna species, the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) has been recorded within the subject site. A number of threatened fauna species have been recorded from the locality and have the potential to occur within the subject site.

An assessment of significance under the TSC Act was undertaken for these fauna species and it was determined that the Proposal is unlikely to a significant impact on any of them. A Species Impact Statement is not required.

A number of mitigation measures have been recommended to minimise impacts on potential habitat prior to and during the works. These are assessed and discussed in Section 6.5.4.

4.2.2 Heritage Act 1977

The *Heritage Act 1977* (Heritage Act) provides protection for items of 'environmental heritage' in NSW. 'Environmental heritage' includes places, buildings, works, relics, movable objects or precincts considered significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. Under the Heritage Act, a person must not disturb or excavate land if they know, or have reasonable cause to suspect that they might discover, expose, move or damage a relic unless they have an excavation permit.

Items considered to be significant to the State can be listed on the State Heritage Register (SHR) and cannot be demolished, altered, moved or damaged, or their significance altered, without approval from the Heritage Council of NSW. Other items may be listed on the National and Commonwealth Heritage Lists, State Heritage Inventory (SHI) or by local Councils in LEPs. Additionally, under the section 170 of the Heritage Act, all government agencies are required to identify, conserve and manage heritage items in their ownership or control. Items are typically listed in a Heritage and Conservation Register, and may also be included on the SHI.

There are no items listed on the SHR located within or adjacent to the study area. The existing Dobroyd Stormwater Channel No 53 (i.e. Iron Cove Creek) which bisects the study area is listed on the Sydney Water section 170 Register. No items listed of local heritage significance occur in the study area. However, the bridge spanning the Dobroyd Canal Stormwater Channel has been identified as a potential unlisted heritage item of local significance.

A Statement of Heritage Impact was prepared for the proposal and considered potential impacts to the listed Dobroyd Stormwater Channel, unlisted bridge and archaeological relics or works and this assessment is discussed in Section 6.3 of this REF. While potential indirect impacts to the listed Channel were identified these were not considered to be significant. The widening of the existing bridge would have a major impact on the heritage values of this unlisted item. The proposal is not

expected to impact archaeological relics or works. Recommendations for mitigation and management of impacts were proposed.

4.2.3 Protection of the Environment Operations Act 1997

The *Protection of the Environment Operations Act 1997* (POEO Act) is the key piece of environment protection legislation administered by the Environment Protection Authority (EPA) and local council (where relevant). The POEO Act provides for the regulation and authorisation of discharges to the environment via environment protection licences (EPL) for developments and activities, as listed on Schedule 1 of the POEO Act. Under section 148 of the POEO Act, relevant authorities must be notified of any pollution incidents that that cause or threaten material harm to the environment.

The proposed works are not a scheduled development work or scheduled activity under the POEO Act and do not require an EPL. Appropriate mitigation and management measures would be established and maintained to avoid pollution incidents and these are outlined in Section 6 of this REF.

The Protection of the Environment (Waste) Regulation 2005 regulates the management and disposal of waste. They contain the requirements for managing, storing, transporting, processing, recovering and disposing of waste. Any contaminated soils would need to be tracked during transportation, and would need to be removed to an appropriately licensed waste facility. Under Section 143 of the POEO Act it is an offence to transport waste to a place that cannot lawfully be used for disposal of that waste.

Waste management measures would include opportunities for resource recovery and classification and disposal facilities approved to receive the wastes, and in accordance with the Waste Avoidance and Resource Recovery Act 2001.

4.2.4 Contaminated Land Management Act 1997

The *Contaminated Land Management Act 1997* (CLM Act) establishes the processes for investigating, and where appropriate, remediating contaminated land and contaminated groundwater. Section 60 of the CLM Act imposes a duty for proponents to report to the EPA if land contamination poses a significant risk of harm.

4.2.5 Land Acquisition (Just Terms Compensation) Act 1991

Three properties would be partially or wholly acquired for the Proposal. All property acquisitions would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*, which aims to guarantee just compensation terms for land that is acquired by an authority of the State.

As the detailed design has not yet been completed, the precise requirements for property acquisition are still to be determined. Roads and Maritime would continue to consult with affected landowners during the detailed design of the proposal.

4.3 Commonwealth legislation

4.3.1 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 or the environment of Commonwealth land. These are considered in Appendix A and chapter 6 of this REF.

A referral is not required for proposed road activities that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. This is because requirements for considering impacts to these biodiversity matters are the subject of a strategic

assessment approval granted under the EPBC Act by the Australian Government in September 2015.

Potential impacts to these biodiversity matters are also considered as part of chapter 6 of this REF and Appendix A.

Findings – matters of national environmental significance (other than biodiversity matters)

The assessment of the proposal's impact on matters of national environmental significance and the environment of Commonwealth land found that there is unlikely to be a significant impact on relevant matters of national environmental significance or on Commonwealth land. Accordingly, the proposal has not been referred to the Australian Government Department of the Environment under the EPBC Act.

Findings – nationally listed biodiversity matters

The assessment of the proposal's impact on nationally listed threatened species, populations, endangered ecological communities and migratory species found that there is unlikely to be a significant impact on relevant matters of national environmental significance. Chapter 6 of the REF describes the safeguards and management measures to be applied.

4.4 Confirmation of statutory position

The proposal is categorised as development for the purpose of a road and is being carried out by or on behalf of a public authority. Under clause 94 of the ISEPP the proposal is permissible without consent. The proposal is not State significant infrastructure or State significant development. The proposal can be assessed under Part 5 of the EP&A Act.

Roads and Maritime is the determining authority for the proposal. This REF fulfils Roads and Maritime's obligation under clause 111 of the EP&A Act to examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment by reason of the activity.

5 Consultation

5.1 Consultation strategy

Roads and Maritime has prepared the Parramatta Road and Great North Road, Five Dock Proposed Intersection Upgrade Community and Stakeholder Engagement Plan (August 2016) for the Proposal. The plan has been developed to support the design of the proposed intersection upgrade. It outlines the communication and engagement approach that will be implemented throughout the concept and detailed design of the proposal.

This plan aims to:

- Identify stakeholders, potential issues and recommended communication activities during design
- Keep key stakeholders, businesses and residents informed of the progress of design
- Provide a general level of awareness for those in the broader community.

Key stakeholders in the proposal have been identified and a range of communication tools will be used to inform the community and stakeholders about the proposal.

These tools include:

- Project web page, phone number and email address
- Project display and community information sessions
- Media releases
- Email distribution of registered stakeholders
- Advertising.

5.2 Community involvement

Consultation with relevant stakeholders, including property owners, was undertaken in October 2015 during early site investigations to inform the design. Consultation involved doorknocks of affected properties to seek approval to access the properties for the investigations.
This REF will be displayed for community and stakeholder comment between 5 December 2016 & 19 December 2016 at the Concord Library and Five Dock Library and on the Roads and Maritime's website. Roads and Maritime will consider and address all comments in a submissions report, which will be made publicly available on Roads and Maritime's website.

VBA will undertake community consultation on the proposed construction program duration and number of night shifts prior to starting construction works.

No consultation regarding property acquisition has occurred to date. Roads and Maritime would consult directly with affected property owners (see Section 5.6).

5.3 Aboriginal community involvement

A search of the Aboriginal Heritage Information Management System (AHIMS) did not identify any Aboriginal sites or places within the Proposal area. Given the Proposal is located on an existing built structure and highly impacted surfaces it is considered unlikely that there would be any impact on items of Aboriginal heritage.

The Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime 2011) is a four-staged process commencing with an internal Roads and Maritime assessment to determine whether a proposal is likely to affect Aboriginal cultural heritage. The PACHCI Stage 1 assessment concluded that the Proposal is unlikely to have any impact on Aboriginal cultural heritage because:

- The Aboriginal Heritage Information Management System (AHIMS) search did not identify any known Aboriginal objects or places in the study area
- The study area does not contain landscape features that indicate the presence of Aboriginal objects
- The Aboriginal cultural heritage potential of the study area appears to be severely reduced due to past disturbance.

Consultation with the Aboriginal community is not considered to be required in accordance with the PACHCI guidelines. The PACHCI checklist and AHIMS search results are included in Appendix H.

5.4 ISEPP consultation

Consultation with City of Canada Bay Council and Inner West Council would be undertaken in accordance with the requirements of ISEPP. Formal consultation is required with councils for development that impacts on council-related infrastructure or services, including that which is likely to cause a disruption to pedestrian or vehicular traffic that is not minor or inconsequential (clause 13). Consultation is also required with the local council where there may be more than minor impact on flood liable land (clause 15). Consultation is also required for substantial impact on stormwater management services (clause 13).

5.5 Government agency and stakeholder involvement

Consultation directly relating to the proposal began in 2014 with discussions with WestConnex representatives regarding possible interaction between the two proposed works, including property acquisition.

Consultation is currently being undertaken with Sydney Water as the Proposal would directly impact land or features owned or managed by this stakeholder. A utility search has commenced and would be finalised through detailed design and consultation with the relevant service providers.

Roads and Maritime would also provide the stakeholders with copies of this REF for information. Consultation with the councils, relevant agencies and stakeholders would be conducted throughout the detailed design and construction phase, as required.

Roads and Maritime would consult with all directly affected landholders before the start of construction, including:

- Landowners whose land would be acquired, to ensure their concerns are clearly understood and can be addressed wherever possible
- Landowners whose access could be affected (access to private properties would be maintained during construction).

5.6 Ongoing or future consultation

As noted in section 5.1, Roads and Maritime has prepared a Community and Stakeholder Engagement Plan for the proposal that outlines the approach to communication and engagement that will be implemented throughout the design phase.

Roads and Maritime would continue to inform residents and stakeholders of the ongoing development of the proposal. This would be carried out using methods such as the distribution of community updates, emails to the stakeholder database, and updates on the Roads and Maritime project website.

The local bus companies would be consulted regarding the location of bus stops and any impacts to bus operations during the construction period. In addition, commuters would be notified in advance of any changes to the use and location of bus stops and services throughout construction.

City of Canada Bay Council and Inner West Council would continue to be updated on the progress of the development of the proposal.

The wider community and motorists would primarily be informed about the proposed work through variable message signs advising motorists of the changed traffic conditions and through media announcements.

This REF will be placed on public display for comment. Following the display period, Roads and Maritime will collate and consider all submissions and responses provided in a submissions report, which will also be made available to the public. After consideration of community comments Roads and Maritime will determine whether the proposal should proceed as proposed, or whether any alterations to the proposal are necessary.

The project information line will be maintained (1800 035 733) for queries that the community or affected road users may have during the public display period and during construction.

5.7 Consultation during public display

The REF will be on public display for 2 weeks from Monday 5 December 2016 to Monday 19 December 2016 and written submissions will be invited during this period. Further community consultation will be undertaken during the public display period to enable the community to comment and ask questions about the Proposal.

Planned consultation activities associated with the public display include:

- Information session

A community information session to give local residents and businesses an opportunity to view the plans and discuss the Proposal with members of the project team will be held at the Chiswick Community Hall, Tuesday 13 December between 4.30pm and 6.30pm.

- Internet:

The review of environmental factors will be available as pdf files on the Roads and Maritime Services website at www.rms.nsw.gov.au/projects.

- Display:

The review of environmental factors can be viewed at Concord Library and Five Dock Library.

- Letter box drop:

A letter box drop will be completed to properties within 200 metres of the proposal area publicising the REF display and community information session.

- Advertisements:

Advertisements will be placed in the "Inner West Weekly" and "Burwood Scene" to publicise the REF display and community information session.

5.7.1 Making a submission

To make a submission on the proposal, please send your written comments to:

Email: nswenquiries@vbajv.com.au
or
Mail: Ventia Boral Amey JV, C&SE, PO Box 838, Rockdale, NSW, 2216
or
Call: Ventia Boral Amey JV on 1800 677 700.

Submissions must be received by Monday 19 December 2016.

5.8 Post-public display consultation

5.8.1 Submissions report

At the conclusion of the public display period for the REF, Roads and Maritime Services will acknowledge receipt of feedback from each respondent. The issues raised by respondents will be consolidated and considered by Roads and Maritime Services.

A Submissions Report will be prepared summarising the key impacts identified in this REF, demonstrating how Roads and Maritime Services considered issues raised during the public display period, and include a summary of mitigation measures proposed to minimise the impacts of the Proposal. The Submissions Report will be made available on Roads and Maritime Services website at www.rms.nsw.gov.au/projects and everyone who made a submission will be individually notified of the outcome.

5.8.2 Construction phase

Should Roads and Maritime Services proceed with the Proposal, consultation activities would continue up to and during construction. These consultation activities would ensure that:

- The community and stakeholders have a high level of awareness of all processes and activities associated with the Proposal
- Accurate, up to date and accessible information is made available
- Timely response is given to issues and concerns raised by the community.

The project team would keep the community, Canada Bay Council and other key stakeholders informed of progress, identify further issues as they arise, and develop additional mitigation measures to minimise potential impacts of the Proposal. Targeted consultation activities such as door knocks, meetings, newsletters, notifications, advertising, signage and verbal communications would continue during the construction phase.

6 Environmental assessment

This section of the REF provides a detailed description of the potential environmental impacts associated with the construction and operation of the proposal. All aspects of the environment potentially impacted upon by the proposal are considered. This includes consideration of:

- Potential impacts on matters of national environmental significance under the EPBC Act
- The factors specified in the guidelines Is an EIS required? (DUAP 1995/1996) as required under clause 228(1) of the Environmental Planning and Assessment Regulation 2000 and the *Roads and Related Facilities EIS Guideline* (DUAP 1996). The factors specified in clause 228(2) of the Environmental Planning and Assessment Regulation 2000 are also considered in Appendix A.

Site-specific safeguards and management measures are provided to mitigate the identified potential impacts.

6.1 Traffic and access

6.1.1 Methodology

A traffic count was completed for the intersection on 20 February 2014 by Austraffic. Traffic modelling for the Parramatta Road corridor was undertaken by Sinclair Knight Merz (SKM) in 2012 SKM 2012a). This was completed to deliver calibrated and validated base models. The base models were used to test the effectiveness of the proposed intersection upgrade (SKM 2012b). A summary traffic assessment was prepared (Positive Traffic 2016, Appendix C) for the REF, informed by the above modelling studies for the Parramatta Road corridor (SKM 2012a and SKM 2012b). The following traffic and access assessment is based on the outcomes of these reports.

6.1.2 Existing environment

Road network

Parramatta Road is a strategic corridor route in the Sydney road network. In the vicinity of the intersection with Great North Road, Parramatta Road includes three travel lanes in each direction. A right turn bay from Parramatta Road into Great North Road is provided at a length of approximately 100 metres.

The three way intersection with Great North Road is signalised. Each direction of Parramatta Road is divided by a concrete median strip and has a footpath on both sides of the road. Lane widths are about 2.5 to 2.8 metres and the shoulders have varying widths. The speed limit is 60 km/hr.

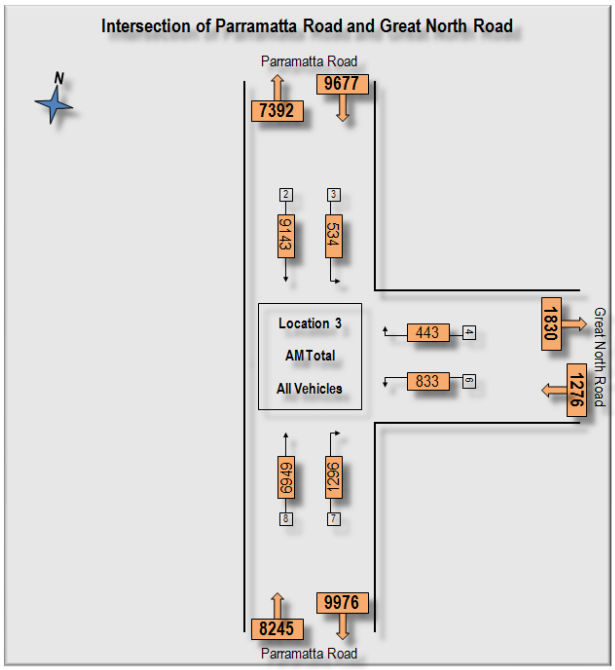
Parramatta Road has clearway restrictions that operate from 6am to 7pm Monday to Friday and 8am to 8pm Saturday and Sunday in both the eastbound and westbound directions. Outside the hours of the clearway restrictions, no stopping and no parking restrictions exist. Bus stop number 204511 is situated on Parramatta Road eastbound between Henry Marine Drive and Dobroyd Parade.

Great North Road is a major collector road linking Parramatta Road in the south with the Five Dock Town Centre in the north. It includes two travel lanes in each direction at its intersection with Parramatta Road. To the north, the road includes a single travel lane in each direction with restricted / unrestricted parallel parking on either side of the street. Lane widths are about 2.5 to 3.5 metres. The speed limit is 60 km/hr.

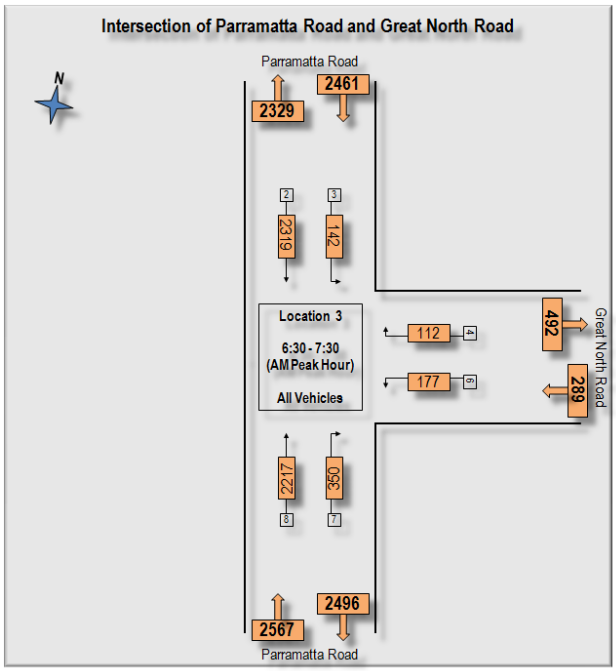
Dobroyd Parade and Henley Marine Drive are local roads. The T-intersections of Parramatta Road and both Dobroyd Parade and Henley Marine Drive are unsignalised and restricted to left in / left out. The speed limit is 50 km/hr.

Traffic environment and crash history

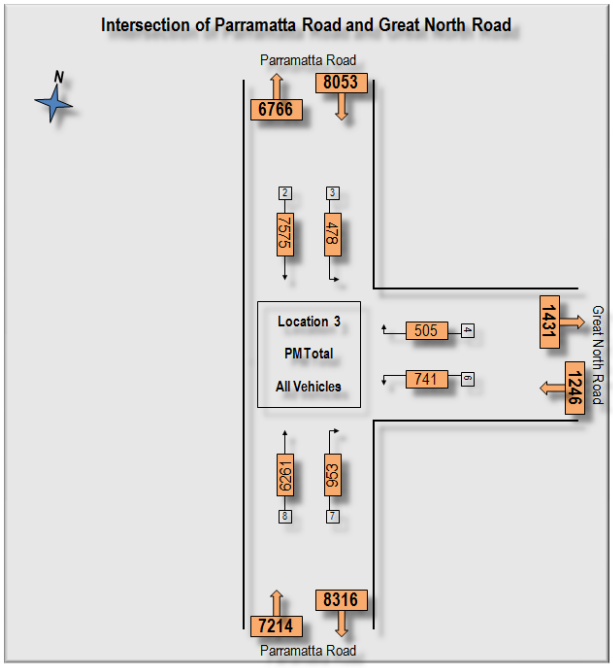
Existing demands on Parramatta Road are high in both directions and reflect those of a strategic corridor. Traffic counts taken on 20 February 2014 found the intersection had the following demands (Table 6-1).



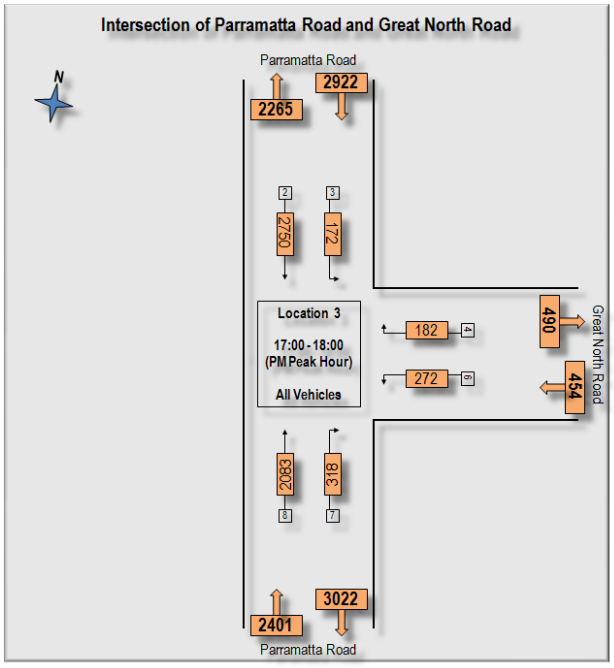
Morning total (6:00–10:00 AM)



Morning peak (6:30–7:30 AM)



Afternoon total (4:00–7:00 PM)



Afternoon peak (5:00–6:00 PM)

Table 6-1: Traffic demand Parramatta Road February 2014

Time period		Light	Heavy	Bus	Total
AM	6:00 – 10:00 Total	17412	1629	157	19198
	6:30 – 7:30 Peak	4845	443	29	5317

Time period		Light	Heavy	Bus	Total
PM	4:00 – 7:00 Total	15915	486	112	16513
	5:00 – 6:00 Peak	5599	135	29	5317

The Parramatta Road corridor exhibits poor levels of service for traffic during both the morning and afternoon peak periods. Observations of traffic conditions in October 2015 noted over queuing in the existing single right turn lane into the Great North Road. This reflects queue length surveys from 20 February 2014, which found between 2–38 vehicles queued for an average of just over 1 minute between 6:18–10:00am and 2–15 vehicles queued for an average of about 4.5 minutes between 4:00–7:00pm.

Pedestrian and cyclist usage of the intersection was also recorded on 20 February 2014 as follows:
- 6:00 – 10:00am total – 73 pedestrians and 35 cyclists
- 4:00 –7:00am total – 76 pedestrians and 19 cyclists.

Peak usage by pedestrian and cyclists was observed at 7:30–8:30am and 5:00–6:00pm.

Between 1 January 2010 to 31 December 2014, for the intersection of Parramatta Road / Great North Road, the following accident statistics were noted:
- A total of 24 reporting accidents occurred at the intersection with 14 accidents resulting in injuries
- The most prevalent type of accident was rear end accidents.

Other infrastructure

Pedestrians are able to cross at the intersection of Great North Road with Parramatta Road using signalised and unsignalised pedestrian crossings. No pedestrian crossings occur at the intersection of Parramatta Road with Dobroyd Parade or Henley Marine Drive. Concrete pedestrian paths are provided along both sides of the road on all roads.

No cycling lanes are provided.

Bus services that travel through the Proposal area include:
- State Transit Route 461 Burwood to City
- State Transit Route 490 Drummoyne-Burwood-Kingsgrove-Hurstville
- State Transit Route 491 Hurstville to Five Dock
- State Transit Route 492 Drummoyne-Burwood-Kingsgrove-Rockdale
- State Transit Night-ride Route N70 Penrith to City.

6.1.3 Potential impacts

Construction

Construction would run over a period of about 43 weeks, during which time there would be additional traffic accessing the study area. The additional traffic would mainly be generated by the deliveries of plant, equipment and materials, and the vehicles of construction workers. Given the high existing traffic volumes through the proposal area, this increase is not expected to impact on the operation of the road network.

Day-time construction works would occur under road barrier so as to maintain traffic flow along Parramatta Road. It is unlikely that lane closures would be required for day-time works. During night-time works, lane closure and contra flow would be employed as required to reduce potential risks to safety of construction personnel and motorists. Construction plant and vehicles (including trucks) would enter and exit the site into the closed traffic lanes under traffic control in accordance

with a vehicle movement plan. In the event that Parramatta Road needs to be closed (e.g. for a large crane lift) a detour would be established with prior approval under a ROL for the works.

Access to the construction compound would be via Henley Marine Drive. Vehicular access to adjacent commercial premises and fast food restaurants would be maintained throughout the construction period.

Plant and equipment would be stored at the main compound or in lanes required for traffic closures within the Proposal site.

The pathway on the northern side of Parramatta Road would be closed to pedestrians for the duration of the works. Alternative access for pedestrians would be provided.

The bus stop number 204511 would be relocated outside the proposed works area, most likely to just before the Great North Road (i.e. in front of the Audi car dealership).

Operation

The provision of a dual lane right turn bay would result in less over queuing of right turning traffic which in turns impedes on westbound traffic in Parramatta Road. The traffic model completed by SKM (SKM 2012b) shows that during the AM peak period, westbound traffic flows improved as a result of the duplication of the right turning bays into Great North Road, whereas eastbound flow conditions remain similar to the base model. The model shows an increase of 1.5% (82 vehicles) eastbound and 5.7% (250 vehicles) westbound in the AM peak period (0700 to 0900). During the PM peak period (1700 to 1900) an 8.2% increase (453 vehicles) eastbound and a -1.2% decrease westbound was modelled against the base model. The model suggests that there is expected to be an overall improvement in the operation of the network by implementing the proposed intersection upgrades at five locations assessed within the model on Parramatta Road. The proposal increases the turning and stacking capacity for the turning movement at the Proposal intersection, which results in less impedance and greater throughput of traffic travelling on Parramatta Road, therefore reducing the frequency and severity of rear end, side swipe and lane change crashes reported on Parramatta Road.

The proposed works would have an overall positive impact on operational traffic conditions both in the vicinity of the site and along the Parramatta Road corridor in general.

As a result of the proposal, about 40m of unrestricted parking space will be lost on Great North Road northbound as shown on Figure 3-1. These spaces are currently located outside the residential premises. However, based on observation it appears that alternative parking is available in nearby local streets and further parking studies will be undertaken as the proposal progresses.

6.1.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Traffic and transport	Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the RTA's *Community Involvement and Communications Resource Manual*. Consultation will include but not limited to door knocks, newsletters or letter box drops	Contractor	Pre-construction / construction	Core standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	providing information on the proposed works, working hours and a contact name and number for more information or to register complaints.			
Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the *Roads and Maritime Traffic Control at Work Sites Manual* (RTA, 2010) and *QA Specification G10 Control of Traffic* (Roads and Maritime, 2008). The TMP will include: • confirmation of haulage routes • measures to maintain access to local roads and properties (as agreed with the property owner during the construction period) • site specific traffic control measures (including signage) to manage and regulate traffic movement • measures to maintain pedestrian and cyclist access • access to construction sites including entry and exit locations • a response plan for any construction traffic incident • consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • monitoring, review and amendment mechanisms.	Contractor	Detailed design / Pre-construction	Core standard safeguard Section 4.8 of QA G36 Environment Protection
Traffic and access	Access for emergency vehicles will be maintained at all times during construction. Any site-specific requirements will be determined in consultation with	Contractor	Construction	Core standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	the relevant emergency services agency.			
Traffic and transport	Access to properties will be maintained during construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority.	Contractor	Construction	Additional standard safeguard
Traffic and transport	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Contractor	Construction	Additional standard safeguard

Other safeguards and management measures that would address traffic and transport impacts are identified in Table 7-1 (ie. Core standard safeguards GEN2 and GEN3).

6.2 Noise and vibration

6.2.1 Methodology

A *Construction and Operational Noise and Vibration Assessment* (Renzo Tonin & Associates 2016) was prepared to quantify potential noise impacts on sensitive receivers from road traffic and construction activity associated with the proposed widening and addition of lanes to Parramatta Road. The noise assessment was undertaken in accordance with the EPA's Interim Construction Noise Guideline (ICNG) and Road Noise Policy (RNP), and RMS's Construction Noise and Vibration Guideline (CNVG) and Environmental Noise Management Manual (ENMM). This section presents a summary of the assessment, which is provided in full in Appendix D.

6.2.2 Existing environment

The Proposal site is surrounded by a mixture of commercial, residential and recreational land uses. Twenty two sensitive receivers were identified as the nearest affected receivers, comprising:

- Four single storey residences
- Two double storey residences
- Three multistorey residential buildings
- One childcare building

The nearest affected noise sensitive receivers are shown in Figure 6-1. Receiver locations R2, R3 and R4 are the nearest residential sensitive receivers are located approximately 11 metres east of the proposed works. The childcare centre is receiver location R12 and is approximately four metres east of the proposed works. The nearest commercial receivers are locations R10 and R11 situated within approximately three and four metres respectively of the proposed works. The nearest

industrial receivers are locations R14 and R22 situated within approximately four and six metres respectively of the proposed works.

The noise environment in the study area is generally controlled by traffic noise from Parramatta Road and Great North Road. Long-term (unattended) noise monitoring was conducted at location M1 (see Figure 6-1) to quantify existing background noise levels and results are presented in Table 6-2. The purpose of the noise monitoring was to establish background noise levels for the setting of construction noise goals for the project.

Consideration was given to additional noise monitoring for the residential receivers located to the west of Parramatta Road in order to establish Noise Catchment Areas (NCAs) for the project. The residential receivers on the western side of Parramatta Road are multistorey apartment buildings where the upper floors overlook the commercial buildings along Parramatta Road. These receivers are affected by industrial noise from the surrounding commercial premises in addition to traffic noise from Parramatta Road. Therefore, noise monitoring results for Location M1 were conservatively used as the background noise levels for all receivers and no NCAs were established for the assessment.

Short-term noise monitoring undertaken with a hand held noise meter was undertaken to measure existing traffic noise levels. These are presented in Table 6-3. The purpose of the noise monitoring was to quantify existing traffic noise levels. This data was used to validate and calibrate the operational noise model. Measurements were undertaken during a free flowing traffic period because during peak periods vehicles along Parramatta Road between Great North Road and Wattle Street were banked up at the intersections and at times at a standstill.

Figure 6-1: Noise monitoring and receiver locations (Renzo Tonin & Associates 2016)

Table 6-2: Background noise levels

Noise monitoring location	L_{A90} Background Noise Levels (dB(A))		
	Day	Evening	Night
M1 – 8 Great North Road	55	52	46

Table 6-3: Traffic noise levels

Noise monitoring location (& measurement number)		Measured $L_{Aeq(15min)}$ Noise Levels (dB(A))	
		Time	Result
S1 – 7m from Parramatta Rd	(1)	12:00pm-12:15pm	74.0
	(2)	12:15pm-12:30pm	76.4
	(3)	12:30pm-12:45pm	74.6
	(4)	12:45pm-1:00pm	74.2

6.2.3 Criteria

Construction noise

The recently released CNVG provides guidance for the establishment of construction noise management levels (NMLs) and the methods for assessing construction noise. There are two parts to the CNVG that are used to determine the type of assessment required to be undertaken:

- Duration of the impact to affected receivers
- Number of affected receivers.

The proposed intersection works are anticipated to occur for more than six weeks and the number of receivers potentially affected by the noise impacts would be many, in accordance with the CNVG. Based on the proposed duration of works and many affected receivers, a quantitative assessment in accordance with the noise objectives of the ICNG has been undertaken.

Construction works are proposed to be undertaken both in standard hours (7am to 6pm Mondays to Fridays and 7am to 1pm Saturdays) and outside of standard hours between 8pm and 5am Sunday to Friday. ICNG states that justification should be provided for works that are proposed to take place outside of standard working hours. The proposed works would be undertaken within normal standard hours where barriers can be set up in adequate buffering from traffic, the remaining proposed works are required to be undertaken outside of standard hours for safety reasons (to minimise working alongside or near heavy traffic flows) and to reduce disruption of traffic on Parramatta Road and Great North Road.

The NMLs at the identified representative receiver locations have been determined on the basis of unattended background noise monitoring supported by attended measurements undertaken for the Proposal and in accordance with the ICNG. NMLs for identified residential and non-residential receivers are presented in Table 6-4 and Table 6-5 respectively.

Table 6-4: Residential receiver noise management levels

Time of day	Noise Management Level $L_{Aeq(15min)}$ (dB(A))	
During recommended standard hours (day)*	RBL + 10dB(A)	55 + 10 = 65
Outside recommended standard hours (evening)	RBL + 5dB(A)	52 + 5 = 57
Outside recommended standard hours (night)		46 + 5 = 51

* During standard construction hours a highly affected noise objective of $L_{Aeq(15min)}$ 75 dB(A) applies at all receivers

Table 6-5: Non-residential receiver noise management levels

Land use and receiver location		Noise Management Level $L_{Aeq(15min)}$ (dB(A))*	
Classrooms at schools and other educational institution	R11#	Internal noise level	45
Commercial premises	R10, R12, R14, R16, R17, R18, R19 and R20	External noise level	70
Industrial premises	R13, R15 and R21	External noise level	75

* NML only applies when premises is in use.# A conservative 10dB(A) reduction from external to internal noise levels has been adopted to allow an external assessment. Therefore, for the internal areas of the childcare centre the equivalent external noise management level would be 55dB(A).

Given that works during the night-time period (ie. 10pm to 7am) are proposed, criteria for sleep disturbance were developed. The ICNG recommends that where construction works are planned to extend over two or more consecutive nights, the assessment should consider maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL. The ICNG refers to the discussion on sleep disturbance provided in the NSW Environmental Criteria for Road Traffic Noise (ECRTN). The ECRTN presents a summary of finding from research conducted on sleep disturbance and concludes the following:

- Maximum internal noise levels below 50 – 55dB(A) are unlikely to cause awakening reactions
- One or two events per night with maximum internal noise levels of 65 – 70dB(A) are not likely to affect health and wellbeing.

As a general rule, building structures of dwellings would typically provide a minimum of 10dB(A) reduction from external noise levels to internal noise levels with windows sufficiently open for fresh air ventilation. Therefore, based on the above internal limits the equivalent external NML for sleep disturbance for the purposes of this construction noise assessment is set as L_{Amax} 65 dB(A).

Construction vibration

The DECC guideline for assessing vibration provides criteria for vibration sources that are:

- Continuous – Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time). Examples include machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).
- Impulsive – Rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). Includes infrequent activities that create up to three distinct vibration events in an assessment period. For example, occasional dropping of heavy equipment, occasional loading and unloading.
- Intermittent – Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude. Examples include trains, nearby

intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers.

Assessment of potential disturbance from vibration on human occupants of building is made in accordance with the DECC '*Assessing Vibration; a technical guideline'* (DECC, 2006). The vibration limits for the preferred and maximum values for human comfort and building damage are summarised below. When applying the human comfort criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest; upright position), y-axis (right side to left side; upright position) or z-axis (foot to head, lateral position). Vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Criteria for different sources of vibration are presented in Table 6-6.

Table 6-6: Preferred and Maximum Levels for Human Comfort

Vibration source & receiver location	**Assessment period***	**Preferred values**		**Maximum values**	
		z-axis	**x & y axis**	**z-axis**	**x & y axis**
Continuous vibration (weighted rms acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
Workshops	Day or night-time	0.04	0.029	0.080	0.058
Impulsive vibration (weighted rms acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-time	0.64	0.46	1.28	0.92
Intermittent Vibration (acceptable vibration dose values, $m/s^{1.75}$, 1-80Hz)				**Preferred value**	**Maximum value**
Residences	Daytime			0.20	0.13
	Night-time			0.40	0.26
Offices, schools, educational institutions and places of worship	Daytime			0.40	0.40
	Night-time			0.80	0.80

Vibration source & receiver location	Assessment period*	Preferred values		Maximum values	
		z-axis	x & y axis	z-axis	x & y axis
Workshops	Daytime			0.80	0.80
	Night-time			1.60	0.80

*Daytime is 7am to 10 and night-time is 10pm to 7am

For structure damage to buildings, different levels are defined in British Standard 7385 Part 2 as:

- Cosmetic – Formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick / concrete block construction.
- Minor – Formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.
- Major – Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.

In German Standard DIN4150-3 damage is defined as “any permanent effect of vibration that reduces the serviceability of a structure or one of its components”. Based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

Table 6-7: Structure damage criteria

Type of structure	Damage level	Velocity* (mm/s)		
BS 7385 Structural Damage Criteria		**4 to 15Hz**	**15 to 40Hz**	**40Hz & above**
Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic	-	50	-
	Minor	-	100	-
	Major	-	200	-
Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
	Minor	30 to 40	40 to 100	100
	Major	60 to 80	80 to 200	200
DIN 4150 Structural Damage Criteria	**At foundation at frequency of***			**Plane of floor uppermost storey**
	1 to 10Hz	**10 to 50Hz**	**50 to 100Hz**	**All frequencies**
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15

* BS 7385 maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer; DIN 4150 vibration velocity

Operational noise

The RNP has the following target noise abatement levels (applicable only to residential type receivers) for existing arterial roads not subject to redevelopment:

- Day-time (7am – 10pm) $L_{Aeq,15hr}$ 60dB(A)
- Night-time (10pm – 7am) $L_{Aeq,9hr}$ 55dB(A).

The results of the long term (unattended) noise survey to determine background noise levels has measured an $L_{Aeq(15hr)}$ of 70dB(A) and an $L_{Aeq(9hr)}$ of 67dB(A), both of which already exceed the above Day and Night target levels, respectively, within the RNP. This monitoring location was chosen as the worst affected receiver representative of the noise catchment area and does not exceed 2dB. The ENMM states that if the noise level during the day or night is predicted to increase by more than 2dB(A) Leq as a result of the upgrade works (road operational noise), noise treatments should be provided where feasible and reasonable.

6.2.4 Potential impacts

Construction

Construction noise

Existing traffic along Parramatta Road are already high and identified receiver locations are currently exposed to high traffic noise levels. Construction traffic from the project is expected to be less than 100 trucks daily, which is insignificant compared to the AADT and traffic noise increase due to construction traffic would be negligible. Construction traffic noise is not considered further from herein.

A list of plant and equipment typical of this type of intersection upgrade and associated sound power levels are presented in the Construction and Operational Noise and Vibration Assessment provided in Appendix D.

Noise levels at any receiver locations resulting from construction works would depend on the location of the receiver with respect to the area of construction, shielding from intervening topography and structures, and the type and duration of construction being undertaken (including combination of plant and equipment). Furthermore, noise levels at receivers would vary significantly over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Noise levels likely to be experienced at the nearby affected residential receivers were calculated based on construction activities and plant and equipment associated with the proposed intersection upgrade. Noise levels were calculated taking into consideration attenuation due to distance between the construction works and the receiver locations and any intervening structures.

Exceedances are predicted at residential receivers for all construction stages. The child care centre is also predicted to experience high levels of construction noise levels when in use. Noise impact areas surrounding the construction works are illustrated in Figure 6-2.

Table 6-8 presents the number of exceedances of the daytime NML at residential receivers for construction stages within exceedances ranges and Table 6-9 presents the same information for evening and night-time periods. The exceedances ranges correspond to mitigation categories outlined in the CNVG.

In light of the predicted noise levels, it is recommended that a feasible and reasonable approach towards noise management measure be applied to reduce noise levels as much as possible to manage impacts from construction noise.

Notes:
1. Predicted level exceeding the highly affected noise objective of 75dB(A) are highlighted in red
2. Predicted level exceeding the Day, Evening and Night Noise Management Levels are highlighted in blue
3. Predicted level exceeding the Evening and Night Noise Management Levels are highlighted in green
4. Predicted level exceeding only the Night Noise Management Level are highlighted in pink

Figure 6-2: Noise impact map (Renzo Tonin & Associates 2016)

Table 6-8: Number of residential receivers exceeding the NML for construction noise assessment scenarios during standard hours

Noise assessment construction stage	Exceedance level (dB(A))	Number of exceedances of NML[1]	Number highly noise affected[2]
1.1 Preliminary works	<5	0	5
	>5–15	6	
	>15–25	3	
	>25	0	
1.2 Utility relocation	<5	3	3
	>5–15	2	
	>15–25	1	
	>25	0	
1.3 Re-linemarking and barriers	<5	2	3
	>5–15	3	
	>15–25	0	
	>25	0	
2.1 Stormwater drainage	<5	4	3
	>5–15	1	
	>15–25	2	
	>25	0	
2.2 Road widening	<5	4	3
	>5–15	2	
	>15–25	3	
	>25	0	
2.3 Bridge widening	<5	2	0
	>5–15	0	
	>15–25	0	
	>25	0	
3.0 Paving / asphalting	<5	2	4
	>5–15	4	

Noise assessment construction stage	Exceedance level (dB(A))	Number of exceedances of NML[1]	Number highly noise affected[2]
	>15–25	3	
	>25	0	
4.0 Landscaping	<5	2	3
	>5–15	3	
	>15–25	0	
	>25	0	

1 – NLMs: Day -65 dB(A), Evening 57 dB(A), Night 51 dB(A)
2 – Highly noise affected: >75 dB(A)

Table 6-9: Number of residential receivers exceeding the NML for construction noise assessment scenarios during evening and night-time hours

Noise assessment construction stage	Exceedance level (dB(A))	Number of exceedances of NML[1]	
		Evening	Night
1.1 Preliminary works	<5	0	0
	>5–15	0	0
	>15–25	3	4
	>25	3	5
1.2 Utility relocation	<5	0	0
	>5–15	6	4
	>15–25	3	2
	>25	0	3
1.3 Re-linemarking and barriers	<5	1	0
	>5–15	5	4
	>15–25	3	2
	>25	0	3
2.1 Stormwater drainage	<5	0	0
	>5–15	6	3
	>15–25	3	3
	>25	0	3

Noise assessment construction stage	Exceedance level (dB(A))	Number of exceedances of NML[1]	
		Evening	Night
2.2 Road widening	<5	0	0
	>5–15	5	1
	>15–25	2	5
	>25	3	3
2.3 Bridge widening	<5	1	1
	>5–15	5	4
	>15–25	0	2
	>25	0	0
3.0 Paving / asphalting	<5	0	0
	>5–15	4	0
	>15–25	2	6
	>25	3	3
4.0 Landscaping	<5	1	0
	>5–15	5	4
	>15–25	3	2
	>25	0	3

1 – NLMs: Day -65 dB(A), Evening 57 dB(A), Night 51 dB(A)

Sleep disturbance

For the assessment of sleep disturbance, predicted external L_{Amax} noise levels from the majority of items of plant and equipment would exceed the upper limit of 65dB(A) at all residential receiver assessment locations (see Table 6-10). In accordance with the ICNG the sleep disturbance assessment is only applicable where construction works are planned to extend over more than two consecutive nights. Therefore, it is recommended that attended noise measurements be undertaken at the nearest affected receivers once equipment is introduced on site at the beginning of night works to establish and quantify actual L_{Amax} noise levels on site. Where L_{Amax} noise levels are measured to exceed the sleep disturbance limit, then a reasonable and feasible approach towards noise management measures should be considered to reduce noise levels as much as possible to manage the impact from construction noise during night-time periods.

Table 6-10: Number of residential receivers exceeding the sleep disturbance upper limit for construction noise assessment scenarios during night works

Noise assessment construction stage	Exceedance level (dB(A))	Number of exceedances of sleep disturbance upper limit[1]
1.1 Preliminary works	<5	0
	>5–15	4
	>15–25	2
	>25	3
1.2 Utility relocation	<5	4
	>5–15	2
	>15–25	3
	>25	0
1.3 Re-linemarking and barriers	<5	2
	>5–15	1
	>15–25	2
	>25	0
2.1 Stormwater drainage	<5	4
	>5–15	2
	>15–25	3
	>25	0
2.2 Road widening	<5	0
	>5–15	5
	>15–25	1
	>25	3
2.3 Bridge widening	<5	2
	>5–15	0
	>15–25	0
	>25	0
3.0 Paving / asphalting	<5	3
	>5–15	3
	>15–25	3

Noise assessment construction stage	Exceedance level (dB(A))	Number of exceedances of sleep disturbance upper limit[1]
	>25	0
4.0 Landscaping	<5	4
	>5–15	2
	>15–25	3
	>25	0

1 – Sleep disturbance upper limit: L_{Amax} 65 dB(A)

Construction vibration

Predicated potential vibration impacts to residential, commercial and industrial receivers are presented in Table 6-11, including whether or not vibration monitoring is considered warranted.

Table 6-11: Potential vibration impacts to sensitive receivers and buildings

Receiver & approx distance to works		Sensitive receiver & building type	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance*	Vibration monitoring#
R1	23m	Residential	Low	Low to medium	Would be considered
R2	11m	Residential	Medium	High	Should be conducted
R3	11m	Residential	Medium	High	Should be conducted
R4	11m	Residential	Medium	High	Should be conducted
R5	37m	Residential	Very low	Low	Not required
R6	43m	Residential	Very low	Low	Not required
R7	58m	Residential	Very low	Low	Not required
R8	51m	Residential	Very low	Low	Not required
R9	70m	Residential	Very low	Low	Not required
R10	3m	Commercial	Medium	High	Should be conducted
R11	4m	Commercial	Medium	High	Should be conducted
R12	4m	Commercial	Medium	High	Should be conducted
R13	10m	Commercial	Low	Low to medium	Would be considered
R14	3m	Industrial	Medium	High	Should be conducted
R15	24m	Commercial	Very low	Low	Not required
R16	19m	Industrial	Low	Low to medium	Would be considered
R17	26m	Commercial	Very low	Low	Not required
R18	33m	Commercial	Very low	Low	Not required
R19	14m	Commercial	Low	Low to medium	Would be considered
R20	38m	Commercial	Very low	Low	Not required

Receiver & approx distance to works		Sensitive receiver & building type	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance*	Vibration monitoring#
R21	35m	Commercial	Very low	Low	Not required
R22	6m	Industrial	Medium	Medium to high	Should be conducted

*risk of adverse comment as a result of construction works
#consideration when works in close proximity

The preferred bridge design option is to install piles in the breakwater and the north east abutment of the Iron Cove Creek Bridge. Tile size would be 750mm and the minimum clearance to the canal structure would be 320mm. The canal structure has been identified as a heritage item and the more stringent DIN 4150-3 Group 3 structural damage criteria is applicable, in the absence of a dilapidation study or structural report on the canal structure. Given the minimum clearance of piling works to the canal structure, there is a very high risk of structure damage from piling works and vibration monitoring must be conducted on site prior to the works to determine vibration through the local ground type and appropriate buffer distances.

Operation

Noise modelling was undertaken using the Road Traffic Noise Module in the CadnaA (version 4.5) noise modelling software. This method is recognised and accepted by both the RMS and the EPA. The model predicts noise levels for free flowing traffic and a modified method has been developed which enables an accurate prediction of noise from high truck exhausts to be taken into account. Inputs and assumptions used in the traffic noise prediction model are detailed in Appendix D. The model was validated and calibrated using the short-term noise monitoring results at Location S1 and concurrent traffic classification counts.

Noise modelling was completed at the residential assessment locations potentially worst affected (R4, R5 and R6) by the proposed upgrade. These locations typically represent residences within the first row of properties where Parramatta Road has moved closer; that is, residences north of Parramatta Road. The predicted traffic noise levels for the 2018 “build” and “no build” scenarios are presented in Table 6-12.

Table 6-12: Predicted operational traffic noise levels at residential receivers

Receiver	$L_{Aeq(15\ hour)}$ day-time noise level			$L_{Aeq(9\ hour)}$ night-time noise level		
	Build	No build	Difference	Build	No build	Difference
R4	70.2	69.8	0.4	65.9	65.4	0.5
R5	62.5	62.2	0.3	59.0	58.7	0.3
R6	60.1	59.9	0.2	56.5	56.3	0.2

The predicted noise levels show a minor increase of up to 0.5dB(A) for the worst affected residential receivers, which is well within the 2dB(A) increase allowance presented in the ENMM.

Therefore, no feasible and reasonable noise mitigation measures are required for any residential properties.

6.2.5 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the *Interim Construction Noise Guideline* (ICNG) and identify • All potential noise and vibration generating activities associated with the activity • A map indicating the locations of sensitive receivers including residential properties • Feasible and reasonable mitigation measures to be implemented • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures. • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.6 of *QA G36 Environment Protection*
Noise and vibration	All personnel working on site are to receive a Project induction which will include requirements of the NVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction / construction	Additional standard safeguard
Noise and vibration	Considerations in equipment selection will include: • Quieter and less noise emitting construction methods where feasible and reasonable • All plant and equipment to be appropriately maintained to ensure optimum running conditions.	Contractor	Pre-construction and Construction	Additional safeguard
Noise and	Considerations in the use and	Contractor	Pre-	Additional

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
vibration	siting of plant will include: • Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be limited/ avoided where possible • The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable • Plant used intermittently to be throttled down or shut down when not in use where practicable. Noise-emitting plant to be directed away from sensitive receivers where possible.		construction and Construction	safeguard
Noise and vibration	Worksites and activities will be planned to minimise noise, such as: • All reasonable and feasible noise control measures should be implemented prior to the commencement of construction works • Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site • Deliveries to occur during standard construction hours where reasonable & feasible	Contractor	Pre-construction and Construction	Additional safeguard
Noise and vibration	Where reasonable and feasible, structures will be used to shield residential receivers from noise such as: • Site shed placement • Temporary or mobile noise screens (where practicable) • Enclosures to shield fixed noise sources such as pumps, compressors, fans etc (where practicable).	Contractor	Pre-construction and Construction	Additional safeguard
Noise and vibration	Dilapidation surveys may be conducted where required prior to construction commencing. Survey requirements would be determined in the Noise and	Contractor	Pre-construction and Construction	Additional standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	Vibration Management Plan.			
Noise and vibration	Site specific buffer distances shall be determined on site prior to the commencement of bored piling adjacent to the Dobroyd Canal. After site specific buffer distances are determined, continuous vibration monitoring of the canal structure would be conducted for the duration of the piling works.	Contractor	Pre-construction and Construction	Additional safeguard
Construction Noise	Non-tonal reversing beepers (or an equivalent mechanism) should be fitted and used on all construction vehicles and mobile plant regularly used on site for periods of over two months.	Contractor	Construction	Additional Safeguard

6.3 Non-Aboriginal heritage

6.3.1 Methodology

The area surrounding the Parramatta Road and Great North Road at Five Dock was assessed for the presence of non-Aboriginal heritage in a Statement of Heritage Impact (SoHI) (Artefact Heritage 2016). An addendum SoHI was prepared by Artefact Heritage (2016a) to assess design amendments to the proposed extension of the Parramatta Road overbridge. This section presents a summary of these assessments, which are provided in full in Appendix E.

6.3.2 Existing environment

Historical context

Following the settlement of Rosehill (renamed Parramatta) the original track from Sydney was well established by 1794 and became a major thoroughfare by the early 19th century. The Great North Road was built by convict labour between 1826 and 1836.

Land grants and subdivision of the areas now known as Ashfield and Haberfield occurred in the early 19th century, and the opening of the railway gave the impetus for the development of Ashfield in 1855. By 1866 industries had started to establish in Ashfield.

The establishment of suburbs such as Haberfield and Ashfield put greater pressure on roads such as Parramatta Road as more people wanted to travel into and out of these areas. The increased traffic on roads necessitated new measures from the Main Roads Board to maintain their condition. Parramatta Road was first tar-paved in 1910 from Taverners Hill to Parramatta and was repaved with a Telford base between Ashfield and Parramatta in 1920. Line-marking was first used along Parramatta Road in the late 1930's and greatly reduced traffic incidents.

Database searches

Searches for non-Aboriginal heritage items listed on the following databases were completed: City of Canada Bay LEP, Ashfield LEP, State Heritage Register and Inventory, Australian Heritage

Places Database, RMS Heritage List and Commonwealth Heritage Database. Refer to Appendix E for full search results and the Heritage Assessment Report.

There is one listed item located within the study area:

- Dobroyd Stormwater Channel No 53 (Item 45710546; Sydney Water Section 170 register). The listing includes the channel beds, walls and coping. The open channel sections extend approximately 3.4 km upstream of the discharge point at Iron Cove to the intersection of Carshalton and Norton Street.

Other items listed in proximity to, but not within the study area are:

- Wadim (Bill) Jegorow Reserve at Cove Street, Haberfield (Australian Heritage Place).
- Haberfield Conservation Area, Haberfield (Australian Heritage Place and Ashfield LEP #C42).
- The Ranch Conservation Area (Ashfield LEP #C37).
- House at 30 Page Avenue, Croydon (Ashfield LEP #427).
- House at 9 Wattle Street, Haberfield (Ashfield LEP #462).

The site inspection identified the bridge spanning the Dobroyd Canal Stormwater Channel as partially intact and containing some of the original 1930s fabric. This unlisted item is related to the program of works undertaken by the Main Roads Board in the first half of the 20th century to improve and modernise Sydney roads. The bridge over the Dobroyd Canal Stormwater Channel meets the local significance threshold for its historical significance only, however is not a listed heritage item.

Site inspection

A site inspection was conducted by Josh Symons (Senior Archaeologist) with representatives of VBA on 12 October 2015. The study area includes Parramatta Road, footpaths bordering the northern and southern margins of the road, and portions of Dobroyd Parade, Henley Marine Drive and Great North Road.

The structures and businesses bordering both the sides of Parramatta Road consist largely of contemporary petrol stations, vehicle sales dealerships and vehicle wash and repair centres. A low lying sandstone wall was identified within the Inner West Council stockpile property, but access to this property was not available at the time of survey (see Plate 6-1 and Plate 6-2). The original 1930s' parapet is still in place on the northern side of the bridge over Iron Cove Creek (see Plate 6-3 and Plate 6-4). However, the southern side was modified in the 1980s and consists of modern materials.

Plate 6-1 Low sandstone wall, view east from Henley Marine Drive

Plate 6-2 Low-lying sandstone wall, view west from Dobroyd Parade

Plate 6-3 View east across extant 1930 concrete railing on northern margin of Iron Cove Creek bridge

Plate 6-4 Plaque on eastern end of parapet facing Parramatta Road with the inscription “MRB 1930”

Archaeological potential

Parramatta Road has been substantially widened and re-surfaced since the early 19th century. Iron Cove Creek bridge has been widened on at least two occasions – the first in 1930 and the second in 1981. The process of widening and resurfacing is likely to have had a high impact on the road and bridge, and the level of impact to the former road surface would depend on the depth of previous resurfacing.

The large majority of extant structures bordering the northern and southern margins of Parramatta Road are relatively recent constructions. This has had a high level of impact on built heritage bordering Parramatta Road.

Iron Cove Creek has been subject to a high level of impact. The original watercourse has been extensively modified and straightened when it was canalised. The canal fabric has been subject to a low level of impact from construction of the Iron Cove Creek Bridge. Immediately to the north and south of the study area the western portion of the canal has been subject to a high level of impact from construction of a box drain beneath Parramatta Road. Due to the level of impact there is low potential for significant archaeological remains within the study area

The assessment considered there to be nil to low potential for archaeological remains associated with early agricultural uses such as postholes, removal of vegetation and early road surfaces and bases and low potential for archaeological remains associated with early subdivisions, industry and road surfaces and bases.

Dependent on the level of impact from road widening and resurfacing, there is low potential for previous telford and macadam road surface to be present. Though archaeological in nature, the buried remains of former telford and macadam road surfaces are a ‘work’ rather than a ‘relic’ under the Heritage Act.

Due to the high level of impact along the Parramatta Road corridor the potential archaeological resources does not meet the local significance threshold.

6.3.3 Potential impacts

Construction

Built heritage

The proposed works would not directly impact the heritage items and conservation areas located outside of the study area.

The proposed works involve the widening of the bridge over the Dobroyd Canal Stormwater Channel would remove the northern portion of the bridge and some of the concrete footings. It is understood that the lower portion of the concrete footings, which affix to the top of the Dobroyd Canal Stormwater Channel, will remain intact.

The proposed works would maintain the visual setting of the canal and overbridge context. Only a small portion of the currently open canal would be covered by the bridge extension. The works would have a negligible increase in visual impact on the canal from the existing overbridge setting.

The proposed works including amended design (piling, construction of new wing walls and extension of the overbridge) would not directly impact the fabric of the Dobroyd Canal Stormwater Channel. The proposed works have the potential for indirect impacts due to proximity to the canal and through vibrations

Archaeological resource

The proposed works include bulk earthworks to 850 millimetres below the road surface, with potential for deeper excavation for drainage works. This would remove any intact archaeological remains associated with early road surfaces and roadside structures that may be located within the study area. However, the archaeological potential of the study area has been assessed as low as previous widening and resurfacing works since the early 19th century are likely to have removed archaeological remains. The process of widening and resurfacing is likely to have had a high impact on the areas bordering Parramatta Road.

The proposed works would involve ground works to install piles for the new bridge extension, and the new retaining and wing walls. The SoHI found that the area next to the canal has been subject to a high level of impact and had low potential for former road surfaces such as Telford road base to remain beneath the current road surface. The 1930 plan of the current overbridge demonstrates that there is low potential for remnants of the original masonry bridge to remain, as the canal was widened and deepened at that time.

It is therefore unlikely that the development would impact on archaeological relics or works.
As 'works', impact to any former macadam or telford road surfaces that may be present beneath the current road surface would not require specific approval under the 'relics' provisions of the Heritage Act (Sections 139–146).

Operation

Once operational, the proposal would not impact non-Aboriginal heritage.

6.3.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage: • Identification of potential environmental risks/impacts due to the works/activities • Management measures to	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.10 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	minimise the potential risk • Mitigation measures to avoid risk of harm and the interface with work activities on site • Implementation of mitigation measures to protect identified heritage items or areas • Identify in toolbox talks where management of non-aboriginal heritage is required such as identification of no go zones and responsibilities under the Heritage Act 1977 and any obtained permits or exemptions • A stop works procedure in the event of actual or suspected potential harm to a heritage feature/place. • Vibration management procedures would be developed and implemented where works resulting in vibration are undertaken within the vicinity of identified heritage items.			
Non-Aboriginal heritage	The RMS *Standard Management Procedure - Unexpected Heritage Items* will be followed in the event that any unexpected heritage items, archaeological remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.10 of QA *G36 Environment Protection*
Non-Aboriginal heritage	Specific measures relating to the Dobroyd Canal Stormwater Channel will include: • Establish an exclusion zone to manage inadvertent impacts to this item during construction • Consultation with Sydney Water's Heritage Advisor regarding requirements in relation to the item prior to works commencing and liaison would continue through the construction period. • A vibration assessment for the canal would be conducted prior	Contractor	Pre-construction and Construction	Additional standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	to works commencing to ensure that there is no inadvertent impact to canal fabric.			
Non-Aboriginal heritage	Specific measures relating to the 1930 road bridge over Iron Cove Creek will include: • Archival recording of the portion of the bridge to be removed according to *NSW Heritage Division standards* (1998).	Project Manager and Contractor	Pre-construction	Additional standard safeguard

6.4 Property and land use

6.4.1 Existing environment

The northern portion of the Proposal (from Arlington Street to Henley Marine Drive) is located within the City of Canada Bay LGA and the suburb of Five Dock. The southern portion of the Proposal (from Dobroyd Parade to Wolseley Street) and the western side of Parramatta Road are located within the Inner West Council LGA and the suburbs of Haberfield, Croydon and Ashfield.

The area is highly urbanised, with a mix of residential and commercial premises occurs along the various sections of the Proposal.

Utilities and services in the vicinity of the proposed works include Roads and Maritime intelligent transport system (ITS) infrastructure, Telstra and Optus telecommunications, Ausgrid electricity and Jemena gas, Sydney Water's water mains and Council stormwater.

6.4.2 Potential impacts

Construction

The main construction impacts to land use would include the use of a property for the construction compound. This would be a temporary use and would be rehabilitated for re-use in accordance with local Council land use and development controls.

The Proposal is primarily located within the existing road reserve, but extends into privately owned land. Three properties, north of Parramatta Road between Henley Marine Drive and Wolseley Street would need to be fully or partially acquired.

Utility adjustments would be undertaken by asset owners including Roads and Maritime, Telstra, Sydney Water, Ausgrid, Optus, Council(s) and Jemena.

Operation

Once operational, the proposal would not impact property or land use.

6.4.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Socio-economic	All property acquisition will be carried out in accordance with the *Land Acquisition Information Guide* (Roads and Maritime, 2012) and the *Land Acquisition (Just Terms Compensation) Act 1991*.	Roads and Maritime project manager	Pre-construction and construction	Additional standard safeguard

6.5 Biodiversity

6.5.1 Methodology

An *Ecological Assessment* (Cumberland Ecology 2016) was prepared for the Proposal and is summarised in this section. The full report is included as Appendix F.

6.5.2 Existing environment

Vegetation communities and flora species

The subject site was surveyed by a botanist on 29 October 2015. The flora survey found no native vegetation communities within the subject site, confirming previous broad scale vegetation mapping. The only vegetation occurring within the subject site comprises urban native and exotic vegetation, which is predominately planted and occupies about 1200 m2 of the subject site. No threatened ecological communities (TEC) occur within the subject site. Vegetation mapping is shown in Figure 6-3.

A total of 49 plant species were recorded within the subject site. Of these, 39 are exotic species, six are native, either planted or common herbaceous species, three are non-endemic planted natives, and one is a native cultivar. A number of exotic weed species (trees, shrubs and grasses) occur within the vegetation (see Plate 6-5). Six of the weeds identified are declared noxious under the *Noxious Weeds Act 1993*. The full species list is included in the Ecological Assessment report in Appendix F.

Seven threatened flora species have been recorded previously within the locality. No threatened species were recorded during the site survey. An analysis of the likelihood of occurrence on the study area for each threatened flora species recorded within the locality concluded that none of threatened flora species known from the locality are likely to occur within the subject site due to the highly degraded and urban nature of the site. The site is highly modified, and no natural habitat for endemic flora is present.

Figure 6-3: Vegetation mapping and threatened species within the subject site (adapted from Cumberland Ecology 2016)

Fauna habitat and species

A fauna habitat assessment was undertaken by an ecologist on 29 October 2015 during the random meander flora survey.

Limited potential habitat for native fauna species, including arboreal mammals and birds, is present on the subject site. No hollow-bearing trees were recorded during the site survey. No large fallen trees, logs, or large branches were recorded within the subject site, and low concentrations of leaf litter are present. Some foraging habitat for non-threatened common bird species, such as the Noisy Miner (*Manorina melanocephala*) is present, in the form of native plantings along Dobroyd Parade. Nesting habitat is potentially present for the non-threatened Common Ringtail Possum (*Pseudocheirus peregrinus*) in the form of exotic shrubs within the area south of Iron Creek. Roosting habitat is potentially present for microbats, including threatened species, within sections of the bridge containing crevices and cracks.

One threatened fauna species, the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) was recorded within the subject site during targeted surveys via ultrasonic call detection (see Figure 6-3). This species is listed as Vulnerable under the TSC Act and likely utilises habitat within the bridge for roosting habitat and/or the fringing vegetation along Iron Cove Creek as a flyway for foraging purposes.

A number of threatened fauna species have been recorded from the locality and have the potential to occur within the subject site. The following threatened fauna species are considered as having a potential to occur within the subject site:

- Grey-headed Flying-fox (*Pteropus poliocephalus*)
- Little Bentwing-bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*).

Limited foraging habitat is present on the site for these species, and some roosting habitat is present underneath the bridge to be upgraded (Plate 6-6).

Plate 6-5 *Ficus microcarpa* var. *hillii* in the west of the subject site

Plate 6-6 Potential roosting habitat for threatened microbat species

No threatened fish species listed under the FM Act have been identified as occurring within the City of Canada Bay LGA and Inner West LGAs.

6.5.3 Potential impacts

Construction

Vegetation communities and flora species

The vegetation within the subject site does not conform to any TEC listed under the TSC Act or the EPBC Act, therefore no impact to TECs is expected to occur. No remnant, native ecological communities will be impacted as a result of the proposed road upgrade works, as none are present on the subject site. Approximately 1,100 m^2 of urban native and exotic vegetation would be removed on the eastern side of Parramatta Road (see Figure 6-4).

Vegetation to be removed on the eastern side of Parramatta Road consists of some planted, endemic, native species such as *Banksia integrifolia* (Coastal Banksia), *Casuarina glauca* (Swamp Oak) and *Acacia elata* (Mountain Cedar Wattle), along with some planted non-endemic native species such as *Grevillea robusta* (Silky Oak). Some scattered individuals of the common native herbs *Cotula australis* (Australian Waterbuttons) and *Commelina cyanea* (Native Wandering Jew) also occur in this area. The majority of the vegetation to be removed consists of planted exotic species, and exotic weed species.

Minor tree trimming of one tree on the western side of Parramatta Road would occur to allow visibility of a new traffic control lantern. This tree is planted and is not an endemic, native species.

The project has the potential to result in a number of minor impacts to flora species within the adjacent land. In addition to the direct removal and modification of vegetation within the subject site potential indirect impacts to flora species include:

- Weed invasion
- Runoff, erosion and sedimentation
- Modification of microhabitat features resulting from long and short-term edge effects (e.g. changes in light filtration).

No threatened flora species are to be impacted as a result of the proposed road upgrade works, as none were located during the site survey. Due to the small, highly degraded, urban nature of the site, it is not likely any individuals of threatened species were present and not detected during the survey.

The proposed works would not exacerbate these impacts further than current conditions, given the location of the subject site within a highly modified urban area. It is expected that the majority of fauna species occurring within the subject site would be hardy native species that would readily adapt to any such changes in habitat.

Figure 4.1. Impacts on the Subject Site

Figure 6-4: Location of potential impacts to flora and fauna (Source: Cumberland Ecology 2016) .

Fauna habitat and species

A small amount of habitat removal/modification could minimally impact threatened fauna species if present. One tree, a *Ficus microcarpa var. hillii* individual with potential to be utilised as foraging habitat by the Grey-headed Flying Fox will be trimmed. This tree is to remain on the subject site, and would only be utilised by the species as part of a much larger foraging range throughout the urban landscape. An assessment of significance under the TSC Act was undertaken for this species and it was determined that the proposed upgrade would not have a significant impact on the Grey-headed Flying-fox.

Two threatened microbat species, the Little Bentwing-bat and the Southern Myotis have potential to utilise the concrete areas under the bridge on the site for roosting, and the rest of the site for foraging. A third threatened microbat species, the Eastern Bentwing-bat, was recorded and likely utilises the site for roosting and/or foraging. An assessment of significance under the TSC Act was undertaken for all three species collectively and it was determined that the proposed upgrade is unlikely to have a significant impact on any of them.

The upgrade works to the eastern side of the bridge may cause a temporary disturbance to microbat species individuals that may be present. Some foraging habitat for the Eastern Bentwing-bat and Little Bentwing-bat would be lost through vegetation removal; however, both of these species would only utilise vegetation on the site as part of a larger foraging range. Additionally, all foraging habitat for the Southern Myotis would be retained as Iron Cove Creek would be retained.

There is potential for direct impacts to fauna species through loss of blossom and fruit producing trees and shrubs. Potential indirect impacts to fauna species include:

- Runoff, erosion and sedimentation
- Increased pollution
- Modification of microhabitat features resulting from long and short-term edge effects (e.g. changes in light filtration).

Operation

Once operational, the proposal would not impact on flora and fauna compared with the existing situation.

The areas under the bridge suitable for roosting habitat would be retained as they are located within the western half of the bridge and are outside of the proposed upgrade works. As this is a bridge on a main road, it is not anticipated that upgrade works would cause a significant increase in noise levels.

Conclusion on significance of impacts

The proposal is not likely to significantly impact threatened species, populations or ecological communities or their habitats, within the meaning of the *Threatened Species Conservation Act 1995* or *Fisheries Management Act 1994* and therefore a Species Impact Statement is not required.

The proposal is not likely to significantly impact threatened species, populations, ecological communities or migratory species, within the meaning of the *Environment Protection and Biodiversity Conservation Act 1999*.

6.5.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design.	Contactor	Detailed design / pre-construction	Core standard safeguard
Vegetation impacts	No stockpiling materials and equipment and parking vehicles and machinery within the dripline of any tree.	Contractor	Construction	Standard safeguard
Vegetation removal	Prior to the start of any clearing a physical clearing boundary is to be demarcated and implemented: • Identification (marking) of the clearing boundary and trees that needs to be removed eg. – use of flagging tape. • Where trees are to be retained, place an exclusion zone fencing outside the tree protection zone • Erect signs to inform personnel of the purpose of the fencing. Signs should be clearly visible and be general in nature, such as 'Exclusion zone' or 'Environmental Protection zone'.	Contractor	Construction	Standard safeguard
Noxious weeds	Declared noxious weeds (ie. *Asparagus aethiopicus*) will be managed according to the requirements stipulated by the Noxious Weeds Act 1993, and any weed removal activities will follow Guide 6 (Weed Management) in the Biodiversity Guidelines (RTA 2011).	Contractor	Pre-construction	Standard safeguard
Revegetation	A landscape plan must be prepared, approved by council and implemented.	Contractor	Construction	Additional safeguard

Other safeguards and management measures that would address biodiversity impacts are identified in section 6.8.3.

6.6 Soils, contamination and hazardous materials

6.6.1 Existing environment

Site history

Information about the site land use history presented in Table 6-13 was obtained from the *WestConnex M4 East environmental impact assessment* (GHD 2015a) and the *Parramatta Road Great North Road Intersection Upgrade Statement of Heritage Impact* (Artefact 2016). A selection of aerial photographs was examined for the WestConnex M4 East project with the area of interest extending to the proposed works. Past activities and land uses along part of the Proposal length have been identified from summary observations and actual aerial photographs included in that report.

Table 6-13: Summary of site history

Date	Summary observations
1797	The route between Sydney and Parramatta was formally laid out under the direction of the Surveyor-General and had become a major thoroughfare for the colony by the early 19th century.
1826	The Great North Road was built by convict labour between 1826 and 1836 and was intended to form part of a network of 'Great Roads' which would radiate to the north, west and south of Sydney
1910	Parramatta Road was first tar-paved from Taverners Hill to Parramatta
1930	The area surrounding Iron Cove Creek is mostly developed. Riparian vegetation was scarce in the lower reaches of Iron Cove Creek. The area east and west of Parramatta Road is predominantly low density residential development.
1951	Commercial/industrial development along Parramatta Road has increased. Riparian vegetation along Iron Cove Creek was now absent.
1961	In general, the area has not changed significantly since 1951. Small commercial/industrial buildings have been modified or re-constructed along Parramatta Road.
1970	Overall there has been little change from 1961. Some residential and commercial/industrial buildings have been modified or reconstructed.
1982	Overall there has been little change from 1970. Some residential and commercial/industrial buildings have been modified or reconstructed.
1991	Urban development has become more intensified in many areas of the map. Land has been subdivided in sections to allow for the construction of more residential buildings. Commercial development has increased, particularly along Parramatta Road.
2002	The area was generally similar to the 1991 aerial photograph. Commercial development has increased along Parramatta Road, and the CBD of Five Dock.
2005	Overall there has been little significant change from 2002.

Geology

Superficial quaternary alluvium is present at the intersection of Great North Road and Parramatta Road and is associated with Iron Cove Creek (GHD, 2015a). Hawkesbury sandstone is present close to Iron Cove Creek.

Soil landscapes

Two main soil landscapes identified in the Proposal area as follows (GHD, 2015a) these are Gymea and disturbed terrain. They are characterised by:

- Gymea erosional soil landscape—present along Iron Cove Creek, bounding Iron Cove Creek (and disturbed terrain). Gymea soils are typically undulating to rolling rises and low hills on Hawkesbury Sandstone. The soil is usually shallow to moderately deep (30-100cm) and is generally yellow and earthy sands. This soil is known for having a high risk for erosion and very low soil fertility
- Disturbed terrain—within the vicinity of Iron Cove Creek. Disturbed terrain is soils known for being disturbed by human activity, including infill with soil, rock, building and waste materials. Turfed fill areas are commonly capped with up to 40 centimetres of sandy loam or up to 60 centimetres of compacted clay over fill or waste materials. These areas are typical of having low localised fertility and potential for toxic materials depending on fill material.

Acid sulfate soils

Acid Sulfate Soils (ASS) mapped in the City of Canada Bay LEP indicates that the Great North Road intersection is Class 5 ASS and Class 2 ASS further along Henley Marine Drive. The Ashfield LEP does not have any ASS mapped.

The site is adjacent to Dobroyd Canal, a concrete lined open channel subject to tidal flows and thus soils in the immediate vicinity of the channel may contain actual/potential ASS. A search of the Australian Soil Resource Information System database on 15 October 2015 found a low probability of ASS at the proposal site with the exception of the north side near Dobroyd Canal (Iron Cove Creek), which is identified as disturbed terrain (elevation between two and four metres AHD). Disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development.

The waste material stockpile discussed below was confirmed to contain acidic soils.

Contaminated land

The area is highly urbanised, with a mix of residential and commercial premises occurring along the various sections of the Proposal. Potentially contaminating land uses along the length of the proposed works include:

- Two service stations
- Two mechanical and panel beating workshops
- A carwash
- An electrical substation
- A Council materials stockpile.

Searches of the EPA Contaminated Sites register in October 2015 did not identify any registered sites within or adjacent to the Proposal area.

Waste materials stockpile

Approximately 1200 cubic metres of construction and demolition waste is located at the southern end of Dobroyd Parade, Five Dock.. The stockpiled waste comprises a main stockpile containing a mixture of soils (gravelly silts) asphalt, concrete, bricks and broken tile fragments that is covered in grass and weeds and a series of smaller discrete stockpiles of asphalt and concrete on the northern flank of the main stockpile (see Plate 6-7 – Plate 6-9).

Plate 6-7 Main stockpile and asphalt and concrete (looking south)

Plate 6-8 Small asphalt stockpile on northern flank of main stockpile

Plate 6-9 Soils (gravelly silts), bricks and broken tile fragments

The stockpiled materials were not surveyed. From visual inspection it appears that soil comprises the greatest volume of stockpiled material, followed by asphalt, concrete, bricks and broken tiles. No asbestos containing materials were observed either within or in the vicinity of the stockpile.

SNC-Lavalin has analysed samples of the stockpiled materials for the purposes of classifying the wastes (refer to Appendix G). The construction and demolition waste has been classified as General Solid Waste based upon comparison against relevant waste classification guidelines (EPA 2014). Further, the material is not asbestos waste based upon an absence of asbestos.

Hazardous materials

A hazardous materials survey of the Proposal has not been undertaken. However hazardous materials may be present within the proposal site, for example:

- Asbestos containing material may exist within the bridge over Iron Cove Creek
- Hazardous building materials such as asbestos containing material, synthetic mineral fibre and lead paint may be present in buildings on properties that are to be acquired
- Roadside utilities may include asbestos cement piping for stormwater or sewer pipes.

6.6.2 Potential impacts

Construction

Impacts to soils within the proposal footprint would primarily result from earthworks during the construction phase. This includes milling and resheeting concrete, removing existing median and footpath, excavation to floor of cut/disposal of material, boring for bridge piles, relocation of utilities and TCS infrastructure and the removal of vegetation. There would be little disturbance to natural soil material on site from these actions. Furthermore, it is unlikely that potential or actual ASS would be disturbed as a result of the proposed excavations

Other potential risks associated with works include:

- Fuel or oil spills or leaks from plant, equipment or vehicles

- Disturbance of actual or potential ASS
- Disturbance of contaminated soils
- Erosion of disturbed soils.
- Dust generation whilst undertaking demolition works

Although no registered contaminated sites exist within the study area, construction activities have the potential to expose and liberate unidentified contaminants contained within soil or fill material (eg. under road pavement). If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.
Exposure to contaminated media or hazardous materials (if any) could pose a risk to workers during construction works or a risk to the surrounding environment through off-site migration via surface water.

In the absence of appropriate management measures, there is a risk that new contaminants may be introduced to the local environment during construction works, for example through fuels and oils used in construction equipment and plant.

Stockpiled wastes would be disposed of at appropriately licensed facilities, as outlined in Section 6.12.3.

Operation

The operation of the proposal would have no material change to soils, to hazardous materials and contamination compared with the existing situation.

6.6.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Contaminated land	A Contaminated Land Management Plan (CLMP) will be prepared and implemented as part of the CEMP for any areas of existing contaminated land or to address land contamination likely to be caused by the activity. The CLMP will be in accordance with the *Guideline for the Management of Contamination* and, as a minimum address the following matters: • control measures to divert surface runoff away from the contaminated land • capture and management of any surface runoff contaminated by exposure to the contaminated land • further investigations required to determine the extent, concentration and type of	Contractor	Detailed design / Pre-construction	Core standard safeguard Section 4.2 of QA *G36 Environment Protection*

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	contamination, as identified in the detailed site investigation (Phase 2) • management of the remediation and subsequent validation of the contaminated land, including any certification required • measures to ensure the safety of site personnel and local communities during construction. • measures if ASS is discovered on site			
Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.	Contractor	Detailed design / Pre-construction / construction	Core standard safeguard Section 4.2 of QA *G36 Environment Protection*
Contaminated land	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services and relevant authorities (including Roads and Maritime and EPA officers).	Contractor	Detailed design / Pre-construction	Core standard safeguard Section 4.3 of QA *G36 Environment Protection*
Contaminated land	Hazardous material inspection including a Part 6 Report to include asbestos is to be undertaken prior to demolition works commencing. Management measures would be developed, if necessary, commensurate to potential risk.	Contractor	Detailed design / Pre-construction	Additional standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	Should any potentially hazardous materials or similar be encountered during demolition then works should stop and the material in question be examined by an appropriate specialist who would identify the material and provide management measures if required.			
Hazards	Appropriate storage (eg. bunds, spill pallets, as appropriate) of fuels, oils, greases and any other hazardous materials associated with construction activities, including maintaining a spill kit within the construction compound to allow site personnel to respond to spills events.	Contractor	Construction	Core standard safeguard

Other safeguards and management measures that would address soil impacts are identified in section 6.8.3.

6.7 Hydrology and flooding

6.7.1 Methodology

No hydrological or flood modelling was undertaken as part of this assessment. The *Parramatta River Estuary Processes Study* (AECOM 2010), *Dobroyd Canal Flood Study* (WMA Water 2013) and *Ashfield Council Interim Flood Development Control Policy, Part E8, Draft Policy March 2014* (Ashfield Council 2014) have informed the assessment of potential impacts to hydrology and flooding.

6.7.2 Existing environment

Hydrology

The Proposal is located within the Dobroyd Canal catchment (also known as Iron Cove Creek), which drains to Iron Cove on the Parramatta River via an open channel and a series of inlet pits and pipes. The catchment includes the suburbs of Ashbury, Ashfield, Burwood, Burwood Heights, Croydon, Croydon Park, Haberfield and Summer Hill and is fully urbanised (AECOM 2010).

Sydney Water Corporation (SWC) owns the larger “trunk” drainage assets including the open channel and the smaller pit and pipe networks are owned by the councils within the catchment (Ashfield, Burwood, City of Canterbury, and City of Canada Bay). Drainage elements in the catchment include kerbs and gutters, pits and pipes, and a network of trunk drainage elements including culverts and open channels (AECOM 2010).

Parramatta Road crosses the Dobroyd Canal approximately 1.4 km upstream of the Iron Cove outlet and the open channel sections extend approximately 2 km further upstream to the intersection of Carshalton and Norton Street. Parramatta Road crosses the Canal via a bridge and a small box culvert with a combined length of approximately 17 metres.

The main channel is tidal to upstream of Parramatta Road.

Flooding

Flooding history of the Dobroyd Canal catchment have been significantly altered as a result of urbanisation in the area and it is therefore unlikely that older flood extents and depths for a given storm would apply to present day conditions. There have been many instances of flooding in the past with November 1961, March 1975 and March 1983 having the greatest number of records (WMA Water 2013).

Major road routes within the Dobroyd Canal catchment have been shown to experience significant flooding during many Annual Exceedance Probability (AEP) design events, which would most likely result in severe traffic disruption extending outside the Dobroyd Canal catchment. The Proposal area would be impacted to varying degrees by flooding, with peak flood depths for a 10% AEP event (that is a one-in-10 chance of the event occurring in any one year) along Parramatta Road near Dobroyd Street and Wolseley Street of up to 0.3 m. Most of the Proposal area would be inundated by up to 0.3–0.5 m of water in a 1% AEP event (that is a one-in-100 chance of the event occurring in any one year).

The Proposal falls within the 1% AEP flood planning area of Ashfield Council (Ashfield Council 2014). No flood mapping was available from the City of Canada Bay Council.

6.7.3 Potential impacts

Construction

Parts of the proposed works and the compound site would be located in areas that could be flooded during major flood events (i.e. 1% AEP). Construction may require temporary works for bridge widening works. These have the potential to temporarily impede flow with the Dobroyd Canal should a high rainfall event occur.

The nature and duration of the proposed works and size of the proposed compound site are considered unlikely to result increased flood risks to the locality. A site specific flood evacuation plan would be prepared prior to construction and implemented as required.

Operation

The Proposal would not alter the topography of the locality or result in any changes to surface drainage pathways. Appropriate road drainage mechanisms have been incorporated into the design of the Proposal. Drainage is designed to accommodate stormwater flows generated from the upgraded intersection, as well as the existing roads and landscape features that contribute to local flows.

6.7.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Flooding	A site specific Flood Evacuation Plan would be prepared and implemented as required as part of the CEMP. It would include the following measures: • Weather and flood monitoring • List equipment to be removed from the site • Responsibility and method for monitoring flood threat (e.g. flood warning information sourced from the BoM website) • Detail staff training requirements and roles and responsibilities for the implementation of the Plan.	Contractor	Construction	Additional safeguard

6.8 Surface water

6.8.1 Existing environment

Dobroyd Canal is a tidally influenced open concrete channel designed to rapidly deliver high volumes of runoff to the Parramatta River estuary. The water quality of Dobroyd Canal is heavily influenced by urban runoff and associated pollutant inflows. The Canal is historically known to carry heavy loads of gross pollutants and oils as well as dissolved and suspended contaminants (Woodlots and Wetlands 1999; cited in AECOM 2010). Excessive sedimentation, organic matter, and litter were observed immediately downstream of the canal. Sydney Water maintains a litter boom to collect litter and other gross pollutants from Dobroyd Canal at the outlet of the canal to Iron Cove Bay (AECOM 2010).

6.8.2 Potential impacts

Construction

Construction of the Parramatta Road bridge extension over Dobroyd Canal would pose the greatest risk to water quality over the construction period. The main bridge construction activities are:

- Demolition of existing road furniture
- Boring for bridge piles – Iron Cove Creek
- Formwork and placing of reinforcement
- Placing of concrete
- Stripping of formwork.

Due to the nature of the proposed works there is potential to impact Iron Cove Creek through the release of sediments and concrete slurry (if not captured).

Prior to the proposed works commencing, controls would be installed within the stormwater channel to contain any potential escaped concrete slurry from the works. Sandbags or similar would be used to divert any water present within the channel around the work site. Controls would be monitored on a regular basis to ensure effectiveness and would not be removed until all works

have been completed at the end of the day. No controls would be left in the stormwater channel overnight, between shifts.

Earthworks required for construction of new road pavement, pedestrian paths and utility adjustments could potentially impact water quality.

Potential impacts may occur through:

- Erosion of soil and sedimentation through stormwater runoff and transport of eroded sediments to Dobroyd Canal
- Accidental spills of fuels, oils, wastewater, or other chemicals from construction vehicles or equipment resulting in contaminant entering the local stormwater system and Dobroyd Canal
- Gross pollutants, including construction materials and wastes falling or being washed into the Canal.

It is considered that the risks to water quality during construction 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.

Operation

The Proposal would not alter the topography of the locality or result in any changes to surface drainage pathways. Appropriate road drainage mechanisms have been incorporated into the design of the Proposal.

The operation of the proposal would have no substantial impacts on downstream water quality and the risks are considered similar those that currently exist along the Proposal length.

6.8.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP.	Contractor	Construction	Core standard safeguard Section 2.1 of *QA G38 Soil and Water Management*
Soil and water	A site specific Erosion and Sediment Control Plan(s) will be prepared and implemented and included in the SWMP. The Plan(s) will identify detailed measures and controls to be applied to appropriate to the level of risk of erosion and sedimentation and as a minimum address the following matters: • Direction of water flow,	Contractor	Construction	Core standard safeguard *QA G38 Soil and Water Management*

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	both off and on site • Diversion of off-site water around or through the site or details of separation of on-site and off-site water • Stabilising disturbed areas as soon as possible • The locations of other erosion and sediment control measures Staged implementation arrangements • Arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) • Specific controls and follow-up measures to be applied in the event of wet weather. • Scour protection and energy dissipaters at locations of high erosion risk • Installation of measures at work entry and exit points to minimise movement of material onto adjoining roads, such as rumble grids or wheel wash bays • Appropriate location and storage of construction materials, fuels and chemicals, including bunding where appropriate.			
Soil and water	A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas.	Contractor	Pre-Construction and Construction	Additional Standard safeguard
Soil and water	Should excavation of the	Contractor	Pre-	Additional

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	disturbed terrain area adjacent to Dobroyd Canal be required, soil testing would be completed to assess acid sulfate potential. If the presence of Acid Sulfate Materials is confirmed, an Acid Sulfate Materials Management Plan will be prepared in accordance with the RTA Guidelines for the Management of Acid Sulfate Materials and implemented as part of the CEMP. The plan will detail the management, handling, treatment and disposal of ASS and will be prepared in compliance with the relevant guidelines.		construction / Construction	Standard safeguard

Other safeguards and management measures that would address surface water impacts are identified in section 6.6.3.

6.9 Aboriginal heritage

6.9.1 Existing environment

A search of the AHIMS on 24 July 2015 did not identify any Aboriginal sites or places within a 1000 metre buffer around the Proposal area (see Appendix H). Given the Proposal is located on an existing built structure and highly impacted surfaces it is considered unlikely that there would be any impact on items of Aboriginal heritage. As such, no consultation has been undertaken with the Aboriginal community in regards to the Proposal.

6.9.2 Potential impacts

Construction

The PACHCI Stage 1 assessment concluded that the Proposal is unlikely to have any impact on Aboriginal cultural heritage because:

- The Aboriginal Heritage Information Management System (AHIMS) search did not identify any known Aboriginal objects or places in the study area
- The study area does not contain landscape features that indicate the presence of Aboriginal objects
- The Aboriginal cultural heritage potential of the study area appears to be severely reduced due to past disturbance.

Consultation with the Aboriginal community is not considered to be required in accordance with the PACHCI guidelines (see Appendix H).

Operation

Once operational, the proposal would not impact Aboriginal heritage.

6.9.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Aboriginal heritage	The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.9 of QA *G36 Environment Protection*

6.10 Landscape character and visual impacts

6.10.1 Methodology

The assessment was carried out in accordance with the *Guideline for Landscape Character and Visual Impact Assessment* (Roads and Maritime, 2013).

The method to measure landscape character and visual impact is based on the combination of the sensitivity of the existing area or view to change and the magnitude (scale, character, distance) of the proposal on that area or view.

Sensitivity refers to the qualities of an area, the number and type of receivers and how sensitive the existing character of the setting is to the proposed change. For example, a pristine natural environment will be more sensitive to change than a built up industrial area.

Magnitude refers to the nature of the project. For example, a large interchange would have a very different impact on landscape character than a localised road widening in the same area.

The combination of sensitivity and magnitude will provide the visual impact for viewpoints (refer to Table 6-14 for grading values).

Table 6-14 Impact grading matrix (Roads and Maritime 2013)

Sensitivity \ Magnitude	High	Moderate	Low	Negligible
High	High Impact	High-Moderate	Moderate	Negligible
Moderate	High-Moderate	Moderate	Moderate-Low	Negligible
Low	Moderate	Moderate-Low	Low	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

6.10.2 Existing environment

Landscape character

The Proposal is located within an urbanised landscape, with industrial, commercial and retail dominating along both sides of Parramatta Road. Businesses bordering Parramatta Road consist largely of fast food outlets; vehicle sales dealerships and vehicle wash and repair centres. There is a pocket of vegetation adjacent to Iron Cove Creek (Dobroyd Canal), but other vegetation is limited along the Proposal length. There are also residential units and houses within close proximity to the proposed works.

The visual curtilage of the heritage listed Dobroyd Canal Stormwater Channel varies along the length of the channel depending on the surrounding land uses, and has not been defined in the Statement of Significance for this item. However, the following points are noted:

- The upper catchment is presently surrounded by urban and industrial development south of Parramatta Road. In this area the channel can only be viewed from various road bridges that cross it
- North of Parramatta Road visual curtilage extends through the boundaries of surrounding parkland and roadways.

The original 1930s balustrade is still in place on the northern side of the bridge over Iron Cove Creek, however the southern side that was modified in the 1980s consists of modern materials. The southern section of the bridge consists of entirely modern materials as this section was modified in the 1980s. Only the northern side of the bridge consists of original materials. The bridge does not display any particularly noteworthy aesthetic qualities (Artefact 2016).

A number of government strategies apply to Parramatta Road. These include:

- *Draft Parramatta Road Urban Transformation Strategy* (UrbanGrowth 2015)
- *Parramatta Road Urban Amenity Improvement Plan* (UrbanGrowth 2015a)
- *Draft Parramatta Road Urban Renewal Strategy* (UrbanGrowth 2015)

The various documents describe the existing condition of the Parramatta Road corridor and actions to be implemented to improve these, including urban design. The various strategies describe Parramatta Road as unattractive in parts, derelict in others and not attracting investment.

Key features identified in the *Parramatta Road Urban Amenity Improvement Plan* (UrbanGrowth NSW 2015a) also apply to the proposed area of works. In general, Parramatta Road currently:

- Is lit by standard pole mounted street lights of a variety of pole and fitting types, with street lighting focused on the road and vehicles rather than pedestrians
- Lacks adequate street furniture and what is present is often in a poor state of repair
- Lacks mature trees and other planting, particularly within the road reserve itself
- Has footpath paving that lacks consistency and is in a poor state of repair.

Approximately 1,100 m^2 of urban native and exotic vegetation would be removed on the eastern side of Parramatta Road. The majority of the vegetation to be removed consists of planted exotic species, and exotic weed species. Figure 6-4 shows vegetation to be removed and trimmed.

An assessment of the Landscape Character Zones is provided in Table 6-15.

Table 6-15 Landscape character zones

Landscape character zone	Description
Great North Road residential zone	This zone includes freestanding homes with well-maintained front gardens and lawns.
Henley Marine Drive residential zone	This zone includes freestanding homes with well-maintained front gardens and lawns along a local road. It also includes a car collision repair business.
Parramatta Road commercial and residential zone	Parramatta Road is bordered by commercial business and is zoned as an enterprise corridor. Businesses include a car dealership, fast food outlets, a car wash and other small businesses. Several multistorey apartment buildings as well as free standing homes are also located within this zone.
Dobroyd Parade commercial and residential zone	This zone includes a childcare centre and includes freestanding homes with well-maintained front gardens and lawns. There is a pocket of vegetation adjacent to Iron Cove Creek (Dobroyd Canal), but other vegetation is limited along the Proposal length.
Parramatta Road corridor	Parramatta Road is a key transport corridor for motorists, freight and public transport and connects Sydney CBD with Parramatta. Parramatta Road includes a total of 6 lanes of generally congested traffic. Road side trees are generally absent except for those in the vicinity of Iron Cove Creek. Minor tree trimming of one tree on the western side of Parramatta Road would occur to allow visibility of a new traffic control lantern.

Visual sensitivity

The key existing viewpoints in the area would be from commercial businesses, residential properties and road users (pedestrian and vehicles). Views to the proposal area are generally confined to the immediate surrounding zones due to the built up nature of the environment.

Key viewpoints were used to assess the potential visual impact of the proposal and are shown in Figure 6-5 and described in Table 6-16. Photos of viewpoints shown in Figure 6-5 are seen in Plate 6-10 to Plate 6-12.

Table 6-16 Key view points of the proposal

Location	Viewpoint	Description
2 Great North Road (Viewpoint 1)	Residential receiver at 2, 4 & 6 Great North Road	These properties are single story residences constructed to face South West onto Great North Road with views onto Parramatta Road. No 2 also has views of the proposed compound site over the boundary fence.
319 Parramatta Road (Viewpoint 2)	Parramatta Road commercial receivers	Businesses along Parramatta Road have direct views of Parramatta Road. These businesses also have views of the bridge over Iron Creek Cove.
Parramatta Road (Viewpoint 3)	Parramatta Road, Road users (pedestrians and vehicles)	Road users have direct views of Parramatta Road, the Bridge over Iron Cove Creek and the trees adjacent to Iron Creek Cove Bridge and between Henley Marine Drive and Dobroyd Parade

Figure 6-5: Key viewpoint locations (VBA 2016)

Plate 6-10 Viewpoint 1 – looking across Parramatta Road at from intersection with Great North Road

Plate 6-11 Viewpoint 2 – looking southeast along Parramatta Road

Plate 6-12 Viewpoint 3 – looking north across Parramatta Road towards Dobroyd Canal

6.10.3 Potential impacts

Landscape Character

The potential impacts to the landscape character zones are presented in Table 6-17. The table includes an assessment of the proposed works on each landscape character zone. Due to the highly urbanised nature of the proposed works area, the character zones are highly disturbed. All landscape character zones have been assessed as low – moderate sensitivity.

During construction the visual environment would be temporarily altered through the presence of the plant and equipment, traffic management barriers, construction vehicles and the construction compound. As some of the works would be undertaken at night, there would be a visual impact resulting from the use of temporary lighting.

During construction, some vegetation would be removed for the Proposal. The removal of vegetation south of Dobroyd Canal would alter the view from Parramatta Road for both static and mobile receptors.

The visual curtilage of the Channel will remain visible through the vegetation and from roadways including Parramatta Road.

The Proposal would involve widening Parramatta Road along the existing alignment. The Proposal would introduce minor changes to the urban landscape due to upgraded pavements, removal of vegetation and removal of some buildings to accommodate the widened road. The works would be

similar to the previous extension of the bridge on the southern side. The overall visual impact would be low.

As part of the vegetation clearing process, weeds will be removed resulting in positive visual impacts.

Positive visual impacts will also occur as a result of upgrades to footpaths as well as replacing the aging 1980's balustrade of Iron Cove Creek Bridge.

Table 6-17 Impact to landscape character zone

Landscape character zone	Sensitivity	Magnitude	Impact
Great North Road residential zone	Low - Moderate	Low - Moderate	Low - Moderate
Henley Marine Drive residential zone	Low - Moderate	Low - Moderate	Low - Moderate
Parramatta Road commercial and residential zone	Low	Low	Low
Debroyd Parade commercial and residential zone	Low - Moderate	Low - Moderate	Low - Moderate
Parramatta Road corridor	Low	Low	Low

Visual sensitivity

The potential impact on sensitive receivers from the key viewpoints is assessed in Table 6-18. The table includes an assessment of the proposed works on each key viewpoint.

The impact of the proposal on the other key viewpoints would be low to moderate-low during construction and/or operation.

Table 6-18 Visual impact of key viewpoints

Viewpoint	Phase	Impact of the proposal	Sensitivity	Magnitude	Impact	Comment
Residential receiver at 2, 4 & 6 Great North Road	Construction	View of construction work along Parramatta Road, great North Road and the site compound. Potential light spill from lights for night work	Low - Moderate	Moderate	Moderate	The construction activities including the operation of the compound site would have a moderate impact on visual amenity due to short distance of receiver from the works.
	Operation	View of completed widening of Parramatta Road	Low - Moderate	Low - Moderate	Low - Moderate	These residential properties will not be visually impacted by tree removal. The properties have views of the intersection where the road widening is proposed. As they are located in a highly urbanised environment impacts from road widening are low – moderate.
Parramatta Road commercial receiver (near 319 Parramatta Road)	Construction	View of construction work along Parramatta Road and the Potential light spill from lights for night work	Low	Moderate	Low-Moderate	Night works would limit the impact on some businesses. These businesses have a view of the bridge over Iron creek Cove where widening is proposed. Tree removal could have a moderate impact.
	Operation	View of completed widening of Parramatta Road and removed trees	Low	Moderate	Moderate	Tree removal could have a moderate impact.
Parramatta Road users (pedestrians and vehicles)	Construction	View of construction work along Parramatta Road and the site compound. Potential light spill from lights for night work	Low	Low	Low	Road users would be travelling through the proposal area within a highly urbanised environment. Road works and other construction activities are common features in the locality and wider region.

Viewpoint	Phase	Impact of the proposal	Sensitivity	Magnitude	Impact	Comment
	Operation	View of completed widening of Parramatta Road and removed mature trees	Low	Moderate	Low-Moderate	The removal of trees to facilitate road widening would have a low-moderate impact. Although road users will have altered views once the works are completed, as the works are located in a highly urbanised environment impacts from road widening are low – moderate.

6.10.4 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Light spills	• Ensure all lights are directed away from residential properties.	Contractor	Construction	Additional safeguard
Landscape, visual, urban design	The CEMP shall include measures and procedures to minimise visual impacts, including: • The worksite is to be kept clean and tidy at all times • Appropriate storage of equipment, stockpile screening and arrangements for the storage and removal of rubbish and waste materials • On completion of work, all vehicles, materials and refuse relating to the works would be removed • Construction lighting to be directed away from sensitive receivers • Vegetation not to be disturbed will be demarcated.	Contractor	Construction	Core standard safeguard

6.11 Socio-economic

6.11.1 Existing environment

As outlined in Section 6.4.1, the Proposal is located within the City of Canada Bay LGA suburb of Five Dock and the Inner West Council LGA and the suburbs of Haberfield, Croydon and Ashfield. The area is highly urbanised, with a mix of residential and commercial premises occurring along the various sections of the Proposal.

Commercial premises located within the immediate vicinity of the Proposal include fast food restaurants, car dealerships, tiles showroom and a service station. Beyond the immediate Proposal extent, commercial premises include fast food restaurants, car dealerships, service station and hardware store, among others.

The Parramatta Road Corridor is a critical link between the Sydney and Parramatta CBDs, the western suburbs and beyond to the Blue Mountains. The corridor facilitates socio-economic processes and development by allowing the movement of people to and from their home and places of work and travel. Traffic delays and road works are a common occurrence on Parramatta Road and stoppages in traffic are familiar to those who travel along it regularly. Implications of lost travel time are beyond the scope of in this REF.

Pedestrians are able to access the Proposal area and buses service the area and stops exist within the Proposal extent.

6.11.2 Potential impacts

Construction

The Proposal would impact on pedestrians for the duration of the construction period as a result of the closure of the pathway on the eastern side of Parramatta Road. Safe, alternative arrangements would be provided for pedestrians during this period.

The current design requires property acquisition and adjustments to three properties, and impacts seven driveway accesses to commercial properties. During construction works to driveways, there would be no vehicular access to these properties. Access would be reinstated at the end of each shift. Vehicular access to adjacent commercial premises and fast food restaurants would be maintained throughout the construction period.

There is potential for positive, short-term business impacts during the construction phase including increased trade for food outlets and service stations.

Some temporary amenity impacts are expected to occur as a result of the construction works, including:

- Construction plant and equipment located directly in front of properties within the Proposal
- Temporary traffic control barriers and signs located on Parramatta Road, Great North Road and surrounding streets
- Change in footpath location during the works
- Loss of vehicular access to some businesses during driveway works
- Temporary loss of services during service relocation and reconnection e.g. electricity and water. .

Operation

There would be positive long term impacts during operation of the Proposal including improved congestion and safety for motorists.

6.11.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
General - notification	All businesses, residential properties and other key stakeholders (eg. child care facilities, schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity. The notification will include details of: the project; construction period and construction hours; contact information for project management staff; complaint and incident reporting; and how to obtain further information.	Contractor	Pre-construction	Core standard safeguard
General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project.	Contractor	Pre-construction / construction	Core standard safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	This will include up-front site induction and regular "toolbox" style briefings.			

6.12 Waste and resource use

6.12.1 Policy setting

The waste regulatory framework is administered under the principal legislation of the *Protection of the Environment Operations Act 1997* (POEO Act) and the *Waste Avoidance and Resource Recovery Act 2001* (WARR Act). The purpose of these Acts are to prevent degradation of the environment, eliminate harmful wastes, reduce the amount of waste generated and establish priorities for waste reuse, recovery and recycling. The WARR Act establishes a waste hierarchy, which comprises the following principles:

- Avoidance of waste – minimising the amount of waste generated during construction by avoiding unnecessary resource consumption (ie. avoiding the use of inefficient plant and construction equipment and avoiding materials with excess embodied energy, waste and excessive packaging)
- Resource recovery – reusing, reprocessing and recycling waste products generated during construction to minimise the amount of waste requiring disposal
- Disposal – where resources cannot be recovered, they would be appropriately disposed of to minimise the potential adverse environmental impacts likely to be associated with their disposal.

By adopting the WARR Act principles, RMS encourages the most efficient use of resources and reduces cost and environmental harm in accordance with the principles of ecologically sustainable development, as outlined in Section 8.2 of this REF.

6.12.2 Potential impacts

The quantities of waste generated during construction are not likely to be substantial. Waste streams likely to be generated during the construction stage include:

- Construction and demolition waste from removal of existing road surface, road furniture and bridge material (soil, bitumen, concrete, asphalt, metal, asbestos containing material, building wastes)
- Stockpiled waste material classified as General Solid Waste
- Excess spoil from excavations
- Green waste from vegetation removal and pruning
- Paper and packaging wastes from materials brought to site
- Sewage from ablutions
- General and domestic waste from site offices and compound.

The materials required during the proposed construction works are not currently restricted resources although, materials such as metals and fuels are considered non-renewable and should be used conservatively.

6.12.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Waste	A Waste Management Plan will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriately handle and dispose of unavoidable waste. The WMP will be prepared taking into account the *Environmental Procedure - Management of Wastes on Roads and Maritime Services Land* and relevant Roads and Maritime Waste Fact Sheets.	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.2 of QA *G36 Environment Protection*
Waste	Hierarchy of waste management would be implemented via: • Separation of general wastes, recyclable/reusable materials, and hazardous wastes to avoid mixing with other materials/wastes. • Regular housekeeping and servicing of waste storages. • General waste and recycling receptacles will be provided onsite. • Waste would be transported to an appropriately licensed waste disposal and/or recycling facility. • Wastes (including green waste) would not be burnt. • Weed removal activities including removal of weeds prior to tree removal works to allow non-weed infested mulched material to be reused on site • Potential for mulching and reuse of cleared vegetation would be balanced against presence of noxious weeds and compliance with necessary weed control measures.	Contractor	Construction	Additional safeguard
Waste	With regard to the stockpiled general solid waste material:	Contractor	Construction	Additional safeguard

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
	• Where practicable, recyclable fractions of the construction and demolition waste (e.g. concrete and asphalt) would be separated for off-site disposal to an appropriately licensed recycling facility.			
Waste	A far as practicable, construction materials would be sourced within the Sydney region so as to reduce transport costs, including fuel usage.	Contractor	Pre-construction / construction	Additional safeguard

6.13 Air quality

6.13.1 Existing environment

No air quality monitoring or modelling has been undertaken for the Proposal. The existing air quality in the area surrounding Parramatta Road and Great North Road Intersection would be heavily influenced by emissions from motor vehicles from the surrounding road network. Major roads include Parramatta Road and Great North Road/ Lyons Road as well as the M4 and Frederick Street. Other local sources of air emission would include residential and commercial land uses particularly petrol stations.

6.13.2 Potential impacts

Construction

Air quality impacts during construction would largely result from dust generated during earthworks and other engineering activities associated with road construction including:

- Clearing of vegetation.
- Transport and handling of soils and materials.
- Road pavement works.

Areas of exposed land would be susceptible to dust generation from wind erosion and mechanical disturbance, depending on the size of exposed areas, the frequency of water spraying and the speed of machinery.

Operation of plant and equipment would generate exhaust fumes, although it is unlikely that these would result in adverse air quality given the context of works along an existing heavily trafficked road.

Potential impacts would be temporary, localised and readily manageable.

Operation

No adverse air quality impacts are anticipated from the Proposal during operation. Improved traffic flow and reduced congestion, and consequently reduced exhaust emissions, may have a beneficial effect to air quality in the immediate vicinity of the proposal.

6.13.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Air	The CEMP shall address potential for air pollution, including: • Identification of potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction • Care during loading and unloading of materials to avoid spills and wind-blown dust • Turn machinery off rather than left to idle when they are not in use • Maintain vehicles to manufacturer's standards • Methods to manage works during strong winds or other adverse weather conditions • Employ measures such as watering or covering exposed areas to minimise or prevent air pollution and dust • Vehicles transporting waste or other materials are to be covered during transportation.	Project Manager and Contractor	Pre-construction	Additional safeguard

6.14 Cumulative impacts

6.14.1 Existing environment

Cumulative environmental impacts of the proposed works include the combined effect of individual impacts associated with the proposal in addition to the impacts of other activities in the area.

The proposal is part of a larger broader program of works to improve traffic flow along Parramatta Road corridor between Strathfield and Five Dock. As part of this program, Roads and Maritime would be upgrading the intersection of Parramatta Rd and Shaftesbury Road at Burwood. The objective of the project is to duplicate the right turning lane from Parramatta Road eastbound into Shaftesbury Road. This would increase the storage capacity and eliminate traffic overflowing onto the Parramatta Road straight through lanes. The project is expected to start construction in the early half of 2018 subject to property acquisition and therefore may occur concurrently with the proposal.

The proposed site compound at the intersection of Parramatta Road and Great North Road at Five Dock will also be used for the Parramatta Road and Shaftesbury Road intersection upgrade project.

The NSW Government's WestConnex project involves constructing an underground tunnel near Parramatta Road with above ground construction sites at Northcote Street and Wattle Street.

Subject to planning approval, WestConnex construction is expected to start mid-2016, with completion planned for early 2019, and therefore may occur concurrently with the Proposal.

6.14.2 Potential impacts

If construction is carried out concurrently with WestConnex and the Parramatta Road/Shaftesbury Road project, cumulative impacts are likely to occur, particularly in relation to traffic, noise and amenity. Travel times may temporarily be affected and some sensitive receivers may be impacted over a greater length of time.

It is also anticipated that construction traffic, dust and noise emission on Henley Marine Dr will increase as a result of the site compound area being utilised for both the Parramatta Road intersection upgrade projects.

6.14.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
Cumulative Impacts	The traffic management plan including Road Occupancy Licenses would be prepared in consultation with the Transport Management Centre taking into consideration the traffic cumulative impact of projects on the Sydney road network.	Project Manager and Contractor	Construction & pre-construction	Additional safeguard
Cumulative Impacts	Undertake regular meetings with WestConnex to discuss co-ordination of the construction works and provision of respite for night works.	Project Manager and Contractor	Construction & pre-construction	Additional safeguard
Cumulative Impacts	The construction environmental management plan (CEMP) would be revised to consider potential cumulative impacts from surrounding development activities as they become known.	Project Manager and Contractor	Construction & pre-construction	Additional safeguard

7 Environmental management

7.1 Environmental management plans (or system)

A number of safeguards and management measures have been identified in the REF in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the proposal. Should the proposal proceed, these safeguards and 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 the safeguards and management measures identified. The CEMP will provide a framework for establishing how these measures will be implemented and who would be responsible for their implementation.

The CEMP will be prepared prior to construction of the proposal and must be reviewed and certified by the VBA JV Environmental Officer, prior to the commencement of any on-site works. 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 QA Specification G10 – Traffic Management.

7.2 Summary of safeguards and management measures

Environmental safeguards and management measures outlined in this REF will be incorporated into the detailed design phase of the proposal and during construction and operation of the proposal, should it proceed. These safeguards and management measures will 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 safeguards and management measures

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
GEN1	General - minimise environmental impacts during construction	A CEMP will be prepared and submitted to VBA JV environmental advisor for approval. As a minimum, the CEMP will address the following: • Any requirements associated with statutory approvals • Details of how the project will implement the identified safeguards outlined in the REF • Issue-specific environmental management plans • Roles and responsibilities • Communication requirements • Induction and training requirements • Procedures for monitoring and evaluating environmental performance, and for corrective action • Reporting requirements and record-keeping • Procedures for emergency and incident management • Procedures for audit and review. The endorsed CEMP will be implemented during the undertaking of the activity.	Contractor	Pre-construction / detailed design	Core standard safeguard
GEN2	General - notification	All businesses, residential properties and other key stakeholders (eg. child care facilities, schools, local councils) affected by the activity will be notified at least five days prior to commencement of the activity. The notification will include details of: the project; construction period and construction hours;	Contractor	Pre-construction	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		contact information for project management staff; complaint and incident reporting; and how to obtain further information.			
GEN3	General – environmental awareness	All personnel working on site will receive training to ensure awareness of environment protection requirements to be implemented during the project. This will include up-front site induction and regular "toolbox" style briefings. Site-specific training will be provided to personnel engaged in activities or areas of higher risk. These include: • Areas of non-Aboriginal heritage sensitivity • Threatened species habitat • Adjoining residential areas requiring particular noise and vibration management measures.	Contractor	Pre-construction / construction	Core standard safeguard
TT1	Traffic and transport	Consultation will be undertaken with potentially affected residences prior to the commencement of and during works in accordance with the RTA's *Community Involvement and Communications Resource Manual*. Consultation will 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.	Contractor	Pre-construction / construction	Core standard safeguard
TT2	Traffic and transport	A Traffic Management Plan (TMP) will be prepared and implemented as part of the CEMP. The TMP will be prepared in accordance with the *Roads and Maritime Traffic Control at Work Sites Manual* and *QA Specification G10 Control of Traffic*. The TMP will include: • Confirmation of haulage routes • Measures to maintain access to local roads and properties (as agreed with the property owner during the construction period) • Site specific traffic control measures (including signage) to manage and regulate traffic movement • Measures to maintain pedestrian and cyclist access	Contractor	Detailed design / Pre-construction	Core standard safeguard Section 4.8 of QA G36 Environment Protection

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		• Requirements and methods to consult and inform the local community of impacts on the local road network • Access to construction sites including entry and exit locations and measures to prevent construction vehicles queuing on public roads. • A response plan for any construction traffic incident • Consideration of other developments that may be under construction to minimise traffic conflict and congestion that may occur due to the cumulative increase in construction vehicle traffic • Monitoring, review and amendment mechanisms.			
TT3	Traffic and transport	Access for emergency vehicles will be maintained at all times during construction. Any site-specific requirements will be determined in consultation with the relevant emergency services agency.	Contractor	Construction	Core standard safeguard
TT4	Traffic and transport	Access to properties will be maintained during construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the relevant local road authority.	Contractor	Construction	Additional standard safeguard
TT5	Traffic and transport	Pedestrian and cyclist access will be maintained throughout construction. Where that is not feasible or necessary, temporary alternative access arrangements will be provided following consultation with affected landowners and the local road authority.	Contractor	Construction	Additional standard safeguard
NV1	Noise and vibration	A Noise and Vibration Management Plan (NVMP) will be prepared and implemented as part of the CEMP. The NVMP will generally follow the approach in the *Interim Construction Noise Guideline* (ICNG) and identify: • All potential significant noise and vibration generating activities associated with the activity • A map indicating the locations of sensitive receivers including residential properties	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.6 of *QA G36 Environment*

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		• Feasible and reasonable mitigation measures to be implemented. • A monitoring program to assess performance against relevant noise and vibration criteria • Arrangements for consultation with affected neighbours and sensitive receivers, including notification and complaint handling procedures • Contingency measures to be implemented in the event of non-compliance with noise and vibration criteria.			*Protection*
NV2	Noise and vibration	All sensitive receivers (eg. child care centres, local residents, schools,) likely to be affected will be notified at least five days prior to commencement of any works associated with the activity that may have an adverse noise or vibration impact. The notification will provide details of: • The project • The construction period and construction hours • Contact information for project management staff • Complaint and incident reporting • How to obtain further information.	Contactor	Detailed design / pre-construction	Core standard safeguard
NV3	Noise and vibration	All personnel working on site are to receive a Project induction which will include requirements of the NVMP. Site-specific training will be given to personnel when working in the vicinity of sensitive receivers.	Contractor	Pre-construction / construction	Additional standard safeguard
NV4	Noise and vibration	Considerations in equipment selection will include: • Quieter and less noise emitting construction methods where feasible and reasonable • All plant and equipment to be appropriately maintained to ensure optimum running conditions	Contractor	Pre-construction and Construction	Additional safeguard
NV5	Noise and vibration	Considerations in the use and siting of plant will include: • Simultaneous operation of noisy plant within discernible range of a	Contractor	Pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		sensitive receiver is to be limited/ avoided where possible. • The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable • Plant used intermittently to be throttled down or shut down when not in use where practicable • Noise-emitting plant to be directed away from sensitive receivers where possible.		and Constructio n	
NV6	Noise and vibration	Worksites and activities will be planned to minimise noise, such as: • All reasonable and feasible noise control measures should be implemented prior to the commencement of construction works • Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site • Deliveries to occur during standard construction hours where feasible and reasonable.	Contractor	Pre-construction and Constructio n	Additional safeguard
NV7	Noise and vibration	Where reasonable and feasible, structures will be used to shield residential receivers from noise such as: • Site shed placement • Temporary or mobile noise screens (where practicable) • Enclosures to shield fixed noise sources such as pumps, compressors, fans etc (where practicable).	Contractor	Pre-construction and Constructio n	Additional safeguard
NV8	Noise and vibration	Dilapidation surveys will be conducted where required prior to construction commencing. Survey requirements would be determined in the Noise and Vibration Management Plan.	Contractor	Pre-construction and Constructio n	Additional standard safeguard
NV9	Noise and vibration	Site specific buffer distances shall be determined on site prior to the commencement of bored piling adjacent to the Dobroyd Canal.	Contractor	Pre-construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		After site specific buffer distances are determined, continuous vibration monitoring of the canal structure would be conducted for the duration of the piling works.		and Constructio n	
NV10	Noise and vibration	Non-tonal reversing beepers (or equivalent) should be fitted and used on all construction vehicles and mobile plant regularly used n site for periods of over two months.	Contractor	Constructio n	Additional safeguard
NAH1	Non-Aboriginal heritage	A Non-Aboriginal Heritage Management Plan (NAHMP) will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to avoid and mitigate impacts to Non-Aboriginal heritage: • Identification of potential environmental risks/impacts due to the works/activities • Management measures to minimise the potential risk • Mitigation measures to avoid risk of harm and the interface with work activities on site • Implementation of mitigation measures to protect identified heritage items or areas • Identify in toolbox talks where management of non-aboriginal heritage is required such as identification of no go zones and responsibilities under the Heritage Act 1977 and any obtained permits or exemptions • A stop works procedure in the event of actual or suspected potential harm to a heritage feature/place. • Vibration management procedures would be developed and implemented where works resulting in vibration are undertaken within the vicinity of identified heritage items.	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.10 of QA *G36 Environment Protection*
NAH2	Non-Aboriginal heritage	The RMS *Standard Management Procedure - Unexpected Heritage Items* will be followed in the event that any unexpected heritage items, archaeological	Contactor	Detailed design /	Core standard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		remains or potential relics of Non-Aboriginal origin are encountered. Work will only re-commence once the requirements of that Procedure have been satisfied.		pre-construction	safeguard Section 4.10 of QA *G36 Environment Protection*
NAH3	Non-Aboriginal heritage	Specific measures relating to the Dobroyd Canal Stormwater Channel will include: • Establish an exclusion zone to manage inadvertent impacts to this item during construction • Consultation with Sydney Water's Heritage Advisor regarding requirements in relation to the item prior to works commencing and liaison would continue through the construction period. • A vibration assessment for the canal would be conducted prior to works commencing to ensure that there is no inadvertent impact to canal fabric.	Contractor	Pre-construction and Construction	Additional standard safeguard
NAH4	Non-Aboriginal heritage	Specific measures relating to the 1930 road bridge over Iron Cove Creek will include: • Archival recording of the portion of the bridge to be removed according to *NSW Heritage Division standards* (1998).	Contractor	Pre-construction	Additional standard safeguard
SE1	Socio-economic	All property acquisition will be carried out in accordance with the *Land Acquisition Information Guide* (Roads and Maritime, 2012) and the *Land Acquisition (Just Terms Compensation) Act 1991*.	Roads and Maritime project manager	Pre-construction and construction	Additional standard safeguard
UT1	Utilities	Prior to the commencement of works: • The location of existing utilities and relocation details will be confirmed following consultation with the affected utility owners • If the scope or location of proposed utility relocation works falls outside of	Contactor	Detailed design / pre-construction	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		the assessed proposal scope and footprint, further assessment will be undertaken.			
B1	Biodiversity	Measures to further avoid and minimise the construction footprint and native vegetation or habitat removal will be investigated during detailed design.	Contractor	Detailed design / pre-construction	Additional safeguard
B2	Biodiversity	No stockpiling materials and equipment and parking vehicles and machinery within the dripline of any tree.	Contractor	Detailed design / pre-construction	Additional safeguard
B3	Biodiversity	Prior to the start of any clearing a physical clearing boundary is to be demarcated and implemented: • Identification (marking) of the clearing boundary and trees that needs to be removed eg. – use of flagging tape. • Where trees are to be retained, place an exclusion zone fencing outside the tree protection zone • Erect signs to inform personnel of the purpose of the fencing. Signs should be clearly visible and be general in nature, such as 'Exclusion zone' or 'Environmental Protection zone'.	Contractor	Detailed design / pre-construction	Additional Safeguard
B4	Biodiversity	Declared noxious weeds (ie. *Asparagus aethiopicus*) will be managed according to the requirements stipulated by the Noxious Weeds Act 1993, and any weed removal activities will follow Guide 6 (Weed Management) in the Biodiversity Guidelines (RTA 2011).	Project Manager and Contractor	Construction	Additional standard safeguard
B5	Biodiversity	A landscape plan must be prepared, approved by council and implemented.	Contractor	During Construction	Additional standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
C1	Contaminated land	A Contaminated Land Management Plan (CLMP) will be prepared and implemented as part of the CEMP for any areas of existing contaminated land or to address land contamination likely to be caused by the activity. The CLMP will be in accordance with the *Guideline for the Management of Contamination* and, as a minimum address the following matters: • control measures to divert surface runoff away from the contaminated land • capture and management of any surface runoff contaminated by exposure to the contaminated land • further investigations required to determine the extent, concentration and type of contamination, as identified in the detailed site investigation (Phase 2) • management of the remediation and subsequent validation of the contaminated land, including any certification required • measures to ensure the safety of site personnel and local communities during construction. • measures if ASS is discovered on site	Contractor	Detailed design / Pre-construction	Core standard safeguard Section 4.2 of QA *G36 Environment Protection*
C2	Contaminated land	If contaminated areas are encountered during construction, appropriate control measures will be implemented to manage the immediate risks of contamination. All other works that may impact on the contaminated area will cease until the nature and extent of the contamination has been confirmed and any necessary site-specific controls or further actions identified in consultation with the Roads and Maritime Environment Manager and/or EPA.	Contractor	Detailed design / Pre-construction / construction	Core standard safeguard Section 4.2 of QA *G36 Environment Protection*
C3	Contaminated land	A site specific emergency spill plan will be developed, and include spill management measures in accordance with the Roads and Maritime *Code of Practice for Water Management* (RTA, 1999) and relevant EPA guidelines. The plan will address measures to be implemented in the event of a spill, including initial response and containment, notification of emergency services	Contractor	Detailed design / Pre-construction	Core standard safeguard Section 4.3

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		and relevant authorities (including Roads and Maritime and EPA officers).			of QA *G36 Environment Protection*
C4	Contaminated land	Hazardous material inspection including a Part 6 Report to include asbestos is to be undertaken prior to demolition works commencing. Management measures would be developed, if necessary, commensurate to potential risk. Should any potentially hazardous materials or similar be encountered during demolition then works should stop and the material in question be examined by an appropriate specialist who would identify the material and provide management measures if required.	Contractor	Detailed design / Pre-construction	Additional standard safeguard
HAZ1	Hazards	Appropriate storage (eg. bunds, spill pallets, as appropriate) of fuels, oils, greases and any other hazardous materials associated with construction activities, including maintaining a spill kit within the construction compound to allow site personnel to respond to spills events.	Contractor	Construction	Core standard safeguard
F1	Flooding	A site specific Flood Evacuation Plan would be prepared and implemented as required as part of the CEMP. It would include the following measures: • Weather and flood monitoring • List equipment to be removed from the site • Responsibility and method for monitoring flood threat (e.g. flood warning information sourced from the BoM website) Detail staff training requirements and roles and responsibilities for the implementation of the Plan.	Contractor	Construction	Additional safeguard
SW1	Soil and water	A Soil and Water Management Plan (SWMP) will be prepared and implemented as part of the CEMP.	Contractor	Construction	Core standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
					Section 2.1 of *QA G38 Soil and Water Management*
SW2	Soil and water	A site specific Erosion and Sediment Control Plan(s) will be prepared and implemented and included in the SWMP. The Plan(s) will identify detailed measures and controls to be applied to appropriate to the level of risk of erosion and sedimentation and as a minimum address the following matters: • Direction of water flow, both off and on site • Diversion of off-site water around or through the site or details of separation of on-site and off-site water • Stabilising disturbed areas as soon as possible • The locations of other erosion and sediment control measures Staged implementation arrangements • Arrangements for managing wet weather events, including monitoring of potential high risk events (such as storms) • Specific controls and follow-up measures to be applied in the event of wet weather. • Scour protection and energy dissipaters at locations of high erosion risk • Installation of measures at work entry and exit points to minimise movement of material onto adjoining roads, such as rumble grids or wheel wash bays • Appropriate location and storage of construction materials, fuels and chemicals, including bunding where appropriate.	Contractor	Construction	Core standard safeguard *QA G38 Soil and Water Management*
SW3	Soil and water	A Spill Management Plan will be prepared and implemented as part of the CEMP to minimise the risk of pollution arising from spillage or contamination on the site and adjoining areas.	Contractor	Pre-Construction and	Additional Standard safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
				Construction	
SW4	Soil and water	The following requirements will be included in the SWMP: • A containment system must capture all waste water/slurry • Concrete washout shall be carried out offsite or in concrete washout areas described in the SWMP • Procedures for testing, treatment and discharge of construction waste water must be as described in the SWMP • Liquid chemical stored on site to be within bunded containers • Any liquid wastes to be disposed of to a licensed facility.	Contractor	Construction	Additional safeguard
SW4	Soil and water	Should excavation of the disturbed terrain area adjacent to Dobroyd Canal be required, soil testing would be completed to assess acid sulfate potential. If the presence of Acid Sulfate Materials is confirmed, an Acid Sulfate Materials Management Plan will be prepared in accordance with the RTA Guidelines for the Management of Acid Sulfate Materials and implemented as part of the CEMP. The plan will detail the management, handling, treatment and disposal of ASS and will be prepared in compliance with the relevant guidelines.	Contractor	Pre-construction / Construction	Additional Standard safeguard
AH1	Aboriginal heritage	The *Standard Management Procedure - Unexpected Heritage Items* (Roads and Maritime, 2015) will be followed in the event that an unknown or potential Aboriginal object/s, including skeletal remains, is found during construction. This applies where Roads and Maritime does not have approval to disturb the object/s or where a specific safeguard for managing the disturbance (apart from the Procedure) is not in place. Work will only re-commence once the requirements of that Procedure have been satisfied.	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.9 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
UD1	Landscape, visual, urban design	• Ensure all lights are directed away from residential properties.	Contractor	Construction	Core standard safeguard
UD2	Landscape, visual, urban design	The CEMP shall include measures and procedures to minimise visual impacts, including: • The worksite is to be kept clean and tidy at all times • Appropriate storage of equipment, stockpile screening and arrangements for the storage and removal of rubbish and waste materials • On completion of work, all vehicles, materials and refuse relating to the works would be removed • Construction lighting to be directed away from sensitive receivers • Vegetation not to be disturbed will be demarcated.	Contractor	Pre-construction / construction	Additional standard safeguard
WST1	Waste	A Waste Management Plan will be prepared and implemented as part of the CEMP. It will provide specific guidance on measures and controls to be implemented to support minimising the amount of waste produced and appropriately handle and dispose of unavoidable waste. The Plan will give effect to any management measures contained in any waste assessment undertaken for the project and include, but not necessarily be limited to: • measures to avoid and minimise waste associated with the project • classification of wastes and management options (re-use, recycle, stockpile, disposal) • statutory approvals required for managing both on and off-site waste, or application of any relevant resource recovery exemptions • procedures for storage, transport and disposal • monitoring, record keeping and reporting. The WMP will be prepared taking into account the *Environmental Procedure* -	Contactor	Detailed design / pre-construction	Core standard safeguard Section 4.2 of QA *G36 Environment Protection*

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
		Management of Wastes on Roads and Maritime Services Land and relevant Roads and Maritime Waste Fact Sheets.			
WST2	Waste	Hierarchy of waste management would be implemented via: • Separation of general wastes, recyclable/reusable materials, and hazardous wastes to avoid mixing with other materials/wastes. • Regular housekeeping and servicing of waste storages. • General waste and recycling receptacles will be provided onsite. • Waste would be transported to an appropriately licensed waste disposal and/or recycling facility. • Wastes (including green waste) would not be burnt. • Potential for mulching and reuse of cleared vegetation would be balanced against presence of noxious weeds and compliance with necessary weed control measures.	Contractor	Construction	Additional safeguard
WST3	Waste	With regard to the stockpiled general solid waste material: • Where practicable, recyclable fractions of the construction and demolition waste (e.g. concrete and asphalt) would be separated for off-site disposal to an appropriately licensed recycling facility • The soil fraction would be neutralised via thorough mixing with approximately two tonnes of agricultural lime • The final soil pH would be validated, with a target soil pH of between 6.5 and 9 • Once the soil pH has been validated, the soil fraction of the construction and demolition waste can be disposed to an appropriately licensed landfill facility as General Solid Waste.	Contractor	Construction	Additional safeguard
WST4	Waste	A far as practicable, construction materials would be sourced within the Sydney region so as to reduce transport costs, including fuel usage.	Contractor	Pre-construction / construction	Additional safeguard

No.	Impact	Environmental safeguards	Responsibility	Timing	Standard / additional safeguard
AIR1	Air	The CEMP shall address potential for air pollution, including: • Identification of potential sources of air pollution (such as dust, vehicles transporting waste, plant and equipment) during construction • Care during loading and unloading of materials to avoid spills and wind-blown dust • Turn machinery off rather than left to idle when they are not in use • Maintain vehicles to manufacturer's standards • Methods to manage works during strong winds or other adverse weather conditions • Employ measures such as watering or covering exposed areas to minimise or prevent air pollution and dust • Vehicles transporting waste or other materials are to be covered during transportation.	Project Manager and Contractor	Pre-construction	Additional safeguard
C1	Cumulative Impacts	The traffic management plan including Road Occupancy Licenses would be prepared in consultation with the Transport Management Centre taking into consideration the traffic cumulative impact of projects on the Sydney road network.	Project Manager and Contractor	Construction & pre-construction	Additional safeguard
C2	Cumulative Impacts	Undertake regular meetings with WestConnex to discuss co-ordination of the construction works and provision of respite for night works.	Project Manager and Contractor	Construction & pre-construction	Additional safeguard
C3	Cumulative Impacts	The construction environmental management plan (CEMP) would be revised to consider potential cumulative impacts from surrounding development activities as they become known.	Project Manager and Contractor	Construction & pre-construction	Additional safeguard

7.3 Licensing and approvals

As the Proposal is being assessed under Part 5 of the EP&A Act, Roads and Maritime is both the proponent and determining authority. Additional licensing and approvals required for the Proposal is summarised in Table 7-2.

Table 7-2: Summary of licensing and approvals required

Instrument	Requirement	Timing
Roads Act 1993	Approval under Section 138 from the appropriate road authority prior to works on roads	Prior to works on roads
Land Acquisition (Just Terms Compensation) Act 1991	Compensation for land acquired for the proposal would be negotiated in accordance with the Act	Prior to land acquisition

8 Conclusion

8.1 Justification

The Parramatta Road corridor is a critical transport link between the Sydney and Parramatta CBDs, the western suburbs and beyond to the Blue Mountains. Great North Road provides direct access to the suburbs of Five Dock, Wareemba and Abbotsford. As part of the NSW Government's Pinch Point Program which targets peak hour traffic hotspots and investigates ways to relieve traffic congestion, RMS identified Parramatta Road as a Pinch Point Corridor, with improvements to key intersections anticipated to provide better travel time for the entire corridor.

Duplicating the right turn bay on Parramatta Road into Great North Road has been modelled to provide improvements to the operational performance of not only that intersection, but the overall corridor. In addition, improved safety outcomes for road users were anticipated.

The REF has assessed the potential, biophysical, social and economic impacts of the preferred option. The Proposal would result in some impacts including noise and vibration impacts, temporary disruptions to traffic flow and access, and property acquisition impacts. A range of measures have been developed to minimise and mitigate the potential adverse impacts of the proposal.

The Proposal is consistent with strategic plans for Sydney and the Parramatta Road Corridor and would deliver a rapid improvement to the recognised pinch point through improved intersection performance.

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.

8.2 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 address constraints in the transport network and have a positive long-term social and economic impact through improved road safety at the intersection.
5(a)(ii) To encourage the promotion and co-ordination of the orderly economic use and development of land.	Not relevant to the Proposal.
5(a)(iii) To encourage the protection, provision and co-ordination of communication and utility services.	Not relevant to the Proposal.
5(a)(iv) To encourage the provision of land for public purposes.	Not relevant to the Proposal.
5(a)(v) To encourage the provision and co-ordination of community services and facilities.	Not relevant to the Proposal.

Object	Comment
5(a)(vi) To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	The Proposal would operate within an established urban environment. The Proposal has been designed to minimise impacts to the environment, and this REF includes safeguards to protect the environment of protected fauna that may utilise the area.
5(a)(vii) To encourage ecologically sustainable development.	Ecologically sustainable development is considered in Sections 8.2.1 to 8.2.4 below.
5(a)(viii) To encourage the provision and maintenance of affordable housing.	Not relevant to the project.
5(b) To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Consultation with City of Canada Bay Council and Inner West Council has been undertaken in accordance with ISEPP (Refer to Section 5 and Appendix I).
5(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	Community consultation would occur thorough detailed design, prior to the commencement of construction, and during the construction period.

8.2.1 The precautionary principle

The Proposal does not pose a threat of serious or irreversible damage to the environment. The potential impacts described in the REF have been predicted with a reasonable level of scientific certainty. Mitigation and management measures have been proposed based on previous experience with similar projects. Therefore, application of the precautionary principle is not appropriate for this Proposal.

8.2.2 Intergenerational equity

The short and long terms impact of the proposed intersection upgrade has been considered and addressed through the development of the concept design and REF and on-balance would benefit both current and future generations.

8.2.3 Conservation of biological diversity and ecological integrity

The Proposal would have a very limited impact on the flora and fauna and would not compromise the biological diversity or ecological integrity of the study area.

8.2.4 Improved valuation, pricing and incentive mechanisms

The Proposal reflects the natural, social and economic values of the locality. This REF has examined the environmental consequences of the Proposal and identified mitigation measures and safeguards for address potential adverse impacts. The value of the environmental safeguards is not able to be determined at this point in time. However, during the project implementation, it would be beneficial to calculate the percentage of overall project costs for inclusion in RMS corporate environmental reporting.

8.3 Conclusion

The proposed upgrade of the intersection of Parramatta Road and Great North Road at Five Dock is subject to assessment under Part 5 of the EP&A Act. 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.

This has included consideration (where relevant) 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. It has also considered potential impacts to matters of national environmental significance listed under the EPBC Act.

The proposal responds to strategic objectives in relation to the Parramatta Road Urban Transformation Program and Pinch Point Program. The proposal as described in the REF best meets the project objectives but would still result in some impacts on local amenity (due to construction noise and vibration) and traffic and access. Safeguards and management measures as detailed in this REF would ameliorate or minimise these expected impacts. The proposal would also deliver a rapid improvement to the recognised pinch point through improved intersection performance and improved safety for all road users. On balance the proposal is considered justified and the following conclusions are made.

Significance of impact under NSW legislation

The proposal would be unlikely to cause a significant impact on the environment. Therefore, it is not necessary for an environmental impact statement to be prepared and approval to be sought from the Minister for Planning under Part 5.1 of the EP&A Act. A Species Impact Statement is not required. The proposal is subject to assessment under Part 5 of the EP&A Act. Consent from Council is not required.

Significance of impact under Australian legislation

The proposal is not likely to have a significant impact on matters of national environmental significance or the environment of Commonwealth land within the meaning of the EPBC Act. A referral to the Australian Government Department of the Environment is not required.

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.

Katie Bagnall
Senior Environmental Consultant
SNC-Lavalin Australia Pty Ltd
Date: 29 November 2016

I have examined this review of environmental factors and accept it on behalf of Roads and Maritime Services.

Robin Ferdous
RMS Project Manager
Easing Sydney's Congestion Program Office
Date: 29/11/2016

10 References

AECOM 2010, *Parramatta River estuary processes study – LGA management summaries,* October 2001. Pp158-160.

Artefact Heritage 2016, Parramatta Road Great North Road Intersection Upgrade, Statement of Heritage Impact, June 2015, RMS.

Artefact Heritage 2016a, Parramatta Road Great North Road Intersection Upgrade, Addendum Statement of Heritage Impact, October 2015, RMS.

Ashfield Council 2014, *Ashfield Council Interim Flood Development Control Policy, Part E8, Draft Policy March 2014*, Effective from 22 April 2014.

Australian Bureau of Statistics 2011, QuickStats [Retrieved October 2015] Website: *http://www.abs.gov.au/websitedbs/censushome.nsf/home/quickstats*

Australian Bureau of Statistics 2012, Data by Region – Canada Bay (A) [Retrieved October 2015] Website: *http://stat.abs.gov.au/itt/r.jsp?databyregion*

Australian Bureau of Statistics 2013, Data by Region – Ashfield (A) [Retrieved October 2015] Website: *http://stat.abs.gov.au/itt/r.jsp?databyregion*

Cumberland Ecology 2016, *Parramatta Road / Great North Road Intersection Upgrade Ecological Assessment,* May 2016, RMS.

DECCW 2009, *Interim Construction Noise Guideline.* July 2009. NSW Department of Environment Climate Change and Water.

DECCW (2011) *Road Noise Policy*. March 2011. NSW Department of Environment Climate Change and Water.

GHD 2015a, WestConnex M4 East. M4 East EIS Appendix P Vol. 2F. September 2015. WestConnex Delivery Authority.

GHD 2015b, *Concept Design – SH5 Parramatta Road*. Sheet number 1001-1029.

Landcom 2004, *Managing Urban Stormwater: Soils and Construction*, Volume 1, 4th Edition.

NSW Department of Premier and Cabinet 2011, *2021: A plan to make NSW number one*, NSW Government: Sydney

NSW Government 2014, *Rebuilding NSW: State Infrastructure Strategy 2014*. November 2014.

NSW Government 2015, *Rebuilding NSW: State Infrastructure Strategy 2014 - Update*. February 2015.

Positive Traffic 2016, *Proposed Upgrade Works – Intersection of Great North Road / Parramatta Road, Traffic Impact Assessment Report*, April 2016, RMS.

Renzo Tonin & Associates 2016, *Parramatta Road and Great North Road Intersection, Five Dock Construction and Operational Noise And Vibration Assessment*, October 2016, RMS.

RMS 6016 *Construction Noise and Vibration Guideline,* April 2016, NSW Roads and Maritime Authority.

RMS 2015a, *Pinch Point Program.* [Retrieved October 2015]. Website: *http://www.rms.nsw.gov.au/projects/key-build-program/pinch-point-program/index.html*

RMS 2015b, *T/81513 Parramatta Road/ Great North Road intersection upgrade Project Brief.* Pp1-13

RTA 2001, *Environmental Noise Management Manual.* December 2001. NSW Roads and Traffic Authority.

RTA 2009, *Traffic flow improvement initiatives for Parramatta Road Corridor Strathfield to Leichhardt, Final Draft Report,* June 2009, NSW Roads and Traffic Authority.

SKM 2012, *Parramatta Road Paramics Modelling 2012 Base Case & Option Testing Paramics Option Network Analysis Report,* NSW Roads and Traffic Authority.

SNC-Lavalin 2016, *T/81513 - Classification of Construction and Demolition Waste*, 8th Dec 2015, Letter Report to VBA-JV.

Sydney Water Corporation March 1998, *Dobroyd SWC 53 Capacity Assessment*, March 1998.

Sydney Water Corporation 2015, *Dobroyd Stormwater Channel No 53 - Heritage*

TfNSW 2012, *NSW Long terms transport master Plan.* December. NSW Government.

TfNSW 2015, *Sydney CBD to Parramatta Strategic Transport Plan*. September 2015. NSW Government.

UrbanGrowth NSW 2015, *Draft Parramatta Road Urban Transformation Strategy*. September 2015. NSW Government.

UrbanGrowth NSW 2015a, Parramatta Road Urban Amenity Improvement Plan. September 2015. NSW Government.

WMA Water 2013, Dobroyd Canal flood study (final draft report) – Ashfield City Council and Burwood City Council. [Retrieved online October 2015] *http://www.ashfield.nsw.gov.au/files/Dobroyd_FloodStudy_20131030_Compiled.pdf*

Terms and acronyms used in this REF

Term / Acronym	Description
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
CBD	Central Business District
CEMP	Construction environmental management plan
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). Provides for the protection of the environment, especially matters of national environmental significance, and provides a national assessment and approvals process.
ESD	Ecologically sustainable development. Development which uses, conserves and enhances the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased
FM Act	*Fisheries Management Act 1994* (NSW)
Heritage Act	*Heritage Act 1977* (NSW)
ISEPP	State Environmental Planning Policy (Infrastructure) 2007
LALC	Local Aboriginal Land Council
LEP	Local Environmental Plan. A type of planning instrument made under Part 3 of the EP&A Act.
LoS	Level of Service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
NES	Matters of national environmental significance under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.
Noxious Weeds Act	*Noxious Weeds Act 1993* (NSW)
NPW Act	*National Parks and Wildlife Act 1974* (NSW)
OEH	NSW Office of Environment and Heritage
OH&S	Occupational Health and Safety
PACHCI	Procedure for Aboriginal Heritage Consultation and Investigation
PEMP	Project Environmental Management Plan
POEO Act	*Protection of the Environment Operations Act 1997* (NSW)

Term / Acronym	Description
QA Specifications	Specifications developed by Roads and Maritime Services for use with road work and bridge work contracts let by Roads and Maritime Services.
REF	Review of Environmental Factors
Roads and Maritime	NSW Roads and Maritime Services
ROL	Road Occupancy Licence under the *Roads Act 1993*
SEPP	State Environmental Planning Policy. A type of planning instrument made under Part 3 of the EP&A Act.
TfNSW	Transport for NSW
The Proposal	Upgrade of Parramatta Road and Great North Road intersection, Five Dock
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
WARR	*Waste Avoidance and Resource Recovery Act 2001* (NSW)

Appendix A1

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 (DUAP 1995/1996) and the *Roads and Related Facilities EIS Guideline* (DUAP 1996) 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?	
The local community may experience some temporary, negative impacts relating to construction noise. These impacts would be alleviated by planning for the noisier activities to be scheduled in consultation with potentially affected sensitive receivers prior to commencing construction works. Some traffic impacts are also expected, however the majority of works that would impact on traffic would be undertaken at night to minimise traffic impacts. Safeguards are outlined in sections 6.1.4 and 6.2.5.	Local, Short-term, negative impact
The Proposal would provide improved safety of the Parramatta Road and Great North Road intersection for motorists (see section 6.1.3).	Long term, positive impact
b. Any transformation of a locality?	
The Proposal would have temporary adverse visual impacts during construction. Safeguards are outlined in section 6.10.4.	Minor, local short-term
The Proposal would not have any significant long term impacts on the locality. Regeneration would be implemented to replace removed vegetation, where practicable.	Long term, positive impact
c. Any environmental impact on the ecosystems of the locality?	
Construction activities would result in removal of urban native and exotic vegetation. Safeguards are outlined in section 6.5.4.	Moderate, local, short-term
Native plantings and regeneration of the site would be implemented to promote native growth where practicable (see section 6.5.4).	Long term, local positive impact
d. Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality?	
Construction activities may cause minor and temporary negative impacts on the aesthetic values of the site. Safeguards are outlined in section 6.10.4.	Short term, minor, negative
The Proposal would result in the improvement of the health of the remnant vegetation by eliminating noxious weeds from the proposal area. Safeguards are outlined in section 6.5.4.	Long-term, positive impact

Factor	Impact
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 would have limited impact on any special values of the locality for present or future generations. Safeguards are outlined in sections 6.3.4 and 6.9.3.	Nil
f. Any impact on the habitat of protected fauna (within the meaning of the *National Parks and Wildlife Act* 1974)?	
The Proposal is unlikely to have a significant impact on the habitat of protected fauna. Safeguards are outlined in section 6.5.4.	Minor, negative, local impact
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 cause direct minor endangerment to localised remnant vegetation including non-native vegetation and the Eastern Bentwing Bat. The proposal is unlikely to have negative effects on the entire species population. Safeguards are outlined in section 6.5.4.	Moderate negative, local, short-term
h. Any long-term effects on the environment?	
The Proposal would result in increased road safety (see section 6.1.3).	Positive, long term
The properties to be acquired would have a moderate, local, long term effect and would also depend on the type of acquisition required (full or partial) (see section 6.4.2).	Moderate negative local impact
i. Any degradation of the quality of the environment?	
The proposal would have short term negative impacts on the local environment as a result of construction works, such as noise and air emissions and vegetation removal. The Proposal would not result in any long term degradation of the environment. Safeguards are outlined in sections 6.2.5, 6.5.4 and 6.13.3.	Short term, minor impact
j. Any risk to the safety of the environment?	
The proposal would create temporary risks to the safety of the environment such as risks associated with pollution of the air, potential contamination and pollution to water during construction. Safeguards are outlined in sections 6.6.3, 6.8.3, 6.12.3 and 6.13.3.	Short term, minor impact
The proposal would not cause any risk to the safety of the environment during operation. Road safety for motorists would have a positive impact as a result of the proposed works (see section 6.1.3).	Minor positive impact

Factor	Impact
k. Any reduction in the range of beneficial uses of the environment? During construction, the proposal is likely to cause minor negative impacts on the beneficial uses of the environment as a result of the pathway on the eastern side of Parramatta Road being closed to pedestrians during construction. Safe detours would be implemented for pedestrians, as outlined in section 6.1.4. During construction and operation, land use would be altered for certain properties that require acquisition. This would have a minor impact on the beneficial uses of the local environment with these businesses either terminating there use or altering the frontage of the businesses. The operation of the proposal would be consistent with the current use of the environment.	 Short-term, minor negative impact Long-term, local, minor negative impact Nil
l. Any pollution of the environment? All waste produced by the proposal would be transported to a licensed disposal facility. Dust generation and emissions from machinery and construction vehicles would be temporary and minor during construction. The proposal would have the potential to result in some short-term water pollution impacts which may occur from sediments, soil nutrients, waste and spilt fuels and chemicals entering the waterway of Dobroyd Canal. With the implementation of mitigation measures outlined in sections 6.6.3, 6.12.3, and 6.13.3, pollution of the environment would not result from the operation of the Proposal. The operation of the proposal would be consistent with the current use of the environment.	 Short-term, negligible Nil
m. Any environmental problems associated with the disposal of waste? Waste would be generated during the Proposal works however the volumes are considered to be minor. Waste would be transported to licensed facility. Potentially hazardous material would be identified and removed in accordance with appropriate guidelines. Safeguards are outlined in sections 6.6.3 and 6.12.3.	 Minor, short-term, negative impacts
n. Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? Construction of the proposal would require relatively small volumes of concrete, steel and other construction materials as well as the consumption of energy for construction works. Given the small scale of the works it is unlikely to affect any resources that are, or are likely to become, in short supply.	 Nil

Factor	Impact
o. Any cumulative environmental effect with other existing or likely future activities? The proposed WestConnex Stage 1 east as well as other local road works, may be undertaken concurrently with the current proposal. This may occur during the construction period only and therefore would be a minor short term impact.	Minor, Short-term, negative local impact
p. Any impact on coastal processes and coastal hazards, including those under projected climate change conditions? The proposal would have no impact on coastal processes and coastal hazards, including those under projected climate change conditions.	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.

A referral is not required for proposed actions that may affect nationally listed threatened species, populations, endangered ecological communities and migratory species. Impacts on these matters are still assessed as part of the REF in accordance with Australian Government significant impact criteria and taking into account relevant guidelines and policies.

Factor	Impact
a. Any impact on a World Heritage property? There would be no impacts on any World Heritage Properties	Nil
b. Any impact on a National Heritage place? There would be no impacts on any National Heritage place. Two heritage places listed below are near to the proposed works: • Wadim (Bill) Jegorow Reserve at Cove Street, Haberfield. • Haberfield Conservation Area, Haberfield. These are unlikely to be affected due to the distance to the proposed works and the safeguards mentioned in sections 6.2.5 and 6.3.3.	Nil
c. Any impact on a wetland of international importance? There would be no impacts on wetlands of international importance.	Nil
d. Any impact on a listed threatened species or communities? There would be no impacts on listed threatened species or communities.	Nil
e. Any impacts on listed migratory species? There would be no impacts on listed migratory species.	Nil
f. Any impact on a Commonwealth marine area? There would be no impacts 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
Additionally, any impact (direct or indirect) on Commonwealth land? There would be no impacts on Commonwealth land.	Nil

Appendix A2

Statutory consultation checklists

Infrastructure SEPP

Council related infrastructure or services

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Stormwater	Are the works likely to have a *substantial* impact on the stormwater management services which are provided by council?	Yes	City of Canada Bay Council and Inner West Council	ISEPP cl.13(1)(a)
Traffic	Are the works likely to generate traffic to an extent that will *strain* the existing road system in a local government area?	No	-	ISEPP cl.13(1)(b)
Sewerage system	Will the works involve connection to a council owned sewerage system? If so, will this connection have a *substantial* impact on the capacity of any part of the system?	No	-	ISEPP cl.13(1)(c)
Water usage	Will the works involve connection to a council owned water supply system? If so, will this require the use of a *substantial* volume of water?	No	-	ISEPP cl.13(1)(d)
Temporary structures	Will the works involve the installation of a temporary structure on, or the enclosing of, a public place which is under local council management or control? If so, will this cause more than a *minor* or *inconsequential* disruption to pedestrian or vehicular flow?	No	-	ISEPP cl.13(1)(e)
Road & footpath excavation	Will the works involve more than *minor* or *inconsequential* excavation of a road or adjacent footpath for which council is the roads authority and responsible for maintenance?	Yes	City of Canada Bay Council and inner West Council	ISEPP cl.13(1)(f)

Local heritage items

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Local heritage	Is there is a local heritage item (that is not also a State heritage item) or a heritage conservation area in the study area for the works? If yes, does a heritage assessment indicate that the potential impacts to the item/area are more than *minor* or	Yes	Sydney Water Corporation	ISEPP cl.14

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
	inconsequential?			

Flood liable land

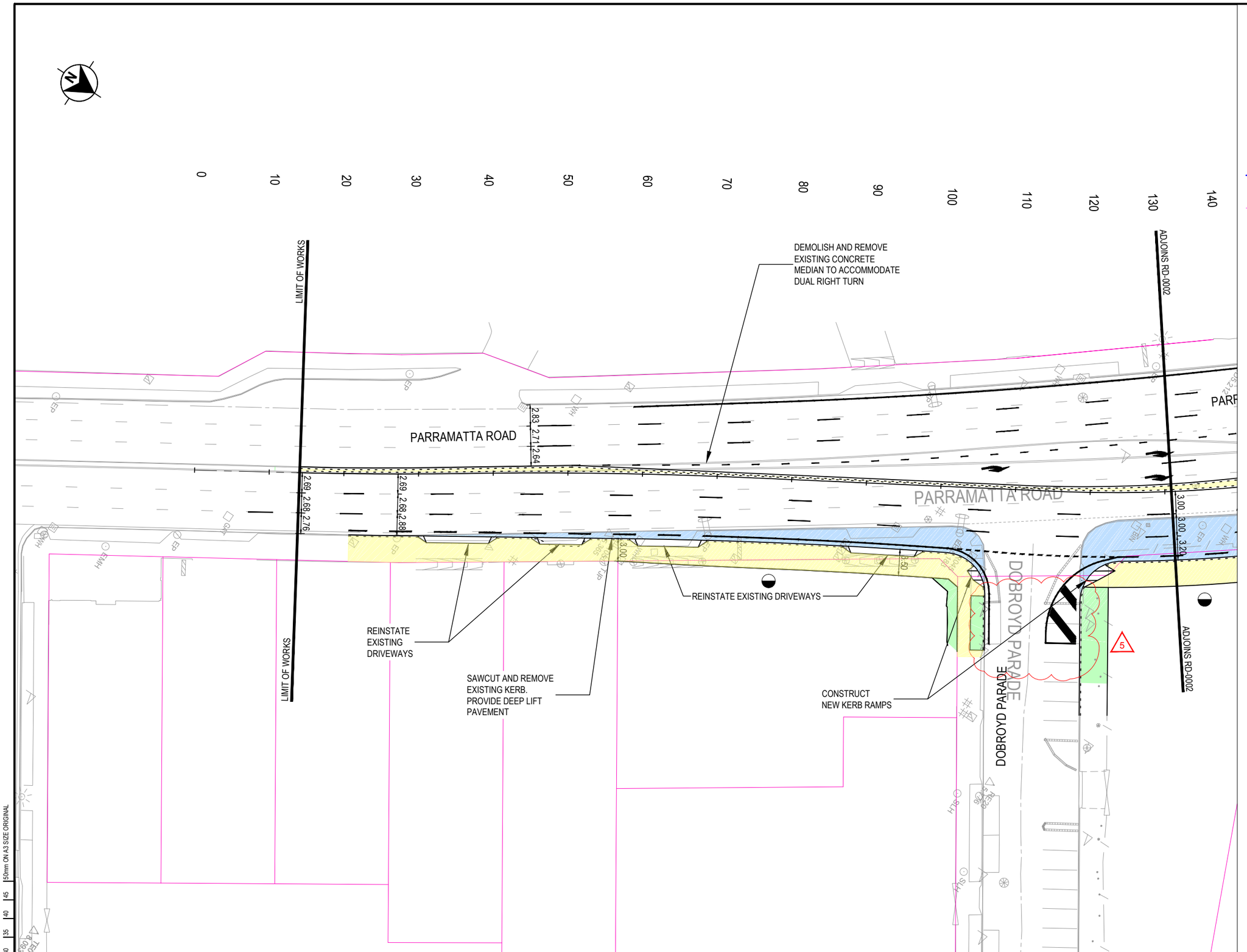
Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
Flood liable land	Are the works located on flood liable land? If so, will the works change flood patterns to more than a *minor* extent?	No	-	ISEPP cl.15

Public authorities other than councils

Issue	Potential impact	Yes / No	If 'yes' consult with	ISEPP clause
National parks and reserves	Are the works adjacent to a national park or nature reserve, or other area reserved under the *National Parks and Wildlife Act 1974*?	No	-	ISEPP cl.16(2)(a)
Marine parks	Are the works adjacent to a declared marine park under the *Marine Parks Act 1997*?	No	-	ISEPP cl.16(2)(b)
Aquatic reserves	Are the works adjacent to a declared aquatic reserve under the *Fisheries Management Act 1994*?	No	-	ISEPP cl.16(2)(c)
Sydney Harbour foreshore	Are the works in the Sydney Harbour Foreshore Area as defined by the *Sydney Harbour Foreshore Authority Act 1998*?	No	-	ISEPP cl.16(2)(d)
Bush fire prone land	Are the works for the purpose of residential development, an educational establishment, a health services facility, a correctional centre or group home in bush fire prone land?	No	-	ISEPP cl.16(2)(f)

Appendix B

Detailed design (50%) and Bridge Concept Design



LEGEND

- PROPOSED PAVEMENT (WIDENING)
- PROPOSED OR REINSTATED FOOTWAY CONCRETE ISLAND / MEDIAN
- PROPOSED GRASS VERGE / PLANTING BED
- PROPOSED BOUNDARY FENCING
- PROPERTY BOUNDARIES (CADASTRAL SURVEY)
- PROPERTY ACQUISITION REQUIRED

NOTES

1. FOR GENERAL NOTES REFER GE-0002.
2. FOR DETAILS OF EXISTING UTILITIES REFER UT-0001 TO 0010
3. FOR PAVEMENT TYPICAL DETAILS REFER TO PV-0201 TO 0203.

NOT FOR CONSTRUCTION

THIS DRAWING MAY BE PREPARED IN COLOUR AND MAY BE INCOMPLETE IF COPIED

50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION / NAME
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REV	AMENDMENT / REVISION DESCRIPTION	APPROVAL	DATE
1	AMENDMENTS AFTER INITIAL 50% DESIGN REVIEW COMMENTS	DH	04.05.16
2	AMENDMENTS AFTER SECOND 50% DESIGN REVIEW COMMENTS	DH	09.06.16
3	AMENDMENTS AFTER REVIEW COMMENTS	DH	04.07.16
4	AMENDMENTS TO VEHICLE RAMPS	DH	11.08.16
5	AMENDMENTS TO PAVEMENT MARKINGS	DH	07.10.16

SCALES ON A3 SIZE DRAWING

0 5 10 20
HORIZONTAL SCALE = 1 : 500

CO-ORDINATE SYSTEM: MGA ZONE 56
HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY

ventia BORAL amey

TITLE	NAME	SIGNED	DATE
DRAWN	MONTY VAGHMARIA		14.04.2016
DRG CHECK	PHILIP BUNDY		14.04.2016
DESIGN	PHILIP BUNDY		14.04.2016
DESIGN CHECK	DAN HUNT		14.04.2016
DESIGN MNGR	DARRAN GRIFFITHS		14.04.2016
PROJECT MNGR	JOEKARL DIAZ		14.04.2016

CLIENT

NSW GOVERNMENT Transport Roads & Maritime Services

CITY OF CANADA BAY
HW5-PARRAMATTA ROAD
PROPOSED PROVISION OF DUAL RIGHT TURN LANES ON PARRAMATTA ROAD ON APPROACH TO GREAT NORTH
DETAIL PLAN

A3

SHEET 1 OF 3

RMS REGISTRATION No. DS2015/003019 | PART

ISSUE STATUS: 50% DETAILED | EDMS No. | SHEET No. RD-0001 | ISSUE 5

CONSTRUCT NEW ALIGNED KERB RAMPS

DEMOLISH EXISTING KERB RAMP AND REINSTATE KERB

FOOTWAY WIDENING - DEMOLISH EXISTING KERB RAMP AND REINSTATE KERB

CONSTRUCT NEW KERB RAMP AND RELOCATE TCS

DEMOLISH AND REMOVE EXISTING CONCRETE MEDIAN TO ACCOMMODATE DUAL RIGHT TURN

CONSTRUCT NEW KERB RAMPS

ADJOINS RD-0001

ADJOINS RD-0003

PARRAMATTA ROAD

GREAT NORTH ROAD

HENLEY MARINE DRIVE

DEMOLISH AND RECONSTRUCT EXISTING CONCRETE ISLAND. CONSTRUCT TYPE SM KERB. LOCATION OF TCS POST TO BE ADJUSTED

CONSTRUCT NEW KERB RAMPS

CONSTRUCT NEW KERB RAMP AND ADJUST TCS POST

REINSTATE EXISTING DRIVEWAYS

TREATMENT OF AMBER TILES BASEMENT AND FORECOURT TO BE CONFIRMED

CONSTRUCT TYPE SA KERB

CONSTRUCT TYPE SA KERB

EXTEND EXISTING BRIDGE DECK TO ACCOMMODATE PROPOSED ROAD RESERVE WIDENING. EXTENT OF DECK, PARAPET PLINTH AND BARRIER TO BE CONFIRMED

LIMIT OF WORKS

LIMIT OF WORKS

LEGEND

- PROPOSED PAVEMENT (WIDENING)
- PROPOSED OR REINSTATED FOOTWAY CONCRETE ISLAND / MEDIAN
- PROPOSED GRASS VERGE / PLANTING BED
- PROPOSED BOUNDARY FENCING
- PROPERTY BOUNDARIES (CADASTRAL SURVEY)
- PROPERTY ACQUISITION REQUIRED

NOTES

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NOT FOR CONSTRUCTION

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50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION / NAME
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REV	AMENDMENT / REVISION DESCRIPTION	APPROVAL	DATE
1	AMENDMENTS AFTER INITIAL 50% DESIGN REVIEW COMMENTS	DH	04.05.16
2	AMENDMENTS AFTER SECOND 50% DESIGN REVIEW COMMENTS	DH	09.06.16
3	AMENDMENTS AFTER FURTHER REVIEW COMMENTS	DH	04.07.16
4	VEHICLE ACCESS RAMP DELETED AND NOTE ADDED AT AMBER TILES	DH	11.08.16
5	AMENDMENTS TO PAVEMENT MARKINGS	DH	07.10.16

SCALES ON A3 SIZE DRAWING
0 5 10 20
HORIZONTAL SCALE = 1 : 500

CO-ORDINATE SYSTEM: MGA ZONE 56
HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY
ventia BORAL amey

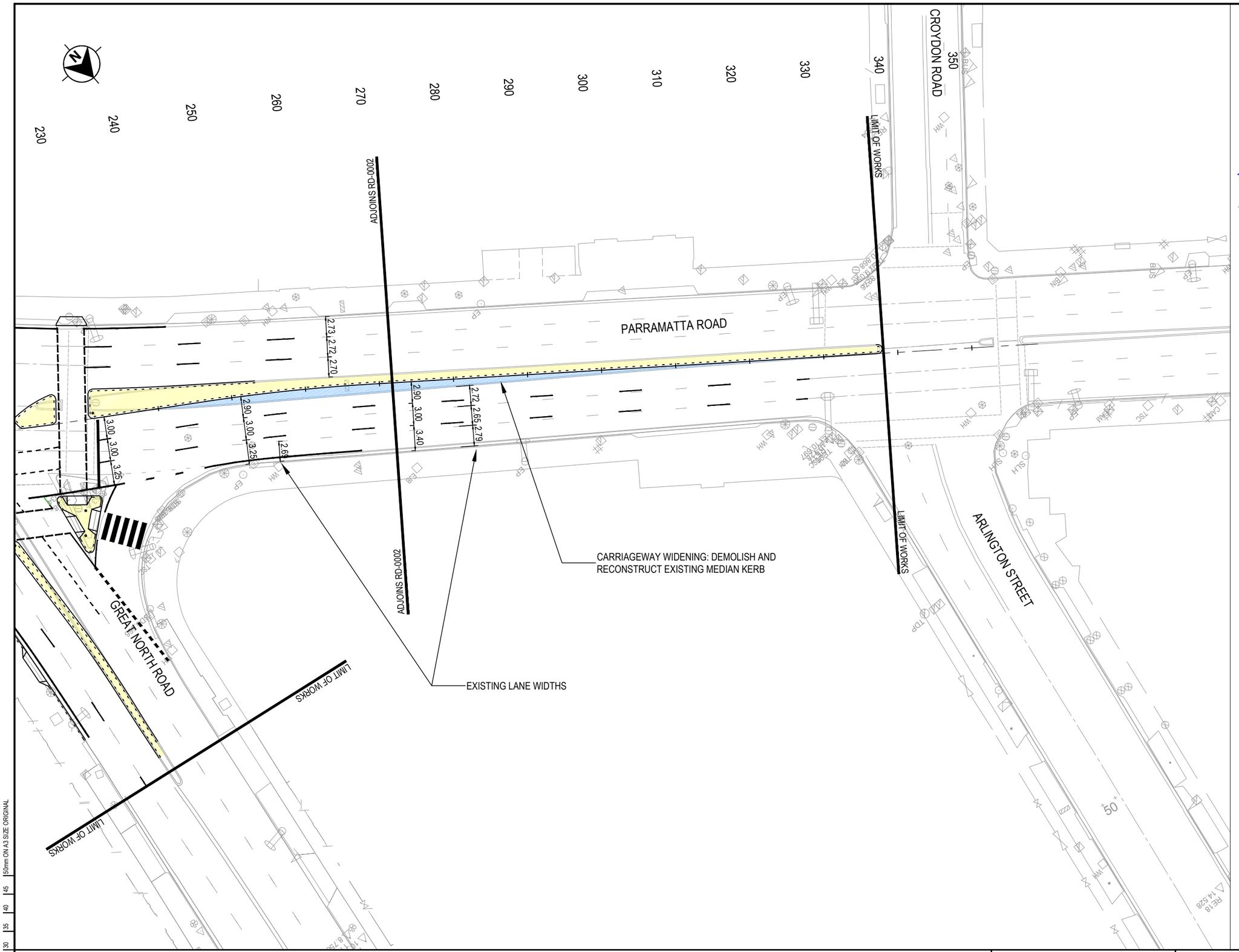
TITLE	NAME	SIGNED	DATE
DRAWN	MONTY VAGHMARIA		14.04.2016
DRG CHECK	PHILIP BUNDY		14.04.2016
DESIGN	PHILIP BUNDY		14.04.2016
DESIGN CHECK	DAN HUNT		14.04.2016
DESIGN MNGR	DARRAN GRIFFITHS		14.04.2016
PROJECT MNGR	JOEKARL DIAZ		14.04.2016

CLIENT
NSW GOVERNMENT Transport Roads & Maritime Services

CITY OF CANADA BAY
HW5-PARRAMATTA ROAD
A3
PROPOSED PROVISION OF DUAL RIGHT TURN LANES ON PARRAMATTA ROAD ON APPROACH TO GREAT NORTH DETAIL PLAN
SHEET 2 OF 3

RMS REGISTRATION No. DS2015/003019 PART

ISSUE STATUS: 50% DETAILED
EDMS No.
SHEET No.: RD-0002
ISSUE: 5



LEGEND

- PROPOSED PAVEMENT (WIDENING)
- PROPOSED OR REINSTATED FOOTWAY CONCRETE ISLAND / MEDIAN
- PROPOSED GRASS VERGE / PLANTING BED
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- PROPERTY BOUNDARIES (CADASTRAL SURVEY)
- PROPERTY ACQUISITION REQUIRED

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50mm ON A3 SIZE ORIGINAL

DRAWING FILE LOCATION / NAME
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REV	AMENDMENT / REVISION DESCRIPTION	APPROVAL	DATE
1	AMENDMENTS AFTER FURTHER REVIEW COMMENTS.	DH	04.07.16
2	ROAD NUMBER CORRECTED	DH	07.10.16

SCALES ON A3 SIZE DRAWING

0 5 10 20

HORIZONTAL SCALE = 1 : 500

CO-ORDINATE SYSTEM: MGA ZONE 56
HEIGHT DATUM: AHD

DRAWINGS / DESIGN PREPARED BY

ventia BORAL amey

TITLE	NAME	SIGNED	DATE
DRAWN	MONTY VAGHMARIA		09.06.2016
DRG CHECK	PHILIP BUNDY		09.06.2016
DESIGN	PHILIP BUNDY		09.06.2016
DESIGN CHECK	DAN HUNT		09.06.2016
DESIGN MNGR	DARRAN GRIFFITHS		09.06.2016
PROJECT MNGR	JOEKARL DIAZ		09.06.2016

CLIENT

NSW GOVERNMENT Transport Roads & Maritime Services

CITY OF CANADA BAY
HW5-PARRAMATTA ROAD

PROPOSED PROVISION OF DUAL RIGHT TURN LANES ON PARRAMATTA ROAD ON APPROACH TO GREAT NORTH DETAIL PLAN

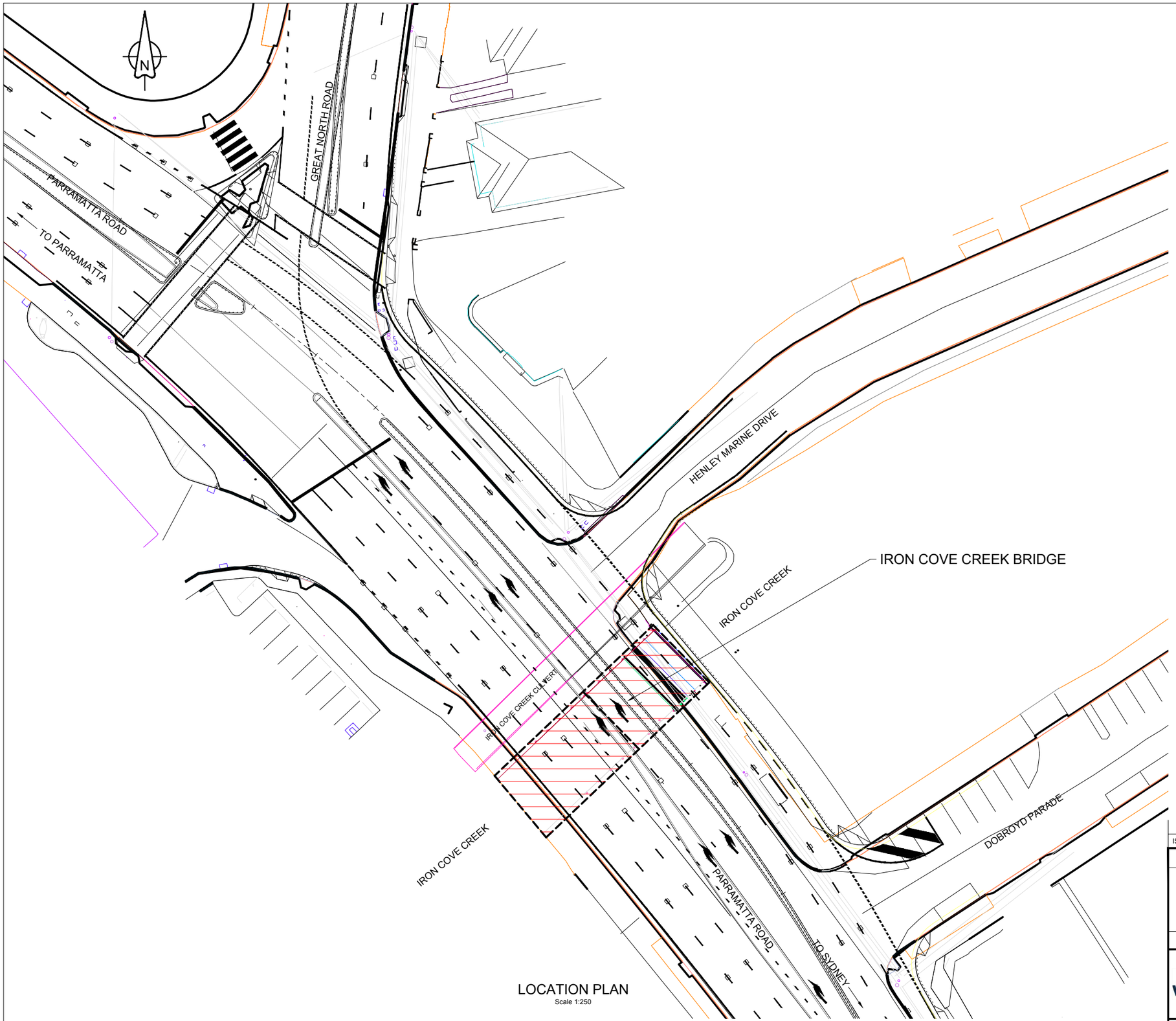
A3

SHEET 3 OF 3

RMS REGISTRATION No. DS2015/003019

PART

ISSUE STATUS: 50% DETAILED
EDMS No.
SHEET No. RD-0003
ISSUE 2



LOCATION PLAN
Scale 1:250

RESIDUAL DESIGN HAZARDS

(The following information has been collected from Preconstruction Information and the VBA Safety in Design Management Process.)

NOTES

1. DIMENSIONS IN METRES UNLESS OTHERWISE SHOWN.
2. ORIGINAL DRAWING SIZE A1. DO NOT SCALE.

ISSUE	DATE	REVISION	PREP	CHECK	AUTH

ROADS & MARITIME SERVICES OF NEW SOUTH WALES

IRON COVE CREEK BRIDGE WIDENING

LOCATION

CLIENT

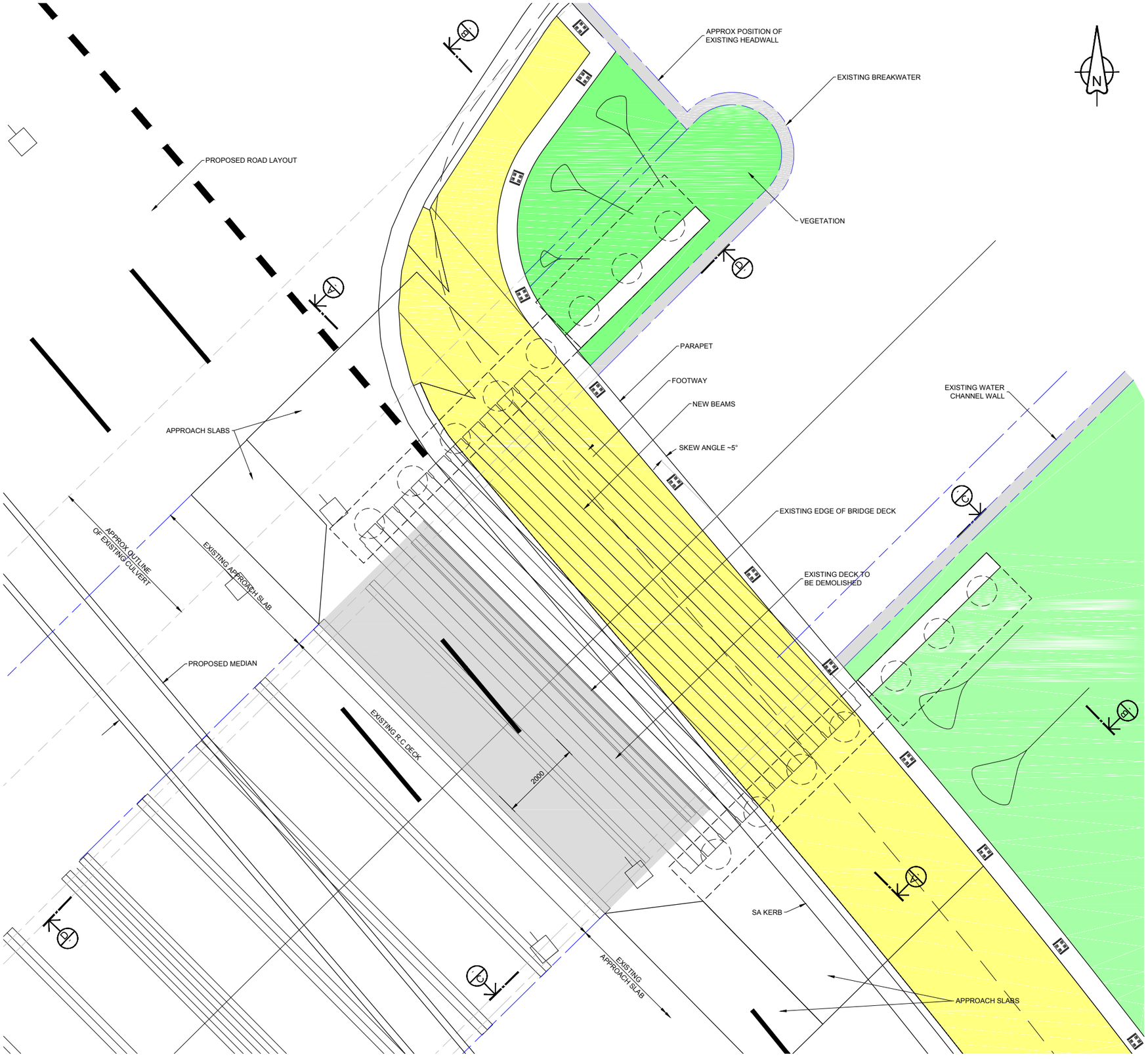
ventia BORAL amey | NSW GOVERNMENT Transport Roads & Maritime Services

PREPARED	CHECKED	REGISTRATION No. OF PLANS:
DESIGN PC	PC	DS2015/003019
DRAWING JEB	PC	BRIDGE No: B41
APPROVED DESIGN QA RECORDS		ISSUE STATUS: PRELIMINARY
PC PRINCIPAL CIVIL ENGINEER		SHEET No: 2 ISSUE: 0

ACCEPTED

PC
PRINCIPAL BRIDGE ENGINEER
DATE 12-10-2016

CAD No: GA-A



GENERAL ARRANGEMENT
Scale 1:50

RESIDUAL DESIGN HAZARDS

(The following information has been collected from Preconstruction Information and the VBA Safety in Design Management Process.)

1. LIVE CARRIAGEWAY
2. WORKING NEAR WATER
3. TREE AND OVERHEAD LINS
4. SERVICES
5. DEMOLITION
6. WORKING AT HEIGHT
7. NOISE AND VIBRATION

NOTES

1. DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
2. ORIGINAL DRAWING SIZE A1. DO NOT SCALE.
3. DIMENSIONS SHALL BE VERIFIED ON SITE AND ADJUSTED TO SUIT THE ACTUAL WORK - AS - EXECUTED DIMENSIONS OF THE EXISTING STRUCTURE.

ISSUE	DATE	REVISION	PREP	CHECK	AUTH

ROADS & MARITIME SERVICES OF NEW SOUTH WALES

IRON COVE CREEK BRIDGE WIDENING

PLAN

CLIENT

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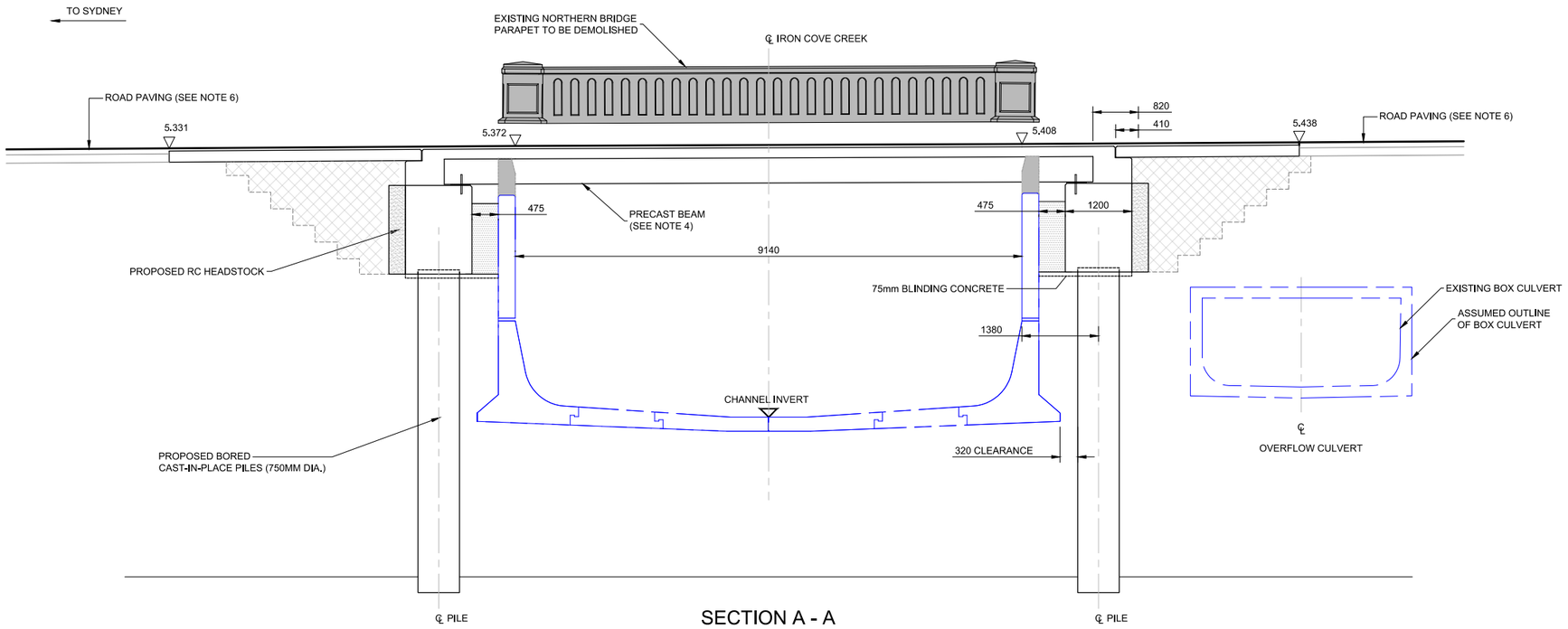
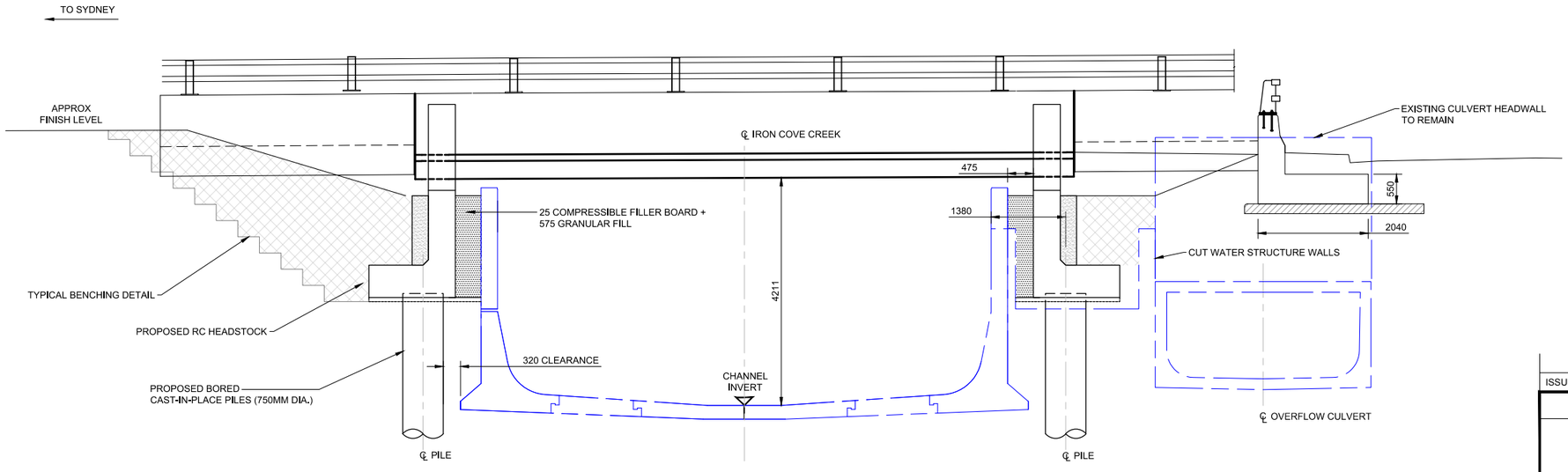
PREPARED	CHECKED	REGISTRATION No. OF PLANS: DS2015/003019	
DESIGN PC	PC		
DRAWING MJ	PC	BRIDGE No:	B41
APPROVED DESIGN QA RECORDS		ISSUE STATUS:	PRELIMINARY
PC PRINCIPAL CIVIL ENGINEER		SHEET No: 3	ISSUE: 0

CAD No: GA-B



SECTION A - A
THROUGH WATERWAY CHANNEL AND BRIDGE
AT LOCATION OF EXISTING PARAPET
Scale 1:50



SECTION B - B
SECTION THROUGH WATERWAY CHANNEL AND
NORTH ELEVATION ON PROPOSED BRIDGE
Scale 1:50

RESIDUAL DESIGN HAZARDS
(The following information has been collected from Preconstruction Information and the VBA Safety in Design Management Process.)

1. LIVE CARRIAGEWAY
2. WORKING NEAR WATER
3. TREE AND OVERHEAD LINES
4. SERVICES
5. DEMOLITION
6. WORKING AT HEIGHT
7. NOISE AND VIBRATION

NOTES

1. DIMENSIONS IN MILLIMETRES UNLESS OTHERWISE SHOWN.
2. ORIGINAL DRAWING SIZE A1. DO NOT SCALE.
3. DIMENSIONS SHALL BE VERIFIED ON SITE AND ADJUSTED TO SUIT THE ACTUAL WORK - AS - EXECUTED DIMENSIONS OF THE EXISTING STRUCTURE.
4. RMS 12m SPAN PSC PLANK, SEE DRAWING DS2015/003019 SHEET 13
5. GRANULAR DRAINAGE FILL:

   - RIVER GRAVEL OR MATERIAL SATISFYING THE FOLLOWING :

1	MAX PARTICLE SIZE	53mm
2	% PASSING 9.5mm SIEVE	<5%

   1 - IN ACCORDANCE WITH TEST METHOD RMS T280

   2 - IN ACCORDANCE WITH TEST METHOD RMS T106

6. REFER TO HIGHWAY DRAWING NO DS2015/003019-PV-0002 FOR PAVEMENT TREATMENT.
7. REDUCED LEVELS TO AUSTRALIAN HEIGHT DATUM

LEGEND

GRANULAR FILL

SELECT FILL

ISSUE	DATE	REVISION	PREP	CHECK	AUTH

ROADS & MARITIME SERVICES OF NEW SOUTH WALES

IRON COVE CREEK BRIDGE WIDENING

ELEVATIONS

CLIENT

ventia BORAL amey NSW GOVERNMENT Transport Roads & Maritime Services

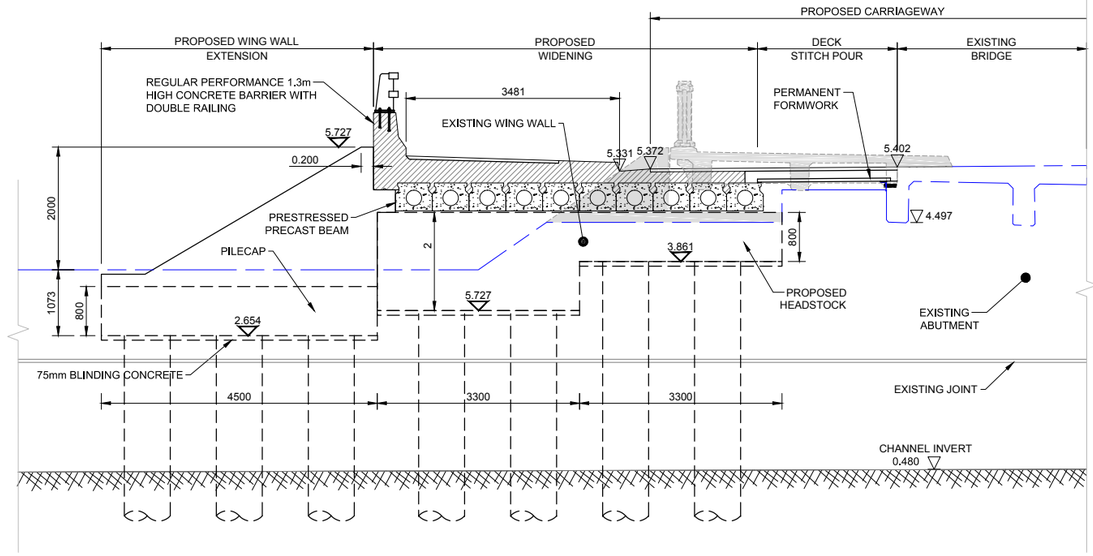
PREPARED	CHECKED	REGISTRATION No. OF PLANS:
DESIGN PC	PC	DS2015/003019
DRAWING MJ	PC	BRIDGE No: B41

APPROVED DESIGN QA RECORDS
PC
PRINCIPAL CIVIL ENGINEER

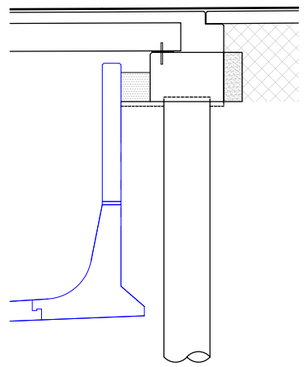
ISSUE STATUS: PRELIMINARY

SHEET No: 4 ISSUE: 0

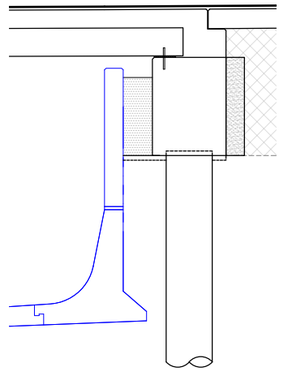
CAD No: PL12-A



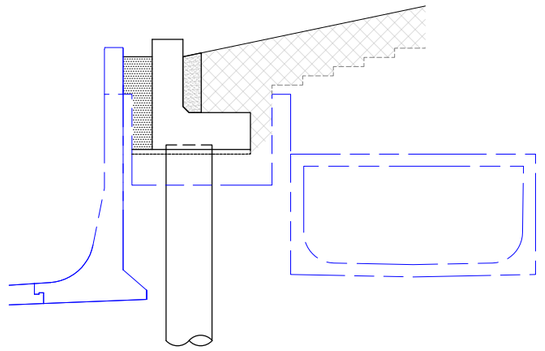
SECTION C - C
(EAST ABUTMENT)
Scale 1:50



PART SECTION E - E
Scale 1:50



PART SECTION F - F
Scale 1:50



PART SECTION G - G
Scale 1:50

SECTION D - D
(WEST ABUTMENT)
Scale 1:50

RESIDUAL DESIGN HAZARDS

(The following information has been collected from Preconstruction Information and the VBA Safety in Design Management Process.)

1. LIVE CARRIAGEWAY
2. WORKING NEAR WATER
3. TREE AND OVERHEAD LINS
4. SERVICES
5. DEMOLITION
6. WORKING AT HEIGHT
7. NOISE AND VIBRATION

NOTES

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ISSUE	DATE	REVISION	PREP	CHECK	AUTH

ROADS & MARITIME SERVICES OF NEW SOUTH WALES

IRON COVE CREEK BRIDGE WIDENING

SECTIONS

CLIENT

Transport Roads & Maritime Services

PREPARED	CHECKED	REGISTRATION No. OF PLANS:
DESIGN PC	PC	DS2015/003019
DRAWING MJ	PC	BRIDGE No: B41
APPROVED DESIGN QA RECORDS		ISSUE STATUS: PRELIMINARY
PC		SHEET No: 5 ISSUE: 0
PRINCIPAL CIVIL ENGINEER		

CAD No: PL12-B

Appendix C

Traffic Impact Assessment

Our Reference: **PT15046**

SNCLAVALIN
55 Clarence Street
Suite 2, Level 17
Sydney, NSW 2000

Via email: Alex.Bamford@snclavalin.com

6 April 2016

Attention: Alex Bamford

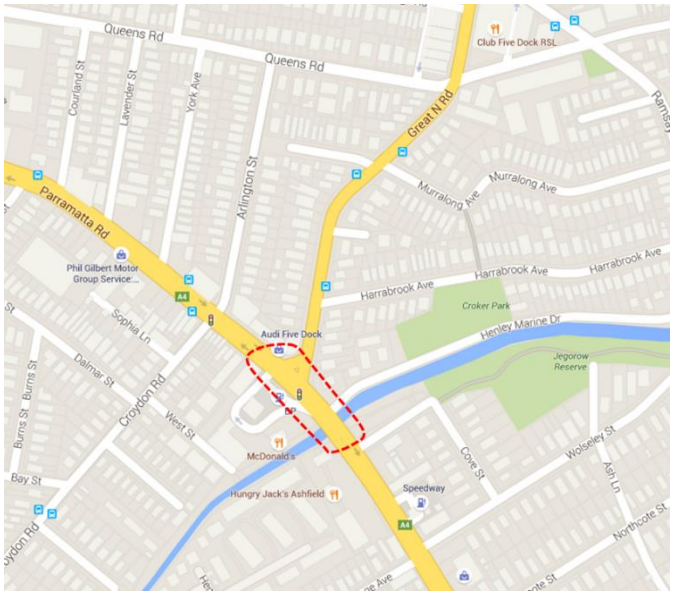
Proposed Upgrade Works – Intersection of Great North Road / Parramatta Road
Traffic Impact Assessment Report

Positive Traffic Pty Ltd has been commissioned by SNC-Lavalin to provide a summary traffic impact assessment report for the proposed upgrade of the intersection of the Great North Road / Parramatta Road, Five Dock. The proposed works form part of the rollout of the pinch point program of the Roads and Maritime Services (RMS).

Site Location

The location of the site is provided below:

Figure 1 – Site Location



© Google Maps

The limit of works within the Parramatta Road corridor extends to a point some 60m west of the intersection of Parramatta Road / Great North Road to western side of the intersection of Parramatta Road / Wolseley Street.

A site inspection of the location was undertaken immediately after the AM peak period on Monday 12 October 2015. A photographic record of this site inspection is provided in **Appendix A** of this report. At the time of the inspection it was noted that the existing right turn bay was subject to over queuing immediately prior to the green phase for the right turn from Parramatta Road into Great North Road. Traffic volumes on Parramatta Road were noted to be heavy in both directions.

Classification Criteria

It is usual to classify roads according to a road hierarchy in order to determine their functional role within the road network. Changes to traffic flows on the roads can then be assessed within the context of the road hierarchy. Roads are classified according to the role they fulfil and the volume of traffic they should appropriately carry. The RMS has set down the following guidelines for the functional classification of roads.

- Arterial Road – typically a main road carrying over 15,000 vehicles per day and fulfilling a role as a major inter-regional link (over 1,500 vehicles per hour)
- Sub-arterial Road – defined as secondary inter-regional links, typically carrying volumes between 5,000 and 20,000 vehicles per day (500 to 2,000 vehicles per hour)
- Collector Road – provides a link between local roads and regional roads, typically carrying between 2,000 and 10,000 vehicles per day (250 to 1,000 vehicles per hour). At volumes greater than 5,000 vehicles per day, residential amenity begins to decline noticeably.
- Local Road – provides access to individual allotments, carrying low volumes, typically less than 2,000 vehicles per day (250 vehicles per hour).

Existing Road Network

Parramatta Road – is the main east – west arterial road through the area carrying large volumes of traffic at most times. In the vicinity of the intersection of Great North Road, Parramatta Road includes three travel lanes in each direction. A right turn bay from Parramatta Road into Great North Road is provided at a length of approximately 100m. Parramatta Road links suburbs to the west (including the business precinct of Parramatta) to the Sydney CBD in the east.

Great North Road – is a major collector road linking Parramatta Road in the south with the Five Dock Town Centre in the north. It includes two travel lanes in each direction at its intersection with Parramatta Road. To the north, the road includes a single travel lane in each direction with restricted / unrestricted parallel parking on either side of the street.

Existing Traffic Conditions

Intersection counts and / or single site intersection modelling was not undertaken as part of this assessment. However, both background traffic flows and regional modelling conducted along the Parramatta Road corridor was obtained to inform an assessment of current traffic conditions. This approach was taken given the significant volume of modelling work undertaken to date.

Accident History

Accident data for the section of Parramatta Road between Croydon Road and Wolseley Street was provided as background information for this report. This information included accidents which occurred at the intersection of Parramatta Road / Great North Road. A copy of the crash data between the dates of 1 January 2010 and 31 December 2014 is provided in **Appendix B** of this report. This section of Parramatta Road includes the intersection with Great North Road identified for upgrade as part of this proposal.

From the crash data provided, the following crash characteristics were noted:

1. Over the four-year period the section of Parramatta Road included 75 reported accidents with one (1) of these accidents a fatality, 36 accidents included injuries and 38 accidents were non casualty crashes;

2. The largest proportion of crashes included rear end accidents with the second largest volume including side impact crashes between vehicles in Parramatta Road and those entering / exiting side streets; and
3. The majority of accidents occurred during daylight hours in fine weather conditions.

For the intersection of Parramatta Road / Great North Road itself, the following accident statistics were noted:

1. A total of 24 reporting accidents occurred at the intersection with 14 accidents resulting in injuries
2. The most prevalent type of accident was rear end accidents

Paramics Base Model Development Report – SKM July 2012[1]

The purpose of this modelling report was to establish a baseline Paramics microsimulation model for the Parramatta Road corridor based on counts of existing traffic demands. Of note, the report recorded the following traffic volumes for the intersection of Great North Road / Parramatta Road as shown in **Table 1**.

Table 1 - 2012 AM Peak Great North Road / Parramatta Rd Traffic Volumes (8:00am – 9:00am)

Intersection	Leg	Direction	Movement	Volume (veh)
Parramatta Rd / Great North Rd	Parramatta Rd East	WB	Through	2401
		WB	Right	124
	Great North Rd	SB	Left	175
		SB	Right	120
	Parramatta Rd West	EB	Left	181
		EB	Through	2522

From **Table 1** it can be seen that baseline traffic flows on each road are generally in line with their classification. Further, Parramatta Road exhibits high traffic flows in both directions despite the expected flow eastbound towards the Sydney CBD in the AM peak.

The PM peak traffic flows at the intersection are presented below in **Table 2**:

Table 2 - 2012 PM Peak Great North Road / Parramatta Rd Traffic Volumes (5:00pm – 6:00pm)

Intersection	Leg	Direction	Movement	Volume (veh)
Parramatta Rd / Great North Rd	Parramatta Rd East	WB	Through	2022
		WB	Right	302
	Great North Rd	SB	Left	234
		SB	Right	180
	Parramatta Rd West	EB	Left	128
		EB	Through	2568

[1] Parramatta Road Paramics Modelling 2012 Base Case & Option Testing Paramics Option Network Analysis Report (2012 SKM)

Proposed Intersection Upgrade

The key elements of the proposal in terms of traffic and intersection configuration are presented below:

- Duplication of the right turn lane from Parramatta Road westbound to Great North Road.
- Widening of Parramatta Road on its northern side (including widening of canal bridge) to accommodate additional turn lane
- Narrowing of existing median in Parramatta Road
- Remove of 1-2 on street parking space in Dobroyd Parade to accommodate Parramatta Road widening
- Adjustment of property access arrangements fronting Parramatta Road (on its northern side) to accommodate widening of Parramatta Road
- Maintaining of three (3) travel lanes in each direction in Parramatta Road.

Plans of the proposed development are provided in **Appendix C** of this report.

As stated above, the current demands on the existing right turn bay exceed the available queuing capacity. In turn, this overqueuing impacts on the adjacent westbound lane/s and reduces westbound capacity. The proposed duplication of the right turn lanes would increase the available queueing capacity and reduce the impacts on westbound traffic.

Modelling of Future Traffic Conditions

SKM were commissioned by the Roads and Maritime Services to build upon the baseline work to prepare a Paramics microsimulation model for the Parramatta Road corridor and investigate potential improvements to traffic conditions through the rollout of intersection improvements.

The upgrade of the intersection of the Great North Road / Parramatta Road intersection was included in the assessment of future traffic conditions. Of note the arrangements assumed in the model match those as currently proposed. The culmination of this report was presented in the "Parramatta Road Paramics Modelling 2012 Base Case & Option Testing Paramics Option Network Analysis Report (2012 SKM).

The approach to the assessment of future traffic conditions was based on an analysis of potential additional traffic throughput following inclusion of the proposed improvements in the modelling. An increase in traffic throughput at an intersection confirmed that the proposed improvements would result in additional capacity at the intersection to accommodate larger demands.

The findings of the report for the proposed improvements at the Great North Road / Parramatta Road from this 2012 is presented in **Table 3** below:

Table 3 – Future Traffic Flows – SKM 2012 Option Testing Report

Intersection	Approach	2012 AM Peak 0700-0900			2012 PM Peak 0700-0900		
		Base	Option	Differences in vehicles (%)	Base	Option	Differences in vehicles (%)
Parramatta Rd / Great North Rd	Eastbound	5,580	5,562	82 (1.5%)	5,550	6,003	453 (8.2%)
	Westbound	4,383	4,633	250 (5.7%)	4,900	4,840	-60 (-1/2%)*

*Negative improvements can be neglected as the difference value is very low

From **Table 3** it can be seen that the proposed improvements would result in an increase of 1.5% - 5.7% throughput of traffic in the AM peak and 8.2% increase in eastbound throughput in the PM peak. However, there would be a small reduction in throughput westbound in the PM peak of 1.2%.

This would indicate that overall the proposed improvements at the intersection of Great North Road / Parramatta Road would have a positive impact on existing traffic conditions. That is, the upgrade, along with the similar upgrades proposed in other locations along the Parramatta Road corridor, provide sufficient storage length to accommodate turning vehicles resulting in minimum overflow of turning bays. Therefore, reducing impedance to through traffic on Parramatta Road and improving the overall operation of the corridor.

Conclusion / Recommendations

This report has provided a summary assessment of the potential benefits to traffic conditions following the proposed upgrade of the intersection of the Great North Road / Parramatta Road to provide a dual right turn from Parramatta Road to Great North Road. The findings of this assessment are presented below:

1. Existing demands on Parramatta Road are high in both directions during the morning and afternoon peak periods.
2. The Parramatta Road corridor exhibits poor levels of service for traffic during both the AM and PM peak periods.
3. Observations of traffic conditions noted over queuing in the existing single right turn lane into the Great North Road.
4. The provision of a dual lane right turn bay would result in less over queuing of right turning traffic which in turn impedes on westbound traffic in Parramatta Road.
5. The proposed works would have an overall positive impact on current / future traffic conditions both in the vicinity of the site and along the Parramatta Road corridor in general.
6. The proposed works would result in improved eastbound throughput at the intersection whilst maintaining similar levels of westbound throughput during peak periods.

Overall the potential impacts of the proposal are considered acceptable.

We trust this report assists you in your planning for the project. Should you require any further information please do not hesitate to contact myself on 0414 462247.

Yours sincerely

DEAN BRODIE
Managing Director

Appendix A – Site Inspection Photographs


Existing Parking - Dobroyd Pde
Oct 12, 2015, 10:33 AM


Henley Marine Dr
Oct 12, 2015, 10:38 AM

Appendix B – 2010 to 2014 RMS Accident Statistics

Summary Crash Report

# Crash Type		
Car Crash	66	88.0%
Light Truck Crash	13	17.3%
Rigid Truck Crash	6	8.0%
Articulated Truck Crash	4	5.3%
'Heavy Truck Crash	(10)	(13.3%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(10)	(13.3%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	9	12.0%
Pedal Cycle Crash	1	1.3%
Pedestrian Crash	2	2.7%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	45	60.0%
Non intersection	30	40.0%

* Up to 10 metres from an intersection

Collision Type		
Single Vehicle	5	6.7%
Multi Vehicle	70	93.3%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	75	100.0%
Other Classified Road	0	0.0%
Unclassified Road	0	0.0%

Contributing Factors		
Speeding	1	1.3%
Fatigue	1	1.3%

Weather		
Fine	54	72.0%
Rain	14	18.7%
Overcast	7	9.3%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	18	24.0%
Dry	57	76.0%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	4	5.3%
Daylight	49	65.3%
Dusk	1	1.3%
Darkness	21	28.0%

Crash Movement		
Intersection, adjacent approaches	14	18.7%
Head-on (not overtaking)	1	1.3%
Opposing vehicles; turning	2	2.7%
U-turn	1	1.3%
Rear-end	33	44.0%
Lane change	9	12.0%
Parallel lanes; turning	2	2.7%
Vehicle leaving driveway	2	2.7%
Overtaking; same direction	0	0.0%
Hit parked vehicle	1	1.3%
Hit railway train	0	0.0%
Hit pedestrian	2	2.7%
Permanent obstruction on road	0	0.0%
Hit animal	0	0.0%
Off road, on straight	0	0.0%
Off road on straight, hit object	3	4.0%
Out of control on straight	1	1.3%
Off road, on curve	0	0.0%
Off road on curve, hit object	0	0.0%
Out of control on curve	1	1.3%
Other crash type	3	4.0%

Speed Limit					
40 km/h or less	0	0.0%	80 km/h zone	0	0.0%
50 km/h zone	2	2.7%	90 km/h zone	0	0.0%
60 km/h zone	70	93.3%	100 km/h zone	0	0.0%
70 km/h zone	3	4.0%	110 km/h zone	0	0.0%

~ 07:30-09:30 or 14:30-17:00 on school days	~ 40km/h or less	0	0.0%	~ School Travel Time Involvement	12	16.0%

CRASHES	75	
Fatal crash	1	1.3%
Injury crash	36	48.0%
Non-casualty crash	38	50.7%

Self Reported Crash	3	4%

Time Group		% of Day	
00:01 - 02:59	3	4.0%	12.5%
03:00 - 04:59	2	2.7%	8.3%
05:00 - 05:59	6	8.0%	4.2%
06:00 - 06:59	4	5.3%	4.2%
07:00 - 07:59	4	5.3%	4.2%
08:00 - 08:59	6	8.0%	4.2%
09:00 - 09:59	2	2.7%	4.2%
10:00 - 10:59	1	1.3%	4.2%
11:00 - 11:59	9	12.0%	4.2%
12:00 - 12:59	7	9.3%	4.2%
13:00 - 13:59	4	5.3%	4.2%
14:00 - 14:59	4	5.3%	4.2%
15:00 - 15:59	4	5.3%	4.2%
16:00 - 16:59	2	2.7%	4.2%
17:00 - 17:59	3	4.0%	4.2%
18:00 - 18:59	3	4.0%	4.2%
19:00 - 19:59	2	2.7%	4.2%
20:00 - 21:59	7	9.3%	8.3%
22:00 - 24:00	2	2.7%	8.3%

Street Lighting Off/Nil		% of Dark
0	of 21 in Dark	0.0%

CASUALTIES	40	
Killed	1	2.5%
Injured	39	97.5%
^ Unrestrained	0	0.0%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Crashes		Casualties
15	2014	13
12	2013	6
14	2012	6
23	2011	11
11	2010	4

McLean Periods			% Week
A	21	28.0%	17.9%
B	1	1.3%	7.1%
C	20	26.7%	17.9%
D	4	5.3%	3.5%
E	3	4.0%	3.6%
F	7	9.3%	10.7%
G	7	9.3%	7.1%
H	4	5.3%	7.1%
I	3	4.0%	12.5%
J	5	6.7%	10.7%

Day of the Week						# Holiday Periods		
Monday	11	14.7%	Thursday	16	21.3%	Sunday	7	9.3%
Tuesday	11	14.7%	Friday	13	17.3%	WEEKDAY	58	77.3%
Wednesday	7	9.3%	Saturday	10	13.3%	WEEKEND	17	22.7%

New Year	0	0.0%	Queen's BD	0	0.0%	Easter SH	7	9.3%
Aust. Day	1	1.3%	Labour Day	2	2.7%	June/July SH	3	4.0%
Easter	0	0.0%	Christmas	0	0.0%	Sept./Oct. SH	4	5.3%
Anzac Day	0	0.0%	January SH	5	6.7%	December SH	0	0.0%

Crashid dataset 6599 - Reported crashes on Parramatta Rd between Croydon Rd & Wolseley St - 1 Jan 10 to 31 Dec 14

Note: Crash self reporting, including self reported injuries began in Oct 2014. Trends from 2014 are expected to vary from previous years. More unknowns are expected in self reported data. For further information refer to Data Manual or report provider.

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Appendix C – Plans of Proposed Intersection Upgrade

TCS 0058

DRAWN BY CADD
DO NOT AMEND MANUALLY

DATE IN SERVICE : 21/04/47

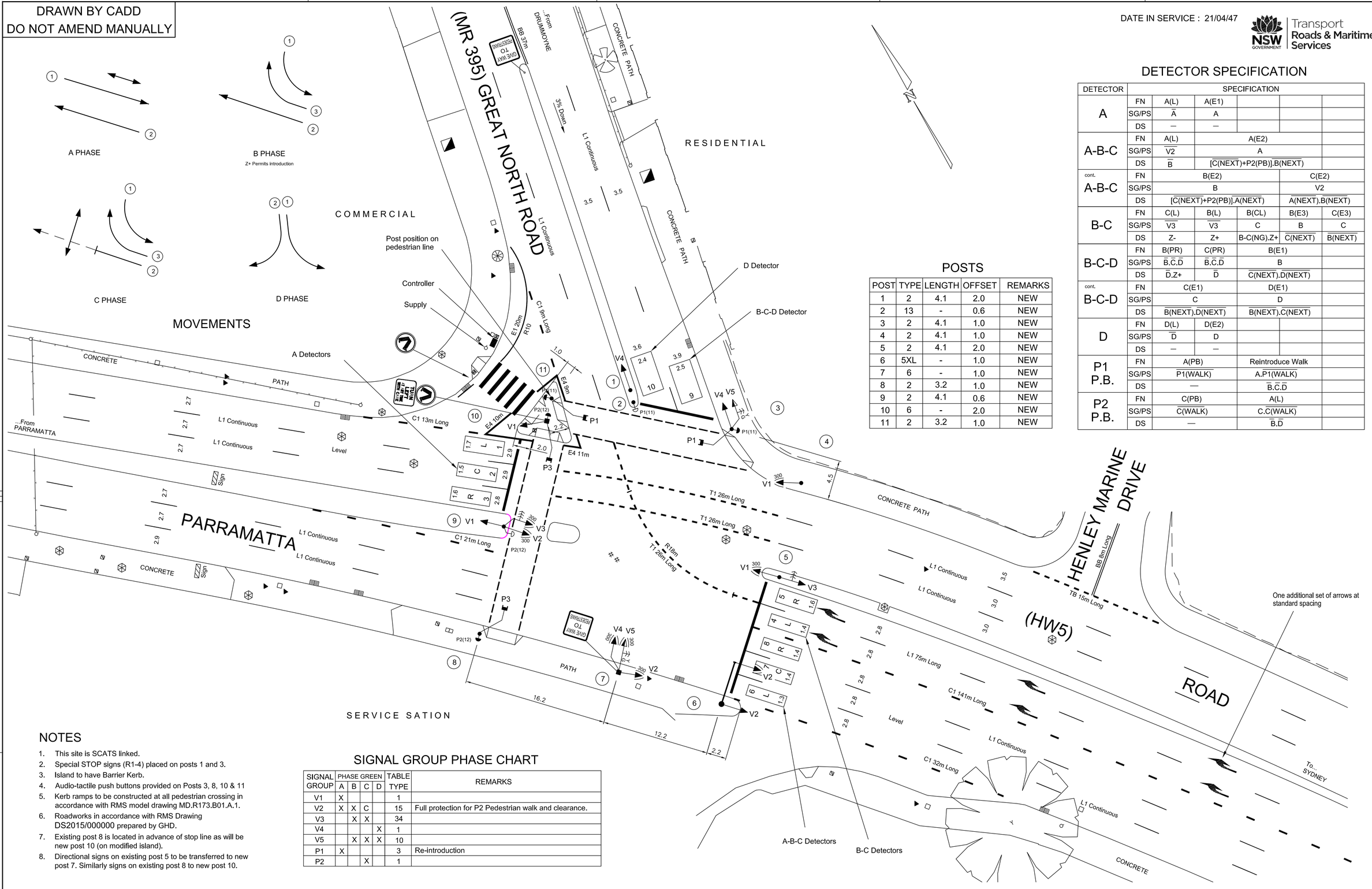
NSW GOVERNMENT | Transport Roads & Maritime Services

DETECTOR SPECIFICATION

DETECTOR		SPECIFICATION				
A	FN	A(L)	A(E1)			
	SG/PS	$\overline{A}$	A			
	DS	—	—			
A-B-C	FN	A(L)	A(E2)			
	SG/PS	$\overline{V2}$	A			
	DS	$\overline{B}$	[C(NEXT)+P2(PB)].B(NEXT)			
cont. A-B-C	FN	B(E2)			C(E2)	
	SG/PS	B			V2	
	DS	[C(NEXT)+P2(PB)].A(NEXT)			A(NEXT),B(NEXT)	
B-C	FN	C(L)	B(L)	B(CL)	B(E3)	C(E3)
	SG/PS	$\overline{V3}$	$\overline{V3}$	C	B	C
	DS	Z-	Z+	B-C(NG).Z+	C(NEXT)	B(NEXT)
B-C-D	FN	B(PR)	C(PR)	B(E1)		
	SG/PS	B.C.D	B.C.D	B		
	DS	D.Z+	D	C(NEXT),D(NEXT)		
cont. B-C-D	FN	C(E1)		D(E1)		
	SG/PS	C		D		
	DS	B(NEXT).D(NEXT)		B(NEXT).C(NEXT)		
D	FN	D(L)	D(E2)			
	SG/PS	$\overline{D}$	D			
	DS	—	—			
P1 P.B.	FN	A(PB)		Reintroduce Walk		
	SG/PS	P1(WALK)		A.P1(WALK)		
	DS	—		B.C.D		
P2 P.B.	FN	C(PB)		A(L)		
	SG/PS	C(WALK)		C.C(WALK)		
	DS	—		B.D		

POSTS

POST	TYPE	LENGTH	OFFSET	REMARKS
1	2	4.1	2.0	NEW
2	13	-	0.6	NEW
3	2	4.1	1.0	NEW
4	2	4.1	1.0	NEW
5	2	4.1	2.0	NEW
6	5XL	-	1.0	NEW
7	6	-	1.0	NEW
8	2	3.2	1.0	NEW
9	2	4.1	0.6	NEW
10	6	-	2.0	NEW
11	2	3.2	1.0	NEW



NOTES

1. This site is SCATS linked.
2. Special STOP signs (R1-4) placed on posts 1 and 3.
3. Island to have Barrier Kerb.
4. Audio-tactile push buttons provided on Posts 3, 8, 10 & 11
5. Kerb ramps to be constructed at all pedestrian crossing in accordance with RMS model drawing MD.R173.B01.A.1.
6. Roadworks in accordance with RMS Drawing DS2015/000000 prepared by GHD.
7. Existing post 8 is located in advance of stop line as will be new post 10 (on modified island).
8. Directional signs on existing post 5 to be transferred to new post 7. Similarly signs on existing post 8 to new post 10.

SIGNAL GROUP PHASE CHART

SIGNAL GROUP	PHASE GREEN A	B	C	D	TABLE TYPE	REMARKS
V1	X				1	
V2	X	X	C		15	Full protection for P2 Pedestrian walk and clearance.
V3		X	X		34	
V4				X	1	
V5		X	X	X	10	
P1	X				3	Re-introduction
P2			X		1	

A ORIGINAL ISSUE

INCOMPLETE
PROPOSED POWER POLE AND DRAIN PIT
LOCATIONS REQUIRED

PUBLIC UTILITY LEGEND		REFERENCE PLANS	
HYDRANT	□	SYMBOLS/ABBS.	VD003-6
STOP VALVE	▲	STD POSIT	VD001-5
GAS VALVE	#	PRES. DETECT	VC005-17
SEWER MANHOLE	⊕	VEH. GROUP OP	TS-TN-019
TELECOM PIT	◪	DET. LOGIC OP	TS-TN-020
ELECT LIGHT POLE	☼	PED. MOVEMNT OP	TS-TN-021
POWER POLE	○		
STAY POLE	⊘		
TELEPHONE BOX	⚿	SURVEYOR: RMS	
TELECOM PILLAR	◕	DATE : 2014	

U.B.D. Ref. Map 234 D12
I.S.G. CO-ORDS E: 311 690 N: 1 250 798

DESIGNED J BATES
CHECKED RB
J BATES SITE CHECKED
J BATES RECOMMENDED

DESIGN APPROVAL
APPROVED
POSITION MANAGER
DATE 23/06/15
DESIGN PREPARED BY
B-Line Drafting

RMS ACCEPTANCE
RECOMMENDED
POSITION
DATE
ACCEPTED
POSITION
DATE

ROADS AND MARITIME SERVICES

CITY OF CANADA BAY COUNCIL AREA
TRAFFIC SIGNALS AT
(HW5) PARRAMATTA ROAD AND
(MR 395) GREAT NORTH ROAD
FIVE DOCK

DESIGN LAYOUT TCS No 0058

EXISTING □ PROPOSED ☒
CADD FILE: VV0058_XA.dgn
SCALE 5 0 (1:200) 5 10
ISSUE A
FILE SF0000/000000
SUPERSEDES SHEET/ISSUE 12/L
REG No. DS0000/000000
TCS No. 0058
SHEET X

$DATE$ $TIME$ $FILE$

Revision 1 - August 2014

Appendix D

Construction and Operational Noise and Vibration Assessment

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

PARRAMATTA ROAD & GREAT NORTH ROAD INTERSECTION, FIVE DOCK

Construction and Operational Noise and Vibration Assessment

21 October 2016

SNC Lavalin Australia Pty Ltd

TH642-01F02 (rev 4) Report

30 1982 2012 ACOUSTIC EXCELLENCE
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Attention:	MR RICHARD PETERSON

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Date	Revision history	Non-issued revision	Issued revision	Prepared	Instructed	Authorised
13.05.2016	Generate report	0	1	WC	MCH	MCH
26.05.2016	Final	-	2	WC	MCH	MCH
07.10.2016	Include piling works/update for RMS comments		3	WC	MCH	MCH
21.10.2016	Updated piling design		4	WC	MCH	MCH

The work presented in this document was carried out in accordance with the Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

This document is issued subject to review and authorisation by the Team Leader noted by the initials printed in the last column above. If no initials appear, this document shall be considered as preliminary or draft only and no reliance shall be placed upon it other than for information to be verified later.

This document is prepared for our Client's particular requirements which are based on a specific brief with limitations as agreed to with the Client. It is not intended for and should not be relied upon by a third party and no responsibility is undertaken to any third party without prior consent provided by Renzo Tonin & Associates. The information herein should not be reproduced, presented or reviewed except in full. Prior to passing on to a third party, the Client is to fully inform the third party of the specific brief and limitations associated with the commission.

The information contained herein is for the purpose of acoustics only. No claims are made and no liability is accepted in respect of design and construction issues falling outside of the specialist field of acoustics engineering including and not limited to structural integrity, fire rating, architectural buildability and fit-for-purpose, waterproofing and the like. Supplementary professional advice should be sought in respect of these issues.

Contents

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1 Introduction

Renzo Tonin & Associates was engaged by SNC Lavalin to undertake an environmental noise assessment for the construction and operation of the proposed upgrade of the Parramatta Road and Great North Road intersection at Five Dock. More specifically, this report quantifies the potential noise impact on sensitive receivers from road traffic and construction activity associated with the proposed widening and addition of lanes to Parramatta Road.

This study identifies sensitive locations and assesses potential noise and vibration impacts against noise and vibration criteria presented in the NSW Environment Protection Authority's (EPA) 'Road Noise Policy' (RNP), 'Interim Construction Noise Guideline' (ICNG) and the NSW Roads & Maritime Service's (RMS) 'Environmental Noise Management Manual' (ENMM). The issues addressed in this study include:

- Noise and vibration emissions during construction of the project; and
- Noise emissions from traffic lanes moving closer to residents on the northern side of Parramatta Road during the operation of the upgrade.

The existing ambient noise environment was determined by conducting unattended long-term noise monitoring at a key residential receiver location. Noise emissions from the proposed intersection upgrade were then calculated at the potentially most affected residential receivers for both the construction and operational phases.

The work documented in this report was carried out in accordance with the requirements of the EPA's 'Road Noise Policy' (RNP), 'Interim Construction Noise Guideline' (ICNG), RMS's 'Environmental Noise Management Manual' (ENMM) and Renzo Tonin & Associates Quality Assurance System, which is based on Australian Standard / NZS ISO 9001.

2 Project Description

Roads and Maritime Services (RMS) propose to upgrade the intersection of Parramatta Road and Great North Road at Five Dock. The upgrade will include the extension of the existing right turn lane and the addition of a second right turn lane from Parramatta Road onto Great North Road and the repositioning of the traffic lanes on the northern side of Parramatta Road between Arlington Street and Wolseley Street, to accommodate the additional lane. The project aims to:

- Improve traffic congestion on Parramatta Road, at the intersection with Great North Road, for the outbound direction, as vehicles in Lane 3 will be less likely to be blocked by the overflowing right turn bay.
- Increase the physical capacity of the right turn movement from Parramatta Road to Great North Road.
- Improve the safety of Parramatta Road, on approach to the intersection with Great North Road, by reducing the frequency of the right turn bay overflowing in to the through lane.
- Review the existing parking provided on the Great North Road, due to the proposed changes.

2.1 Scope of Works

The scope of works for the project is as follows:

- Duplication of the right turn lane from Parramatta Road to Great North Road;
- Review the on-street parking permitted on Great North Road;
- Pavement widening on the northern side of Parramatta Road;
- Relocation of traffic control systems infrastructure to suit the new intersection layout;
- Asphalt milling and resheeting;
- Installing piles in the breakwater and the north east abutment of Iron Cove CreekBridge;
- Utility adjustments;
- Signage and line marking adjustments;
- Adjustments to driveway accesses;
- Property acquisition and adjustment;
- Bus shelter relocation;
- Bridge works;

- Modification to stormwater drainage infrastructure; and
- Tree removal and trimming.

2.2 Sensitive Receivers

The following noise sensitive receivers were identified during a site inspection to be the nearest affected receivers.

Table 2.1 – Sensitive Receiver Locations

Receiver	Address	Description
R1	7 Great North Rd	Single storey residential building located approximately 23m to the north of the proposed intersection upgrade works
R2	8 Great North Rd	Single storey residential building located approximately 11m to the east of the proposed intersection upgrade works
R3	6 Great North Rd	Single storey residential building located approximately 11m to the east of the proposed intersection upgrade works
R4	4 Great North Rd	Double storey residential building located approximately 11m to the east of the proposed intersection upgrade works
R5	1A Henley Marine Dr	Double storey residential building located approximately 37m to the east of the proposed intersection upgrade works
R6	16 Cove St	Single storey residential building located approximately 43m to the east of the proposed intersection upgrade works
R7	18-20 Knocklayde St – Eastern-most Building	Multistorey residential building located approximately 58m to the west of the proposed intersection upgrade works
R8	18-20 Knocklayde St – Northern-most Building	Multistorey residential building located approximately 51m to the west of the proposed intersection upgrade works
R9	586 Parramatta Rd	Multistorey residential building located approximately 70m to the west of the proposed intersection upgrade works
R10	Audi – 3-7 Parramatta Rd	Double store commercial building located approximately 3m to the north of the proposed intersection upgrade works
R11	Amber Five Dock – 1 Parramatta Rd	Single storey commercial building located approximately 4m to the east of the proposed intersection upgrade works
R12	Little VIP Childcare – 113 Dobroyd Pde	Childcare centre building located approximately 4m to the east of the proposed intersection upgrade works
R13	Platinum Car Wash -315 Parramatta Rd	Single storey commercial building located approximately 10m to the east of the proposed intersection upgrade works
R14	Automotive Hospital – 313 Parramatta Rd	Single storey industrial building located approximately 3m to the east of the proposed intersection upgrade works
R15	Unigas Service Station – 273 Parramatta Rd	Single storey commercial building located approximately 24m to the east of the proposed intersection upgrade works
R16	Muirs Prestige Smash Repairs – 271 Parramatta Rd	Single storey industrial building located approximately 19m to the east of the proposed intersection upgrade works
R17	Victory & Indian Motorcycle – 542-554 Parramatta Rd	Single storey commercial building located approximately 26m to the west of the proposed intersection upgrade works
R18	Hungry Jacks – 542-554 Parramatta Rd	Single storey commercial building located approximately 33m to the west of the proposed intersection upgrade works

Receiver	Address	Description
R19	KFC – 542-554 Parramatta Rd	Single storey commercial building located approximately 14m to the west of the proposed intersection upgrade works
R20	McDonald's – 582 Parramatta Rd	Single storey commercial building located approximately 38m to the west of the proposed intersection upgrade works
R21	BP Service Station – 584 Parramatta Rd	Single storey commercial building located approximately 35m to the west of the proposed intersection upgrade works
R22	Five Dock Substation – 590 Parramatta Rd	Double storey industrial building located approximately 6m to the west of the proposed intersection upgrade works

Figure 1 presents the site and surrounds of the study area. The nearest affected noise sensitive receivers are also presented in the figure.

Figure 1 – Locality Map Showing Site, Surrounds and Monitoring & Receiver Locations

2.3 Construction Hours

Construction works are anticipated to be conducted during the following construction hours:

- Daytime work hours – 7am to 6pm, Monday to Friday; and 7am to 1pm on Saturdays
- No works on Sundays or Public Holidays

Works may be conducted out of hours depending on road/lane closure and safety requirements. The duration of the works is estimated to be 7 months

3 Existing Noise Environment

3.1 Noise Monitoring Locations

To determine existing background L_{90} noise levels near the intersection upgrade, long-term noise monitoring was undertaken at the following location:

- **Location M1 – 8 Great North Road**
  Noise monitor was located in the front yard, in the free field and facing Great North Road at a distance of approximately 7m from the edge of the existing carriageway. Noise environment representative of the nearest affected receiver locations.

To quantify the existing ambient noise environment, long-term (unattended) noise monitoring was conducted between Friday 30th October and Wednesday 11th November 2015 at the monitoring location. Figure 1 shows the long term noise monitoring location.

Weather information was obtained from the Bureau of Meteorology for the area over this monitoring period and any data adversely affected by rain, wind or extraneous noise were discarded.

To determine existing traffic noise L_{eq} noise levels near the intersection upgrade along Parramatta Road, short-term noise monitoring was undertaken at the following location:

- **Location S1 –** 542-554 Parramatta Road
  Noise monitoring was conducted in the open air carpark, in the free field and facing Parramatta Road at a distance of approximately 7m from the edge of the existing carriageway.

To quantify the existing traffic noise levels, short-term (attended) noise monitoring was conducted on Tuesday 10th November 2015 at the monitoring location. Figure 1 shows the short term noise monitoring location.

Appendix A of this report presents a description of acoustic terms. The graphical recorded output from long term noise monitoring is included in Appendix D of this report. The graphs in Appendix D were analysed to determine a single assessment background level (ABL) for each day, evening and night period, in accordance with the NSW 'Industrial Noise Policy'.

3.2 Existing Background Noise Levels

The noise environment in the study area is generally controlled by traffic noise from Parramatta Road and Great North Road. Long-term noise monitoring was conducted to quantify existing background noise levels. The purpose of the noise monitoring was to establish background noise levels for the setting of construction noise goals for the project.

Existing background noise levels are presented in Table 3.1 below.

Table 3.1 – Measured Background (L_{90}) Noise Levels, dB(A)

Noise Monitoring Location	L_{A90} Background Noise Levels		
	Day	Evening	Night
Location M1 – 8 Great North Road	55	52	46

3.2.1 Existing Traffic Noise Levels

Existing traffic noise levels are presented in Table 3.2 below.

Table 3.2 – Measured Traffic (Leq) Noise Levels, dB(A)

Measurement No.	Location	Time	Measured $L_{Aeq(15min)}$ Noise Level
1	S1 – 7m from Parramatta Rd	12:00pm-12:15pm	74.0
2		12:15pm-12:30pm	76.4
3		12:30pm-12:45pm	74.6
4		12:45pm-1:00pm	74.2

Measurements were undertaken during a free flowing traffic period because during peak periods, vehicles along Parramatta Road, between Great North Road and Wattle Street, were banked up at the intersections and at times at a standstill.

4 Construction Noise Assessment

4.1 Construction Noise Objectives

4.1.1 Construction Noise Management Levels at Residences

Construction noise management levels are determined by the NSW 'Interim Construction Noise Guideline' (ICNG, DECC 2009). Table 4.1 below (reproduced from Table 2 of the ICNG) sets out the noise management levels for residences and how they are to be applied.

The guideline intends to provide respite for residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

The rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours).

Table 4.1 – Noise Management Levels at Residential Receivers

Time of Day	Management Level $L_{Aeq\ (15\ min)}$*	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 + 10dB(A)	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 duration, as well as contact details.
	Highly noise affected 75dB(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: • 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) • 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 + 5dB(A)	A strong justification should 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 5dB(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.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 metres above ground level. If the property boundary is more than 30 metres from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 metres of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Residential receivers are considered 'noise affected' where construction noise levels are greater than the noise management levels identified in Table 4.1 above. The noise affected level represents the point above which there may be some community reaction to noise. Where predicted and/or measured construction noise levels exceed noise management levels, all feasible and reasonable work practices will be applied to meet the management levels.

During standard construction hours a highly affected noise objective of $L_{Aeq(15min)}$ 75 dB(A) applies at all receivers.

Table 4.2 identifies the adopted construction noise management levels (NMLs) for the nearest affected receivers identified in Section 2.2. The NMLs for the receiver locations are derived from the RBLs represented by the background noise levels measured at the monitoring location and presented in Section 3.2.

Table 4.2 – Summary of Construction Noise Management Levels at Residential Receivers

Time of Day	Management Level $L_{Aeq(15min)}$	Management Level $L_{Aeq(15min)}$ at all Residential Receiver Locations
During recommended standard hours (day)	RBL + 10dB(A)	55 + 10 = **65**
Outside recommended standard hours (evening)	RBL + 5dB(A)	52 + 5 = **57**
Outside recommended standard hours (night)		46 + 5 = **51**

4.1.2 Other Noise Sensitive Receiver Locations

Table 4.3 sets out the ICNG noise management levels for other noise sensitive receiver locations. As there are commercial and industrial receivers surrounding the proposed upgrade, these premises will also be assessed for construction noise.

Table 4.3 – Noise Management Levels at Other Noise Sensitive Land Uses

Land use	Where objective applies	Management level $L_{Aeq\ (15\ min)}$
Classrooms at schools and other educational institutions	Internal noise level	45 dB(A)
Commercial premises	External noise level	70 dB(A)
Industrial premises	External noise level	75 dB(A)

Notes: 1. Noise management levels apply when premises are in use only

Based on the above table, the following management levels would be applicable for Receivers R10 to R22:

- Receiver R10, R11, R13, R15, R17, R18, R19, R20 and R21 are commercial type premises and the applicable noise management level is **70dB(A)**.
- Receiver R12 is a childcare centre and therefore, the applicable noise management level of 45dB(A) is applicable for internal areas associated with the childcare centre. A conservative

10dB(A) reduction from external to internal noise levels has been adopted to allow an external assessment. Therefore, for the internal areas of the childcare centre the equivalent external noise management level would be **55dB(A)**.

- Receivers R14, R16 and R22 are industrial type premises and the applicable noise management level is 75dB(A).

4.1.3 Sleep Disturbance

Given that works during the night time period (ie. 10pm to 7am) are proposed, the assessment of sleep disturbance is to be undertaken.

The ICNG recommends that where construction works are planned to extend over two or more consecutive nights, the assessment should consider maximum noise levels and the extent and frequency of maximum noise level events exceeding the RBL. The ICNG (p15) refers to the discussion on sleep disturbance provided in the NSW Environmental Criteria for Road Traffic Noise (ECRTN, Environment Protection Authority 1999, pp 25-30). The ECRTN presents a summary of the findings from all the research conducted world-wide on sleep disturbance, and after consideration of all the information presented it concludes the following:

- Maximum internal noise levels below 50-55dB(A) are unlikely to cause awakening reactions.
- One or two events per night with maximum internal noise levels of 65-70dB(A) are not likely to affect health and wellbeing. (ECRTN p29)

As a general rule, building structures of dwellings would typically provide a minimum of 10dB(A) reduction from external noise levels to internal noise levels with windows sufficiently open for fresh air ventilation. Therefore, based on the above internal limits the equivalent external NML for sleep disturbance for the purposes of this construction noise assessment is set as **L_{Amax} 65 dB(A)**.

4.2 Construction Noise Sources

Construction work is anticipated to be carried out during standard daytime hours whenever practicable; however, there may be periods of evening or night time works.

The following table lists construction plant and equipment likely to be used by the contractor to carry out the necessary construction work for the intersection upgrade. It is noted that the plant and equipment presented may be used during night time construction works.

Table 4.4 – Typical Construction Equipment & Sound Power Levels

Plant Description	Sound Power Levels, dB(A) re. 1pW	
	L_{Aeq}	L_{Amax}[1]
Chainsaw	116	121
Concrete Saw	115	118
Hydraulic Jack	115	121

Plant Description	Sound Power Levels, dB(A) re. 1pW	
	L_{Aeq}	L_{Amax}[1]
Road Saw Cutter	115	118
Piling Rig - Bored	112	115
Cranes	110	115
Hand-held Equipment	110	115
Loaders	110	115
Asphalt Paver	109	114
Line Marking Equipment	108	112
Profile and Milling Machines	108	111
Truck and Trailer	108	113
Bobcat	107	115
Excavators	107	115
Concrete Agitator Truck	106	110
Rollers	106	110
Tree Mulcher	106	110
Water Carts	104	108
Day Makers	100	106
Elevated Working Platform	100	106
Generator	100	106

Note: 1. Only applicable for the assessment of night time works

The sound power levels for the majority of activities presented in the above table are based on maximum levels given in Table A1 of Australian Standard 2436 - 2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites", ICNG, information from past projects and information held in the Renzo Tonin & Associates library files.

4.3 Construction Noise Assessment

Noise levels at any receiver locations resulting from construction works would depend on the location of the receiver with respect to the area of construction, shielding from intervening topography and structures, and the type and duration of construction being undertaken. Furthermore, noise levels at receivers would vary significantly over the total construction program due to the transient nature and large range of plant and equipment that could be used.

Table 4.5 presents noise levels likely to be experienced at the nearby affected receivers based on the construction activities and plant and equipment associated with the proposed intersection upgrade. Noise levels were calculated taking into consideration attenuation due to distance between the construction works and the receiver locations and any intervening structures.

Table 4.5 – Predicted $L_{Aeq(15min)}$ Noise Levels for Typical Construction Plant, dB(A)

Equipment / Plant	Predicted $L_{eq(15min)}$ Construction Noise Levels at Receiver Location																					
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22
Noise Management Level	*Day 65 / Evening 57 / Night 51*									*70*	*70*	*55*	*70*	*75*	*70*	*75*	*70*	*70*	*70*	*70*	*70*	*75*
Concrete Saw	72	82	84	84	71	68	67	66	66	93	94	88	84	100	73	75	70	72	80	68	72	88
Hydraulic Jack	72	82	84	84	71	68	67	66	66	93	94	88	84	100	73	75	70	72	80	68	72	88
Road Saw Cutter	72	82	84	84	71	68	67	66	66	93	94	88	84	100	73	75	70	72	80	68	72	88
Piling Rig - Bored	51	47	45	61	67	65	59	61	57	57	66	77	62	56	52	52	52	58	63	57	57	58
Cranes	67	77	79	79	66	63	62	61	61	88	89	83	79	95	68	70	65	67	75	63	67	83
Hand-held Equipment	67	77	79	79	66	63	62	61	61	88	89	83	79	95	68	70	65	67	75	63	67	83
Loaders	67	77	79	79	66	63	62	61	61	88	89	83	79	95	68	70	65	67	75	63	67	83
Asphalt Paver	66	76	78	78	65	62	61	60	60	87	88	82	78	94	67	69	64	66	74	62	66	82
Line Marking Equipment	65	75	77	77	64	61	60	59	59	86	87	81	77	93	66	68	63	65	73	61	65	81
Profile and Milling Machines	65	75	77	77	64	61	60	59	59	86	87	81	77	93	66	68	63	65	73	61	65	81
Truck and Trailer	65	75	77	77	64	61	60	59	59	86	87	81	77	93	66	68	63	65	73	61	65	81
Bobcat	64	74	76	76	63	60	59	58	58	85	86	80	76	92	65	67	62	64	72	60	64	80
Excavators	64	74	76	76	63	60	59	58	58	85	86	80	76	92	65	67	62	64	72	60	64	80
Concrete Agitator Truck	63	73	75	75	62	59	58	57	57	84	85	79	75	91	64	66	61	63	71	59	63	79
Rollers	63	73	75	75	62	59	58	57	57	84	85	79	75	91	64	66	61	63	71	59	63	79
Tree Mulcher	63	73	75	75	62	59	58	57	57	84	85	79	75	91	64	66	61	63	71	59	63	79
Water Carts	61	71	73	73	60	57	56	55	55	82	83	77	73	89	62	64	59	61	69	57	61	77
Day Makers	57	67	69	69	56	53	52	51	51	78	79	73	69	85	58	60	55	57	65	53	57	73
Elevated Working Platform	57	67	69	69	56	53	52	51	51	78	79	73	69	85	58	60	55	57	65	53	57	73
Generator	57	67	69	69	56	53	52	51	51	78	79	73	69	85	58	60	55	57	65	53	57	73

Equipment / Plant	Predicted $L_{eq(15min)}$ Construction Noise Levels at Receiver Location																				
	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17	R18	R19	R20	R21	R22
Top 3 Noisiest Plant Operating Concurrently	77	87	88	89	76	73	72	71	71	98	98	92	88	105	78	79	75	77	85	73	76	93

Notes:
1. Predicted level exceeding the highly affected noise objective of 75dB(A) are in red font
2. Predicted level exceeding the Day, Evening and Night Noise Management Levels are in blue font
3. Predicted level exceeding the Evening and Night Noise Management Levels are in green font
4. Predicted level exceeding only the Night Noise Management Level are in pink font

Based on the predicted L_{Aeq} construction noise levels presented in the table above, the daytime construction noise management levels would be exceeded at all receivers except Receivers R16, R17 and R20. Furthermore, Receivers R1, R2, R3, R4, R5, R10, R11, R12, R13, R14, R15, R16, R18, R19, R21 and R22 have been predicted to be impacted by construction noise levels above the highly noise affected level [ie. > 75dB(A)].

For out of hours works during the evening period (6pm to 10pm), the evening construction noise management level would be exceeded at all receivers except Receivers R16, R17 and R20.

For out of hours works during the night time period (10pm to 7am), the night construction noise management level would be exceeded at all residential receivers.

Noise impact areas surrounding the construction works are shown in Appendix F.

In light of the predicted noise levels above, it is recommended that a feasible and reasonable approach towards noise management measures be applied to reduce noise levels as much as possible to manage the impact from construction noise.

Further details on construction noise mitigation and management measures are provided in Section 4.4 below.

4.3.1 Sleep Disturbance Assessment

In addition to the above predicted noise levels, Table 4.6 below presents a summary of the predicted L_{Amax} noise levels at residential receivers during the night time construction works. As discussed previously, in accordance with the ICNG the sleep disturbance assessment is only applicable where construction works are planned to extend over more than two consecutive nights.

Table 4.6 – Predicted L_{Amax} Construction Noise Levels for Night Works, dB(A)

Equipment / Plant	Predicted L_{Amax} Construction Noise Levels at Receiver Location								
	R1	R2	R3	R4	R5	R6	R7	R8	R9
Sleep Disturbance Upper Limit					*65*				
Concrete Saw	**75**	**85**	**87**	**87**	**74**	**71**	**70**	**69**	**69**
Hydraulic Jack	**78**	**88**	**90**	**90**	**77**	**74**	**73**	**72**	**72**
Road Saw Cutter	**75**	**85**	**87**	**87**	**74**	**71**	**70**	**69**	**69**
Piling Rig - Bored	54	50	48	64	**70**	**68**	62	64	60
Cranes	**72**	**82**	**84**	**84**	**71**	**68**	**67**	**66**	**66**
Hand-held Equipment	**72**	**82**	**84**	**84**	**71**	**68**	**67**	**66**	**66**
Loaders	**72**	**82**	**84**	**84**	**71**	**68**	**67**	**66**	**66**
Asphalt Paver	**71**	**81**	**83**	**83**	**70**	**67**	**66**	65	65
Line Marking Equipment	**69**	**79**	**81**	**81**	**68**	65	64	63	63
Profile and Milling Machines	**68**	**78**	**80**	**80**	**67**	64	63	62	62
Truck and Trailer	**70**	**80**	**82**	**82**	**69**	**66**	65	64	64

Equipment / Plant	Predicted L_{Amax} Construction Noise Levels at Receiver Location								
	R1	R2	R3	R4	R5	R6	R7	R8	R9
Bobcat	**72**	**82**	**84**	**84**	**71**	**68**	**67**	**66**	**66**
Excavators	**72**	**82**	**84**	**84**	**71**	**68**	**67**	**66**	**66**
Concrete Agitator Truck	**67**	**77**	**79**	**79**	**66**	63	62	61	61
Rollers	**67**	**77**	**79**	**79**	**66**	63	62	61	61
Tree Mulcher	**67**	**77**	**79**	**79**	**66**	63	62	61	61
Water Carts	65	**75**	**77**	**77**	64	61	60	59	59
Day Makers	63	**73**	**75**	**75**	62	59	58	57	57
Elevated Working Platform	63	**73**	**75**	**75**	62	59	58	57	57
Generator	63	**73**	**75**	**75**	62	59	58	57	57

Notes:
1. Sleep disturbance assessment is applicable for residential receivers only.
2. Predicted levels are external noise levels at residential receivers only
3. Predicted L_{Amax} noise levels exceeding the Sleep Disturbance Upper Limit are in red font

For the assessment of sleep disturbance, it can be seen that predicted external L_{Amax} noise levels from the majority of the items of plant and equipment would exceed the upper limit of 65dB(A) at all assessment locations. Therefore, it is recommended that attended noise measurements be undertaken at the nearest affected receivers once equipment is introduced on site at the beginning of night works to establish and quantify actual L_{Amax} noise levels on site. Where L_{Amax} noise levels are measured to exceed the sleep disturbance limit, then a reasonable and feasible approach towards noise management measures should be considered to reduce noise levels as much as possible to manage the impact from construction noise during night time periods.

4.4 Construction Noise Mitigation

The following recommendations provide in-principle noise control solutions to reduce construction noise impacts to noise affected receivers. Where actual construction activities differ from those assessed in this report, more detailed design of noise control measures may be required.

The advice provided here is in respect of noise only. Supplementary professional advice may need to be sought in respect of fire ratings, structural design, buildability, fitness for purpose and the like.

4.4.1 General Noise Management Measures

Table 4.7 sets out general noise mitigation measures to be implemented as part of the intersection upgrade works, as required.

Table 4.7 – General Mitigation Measures to Reduce Construction Noise

Action Required	Details
Management Measures	
Implement community consultation measures – inform community of construction activity and potential impacts	Incorporate into Community Liaison Plan
Site inductions	All employees, contractors and subcontractors are to receive a Project induction. The environmental component may be covered in toolboxes and should include: • all relevant project specific and standard noise mitigation measures; • relevant licence and approval conditions; • permissible hours of work; • any limitations on high noise generating activities; • location of nearest sensitive receivers; • construction employee parking areas; • designated loading/unloading areas and procedures; • site opening/closing times (including deliveries); and • environmental incident procedures.
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height where practicable, throwing of metal items and slamming of doors.
Monitoring	Noise monitoring should be considered for the duration of the works as detailed in Section 4.4.4.
Source Controls	
Construction hours and scheduling	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise levels should be scheduled during less sensitive time periods if practicable.
Construction respite period	Noise generating activities with impulsive, tonal or low frequency characteristics (such as impact piling, jack hammering, etc) should only be carried out: • in continuous blocks, up to but not exceeding 3 hours each; and • with a minimum respite period of one hour between each block.
Equipment selection	Use quieter and less noise emitting construction methods where feasible and reasonable.
Maximum noise levels	All plant and equipment to be appropriately maintained to ensure optimum running conditions, with periodic monitoring.
Rental plant and equipment	The noise levels of plant and equipment items are to be considered in rental decisions and in any case cannot be used on site unless compliant with the criteria in Table 4.4.
Use and siting of plant	Simultaneous operation of noisy plant within discernible range of a sensitive receiver is to be limited/ avoided where possible. The offset distance between noisy plant and adjacent sensitive receivers is to be maximised where practicable. Plant used intermittently to be throttled down or shut down when not in use where practicable. Noise-emitting plant to be directed away from sensitive receivers where possible.
Plan worksites and activities to minimise noise	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site.

Action Required	Details
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) should be fitted and used on all construction vehicles and mobile plant regularly used on site for periods of over two months where practicable.
Minimise disturbance arising from delivery of goods to construction sites	Ensure all deliveries occur during standard construction hours.
Path Controls	
Shield sensitive receivers from noisy activities	Where reasonable and feasible, use structures to shield residential receivers from noise such as: • site shed placement; • earth bunds; • temporary or mobile noise screens (where practicable) • enclosures to shield fixed noise sources such as pumps, compressors, fans etc (where practicable); and • consideration of site topography when situating plant.

4.4.2 Noise Control Measures

Implementation of noise control measures, such as those suggested in Australian Standard 2436-2010 "Guide to Noise Control on Construction, Demolition and Maintenance Sites", are expected to reduce predicted construction noise levels. Reference to Australian Standard 2436-2010, Appendix C, Table C1 suggests possible remedies and alternatives to reduce noise emission levels from typical construction equipment. Table C2 in Appendix C presents typical examples of noise reductions achievable after treatment of various noise sources. Table C3 in Appendix C presents the relative effectiveness of various forms of noise control treatment.

Table 4.8 below presents noise control methods, practical examples and expected noise reductions according to AS2436 and according to Renzo Tonin & Associates' opinion based on experience with past projects.

Table 4.8 – Relative Effectiveness of Various Forms of Noise Control, dB(A)

Noise Control Method	Practical Examples	Typical Noise Reduction Possible in Practice	
		AS 2436	Renzo Tonin & Associates
Distance	Doubling of distance between source and receiver	6	6
Screening	Acoustic barriers such as earth mounds, temporary, mobile or permanent noise barriers	5 to 10	5 to 10
Acoustic Enclosures	Engine casing lagged with acoustic insulation and plywood	5 to 10	5 to 10
Engine Silencing	Residential class mufflers	15 to 25	10 to 20
Substitution by alternative process	Use electric motors in preference to diesel or petrol	-	15 to 25

The Renzo Tonin & Associates' listed noise reductions are conservatively low and should be referred to in preference to those of AS2436, for this project.

Table 4.9 below identifies possible noise control measures, which are applicable for the construction plant likely to be used on site.

Table 4.9 – Noise Control Measures for Likely Construction Plant

Plant Description	Screening	Acoustic Enclosures	Silencing	Alternative Process
Concrete Saw	✔	✖	✔	✖
Hydraulic Jack	✔	✖	✔	✔
Road Saw Cutter	✔	✖	✔	✖
Piling Rig - Bored	✔	✖	✔	✖
Cranes	✔	✖	✔	✖
Hand-held Equipment	✔	✔	✖	✖
Loaders	✔	✖	✔	✖
Asphalt Paver	✔	✖	✔	✖
Line Marking Equipment	✔	✖	✔	✖
Profile and Milling Machines	✔	✖	✔	✖
Truck and Trailer	✔	✖	✔	✖
Bobcat	✔	✖	✔	✖
Excavators	✔	✖	✔	✖
Concrete Agitator Truck	✔	✖	✔	✖
Rollers	✔	✖	✔	✖
Tree Mulcher	✔	✖	✔	✖
Water Carts	✔	✖	✔	✖
Day Makers	✔	✔	✔	✖
Elevated Working Platform	✔	✖	✔	✖
Generator	✔	✔	✔	✖

Preliminary testing is recommended prior to commencement of works to ensure efficient noise attenuation performance is achieved using any of the methods listed above.

4.4.3 Managing High Noise Impact Activities

Construction noise levels presented in Table 4.5 indicate predicted noise levels at the residential receiver locations may potentially at times exceed the ICNG 'highly noise affected' noise management level of 75dB(A). In addition to the noise mitigation and management measures discussed above, it is recommended that extensive consultation be carried out with residences experiencing noise above the highly noise affected level of 75dB(A), to manage the potential noise impacts to these properties.

It may be necessary to restrict the times during which construction activities occur in the immediate vicinity of these properties or to offer respite periods by taking into account:

- Times identified by the residents when they are less sensitive to noise, for example between 9am and 3pm when residents are likely to be at work/ school etc; and

- If the residents are prepared to accept a longer period of construction in exchange for restrictions on construction times (ie. respite periods).

4.4.4 Regular Periodic Noise Monitoring

The following approach should be adopted with regard to noise monitoring procedures during the construction works.

- Where potential noise impacts are predicted to be within 10 to 15dB(A) of the noise management level, the potential construction noise nuisance is considered to be moderate. Noise monitoring should be carried out to confirm predicted noise impacts within two weeks of commencement of construction. Reasonable and feasible noise reduction measures should be investigated, where necessary.
- Where potential noise impacts are predicted to be more than 15dB(A) above the noise management levels, the potential construction noise nuisance is considered to be high. All reasonable and feasible noise control measures should be implemented prior to the commencement of construction works. Noise compliance monitoring for all major equipment and activities on the sites should be undertaken prior to their commencement of work on site. Finally, noise levels during construction should be monitored and where exceeded, further noise reduction measures (where reasonable and feasible) should be implemented eg. restrict working hours, use silencing equipment, etc.

4.4.5 Complaints Handling Procedure

In addition to the noise mitigation measures outlined above, it is recommended that a management procedure be put in place to deal with noise complaints that may arise from the construction works. Each complaint would need to be investigated and appropriate noise amelioration measures put in place to mitigate future occurrences, where the noise in question is in excess of allowable limits.

An example of a construction noise management procedure is presented in Appendix C.

5 Construction Vibration

5.1 Vibration Criteria

Construction vibration is associated with three main types of impact:

- disturbance to building occupants;
- potential damage to buildings; and
- potential damage to sensitive equipment in a building.

Generally, if disturbance to building occupants is controlled, there is limited potential for structural damage to buildings.

Vibration amplitude may be measured as displacement, velocity, or acceleration.

- Displacement (x) measurement is the distance or amplitude displaced from a resting position. The SI unit for distance is the meter (m), although common industrial standards include mm.
- Velocity ($v=\Delta x/\Delta t$) is the rate of change of displacement with respect to change in time. The SI unit for velocity is meters per second (m/s), although common industrial standards include mm/s. The Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis (x, y, and z) then the resultant PPV is the vector sum (i.e. the square root of the summed squares of the maximum velocities) regardless of when in the time history those occur.
- Acceleration ($a=\Delta v/\Delta t$) is the rate of change of velocity with respect to change in time. The SI unit for acceleration is meters per second squared (m/s2).

Construction vibration goals are summarised below.

5.1.1 Disturbance to Buildings Occupants

Assessment of potential disturbance from vibration on human occupants of buildings is made in accordance with the DECC '*Assessing Vibration; a technical guideline*' (DECC, 2006). The guideline provides criteria which are based on the British Standard BS 6472-1992 '*Evaluation of human exposure to vibration in buildings (1-80Hz)*'. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent'. Table 5.1 provides definitions and examples of each type of vibration.

Table 5.1 – Types of Vibration

Type of vibration	Definition	Examples
Continuous vibration	Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time)	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery).

Type of vibration	Definition	Examples
Impulsive vibration	A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria.

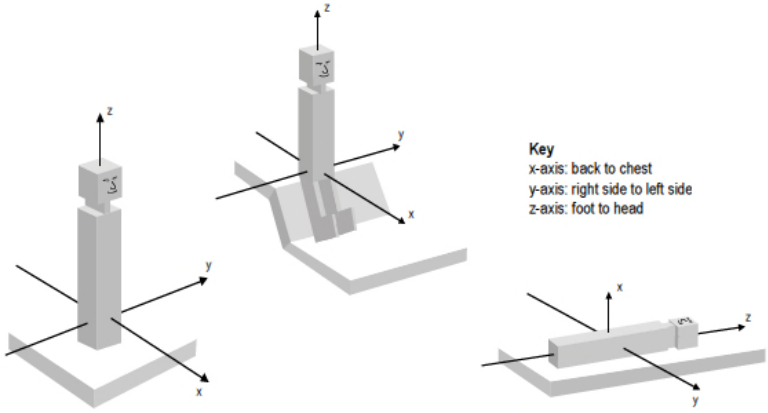
Source: Assessing Vibration; a technical guideline, Department of Environment & Climate Change, 2006

The vibration criteria are defined as a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

> *'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).'*

When applying the criteria, it is important to note that the three directional axes are referenced to the human body, i.e. x-axis (back to chest), y-axis (right side to left side) or z-axis (foot to head). Vibration may enter the body along different orthogonal axes and affect it in different ways. Therefore, application of the criteria requires consideration of the position of the people being assessed, as illustrated in Figure 2. For example, vibration measured in the horizontal plane is compared with x- and y-axis criteria if the concern is for people in an upright position, or with the y- and z- axis criteria if the concern is for people in the lateral position.

Figure 2 – Orthogonal Axes for Human Exposure to Vibration



The preferred and maximum values for continuous and impulsive vibration are defined in Table 2.2 of the guideline and values for the type of receivers surrounding the site are reproduced in Table 5.2.

Table 5.2 – Preferred and Maximum Levels for Human Comfort

Location	Assessment Period[1]	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous Vibration (Weighted RMS Acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive Vibration (Weighted RMS Acceleration, m/s^2, 1-80Hz)					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

Notes: 1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

The acceptable vibration dose values (VDV) for intermittent vibration are defined in Table 2.4 of the guideline and values for the type of receivers surrounding the site are reproduced in Table 5.3

Table 5.3 – Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred Value	Maximum Value	Preferred Value	Maximum Value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1. Daytime is 7:00am to 10:00pm and night-time is 10:00pm to 7:00am

5.1.2 Building Damage

Potential structural damage of buildings as a result of vibration is typically managed by ensuring vibration induced into the structure does not exceed certain limits and standards, such as British Standard 7385 Part 2 and German Standard DIN4150-3. Currently there is no existing Australian Standard for assessment of structural building damage caused by vibration energy.

Within British Standard 7385 Part 1: 1990, different levels of structural damage are defined:

- *Cosmetic - The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*
- *Minor - The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*

- *Major - Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

The vibration limits in Table 1 of British Standard 7385 Part 2 (1993) are for the protection against cosmetic damage, however guidance on limits for minor and major damage is provided in Section 7.4.2 of the Standard:

> *"7.4.2 Guide values for transient vibration relating to cosmetic damage*
>
> *Limits for transient vibration, above which cosmetic damage could occur are given numerically in Table 1 and graphically in Figure 1. In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the guide values for the building types corresponding to line 2 are reduced. Below a frequency of 4 Hz, where a high displacement is associated with a relatively low peak component particle velocity value a maximum displacement of 0.6 mm (zero to peak) should be used.*
>
> *Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 1, and major damage to a building structure may occur at values greater than four times the tabulated values."*

Within DIN4150-3, damage is defined as "*any permanent effect of vibration that reduces the serviceability of a structure or one of its components"* (p.2). The Standard also outlines:

> *"that for structures as in lines 2 and 3 of Table 1, the serviceability is considered to have been reduced if*
>
> - *cracks form in plastered surfaces of walls;*
> - *existing cracks in the building are enlarged;*
> - *partitions become detached from loadbearing walls or floors.*
>
> *These effects are deemed 'minor damage. " (DIN4150.3, 1990, p.3)*

While the DIN Standard defines the above damage as 'minor', based on the definitions provided in BS7385, the DIN standard is considered to deal with cosmetic issues rather than major structural failures.

British Standard

British Standard 7385: Part 2 '*Evaluation and measurement of vibration in buildings*', can be used as a guide to assess the likelihood of building damage from ground vibration. BS7385 suggests levels at which 'cosmetic', 'minor' and 'major' categories of damage might occur.

The cosmetic damage levels set by BS 7385 are considered 'safe limits' up to which no damage due to vibration effects has been observed for certain particular building types. Damage comprises minor non-structural effects such as hairline cracks on drywall surfaces, hairline cracks in mortar joints and cement

render, enlargement of existing cracks and separation of partitions or intermediate walls from load bearing walls. 'Minor' damage is considered possible at vibration magnitudes which are twice those given and 'major' damage to a building structure may occur at levels greater than four times those values.

BS7385 is based on peak particle velocity and specifies damage criteria for frequencies within the range 4Hz to 250Hz, being the range usually encountered in buildings. At frequencies below 4Hz, a maximum displacement value is recommended. The values set in the Standard relate to transient vibrations and to low-rise buildings. Continuous vibration can give rise to dynamic magnifications due to resonances and may need to be reduced by up to 50%. Table 5.4 sets out the BS7385 criteria for cosmetic, minor and major damage.

Regarding heritage buildings, British Standard 7385 Part 2 (1993) notes that "*a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive*" (p.5).

Table 5.4 – BS 7385 Structural Damage Criteria

Group	Type of Structure	Damage Level	Peak Component Particle Velocity[1], mm/s		
			4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	Cosmetic		50	
		Minor[2]		100	
		Major[2]		200	
2	Un-reinforced or light framed structures Residential or light commercial type buildings	Cosmetic	15 to 20	20 to 50	50
		Minor[2]	30 to 40	40 to 100	100
		Major[2]	60 to 80	80 to 200	200

Notes: 1. Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

2. Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

German Standard

German Standard DIN 4150 - Part 3 '*Structural vibration in buildings - Effects on Structure*' (DIN 4150-3), also provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are generally recognised to be conservative.

DIN 4150-3 presents the recommended maximum limits over a range of frequencies (Hz), measured in any direction, and at the foundation or in the plane of the uppermost floor of a building or structure. The vibration limits increase as the frequency content of the vibration increases. The criteria applicable to the receiver structure types surrounding the site are presented in Table 5.5.

Table 5.5 – DIN 4150-3 Structural Damage Criteria

Group	Type of Structure	Vibration Velocity, mm/s			
		At Foundation at Frequency of			Plane of Floor Uppermost Storey
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3[1]	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (eg buildings under a preservation order)	3	3 to 8	8 to 10	8

Notes 1. This is applicable to the Iron Cove Creek canal structure

5.2 Potential Vibration Impacts

Based on the proposed plant items presented in Section 4.2, vibration generated by construction plant was estimated and potential vibration impacts are summarised in Table 5.6 below. The assessment is relevant to the identified residential, commercial and industrial type buildings

Table 5.6 – Potential Vibration for Residential, Commercial and Industrial Properties

Receiver Location	Approx. distance to nearest buildings from works	Type of nearest sensitive buildings	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance	Vibration monitoring
R1	23m	Residential	Low risk of structural damage from construction works.	Low to medium risk of adverse comment as a result of construction works.	Vibration monitoring would be considered.
R2	11m	Residential	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R3	11m	Residential	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R4	11m	Residential	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R5	37m	Residential	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.

Receiver Location	Approx. distance to nearest buildings from works	Type of nearest sensitive buildings	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance	Vibration monitoring
R6	43m	Residential	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R7	58m	Residential	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R8	51m	Residential	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R9	70m	Residential	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R10	3m	Commercial	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R11	4m	Commercial	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R12	4m	Commercial	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R13	10m	Commercial	Low risk of structural damage from construction works.	Low to medium risk of adverse comment as a result of construction works.	Vibration monitoring would be considered when works occur in close proximity.
R14	3m	Industrial	Medium risk of structural damage from construction works.	High risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.
R15	24m	Commercial	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R16	19m	Industrial	Low risk of structural damage from construction works.	Low to medium risk of adverse comment as a result of construction works.	Vibration monitoring would be considered.
R17	26m	Commercial	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R18	33m	Commercial	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.

Receiver Location	Approx. distance to nearest buildings from works	Type of nearest sensitive buildings	Assessment on potential vibration impacts		
			Structural damage risk	Human disturbance	Vibration monitoring
R19	14m	Commercial	Low risk of structural damage from construction works.	Low to medium risk of adverse comment as a result of construction works.	Vibration monitoring would be considered.
R20	38m	Commercial	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R21	35m	Commercial	Very low risk of structural damage from construction works.	Low risk of adverse comment as a result of construction works	Vibration monitoring not required.
R22	6m	Industrial	Medium risk of structural damage from construction works.	Medium to high risk of adverse comment as a result of construction works.	Vibration monitoring should be conducted when works occur in close proximity.

Recommendations for reduction potential vibration impacts, including minimum working distances for construction plant are provided in Section 5.3.1 below.

5.2.1 Bored Piling adjacent to Iron Cove Creek Canal

The preferred bridge design option is to install piles in the breakwater and the north east abutment of the Iron Cove Creek Bridge. As advised by the client the pile size will be 750mm and the minimum clearance to the canal structure is 320mm. The canal structure has been identified as a heritage item and the more stringent DIN 4150-3 Group 3 structural damage criteria is applicable, in the absence of a dilapidation study or structural report on the canal structure. Given the minimum clearance of piling works to the canal structure, there is a very high risk of structure damage from piling works and vibration monitoring **must** be conducted on site prior to the works to determine vibration through the local ground type and appropriate buffer distances.

5.3 Vibration Mitigation

5.3.1 Recommended Minimum Buffer Distances

The pattern of vibration radiation is very different to the pattern of airborne noise radiation, and is very site specific as final vibration levels are dependent on many factors including the actual plant used, its operation and the intervening geology between the activity and the receiver. Accordingly, based on a database containing vibration measurements from past projects and library information, Table 5.7 below presents the recommended minimum working distances for high vibration generating plant.

Table 5.7 – Recommended Minimum Working Distances for Vibration Intensive Plant

Plant item	Rating / description	Minimum working distance	
		Cosmetic damage	Human response
Vibratory Roller[1]	< 50 kN (Typically 1-2 tonnes)	5 m	15m – 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
	> 300 kN (Typically 13-18 tonnes)	20 m	100 m
	> 300 kN (Typically > 18 tonnes)	25 m	100 m
Piling Rig - Bored	-	10m	15m
Excavators[2]	< 30 Tonne (travelling/ digging)	10 m	15 m
Loaders[2]	-	-	5 m
Small Hydraulic Hammer[2]	300kg (5-12 tonne excavator)	2 m	7 m
Medium Hydraulic Hammer[2]	900kg (12-18 tonne excavator)	7 m	23 m
Large Hydraulic Hammer[2]	1600kg (18-34 tonne excavator)	22 m	73 m
Truck Movements[2]	-	-	10 m

Notes: 1. TCA Construction Noise Strategy (Rail Projects) November 2011
2. Renzo Tonin & Associates project files, databases & library

Site specific buffer distances should be determined once vibration emission levels are measured from each plant item prior to the commencement of their regular use on site. Where construction activity occurs in close proximity to sensitive receivers, minimum buffer distances for building damage should be determined by site measurements and maintained.

5.3.2 Bored Piling adjacent to Iron Cove Creek Canal

Site specific buffer distances **must** be determined on site prior to the commencement of bored piling adjacent to the Iron Cover Creek canal. It is recommended that after site specific buffer distances are determined, continuous vibration monitoring of the canal structure should be conducted for the duration of the piling works.

5.3.3 Vibration Management Measures

The following vibration management measures are provided to minimise vibration impact from construction activities to the nearest affected receivers and to meet the relevant human comfort and building damage vibration limits:

1. A management procedure should be implemented to deal with vibration complaints. Each complaint should be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures should be put in place to mitigate future occurrences. An example of a construction vibration management procedure is presented in Appendix C.

2. Where vibration is found to be excessive, management measures should be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller equipment, establishment of safe buffer zones as mentioned above, and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.

3. Where construction activity occurs in close proximity to sensitive receivers, vibration testing of actual equipment on site would be carried out prior to their commencement of site operation to determine acceptable buffer distances to the nearest affected receiver locations.

4. Dilapidation surveys should be conducted at all residential and other sensitive receivers within 50 metres of the construction site. Notification by letterbox drop would be carried out for all occupied buildings within 100m of the construction site. These measures are to address potential community concerns that perceived vibration may cause damage to property.

6 Operational Traffic Noise Assessment

6.1 Traffic Noise Criteria

The EPA's 'Road Noise Policy' (RNP) sets out criteria to be applied to particular types of road and land uses. These noise criteria are to be applied when assessing noise impact and determining mitigation measures for developments that are potentially affected by road traffic noise, with the aim of preserving the amenity appropriate to the land use.

The upgrade of the Parramatta Road and Great North Road intersection involves upgrading the existing intersection to have an additional new lane for turning right from Parramatta Road onto Great North Road to improve safety and reduce congestion. Therefore, the project is not specifically assessed against the RNP since p5 of the RNP states that;

> *"Some works that are either minor or required to improve safety are not covered by this RNP."*

The RMS's 'Environmental Noise Management Manual' (ENMM) further states that;

> *"…the main noise level targets in the ECRTN apply for new roads and road "redevelopments". Road "redevelopments" are defined in the ECRTN as works where it is proposed to increase traffic carrying capacity, change the traffic mix or change the road's alignment through design or engineering changes. They do not include road reconstruction and "minor" road works to improve safety, such as the straightening of curves, the installation of traffic control devices or "minor" realignments. There are no noise level targets in the ECRTN for minor road upgrades."*

Although the ENMM references the ECRTN, which has been superseded by the RNP, the above statement is also applicable to the RNP.

Therefore, since there are no noise level targets for this project, the ENMM goes on to say that;

> *"However, if the noise level during the day or the night is predicted to increase by more than 2 dB(A) L_{eq} as a result of upgrade works (other than realignments) which are not "redevelopments", and the predicted noise level is higher than the guidelines for existing roads set out in Section 3.2 of the Environmental Criteria for Road Traffic Noise, noise treatments should be provided where feasible and reasonable."*

Given that the RNP replaces the ECRTN, Table 8 of Section 4.4 of the RNP has the following target noise abatement levels for existing arterial roads not subject to redevelopment:

- **$L_{Aeq,15hr}$ 60dB(A) Day**
- **$L_{Aeq,9hr}$ 55dB(A) Night**

It is noted that the above target levels are only applicable to residential type receivers.

The results of the long term noise survey has determined an $L_{Aeq(15hr)}$ of 70dB(A) and an $L_{Aeq(9hr)}$ of 67dB(A), both of which already exceed the above Day and Night targets, respectively. Therefore, where predicted noise levels at any residential receiver increases by more than 2dB(A), noise treatments should be provided where it is reasonable and feasible to do so.

6.2 Traffic Flow and Composition Summary

A traffic classification survey was undertaken by TCS at the Parramatta Road and the Great North Road intersection from Tuesday 3rd to Wednesday 4th November 2015. The survey was conducted concurrently with the long term unattended noise monitoring and the traffic data obtained were used to validate the noise model.

The existing 15 hour and 9 hour volumes and compositions used for validation of the noise model are presented in Table 6.1 below.

Table 6.1 – Existing 2015 Traffic Volumes and Composition

Traffic Direction	7am – 10pm (15 hour)		10pm – 7am (9 hour)	
	Total Vehicles	% Heavy Vehicles	Total Vehicles	% Heavy Vehicles
Great North Rd – Southbound left turn	2,920	5.5	398	2.3
Great North Rd – Northbound right turn	1,986	9.1	287	6.6
Parramatta Rd – Eastbound through	30,121	6.5	7,874	9.5
Parramatta Rd – Eastbound left turn	2,072	8.9	260	10.8
Parramatta Rd – Westbound through	26,562	8.0	7,255	6.3
Parramatta Rd – Westbound right turn	3,810	4.3	586	3.6

The project is expected to be completed by 2018 and for future traffic volumes it has been assumed that a typical annual linear growth of 2% would occur. As the works is considered to be a minor upgrade, the difference in future traffic volumes and compositions for "build" and "no build" scenarios are expected to be the same.

The future 15 hour and 9 hour volumes and compositions used in the noise model are presented in Table 6.2 below.

Table 6.2 – Future 2018 Traffic Volumes and Composition

Traffic Direction	7am – 10pm (15 hour)		10pm – 7am (9 hour)	
	Total Vehicles	% Heavy Vehicles	Total Vehicles	% Heavy Vehicles
Great North Rd – Southbound left turn	3,099	5.5	422	2.3
Great North Rd – Northbound right turn	2,108	9.1	305	6.6
Parramatta Rd – Eastbound through	31,965	6.5	8,356	9.5
Parramatta Rd – Eastbound left turn	2,199	8.9	276	10.8
Parramatta Rd – Westbound through	28,188	8.0	7,699	6.3
Parramatta Rd – Westbound right turn	4,043	4.3	622	3.6

All traffic noise predictions in Section 6.3 below are based on the traffic volume and heavy vehicle proportion data set out in the above tables.

6.3 Traffic Noise Prediction Modelling

6.3.1 Noise Prediction Model

Noise modelling was undertaken using the Road Traffic Noise Module in the CadnaA (version 4.5) noise modelling software. This method is recognised and accepted by both the RMS and the EPA.

The traffic noise prediction model adopted by CadnaA is based on a method developed by the United Kingdom of Environment entitled 'Calculation of Road Traffic Noise (1988)' known as the CoRTN88 method. This method has been adapted to Australian conditions and extensively tested by the Australian Road Research Board. The model predicts noise levels for free flowing traffic and a modified method has been developed which enables an accurate prediction of noise from high truck exhausts to be taken into account.

Table 6.3 following sets out the inputs and assumptions used in the traffic noise prediction model.

Table 6.3 – Summary of CadnaA Noise Modelling Inputs

Input Parameters	Data Acquired From
Traffic volumes, compositions	Noise model verification: 2015 traffic classification survey results from TCS (see Table 6.1) Noise prediction modelling: 2018 predicted traffic volumes based on 2015 traffic volumes plus 2% annual linear growth (see Table 6.2)
Speeds	Existing posted speed: 60km/h for Parramatta Road and Great North Road
Gradient of roadway	From existing topography and future road design
Source height	0.5 metre for car exhaust, 1.5 metres for car and truck engines and 3.6 metres for truck exhaust as detailed within CoRTN88
Ground topography at receiver and road	2 metre ground contours from Department of Lands and future road design supplied by client
Angles of view from receiver	Determined during site inspections and aerial photos
Structures and cuttings on opposite side of road	Determined during site inspections and review of concept design. No significant structures or cuttings identified
Air and ground absorption	Detailed within CoRTN88, ground absorption varied along route. Numeric values varied between 0 (hard surface) to 1 (soft ground). A value of 0.75 was used for this project
Receiver heights	1.5 metre above ground level for ground floor and 4.5 metre above ground level for 1st floor
Facade correction	+2.5dB(A)
Correction for Australian conditions	• -1.7 dB(A) for 'at facade' conditions • -0.7 dB(A) for 'free field' conditions from Australian Road Research Board (ARRB) Transport Research (Saunders et al 1983)
Acoustic properties of road surfaces	Dense graded asphalt – no corrections applied
Roadside barriers	No existing roadside barriers

Input Parameters	Data Acquired From
Existing traffic noise levels (L_{Aeq})	Based on short term noise monitoring results

6.3.2 Model Validation

The model was validated and calibrated using the short-term noise monitoring results at Location S1 and concurrent traffic classification counts undertaken by Renzo Tonin & Associates.

Table 6.4 summarises the results of the traffic noise model verification using the short term noise measurement and concurrent traffic counting results.

Table 6.4 – Short Term Noise Model Verification Results, dB(A)

Measurement No.	Location	Time	$L_{Aeq(15min)}$ Noise Level		
			Measured	Modelled	Variation
1	S1 – 7m from Parramatta Rd	12:00pm-12:15pm	74.0	74.6	0.6
2		12:15pm-12:30pm	76.4	75.6	-0.8
3		12:30pm-12:45pm	74.6	74.9	0.3
4		12:45pm-1:00pm	74.2	74.9	0.7
				MEAN	**0.2**

The noise model validation results presented in Table 6.4 above show that the traffic noise model predicts results that are generally in good agreement with the noise monitoring and there is a reasonable level of confidence that can be placed on the noise model for predicting future traffic noise levels.

It is noted that the measured levels were for a free flowing traffic period as during peak periods, vehicles along Parramatta Road, between Great North Road and Wattle Street, were banked up at the intersections and at times at a standstill. The peak period traffic movements would not be conducive for verification in a traffic noise model.

Therefore, no corrections have been applied to the model when generating the operational noise predictions for future traffic noise scenarios.

6.3.3 Traffic Noise Model Prediction Result

Noise modelling was completed at the residential assessment locations potentially worst affected by the proposed upgrade. These locations typically represent residences within the first row of properties where Parramatta Road has moved closer; that is, residences north of Parramatta Road. The predicted traffic noise levels for the 2018 "build" and "no build" scenarios are presented in the table below.

Table 6.5 – Change in 2018 Traffic Noise Levels with Upgrade, dB(A)

Receiver	$L_{Aeq(15\ hour)}$ Daytime Noise Level			$L_{Aeq(9\ hour)}$ Night Time Noise Level		
	Build	No Build	Difference	Build	No Build	Difference
R4 – 4 Great North Rd	70.2	69.8	0.4	65.9	65.4	0.5
R5 – 1A Henry Marine Dr	62.5	62.2	0.3	59.0	58.7	0.3
R6 – 16 Cove St	60.1	59.9	0.2	56.5	56.3	0.2

The predicted noise levels presented in Table 6.5 shows a minor increase of up to 0.5dB(A) for the worst affected residential receivers, which is well within the 2dB(A) increase allowance presented in the ENMM.

Therefore, no feasible and reasonable noise mitigation measures are required for any residential properties.

7 Conclusion

Renzo Tonin & Associates has completed a noise assessment for the construction and operation of the intersection upgrade at Parramatta Road and Great North Road in Five Dock

Noise emission from day time, evening and night time construction works associated with the proposed intersection upgrade were predicted to potentially exceed the applicable noise management levels at the nearest affected receivers and the residential receivers may also potentially be highly noise affected [ie. >75dB(A)]. Furthermore, maximum noise levels, for the assessment of sleep disturbance may exceed the applicable sleep disturbance upper limit at the nearest affected residences.

In-principle recommendations are provided in Section 4.4 and Section 5.3.3 to limit the potential impact of noise and vibration generated by construction activities to acceptable levels. In addition, buffer distances for vibration compliance have been provided as guidance; however, should be determined in more detail prior to the start of construction works through on site measurements of vibration.

Operational traffic noise impacts as a result of the upgraded intersection were predicted to not increase by more than 2dB(A) at all potentially affected residential properties and therefore, there is no requirement for any noise mitigation treatment.

APPENDIX A Glossary of Terminology

The following is a brief description of the technical terms used to describe noise to assist in understanding the technical issues presented.

Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment period	The period in a day over which assessments are made.
Assessment point	A point at which noise measurements are taken or estimated. A point at which noise measurements are taken or estimated.
Background noise	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L90 noise level (see below).
Decibel [dB]	The units that sound is measured in. The following are examples of the decibel readings of every day sounds: 0dB The faintest sound we can hear 30dB A quiet library or in a quiet location in the country 45dB Typical office space. Ambience in the city at night 60dB CBD mall at lunch time 70dB The sound of a car passing on the street 80dB Loud music played at home 90dB The sound of a truck passing on the street 100dB The sound of a rock band 115dB Limit of sound permitted in industry 120dB Deafening
dB(A)	A-weighted decibels. The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter.
Frequency	Frequency is synonymous to pitch. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Impulsive noise	Having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent noise	The level suddenly drops to that of the background noise several times during the period of observation. The time during which the noise remains at levels different from that of the ambient is one second or more.
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.

L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Reflection	Sound wave changed in direction of propagation due to a solid object obscuring its path.
SEL	Sound Exposure Level (SEL) is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain Leq sound levels over any period of time and can be used for predicting noise at various locations.
Sound	A fluctuation of air pressure which is propagated as a wave through air.
Sound absorption	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound level meter	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound pressure level	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound power level	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise	Containing a prominent frequency and characterised by a definite pitch.

APPENDIX B Specification for Construction Noise Monitoring

B.1 Scope

This document specifies methods for undertaking noise monitoring during the construction phase of the project.

B.2 Referenced Standards and Guidelines

- Australian Standard AS IEC 61672.1 2004 '*Electroacoustics - Sound Level Meters - Specifications*'
- Australian Standard AS 1259.2-1990 '*Acoustics - Sound Level Meters*'
- Australian Standard AS 1055-1997 '*Acoustics - Description and Measurement of Environmental Noise*'
- NSW '*Interim Construction Noise Guideline*' (Department of Environment and Climate Change 2009)
- NSW '*Industrial Noise Policy*' (Environment Protection Authority 2000)

B.3 Testing Procedures

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking acoustic measurements.

All noise monitoring equipment used must be at least Type 2 instruments as described in AS 1259.2-1990 and calibrated to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics). The calibration of the monitoring equipment shall also be checked in the field before and after the noise measurement period, and in the case of long-term noise monitoring, calibration levels shall be checked at minimum weekly intervals.

Long-term noise monitoring equipment or Noise Loggers, consist of sound level meters housed in weather resistant enclosures. The operator may retrieve the data at the conclusion of each monitoring period in person or remotely if the logger is fitted with mobile communications.

All environmental noise measurements shall be taken with the following meter settings:

- Time constant: FAST (ie 125 milliseconds)
- Frequency weightings: A-weighting
- Sample period: 15 minutes

All outdoor noise measurements shall be undertaken with a windscreen over the microphone. Windscreens reduce wind noise at the microphones.

Measurements of noise should be disregarded when it is raining and/or the wind speed is greater than 5m/s (18km/h).

B.4 Long-Term (Unattended) Monitoring

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

Noise monitoring equipment shall be placed at positions which have unobstructed views of general site activities, while acoustically shielded as much as possible from non-construction site noise (eg. road traffic, rail noise and other surrounding noise).

Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory for later retrieval is the following A-weighted noise levels: L_{min}, L_{90}, L_{eq}, L_{10}, L_1 and L_{max}.

Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Meteorological conditions including wind velocity, wind direction and rainfall shall be monitored over the entire noise monitoring period, either on site or recorded from the nearest weather station to the project site.

B.5 Short-Term (Attended) Monitoring

Where noise complaints or requests from relevant authorities are received, attended short-term noise monitoring shall also be conducted at the requested outdoor location (unless the issue is related to regenerated noise from tunnelling and driveage works) and at any other relevant noise receiver location with closest proximity to the construction activities.

Short-term noise monitoring shall be used to supplement long-term noise monitoring undertaken at nearby locations, and to establish whether noise levels measured by the long-term noise monitors are determined by construction activities carried out on site.

All attended short-term noise monitoring shall be recorded over 15 minute sample intervals. Noise levels are to be recorded at a minimum rate of 10 samples per second. Every 15 minutes, the data is to be processed statistically and stored in memory. The minimum range of noise metrics to be stored in memory and reported is the following A-weighted noise levels: L_{min}, L_{90}, L_{eq}, L_{10}, L_1 and L_{max}.

In addition to measuring and reporting overall A-weighted noise levels, statistical L_{90}, L_{eq}, L_{10} noise levels shall be measured and reported in third-octave band frequencies from 31.5Hz to 8kHz.

Where the noise monitors are placed within 3.5 metres of building facades, walls or cliffs, then a reflection correction of up to -2.5dB(A) shall be applied to remove the effect of increased noise due to sound reflections from such structures.

Outdoor noise monitoring is to be undertaken with the microphone at a height of 1.2 – 1.5m from the ground, unless noise measurements are taken from a balcony or veranda, in which case the same microphone height shall apply off the floor.

Noise measurements inside buildings should be at least 1m from the walls or other major reflecting surfaces, 1.2 m to 1.5m above the floor, and 1.5m from windows.

Noise monitoring shall be undertaken in accordance with the environmental noise measurement requirements stipulated in the reference standards and documents listed above.

The following information shall be recorded:

- Date and time of measurements;
- Type and model number of instrumentation;
- Results of field calibration checks before and after measurements;
- Description of the time aspects of each measurement (ie sample times, measurement time intervals and time of day);
- Sketch map of area;
- Measurement location details and number of measurements at each location;
- Weather conditions during measurements, including wind velocity, wind direction, temperature, relative humidity and cloud cover
- Operation and load conditions of the noise sources under investigation
- Any adjustment made for presence or absence of nearby reflecting surfaces; and
- Noise due to other sources (eg traffic, aircraft, trains, dogs barking, insects etc).

APPENDIX C Construction Vibration Monitoring Specification

C.1 Scope

This document specifies methods for undertaking vibration monitoring during the construction phase of the project. Vibration monitoring during construction activities may be carried out for the following reasons:

- To confirm acceptability of construction techniques, or confirm compliance with limits for structural or cosmetic damage of buildings; or
- To assess compliance with vibration limits for human exposure to vibration.

Monitoring may be carried out in response to specific conditions of approval or complaint. However, the recommended work practice is to conduct proactive monitoring and establish procedures that provide greater assurance of compliance with relevant policy guidelines and Standards throughout all phases of the project works. It is noted that this specification does not address monitoring of blasting activities.

C.1.1 Requirements for Vibration Monitoring

Vibration monitoring is to be carried out at the following times in accordance with this CNVMP:

- At the commencement of operation of each piece of plant equipment or site activity which has the potential to generate significant vibration levels. The objective of this monitoring is to refine the indicative working distances for vibration generating equipment and provide site-specific minimum working distances. Refer to procedure below for establishment Vibration Minimum Working Distances.
- Where vibration complaints or requests from relevant authorities, at the requested location and at any other relevant vibration receiver location with closest proximity to the construction activities. This may be carried out with short-term or long-term monitoring methods.

Vibration amplitude may be measured as displacement, velocity, or acceleration.

- **Displacement** (x) measurement is the distance or amplitude displaced from a resting position. The SI unit for distance is the meter (m), although common industrial standards (including the TfNSW vibration limits) include mm.
- **Velocity** ($v=\Delta x/\Delta t$) is the rate of change of displacement with respect to change in time. The SI unit for velocity is meters per second (m/s), although common industrial standards (including the TfNSW vibration limits) include mm/s. The Peak Particle Velocity (PPV) is the greatest instantaneous particle velocity during a given time interval. If measurements are made in 3-axis (x, y, and z) then the resultant PPV is the vector sum (i.e. the square root of the summed squares of the maximum velocities) regardless of when in the time history those occur.

- **Acceleration** ($a=\Delta v/\Delta t$) is the rate of change of velocity with respect to change in time. The SI unit for acceleration is meters per second squared (m/s^2).

C.2 Referenced Standards and Guidelines

- AS 2775-2004 *Mechanical vibration and shock – Mechanical mounting of accelerometers*
- AS 2670.2-1990 *Evaluation of human exposure to whole body vibration*
- BS 6472-1992 *Guide to evaluation of human exposure to vibration in buildings (1 Hz to 80 Hz)*
- BS 6841–1987 *Guide to measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock*
- BS 7482–1991 Parts 1 and 3: *Instrumentation for the measurement of vibration exposure of human beings*
- BS 7385:1 *Evaluation and Measurement for Vibration in Buildings – Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings*
- BS 7385:2 *Evaluation and Measurement for Vibration in Buildings – Part 2: Guide to Damage Levels from Ground borne Vibration*
- DIN 4150-1999 Part 3 *Structural vibration – Effects of vibration on structures*
- ISO 4866 *Mechanical Vibration & Shock – Vibration of Buildings – Guidelines for the Management of the Vibrations and Evaluation of their Effects on Buildings*
- NSW DEC (EPA) 2006 *Assessing Vibration: A technical guide*

Vibration monitoring shall be undertaken in accordance with the vibration measurement requirements stipulated in the reference Standards and guidelines listed above; however, the following notes of importance are included herein.

C.3 Vibration Minimum Working Distances

Minimum working distances are to be established for each vibration generating item of equipment, as identified, to provide a site-specific minimum working distances.

The testing regime should commence at a suitable time to allow sufficient time to amend construction techniques as necessary, without affecting the overall construction program.

Minimum working distances are to be established using identical equipment or simulated practices at a location removed from the sensitive structure or receiver.

Sufficient measurements are to be carried out in accordance with the relevant Standards to confirm the minimum working distances and confirm the acceptable work practices that are likely to be compliant given the proximity of actual works to sensitive receivers and structures.

Consultation between consultants, engineers and the construction team may be required where revision to work practices is required.

C.3.1 Personnel and Equipment

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking vibration measurements.

All vibration monitoring equipment used must be calibrated at least once every two years to Standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics).

Vibration monitors consist of a computer unit connected by cable to a tri-axial vibration transducer which senses vertical, axial and horizontal vibration, or three separate uni-axial vibration transducers positioned in the vertical, axial and horizontal axes. The parameters to be measured differ dependent upon the relevant Standards but may include:

Assessment Type	Type of Vibration	Relevant Standard/Guideline	Measurement Parameters
Human comfort	Continuous and impulsive	DECC guideline BS 6472-1992	RMS acceleration, 1-80Hz. 1/3 octave weighted as defined in BS6841-1987
	Intermittent vibration	DECC guideline BS 6472-1992	RMS acceleration, 1-80Hz Vibration Dose Values (VDVs) in accordance with BS6472-1992
Structural damage	Non-blasting	DIN 4150-1999 Part 3	Peak-particle velocity (PPV), 1-100Hz
	Non-blasting	BS 7385 Part 2	Peak-particle velocity (PPV), 4-250Hz
Structural damage – sensitive structures	Non-blasting	DIN 4150-1999 Part 3	Peak-particle velocity (PPV), 1-100Hz

Short-term vibration monitors should allow real-time analysis of vibration levels to assist assessment and feedback on the subject operations and procedures.

C.3.2 Monitoring Procedure

Vibration monitoring equipment should be installed in accordance with the following guidance:

- At a location equivalent to the site and ground conditions at the sensitive receiver location. The working distances should not be established via immediate measurement and activities near the sensitive structure.
- The surface should be solid and rigid in order to best represent the vibration levels entering the building/structure under investigation.
- The vibration sensor or transducer should not be mounted on loose gravel or other unstable surfaces.

- The vibration geophone or transducer(s) should be directly mounted to the vibrating surface using bees wax, double sided adhesive tape, or magnetically fixed to a mounting plate fastened to the vibrating surface.
- Where a suitable mounting surface is unavailable, a metal stake (at least 300mm in length) with a mounting plate should be driven into solid ground adjacent to the building of interest. The vibration sensor or transducer shall be fixed on top of the mounting plate.

The following information shall be recorded:

- Date and time of measurements;
- Type and model number of instrumentation;
- Description of the time aspects of each measurement (i.e. sample times, measurement time intervals and time of day);
- Sketch map of area;
- Measurement location details (including distance from vibrating source) and number of measurements at each location;
- Operation and load conditions of the vibrating plant under investigation and distance from the measurement location; and
- Possible vibration influences from other sources (e.g. other mechanical plant, traffic, railway).

C.4 Long-term (Unattended) Monitoring

Long-term unattended vibration monitoring shall be undertaken continuously whilst the vibrating plant is operational within the pre-determined 'minimum working distances' from potentially affected buildings or sensitive structures. Long-term unattended vibration monitoring is generally carried out for the assessment of structural or cosmetic damage rather than human exposure.

C.4.1 Personnel and Equipment

The following procedures are to be followed by personnel suitably qualified and experienced in undertaking vibration measurements.

All vibration monitoring equipment used must be calibrated at least once every two years to Standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics).

Vibration monitors consist of a computer unit connected by cable to a tri-axial vibration transducer which senses vertical, axial and horizontal vibration, or three separate uni-axial vibration transducers positioned in the vertical, axial and horizontal axes.

Long-term monitoring for the management of structural and cosmetic damage should include the following:

- Vibration levels are to be monitored continuously with the following parameters being stored at a maximum interval period of 5 minutes:
  - Peak-particle velocity (PPV) between 1 Hz and 100 Hz for each direction of the tri-axial geophone (or transducers) and vector-sum peak-particle velocity [DIN4150.3];
  - Peak-particle velocity (PPV) between 4 Hz and 250 Hz for each direction of the tri-axial geophone (or transducers) and vector-sum peak-particle velocity [BS 7385.2].
- Vibration levels are to be stored at the pre-defined intervals in the logger memory for record, data analysis or post-processing. Data may be retrieved at the conclusion of each monitoring period either by operator download or remotely via a telephone modem if the logger is fitted with a remote communications option.
- Monitors should be fitted with an audible, visual, SMS or email alert system, triggered to provide warning when the measured level of vibration approaches or exceeds the limits defined by the relevant Standard.
- Where the trigger limits are exceeded, a detailed waveform recording should be stored including a detailed frequency spectrum for assessment against the frequency limit curve.

C.4.2 Monitoring Location and Mounting

Vibration monitoring equipment should be installed in accordance with the following guidance:

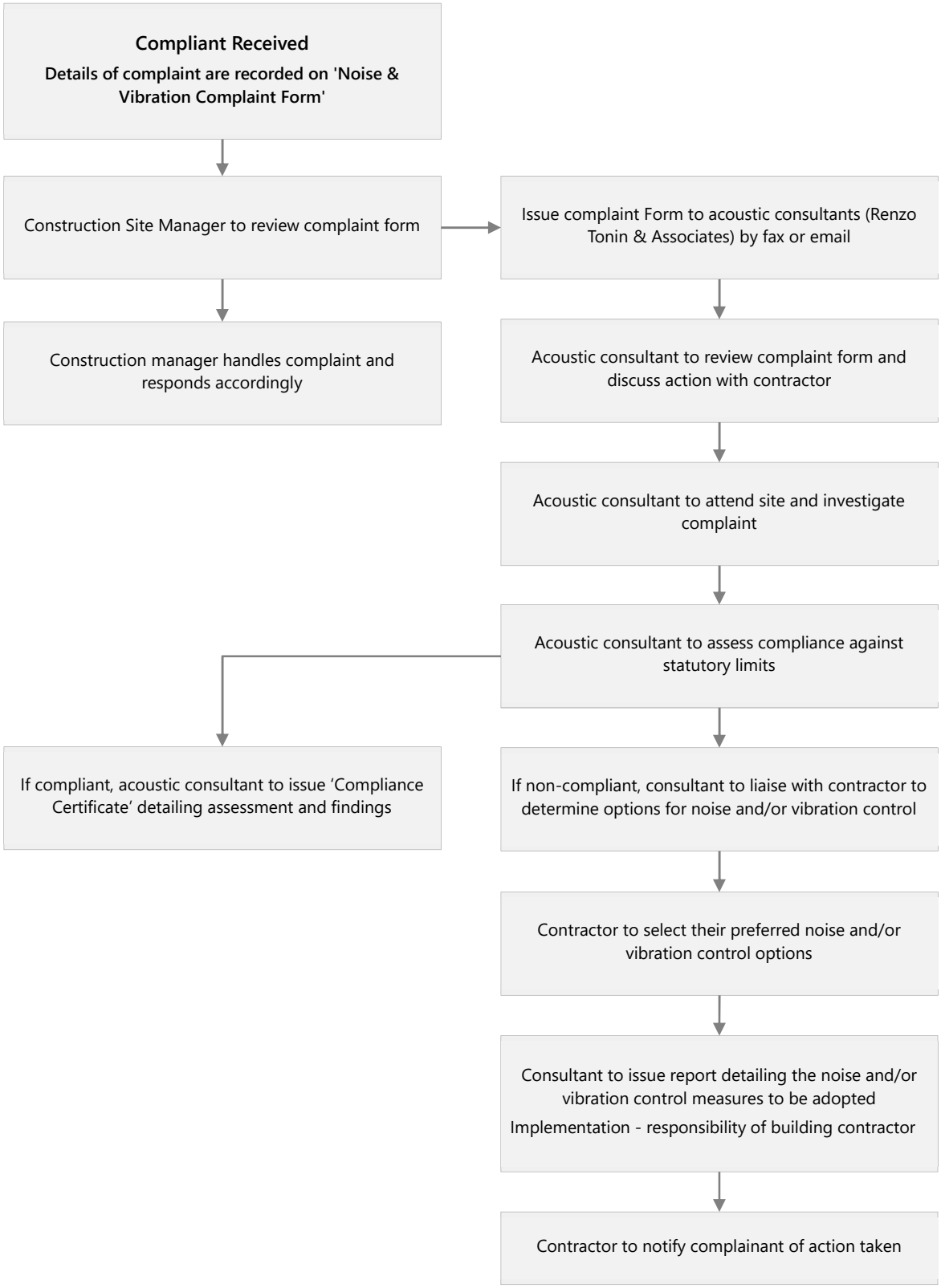
- Equipment should be positioned at the footings or foundations of the building of interest, closest to the vibrating plant.
- The mounting surface should be solid and rigid in order to best represent the vibration levels entering the structure of the building under investigation.
- The vibration geophone or transducer(s) should not be mounted on loose tiles, loose gravel or other unstable surfaces.
- The vibration geophone or transducer(s) should be directly mounted to the vibrating surface using bees wax, double sided adhesive tape, or magnetically fixed to a mounting plate fastened to the vibrating surface.
- Where a suitable mounting surface is unavailable, a metal stake (at least 300mm in length) with a mounting plate should be driven into solid ground adjacent to the building of interest. The vibration sensor or transducer shall be fixed to the mounting plate.

C.5 Vibration Measurements in Response to Complaints

Proactive vibration monitoring and establishment of procedures that comply with the policy guidelines and Standards is the recommended work practice to reduce the risk of complaint regarding vibration from the site.

There may however be cases where specific monitoring is required to investigate a complaint or issue identified during the project works. Vibration monitoring may be carried out using either short-term or long-term methodologies depending on the nature of the complaint. Short-term attended manned procedures would generally be carried out when measurements are required inside a property or where immediate action and detailed observations are required to be made at the time of measurements. Short-term monitoring would generally follow the procedures outlined for the establishment of Minimum Working Distances. Long-term monitoring would be carried out as described in section D.4 above.

APPENDIX D Noise & Vibration Complaint Management Procedure



NOISE COMPLAINT FORM

Project title: _____ **Date:** _____

Site contractor: _____ **Phone:** _____

Site contact: _____ **Email:** _____

Complaint details

Received by (circle): Phone / Email / In person / Other: _____

Name: _____ H Ph: _____

Address: _____ W Ph _____

Email: _____ M Ph _____

Describe when the problem occurred (date and time), what equipment caused the complaint (if known) and where person was standing when he/she experienced the noise:

Investigation

Question foreman responsible on site and obtain information on what equipment or processes would most likely have caused the complaint:

Following approval from the Project Manager, email/fax this form to Renzo Tonin & Associates

APPENDIX E Noise Monitoring Results

RENZO TONIN & ASSOCIATES
inspired to achieve

Acoustics
Vibration
Structural Dynamics

sydney@renzotonin.com.au
www.renzotonin.com.au

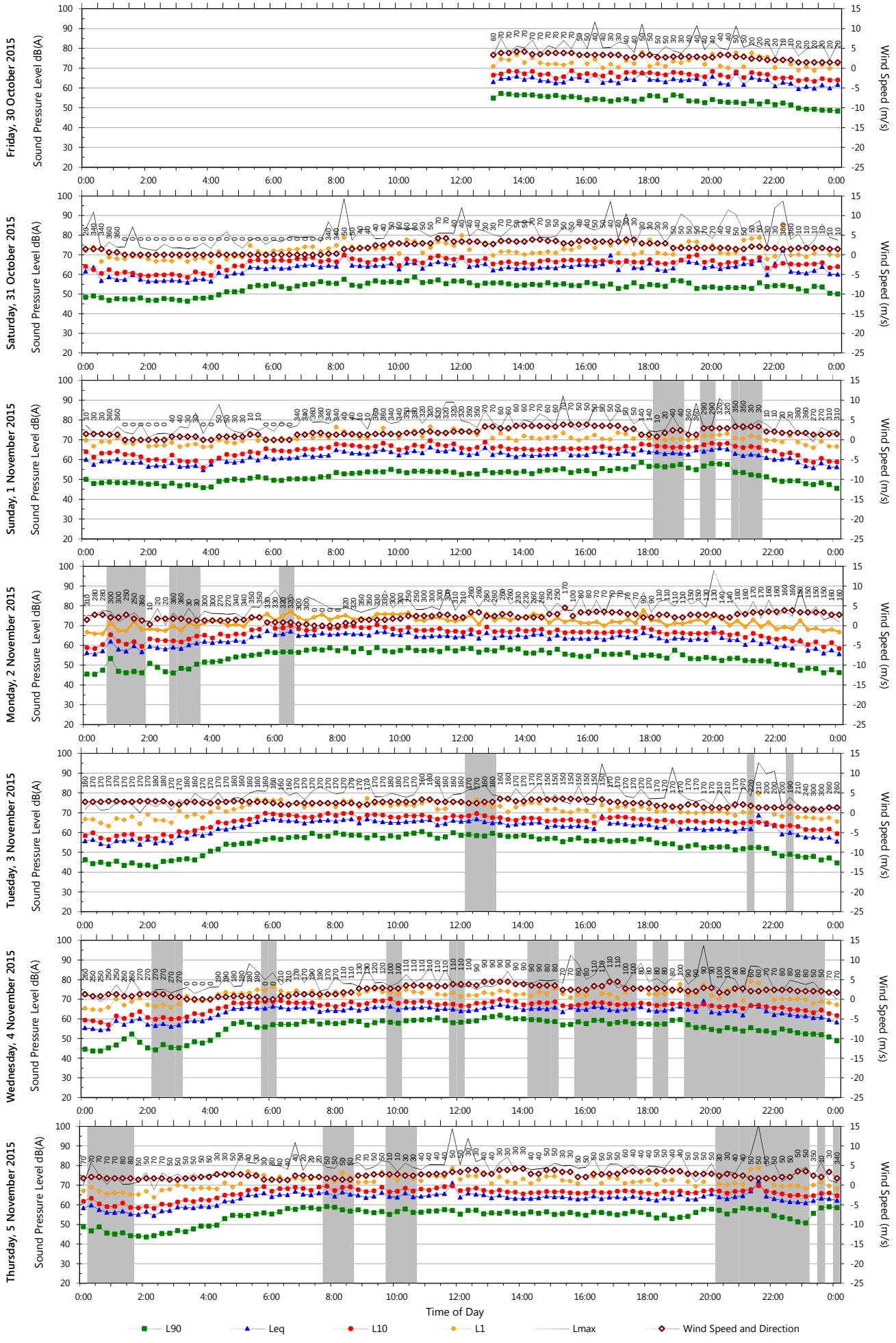
8 Great North Road, Five Dock

Background & Ambient Noise Monitoring Results - NSW 'Industrial Noise Policy', 2000

	L_{A90} Background Noise Levels[4]			L_{Aeq} Ambient Noise Levels		
Date	**Day[1]**	**Evening[2]**	**Night[3]**	**Day[1]**	**Evening[2]**	**Night[3]**
Friday-30-October-2015	-	51.9	46.8	-	64.1	60.8
Saturday-31-October-2015	54.1	52.8	46.8	65.0	64.7	61.6
Sunday-01-November-2015	52.9	-	-	63.5	-	-
Monday-02-November-2015	55.1	52.0	43.5	65.0	63.4	61.4
Tuesday-03-November-2015	55.8	51.2	-	65.0	63.4	-
Wednesday-04-November-2015	-	-	-	-	-	-
Thursday-05-November-2015	55.1	-	-	64.7	-	-
Friday-06-November-2015	55.4	-	46.7	65.9	-	61.8
Saturday-07-November-2015	54.3	52.7	46.5	64.2	62.7	60.3
Sunday-08-November-2015	54.0	50.5	43.0	62.6	62.6	61.8
Monday-09-November-2015	54.0	50.8	43.0	65.3	63.7	61.7
Tuesday-10-November-2015	54.6	52.1	45.1	65.8	62.0	61.0
Wednesday-11-November-2015	-	-	-	-	-	-
Representative Weekday[5]	**55.1**	**51.9**	**45.1**	**65.3**	**63.4**	**61.4**
Representative Weekend[5]	**54.0**	**52.7**	**46.5**	**63.9**	**63.4**	**61.3**
Representative Week[5]	**54.5**	**52.0**	**45.8**	**64.8**	**63.4**	**61.3**

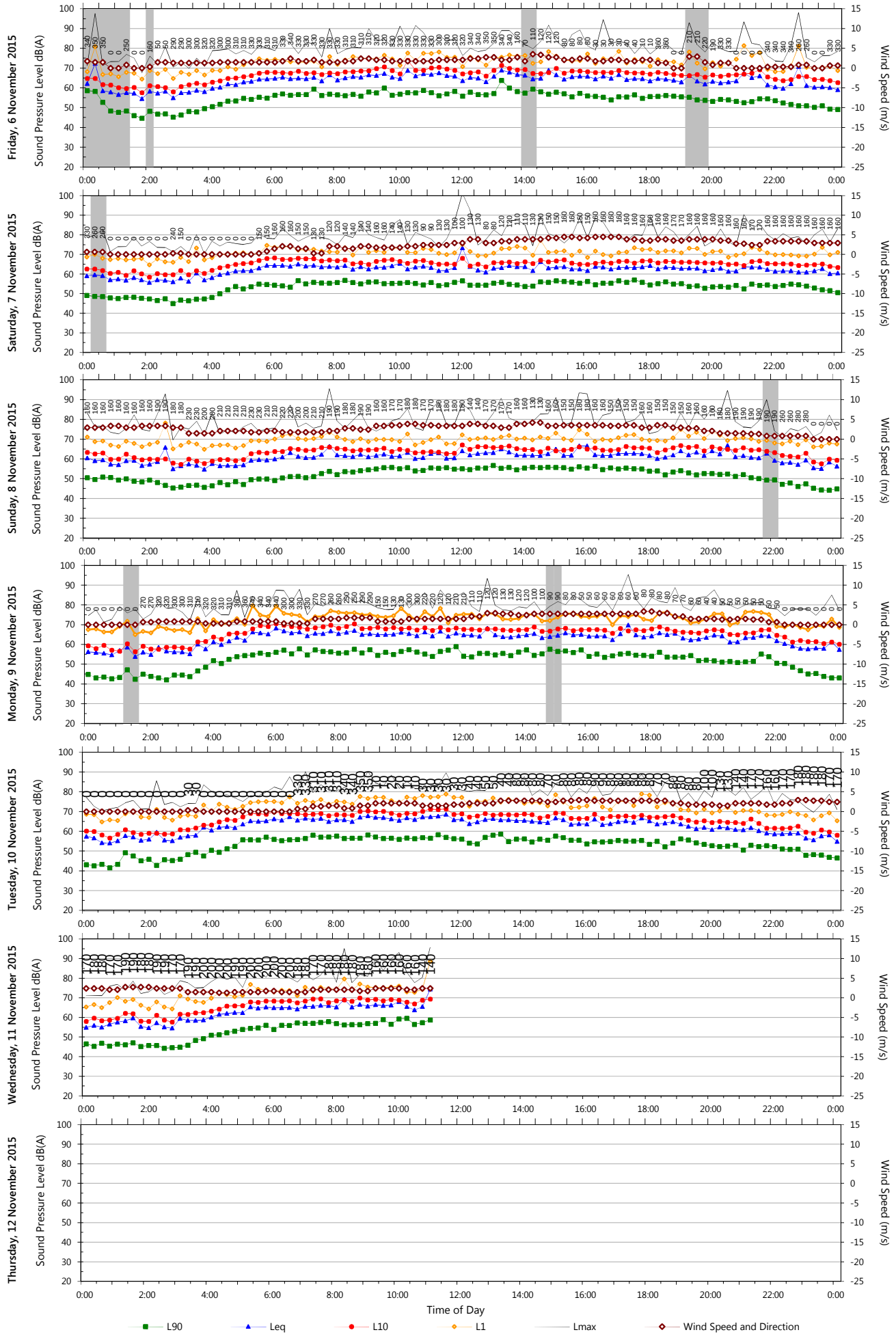
Notes:

1. Day is 8:00am to 6:00pm on Sunday and 7:00am to 6:00pm at other times
2. Evening is 6:00pm to 10:00pm
3. Night is the remaining periods
4. Assessment Background Level (ABL) for individual days
5. Rating Background Level (RBL) for L_{A90} and logarithmic average for L_{Aeq}



Data File: 2015-10-30_SLM_000_123_Rpt_Report.txt

Template: QTE-26 (rev 5) Logger Graphs Program



Data File: 2015-10-30_SLM_000_123_Rpt_Report.txt

Template: QTE-26 (rev 5) Logger Graphs Program

APPENDIX F Noise Impact Map

Notes:
1. Predicted level exceeding the highly affected noise objective of 75dB(A) are highlighted in red
2. Predicted level exceeding the Day, Evening and Night Noise Management Levels are highlighted in blue
3. Predicted level exceeding the Evening and Night Noise Management Levels are highlighted in green
4. Predicted level exceeding only the Night Noise Management Level are highlighted in pink

Appendix E

Statement of Heritage Impact

21 October 2016

Katie Bagnall
Consultant Environment & Geoscience
SNC-Lavalin
55 Clarence Street
Sydney NSW 2000

Dear Ms Bagnall,

Re. Parramatta Road Great North Road Intersection Upgrade -design amendments—addendum Statement of Heritage Impact

As part of the Roads and Maritime Services (Roads and Maritime) Sydney Congestion Treatments (Pinch Point) program, it is proposed to duplicate the right turn lane from Parramatta Road (outbound) to Great North Road (northbound) to provide additional capacity.

The Ventia Boral Amey Joint Venture (VBAJV) has been engaged by Roads and Maritime to carry out the proposed works. SNC-Lavalin, on behalf of VBAJV, are preparing the review of environmental factors (REF) in accordance with the requirements of Part 5 of the NSW Environmental Planning and Assessment Act 1979 (EP&A Act) for the proposal. Artefact Heritage has been engaged by SNC-Lavalin to prepare a Statement of Heritage Impact (SoHI) for the proposed works, which was completed in June 2016.

The following letter report is an addendum to the SoHI prepared by Artefact Heritage in June 2016. It provides an updated statement of heritage impact following design amendments to the proposed extension of the Parramatta Road overbridge component of the proposal.

The proposal includes widening the existing Parramatta Road bridge over Dobroyd Canal Stormwater Channel No 53 near the intersection of Parramatta Road and Henley Marine Drive. Dobroyd Canal Stormwater Channel No 53 is a locally significant heritage item listed on Sydney Water section 170 heritage and conservation register. Although the Parramatta Road overbridge is not listed on any heritage registers, the June 2016 SoHI assessed the item as demonstrating local significance for its historic values.

Design Amendments

The proposal consists of duplicating the right turn lane from Parramatta Road westbound into Great North Road at Five Dock. The northern portion of the existing Parramatta Road overbridge would need to be widened as part of the proposal. There have been a number of design changes to the bridge widening portion of the proposal subsequent to finalisation of the SoHI. The extension still includes the removal of the northern section of the bridge, which has been previously assessed. The following is a description of design amendments subject to this letter report:

Design changes

- new retaining wall on the west side of Dobroyd Canal
- new wing wall on the east side of Dobroyd Canal

- new safety barrier and kerb line on Parramatta Road
- new beams for extension to bridge
- 15 new piles for extension to bridge

Detailed design, including the placement and depth of the piles with regard to the Dobroyd Canal Stormwater Channel No 53, are included as Figure 10, Figure 11, Figure 12, and Figure 13.

Description and Significance of Heritage Items

Amendments to the proposal would potentially impact two items of local significance, including the Dobroyd Canal Stormwater Channel No 53 and the existing (unlisted) Parramatta Road bridge over Iron Cove Creek (ie Dobroyd Canal). A description of each item is included in Tables 1 and 2 below.

Table 1: Description and significance of the Dobroyd Canal Stormwater Channel No 53

Dobroyd Canal Stormwater Channel No 53[1]	
Image (Source: Artefact 2016)	
Significance	Local
Description	The Dobroyd Canal stormwater channel discharges into Iron Cove just to the west of Dobroyd Point in conjunction with the local street drainage systems. It serves the suburbs of Haberfield, Leichhardt, Burwood, Croydon and Ashfield, a total of 800 hectares. The main open channel ends near the intersection of Carshalton and Norton Streets. Along the way, main underground branches take off to the Ashfield, Burwood and Haberfield areas, while two smaller underground branches extend west from the main open channel. The stormwater channel has been upgraded by replacing the original brick forms with reinforced concrete in most sections. The remaining heritage fabric survives under the railway tracks between Thomas and Hunt Streets. It has a U-shaped cross section of 3.66m wide x 3.05m high. The brickwork was laid in English bond on the sides and stretcher bond on the bottom. It originally extended for a length of 714 metres from Thomas Street to Hunt Street. The length under the railway has been retained in service as a permanent record of the construction skills of the period. The Ashfield Branch is mainly covered or piped underground and joins the main open channel near Heighway Ave. The first length of 185 metres was also constructed in brick with an oviform cross section 1.52m x 1.22m. A local modification to the canal includes a box culvert the extends around the western side of the canal and beneath Parramatta Road. The channel for the box culvert splits from the main canal approximately 15 metres south of Parramatta Road before re-joining the main

[1] Extracted from OEH 2002 with additions relating to construction of a box culvert beneath Parramatta Road

Dobroyd Canal Stormwater Channel No 53[1]	
	canal approximately 12 metres north of Parramatta Road. The modification to the canal has involved removal of fabric and replacement with concrete of a similar appearance. A small "breakwater" extends to the north and south of Parramatta Road to the confluence of the box culvert channel and canal. The breakwater on the northern side of Parramatta Road has cut through the concrete wingwall of the 1930 Parramatta Road overbridge and the canal fabric. The box culvert was installed in the second half of the 20th century. It is evident across several suburbs where it remains as an open channel. It passes through several different suburban areas including parks and playing fields, residential areas and adjacent to roads.
Statement of significance	The Dobroyd Canal stormwater channel is a representative example of one of the first stormwater channels built in the 1890's to alleviate the City's public health problems. It still includes a length of brickwork drain illustrating the construction skills of the time. Overall the different sections, built at various times, illustrate the progress and improved construction methods made over a period of 100 years. It is of particular historical significance as it was one of a group of the first nine purpose-built stormwater drains to be constructed in Sydney in the 1890's. Prior to this period the water courses which served to carry stormwater were entirely in their natural state and were receptacles of sewage from the large population which had settled in the suburbs. In 1890, the then-minister for Public Works, the Hon. Bruce Smith MLA., appalled at the unhealthy conditions prevailing at the time, proposed a separate system of stormwater drains be built to help alleviate the problem. By 1897 nine stormwater channels had been built including Dobroyd. The operational curtilage of the channel includes the channel bed, walls and coping. The visual curtilage will vary along the length of the channel depending on the surrounding land-uses. To formulate a specific curtilage statement that includes details of surrounding land use and encroachment of various developments would require further investigations and is beyond the scope of this study. However, in general the visual curtilage can be described as follows: 1) Open sections of the channel commence from Iron Cove to Norton Street in Croydon 2) Sections of the Chidgeys SWC, Alt Street Branch and the Croydon Branch are also open. 3) The upper catchment is presently surrounded by urban and industrial development south of Parramatta Road. In this area the channel can only be viewed from various road bridges that cross it. 4) North of Parramatta Road visual curtilage extends through the boundaries of surrounding parkland and roadways 5) The downstream section of the channel is part of the cultural landscape of the Timbrell Park and the channel can be viewed from the Main Western Railway Line and bridges on Dobroyd Parade and Ramsey Street.

Table 2: Description and significance of the unlisted 1930s road bridge over Iron Cove Creek

1930s road bridge over Iron Cove Creek[2]	
Image (Source: Artefact 2016)	
Significance	Unlisted item. June 2016 SoHI assessed the bridge as demonstrating local significance.
Description	The bridge was constructed during the 1930s as part of the Main Roads Board program of works to improve Sydney's roads. The bridge was constructed in the same location as an early bridge indicated on the 1860s Concord Parish map. The southern section of the bridge consists of entirely modern materials as this section was modified in the 1980s. Only the northern side of the bridge consists of original materials.
Statement of significance	The bridge over the Dobroyd Canal Stormwater Channel No 53 meets the local significance threshold for its historical significance only. Parish maps show the creek crossing has been in existence since the 1860s. The 1930s fabric evident at the site today is related to the program of works undertaken by the Main Roads Board to improve Sydney roads, including Parramatta Road, after the introduction of the motor vehicle.

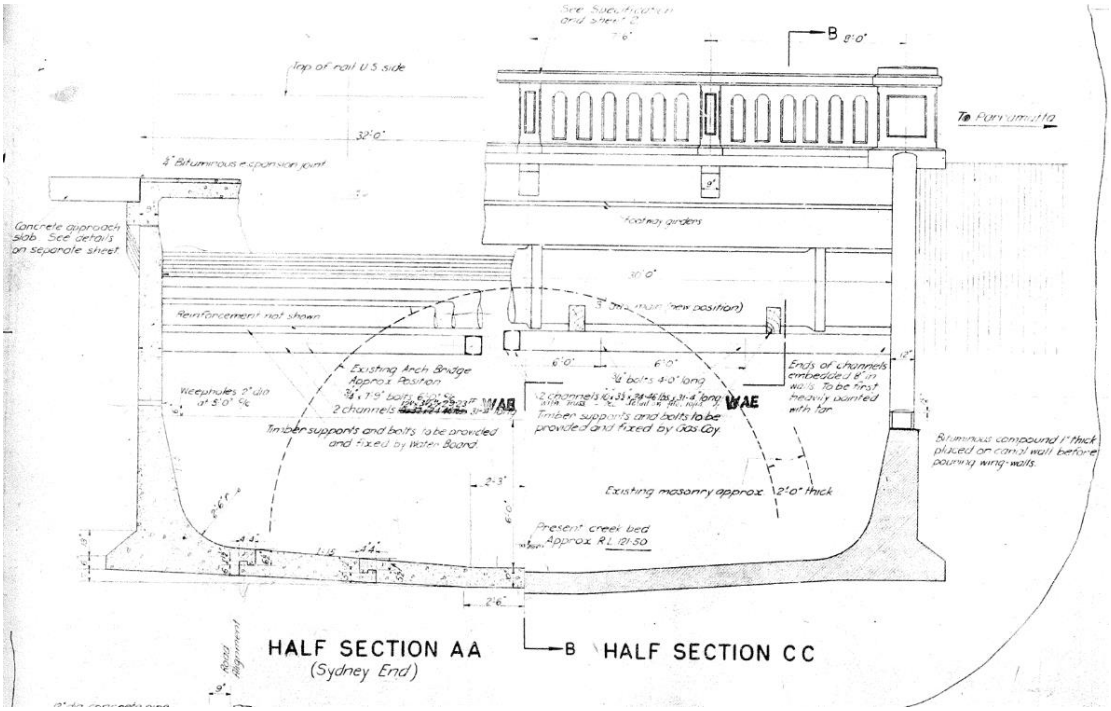
[2] Extracted from Artefact June 1016

Assessment of Archaeological Potential

The archaeological assessment prepared as part of the June 2016 SoHI identified that there is low potential for archaeological remains associated with upgrades to Parramatta Road during the early- to mid-twentieth century.

The existing Parramatta Road overbridge was constructed in place of a smaller stone arch structure in 1930, as shown in Figure 1. The overall shape and size of the canal was widened when the existing bridge was constructed, removing the masonry arch of the previous overbridge. Based on information in the 1930 plan, there is low potential for archaeological remains of the former masonry bridge.

Figure 1: 1930s section drawing of canal, showing removal of previous sandstone arched bridge



Heritage Impact Assessment

Proposed Works

New Beams and Piles for Bridge Extension

The construction of the bridge extension would involve excavation to install new supporting piles for the wider bridge structure. This would involve the excavation for 15 new piles to a depth of up to 3m below the existing invert of the concrete channel. The piles would be bored cast-in-place piles measuring 750mm in diameter The new wing walls on each side of the canal, resting on the piles, would support the bridge extension supporting beams. Approximately two metres of existing overbridge fabric would be removed. The amount of fabric removed from the overbridge is consistent with that assessed in the June 2016 SoHI.

Seven piles would be placed along the eastern side of the canal and eight along the western side. Those down the western side of the canal would be placed within an area modified during construction of the box culvert. The piles will be placed outside of the canal wall and would not directly impact canal fabric. There would be 320mm clearance between the canal and the piles. The

method of piling using bored cast-in-place piles was selected to minimise potential for impacts to the canal.

Figure 2: Plan view of bridge extension, showing pile locations as circles (North to top of page). A full copy of this plan is included at the end of this report as Figure 11.

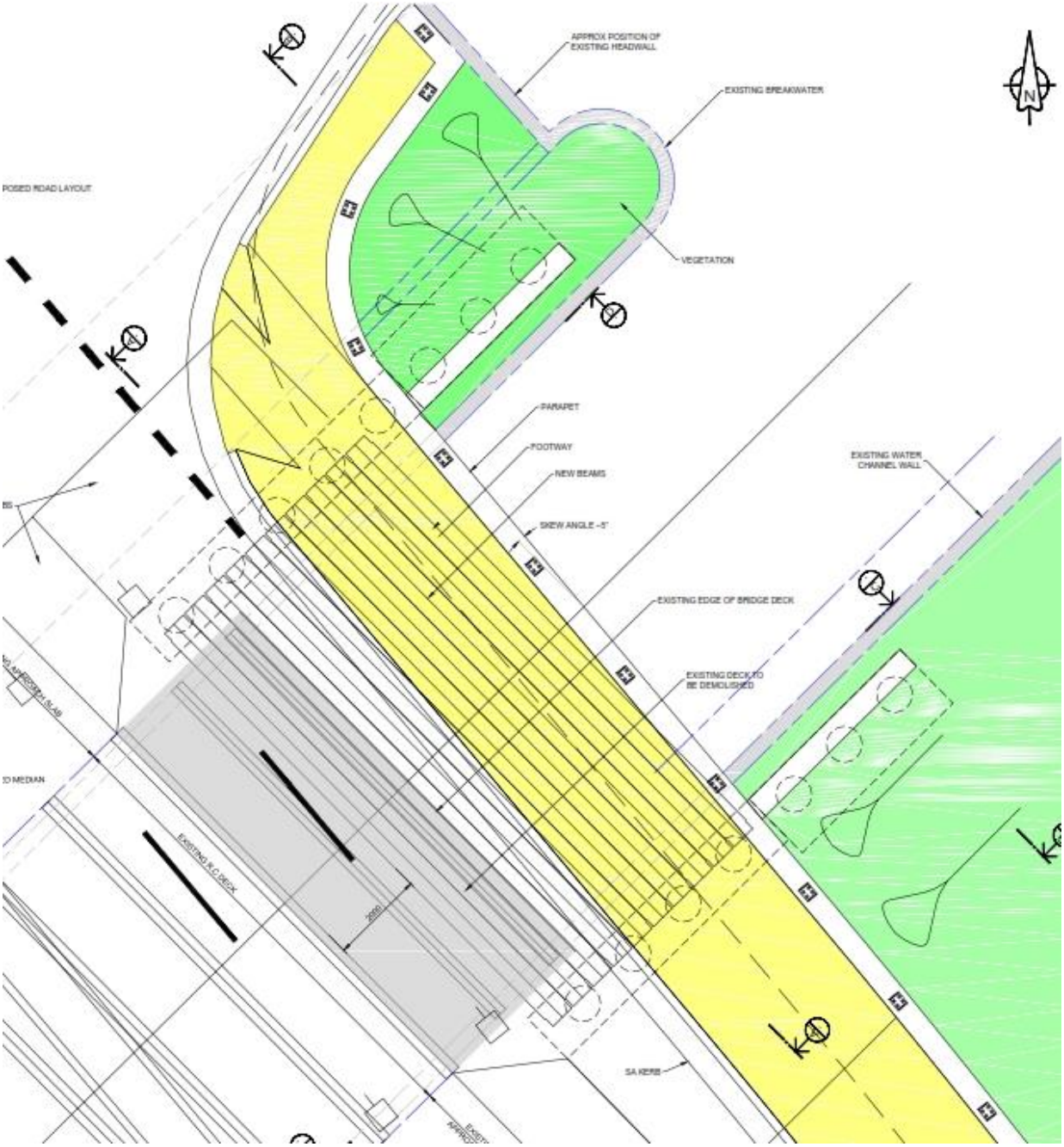


Figure 3: Section of east abutment showing pile locations into channel invert

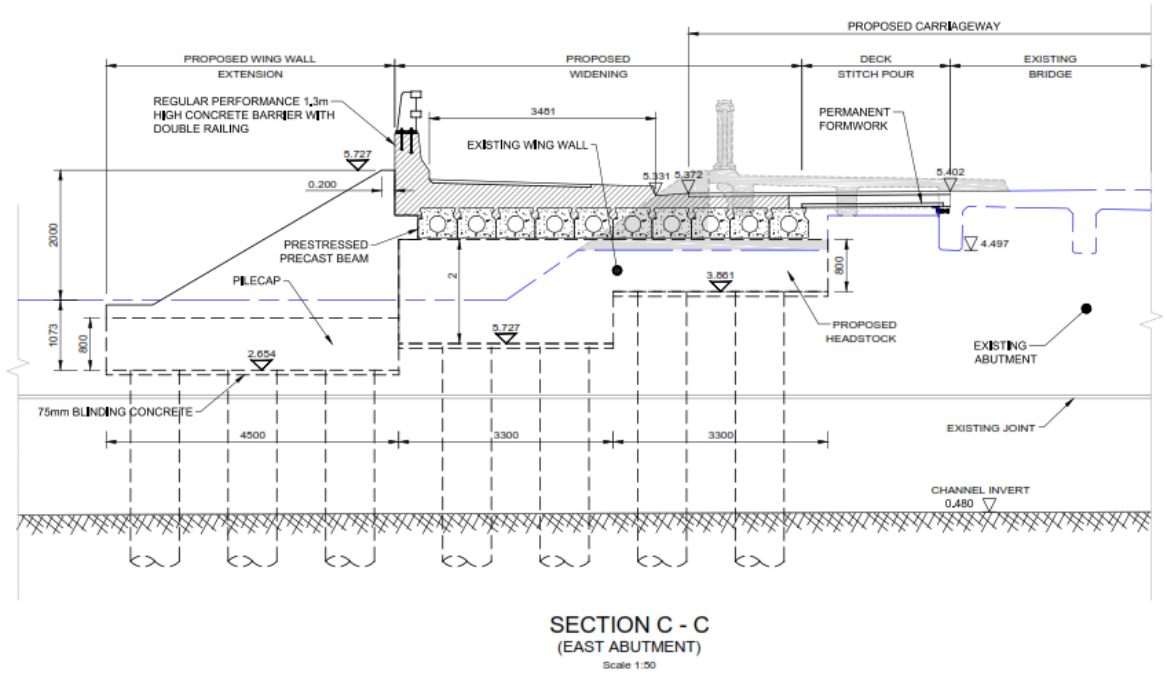
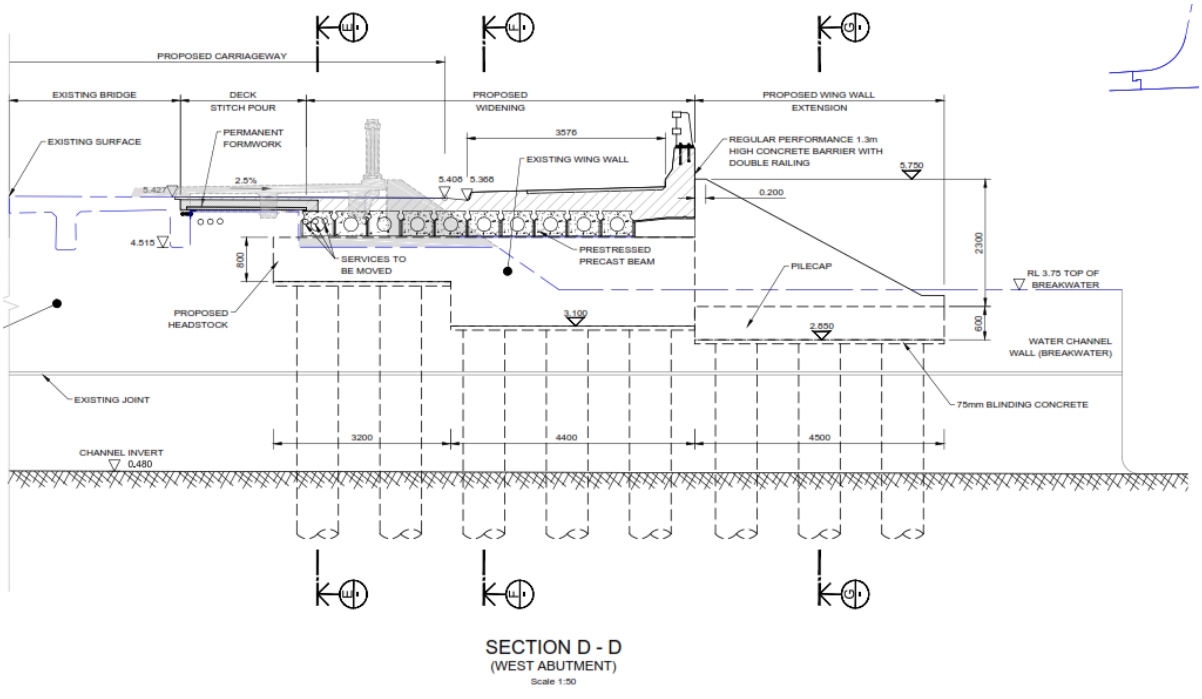


Figure 4: Section of west abutment showing pile locations into channel invert



Retaining and Wing Walls on Canal

A new retaining wall would be instated on the western side of the canal to the north of Parramatta Road. The retaining wall would be approximately 13m in extent. On the eastern side of the canal, a new wing wall would be installed next to the existing retaining wall, up to 6m in extent. These new works would not involve the removal of any original fabric from the existing concrete canal.

Figure 5: Section view looking south of proposed works along the existing northern margin of the 1930 overbridge, showing the original concrete parapet to be removed, box culvert to right of figure, pile locations along the eastern and western sides of the canal, and concrete headstock to be placed on top of piles and behind current wing wall

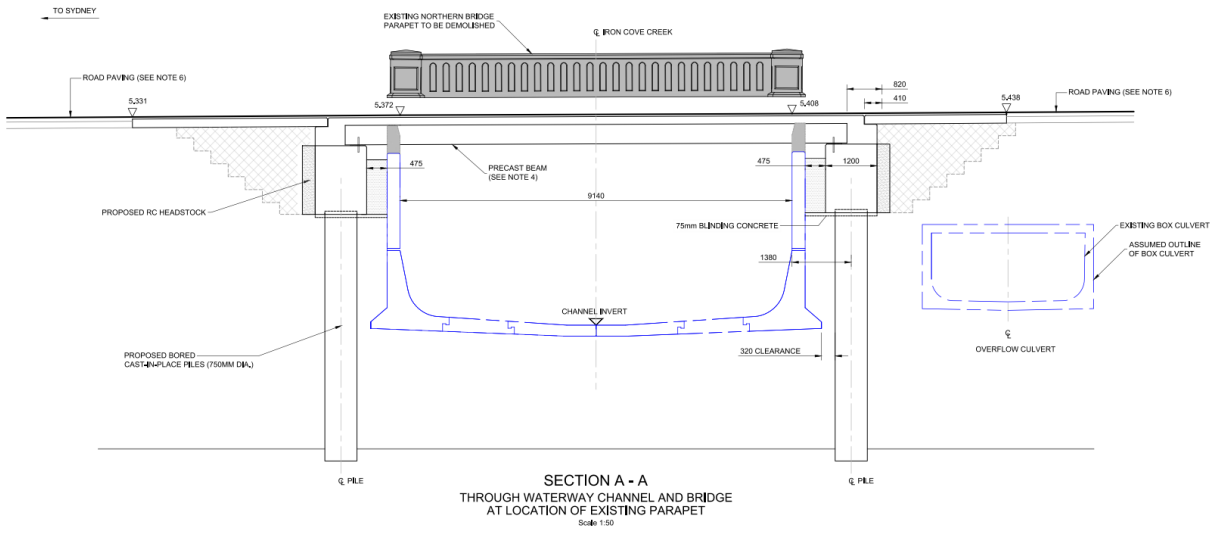
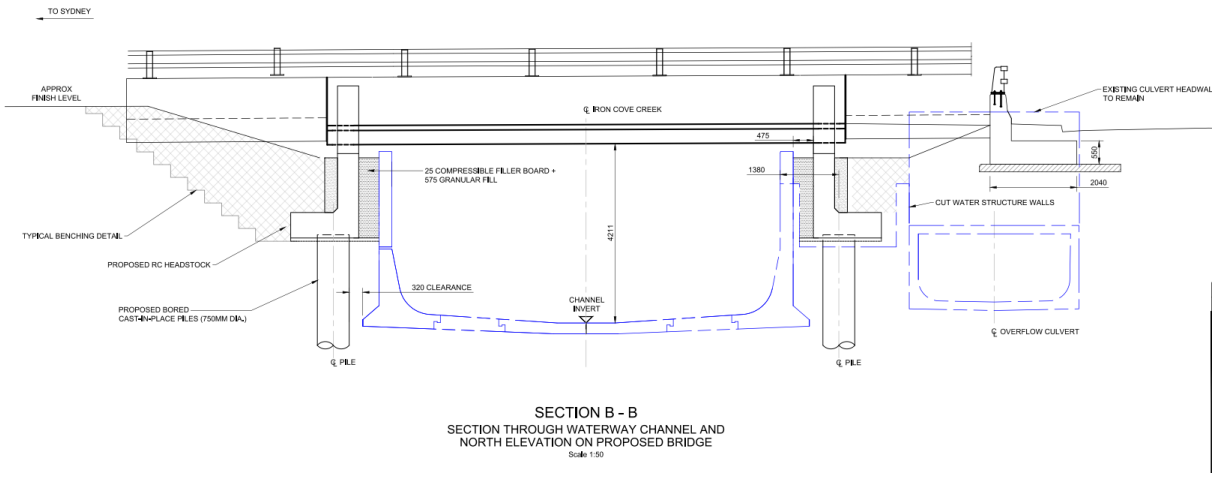


Figure 6: Section view looking south at the proposed northern extent of the extended overbridge, showing pile locations to east and west of existing canal, new wing walls to the east and west of existing canal fabric, and box culvert to the right of figure.



Safety Barrier and Kerb Line on Parramatta Road

The new safety barrier and kerbline are consistent with the modified bridge design as assessed in the June 2016 SoHI. The original concrete parapet would be removed and a new kerbline and safety barrier constructed along northern margin of the bridge following completion of bridge expansion works. A section view of the proposed new safety barrier is shown in Figure 6.

Figure 7: View of 1930 overbridge and canal (left side of photo) and box culvert (later addition) and associated canal modifications (right side of photo)

Figure 8: View west from 1930 overbridge of modified section of canal wall associated with box culvert (later addition)

Figure 9: View of modified 1930 wing wall on western side of canal, showing original 1930 wing wall fabric (centre of photo) and later wing wall addition (left side of photo) when the box culvert was constructed

The following table provides a heritage impact assessment of the proposed design amendments.

Table 3: Statement of Heritage Impact for Amended Designs

Heritage Item	Updated Statement of Heritage Impact
Dobroyd Canal Stormwater Channel No 53	The amended designs, including piling, construction of new wing walls and extension of the overbridge, would not directly impact on canal fabric. The proposed works have the potential for indirect impacts due to proximity to the canal and through vibrations, which can be reduced through the employment of suitable mitigation measures and recommendations (outlined in Table 4). The proposed works would maintain the visual setting of the canal and overbridge context. Only a small portion of the currently open canal would be covered by the bridge extension. The works would have a negligible increase in visual impact on the canal from the existing overbridge setting.

Heritage Item	Updated Statement of Heritage Impact
1930 road bridge over Iron Cove Creek	Design amendments will not alter the intent of the original proposal as assessed in the June 2016 SoHI to remove approximately two metres of the existing bridge and extend the bridge width with new materials. The amount of fabric removed from the overbridge is consistent with that assessed in the June 2016 SoHI. Removal of original bridge fabric would have a major direct impact on the overbridge, which is consistent with the assessment as outlined in the June 2016 SoHI.
Archaeological resource	The proposed works would involve ground works to install the 15 piles for the new bridge extension, and the new retaining and wing walls. The June 2016 SoHI determined that the area next to the canal has been subject to a high level of impact. The archaeological assessment component of the June 2016 SoHI identified that there is low potential for former road surfaces such as Telford road base to remain beneath the current road surface. The 1930 plan of the current overbridge demonstrates that there is low potential for remnants of the original masonry bridge to remain, as the canal was widened and deepened at that time.

Conclusions

Design amendments for the Parramatta Road bridge extension over Dobroyd Canal Stormwater Channel No 53 would include 15 new piles into the ground on the western and eastern sides of the canal, extension of the bridge with new beams, a new retaining and wing wall, and a new kerb line with a safety barrier.

The amended design would not result in direct impacts to existing canal wing walls and fabric. The amended design has the potential for indirect (vibration) impacts to the Dobroyd Canal Stormwater Channel No 53, therefore a vibration assessment is recommended prior to works commencing. A vibration assessment was not a recommendation of the June 2016 SoHI.

The amended design would have a negligible impact on the setting and context of the Dobroyd Canal Stormwater Channel No 53.

The amended design would result in the same amount of 1930 overbridge fabric removal as assessed in the June 2016 SoHI. Approximately two metres of bridge fabric, including the extant northern concrete parapet, would be removed and the bridge extended with new materials.

The amended design would include excavation in areas assessed in the June 2016 SoHI as demonstrating low potential for containing evidence of former road surfaces and previous masonry arch bridge. The 1930 overbridge construction plans indicate it is likely that the previous masonry arch bridge was completely removed during widening and deepening of the canal.

Table 4: Amended design impacts and mitigation measures

Heritage item	June 2016 SoHI – assessed impacts	Amended Design September 2016 – assessed impacts	Mitigation Measures
			A vibration assessment for the canal should be conducted prior to works commencing to ensure that there is no inadvertent impact to canal fabric.
Dobroyd Canal Stormwater Channel No 53	The proposed works do not involve direct impacts to the canal	Negligible visual impact Potential indirect impact from vibration due to close proximity of piling and construction of new wing wall and retaining wall	In accordance with the June 2016 SoHI, liaison with Sydney Water Heritage Advisor should continue throughout the life of the proposal In accordance with the June 2016 SoHI, details of this heritage item should be included in the Construction Environment Management Plan (CEMP)
1930 road bridge over Iron Cove Creek	Major direct impact	Major direct impact	In accordance with the June 2016 SoHI, the portion of the bridge to be removed would be archivally recorded according to NSW Heritage Division standards (1998), prior to the commencement of works.
Archaeological resource	Low potential to impact archaeological remains in the canal area	Low potential to impact archaeological remains in the canal area	In accordance with the June 2016 SoHI. the Roads and Maritime Standard Management Procedure for Unexpected Heritage Items (2015) should be implemented in the case of unexpected finds.

Recommendations

The recommendations provided in the initial SoHI (Artefact June 2016) still apply. The following recommendations are also made in relation to the proposed works considered in this report:

- A copy of this report with the June 2016 SoHI should be forwarded to the Sydney Water Heritage Advisor.
- Liaison with the Sydney Water Heritage Advisor should continue throughout the life of the project.
- The Construction Environmental Management Plan should incorporate a Temporary Protection Plan for heritage items to be implemented prior to and for the duration of the works. Such plan should outline the protection measures to be taken by all contractors whilst carrying out the works to avoid structural impacts as well as direct impact on the fabric of these heritage items. The Temporary Protection Plan should consider the heritage-listed Dobroyd Canal Stormwater Channel No 53.
- A vibration assessment for the proposed piling should be conducted prior to work commencing.
- The portion of the bridge to be removed would be archivally recorded according to NSW Heritage Division standards (1998), prior to the commencement of works.
- If unexpected finds are uncovered, the Roads and Maritime Standard Management Procedure for Unexpected Heritage Items (2015) unexpected finds procedure should be implemented.

If you require any additional information, please do not hesitate to contact me.

Kind regards,

Shona Lindsay
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02 9518 8411

References

Artefact Heritage, June 2016, *Parramatta Road Great North Road Intersection Upgrade. Statement of Heritage Impact.* Prepared for SNC-Lavalin on behalf of VBAJV.

Office of Environment and Heritage (OEH) 2002, *Dobroyd Stormwater Channel No 53.* Accessed online at: http://www.environment.nsw.gov.au/heritageapp/ViewHeritageItemDetails.aspx?ID=4571056 (02/09/2016).

Figure 10: Proposed location of extension to bridge (Source: VBA JV)

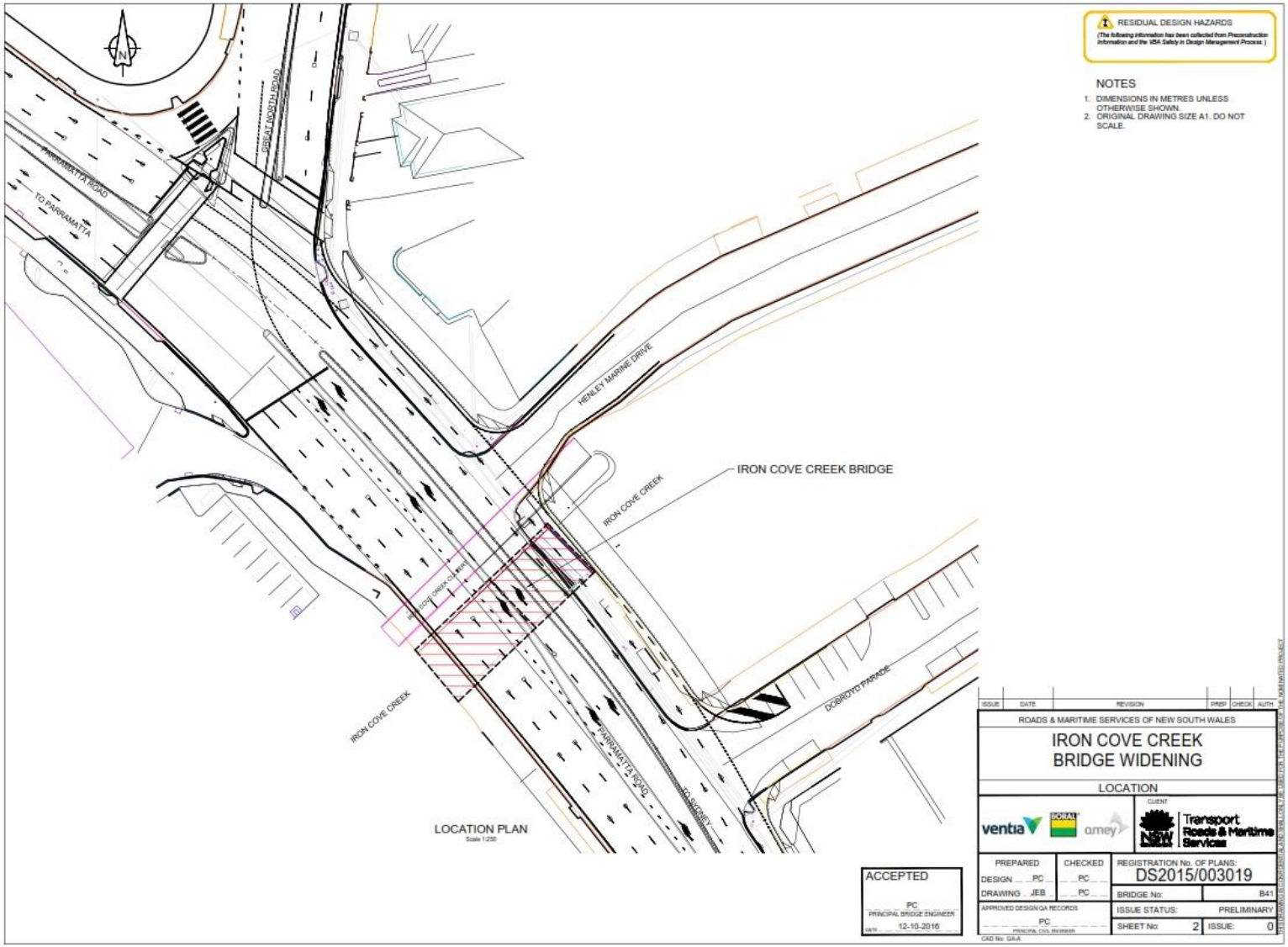


Figure 11: Proposed plan of widening to bridge deck (Source: VBA-JV)

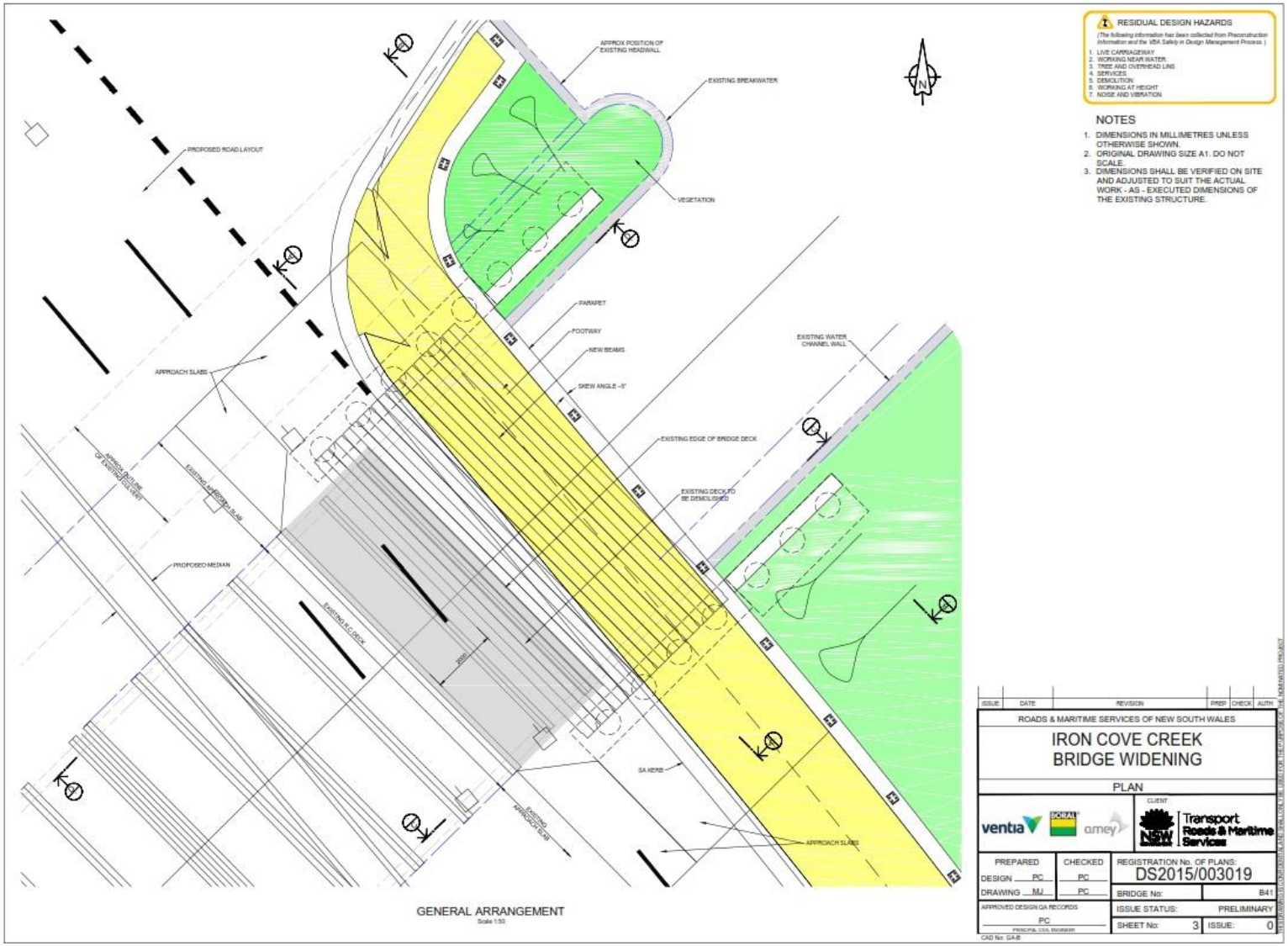


Figure 12: Proposed section though waterway channel (Source: VBA-JV)

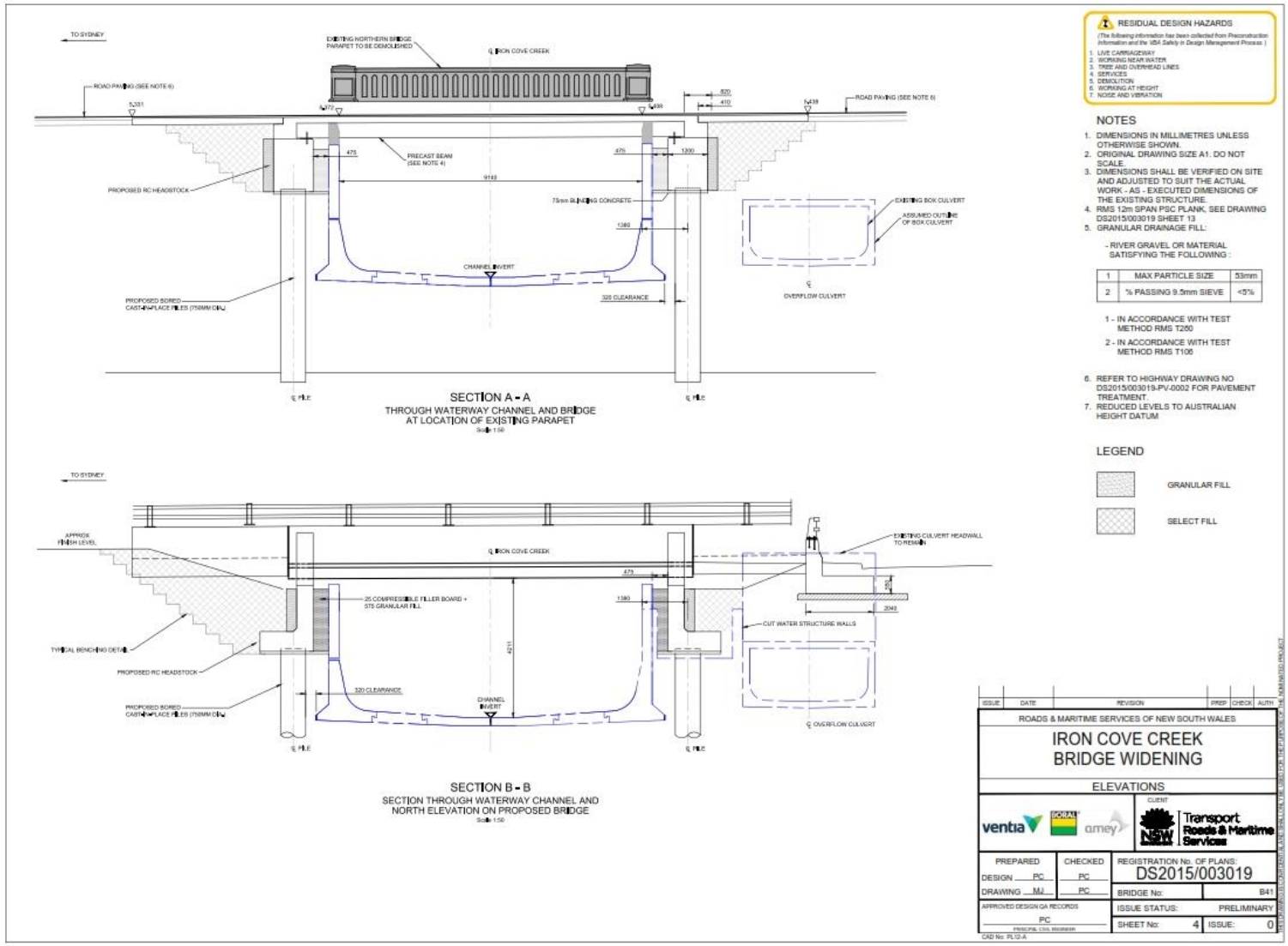
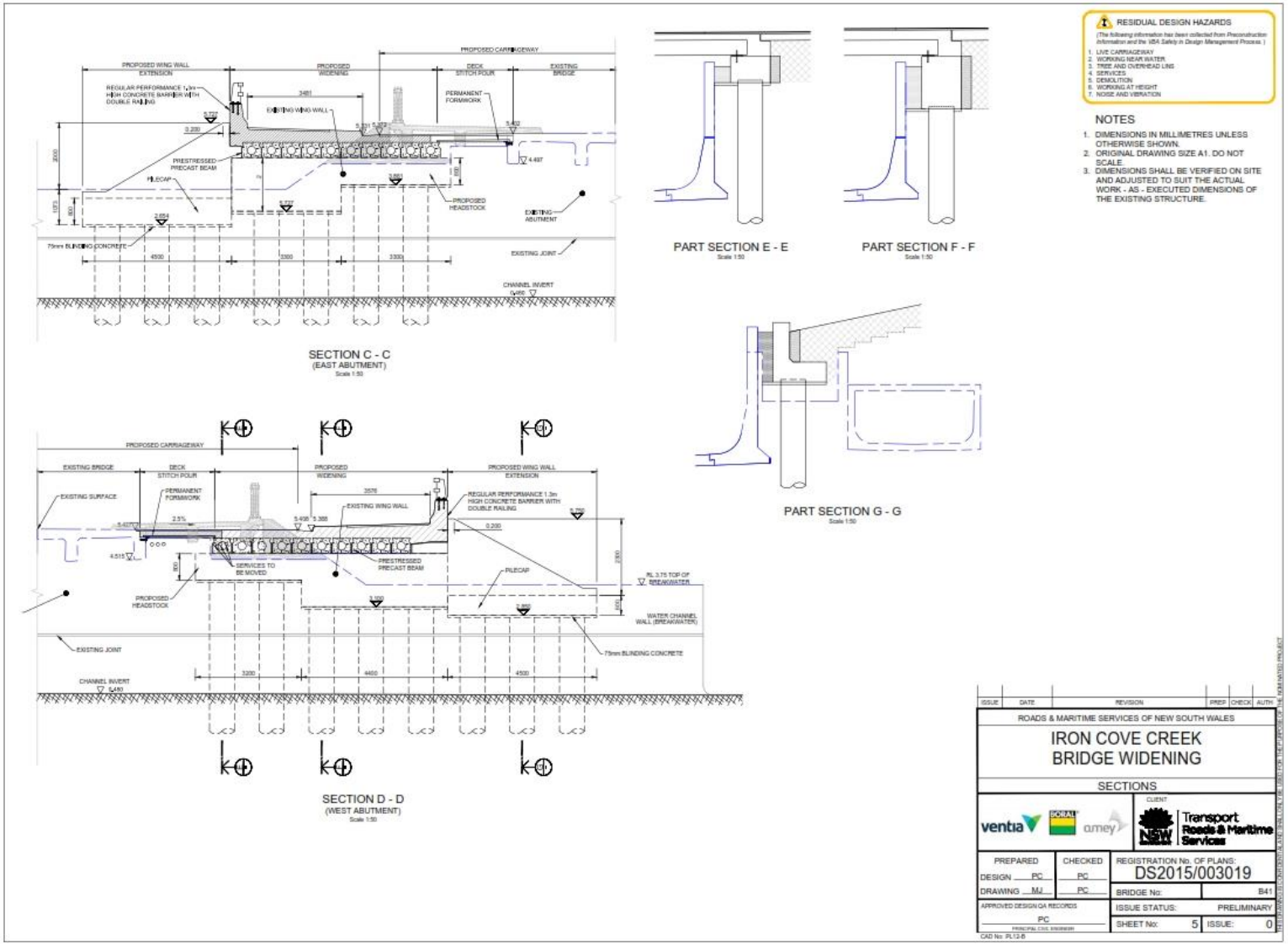


Figure 13: Proposed section though waterway channel (Source: VBA-JV)



Parramatta Road Great North Road Intersection Upgrade

Statement of Heritage Impact

Report to SNC-Lavalin

June 2016

artefact

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EXECUTIVE SUMMARY

As part of the Roads and Maritime Services (Roads and Maritime) Sydney Congestion Treatments (Pinch Point) program, it is proposed to duplicate the right turn lane from Parramatta Road (outbound) to Great North Road (northbound) to provide additional capacity.

The Ventia Boral Amey Joint Venture (VBAJV) have been engaged by Roads and Maritime to carry out the proposed works. SNC-Lavalin, on behalf of VBAJV, are preparing the review of environmental factors (REF) in accordance with the requirements of Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the project.

Artefact Heritage has been engaged by SNC-Lavalin to prepare a Statement of Heritage Impact (SoHI) for the proposed works. It identifies listed heritage items and historical archaeological potential that may be present within the study area, assesses the proposal's heritage impact, and provides management and mitigation measures.

Overview of findings

- The Dobroyd Canal Stormwater Channel no. 53 (4571056) listed on the section 170 Sydney Water register is located below the study area. The proposal may result in indirect impacts to this item.
- The bridge spanning the Dobroyd Canal Stormwater Channel has been identified as a potential unlisted heritage item. The proposal would result in a major impact to the heritage values of this item.
- There is nil-low potential for archaeological relics and works to be located within the study area, including remains of early surfaces associated with Parramatta Road. The proposal is therefore unlikely to impact archaeological relics or works.

Recommendations

Built heritage

- The original northern portion of the 1930s bridge over the Dobroyd Canal Stormwater Channel should be archivally recorded prior to removal. This will include photographic recording and documentation of that process in accordance with NSW Heritage Division guidelines.
- Indirect impacts to the Dobroyd Canal Stormwater Channel should be avoided. Details of this heritage item should be included in the Construction Management Plan (CMP) and an exclusion zone established during construction.
- Sydney Water's Heritage Advisor should be consulted regarding comments or requirements in relation to the Dobroyd Canal Stormwater Channel prior to works commencing.

Archaeology

- The proposed works are not expected to impact archaeological relics or works and therefore no further archaeological approval or investigation is required.

- However there is some potential that isolated archaeological finds may be unexpectedly found during ground works. Therefore the following Unexpected Finds Procedure should be implemented during works associated with the current subdivision proposal:
  - Stop work within the affected area, protect the potential archaeological find, and inform environment staff or supervisor.
  - Contact a suitable qualified archaeologist to assess the potential archaeological find.
  - If archaeological relics are identified the NSW Heritage Division must be notified in accordance with the Heritage Act.
  - Further assessment and archaeological permit approvals from the NSW Heritage Division may be required prior to works recommencing in the affected area.
  - Where the unexpected finds are identified as works associated with former road surfaces, it is likely that monitoring of works in that area and archival recording by a suitably qualified heritage consultant may be required.

CONTENTS

FIGURES

PLATES

TABLES

1.0 INTRODUCTION

1.1 Background

As part of the Roads and Maritime Services (Roads and Maritime) Sydney Congestion Treatments (Pinch Point) program, it is proposed to duplicate the right turn lane from Parramatta Road (outbound) to Great North Road (northbound) to provide additional capacity.

The Ventia Boral Amey Joint Venture (VBAJV) have been engaged by Roads and Maritime to carry out the proposed works. SNC-Lavalin, on behalf of VBAJV, are preparing the review of environmental factors (REF) in accordance with the requirements of Part 5 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) for the project.

Artefact Heritage has been engaged by SNC-Lavalin to prepare a Statement of Heritage Impacts (SoHI) for the proposed works. REF.

1.2 Proposal

The proposed works include duplicating an existing right turn bay northbound from Parramatta Road to Great North Road, widening of the bridge over Iron Cove Creek (also known as Dobroyd Canal) and widening both sides of Parramatta Road between Arlington Street and Wolseley Street. The works involve the removal of 850 millimetres of the road surface and subsequent re-sealing. The proposed works also include the relocation of some utilities.

1.3 Study Area

The study area includes the section of Parramatta Road generally located between Page Avenue, Ashfield to the east and Great North Road, Five Dock to the west. The study area also includes portions of the area immediately north of Parramatta Road, including sections of Dobroyd Parade and Henley Marine Drive. The study area is shown in Figure 1.

1.4 Scope of this Assessment

The purpose of this SoHI is to assess the proposal's potential to impact non-Aboriginal heritage. The SoHI will inform the REF for the project.

The assessment includes:

- An overview of the historical development of the study area
- Identification of listed and unlisted heritage items, and potential archaeological remains within the study area
- Results of a site inspection
- Assessment of significance for heritage items and potential archaeological remains within the study area
- Recommendations on appropriate management and mitigation measures in line with statutory requirements.

1.5 Report Authorship and Acknowledgements

This report was prepared by Claire Rayner (Heritage Consultant) with input from Josh Symons (Senior Heritage Consultant), and reviewed by Abi Cryerhall (Principal, Historic Heritage).

1.6 Limitations

This report does not include Aboriginal heritage assessment. The Ashfield Council property between Dobroyd Stormwater Canal, Dobroyd Parade and Parramatta Road was not accessed for this assessment.

Figure 1: Location of the study area

2.0 STATUTORY CONTEXT

2.1 Environmental Planning and Assessment Act 1979

The *Environment Planning and Assessment Act 1979* (EP&A Act) is administered by the Department and provides planning controls and requirements for environmental assessment in the development approval process. This proposed works will be assessed under Part 5 of the EP&A Act.

Planning decisions within Local Government Areas (LGAs) are guided by Local Environmental Plans (LEPs). Each LGA is required to develop and maintain an LEP that includes Aboriginal and historical heritage items which are protected under the EP&A Act 1979 and the Heritage Act 1977 (Heritage Act). The study area is subject to Ashfield LEP (2013).

2.2 NSW Heritage Act 1977

The NSW *Heritage Act 1977* (Heritage Act) provides protection for items of 'environmental heritage' in NSW. 'Environmental heritage' includes places, buildings, works, relics, movable objects or precincts considered significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. Items considered to be significant to the State can be listed on the State Heritage Register (SHR) and cannot be demolished, altered, moved or damaged, or their significance altered, without approval from the Heritage Council of NSW.

State Heritage Register

The SHR was established under Section 22 of the Heritage Act and is a list of places and objects of particular importance to the people of NSW, including archaeological sites. The SHR is administered by the Heritage Division of the Office of Environment and Heritage (OEH) and includes a diverse range of over 1500 items, in both private and public ownership. To be listed, an item must be deemed to be of heritage significance for the whole of NSW.

There are no items listed on the SHR located within or adjacent to the study area.

Archaeological relics

The Heritage Act also provides protection for 'relics', which includes archaeological material or deposits. Section 4 (1) of the Heritage Act (as amended in 2009) defines a relic as:

> *"...any deposit, artefact, object or material evidence that:*
>
> *(a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
>
> *(b) is of State or local heritage significance"*

Section 139 to 145 of the Heritage Act prevents the excavation or disturbance of land known or likely to contain relics, unless under an excavation permit. Section 139 (1) states:

A person must not disturb or excavate any land knowingly or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, damaged or destroyed unless the disturbance is carried out in accordance with an excavation permit.

Section 170 Registers

Under the Heritage Act all government agencies are required to identify, conserve and manage heritage items in their ownership or control. Section 170 requires all government agencies to maintain a Heritage and Conservation Register that lists all heritage assets and an assessment of the significance of each asset. They must ensure that all items inscribed on its list are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Government on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of items and are based on NSW heritage legislation and guidelines.

Works

The Heritage Act identified 'works' as being in a separate category to archaeological 'relics.' 'Works' refer to past evidence of infrastructure. 'Works' may be buried, and therefore archaeological in nature, however, exposure of a 'work' does not trigger reporting obligations under the relics provisions of the Heritage Act. 'Works', as items of environmental heritage, have the potential to provide information that contributes to our knowledge of past practices, and good environmental practice recognises this. Roads and Maritime, for example, uses its Standard Management Procedure: Unexpected Heritage Items (Roads and Maritime 2015) to manage the discovery of such items.

2.3 Register Searches

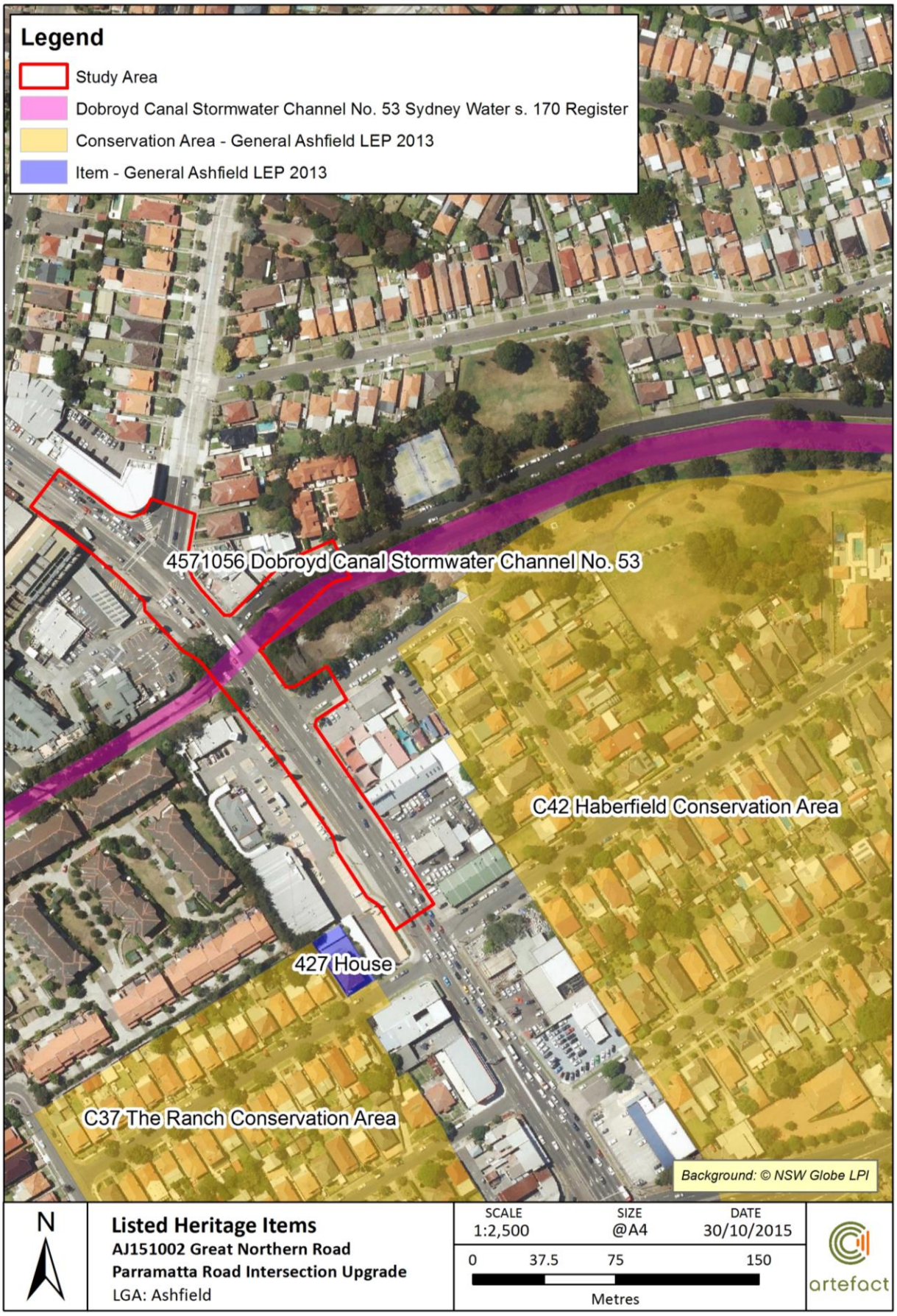
No Items listed on the Canada Bay LEP (2013) are located in the vicinity of the study area.

There are three items listed on the Ashfield LEP (2013) located adjacent to the study area. There is one item listed on the Sydney Water Section 170 Register located within the study area. These items are summarised in the table below and Figure 2.

Table 1: Location of listed Heritage items in relation to the study area

Item No	Item Name	Register	Relationship to study area
427	House	Ashfield LEP	Adjacent to
C42	Haberfield Conservation Area	Ashfield LEP	Adjacent to
C37	The Ranch Conservation Area	Ashfield LEP	Adjacent to
4571056	Dobroyd Canal Stormwater Channel No. 53	Sydney Water s.170 Register	Within

Figure 2: Location of heritage items in relation to the study area



3.0 HISTORICAL CONTEXT

3.1 Early Land Grants and Road Alignments (1788 – 1890s)

The original track linking Rosehill and Sydney was formed shortly after Rosehill was settled[1]. Rose Hill was renamed Parramatta in 1791[2]. It is unknown who was responsible for establishing the original route the track followed but by 1794 it had been widened and cleared to make it more suitable for carriages[3]. The route was formerly laid out in 1797 under the direction of the Surveyor-General Augustus Alt[4] and had become a major thoroughfare for the colony by the early 19th century[5]. The popularity of Parramatta road encouraged the establishment of businesses and suburbs along the route. The poor condition of Parramatta Road was a constant nuisance to road users in the early 19th century. In July 1806 an order was made instructing drivers of empty vehicles leaving Sydney for Parramatta to carry loads of brick-bats from the brickfields and drop them in places along the road appointed by the Overseer of Roads[6].

The Great North Road was built by convict labour between 1826 and 1836[7]. The road was intended to form part of a network of 'Great Roads' which would radiate to the north, west and south of Sydney[8]. The techniques used to construct the Great North Road followed the revolution in scientific road building development in England[9]. Construction of the road through Haberfield and Five Dock was part of a branch planned by Major Thomas Mitchell, a prominent figure in the construction of the Grest North Road shortly after his arrival to the colonies in 1827[10].This branch greatly improved access to the area between the river and Parramatta Road channelling traffic to and from the northern side of the river through the Five Dock area[11]. The land along the road was subdivided in the late 1830s

The suburb of Haberfield was originally part of a 480 acre grant made to Nicholas Bayly in 1803[12]. Bayly named his grant Sunning Hill Farm and is said to have planted the first Norfolk Pines in the area[13]. Following Bayly's death in 1826 the grant was acquired by Simeon Lord who then passed it onto his daughter, Sarah upon her marriage to Dr David Ramsay[14]. The Ramsay's renamed the estate Dobroyd Estate[15]. Dobroyd estate was subdivided over time between the Ramsay family however, remained largely undeveloped until the 1900s when realty agents R Stanton and W H Nicholls acquired much of the area now known as Haberfield[16].

By 1810 all of the land comprising of today's Ashfield municipal area had been granted to officers and men of the Rum Corps[17]. Surveyor General Augustus Alt was one of the first colonists to be granted land in the area receiving 100 acres in Croydon and another 250 acres in Ashfield in 1801[18]. The

[1] Jervis, J 1961 *The Cradle City of Australia: A history of Parramatta 1788-1961*, Halstead Press, Sydney
[2] Kass, T 2008 "Parramatta" http://dictionaryofsydney.org/entry/parramatta accessed on 27 October 2015
[3] Wotherspoon, G 2010a "The Road West" http://dictionaryofsydney.org/entry/the_road_west accessed on 27 October 2015
[4] RTS Heri tage and Conservation Register
[5] Wotherspoon 2010a
[6] Jervis 1961: 55
[7] Karskens, G 1999 The Convict Trail Project Conservation Management Plan
[8] ibid
[9] ibid
[10] Karskens 1999
[11] Iron Cove Creek S. 170 register entry
[12] Pollon, F 1988, *The Book of Sydney Suburbs*, Angus and Robertson, North Ryde: 118
[13] ibid
[14] Jackson-Stepowski, S 2008, "Haberfield" http://dictionaryofsydney.org/entry/haberfield accessed on 27 October 2015
[15] ibid
[16] Pollon 1988: 119
[17] Pratten, C n.d A Short Walk Through Ashfield's Past, Ashfield Municipal Council, Ashfield.
[18] Pollon 1988: 8

name 'Ashfield' was first recorded in a newspaper advertisement in early 1816[19]. Subdivision occurred earlier in Ashfield than Haberfield. Elizabeth Underwood, then owner of Ashfield Park, subdivided lots along the north side of Liverpool Road in 1838[20]. These lots became known as the Village of Ashfield. The opening of the railway gave impetus for the development of Ashfield when it was established in 1855[21]. By 1866 industries had started to establish themselves in Ashfield including a steam mill, Boylson's bakery and Tancred's soap and candle manufacturers[22].

3.2 Subdivisions, Garden Suburbs and Road Upgrades (late 19th Century – 1950s)

The increasing popularity of the motor vehicle throughout the early 20th century was matched by the increasing traffic and use of Sydney's Roads[23]. Areas along the main roads in Sydney attracted subdivisions and businesses to become established in areas that were previously undeveloped scrub. The establishment of suburbs such as Haberfield and Ashfield put greater pressure on roads such as Parramatta Road as more people wanted to travel into and out of these areas. The increased traffic on roads necessitated new measures to maintain their condition. Parramatta Road was first tar-paved in 1910 from Taverners Hill to Paramatta[24]. This mounting pressure on roads and the need to maintain them was met by the establishment of the Main Roads Board, a government body responsible for maintaining and building roads deemed to be Main Roads[25]. The Main Roads Board (MRB) set about a program of maintaining and improving Sydney roads during the 1920s. Parramatta Road measured 24 feet or 7.3 metres in 1925[26]. Part of the MRB program of road works included widening main roads to a national standard of 25.6 metres and paving the roads to take the increasing traffic loads[27]. Previously roads were generally left as a cleared route with the natural soil as a surface. Roads through Sydney often utilised the natural sandstone as a base and macadamised roads were generally favoured[28]. Parramatta was repaved with a Telford base between Ashfield and Parramatta in 1920.

Stanton's vision for a model garden suburb greatly influenced the design of Haberfield[29]. The Garden City Movement originating from Britain aimed to separate industrial, commercial and residential land uses. The garden suburb sought to provide pleasant healthy suburban estates complete with integrated drainage and sewerage systems[30]. In order to achieve this vision Stanton kept tight control over the style of houses, the layout of the blocks, the inclusion of parklands and the alignment of the streets[31]. The venture proved to be a great success predating the first garden suburbs in Britain by five years[32]. By the 1940s all of the Haberfield allotments had been built on.

The first motor vehicle plant was constructed on the South side of Parramatta Road near Frederick Street, Australian Motors established in 1920[33]. These buildings later became part of the AWA complex until the 1990s when they were demolished[34].

[19] Pratten n.d: 1
[20] ibid
[21] Pratten n.d.: 2
[22] Pollon 1988: 9
[23] RTA Thematic History
[24] ibid
[25] ibid
[26] ibid
[27] Ibid
[28] ibid
[29] Jackson-Stepowski 2008
[30] Haberfield Heritage Conservation Area Ashfield Municipal Council DCP 2007
[31] ibid
[32] ibid
[33] Pratten n.d 1988
[34] Ibid

3.3 Road Modernization (1950s to Present)

The high volume of traffic on Sydney roads has meant that the program of improvement works started by the MRB in the 1920s has continued up to the present to meet demand. As new road technologies developed around the world these were bought to Australia and applied to roads here. The first line marking machinery was bought to NSW from the USA in 1937 and its use greatly reduced traffic incidents on Parramatta Road[35]. The establishment of the Haberfield Conservation Area has preserved much of the original layout of Stanton's garden suburb. The areas adjacent to Parramatta Road are generally populated by car yards, sales rooms and fast food outlets serving as a buffer between the residential character of Ashfield and Haberfield.

[35] Pratten n.d 1988

4.0 SITE INSPECTION

4.1 Introduction

A site inspection was conducted by Josh Symons (Senior Archaeologist) with representatives of the LBAJV on 12 October 2015. The aims of the site inspection were to discuss the scope of the project with LBAJV representatives, make observations of the stormwater drain listed item (Dobroyd Canal Stormwater Channel) and identify any visible archaeological remains or potential heritage items. The inspection of the study area was conducted on foot.

4.2 Site Inspection Results

The study area includes Parramatta Road, footpaths bordering the northern and southern margins of the road, and portions of Dobroyd Parade, Henley Marine Drive and Great North Road. The structures and businesses bordering both the sides of Parramatta Road consist largely of contemporary petrol stations, vehicle sales dealerships and vehicle wash and repair centres (Plate 1-Plate 3). A low lying sandstone wall was identified within the Ashfield Council stockpile property (Plate 4-Plate 5). Access to this property was not available at the time of survey. The original 1930s balustrade is still in place on the northern side of the bridge over Iron Cove Creek (Plate 6-Plate 7). However, the southern side was modified in the 1980s and consists of modern materials.

Plate 1: View southeast across Parramatta Road showing contemporary structures

Plate 2: View southwest across Parramatta Road showing southern side of Iron Cove Creek bridge and modern metal railing

Plate 3: View northeast across Parramatta Road to brick building at 313 Parramatta Road, Haberfield

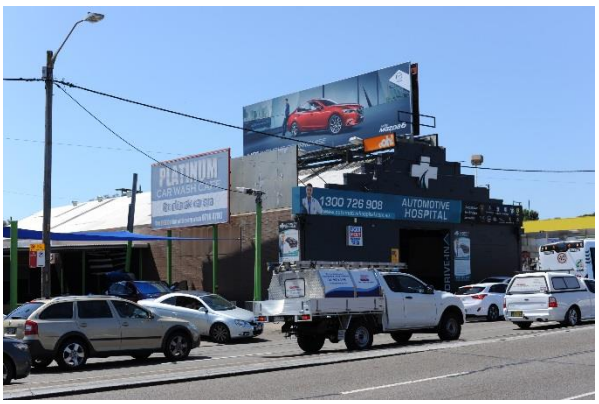


Plate 4: View east from Henley Marine Drive showing portion of low-lying sandstone wall within Ashfield Council stockpile property

Plate 5: View west from Dobroyd Parade showing portion of low-lying sandstone wall within Ashfield Council stockpile property

Plate 6: View east across extant 1930 concrete railing on northern margin of Iron Cove Creek bridge

Plate 7: Plaque on eastern end of concrete railing facing Parramatta Road with the inscription "MRB 1930"

5.0 HERITAGE ASSESSMENT

5.1 Listed Heritage Items

There is one listed item located within and below the study area (Figure 2). This is the Dobroyd Canal Stormwater Channel no. 53 listed on the Sydney Water Section 170 Heritage Register. There are two conservation areas listed on the Ashfield LEP located to the north and south of the study area as well as a house that is also listed on the LEP located to the south west of the study area (Figure 2).

5.1.1 Dobroyd Canal Stormwater Channel no. 53 (4571056)

The Dobroyd Canal Stormwater Channel no. 53 runs beneath Parramatta road within the study area. The listing includes the channel beds, walls and coping. The canal is open to the north of Parramatta Road where it runs to the discharge point at Iron Cove and runs underground south of Parramatta Road around Banks Street.

The statement of significance is as follows:

> *The Dobroyd Stormwater Channel is a representative example of one of the first stormwater channels built in the 1890's to alleviate the city's severe public health problems. It still includes a length of brickwork drain illustrating the construction skills of the time. Overall the different sections, built at various times, illustrate the progress and improved construction methods made over a period of 100 years. It is of particular historical significance as it was one of a group of the first nine purpose built stormwater drains to be constructed in Sydney in the 1890's. Prior to this period the watercourses which served to carry stormwater were entirely in their natural state and were receptacles of sewage from the large population which had settled in the suburbs. In 1890, the then Minister for Public Works, the Hon. Bruce Smith MLA., appalled at the extremely unhealthy conditions prevailing at the time, proposed a separate system of stormwater drains be built to help alleviate the problem. By 1897 nine stormwater channels had been built including Dobroyd. The operational curtilage of the channel includes the channel bed, walls and coping. The visual curtilage will vary along the length of the channel depending on the surrounding landuses. To formulate a specific curtilage statement that includes details of surrounding landuse and encroachment of various developments would require further investigations and is beyond the scope of this study. However, in general the visual curtilage can be described as follows: 1) Open sections of the channel commence from Iron Cove to Norton Street in Croydon. 2) Sections of the Chidgeys SWC, Alt Street Branch and the Croydon Branch are also open. 3) The upper catchment is presently surrounded by urban and industrial development south of Parramatta Road. In this area the channel can only be viewed from various road bridges that cross it. 4) North of Parramatta Road visual curtilage extends through the boundaries of surrounding parkland and roadways. 5) The downstream section of the channel is part of the cultural landscape of the Timbrell Park and the channel can be viewed from the Main Western Railway Line and bridges on Dobroyd Parade and Ramsey Street.*[36]

[36] Taken from Sydney Water Section 170 Register listing

5.1.2 Haberfield Conservation Area

The Haberfield Conservation Area was first registered as an Urban Conservation Area by the National Trust in 1978[37]. The conservation area encompasses the suburb of Haberfield extending north east from Parramatta Road to the banks of Parramatta river and south from the Dobroyd Canal Stormwater Channel to the Hawthorn Canal Stormwater Channel. The Conservation area is located outside of the study area.

The statement of Significance is as follows:

> *Haberfield has historic significance as the first successful comprehensively planned and marketed Garden Suburb in Australia. Designed and developed by real estate entrepreneur and town planning advocate, Richard Stanton, its subdivision layout and tree lined streets, its pattern of separate houses on individual lots (the antithesis of the unhealthy crowded inner suburbs of the period) and its buildings and materials, clearly illustrate his design and estate management principles. Haberfield pre-dates the first Garden Suburbs in Britain by some five years.*
>
> *It is significant in the history of town planning in NSW. The separation of land uses, exclusion of industry and hotels, designation of land for community facilities and its comprehensive provision of utility services and pre-development estate landscaping profoundly affected housing trends, state subdivision practice and planning legislation in 20th century Australia.*
>
> *It is significant in the history of Australian domestic architecture for its fine ensemble of Federation houses and their fences, and shops, most with their decorative elements intact.*
>
> *It is outstanding for its collection of modest Federation houses displaying skilful use of materials and a high standard of workmanship of innovative design and detail particularly reflective of the burgeoning naturalistic spirit of the Federation ear in which they were built.*
>
> *The form, materials, scale and setback of buildings and their landscaped gardens fronting tree lined streets together provide mature streetscapes of aesthetic appeal.*
>
> *Haberfield is a major research repository of the Federation era, garden design and plant material, architectural detail, modest house planning, public landscaping and utility provision.*[38]

5.1.3 The Range Conservation Area

This conservation area comprises all the properties addressing Page Avenue and Earle Avenue zoned Residential, house numbers 39-55 on Henry Street and the residential properties facing Frederick Street between Henry Street and Parramatta Road: a total of 67 properties[39]. The conservation area encompasses a 10 acre subdivision described as 'The Ranch' offered for sale by

[37] Ashfield Municipal Council DCP 2007 Part C7 Haberfield Heritage Conservation Area
[38] ibid
[39] Taken from The Range Conservation Area 2003 listing

auction in March 1923. The conservation area is located south of the study area. The conservation area includes item 427, House listed on the Ashfield LEP.

The statement of significance is as follows:

> *The cultural significance of The Ranch Conservation Area derives from the following factors—*
>
> *(a) The history of the area, the original building and the later subdivisions, culminating in the present arrangement, has great and compelling interest as a part of the story of Ashfield.*
>
> *(b) The streetscapes are generally homogeneous and attractive, comprising only residences, which are compatible in architectural style (essentially the Sydney version of the Inter-War California Bungalow), as well as form, materials, textures, colours and details.*
>
> *(c) The gentleness of residential scale is notable.*
>
> *(d) Despite modifications the buildings possess a high degree of originality and intactness.*

5.2 Potential Unlisted Heritage Item

The site inspection identified the bridge spanning the Dobroyd Canal Stormwater Channel as partially intact and containing some of the original 1930s fabric. This unlisted item is related to the program of works undertaken by the Main Roads Board in the first half of the 20th century to improve and modernise Sydney roads.

5.2.1 Assessing Heritage Significance

Determining the significance of heritage is undertaken by utilising a system of assessment centred on the Burra Charter of Australia ICOMOS. In NSW heritage is assessed against seven criteria (Table 2). Significance assessment is guided by the NSW Heritage Manual: Assessing heritage significance (NSW Heritage Office 2001). If an item meets one of the seven heritage criteria, and retains the integrity of its key attributes, it can be considered to have significance.

Table 2: NSW Heritage assessment criteria

Criteria	Description
A – Historical Significance	An item is important in the course or pattern of the local area's cultural or natural history
B – Associative Significance	An item has strong or special associations with the life or works of a person, or group of persons, of importance in the local area's cultural or natural history
C – Aesthetic Significance	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in the local area
D – Social Significance	An item has strong or special association with a particular community or cultural group in the local area for social, cultural or spiritual reasons

E – Research Potential	An item has potential to yield information that will contribute to an understanding of the local area's cultural or natural history
F – Rarity	An item possesses uncommon, rare or endangered aspects of the local area's cultural or natural history
G – Representativeness	An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places of cultural or natural environments (or the cultural or natural history of the local area)

5.2.2 Heritage significance assessment for 1930 bridge

Criterion	Discussion
A Historical significance	The bridge was constructed during the 1930s as part of the Main Roads Board program of works to improve Sydney's roads. The bridge was constructed in the same location as an early bridge indicated on the 1860s Concord Parish map. The Bridge is associated with this rise in importance of roads after the introduction of the motor vehicle in the early 20th century. The item meets the threshold of **local significance** under this criterion.
B Associative significance	The item is not considered to have a strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area) The item **does not** meet the threshold of local significance under this criterion.
C Aesthetic significance	The southern section of the bridge consists of entirely modern materials as this section was modified in the 1980s. Only the northern side of the bridge consists of original materials. The bridge does not display any particularly noteworthy aesthetic qualities. The item **does not** meet the threshold of local significance under this criterion.
D Social significance	The bridge does not have a strong or special association with a particular community or cultural group in the local area. The item **does not** meet the threshold for local significance under this criterion.
E Technical/Research significance	There are other more complete examples of this type of bridge in Sydney. The bridge would not contribute to technical or research questions about early 20th century bridge design. The item **does not** meet the threshold for local significance under this criterion.
F Rarity	There are many similar bridges in the area and other localities in NSW. The item **does not** meet the threshold of local significance under this criterion.
G Representative	The item has been modified and there are other more complete examples in the local area that are representative of the item. The item **does not** meet the threshold of local significance under this criterion.

5.2.3 Statement of significance

The bridge over the Dobroyd Canal Stormwater Channel meets the local significance threshold for its historical significance only. Parish maps show the creek crossing has been in existence since the 1860s. The 1930s fabric evident at the site today is related to the program of works undertaken by the

Main Roads Board to improve Sydney roads, including Parramatta Road, after the introduction of the motor vehicle.

6.0 ARCHAEOLOGICAL POTENTIAL AND SIGNIFICANCE

6.1 Background

The following section provides an archaeological assessment for the study area. Historical (non-Aboriginal) archaeological potential is assessed by identifying former land uses and associated features through historical research, and evaluating whether subsequent actions (either natural or human) may have impacted on evidence for these former land uses.

This discussion of the historical archaeological potential of the study area is not intended to be exhaustive. Based on the history of the site and the likely lack of disturbance that has occurred in some areas, there is always some probability that unexpected historical archaeological remains may be encountered during works.

6.2 Parramatta Road phases

The section of Parramatta Road encompassed by the study area has consistently been as a route between Sydney and Parramatta since 1791. During that time the road has undergone various phases of modifications these are summarised as:

- 1791 – early 20th century road cleared from bush and most likely consisted of the natural soil surface. Early roads in Sydney often used natural sandstone as a road base.
- 1910 – road between Taverners Hill and Parramatta tar-paved
- 1920s – road between Ashfield and Parramatta resurfaced with Telford road base.
- Post 1920s – Road was widened to meet national standards and continual works to modernise and maintain the road have been undertaken.

6.3 Previous impacts

Earlier impacts need to be identified before an assessment of archaeological potential can be prepared. Subsurface impacts associated with former or current land-use have the potential to remove or damage potential archaeological remains.

6.3.1 Parramatta Road

Parramatta Road has been substantially widened and re-surfaced since the early 19th century. Iron Cove Creek bridge has been widened on at least two occasions – the first in 1930 and the second in 1981. This process of widening is likely to have had a high impact on the areas bordering Parramatta Road. The process of widening and re-surfacing is likely to have had a moderate-high impact on former macadam and telford road surfaces. The level of impact to the former road surface would depend on the depth of previous resurfacing.

The process of widening Parramatta Road has included a sequence of moderate-high level impacts to the crossing of Iron Cove Creek. This includes removal of a stone arched bridge over Iron Cove Creek when Parramatta Road was widened in 1930 (high impact), and removal of the southern portion of the extant bridge during further widening works in 1981 (moderate impact to the 1930 bridge).

6.3.2 Structures bordering Parramatta Road

The site inspection illustrated the fact that the large majority of extant structures bordering the northern and southern margins of Parramatta Road are relatively recent constructions. This has had a high level of impact on built heritage bordering Parramatta Road.

6.3.3 Iron Cove Creek

Iron Cove Creek has been subject to a high level of impact. The original watercourse has been extensively modified and straightened when it was canalised. The canal fabric has been subject to a low level of impact from construction of the Iron Cove Creek Bridge. Immediately to the north and south of the study area the western portion of the canal has been subject to a high level of impact from construction of a box drain beneath Parramatta Road.

6.4 Archaeological Potential Assessment

The potential impacts to the study area have been outlined in the previous section. A series of gradations of potential have been identified and mapped to indicate the degree to which archaeological remains are likely to survive within the study area. The identified levels of archaeological potential are:

Low Potential: subsequent land-use and impacts are likely to have removed archaeological remains or historical research indicate low level previous occupation and activity.

Moderate Potential: historical evidence of previous occupation and while there are impacts in this area a range of archaeological remains may to survive across the site, including former road surfaces and paths, the footings of buildings, wells, cisterns and rubbish pits in areas where the road was widened.

6.4.1 Phase 1: Early Road Alignments 1791 – late 19th century

The initial Parramatta Road is described as a three metre wide dirt road. There is evidence to suggest that Sydney Roads took advantage of the natural sandstone as road bases around this time. The area bordering the road was largely agricultural. This could have included grazing of animals, small farms and market gardens. Whilst it is possible that the study area had been cleared of vegetation by this time it is unlikely that any substantial landform modification took place until the mid 19th century subdivisions that occurred in Ashfield and in the early 20th century for Haberfield. It was also during this time that the Dobroyd Canal Stormwater Channel was established.

Potential archaeological remains typically associated with these types of uses are likely to be ephemeral in nature and include:

- Evidence of vegetation removal (occasionally associated with the burning of tree stumps and opportunistic deposition of rubbish within the resulting tree boles)
- Evidence of lot divisions and fence lines
- Evidence of narrower road alignment
- Evidence of formalisation of Iron Cove Creek
- Evidence of modification of landforms to suit agricultural purposes, such as the installation of garden beds, introduction of topsoil or ploughing.

Archaeological remains associated with the early alignment of Parramatta Road are likely to be ephemeral in nature and to have been removed during subsequent modifications. There could be some potential that sandstone blocks used as road base could be located at depth. It is unlikely that remains associated with early agriculture along the Parramatta Road in this area will be located in the study area.

There is nil-low potential for archaeological remains associated with this phase to be present within the study area

6.4.2 Phase 2: Road Upgrades early 20th century to 1950s

Parramatta Road was recorded to be 7.3 metres wide in 1925. A national standard for road width of 25.6 metres was established in the same year and it is likely that Parramatta Road was widened after this time. The road is reported to have been tar-paved in 1910 and resurfaced with a Telford base in 1925. The current bridge spaning Dobroyd Canal Stormwater Channel was constructed in 1930 with the northern side retaining the original materials. Industries started to emerge along Parramatta Road at this time including the short lived Australian Motors Plant. It was at this time that the northern properties along Parramatta Road were subdivided and the garden suburb of Haberfield was established.

The potential archaeological remains associated with this phase are likely to include

- Previous road surfaces and bases
- Evidence of early lot divisions and fence lines
- Footings of buildings adjacent to Parramatta Road before it was widened.

There is low potential for archaeological remains associated with phase 2 to be present within the study area.

6.4.3 Summary

The potential for archaeological remains to be located within the study area for each phase is summarised below:

Phase 1 – nil-low potential for archaeological remains associated with early agricultural uses such as postholes, removal of vegetation and early road surfaces and bases.

Phase 2 – low potential for archaeological remains associated with early subdivisions, industry and road surfaces and bases.

6.5 Archaeological significance

6.5.1 Introduction

The Heritage Division of the OEH issued a new set of guidelines in 2009: *Assessing Significance for Historical Archaeological Sites and 'Relics'*. The following section presents a discussion of the potential archaeological resource in accordance with these guidelines.

6.5.2 Archaeological research potential

Consideration of archaeological research potential is required when undertaking a significance assessment of an historical archaeological site. Bickford and Sullivan espoused the principles and

developed a framework in order to assess archaeological research potential. These principles have been incorporated into three questions and should be used as a guide for assessing the significance of an archaeological site[40]:

- Can the site contribute knowledge that no other site can?
- Can the site contribute knowledge that no other resource can?
- Is this knowledge relevant to general questions about human history or other substantive questions relating to Australian history, or does it contribute to other major research questions?

The study area has nil - low potential to contain an archaeological resource that may be able to support and enhance the current state of knowledge about its phases of occupation. Any surviving archaeological remains within the study area are likely to have been truncated by successive phases of demolition and construction that have occurred throughout the 20th century. Other more intact sites dating to the same time periods may be able to provide archaeological data and contribute to research questions to a greater extent than the current study area.

Given the disturbed nature of the study area the potential archaeological resource is unlikely to contribute to current archaeological research agendas.

6.5.3 Archaeological significance assessment

The assessment of the significance of the potential archaeological resource contained within the study area against the NSW heritage assessment criteria is outlined in below.

Criteria	Description
A – Historical Significance	There is nil-low potential for archaeological remains to be present at this site, therefore the potential archaeological resource would be unlikely to have historical significance for its ability to provide information relating to the development of the study area and Parramatta Road in general. Though considered unlikely to be present, intact remains of the early road surfaces of Parramatta Road would provide information or this important route. **The potential archaeological resource does not meet the local significance threshold under this criterion.**
B – Associative Significance	Parramatta road does have associative links to significant figures within the early settlement of Sydney and Parramatta. The potential archaeological resource is unlikely to contribute significantly to the knowledge of these prominent figures. **The potential archaeological resource does not meet the local significance threshold under this criterion.**
C – Aesthetic Significance	Although it is recognised that exposed in situ archaeological remains may have distinctive/attractive qualities, only rarely are these considered 'important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW'. **The potential archaeological resource does not meet the local significance threshold under this criterion.**

[40] Bickford, A and S Sullivan, pp. 23-24

D – Social Significance	The site does not have a strong or special association with a particular community or cultural group in the local area. **Therefore, the potential archaeological resource does not meet the local significance threshold under this criterion**.
E – Research Potential	The study area has nil-low potential to contain an archaeological resource that may be able to support and enhance the current state of knowledge about its phases of occupation. These remains are likely have been heavily impacted by road maintenance and construction activities during the late 19th century and 20th century. Though considered unlikely to be present, intact remains of road surfaces could be compared to other similar sites and provide research data for early road construction in Sydney. **The potential archaeological resource does not meet the local significance threshold under this criterion.**
F – Rarity	Archaeological remains associated with the earliest European settlement of the Ashfield area would be rare. The archaeological remains associated with the original Parramatta Road alignment would be rare as an early example of road construction. Given the subsequent history of the site it is unlikely that remains of these phases would be located intact within the study area. **The potential archaeological resource does not meet the local significance threshold under this criterion.**
G – Representativeness	The potential archaeological remains within the study area are likely to be representative of roads and commercial uses typically found in commercialised contexts. Although any remains are likely to demonstrate the principle characteristics of this type site, it is unlikely that they would be considered particularly representative. **The potential archaeological resource does not meet the local significance threshold under this criterion.**

6.6 Statement of Archaeological Significance

Due to the level of impact within the study area from repeated widening of Parramatta Road and canalisation of Iron Cove Creek, there is low potential for significant archaeological remains within the study area. Dependent on the level of impact from road widening and resurfacing, there is low potential for previous telford and macadam road surface to be present. Though archaeological in nature, the buried remains of former telford and macadam road surfaces are a 'work' rather than a 'relic' under the Heritage Act.

Due to the high level of impact along the Parramatta Road corridor the potential archaeological resources does not meet the local significance threshold.

7.0 HERITAGE IMPACT ASSESSMENT

7.1 Proposed works

The proposed works involved the following physical work:

- Duplication of the right turn from Parramatta Road to Great North Road
- Review the parking permitted on Great North Road
- Pavement widening Parramatta Road and Great North Road
- Relocation of TCS infrastructure to suite the new intersection layout
- Utility adjustments
- Adjustments to driveway access
- Property acquisition and adjustment
- Bus shelter relocation
- Bridgeworks including widening
- Modifications to stormwater drainage infrastructure
- Tree removal and trimming.

The design pavement profile is yet to be confirmed. It is anticipated that at least 520 millimetres of pavement would be required in newly constructed road pavement outside the limits of the bridge. Over the bridge would require replacement of the existing foot and extension with precast bridge elements of variable thickness. The works would be similar to the previous extension of the bridge on the southern side.

Figure 3: Concept design, eastern section of study area

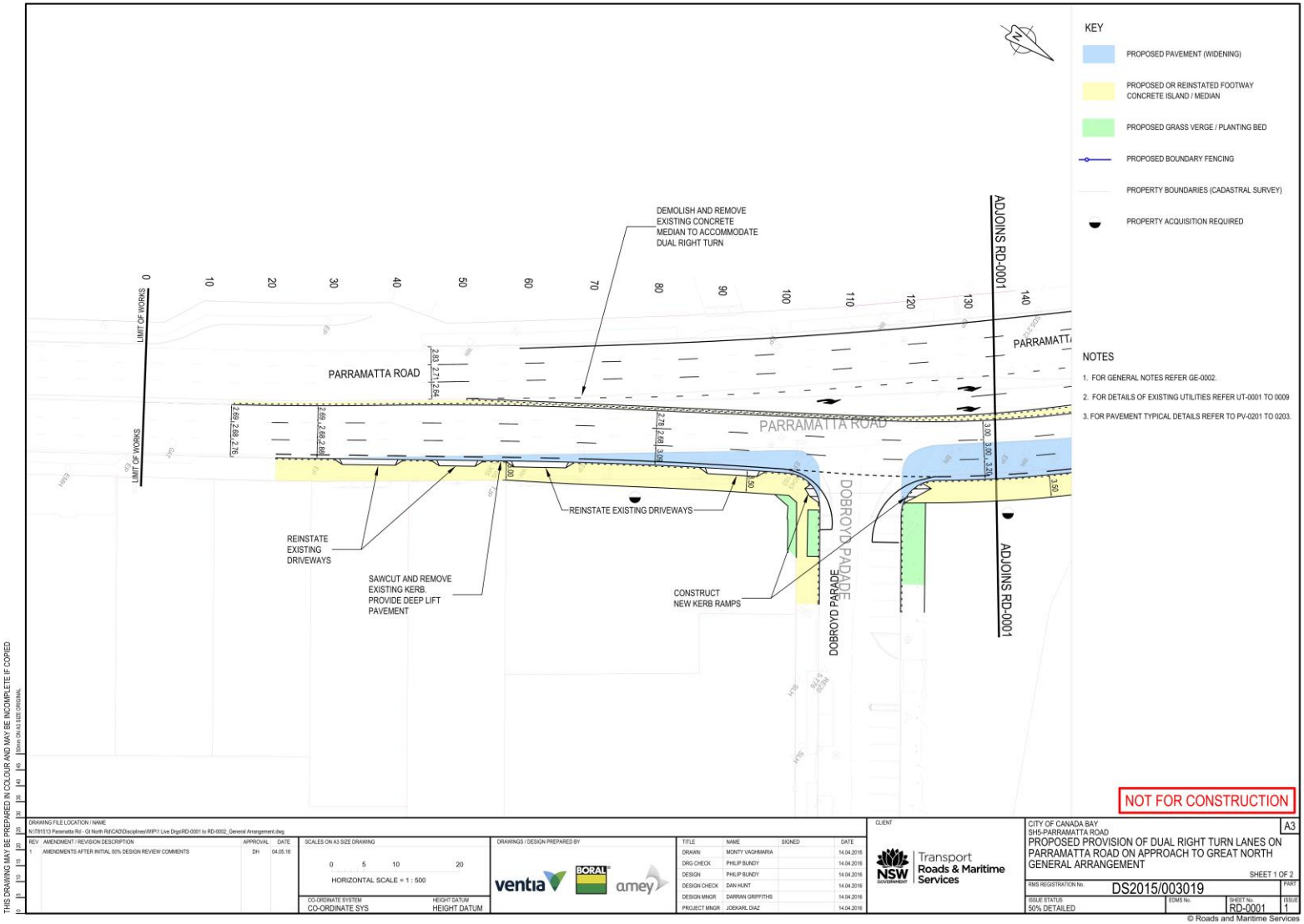
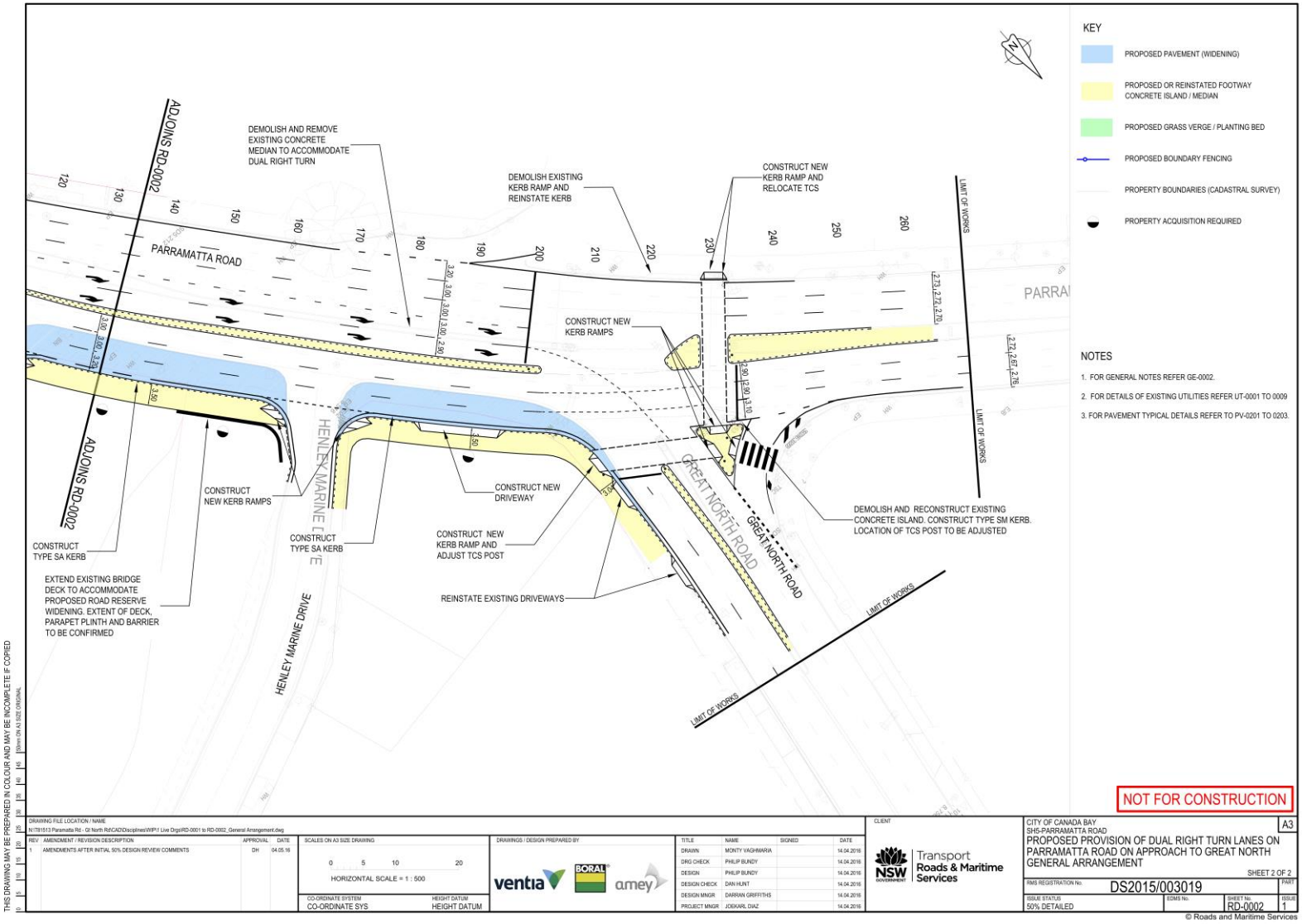


Figure 4: Concept design, western section of study area



7.2 Impact assessment

7.2.1 Built heritage

The proposed works would not directly impact the heritage items and conservation areas located outside of the study area.

This impacts assessment is based on the assumption that the works will not involve direct impact to the Dobroyd Canal Stormwater Channel.

The proposed works involve the widening of the bridge over the Dobroyd Canal Stormwater Channel would remove the northern portion of the bridge and some of the concrete footings. It is understood that the lower portion of the concrete footings, which affix to the top of the Dobroyd Canal Stormwater Channel, will remain intact. Archival recording prior to construction impacts would mitigate the impact to the 1930 bridge.

The proposed works do not involve direct impacts to the Dobroyd Canal Stormwater Channel. There is the potential that this item could be impacted indirectly from the construction works given its proximity to the works. An exclusion zone should be established around this item to manage inadvertent impacts to this item during construction.

7.2.2 Archaeological resource

The proposed works include bulk earthworks to 850 millimetres below the road surface, with potential for deeper excavation for drainage works. This would remove any intact archaeological remains associated with early road surfaces and roadside structures that may be located within the study area. However, the archaeological potential of the study area has been assessed as low therefore it is unlikely that the development would impact on archaeological relics or works.

As works, impact to any former macadam or telford road surfaces that may be present beneath the current road surface would not require specific approval under the ‘relics’ provisions of the Heritage Act (Sections 139-146).

7.2.3 Summary of impacts and mitigation measures

A summary of impacts and mitigation measures for the proposed works is outlined below in Table 3.

Table 3: Summary of identified significance, impacts and mitigation measures

Item	Significance	Physical impacts to heritage fabric and/or archaeological potential	Mitigation Measures
Dobroyd Canal Stormwater Channel	Local	No impacts	An exclusion zone should be established around this item to manage inadvertent impacts to this item during construction. Sydney Water's Heritage Advisor should be consulted regarding comments or requirements in relation to the Dobroyd Canal Stormwater Channel prior to works commencing. Further assessment and mitigation measures where the proposal is changed to impact the Dobroyd Canal Stormwater Channel.
Haberfield Conservation Area	Local	No impacts	Further assessment and mitigation measures where the proposal is changed to impact the Haberfield Conservation Area.
The Ranch Conservation Area	Local	No impacts	Further assessment and mitigation measures where the proposal is changed to impact the Ranch Conservation Area.
1930 road bridge over Iron Cove Creek	Local	Removal and replacement of the northern portion of the bridge	The portion of bridge to be removed would be archivally recorded according to NSW Heritage Division standards (1998), prior to the commencement of works.
Archaeological resource	Likely to have been impacted. No identified significance	Drain and wall would be removed by the proposed works.	The Roads and Maritime Standard Management Procedure for Unexpected Heritage Items (2015) should be implemented in the case of unexpected finds. Further assessment and mitigation measures required where unexpected finds encountered, such as archival recording of any former road surfaces encountered.

8.0 CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

- The Dobroyd Canal Stormwater Channel no. 53 (4571056) listed on the section 170 Sydney Water register is located below the study area. The proposal may result in indirect impacts to this item.
- The bridge spanning the Dobroyd Canal Stormwater Channel has been identified as a potential unlisted heritage item. The proposal would result in a major impact to the heritage values of this item.
- There is nil-low potential for archaeological relics and works to be located within the study area, including remains of early surfaces associated with Parramatta Road. The proposal is therefore unlikely to impact archaeological relics or works.

8.2 Recommendations

8.2.1 Built heritage

- The original northern portion of the 1930s bridge over the Dobroyd Canal Stormwater Channel should be archivally recorded prior to removal.
- Indirect impacts to the Dobroyd Canal Stormwater Channel should be avoided. Details of this heritage item should be included in the Construction Management Plan (CMP) and an exclusion zone established during construction.
- Sydney Water's Heritage Advisor should be consulted regarding comments or requirements in relation to the Dobroyd Canal Stormwater Channel prior to works commencing.

8.2.2 Archaeology

- The proposed works are not expected to impact archaeological relics or works and therefore no further archaeological approval or investigation is required.
- However there is some potential that isolated archaeological finds may be unexpectedly found during ground works. Therefore the following Unexpected Finds Procedure should be implemented during works associated with the current subdivision proposal:
  - Stop work within the affected area, protect the potential archaeological find, and inform environment staff or supervisor.
  - Contact a suitable qualified archaeologist to assess the potential archaeological find.
  - If archaeological relics are identified the NSW Heritage Division must be notified in accordance with the Heritage Act.
  - Further assessment and archaeological permit approvals from the NSW Heritage Division may be required prior to works recommencing in the affected area.
  - Where the unexpected finds are identified as works associated with former road surfaces, it is likely that monitoring of works in that area and archival recording by a suitably qualified heritage consultant may be required.

9.0 REFERENCES

Haberfield Heritage Conservation Area Ashfield Municipal Council DCP 2007

Jackson-Stepowski, S 2008, “Haberfield” http://dictionaryofsydney.org/entry/haberfield accessed on 27 October 2015

Jervis, J 1961 The Cradle City of Australia: A history of Parramatta 1788-1961, Halstead Press, Sydney

Karskens, G 1999 The Convict Trail Project Conservation Management Plan

Kass, T 2008 “Parramatta” http://dictionaryofsydney.org/entry/parramatta accessed on 27 October 2015

Wotherspoon, G 2010a “The Road West” http://dictionaryofsydney.org/entry/the_road_west accessed on 27 October 2015

Pollon, F 1988, The Book of Sydney Suburbs, Angus and Robertson, North Ryde

Pratten, C n.d A Short Walk Through Ashfield’s Past, Ashfield Municipal Council, Ashfield

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Appendix F

Ecological Assessment

PARRAMATTA ROAD/ GREAT NORTH ROAD INTERSECTION

Ecological Assessment

For:

SNC-Lavalin

May 2016

Final

cumberland ecology

PO Box 2474
Carlingford Court 2118

Report No. 15173RP1

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Version	Date Issued	Amended by	Details
1	11/11/2015	MP, BF, KW	Draft
2	9/05/2016	MP	Final

Approved by: Dr David Robertson

Position: **Director**

Signed: David Robertson

Date: *9 May, 2016*

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Glossary of Terms

EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FM Act	NSW *Fisheries Management Act 1994*
KTP	Key Threatening Process
Locality	The area within a 10km radius of the subject site
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
REF	Review of Environmental Factors
RMS	Roads and Maritime Service
Subject site	Parramatta Road and Great North Road intersection in Five Dock (see **Figure 1.1**)
TEC	Threatened Ecological Community
TSC Act	NSW *Threatened Species Conservation Act 1995*

Chapter 1

Introduction

Cumberland Ecology has been requested by SNC-Lavalin to undertake an ecological assessment of areas that are to be modified or removed to facilitate the upgrade of a section of road located at the Parramatta Road and Great North Road intersection in Five Dock (hereafter referred to as the 'subject site') (**Figure 1.1**). This ecological assessment will form part of a Review of Environmental Factors (REF) that is being produced by SNC-Lavelin for NSW Roads and Maritime Services (RMS).

1.1 Purpose

The purpose of this report is to describe the current biodiversity values of the subject site and to assess the potential impacts of the proposed works on flora and fauna, particularly threatened species, populations and communities that are listed under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The specific objectives of this report are to:

- Describe the vegetation communities on the subject site;
- Describe fauna habitats and fauna usage of the subject site;
- Identify any threatened species, populations or ecological communities (as listed under the TSC Act and/or EPBC Act) existing on the subject site;
- Assess the likelihood of occurrence of threatened species, populations or communities (as listed under the TSC Act and/or EPBC Act) within the subject site;
- Assess the potential impact of the project on threatened communities, flora and fauna, including the completion of Assessments of Significance under Section 5A of the NSW *Environmental Planning and Assessment Act 1979*; and
- Where relevant, recommend mitigation measures to reduce the impacts of the proposed development on biodiversity values.

1.2 Description of Proposed Works

Roads and Maritime proposes to upgrade the intersection of Parramatta Road and Great North Road, Five Dock. The proposed upgrade would include duplicating an existing right turn bay northbound from Parramatta Road to Great North Road, widening of the bridge over Iron Cove Creek (also known as Dobroyd Canal) and widening of both sides of Parramatta Road between Arlington Street and Wolseley Street

There will be two types of vegetation disturbance associated with the proposed works:

- Trimming of two trees along the western side of Parramatta Road; and
- Removal of vegetation along the eastern side of Parramatta Road;

In addition to the vegetation disturbance, the eastern sections of the bridge over Iron Cove Creek will be replaced.

Coordinate System: MGA Zone 56 (GDA 94)

Great North Road
Parramatta Road
Henley Marine Drive
Iron Creek
Dobroyd Parade
Wolseley Street

Legend

Subject Site

Grid North

Image Source:
Image © 2015 Aerometrex
(dated 01-01-2014)

Data Source:
OEH (2013). The Native Vegetation of the Sydney Metropolitan Area. Office of Environment and Heritage NSW.

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I:\...\15173\Figures\RP1\20151111\Figure 1.1. The Subject Site

Figure 1.1. The Subject Site

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Chapter 2

Methodology

2.1 Desktop Assessment

Database analysis was conducted for the locality using both the NSW Office of Environment and Heritage (OEH) Atlas of NSW Wildlife (OEH, 2015) and the Commonwealth Department of the Environment (DoE) Protected Matters Search Tool (DoE, 2015). The locality is defined as the area within a 10 km radius of the subject site. The Atlas of NSW Wildlife Database search was used to generate records of threatened flora and fauna species listed under the TSC Act within the locality of the subject site. The Protected Matters Search Tool generated a list of Matters of National Environmental Significance listed under the EPBC Act potentially occurring within the locality of the subject site. The lists generated from these databases were reviewed against available knowledge of the subject site, in conjunction with the abundance, distribution and age of records, to ascertain the likelihood of occurrence of threatened species within the subject site.

Database searches also included interrogation of the NSW Department of Primary Industries Threatened & protected species - records viewer (DPI, 2015) to determine the potential occurrence of threatened species listed under the NSW *Fisheries Management Act 1994* (FM Act). Searches were conducted for the Canada Bay and Ashfield Local Government Areas (LGA).

Previous broad-scale mapping conducted by OEH (formerly the Department of Environment, Climate Change and Water) for the Sydney Metropolitan catchment .(OEH, 2013) was utilised to determine potential vegetation communities likely to occur within the subject site and surrounds.

2.2 Flora Survey

The subject site was surveyed by a botanist on 29 October 2015. A random meander throughout the entire subject site was performed where notes were taken, specifically the plant species observed and the condition of the vegetation to be impacted as a result of the proposed works. The location of the random meander within the subject site and surrounds is shown in **Figure 2.1**). Photographs of the subject site were also taken to document the vegetation condition. Surveys included verification of any existing vegetation mapping, along with targeted searches for threatened flora listed under the TSC Act and/or EPBC Act that are known to occur in the locality.

2.3 Fauna Survey

2.3.1 Fauna Habitat Assessment

A fauna habitat assessment was undertaken by an ecologist on 29 October 2015 during the random meander flora survey (see **Figure 2.1**). The fauna habitat assessment included consideration of important indicators of habitat condition and complexity including the occurrence of microhabitats such as tree hollows, fallen logs, bush rock, culverts, drainage pipes and wetland areas such as creeks and soaks. Structural features considered included the nature and extent of the understorey and ground stratum and extent of canopy. Any suitable habitat identified was recorded using a hand held Global Positioning System unit, and the trees details such as species, and number and size of hollows were recorded. The survey also included an assessment of the presence of habitat features suitable for use by threatened fauna species known from the locality.

2.3.2 Targeted Threatened Microbat Surveys

Targeted surveys for threatened microbats through ultrasonic call detection were undertaken with an Anabat unit. The Anabat unit was placed near the entrance of the bridge to undergo works as it was identified as providing suitable habitat for threatened microbats known to occur in the locality (see **Figure 2.1**). The Anabat unit was left for a period of five nights and the data collected was analysed to determine if any microbats utilise the habitats within the subject site.

A visual inspection underneath the bridge to undergo works was also undertaken where any crevices suitable for microbats were searched with an endoscope.

2.4 Limitations

Vertebrate fauna and vascular flora of the locality are well known based upon a sizeable database of past records. The surveys by Cumberland Ecology added to the existing database and helped to provide a clear indication of the likelihood that various species occur, or are likely to occur within the subject site. The data obtained from database assessment and surveys of the subject site furnished an appropriate level of information to support this assessment.

The weather conditions at the time of the flora surveys were generally favourable for plant growth and production of features required for identification of most species. Shrubs, grasses, herbs and creepers were readily identifiable in most instances. It is expected that not all flora species present would have been recorded during surveys. Despite this, it is considered that sufficient information has been collected to assess issues including conservation significance of the flora, condition and viability of vegetation and likely impact on native vegetation. An assessment of the likelihood of occurrence of threatened flora species recorded within the locality of the subject site in the database searches was undertaken to supplement the flora survey.

Only targeted surveys for microbats were undertaken to supplement the habitat assessment for the subject site. The data produced by the microbat surveys and habitat assessment is intended to be indicative of the types of species that could occur within the subject site. An assessment of the likelihood of occurrence of threatened and migratory fauna species listed for the locality in the database searches was undertaken to supplement the microbat surveys and habitat assessment. The combination of these techniques is considered appropriate for assessing the habitat values for threatened fauna within the subject site.

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Subject Site
- Survey Tracks
- Anabat Location

Grid North

Image Source:
Image © 2015 Aerometrex
(dated 01-01-2014)

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I:\...\15173\Figures\RP1\20151111\Figure 2.1. Survey Locations

Figure 2.1. Survey Locations

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Chapter 3

Results

3.1 Vegetation Communities

The flora survey undertaken of the subject site found no native vegetation communities within the subject site, which confirmed previous vegetation mapping prepared by OEH. The only vegetation occurring within the subject site is comprised of urban native and exotic vegetation, which is predominately planted (see **Figure 3.1**). This vegetation occupies 1,200m^2 of the subject site. No threatened ecological communities occur within the subject site.

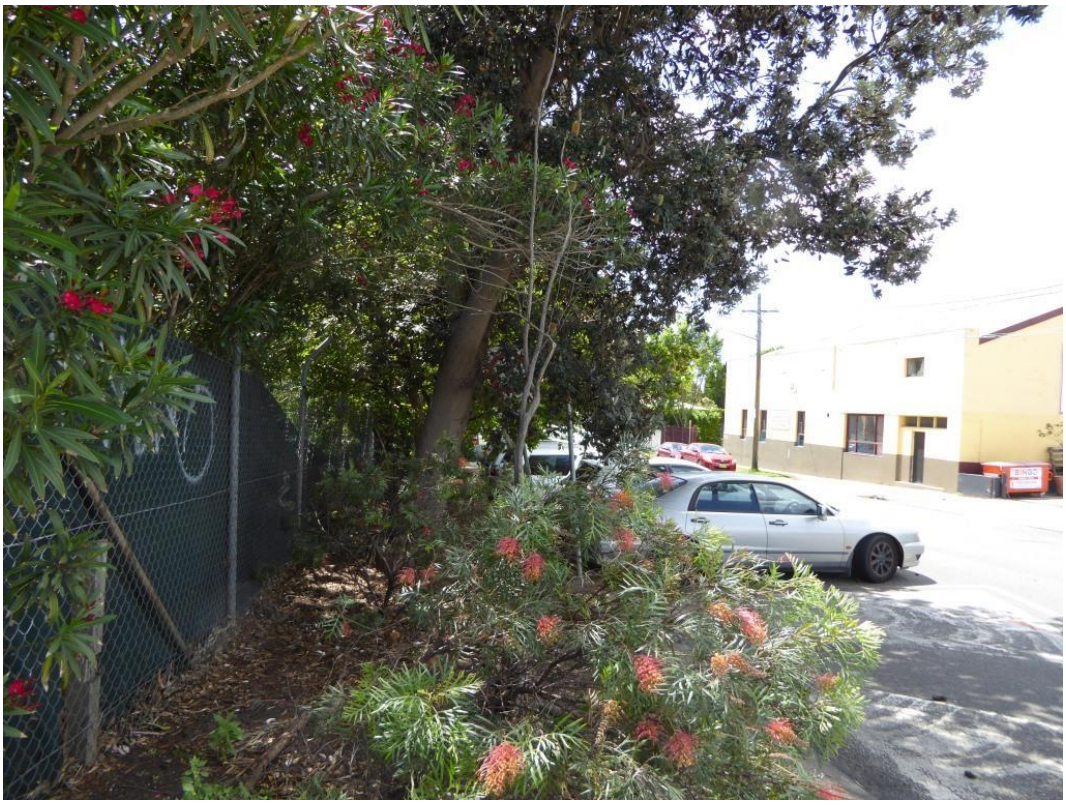
The western side of the subject site is comprised of two planted trees, an individual non-endemic native, *Ficus microcarpa* var. *hillii* (Hill's Weeping Fig) and an individual exotic, *Celtis sinensis* (Japanese Hackberry). Both individuals are planted as part of a street scape (**Photograph 3.1**). The eastern side of the subject site predominately comprises urban exotic vegetation, with some planted native species, some of which are not endemic to the Sydney region.

The north side of Iron Cove Creek contains *Casuarina glauca* (Swamp Oak) planted in mulched beds, lacking a shrub or ground layer. The corner of the intersection of Parramatta Road and Henley Marine Drive contains a planted, tree sized *Acacia elata* (Mountain Cedar Wattle) individual, occurring along with the exotic weed *Cinnamomum camphora* (Camphor Laurel). Beneath these trees is a shrub layer of exotic weeds including *Celtis sinensis* (Japanese Hackberry), *Phoenix canariensis* (Phoenix Palm), and *Ligustrum lucidum* (Broad-leaf Privet). The ground layer in this corner patch of vegetation consists of weed species such as *Megathyrsus maximus* (Guinea Grass), *Bidens pilosa* (Cobbler's Pegs), and *Araujia sericifera* (Moth Vine), along with the native forb *Commelina cyanea* (Native Wandering Jew).

The south side of Iron Cove Creek contains a canopy of planted native and exotic trees, surrounding a soil refuse pile grown over by exotic weed species. Planted along the southern bank of the creek are large trees of the exotic hybrid *Erythrina x sykesii* (Coral Tree), and along the south-western border with Parramatta Road, the exotic shrub *Nerium oleander* (Oleander). Planted along the Dobroyd Parade frontage is the native tree *Banksia integrifolia* (Coast Banksia), non-endemic native *Grevillea robusta* (Silky Oak), and the exotic *Jacaranda mimosifolia* (Jacaranda) (**Photograph 3.2**). The non-endemic native shrub *Callistemon viminalis* (Weeping Bottlebrush) and the native cultivar *Grevillea* 'Robyn Gordon' are planted beneath these trees.

The centre of the area of the subject site south of Iron Cove Creek consists of dumped soil, covered by exotic weed species (**Photograph 3.3**). The shrubs *Ricinus communis* (Castor Oil) and *Cestrum parqui* (Green Cestrum) are present in this area, and the ground layer is dominated by the grass *Pennisetum clandestinum* (Kikuyu). Other exotics present include *Verbena bonariensis* (Purpletop), *Solanum nigrum* (Blackberry Nightshade) and *Asparagus plumosus* (Climbing Asparagus Fern).

Photograph 3.1 *Ficus microcarpa* var. *hillii* in the west of the subject site



Photograph 3.2 Native and exotic plantings along Dobroyd Street frontage

Photograph 3.3 Exotic vegetation along southern bank of Iron Creek and soil refuse pile

3.2 Flora Species

3.2.1 General Species

A total of 49 plant species were recorded within the subject site. Of these, 39 are exotic species, six are native, either planted or common herbaceous species, three are non-endemic planted natives, and one is a native cultivar. A complete list of species recorded during the site survey is provided in **Appendix A**.

3.2.2 Threatened Species

Seven threatened flora species have been recorded previously within the locality. No threatened species were recorded during the site survey. An analysis of the likelihood of occurrence on the study area for each threatened flora species recorded within the locality is provided in **Appendix B**. This assessment concluded that none of threatened flora species known from the locality are likely to occur within the subject site due to the highly degraded and urban nature of the site. The site is highly modified, and no natural habitat for endemic flora is present.

3.3 Fauna Species

3.3.1 Fauna Habitat

Limited potential habitat for native fauna species, including arboreal mammals, bats, and birds, is present on the subject site. No hollow-bearing trees were recorded during the site survey. No large fallen trees, logs, or large branches were recorded within the subject site, and low concentrations of leaf litter are present. Some foraging habitat for non-threatened common bird species, such as the Noisy Miner (*Manorina melanocephala*) is present, in the form of native plantings along Dobroyd Parade (**Photograph 3.2**). Nesting habitat is potentially present for the non-threatened Common Ringtail Possum (*Pseudocheirus peregrinus*) in the form of exotic shrubs within the area south of Iron Cove Creek (**Photograph 3.3**). Roosting habitat is potentially present for microbats, including threatened species, within sections of the bridge containing crevices and cracks (**Photograph 3.4**)

3.3.2 Threatened Species

One threatened fauna species, the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) has been recorded within the subject site. The location of this species is shown in **Figure 3.1**. This species was recorded during targeted surveys via ultrasonic call detection. This species is listed as Vulnerable under the TSC Act and likely utilises habitat within the bridge for roosting habitat and/or the fringing vegetation along Iron Cove Creek as a flyway for foraging purposes.

A number of threatened fauna species have been recorded from the locality and have the potential to occur within the subject site. **Appendix C** analyses the likelihood of occurrence within the subject site for each threatened fauna species recorded or predicted to occur

within the locality. The following threatened fauna species are considered as having a potential to occur within the subject site:

- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Little Bentwing-bat (*Miniopterus australis*); and
- Southern Myotis (*Myotis macropus*).

Limited foraging habitat is present on the site for these species, and some potential roosting habitat is present within the cracks and crevices located underneath the western half of the bridge to be upgraded (**Photograph 3.4**).

Photograph 3.4 Potential roosting habitat for threatened microbat species (cracks and crevices circled in red)

3.4 Aquatic Species

No threatened fish species listed under the FM Act have been identified as occurring within the Canada Bay or Ashfield LGA, in which the subject site occurs.

Coordinate System: MGA Zone 56 (GDA 94)

Legend

Subject Site

Eastern Bentwing-bat

Vegetation Community

Urban Native and Exotic Cover

Grid North

Image Source:
Image © 2015 Aerometrex
(dated 01-01-2014)

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Figure 3.1. Vegetation Mapping and Threatened Species within the Subject Site

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I:\...\15173\Figures\RP1\20151111\Figure 3.1. Vegetation Mapping_Threatened Species

Chapter 4

Impact Assessment

4.1 Vegetation Communities

The vegetation within the subject site does not conform to any TEC listed under the TSC Act or the EPBC Act, therefore no impact to TECs is expected to occur. No remnant, native ecological communities will be impacted as a result of the proposed road upgrade works, as none are present on the subject site. Approximately 1,100m^2 of urban native and exotic vegetation will be removed on the eastern side of Parramatta Road and an additional 100m^2 of urban native and exotic vegetation will be trimmed on the western side of Parramatta Road (**Figure 4.1**).

4.2 Flora Species

4.2.1 General Species

As a result of the proposed road upgrade two trees will be trimmed on the western side of Parramatta Road within the subject site. These trees are planted and are not endemic, native species.

Vegetation to be removed on the eastern side of Parramatta Road consists of some planted, endemic, native species such as *Banksia integrifolia* (Coastal Banksia), *Casuarina glauca* Swamp Oak) and *Acacia elata* (Mountain Cedar Wattle), along with some planted non-endemic native species such as *Grevillea robusta* (Silky Oak). Some scattered individuals of the common native herbs *Cotula australis* (Australian Waterbuttons) and *Commelina cyanea* (Native Wandering Jew) also occur in this area. The majority of the vegetation to be removed consists of planted exotic species, and exotic weed species.

The project has the potential to result in a number of minor impacts to flora species within the adjacent land. In addition to the direct removal and modification of vegetation within the subject site potential indirect impacts to flora species include:

- Weed invasion;
- Runoff, erosion and sedimentation; and
- Modification of microhabitat features resulting from long and short-term edge effects (e.g. changes in light filtration).

The project is not considered to exacerbate these impacts further than current conditions, given the location of the subject site within a highly modified urban area. A number of mitigation measures are proposed to minimise these impacts (see **Chapter 5**).

4.2.2 Threatened Species

No threatened flora species are to be impacted as a result of the proposed road upgrade works, as none were located during the site survey. Due to the small, highly degraded, urban nature of the site, it is not likely any individuals of threatened species were present and not detected during the survey.

4.3 Fauna Species

4.3.1 General Species

The project has the potential to result in a number of minor direct and indirect impacts to fauna species and their habitat within the subject land. Potential direct impacts to fauna species include:

- Loss of blossom and fruit producing trees and shrubs.

Potential indirect impacts to fauna species include;

- Runoff, erosion and sedimentation;
- Increased pollution; and
- Modification of microhabitat features resulting from long and short-term edge effects (e.g. changes in light filtration).

The project is not considered to exacerbate these impacts further that current conditions, given the location of the subject site within a highly modified urban area. It is expected that the majority of fauna species occurring within the subject site would be hardy native species that would readily adapt to any such changes in habitat. Despite this, a number of mitigation measures are proposed to minimise these impacts (see **Chapter 5**).

4.3.2 Threatened Species

A small amount of habitat removal/modification could minimally impact threatened fauna species if present. One tree, a *Ficus microcarpa* var. *hillii* individual with potential to be utilised as foraging habitat by the Grey-headed Flying Fox will be trimmed. This tree is to remain on the subject site, and would only be utilised by the species as part of a much larger foraging range throughout the urban landscape. An assessment of significance under the TSC Act was undertaken for this species and it was determined that the proposed upgrade would not have a significant impact on the Grey-headed Flying-fox (see **Appendix D**).

Two threatened microbat species, the Little Bentwing-bat and the Southern Myotis have potential to utilise the concrete areas under the bridge on the site for roosting, and the rest of

the site for foraging. A third threatened microbat species, the Eastern Bentwing-bat, was recorded and likely utilises the site for roosting and/or foraging. An assessment of significance under the TSC Act was undertaken for all three species collectively and it was determined that the proposed upgrade is unlikely to a significant impact on any of them (see **Appendix D**). The areas under the bridge suitable for roosting habitat will be retained as they are located within the western half of the bridge and are outside of the proposed upgrade works. However, bridge upgrade works to the eastern side of the bridge may cause a temporary disturbance to any individuals present. As this is a bridge on a main road, it is not anticipated that upgrade works will cause a significant increase in noise levels. Some foraging habitat for the Eastern Bentwing-bat and Little Bentwing-bat will be lost through vegetation removal; however, both of these species would only utilise vegetation on the site as part of a larger foraging range. Additionally, all foraging habitat for the Southern Myotis will be retained as Iron Cove Creek will be retained.

Coordinate System: MGA Zone 56 (GDA 94)

Legend

- Subject Site
- Vegetation to be removed
- Vegetation to be trimmed
- Bridge Maintanence

Vegetation Community

- Urban Native and Exotic Cover

Grid North

Image Source:
Image © 2015 Aerometrex
(dated 01-01-2014)

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I:\...\15173\Figures\RP1\20151111\Figure 4.1. Impacts_Subject Site

Figure 4.1. Impacts on the Subject Site

Chapter 5

Mitigation Measures

The impacts to flora and fauna values within the subject site are considered minimal given the location of the subject site within a highly modified urban area. Despite this, it is recommended that a number of measures are implemented to minimise impacts to flora and fauna values, including:

- Use of suitable runoff, sedimentation, erosion and pollution controls during construction;
- Clear demarcation of trees to be removed to avoid any unnecessary vegetation removal;
- Use of locally occurring native species within landscape design, which may provide potential habitat for native fauna species such as birds and reptiles;
- Pre-clearing assessment by appropriately qualified personnel to determine if any fauna is present at the time the clearing is to take place. This should include inspecting any potential microbat habitat located under the bridge to be impacted;
- Supervision of vegetation removal by appropriately qualified personnel to rescue any resident fauna present; and
- Undertake any clearing works during the summer and at night as nocturnal species are the most likely to be encountered during clearing and/or bridge maintenance works. This will decrease potential impacts on any residing fauna as they will be less likely to be present in their nesting/roosting habitat during works.

Chapter 6

Conclusion and Recommendations

The proposed works will require the removal 1,100 m^2 of urban native and exotic vegetation, within a highly degraded, urban site, trimming of two planted trees comprising 100m^2, and upgrade works to a bridge. The vegetation within the subject site is comprised of urban native and exotic vegetation.

Some threatened fauna species are considered to have the potential to occur within the subject site due to the presence of limited foraging and roosting habitat. The Eastern Bentwing-bat was recorded during targeted surveys and likely utilises the bridge for roosting habitat and/or surrounding vegetation for foraging. The removal of vegetation and habitat within the subject site is not considered to result in a significant impact to flora and fauna values, including the Eastern Bentwing-bat, as the habitat impacted is highly disturbed and the majority of the potential roosting habitat for threatened bats will be retained. Despite this, a number of mitigation measures have been recommended to minimise the minor impacts that the project may have on flora and fauna values.

No TSC Act or EPBC Act listed threatened flora, fauna, or communities are expected to be significantly impacted as a result of the proposed road upgrade works, and a Species Impact Statement, and/or EPBC referral, is not required.

References

DoE (2015). "EPBC Protected Matters Search Tool." Retrieved 2015, from http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst-coordinate.jsf.

DPI (2015). "Threatened & protected species - records viewer." 2015, from http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer.

OEH (2013). *The Native Vegetation of the Sydney Metropolitan Area*. Office of Environment and Heritage NSW (OEH).

OEH (2015). "Atlas of NSW Wildlife." 2015, from http://www.bionet.nsw.gov.au/.

Appendix A

Flora Species List

Table A.1 Flora species list

Family	*	Scientific Name	Common Name
Trees			
Casuarinaceae		*Casuarina glauca*	Swamp Oak
Fabaceae (Faboideae)	*	*Erythrina x sykesii*	Coral Tree
Fabaceae (Mimosoideae)		*Acacia elata*	Mountain Cedar Wattle
Moraceae	*	*Ficus microcarpa var. hillii*	Hill's Weeping Fig
Proteaceae		*Banksia integrifolia*	Coast Banksia
Proteaceae	*	*Grevillea robusta*	Silky Oak
Ulmaceae	*	*Celtis sinensis*	Japanese Hackberry
Small Trees			
Bignoniaceae	*	*Jacaranda mimosifolia*	Jacaranda
Casuarinaceae		*Casuarina glauca*	Swamp Oak
Lauraceae	*	*Cinnamomum camphora*	Camphor Laurel
Shrubs			
Apocynaceae	*	*Nerium oleander*	Oleander
Arecaceae	*	*Phoenix canariensis*	Canary Island Date Palm
Casuarinaceae		*Casuarina glauca*	Swamp Oak
Euphorbiaceae	*	*Ricinus communis*	Castor Oil Plant
Myrtaceae	*	*Callistemon viminalis*	Weeping Bottlebrush
Oleaceae	*	*Ligustrum lucidum*	Large-leaved Privet
Proteaceae		*Grevillea 'Robyn Gordon' (cultivar)*	
Solanaceae	*	*Cestrum parqui*	Green Cestrum,
Ulmaceae	*	*Celtis sinensis*	Japanese hackberry
Groundcovers			
Apiaceae	*	*Cyclospermum leptophyllum*	Slender Celery
Asteraceae	*	*Bidens pilosa*	Cobbler's Pegs
Asteraceae	*	*Cirsium vulgare*	Spear Thistle
Asteraceae	*	*Conyza bonariensis*	Flaxleaf Fleabane
Asteraceae	*	*Conyza sumatrensis*	Fleabane
Asteraceae		*Cotula australis*	Common Cotula
Asteraceae	*	*Hypochaeris radicata*	Flatweed

Table A.1 Flora species list

Family	*	Scientific Name	Common Name
Asteraceae	*	*Lactuca saligna*	Willow-leaved Lettuce
Asteraceae	*	*Lactuca serriola*	Prickly Lettuce
Asteraceae	*	*Sonchus oleraceus*	Common Sow-thistle
Asteraceae	*	*Taraxacum officinale*	Dandelion
Brassicaceae	*	*Lepidium didymum*	Lesser Swinecress
Caryophyllaceae	*	*Stellaria media*	Common Chickweed
Chenopodiaceae	*	*Chenopodium album*	Fat Hen
Commelinaceae		*Commelina cyanea*	Native Wandering Jew
Euphorbiaceae	*	*Euphorbia peplus*	Petty Spurge
Myrsinaceae	*	*Anagallis arvensis*	Blue Pimpernel
Pittosporaceae		*Pittosporum undulatum*	Native Daphne
Plantaginaceae	*	*Plantago lanceolata*	Ribwort
Poaceae	*	*Bromus catharticus*	Prairie Grass
Poaceae	*	*Cynodon dactylon*	Common Couch
Poaceae	*	*Ehrharta erecta*	Panic Veldtgrass
Poaceae	*	*Ehrharta longiflora*	Annual Veldtgrass
Poaceae	*	*Megathyrsus maximus*	Guinea Grass
Poaceae	*	*Nassella neesiana*	Chilean Needlegrass
Poaceae	*	*Pennisetum clandestinum*	Kikuyu
Solanaceae	*	*Solanum nigrum*	Black Nightshade
Urticaceae	*	*Parietaria judaica*	Pellitory
Verbenaceae	*	*Verbena bonariensis*	Purpletop
Vines			
Apocynaceae	*	*Araujia sericifera*	Moth Vine
Asparagaceae	*	*Asparagus aethiopicus*	Ground Asparagus
Asparagaceae	*	*Asparagus plumosus*	Climbing Asparagus Fern

** denotes exotic species*

Appendix B

Threatened Flora Likelihood of Occurrence

Table B.1 Threatened flora likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
Casuarinaceae	*Allocasuarina glareicola*		E	E		Occurs in Castlereagh woodland on lateritic soil.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Convolvulaceae	*Wilsonia backhousei*	Narrow-leafed Wilsonia	V		45	Occurs on the margins between salt marshes and lakes.	Unlikely, although recorded in the locality the site lacks suitable habitat. Salt marsh vegetation and lakes are not present within the subject site.
Ericaceae	*Epacris purpurascens* var. *purpurascens*		V		5	Found in various habitat types, mainly containing strong shale influence.	Unlikely, although recorded in the locality the site lacks suitable habitat. Soils within the site are highly modified, and do not consist of shale clays.
Fabaceae (Faboideae)	*Dillwynia tenuifolia*		V		1	Occurs in Castlereagh Ironbark Forest and Shale Gravel Transition Forest.	Unlikely, although recorded in the locality the site lacks suitable habitat. Neither vegetation community the species is associated with is present within the subject site.
Fabaceae (Mimosoideae)	*Acacia pubescens*	Downy Wattle	V	V		Occurs on alluviums, shales and at the intergrade between shales and sandstones. The soils are characteristically gravely soils, often with ironstone.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Fabaceae (Mimosoideae)	*Acacia terminalis* subsp. *terminalis*	Sunshine Wattle	E	E		Occurs on coastal scrub and dry sclerophyll woodland on sandy soils.	Unlikely, not recorded in the locality and the site lacks suitable habitat.

Table B.1 Threatened flora likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
Geraniaceae	*Pelargonium* sp. Striatellum		E	E		Only known to occur at four locations, with three on lake beds and the other on basalt plains.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Myrtaceae	^^*Callistemon linearifolius*	Netted Bottle Brush	V		2	Grows in dry sclerophyll forest on the coast and adjacent ranges.	Unlikely, although recorded in the locality the site lacks suitable habitat. Dry sclerophyll forest is not present within the site.
Myrtaceae	*Darwinia biflora*		V	V	1	Darwinia biflora occurs in Sandstone Ridgetop woodlands where the weathered shale-capped ridges intergrade with Hawkesbury Sandstone.	Unlikely, although recorded in the locality the site lacks suitable habitat. Sandstone ridgetop woodland is not present on the site, and based on landscape, would not historically have been present.
Myrtaceae	*Eucalyptus camfieldii*	Camfield's Stringybark	V	V		Found in exposed areas on sandstone ridges, slopes and plateaus near tall coastal heath or low open woodland.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Myrtaceae	*Eucalyptus nicholii*	Narrow-leaved Black Peppermint	V	V	3	Often found in dry grassy woodland mainly on infertile soils.	Unlikely, although recorded in the locality all local occurrences are planted. Species is not endemic to the Sydney Region.
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V		Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Unlikely, not recorded in the locality and the site lacks suitable habitat.

Table B.1 Threatened flora likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
Myrtaceae	*Melaleuca biconvexa*	Biconvex Paperbark	V	V		Occurs in damp places near streams on alluvial soils.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Myrtaceae	*Syzygium paniculatum*	Magenta Lilly Pilly	E	V	2	Rainforest species on sandy soils.	Unlikely, although recorded in the locality the site lacks suitable habitat. No rainforest is present within the subject site.
Orchidaceae	*Caladenia tessellata*	Thick Lip Spider Orchid	E	V		Prefers grassy sclerophyll woodland on clay loam or sandy soils.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Orchidaceae	*Cryptostylis hunteriana*	Leafless Tongue-orchid	V	E		Occurs in a variety of habitats including woodland and swamp-heath. Larger populations typically occur in Eucalyptus sclerophylla, E. sieberi, Corymbia gummifera and Allocasuarina littoralis dominated woodland.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Orchidaceae	*Genoplesium baueri*	Yellow Gnat-orchid	E	E		Found in dry sclerophyll forest and moss gardens over sandstone.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Orchidaceae	*Pterostylis saxicola*	Sydney Plains Greenhood	E	E		Occurs above cliffs in depressions in sandstone rock shelves.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Poaceae	*Deyeuxia appressa*		E	E		The species has not been seen in 60 years and little is known about its habitat requirements.	Unlikely, not recorded in the locality and the site lacks native grasses.
Rutaceae	*Asterolasia*		E	E		Found on Hawkesbury sandstone in sheltered	Unlikely, not recorded in the locality and

Table B.1 Threatened flora likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
	elegans					forests on mid- to lower slopes and valleys.	the site lacks suitable habitat.
Santalaceae	*Thesium australe*	Austral Toadflax	V	V		Occurs in grassland or grassy woodland. Often found in damp sites in association with Themeda australis (Kangaroo Grass). A root parasite that takes water and some nutrient from other plants, especially T. australis.	Unlikely, not recorded in the locality and the site lacks suitable habitat.
Thymelaeaceae	*Pimelea curviflora* var. *curviflora*		V	V	1	Occurs in open forest on sandy soil derived from sandstone and on lateritic soils.	Unlikely, although recorded in the locality the site lacks suitable habitat. An open forest on sandy soils is not present within the subject site.
Thymelaeaceae	*Pimelea spicata*		E	E		Occurs on the Cumberland Plain in well-structured clay soils, especially in Cumberland Plain Woodland and Moist Shale Woodland.	Unlikely, not recorded in the locality and the site lacks suitable habitat. The site is not within the Cumberland Plain, and well-structured clay soils are not present.
Zannichelliaceae	*Zannichellia palustris*		E		4	Species is known to occur in the lower Hunter and Sydney Olympic Park. Grows in fresh or slightly saline stationary or slow flowing water.	Unlikely, although recorded in the locality the site lacks suitable habitat. Aquatic habitat within the subject site consists of concrete drainage channels only, and lacks substrate for plant growth.

TSC Act Status / EPBC Act Status: V = Vulnerable; E = Endangered

**Data obtained from Atlas of NSW Wildlife*

Appendix C

Threatened Fauna Likelihood of Occurrence

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
Amphibia							
Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E	V	6125	Large permanent freshwater wetlands, with dense stands of reeds.	Unlikely, although large number of records in the locality, the site lacks suitable habitat.
Hylidae	*Litoria raniformis*	Growling Grass Frog	E	V		Primarily occurs in emergent vegetation in or near the edges of slow-flowing water bodies.	Unlikely as not recorded in the locality and no suitable habitat is present.
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V		Found in heath, woodland and open forest with sandy soils. Spends majority of time within 300 m of breeding site.	Unlikely as not recorded in the locality and no suitable habitat is present.
Myobatrachidae	*Mixophyes balbus*	Stuttering Frog		V		Permanent flowing rocky rivers and streams. It inhabits rainforest, wet sclerophyll forest and montane forests, it is rarely encountered far from a stream.	Unlikely as not recorded in the locality and no suitable habitat is present.
Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V		7	Occurs in open forests, at periodically wet drainage lines below sandstone ridges. Mainly found on Hawkesbury and Narrabeen Sandstones.	Unlikely, although recorded in the locality, the site lacks suitable habitat.
Aves							
Accipitridae	*Pandion cristatus*	Eastern Osprey	V		1	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes.	Unlikely as only one record from the locality and the site lacks preferred habitat.

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
Accipitridae	*Circus assimilis*	Spotted Harrier	V		2	Species occurs throughout the mainland preferring grassy open woodland, inland riparian woodland, grassland and shrub steppe. Species roosts in stick nests in trees.	Unlikely as only two records from the locality and the site lacks preferred habitat.
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V		1	The Little Eagle occupies habitats rich in prey within open eucalypt forest, woodland, or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Anatidae	*Stictonetta naevosa*	Freckled Duck	V		1	Prefers permanent freshwater swamps and creeks with dense Cumbungi, Lignum or Tea-tree. Breeding occurs in ephemeral swamps.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E	E	4	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.).	Unlikely as low number of records from the locality and the site lacks preferred habitat.
Ardeidae	*Ixobrychus flavicollis*	Black Bittern	V		1	Occurs in both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	E		3	Inhabits open forest and woodlands containing a grassy ground layer.	Unlikely as low number of records from the locality and the site lacks preferred habitat.

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
Charadriidae	*Charadrius leschenaultii*	Greater Sand-plover	V	M	1	Occurs on sheltered sandy, shelly or muddy beaches or intertidal areas.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Columbidae	*Ptilinopus superbus*	Superb Fruit-Dove	V		1	Most often occurs in rainforest and closed forests but also found in eucalypt or acacia woodland. Requires fruit-bearing trees.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Dasyornithidae	*Dasyornis brachypterus*	Eastern Bristlebird	E	E		Inhabits dense, low vegetation in heath and open woodland. In northern NSW occurs in open forest with dense grass understorey and sparse mid-storey. Nests on or near ground in dense vegetation.	Unlikely as not recorded in the locality and no suitable habitat is present.
Falconidae	*Falco subniger*	Black Falcon	V		1	Occurs primarily in inland regions and is widely but sparsely distributed.	Unlikely as only one record from the locality and the site is highly disturbed.
Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E		1	Prefers intertidal flats of inlets and bays, open beaches and sandbanks. Nests primarily on coastal or estuarine beaches.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Laridae	*Sternula albifrons*	Little Tern	E	M	5	Almost exclusively coastal occurring in sheltered environments.	Unlikely as low number of records from the locality and the site lacks preferred habitat.
Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	CE	E		The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and	Unlikely as not recorded in the locality and no suitable habitat is present.

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
						riparian forests of River Sheoak.	
Meliphagidae	*Epthianura albifrons*	White-fronted Chat population in the Sydney Metropolitan Catchment Management Area	E		22	Occurs in damp open habitats along the coast where it forages on bare or grassy ground in wetland areas. Builds nests in vegetation near the ground.	Unlikely, although moderate number of records in the locality, the site lacks suitable habitat.
Meliphagidae	*Epthianura albifrons*	White-fronted Chat	V		22	Occurs in damp open habitats along the coast where it forages on bare or grassy ground in wetland areas. Builds nests in vegetation near the ground.	Unlikely, although moderate number of records in the locality, the site lacks suitable habitat.
Meliphagidae	*Grantiella picta*	Painted Honeyeater	V	V		Prefers Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.	Unlikely as not recorded in the locality and no preferred habitat is present.
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	V		1	Found in eucalypt forests and woodlands containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Petroicidae	*Petroica boodang*	Scarlet Robin	V		1	Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within an open understorey of shrubs and grasses and	Unlikely as only one record from the locality and the site lacks preferred habitat.

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
						sometimes open areas. Abundant logs and coarse woody debris are important structural components of its habitat. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. It forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris.	
Psittacidae	*Lathamus discolor*	Swift Parrot	E	E	1	Forests, woodlands, plantations, banksias, street trees and gardens.	Unlikely as only one record from the locality and the site is highly disturbed.
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	V		3	Mostly occurs in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their ranges, and in remnant woodland patches and roadside vegetation. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees are also used.	Unlikely as low number of records from the locality and the site lacks preferred habitat.
Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E	E	2	Prefers areas of cover fringing on swamps, dams and other marshy areas.	Unlikely as only two records from the locality and the site lacks preferred habitat.
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper	E	M.	332	The Curlew Sandpiper is found in coastal areas with intertidal mudflats, including estuaries, inlets	Unlikely, although large number of records in the locality, the site lacks

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
						and lagoons, and ponds in saltworks. The species have also occasionally been recorded inland around lakes , dams and waterholes with mud or sand present. Main requirements for feeding habitats are the presence of mudflats or shallow water up to 60mm. The Curlew Sandpiper may also forage in saltmarsh environments and flooded paddocks.	suitable habitat.
Scolopacidae	*Limosa limosa*	Black-tailed Godwit	V	M.	11	The Bar-tailed Godwit is mainly a coastal species, and inhabits intertidal sandflats, mudflats, estuaries, harbours and coastal lagoons. The species have been recorded in coastal sewage farms and saltlakes and brackish wetlands, sandy ocean beaches, rock platforms, and around beds of seagrass. Main habitat requirements for roosting include sandy beaches and near-coastal saltmarsh, while preferred feeding habitats include shallow water or the edge of water in tidal estuaries, harbours, or soft mud with seagrass beds.	Unlikely, although moderate number of records in the locality, the site lacks suitable habitat.
Scolopacidae	*Numenius madagascariensis*	Eastern Curlew		CE	8	Prefers sheltered coasts, especially estuaries, bays, harbours, inlets and lagoons. Also known to occur in sewage farms, wetlands and mangroves.	Unlikely, although moderate number of records in the locality, the site lacks suitable habitat.

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
						Species roosts on sandy spits and in low Saltmarsh or mangroves.	
Scolopacidae	*Xenus cinereus*	Terek Sandpiper	V	M.	1	Occurs on coastal mudflats, lagoons, creeks and estuaries, favouring mudbanks and sandbanks.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Strigidae	*Ninox connivens*	Barking Owl	V		1	Found in open forest and woodland, including fragmented remnants, often next to farmland.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Strigidae	*Ninox strenua*	Powerful Owl	V		59	Habitat for this species is widespread and is primarily tall moist eucalypt forest of the eastern tableland edge and the mosaic of wet and dry sclerophyll forests occurring on undulating gentle terrain nearer the coast. Optimal habitat includes a tall shrub layer and abundant hollows supporting high densities of arboreal marsupials. Pairs occupy large, probably permanent home and nest in large hollows.	Unlikely, although high number of records in the locality, the site lacks suitable habitat.
Tytonidae	*Tyto longimembris*	Eastern Grass Owl	V		1	Occurs in areas with tall grass including swamps, grassy plains and flood plains. Species breeds on the ground within dense trodden grass.	Unlikely as only one record from the locality and the site lacks preferred habitat.
Gastropoda							
Camaenidae	*Pommerhelix*	Dural Land		E		Occurs in communities that interface between	Unlikely as not recorded in the locality

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
	duralensis	Snail				shale-derived and sandstone-derived soils, with forested habitats. Shelters under rock or inside curled-up bark.	and no suitable habitat is present.
Mammalia							
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E		Occurs in wide variety of habitats from open woodland to rainforests in large remnants. Dens in tree hollows, hollow logs or rock crevices.	Unlikely as not recorded in the locality and no suitable habitat is present.
Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E	V		Occupies rock outcrops, escarpments and cliffs with features such as caves, fissures and ledges. Browses on adjacent vegetation. Has a home range of about 15 ha and shelters in caves.	Unlikely as not recorded in the locality and no suitable habitat is present.
Muridae	*Pseudomys novaehollandiae*	New Holland Mouse		V		Inhabit open heathland, open woodland and vegetated sand dunes in coastal areas and up to 100 km inland on sandstone country up to 900m altitude.	Unlikely as not recorded in the locality and no suitable habitat is present.
Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot population in inner western Sydney	E		18	Shelters under houses and buildings and forages in parkland and back-yards.	Unlikely, although moderate number of records in the locality, the site provides minimal suitable habitat that is highly disturbed.
Phascolarctidae	*Phascolarctos cinereus*	Koala	V	V		Inhabits eucalypt woodlands and forests.	Unlikely as not recorded in the locality and no suitable habitat is present.

Table C.1 Threatened fauna likelihood of occurrence

Family	Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Locality Count*	Habitat Requirements	Likelihood of Occurrence
	(combined populations of Qld, NSW and the ACT)						
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	36	Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Potential as moderate number of occurrences in the locality and some foraging habitat is present.
Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V	V		Requires sandstone cliffs and fertile woodland.	Unlikely as not recorded in the locality and no suitable habitat is present.
Vespertilionidae	*Miniopterus australis*	Little Bentwing-bat	V		1	Found in various habitat including moist eucalypt forest, rainforest, wet and dry sclerophyll forest, stormwater drains, bridges and culverts.	Potential as recorded in the locality and suitable roosting habitat is present.
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		18	Forages above the canopy and eats mostly moths. Roosts in caves, old mines, road culverts.	Potential as recorded in the locality and suitable roosting habitat is present.
Vespertilionidae	*Myotis macropus*	Southern Myotis	V		4	Preference for riparian habitat and forages over streams and pools. Roosts in caves, mines, tree hollows, under bridges, tunnels and in dense vegetation.	Potential as recorded in the locality and suitable roosting habitat is present.

TSC Act Status / EPBC Act Status: V = Vulnerable; E = Endangered, CE = Critically Endangered, M = Migratory

**Data obtained from Atlas of NSW Wildlife*

Appendix D

Assessments of Significance

D.1 Grey-headed Flying-fox

(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 subject site represents a small area of foraging habitat available to this potentially occurring species in the locality. This species would likely only utilise the subject site periodically as part of a much broader foraging range. As suitable foraging habitat will be retained within the subject site and in the locality, the proposed development is not likely to have an adverse effect on the life cycle of this species such that a viable local population would be placed at risk of extinction.

(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.*

Not applicable.

(c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) 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

(ii) 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.

Not applicable.

(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 proposed development will require the trimming of one Hill's Weeping Fig tree which will result in the removal of approximately 100m^2 of potential foraging habitat for this species.

The proposed upgrade is not likely to fragment or isolate any areas of habitat for this species, but will further encroach into available foraging habitat.

The habitat to be removed as a result of the proposed works is not considered to be important for this species long-term survival as it only represents a small portion of foraging habitat. Suitable foraging habitat will remain within the subject site and in the locality. Additionally, no flying fox camps will be impacted on.

(e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat for these species has currently been identified by the Director-General of OEH.

(f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

No national recovery plan or threat abatement plans have been prepared for any of these species.

(g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The following key threatening processes (KTPs) are relevant to the proposed works:

- Clearing of native vegetation.

The KTP of 'Clearing of native vegetation' may potentially impact habitat for this species further than current conditions. However, the vegetation on the subject site is not considered to constitute significant habitat for this species as it only represent a small portion of foraging habitat. As potential habitat within the subject site will be retained, the clearing of native vegetation is not likely to significantly impact the Grey-headed Flying-fox.

Conclusion

The Hill's Weeping Fig to be trimmed as a result of the proposed upgrade would likely only be used by this species periodically as part of a much broader foraging range. As no flying fox camp will be impacted and suitable habitat will be retained within the subject site and the locality, the proposed upgrade is unlikely to adversely impact the long-term survival of a local population of the Grey-headed Flying-fox.

D.2 Microbats

The following three microbat species area assessed collectively in the following assessment of significance due to their similar habitat requirements:

- Little Bentwing-bat (*Miniopterus australis*) – listed as vulnerable under the TSC Act;

- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) – listed as vulnerable under the TSC Act; and
- Southern Myotis (*Myotis macropus*) – listed as vulnerable under the TSC Act.

(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 subject site represents a small area of suitable roosting and foraging habitat for all three species. A small area of suitable foraging habitat will be removed for the Eastern Bentwing-bat and Little Bentwing-bat as a result of the proposed upgrade; however suitable foraging habitat will be retained for these species within the locality, including areas adjacent to the subject site. Potential roosting habitat for these species within the subject site is present within the western half of the under sections of the bridge to be replaced. As maintenance works will be limited to the eastern edge of the bridge, all suitable roosting habitat will be retained. As suitable foraging and roosting habitat will be retained, the proposed upgrade is unlikely to place a local population of these species at risk of extinction.

(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.*

Not applicable.

(c) *In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:*

(i) 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

(ii) 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.

Not applicable.

(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 proposed upgrade will require the removal of approximately 1,100m^2 of potential foraging habitat for the Little Bentwing-bat and Eastern Bentwing-bat. This includes the removal of the eastern section of bridge that is to be upgraded.

The proposed development is not likely to fragment or isolate any areas of habitat for these species, but will further encroach into available sub-optimal foraging habitat. As these species are highly mobile, connectivity to off-site vegetation will be retained.

The habitat to be removed as a result of the proposed upgrade is not considered to be important for these species' long-term survival. Suitable habitat will remain within the subject site and in the locality. Additionally, connectivity to offsite habitat will remain intact for the duration of the development.

(e) *Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No critical habitat for these species has currently been identified by the Director-General of OEH.

(f) *Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.*

No national recovery plan or threat abatement plans have been prepared for any of these species.

(g) *Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.*

The following KTPs are relevant to the proposed works:

- Clearing of native vegetation.

The KTP of 'Clearing of native vegetation' may potentially impact habitat for this species further than current conditions. However, the vegetation on the subject site is not considered to constitute significant habitat. As potential habitat within the subject site and connectivity to offsite habitat will be retained, the clearing of native vegetation is not likely to significantly impact habitat for these threatened species.

Conclusion

Although approximately 1,100m^2 of potential foraging habitat for the Eastern Bentwing-bat and Little Bentwing-bat will be removed as a result of the proposed development, this habitat is highly disturbed being located adjacent to a major road and these species would likely only utilise it at part of broader foraging range. Furthermore, areas of suitable foraging habitat will be retained in areas located adjacent to the subject site. The sections of bridge to be replaced represents a small area of foraging habitat, and all potential roosting habitat within the bridge will be retained. Therefore, the proposed development is unlikely to adversely impact the long-term survival of a local population of any of these species.

Appendix G

Stockpile Waste Classification

SNC-LAVALIN AUSTRALIA PTY LTD
ABN 50 085 951 542

Level 17, 55 Clarence Street
Sydney NSW 2000 Australia
61 2 9262 6011 61 2 9262 6077

REF NO. 140250_LBA-JV_L11

8th December 2015

Ventia Boral Amey Joint Venture
422 West Botany St
Rockdale, NSW 2216

ATTN: Michael Ibrahim, Project Engineer, Sydney SMC.

RE: T/81513 - Classification of Construction and Demolition Waste

Dear Michael,

Introduction

This letter relates to the classification of approximately 1200 cubic metres of construction and demolition waste located upon the southern end of 113 Dobroyd Parade, Five Dock, NSW (Lot 1 and 2 of DP 590209, Volume 13637, Folio 94) (refer to Figure 1).

Removal and off-site disposal of this waste stockpile is required as part of civil works associated with the Roads and Maritime Service (RMS) upgrade of the intersection at Parramatta Road and Great North Road, Five Dock, NSW.

The purpose of this letter is to provide the following:

- Classification of the stockpile in accordance with the Protection of the Environment Operations (Waste) Regulation 2014 and relevant NSW Environment Protection Authority (EPA) guidelines; and
- Provide an overview of any management measures required in the handling of the material prior to off-site disposal (where required).

Description of the Stockpile

The stockpile site is located within the Ashfield City Council Local Government Area and is owned and operated by Council. It is understood that over the last few years has been used for the uncontrolled stockpiling of construction and demolition waste (i.e. specific waste sources and associated quantities are nor known) (SNC-Lavalin 2015).

The stockpiled waste comprises a main stockpile containing a mixture of soils (gravelly silts) asphalt, concrete, bricks and broken tile fragments that is covered in grass

and weeds and a series of smaller discrete stockpiles of asphalt and concrete on the northern flank of the main stockpile (refer to photographs in Attachment A).

A search of council records suggests a service station was constructed in 1952 upon the site and a range of light commercial development applications were lodged but not approved by Council from 1994 to 2000 (e.g. for brick and tile services) (City of Canada Bay Council 2015). There is currently no above ground buildings or fuel dispensing infrastructure at the site. However, is not known whether any of the construction and demolition waste within the stockpile is associated with the demolition of the former service station.

The site is adjacent to Dobroyd Canal, a concrete lined open channel subject to tidal flows and thus soils in the immediate vicinity of the channel may contain actual / potential acid sulphate soils. A search of the Australian Soil Resource Information System database on 15 October 2015 found a low probability of ASS at the proposal site with the exception of the north side near Dobroyd Canal (Iron Cove Creek), which is identified as disturbed terrain (elevation between two and four metres AHD). Disturbed terrain may include filled areas, which often occur during reclamation of low lying swamps for urban development.

The stockpiled materials were not surveyed. From visual inspection it appears that soil comprises the greatest volume of stockpiled material, followed by asphalt, concrete, bricks and broken tiles.

No asbestos containing materials were observed either within or in the vicinity of the stockpile.

Stockpile Sampling and Analysis

A total of five composite samples were collected from the main stockpile (S1, S2, S3, S4 and S5) and one discrete sample of asphalt material (S6) was collected from one of the smaller discrete stockpiles of asphalt on the northern flank of the main stockpile.

The sampling was spatially unbiased and each composite sample comprised three subsamples. Sampling was undertaken with a polyurethane garden trowel that was decontaminated between sampling locations.

Samples were then submitted to a NATA registered laboratory for the following analysis:

- Total Recoverable Hydrocarbons (TRH C_6-C_{40}) (all samples);
- Benzene, toluene, ethyl benzene and xylenes (all samples);
- Poly-Aromatic Hydrocarbons (PAHs) (all samples);
- Asbestos (S1, S2, S3, S4, S5);

- Organo-chlorine (OC) and organo-phosphate (OP) pesticides (S1, S2, S3, S4, S5);
- Total metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc) (S1, S2, S3, S4, S5);
- Acid sulphate soil preliminary screening test (pH_{field} and pH_{fox}) (S1, S2, S3, S4, S5);
- Follow up Toxicity Characteristic Leaching Procedure (TCLP) in relation to samples that reported elevated total concentrations of benzo(a)pyrene (all samples); and
- Follow up acid base accounting test work (POCAS suite) in relation to samples that reported pH_{field} and pH_{fox} values that suggested the potential presence of aci-sulphate soils (S4).

The laboratory analysis was based upon an unknown origin of the construction and demolition waste and the possible presence of acid-sulphate soils. The laboratory analysis was undertaken at Envirolab Services based in Ashley Street, Chatswood, NSW. All analytical methods are NATA accredited. Copies of the original chain of custody and laboratory reports are provided in Attachment 2.

Waste Classification

The construction and demolition waste has been classified as General Solid Waste based upon comparison against relevant waste classification guidelines (EPA 2014) (refer to Table C-1).

The construction and demolition waste is not asbestos waste based upon an absence of asbestos (refer to Table C-2).

Presence of Acid Sulphate Soils

Composite sample S4 reported a difference between pH_{field} and pH_{fox} of 3.1 (refer to Table C-3). It was on that basis that this sample was submitted for follow up acid base accounting test work (POCAS suite) (refer to Table C-4).

Composite sample S4 reported a S_{POS} value of 0.07%. This value exceeds the action criteria value (0.03%) (RTA 2005). The action criteria value was set at 0.03% in light of the gravelly silt texture of the soils. In compliance with RMS acid sulphate soil management practices (RTA 2005) the soil fraction of the construction and demolition waste will require neutralization prior to off-site disposal.

Recommendations

Where practicable, recyclable fractions of the construction and demolition waste (e.g. concrete and asphalt) can be separated for off-site disposal to an appropriately licensed recycling facility.

The soil fraction should be neutralized via thorough mixing with approximately two tonnes of agricultural lime prior to off-site disposal. The calculated mass of agricultural lime was based upon the following assumptions:

- Composite sample S4 represents 20% of the overall waste tonnage;
- An effective neutralization capacity of 80% for agricultural lime;
- Bulk density of 2 tonne per cubic metre; and
- Factor of safety of 1.5.

The final soil pH should be validated prior to off-site disposal. The target is a soil pH of between 6.5 and 9.

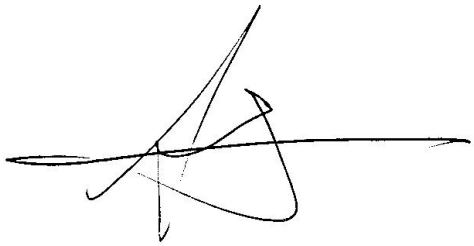
Once the soil pH has been validated, the soil fraction of the construction and demolition waste can be disposed to an appropriately licensed landfill facility as General Solid Waste.

Close

I trust that this information satisfies your requirements. If you require any further assistance, please do not hesitate to contact me by telephone on 02 9262 6011 or by email at andrew.botfield@snclavalin.com.

Yours sincerely

SNC-LAVALIN AUSTRALIA PTY LTD



Andrew Botfield

Principal Geoscientist

References

ASSMAC. 1998. Acid Sulfate Soil Manual. New South Wales Acid Sulfate Soil Management Advisory Committee. August 1998.

EPA. 2014. Waste Classification Guidelines. Part 1: Classifying waste. November 2014. NSW Environment Protection Authority, Sydney, NSW.

RTA. 2005. Guidelines for the Management of Acid Sulfate Materials. Roads and Traffic Authority NSW. April 2005.

SNC-Lavalin. 2015. Review of Environmental Factors, Upgrade of Parramatta Road and Great Northern Road Intersection. December 2015. Prepared by SNC-Lavalin Australia Pty Ltd. 55 Clarence Street, Sydney, NSW.

City of Canada Bay Council. 2015. Search of council records in relation to land development applications. Email communications from Chris Curtis (City of Canada Bay Council) to Michael Ibrahim. 19th November 2015.

FIGURES

Figure 1: Location of construction and demolition waste

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ATTACHMENT A

SITE PHOTOGRAPHS

Photo A-1: Main stockpile and asphalt and concrete (looking south)

Photo A-2: Small asphalt stockpile on northern flank of main stockpile

Photo A-3: Soils (gravelly silts), bricks and broken tile fragments

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ATTACHMENT B

CHAIN OF CUSTODY AND LABORATORY REPORT INFORMATION

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RESULTS SUMMARY

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Table C1: Comparison against the General Solid and Restricted Solid Waste Guidelines (EPA 2014)

Parameter	Unit	General Solid Waste Criteria	Restricted Solid Waste Criteria	Mean	Standard Deviation	95% Upper Confidence Limit (UCL)	S1	S2	S3	S4	S5	S6
							29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015
TRH C6 - C9	mg/kg	650	2600	<25	0	<25	<25	<25	<25	<25	<25	<25
Benzene	mg/kg	10	40	<0.2	0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Toluene	mg/kg	288	1152	<0.5	0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Ethylbenzene	mg/kg	600	2400	<1	0	<1	<1	<1	<1	<1	<1	<1
m+p-xylene	mg/kg	1000	4000	<3	0	<3	<2	<2	<2	<2	<2	<2
o-Xylene	mg/kg						<1	<1	<1	<1	<1	<1
TRH C10 - C14	mg/kg	See Below	See Below				<50	<50	<50	<50	<50	580
TRH C15 - C28	mg/kg						390	<100	180	570	440	3800
TRH C29 - C36	mg/kg						690	190	390	1700	840	1200
TRH C10 - C36	mg/kg	10000	40000	1828.33	1969.68	3404.41	1080	190	570	2270	1280	5580
Naphthalene	mg/kg	NGV	NGV	0.20	0.29	0.43	<0.1	<0.1	<0.1	0.7	0.1	0.4
Acenaphthylene	mg/kg	NGV	NGV	0.23	0.16	0.36	0.4	0.1	0.2	0.4	0.3	<0.1
Acenaphthene	mg/kg	NGV	NGV	0.27	0.31	0.51	0.1	<0.1	<0.1	0.7	0.2	0.6
Fluorene	mg/kg	NGV	NGV	0.20	0.24	0.40	0.1	<0.1	<0.1	0.6	0.1	0.4
Phenanthrene	mg/kg	NGV	NGV	3.45	3.24	6.04	2.2	0.8	1.3	9.5	2.3	4.6
Anthracene	mg/kg	NGV	NGV	1.10	0.83	1.77	0.9	0.2	0.4	2.5	1.1	1.5
Fluoranthene	mg/kg	NGV	NGV	9.33	6.38	14.44	8.7	2.4	3.5	20	9.4	12
Pyrene	mg/kg	NGV	NGV	9.38	6.54	14.62	9.2	2.5	3.8	21	9.8	10
Benzo(a)anthracene	mg/kg	NGV	NGV	4.52	2.96	6.88	3.6	1.4	2	9.5	5.9	4.7
Chrysene	mg/kg	NGV	NGV	5.20	3.41	7.93	5.5	1.4	2.1	11	5.4	5.8
Benzo(b,j+k)fluoranthene	mg/kg	NGV	NGV	9.05	6.18	14.00	15	2.7	4.1	18	8.7	5.8
TOTAL Benzo(a)pyrene	mg/kg	^10	^23	5.33	3.62	8.23	9.5	1.9	2.8	10	5.3	2.5
TCLP Benzo(a)pyrene	mg/L	^0.04	^0.16	<0.001	0.00	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Indeno(1,2,3-c,d)pyrene	mg/kg	NGV	NGV	2.92	1.68	4.26	4.3	1.1	1.5	5.3	3.4	1.9
Dibenzo(a,h)anthracene	mg/kg	NGV	NGV	0.50	0.30	0.74	0.9	0.2	0.2	0.8	0.5	0.4
Benzo(g,h,i)perylene	mg/kg	NGV	NGV	2.23	1.17	3.17	3.6	0.8	1	3.4	2.2	2.4
Total Positive PAHs	mg/kg	200	800	65.17	45.07	101.23	64	15	23	140	81	68
Endosulfan I	mg/kg	60	240	<0.3	0	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	
Endosulfan II	mg/kg						<0.1	<0.1	<0.1	<0.1	<0.1	
Endosulfan Sulphate	mg/kg						<0.1	<0.1	<0.1	<0.1	<0.1	
Chlorpyriphos	mg/kg	4	16	<0.1	0	<0.3	<0.1	<0.1	<0.1	<0.1	<0.1	

Key		
	Value	Concentration above General Solid Waste threshold
	Value	Concentration above Restricted Solid Waste threshold

Notes: ^Maximum values for leachable concentration and specific contaminant concentration (SCC) when used together (EPA 2014). NGV – no guideline value.

Table C1 (continued): Comparison against the General Solid and Restricted Solid Waste Guidelines (EPA 2014)

				Sample			S1	S2	S3	S4	S5	S6
				Date Sampled	Mean	Standard Deviation	95% Upper Confidence Limit (UCL)	29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015
Parameter	**Unit**	**General Solid Waste Criteria**	**Restricted Solid Waste Criteria**										
HCB	mg/kg	<50	<50		<1.7	0	<1.7	<0.1	<0.1	<0.1	<0.1	<0.1	
alpha-BHC	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
gamma-BHC	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
beta-BHC	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Heptachlor	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
delta-BHC	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Aldrin	mg/kg							<0.1	0.2	<0.1	<0.1	<0.1	
Heptachlor Epoxide	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
gamma-Chlordane	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
alpha-chlordane	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
pp-DDE	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Dieldrin	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Endrin	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
pp-DDD	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
pp-DDT	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Endrin Aldehyde	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Methoxychlor	mg/kg	NGV	NGV		<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Azinphos-methyl (Guthion)	mg/kg	NGV	NGV		<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Bromophos-ethyl	mg/kg	NGV	NGV		<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Diazinon	mg/kg	NGV	NGV		<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Ronnel	mg/kg	NGV	NGV		<0.1	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
Chlorpyriphos-methyl	mg/kg	250	1000		<0.7	0	<0.7	<0.1	<0.1	<0.1	<0.1	<0.1	
Dichlorvos	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Dimethoate	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Ethion	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Fenitrothion	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Malathion	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Parathion	mg/kg							<0.1	<0.1	<0.1	<0.1	<0.1	
Key	Value	Concentration above General Solid Waste threshold											
	Value	Concentration above Restricted Solid Waste threshold											

Notes: NGV – no guideline value.

Table C1 (continued): Comparison against the General Solid and Restricted Solid Waste Guidelines (EPA 2014)

Sample				Mean	Standard Deviation	95% Upper Confidence Limit (UCL)	S1	S2	S3	S4	S5	S6
Date Sampled							29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015
Parameter	Unit	General Solid Waste Criteria	Restricted Solid Waste Criteria									
Arsenic	mg/kg	100	400	6.80	3.96	9.97	10	9	7	<4	8	
Cadmium	mg/kg	20	80	0.00	0.00	0.00	<0.4	<0.4	<0.4	<0.4	<0.4	
^Chromium	mg/kg	100	400	17.40	9.76	25.21	32	17	14	5	19	
Copper	mg/kg	NGV	NGV	32.80	5.40	37.12	38	36	34	24	32	
Lead	mg/kg	100	400	44.60	15.68	57.15	47	54	46	18	58	
Mercury	mg/kg	4	16	0.00	0.00	0.00	<0.1	<0.1	<0.1	<0.1	<0.1	
Nickel	mg/kg	40	160	11.80	3.56	14.65	9	10	9	17	14	
Zinc	mg/kg	NGV	NGV	67.20	29.22	90.58	62	110	71	28	65	
Key	Value	Concentration above General Solid Waste threshold										
	Value	Concentration above Restricted Solid Waste threshold										

Notes: NGV – no guideline value.

Table C2: Asbestos Results

Sample				Mean	Standard Deviation	95% Upper Confidence Limit (UCL)	S1	S2	S3	S4	S5	S6
Date Sampled							29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015
Parameter	Unit	[1]General Solid Waste	[2]Restricted Solid Waste									
Asbestos ID in soil	0.1 g/kg	Reporting Limit		<0.1	0	<0.1	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	No asbestos detected at reporting limit of 0.1g/kg: Organic fibres detected	
Trace Analysis	-	-		-	-	-	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	No asbestos detected	

Table C3: Preliminary Screening Using Acid Sulfate Soil Manual (ASSMAC 1998)

Sample			Mean	Standard Deviation	95% Upper Confidence Limit (UCL)	S1	S2	S3	S4	S5
Date Sampled						29/10/2015	29/10/2015	29/10/2015	29/10/2015	29/10/2015
Parameter	**Unit**	**^Screening Criteria**								
pHF (field pH test)*	pH Units	4	8.32	0.27	8.08	8.5	8.6	8.3	7.9	8.3
pH_{FOX} (field peroxide test)*	pH Units	3	6.8	1.15	5.79	6.9	7.4	7.6	4.8	7.3
Delta pH (pH field - pH fox)	pH Units	2	1.52	0.94	2.35	1.6	1.2	0.7	3.1	1
Key	Value	Suggests presence of actual and or potential acid sulphate soils and sample/s should be subject to full POCAS analytical suite.								

Notes: ^Threshold criteria based upon the principals of Acid Sulfate Soil Manual (ASSMAC 1998).

Table C4: Complete POCAS Suite for Sample S4

Sample	pH kcl	TAA pH 6.5	s-TAA pH 6.5	pH Ox	TPA pH 6.5	s-TPA pH 6.5	TSA pH 6.5	s-TSA pH 6.5	ANCE	a-ANCE	s-ANCE	SKCl	SP	SPOS	a-SPOS
Units	**pH units**	**moles H+/t**	**%w/w S**	**pH units**	**moles H+/t**	**%w/w S**	**moles H+/t**	**%w/w S**	**% CaCO3**	**moles H+/t**	**%w/w S**	**%w/w S**	**%w/w**	**%w/w**	**moles H+/t**
Reporting Limit		**5**	**0.01**		**5**	**0.01**	**5**	**0.01**	**0.05**	**5**	**0.05**	**0.005**	**0.005**	**0.005**	**5**
S4	6.9	<5	<0.01	4.5	9	0.01	9	0.01	<0.05	<5	<0.05	<0.005	0.07	0.07	44
Key	Value	^Exceedance of action criteria (equivalent %S of 0.03%) in consideration of tonnage and texture of material.													

Notes: ^Threshold criteria based upon ASM Procedure No.1 – Attachment 2 (RTA 2005).

Appendix H

Procedure for Aboriginal Heritage Consultation and Investigation Checklist and Aboriginal Heritage Information Management System search

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : parra rd great nth rd

Client Service ID : 239046

Roads and Maritime Services - Wollongong

Lvl 5, 90 Crown Street PO Box 477
Wollongong New South Wales 2520

Attention: Jeff Nelson

Email: jeffrey.nelson@rms.nsw.gov.au

Date: 16 August 2016

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lat, Long From : -33.8759, 151.1259 - Lat, Long To : -33.8707, 151.1342 with a Buffer of 50 meters, conducted by Jeff Nelson on 16 August 2016.

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:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

Transport
Roads & Maritime
Services

16/08/2016

Hannah D'eau
Environment Officer
Easing Sydney's Congestion Program Office | Journey Management

Dear Hannah

Re: Preliminary assessment results for the Upgrade of Parramatta Rd and Great North Rd Intersection project proposal based on Stage 1 of the *Procedure for Aboriginal cultural heritage consultation and investigation* (the procedure).

The project, as described in the Stage 1 assessment checklist, 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 any known Aboriginal objects or places in the immediate 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 work to be undertaken is within a highly disturbed area including, road corridor, commercial and residential.
- The site or ancillary compound areas to be established will be on established sites, as identified in the REF.

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 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 do not hesitate to contact me.

Yours sincerely

Jeff Nelson
Aboriginal Cultural Heritage Officer (ACHO) – Sydney Region
Roads and Maritime Services

Level 3, 27 Argyle Street, Parramatta, NSW 2151
M 0413 368 261| **F** 02 8849 2886| **E** Jeffrey.nelson@rms.nsw.gov.au www.rta.nsw.gov.au/rmservices/index.html| **13 22 13**

Appendix I

Community consultation report and records

Parramatta Road and Great North Road, Five Dock
Proposed intersection upgrade

Community and stakeholder engagement plan

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Version history

Version	Author	Date	Details
0.1	Stella Cimarosti	9 May 2016	First Draft
0.2	Kiara Brown	16 May 2016	Minor amendments
0.3	Stella Cimarosti	8 August 2016	Update to reflect display of the REF

Contents

Introduction and context

Purpose

This stakeholder and community engagement plan (the Plan) has been developed to support the design of proposed intersection upgrade at Parramatta Road and Great North Road, Five Dock. It outlines the communication and engagement approach that will be implemented throughout the concept/detailed design of the Project.

Communication and engagement has already been undertaken by Ventia Boral Amey Joint Venture during the investigation stage of the Project. This Plan reflects the previous communication and engagement and aims to:

- Identify stakeholders, potential issues and recommended communication activities during design
- Keep key stakeholders, businesses and residents informed of the progress of design
- Provide a general level of awareness for those in the broader community.

Project background

Parramatta Road is a key arterial road connecting the Sydney CBD with Parramatta. It is a key access point for the M4 Motorway, the City West Link Road and Sydney's western suburbs. The upgrade is being proposed as part of the NSW Government's $246 million Pinch Point Program, which aims to reduce traffic delays, manage congestion and improve travel times on Sydney's major roads particularly during weekday peak periods.

Motorists travelling westbound on Parramatta Road are experiencing delays due to extensive queuing in the right lane to turn into Great North Road and overflowing into through lanes during weekday peak periods.

Communication and engagement took place during the investigation phase of this project. Local residents and business' were informed of the investigation work. Certain properties were doorknocked at this stage regarding property access (see appendix C for details)

The Proposal

The proposal involves installing an additional right turn lane on Parramatta Road to increase capacity for cars turning right into Great North Road. This will include widening the road on both Parramatta Road and Great North Road to accommodate the additional turning lanes.

Due to the widening involved in this proposal partial property acquisition is required.

Roads and Maritime will carry out community and stakeholder consultation on the concept design once investigation work has been completed. The night work consultation will be conducted separately.

Project area profile

The Project area around Parramatta Road at Great North Road is within the City of Canada Bay and the Ashfield Council local Government areas. Canada Bay and Ashfield are a mixture of residential, commercial and light industrial areas.

Parramatta Road splits these local Government areas. The northern side of Parramatta Road is part of Canada Bay Council, while the southern side is part of Ashfield Council.

An estimated 84,906 residents live in the Canada Bay local Government area and an estimated 39,667 live in the Ashfield local Government area.

The project area sits within the suburbs of Five Dock and Croydon. The most common ancestries within these suburbs are Italian, Australian, Chinese and English.

The project is in close proximity to Westconnex, a high profile and highly sensitive project within this area. Community members are highly interested in this project and there are a number of shared stakeholders.

Project milestones

Table 1

Milestones	Date
Site investigations	October 2015 – April 2016
Property acquisition process started (internally)	February 2016
Residents affected by acquisition doorknocked by VBA JV and RMS	Early June 2016
Display the REF	November 2016
Construction consultation	TBC
Westconnex start of work	TBC
Start of work	2018
Open to traffic	2018

Handover	2018

Communication and engagement objectives

The key stakeholder and community participation objectives are:

- To identify and incorporate emerging community and stakeholder matters where possible
- To provide community and stakeholders with evidence of how matters are being addressed and used to inform detailed design.
- Provide regular and timely information to community and stakeholders on each project while also referencing the broader program context and outcomes

Stakeholder analysis

These stakeholders may either be impacted by the project or may influence or become advocates for the project. A detailed stakeholder listing is available at Appendix B.

Key messages

Key messages will be developed and updated as the Project progresses to ensure consistency across all communication and engagement activities. All project team members should be aware of the key messages to ensure consistent information is shared with communities and stakeholders. Any changes to key messages will be distributed to all project team members during the progression of the Project.

Key messages for this project are listed below and will be updated as required:

- The NSW Government's is funding this proposal as part of its $246 million Pinch Point Program, which aims to reduce traffic delays, manage congestion and improve travel times on Sydney's major roads particularly during weekday peak periods
- The proposal involves duplicating the right turn lane from Parramatta Road into Great North Road to increase capacity and stop queuing into the through lanes.
- The project is titled 'intersection improvement Parramatta Road and Great North Road, Five Dock'
- The projects benefits are; reduces congestion and more reliable travel times on Parramatta Road and increase capacity for vehicles turning right into Great North Road
- This proposal is funded under the Pinch Point Program and is focused on easing congestion. The State Government has a number of current projects aimed at easing congestion in Sydney including Westconnex. This project is funded under the Pinch Point Program and is being delivered by Roads and Maritimes delivery partner, Ventia Boral Amey Joint Venture (VBA JV)
- Parramatta Road is a key arterial road in Sydney connecting the Sydney CBD and Parramatta
- Parramatta Road experiences high congestion during peak periods. Traffic growth will continue to increase congestion and travel time if roads are not upgraded
- Roads and Maritime Services recognises the importance of involving the community in the development of this project
- Roads and Maritime Services will make every effort to minimise impact on traffic flows and local residents and businesses around the busy Parramatta Road area during any work carried out
- Feedback received will be considered in developing the project

- For information about the Project, please contact the project team:

  Phone 1800 677 700

  Email nswenquiries@vbajv.com.au

  Mail

  Ventia Boral Amey JV

  C&SE

  PO Box 838

Rockdale NSW 2216

Communication approach

Our communication approach for the Project will focus on consultation with local residents and business owners keeping the community informed and involved in the progress and delivery of the project.

Engagement tools and techniques

Communication Tool	Purpose	Target audience
Key stakeholder meetings (as required)	Build relationships Provide information and invite feedback Identify issues and work together to develop solutions	Key stakeholders - Westconnex - Local council - Local residents - Local business'(particularly those at the intersection and those impacted by acquisition) - STA
Door-knocks to impacted residents / businesses	Inform about consultation and property acquisition Provide key contact information Ie. RMS property for acquisition and VBA JV for project related Maintain personal contact and relationships with sensitive receivers	Local residents and businesses
Corflute signs	Provide information about the proposed project in the local area to those who may not receive the notification letter	All
Notifications and updates	Provide information about consultation Provide updates about key milestones to the local community and stakeholders	Local residents, stakeholders and businesses
Website	Provide information about the proposed project	All
Media releases and traffic alerts	Provide information to road users as well as a wider audience	All
Newspaper advertisement	Provide details of the REF display and community information sessions	Local residents, stakeholders and businesses
Community information sessions	To display the REF and engage with the community	Local residents, stakeholders and businesses

Communication Tool	Purpose	Target audience
Copies of REF in community space (ie. Library or community centre)	To display the REF and engage with the community	Local residents, stakeholders and businesses
Project Information Telephone Contact Number and Email	Provide a means by which interested community members and stakeholders may contact the Project team during consultation	All

Communication protocols

Project phone info line and enquiries email

VBA JV is Roads and Maritime's delivery partner in this project. VBA JV has community email, postal address and 1800 number which are available during the project duration. The project team from VBA JV will monitor the phone and emails during consultation and respond as required.

The communication channels will be disseminated in the community through notification letters, doorknocks, corflute signage and the Roads and Maritime website.

Complaints/ enquiries management

VBA JV will respond to community and stakeholder enquiries within two business hours.

This will include:

- The efficient recording, tracking and responding to enquiries and complaints including:
    - Date and time of contact.
    - Method of communication.
    - Full name, address and contact details.
    - Nature of the enquiry or complaint and the issues raised.
    - Names of the people involved throughout.
    - Action taken and the details of the resolution, including response times.

Media and government

VBA JV will not respond directly to enquiries from journalists or elected representatives. All enquiries from elected representatives and the media will be forwarded to Roads and Maritime Media team.

Roads and Maritime media contact line – 8588 5999

Evaluation

The communication approach and processes as described in this Plan will be evaluated continuously throughout the Project. This will allow the Project team and Roads and Maritime to make any updates to the plan and its processes as necessary in order to:

- Measure the effectiveness of communication techniques and identify any areas for improvement.
- Identify new stakeholders and emerging issues.
- Monitor compliance with communication protocols.

The evaluation will be achieved by reviewing:

- Tracked enquiries and complaints to identify issues, emerging trends and timeliness of close out.
- Satisfaction of impacted property owners with information frequency, availability and content.
- Delivery of communication material on time and within budget.

Appendix A – Project Area

Appendix B – Stakeholder List

Stakeholders	
GOVERNMENT	
City of Canada Bay	council@canadabay.nsw.gov.au
Ashfield Council	info@ashfield.nsw.gov.au
State Electorate of Drummoyne	drummoyne@parliament.nsw.gov.au
State Electorate of Strathfield	Strathfield@parliament.nsw.gov.au
State Electorate of Summer Hill	summerhill@parliament.nsw.gov.au
Federal Electorate of Reid	Craig.laundy.mp@aph.gov.au
Transport Management Centre (TMC)	tmc.comms@tmc.transport.nsw.gov.au
EMERGENCY SERVICES	
Ambulance Service of NSW, Sydney Zone	metrosydneysouth@ambulance.nsw.gov.au; jgilchrist@ambulance.nsw.gov.au; AMcalpine@ambulance.nsw.gov.au; LMMoore@ambulance.nsw.gov.au; KCRONAN@ambulance.nsw.gov.au; mcorlis@ambulance.nsw.gov.au
NSW Fire and Rescue	info@fire.nsw.gov.au
NSW Rural Fire Service Headquarters	state.operations@rfs.nsw.gov.au
NSW State Emergency Service (SES), Sydney South Region	ssr.admin@ses.nsw.gov.au
Burwood Fire Station 12B Livingstone Street Burwood NSW 2134	
Five Dock Police Station 13 Garfield Street Five Dock NSW 2046	
TRANSPORT SERVICES	
STA – Southern Region	pwhitney@sta.nsw.gov.au rbekdache@sta.nsw.gov.au bsinatambou@sta.nsw.gov.au cchichmanian@sta.nsw.gov.au sblight@sta.nsw.gov.au rayoub@sta.nsw.gov.au
Premier Cabs	premier@premiercabs.com.au
RSL Cabs	contactus@rslcabs.com.au
Legion Taxis Administration	admin@legioncabs.com.au
Taxis Combined	feedback@ccnetwork.com.au
Heavy Vehicles Unit	Mary.crouch@rms.nsw.gov.au
ASSET OWNERS	
Ausgrid	contestability@ausgrid.com.au
Jemena Gas South	customerrelations@jemena.com.au
Nextgen	dbydnext@visionstream.com.au
Optus	dartnsw@optus.com.au
Pipe Networks	enquiry@pipenetworks.com
Sydney Water	michael.hayes@sydneywater.com.au; roadrestoration@sydneywater.com.au
Telstra	simon.barlow@team.telstra.com; f0501488@team.telstra.com
WestConnex	info@westconnex,com.au amber.cameron@westconnex.com.au
LOCAL COMMUNITY/SENSITIVE RECEIVERS	
Audi Five Dock	newsales@audifivedock.com.au
BP Connect Ashfield	580-586 Parramatta Road

	Croydon NSW 2132
~~Nando's~~	~~582 Parramatta Road Ashfield NSW 2131~~
McDonalds	582-586 Parramatta Road Croydon NSW 2132
Subway	12 West Street Croydon NSW 2131
Property Acquisition	
Canal	The Metropolitan Water Sewerage and Drainage Board C/- Jones Lang Lasalle PO Box 399 Parramatta NSW 2124
Amber Tiles	Amber Tiles 1 Parramatta Road Five Dock NSW 2046
Owner of Amber Tiles property	Jian Wen Zhang 40 Hay Street Croydon Park NSW 2133
Owner of vacant land	Ashfield Council 260 Liverpool Road Ashfield NSW 2131
Car Wash	Car Wash 315-319 Parramatta Road Haberfield NSW 2045
Owner of Car Wash	Wymill Pty Limited 636 Parramatta Road Croydon NSW 2132
Petrol Station	Petrol Station 273 Parramatta Road Haberfield NSW 2045
Owner of petrol station	Azzi Investments Pty Ltd 51 Gueuducourt Avenue Earlwood NSW 2206
STAKEHOLDERS EXPRESSING INTEREST	

Property Acquisition	
Canal 1 Parramatta Road Five Dock NSW 2046	Owner: The Metropolitan Water Sewerage and Drainage Board C/- Jones Lang Lasalle PO Box 399 Parramatta NSW 2124
Amber Tiles 1 Parramatta Road Five Dock NSW 2046	Owner: Jian Wen Zhang 40 Hay Street Croydon Park NSW 2133
Vacant council land 321 Parramatta Road Haberfield NSW 2046	Owner: Ashfield Council 260 Liverpool Road Ashfield NSW 2131
Car Wash ~~315-319 Parramatta Road~~ ~~Haberfield NSW 2045~~	Owner: Wymill Pty Limited 636 Parramatta Road Croydon NSW 2132
Petrol Station 273 Parramatta Road Haberfield NSW 2045	Owner: Azzi Investments Pty Ltd 51 Gueuducourt Avenue Earlwood NSW 2206

APPENDIX C - DOORKNOCKING

Doorknock report:

Doorknock Date: Wednesday 7 October

Purpose: property access for investigation work

Outcome: no issues were encountered with business owners, those who were reached were happy for the investigations to take place.

Address	Comments
1/2 Great North Road	Not home
2/2 Great North Road	Construction was taking place. Knocked, but no one answered. Left the letter in the door
3/2 Great North Road	Not home
4/2 Great North Road	Home. Name: Damien Will read through the info and scan back. No concerns.
Amber Tiles 3 Parramatta Road Five Dock NSW 2046 Note: There is a mechanics that runs underneath Amber tiles (property 1a).	[Note: Is actually property #1] Business owner: Scott Norman 9716 6214 fivedock@ambertiles.com.au Form signed
Car Wash	Owner wasn't there. Left the information with a lady behind the cafe. Asked what the owners name was, she didn't know.
Automotive Hospital 313 Parramatta Road Haberfield NSW 2045	Tim Kaudemir Happy for the investigations to take place. No contact details left. Form signed
Petrol Station 273 Parramatta Road Haberfield NSW 2045	Manager: Elias Khouri Happy for the investigations to take place. Form signed PH: 97164940 M: 0499 399 999

Summary

No issues were encountered with business owners, those who were reached were happy for investigations to take place.

No further contact has been made with the car wash and the residential homes at 2 Great North Road.

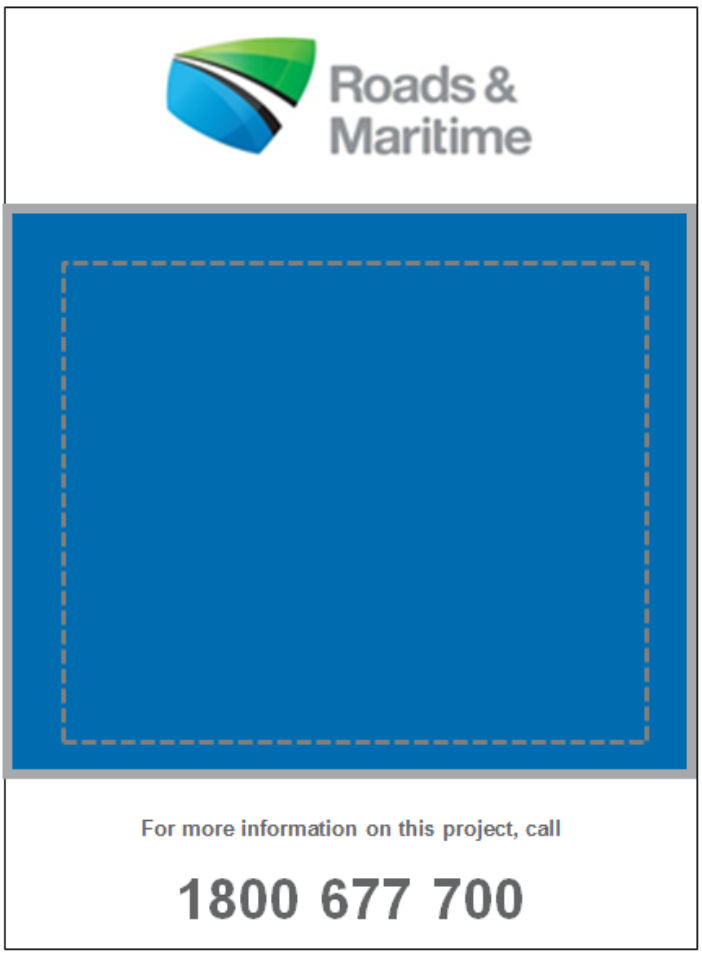
As we have been unable to get in touch with the car wash (phone number is disconnected) we plan to go out again to speak to the business owner. At this time we will also doorknock the residential properties at 2 Great North Road.

Recommendation

Proceed with investigations as planned.

APPENDIX D - CORFLUTE SIGNS

These signs will be used to inform the local community of the consultation. Signs will be places at the intersection.



EXAMPLE

Appendix E – distribution zone

rms.nsw.gov.au

contactus@rms.nsw.gov.au

Customer feedback
Roads and Maritime
Locked Bag 928,
North Sydney NSW 2059

Transport
Roads & Maritime
Services