M5 Motorway
Westbound Traffic upgrade

Options Evaluation Report

Transport for NSW | December 2019
# TABLE OF CONTENTS

Executive summary ........................................................................................................................................... 5

1 Introduction..................................................................................................................................................... 7
   1.1 Project context ......................................................................................................................................... 7
   1.2 Project objectives .................................................................................................................................. 9

2 Strategic planning ......................................................................................................................................... 9

3 Stakeholder involvement ............................................................................................................................... 11
   3.1 Strategy ................................................................................................................................................ 11
   3.2 Stakeholders .......................................................................................................................................... 11
   3.3 Workshops ........................................................................................................................................... 11
   3.4 Consultation and communication ........................................................................................................ 12

4 Preliminary environmental investigation .................................................................................................... 12
   4.1 Constraints and opportunities ............................................................................................................... 13
   4.2 Aboriginal heritage ............................................................................................................................... 13
   4.3 Flooding ............................................................................................................................................... 14
   4.4 Land use and property ......................................................................................................................... 15
   4.5 Utilities .............................................................................................................................................. 16
   4.6 Biodiversity ....................................................................................................................................... 16

5 Process to select the recommended option .................................................................................................. 17

6 Identification of options ............................................................................................................................... 18
   6.1 Long Listed Options ............................................................................................................................. 19
   6.2 Short Listed Options ............................................................................................................................. 19
   6.3 Consultation with key stakeholders ...................................................................................................... 22
   6.4 Further refinement of short listed options ......................................................................................... 24

7 Recommended Option .................................................................................................................................. 26

8 Next steps .................................................................................................................................................... 26

9 References ................................................................................................................................................... 27

Attachment 1

Attachment 2

Attachment 3
Figures

Figure 1: Greater Sydney Structure Plan 2056 – the three cities .................................................................7
Figure 2: Weaving issue on M5 Motorway westbound .....................................................................................8
Figure 3: M5 Motorway westbound traffic upgrade project study area ............................................................8
Figure 4: Location of Moorebank Logistics Park .............................................................................................10
Figure 5: Aboriginal Heritage ..........................................................................................................................14
Figure 6: Flood Prone Lane ..............................................................................................................................15
Figure 7: Current Land Use surrounding M5 Motorway between Moorebank Avenue and Hume Highway 16
Figure 8: Endangered species sightings ........................................................................................................17
Figure 9: Native vegetation ..............................................................................................................................17
Figure 10: Process to select the recommended option .....................................................................................18
Figure 11: Option 1B-Collector Ramp with Underpass at Moorebank Avenue ..................................................20
Figure 12: Option 2B-Collector Ramp with Overpass at Moorebank Avenue ...................................................21
Figure 13: Option 4B – Braided Ramps West of Georges River with Overpass at Hume Highway Exit Ramp and Overpass of Hume Highway .................................................................................22

Tables

Table 1: Workshops conducted by Transport for NSW ..................................................................................12
Table 2: Short Listed Options .......................................................................................................................20
Table 3: Risk Management workshop purpose and outcomes .......................................................................22
Table 4: Value Management workshop assessment criteria and recommendations ....................................23
Table 5: Design Refinements to Short Listed Option 1B and Option 2B. .......................................................25
Executive summary

Transport for NSW has identified a recommended option for the M5 Motorway westbound traffic upgrade project between Moorebank Avenue and the Hume Highway, following an intensive process of investigations, planning, design work and community and stakeholder consultation based on the strategic design developed by Transport over the last year.

The purpose of this project is to eliminate the issue of westbound vehicles entering the M5 Motorway at Moorebank Avenue from weaving with vehicles exiting to the Hume Highway. Removing the “weave” movements will reduce congestion, increase traffic flow efficiency, improve safety and reduce road incidents.

The recommended option would provide a new two lane bridge over George’s River and the southern passenger and freight rail line, connecting the M5 Motorway and Moorebank Avenue to the Hume Highway. It will also include a new underpass at Moorebank Avenue which would connect M5 Motorway westbound traffic to the Hume Highway, enabling the closure of the M5 westbound Hume Highway exit.

The potential benefits of this option include:

- Removal of a significant source of congestion that impacts upon the wider Sydney road network
- Increased efficiency of traffic flow across the Georges River
- Safety improvements and reduction in road incidents
- Complement adjoining projects and allow road users to realise the full benefit from a network of projects in the vicinity.

The recommended option would eliminate the issue of westbound traffic weaving on the M5 Motorway between Moorebank Avenue and the Hume Highway. The option was selected over other shortlisted options as it would provide the best traffic improvements for the least impact to the environmental and local community.

This option is described further in Section 6.

Background

Transport has developed a 10 year enabling roadworks program for the Liverpool sub-region in south-west Sydney, referred to in this document as the Moorebank Intermodal Terminal Road Access Program (MITRA). The program has been developed to address increasing levels of freight and general traffic that are anticipated as a result of the forecast growth of Liverpool CBD, regional traffic growth, and the proposed Moorebank Logistics Park facility.

The surrounding road network of the Moorebank Logistics Park needs to be improved to efficiently distribute truck traffic from logistics centres and businesses to the nearby motorway network. The enabling roadworks program aims to enhance the capacity and efficiency of the Liverpool subregion’s arterial road network and their major intersections and connecting roads, particularly those surrounding Liverpool CBD and the Moorebank Logistics Park.

To improve efficiency of the surrounding road network, three initiatives were recommended for short to medium term implementation. One of these initiatives recommended the removal of the M5 Motorway westbound traffic weaving issue between Moorebank Avenue and the Hume Highway. This initiative aims to aid distribution of trucks, as well as improve safety by addressing congestion and reducing incidents on the M5 Motorway and surrounding road network.
Purpose of report

The purpose of this report is to describe the recommended option, alternatives investigated and the reasons supporting its selection. It outlines the steps, and records the assessment and decision-making processes followed to identify the recommended option to improve the efficiency of the M5 Motorway westbound between Moorebank Avenue and the Hume Highway.

Recommended option selection process

The recommended option was identified through an extensive short-listing and option elimination process, which examined constraints and assumptions, potential impacts and benefits.

Key stakeholders attended various workshops in early 2019 to examine risk, constructability, health and safety and value for money against the project objectives. Workshop participants agreed on the key performance indicators to effectively score each longlisted option to meet the agreed project objectives. This workshop agreed on the assessment criteria and methodology to determine the recommended corridor option. As a result of this assessment, three options were shortlisted.

Further assessment and review of these shortlisted options concluded that they were the most viable options. The recommended option was considered as the most viable based on the least impact on community, environmental and visual amenity, better value for money and best response to the identified risks. The other shortlisted options had higher estimated construction costs, and included features such as merging on a curve which can cause safety issues and steep slopes which can slow down heavy vehicles.

Next steps

The recommended option will be displayed for community comments. This will provide an opportunity for the community to review the recommended option and provide feedback. Transport will use this information to further refine and confirm the recommended option for endorsement.
1 Introduction

1.1 Project context

Transport for NSW has developed a 10 year enabling roadworks program (MITRA) for the Liverpool sub-region in south-west Sydney to address increasing levels of freight and general traffic that are anticipated as a result of the forecast growth of Liverpool CBD, regional traffic growth and the Moorebank Logistics Park facility, which is currently under construction. The Moorebank Logistics Park is estimated to generate over 6,600 additional heavy vehicle trips per day and 10,000 additional light vehicle trips per day both in and out. The additional traffic from the Moorebank Logistics Park, while substantial, is just a small percentage of the additional traffic that will be generated by the population and employment growth in South-West Sydney.

The location and regional planning context of Liverpool is shown in Figure 1 below:

Figure 1: Greater Sydney Structure Plan 2056 – the three cities

As part of the enabling roadworks program, three medium to long-term initiatives were recommended, including upgrading and extending Cambridge Avenue from Moorebank Avenue to Campbelltown Road and the Hume Motorway, planning for a future west Liverpool bypass, and removing the M5 Motorway...
westbound traffic weaving issue between Moorebank Avenue and the Hume Highway. The M5 Motorway westbound traffic upgrade initiative would assist with the distribution of trucks, as well as improve safety by addressing congestion and reducing incidents on the M5 Motorway.

The section of the M5 Motorway between Moorebank Avenue and Hume Highway is a significant source of congestion that affects broader road network performance. Congestion and unsafe driving conditions arise when westbound traffic entering the motorway at Moorebank Avenue crosses paths with traffic exiting the motorway to the Hume Highway. This traffic weaving causes incidents and slows westbound traffic on the M5 Motorway to the east of Moorebank Avenue. A diagram showing this is located in Figure 2 below.

Figure 2: Weaving issue on M5 Motorway westbound

![Diagram of M5 Motorway westbound traffic weaving issue](image)

The M5 Motorway between the interchanges with Heathcote Road and the M7 Motorway has three dedicated through lanes in each direction. Due to the short distance between Heathcote Road, Moorebank Avenue and the Hume Highway, there is not enough distance for full length merge lanes and diverge lanes between the interchanges. The merge and diverge lanes between these interchanges are joined, so the cross section between these interchanges is four lanes wide in each direction.

The project is located adjacent to the M5 Motorway across the suburbs of Wattle Grove, Moorebank and Casula within the Liverpool City Council local government area. The area contains a number of interchanges over a short distance including the M5 interchange with Heathcote Road to the east, Moorebank Avenue and the Hume Highway to the west. The project study area is shown in Figure 3 below:

Figure 3: M5 Motorway westbound traffic upgrade project study area

![Diagram of M5 Motorway westbound traffic upgrade project study area](image)
1.2 Project objectives

The primary objectives for the M5 Motorway westbound traffic upgrade are to:

- Maximise efficiency of the higher order road network
- Provide efficient and reliable access between the Moorebank Logistics Park precinct and the State road network
- Support the M5 Motorway as the key through-traffic connection for South-West Sydney
- Support the growth of and access to Liverpool CBD through provision of an efficient arterial road access network.

The secondary objectives in undertaking the project are to:

- Contribute to strategic land use outcomes
- Incorporate necessary bus priority and active transport measures into proposals to contribute to the performance of those modes
- Provide solutions that contribute to improved road safety outcomes.

2 Strategic planning

The M5 Motorway currently serves a Movement function and is the key through-traffic arterial connection for south-west Sydney, supporting economic and residential growth in the region.

The M5 Motorway will ultimately serve as a major transit link connecting south-west Sydney with the future Western Sydney International Airport and Western Sydney Parklands, as well as the Moorebank Logistics Park.

The Western Sydney City Deal (District Plan), March 2018

The Western Sydney City Deal (District Plan) dated 2018 is a 20 year agreement between all three levels of government to transform Western Sydney, which aims to improve community infrastructure and liveability in Western Parkland City.

Planning Priority W7 (Establishing the land use and transport structure to deliver a liveable, productive and sustainable Western Parkland City), which specifically details an objective to ensure the freight and logistics network is competitive and efficient and describes an aim to provide industrial and freight activities with good access to the strategic freight network including motorways and rail. This project will directly contribute to this priority by removing conflicting traffic flows, facilitating smoother connections between the Moorebank Logistics Park and the surrounding road network.

Moorebank Logistics Park

The Moorebank Logistics Park development will provide a rail ‘port shuttle’ between Port Botany and the Moorebank precinct for import/export freight, with a separate terminal for interstate freight and warehousing. Freight will be carried via rail from and to Port Botany and re-distributed by truck to warehouses and businesses throughout Western Sydney and regional NSW. It is planned to have a throughput of 0.5M Interstate containers, 1.2M Import-Export containers, freight village and 850,000m² of warehousing.
The Moorebank Logistics Park is strategically located in south-west Sydney near key National Land Transport Network elements of the M5 and M7 Motorways, the Hume Highway, and the Southern Sydney Freight Rail Line.

This project aims to improve traffic flow and efficiency between the M5 Motorway and the Moorebank Logistics Park, which is estimated to generate over 6600 heavy vehicle trips per day and 10,000 light vehicle trips per day both in and out.

The location of the Moorebank Logistics Park is shown in Figure 4 below:

**Figure 4: Location of Moorebank Logistics Park**

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**Enabling Roadworks Program / Moorebank Intermodal Terminal Road Access Strategy (MITRA), Transport for NSW**

Transport has developed a 10 year enabling roadworks program (MITRA) for the Liverpool sub-region in south-west Sydney to address increasing levels of freight and general traffic which is anticipated as a result of the forecast growth of Liverpool CBD, regional traffic growth and the Moorebank Logistics Park, which is currently under construction. MITRA is also described as a NSW Government committed initiative in the Freights and Ports Plan 2018-2023.

Removal the M5 Motorway westbound traffic weave issue, between Moorebank Avenue and the Hume Highway, was an initiative recommended by MITRA to assist with the distribution of trucks and improvement of road safety.

**Freight and Ports Plan 2018-2023, Transport for NSW**

The **Freight and Ports Plan 2018-2023** was developed by Transport as a call to action for government and industry to collaborate on clear initiatives and targets to make the NSW freight task more efficient and safe. The key objectives of the plan are to:

- drive economic growth
increase efficiency, connectivity and access for freight
• deliver greater capacity by investing and enabling regional growth
• improve safety and sustainability

The plan describes priorities to manage congestion for key freight areas and around major freight terminals and depots, including Moorebank Logistics Park, as well as managing congestion on the M5 West.

MITRA is described as a NSW Government committed initiative in Goal 2 “Deliver new infrastructure to increase road freight capacity and improve safety”. The aim of MITRA is to construct road infrastructure to support the Moorebank Logistics Park and address forecast increases in traffic.

3 Stakeholder involvement

The recommended option was developed in consultation with major stakeholders including planning and approval agencies.

3.1 Strategy

Consultation with major stakeholders to date has been through a range of workshops and meetings to establish: vision and objectives; constraints and opportunities; risks; options; and recommendations.

3.2 Stakeholders

Transport consulted with various stakeholders throughout the development of the recommended option.

The stakeholders listed below include those from Transport identified as being expected to have an interest in, or potentially be affected by, the M5 Motorway westbound traffic upgrade:

• Transport for NSW
• Transport Management Centre (TMC)
• Liverpool City Council (LCC)
• Interlink (M5 Motorway Operator)
• QUBE (Moorebank Logistics Park developer)
• DM Roads and VBA (Roads Stewardship Maintenance Contractors)
• Endeavour Energy
• Jemena
• Sydney Water
• Telstra
• Optus Uecomm
• Nexgen
• NBN
• Sydney Trains
• ARTC

These stakeholders will be consulted where relevant throughout the design process.

3.3 Workshops

Transport consulted with stakeholders during development of the recommended option through a series of workshops held in March 2019. These workshops were held with subject matter experts to analyse options against criteria relating to vision and objectives, constraints and opportunities, assumptions and risks to identify a recommended option for the M5 Motorway westbound traffic upgrade.
Table 1: Workshops conducted by Transport for NSW

<table>
<thead>
<tr>
<th>Workshop</th>
<th>Date Held</th>
<th>Attending Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Management Workshop</td>
<td>13/03/2019</td>
<td>• Transport&lt;br&gt;• DM Roads (Stewardship Maintenance Contractor – Sydney West Zone)&lt;br&gt;• C2C (Constructability Specialist)</td>
</tr>
<tr>
<td>Constructability Workshop</td>
<td>15/03/2019</td>
<td>• Transport&lt;br&gt;• DM Roads (Stewardship Maintenance Contractor – Sydney West Zone)&lt;br&gt;• Ventia Boral Amey (Stewardship Maintenance Contractor – Sydney East Zone)&lt;br&gt;• C2C (Constructability Specialist)</td>
</tr>
<tr>
<td>Health &amp; Safety in Design Workshop</td>
<td>15/03/2019</td>
<td>• Transport&lt;br&gt;• DM Roads (Stewardship Maintenance Contractor – Sydney West Zone)&lt;br&gt;• Ventia Boral Amey (Stewardship Maintenance Contractor – Sydney East Zone)&lt;br&gt;• C2C (Constructability Specialist)</td>
</tr>
<tr>
<td>Value Management Workshop</td>
<td>28/03/2019</td>
<td>• Liverpool City Council&lt;br&gt;• Transport&lt;br&gt;•</td>
</tr>
</tbody>
</table>

3.4 Consultation and communication

Transport will consult the community and stakeholders as part of the project development process as key milestones approach.

Communication will be via printed materials, a project website, media releases, Government announcements, advertising and public information sessions and a continuation of stakeholder engagement meetings and workshops.

The recommended option described in Section 0 and will be displayed for community comment.

4 Preliminary environmental investigation

A preliminary environmental investigation (PEI) was prepared to identify potential opportunities and environmental constraints that may influence the development of design options for the upgrade.

Subject to acceptance of the recommended option, The Proposal would be subject to environmental impact assessment under Part 5 of the NSW Environmental Planning and Assessment Act 1979. If approved, Transport would then consider whether to proceed with implementation of The Proposal. Environmental impact assessment requires the proponent, Transport in this case, to carry out various detailed investigations including those identified in the PEI.
4.1 Constraints and opportunities

A constraints analysis was completed to assess the existing conditions in the study area which may influence development of road upgrades. It involved preliminary mapping of environmental information, major utilities, existing and proposed future land uses.

The analysis was primarily based on readily available data, with limited field investigation carried out.

**Constraints**

- M5 Motorway needs to remain operational with minimal disruption
- Environmental risks of bridge construction over Georges River
- Private and commonwealth property adjacent to the M5 corridor
- Technical risks of bridge construction over the rail line
- Major utility crossings of M5 alignment
- Endangered flora and fauna in the study area
- Minimising the upstream flood impacts caused by new structures in the flood plain adjacent to Georges River
- Contaminated sites have been identified within the project corridor.

**Opportunities**

- Improvement of the safety performance and journey time reliability of the M5 motorway westbound
- Provide efficient access for Moorebank Logistics Park traffic to/from the adjacent motorway network
- Provision of noise mitigation for noise affected properties to the south of the M5
- Provision of formal pedestrian and cyclist access across the Georges River.

4.2 Aboriginal heritage

The PEI reported that prior to European settlement the land in the study area was occupied by the Darug people and the neighbouring Tharawal and Gandangara peoples. The land was known as Gunyungalung and the Georges River was an important corridor that enabled transport, communication, economic and cultural interaction (Goodall & Cadzow, 2009 in NSW Heritage Office State Heritage Register and Inventory).

The PEI also reported four Potential Archaeological Deposits within the study area, one with an artefact find. These sites are shown below in Figure 5 and include Collingwood Precinct to the north of the Proposal. Collingwood Precinct was a “high ground” meeting place for Tharawal, Gandangara and Dharug people and a vantage point from which to observe country. It was a site of early engagement and conflict with the colonial settlers and is still used today as an Aboriginal meeting place (OEH, 2013).
Stage 1 of the Transport for NSW Procedure for Aboriginal cultural heritage consultation and investigation (PACHCI) was undertaken by a Transport Aboriginal Cultural Heritage Officer in early 2019. The Potential Archaeological Deposit sites identified in the PEI were either outside the footprint of the project, or had been previously removed. The investigation assessed the project as being unlikely to have an impact on Aboriginal cultural heritage.

There is still the potential of Aboriginal objects being discovered during the course of the project; however this potential is limited given that the study area is largely urbanised landscapes. Any discoveries during the project will result in the project team following the steps outlined in the Transport Unexpected Archaeological Finds Procedure.

Impacts to any properties with Aboriginal Land Councils or Native Title will need to be investigated and addressed during the concept design.

4.3 Flooding

The Liverpool LEP Flood Planning Area Map identifies the Georges River within the study area as flood prone. Figure 6 illustrates that the land particularly to the east of the Georges River in the vicinity of the Moorebank Business Park and Greenhills Industrial Estate as flood prone.
While it is not possible to prevent the flood impacts of the Georges River during rain events, a flood assessment will be completed by a qualified professional to ensure that any new Georges River crossing is designed with adequate flood immunity and climate change allowance that the bridge minimises or eliminates any additional flood risk to the study area.

In addition to any flood impacts generated by a new Georges River crossing, the following developments will be taken into account when assessing the flooding:

- The development of the Moorebank Logistics Park site.
- The new rail bridge constructed over the Georges River at the southern extent of the Moorebank Logistics Park site.
- The construction of a new bridge over the Georges River south of the existing low level bridge as part of the Cambridge Avenue upgrade.

4.4 Land use and property

The area surrounding the M5 Motorway between Moorebank Avenue and the Hume Highway is a mixture of suburban residential, commercial and industrial, parklands and waterway. The main land uses include:

- Private residential properties in the suburbs of Wattle Grove, Casula and Liverpool
- Industrial (high proportion) – Moorebank Logistics Park (under construction), Moorebank Business Park, Greenhills Industrial Estate
- Waterways - Georges River (the Preliminary Environmental Investigation reported that the Georges River is used for recreational activities including by the NSW Barefoot Water Ski Club who operate in the section between the M5 Motorway bridge and the Liverpool Weir)
- Transport - Main Southern Rail Line, Southern Sydney Freight Line and M5 Motorway
• Parklands - Helles Park and Rifle Range Park.

Current land ownership data shown in Figure 7 indicates that the majority of the project would be located within the existing M5 Motorway corridor, with additional parcels owned by Transport for NSW. Some Commonwealth owned, privately owned and Council owned land is also located along the proposed alignment.

**Figure 7: Current Land Use surrounding M5 Motorway between Moorebank Avenue and Hume Highway**

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**Proposed future land use**

The area surrounding the project will become predominantly industrial zoned land with the construction of the Moorebank Logistics Park. In addition to Moorebank Logistics Park, some other future land uses which may affect the area include:

• Ongoing residential development in Casula
• Revitalisation of Liverpool City Centre
• Western Sydney International Airport and Aerotropolis

The role of M5 Motorway between Moorebank Avenue and the Hume Highway will change substantially with the completion of the Moorebank Logistics Park, which is estimated to generate over 6,600 heavy vehicle trips per day and 10,000 light vehicle trips per day both in and out.

### 4.5 Utilities

Major public utility assets of Endeavour Energy, Jemena, Telstra, Optus, NBNCo and Sydney Water are present within the study area.

The recommended option has the potential to require relocation or physical protection of public utilities. This may require temporary disruption to provision of services. Transport will consult with utility asset owners during the next phase of the project with the aim to minimise impacts.

### 4.6 Biodiversity

The PEI reported a number of threatened flora and fauna species sightings within the study area. Endangered fauna species are shown below in Figure 8 and include sightings of Grey Head Flying Fox directly adjacent to the existing M5 motorway.
Native vegetation in the study area is shown below in Figure 9 and includes areas of Castlereagh Scribblygum Woodland and Cumberland Riverflat Forest which are endangered ecological communities.

Figure 9: Native vegetation

Source: Preliminary Environmental Investigation, SLR 2015

5 Process to select the recommended option

The recommended option for the M5 Motorway westbound traffic upgrade between Moorebank Avenue and the Hume Highway was identified through a routine staged project development process as illustrated in Figure 10 below:
Figure 10: Process to select the recommended option

Transport prepared a longlist of options for assessment, building on recommendations made by the MITRA strategy. These options were shortlisted based on an analysis of key constraints and compliance with relevant design criteria, then key stakeholders were then engaged in a value management process, as outlined in Section 3. Constructability, HSiD and Risk workshops were conducted which identified key constructability issues and risks for each option.

The Value Management Workshop participants assessed the shortlisted options based on the qualitative assessment against criteria which reflected what the project must achieve and the comparative strategic cost estimates of each option. Two similar options qualified as suitable subject to the satisfactory resolution of key constructability issues (which were mainly centred on traffic management during construction and utility impacts).

Design refinement, investigation and re-assessment were undertaken based on the workshop recommendations and a suitable option was clearly demonstrated. The option was then confirmed as the recommended option following further consultation with the relevant stakeholders. The recommended option is considered the most economically viable based on estimated costings and constraints.

6 Identification of options

The purpose of this project is to eliminate the issue of westbound vehicles entering the M5 Motorway at Moorebank Avenue from weaving with vehicles exiting to the Hume Highway. This will remove a source of congestion, increase traffic flow efficiency, improve safety and reduce road incidents.

MITRA identified two options for eliminating the westbound weaving issue on the M5 Motorway between Moorebank Avenue and the Hume Highway. Additional options were then identified by the project team, which resulted in a longlist of eight (8) options. These options are described in the sections below.
6.1 Long Listed Options

Following recommendations by MITRA, a constraints analysis was undertaken and a total of eight (8) potential options were identified. These options represented the ways in which the constraints within the investigation area could be responded to at a high level.

Options were then eliminated for reasons including: significant departures from geometric standards (i.e. vertical/horizontal geometry, grades), unrealistic or uneconomical bridge spans, impact to existing structures, impact to critical utilities, impact to community and property, impact to adjacent road network and traffic staging impacts. Following a detailed comparison based on these key constraints and criteria, three (3) suitable options qualified as suitable to proceed to the value management process.

Please see Attachment 1 for a detailed description of the long listed options.

6.2 Short Listed Options

Following a detailed comparison of the long listed options based on key constraints and compliance with relevant design criteria, three (3) options (1B, 2B and 4B) were shortlisted and strategic designs developed for each option.

The shortlisted options then went through the following steps, which included:

- Traffic Options Assessment to assess the relative traffic performance of each option
- Strategic Estimates for each shortlisted option
- Risk Management Workshop to review the scope and extents of the options and identify their overall project risks.
- Constructability and Health and Safety in Design Workshop to recommend options suitable to proceed
- A Value Management Workshop to confirm a recommended option.

These options are described in Table 2 below:
<table>
<thead>
<tr>
<th><strong>Table 2: Short Listed Options</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option 1B-Collector Ramp with Underpass at Moorebank Avenue</strong></td>
</tr>
</tbody>
</table>

**Figure 11: Option 1B-Collector Ramp with Underpass at Moorebank Avenue**

Note this option is similar to 2B; difference is highlighted:

- M5 Motorway westbound traffic for the Hume Highway exits east of Moorebank Avenue in a two-lane shared exit with westbound traffic for Moorebank Avenue.
- Westbound traffic for Moorebank Avenue diverges from the shared exit and connects to the existing exit ramp to the Moorebank Avenue Interchange.
- **Westbound traffic for the Hume Highway on a new separate two-lane carriageway passes under Moorebank Avenue in a cut and cover underpass structure south of the Moorebank Avenue interchange.**
- The new two-lane carriageway then merges from two lanes to one.
- Moorebank Avenue westbound traffic for the Hume Highway separates from the Moorebank Avenue westbound traffic entering the M5 and joins the new carriageway in an added lane.
- The existing Moorebank Avenue westbound entry to the M5 remains open.
- The new two-lane carriageway crosses the Georges River and the railway on a long bridge with similar pier spacing to the existing M5 Georges River bridges.
- The new carriageway connects the M5 and Moorebank Avenue traffic to the existing Hume Highway exit ramp.
- The existing exit from the M5 Motorway westbound to the Hume Highway is closed.
- A new shared path is provided along the southern side of new carriageway and proposed bridge between Moorebank Avenue and the Hume Highway.
- Modifications are made to the Moorebank Avenue/M5 Interchange TCS allowing pedestrian and cyclist crossing of the southern leg of the intersection.
Note—this option is similar to 1B; difference is highlighted:

- M5 motorway westbound traffic for the Hume Highway exits east of Moorebank Avenue in a two-lane shared exit with westbound traffic for Moorebank Avenue.
- Westbound traffic for Moorebank Avenue diverges from the shared exit and connects to the existing exit ramp to the Moorebank Avenue Interchange.
- Westbound traffic for the Hume Highway on a new separate two-lane carriageway climbs at approximately six per cent and passes over Moorebank Avenue on a bridge south of the Moorebank Avenue interchange with a pier in the median of Moorebank Avenue.
- The new two-lane carriageway then falls back down at approximately six per cent to the same level as the existing M5 where it merges from two lanes to one.
- Moorebank Avenue westbound traffic for the Hume Highway separates from the Moorebank Avenue westbound traffic entering the M5 and joins the new carriageway in an added lane.
- The existing Moorebank Avenue westbound entry to the M5 remains open.
- The new two lane carriageway crosses the Georges River and the railway on a long bridge with similar pier spacing to the existing M5 Georges River bridges.
- The new carriageway connects the M5 and Moorebank Avenue traffic to the existing Hume Highway exit ramp.
- The existing exit from the M5 Motorway westbound to the Hume Highway is closed.
- A new shared path is provided along the southern side of new carriageway and proposed bridge between Moorebank Avenue and the Hume Highway.
- Modifications are made to the Moorebank Avenue/M5 Interchange TCS allowing pedestrian and cyclist crossing of the southern leg of the intersection. Existing M5 westbound Hume Highway exit is closed.
Option 4B – Braided Ramps West of Georges River with Overpass at Hume Highway Exit Ramp and Overpass of Hume Highway

Figure 13: Option 4B – Braided Ramps West of Georges River with Overpass at Hume Highway Exit Ramp and Overpass of Hume Highway

- Moorebank Avenue traffic for Hume Highway and Moorebank Ave traffic for the M5 cross the Georges River on two separate one lane long bridges
- Moorebank Avenue traffic for Hume Highway joins the existing exit to the Hume Highway
- Moorebank Avenue traffic for the M5 westbound spans the existing Hume Highway exit with a continuation of the Georges River bridge and then spans the Hume Highway before joining the M5 with an entry ramp west of the Hume Highway
- Existing entry ramp from Moorebank Avenue to the M5 Motorway westbound is closed.

For some explanation of the different solutions to the issue of inadequate spacing between motorway interchanges (such as braided ramps and collector ramps), refer to Attachment 3 which is taken from Roads and Maritime Services Motorway Design Guide – Capacity and Flow Analysis (2017).

6.3 Consultation with key stakeholders

A series of workshops with key stakeholders were held in March 2019. The first three workshops were designed to identify the main project risks, safety issues, and constructability constraints.

A description of these workshops is given in Table 3 below:

<table>
<thead>
<tr>
<th>Table 3: Risk Management workshop purpose and outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Management Workshop – March 2019</strong></td>
</tr>
<tr>
<td><strong>Purpose:</strong></td>
</tr>
<tr>
<td>• Provide a forum for engagement with a broad section of project stakeholders, and obtain information on the risks to be addressed during development.</td>
</tr>
<tr>
<td>• To record information about the risk profile as identified across the range of risk topics for the strategic design. It identifies the issues and risks the designer shall address within the design, and identify those risks to be managed.</td>
</tr>
<tr>
<td><strong>Outcome:</strong></td>
</tr>
<tr>
<td>• None of the shortlisted options were considered to present unacceptable risks that could not be avoided, minimised, mitigated or controlled with further investigation.</td>
</tr>
<tr>
<td>• Further development of the risks and mitigation measures will continue as a part of the concept design and planning approval process.</td>
</tr>
</tbody>
</table>
Constructability Workshop – March 2019

**Purpose:**
- To identify potential complexities for construction, operation or maintenance of the three (3) shortlisted options

**Outcome:**
- None of the constructability issues were considered to present unacceptable risks that could not be avoided, minimised, mitigated or controlled with further investigation.
- Option 2B was assessed as having the lowest constructability risk of all the shortlisted options; however Option 1B was very similar and would be further considered pending satisfactory resolution of key constructability issues.

Health & Safety in Design Workshop – March 2019

**Purpose:**
- to identify, for current designs, any health and safety hazards for workers and those in the vicinity of the asset
- to eliminate safety hazards – so far as is reasonably practicable (SFAIRP)
- demonstrate consultation, with workers who carry out work for the business or undertaking who are, or are likely to be, directly affected by a work health and safety matter

**Outcome:**
- None of the options present unacceptable health and safety issues that could not be avoided, minimised, mitigated or controlled with further investigation.

The Value Management workshop held at the end of March to review the strategic options, evaluate them against appropriate assessment criteria and provide a recommended option to progress the project.

Participants were provided with an overview of the project background and project objectives, and as a group, agreed the assessment criteria and decision making process for the workshop. Participants were given an overview of the long listed corridor options and key constraints of the project corridor. The group was then introduced to the shortlisted options and scored the options against the agreed assessment criteria. The group was also given the opportunity to highlight items for further consideration as the project planning proceeded.

The agreed assessment criteria and workshop recommendations are detailed in Table 4 below:

**Table 4: Value Management workshop assessment criteria and recommendations**

<table>
<thead>
<tr>
<th>Assessment Criteria</th>
<th>Workshop recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional:</strong></td>
<td>Both qualitative and quantitative assessment of options against the assessment criteria resulted in two options being recommended for further investigation (Option 1B &amp; 2B – see Section 6.2 for further detail of these options).</td>
</tr>
<tr>
<td></td>
<td>Both options were very similar; however Option 1B demonstrated the greatest value for money, being a good fit with the existing and future planning. It was considered to have the least visual and noise impact of all options.</td>
</tr>
<tr>
<td></td>
<td>There were key constructability, traffic control and utility issues which required satisfactory resolution in order to recommend one option.</td>
</tr>
<tr>
<td></td>
<td>Maximises travel time efficiency and reliability of the network (including the M5 Motorway)</td>
</tr>
<tr>
<td></td>
<td>Minimises the complexity of constructability and allows for maximum flexibility in construction methods</td>
</tr>
<tr>
<td></td>
<td>Minimises safety risks during construction, operation, maintenance and demolition as well as to the general public</td>
</tr>
<tr>
<td></td>
<td>Minimises impact on major public utilities</td>
</tr>
<tr>
<td></td>
<td>Best fits with existing and future planning and local connectivity (including other Moorebank Logistics Park projects, public transport, railway,</td>
</tr>
</tbody>
</table>
### Assessment Criteria

<table>
<thead>
<tr>
<th>Workshop recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A number of actions were made, which included further investigation and refinement of designs of Option 1B and Option 2B, to satisfactorily resolve key constructability issues.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Socio-economic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Minimises direct impacts to properties (ie. acquisition and access impacts) including to lots, houses, businesses, community facilities and Commonwealth land</td>
</tr>
<tr>
<td>• Minimises direct and indirect impact on businesses during construction</td>
</tr>
<tr>
<td>• Minimises social impacts (ie. community impacts, roads users, etc.) associated with traffic disruption during construction</td>
</tr>
<tr>
<td>• Minimises access impacts to river users during construction (ie. access to and from the river).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Minimises impact on biodiversity (ie. vegetation communities, areas of ecological value, threatened fauna and flora species, fishing grounds and sensitive environmental areas, etc.)</td>
</tr>
<tr>
<td>• Minimises potential disturbance to contaminated sites (ie. reduce earthworks/fill)</td>
</tr>
<tr>
<td>• Minimises visual impacts and maximises amenity</td>
</tr>
<tr>
<td>• Minimises the level of impact of noise during operation.</td>
</tr>
</tbody>
</table>

Following this assessment, it was found that Option 1B provided the most economically viable solution, with some constructability issues that may be resolved with further refinement and investigation. It would have the least visual and noise impact, provide a good fit with the existing and future planning and local connectivity.

Option 2B was found to best suit the project objectives, with less utility impacts, some noise impacts that could be addressed using suitable design treatments and it demonstrated minimal disruption to traffic during construction and the construction staging.

Option 4B was found no longer suitable due to prominent disadvantages when compared to Option 1B and Option 2B. It had the largest impact to the community of all the options with respect to noise and visual impacts. It was also the least cost effective and potentially impacted on future projects planned for the M5 corridor.

The participants recommended that both options (1B and 2B) proceed and be subject to further refinements and investigations to find suitable solutions for identified constructability issues.

### 6.4 Further refinement of short listed options

The outcome of the Value Management Workshop was that two options (1B and 2B) qualified as suitable, subject to design refinements and further investigation to resolve key constructability issues.

In conjunction with design refinements, more detailed investigations were carried out including additional traffic assessments and refinement of cost estimates to support the multi-criteria analysis for selecting a
recommended option. Consultation with key stakeholders including traffic management specialists and Transport internal stakeholders provided additional information for consideration.

The design refinements carried out for Option 1B and Option 2B in order to identify a recommended option are described in Table 5 below:

Table 5: Design Refinements to Short Listed Option 1B and Option 2B

<table>
<thead>
<tr>
<th>Option 1B-Collector Ramp with Underpass at Moorebank Avenue</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural design of Moorebank Avenue underpass:</strong></td>
<td></td>
</tr>
<tr>
<td>A strategic structural design was developed for the new carriageway overpass over Moorebank Avenue. The design is a cut and cover bridge structure about 70m long. The width of the underpass is 11.5m between the concrete barriers which sit in front of vertical abutment walls. The deck is made from concrete and has an asphalt wearing surface. The superstructure is made up of prestressed concrete planks with a span of 17m. The abutments are vertical walls with narrow benches located at the headstocks to facilitate future inspection. The proposed minimum vertical clearance under the structure is 5.4m. There are piled retaining walls on the approaches to the bridge which are up to 5m deep.</td>
<td></td>
</tr>
<tr>
<td><strong>Traffic staging of Moorebank Avenue underpass:</strong></td>
<td></td>
</tr>
<tr>
<td>One of the key issues identified with Option 1B at the various workshops held was the difficulty of constructing an underpass under Moorebank Avenue while still maintaining traffic flow along Moorebank Avenue. In consultation with Transport construction management team, the design team developed a traffic staging design for the construction of the underpass. The proposed traffic staging involved constructing the underpass in two halves, and switching the traffic from one side of Moorebank Avenue to the other during each stage to maintain traffic flow. The traffic staging design resulted in a reduction in the lanes on approach to the M5 / Moorebank Avenue interchange. This lane reduction was assessed as having a minor impact on the capacity of the intersection. After consultation with the Transport Management Centre, the staging of the underpass design was no longer considered a major issue.</td>
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<table>
<thead>
<tr>
<th>Option 2B-Collector Ramp with Overpass at Moorebank Avenue</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural design of Moorebank Avenue overpass:</strong></td>
<td></td>
</tr>
<tr>
<td>A strategic structural design was developed for the new carriageway overpass over Moorebank Avenue. The design is a two span structure about 70m long with a pier located in the median in the centre of Moorebank Avenue. The width of the structure is 11.5m between the barriers which are concrete with steel rails. The deck is made from concrete and has an asphalt wearing surface. The superstructure is made up of five Type 5 super-tee girders with a maximum span of 36m. The abutments are vertical reinforced soil walls with narrow benches located at the headstocks to facilitate future inspection. The proposed minimum vertical clearance over the existing Moorebank Avenue is 5.4m. There are large reinforced retaining wall structures on the approaches to the bridge which are up to 14m high.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design Refinements Common to both Option 1B and Option 2B</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structural design of bridge over Georges River and railway:</strong></td>
<td></td>
</tr>
<tr>
<td>A strategic structural design was developed for the new carriageway bridge over Georges River and railway. The design is a seven span structure about 300m long with spans across the Georges River floodplain and main channel, Powerhouse Road, Main Southern Railway and Southern Sydney Freight Line and Lakewood Crescent. The width of the structure is 10.5m between the barriers which are concrete with steel rails and an additional 3.5m shared path on the southern side of the bridge. The deck is made from concrete and has an asphalt wearing surface. The superstructure is made up of bulb-tee concrete girders with a maximum span of 42m and steel box girders with a maximum span of 58m. The abutments are spill through type abutments with narrow benches located at the headstocks to facilitate future inspection. The proposed minimum vertical clearance over the existing Southern Sydney Freight Railway line is 7.5m.</td>
<td></td>
</tr>
</tbody>
</table>
7 Recommended Option

After considering all the aspects of options described in Section 6, Option 1B (Collector ramp with underpass at Moorebank Avenue) demonstrates the best value for money and suitability to the project needs.

Key features of the recommended option include:

- M5 westbound traffic for the Hume Highway exits east of Moorebank Avenue in a shared exit, enabling closure of the existing westbound exit to Hume Highway
- M5 westbound traffic for the Hume Highway underpasses Moorebank Avenue
- A new two lane bridge over the Georges River and the railway connects M5 and Moorebank Avenue traffic to the Hume Highway.

The Option 1B alignment fits with the surrounding terrain with little visual and noise impacts to the surrounding community and low grades particularly suited to heavy vehicles. These factors in particular made Option 1B stand out over the closest alternative - Option 2B. Option 1B also fits in well with future planning along the M5 corridor and is the least expensive option to construct, making it a clearly superior solution to Option 4B.

The main concerns with Option 1B raised at the various workshops included the constructability of the underpass of Moorebank Avenue. Further refinement of the option including preliminary design of the traffic staging of the underpass and consultation with the Transport Management Centre proved that this issue can be overcome with additional planning.

For further description of this option, please see Section 6.2.

For the Strategic Design of this option refer to Attachment 2.

8 Next steps

The recommended option will be displayed publicly by the end of 2019. This will provide an opportunity for the community to review the recommended option and provide feedback. Transport will use this information to further refine and confirm the preferred option for development.
9 References

- NSW Freights and Ports Plan 2018-2023 (September 2018), Transport for NSW
- The Western Sydney City Deal (March 2018), Australian Government and NSW Government
- Preliminary Environmental Investigation, Hume Highway West-facing Ramps M5 Motorway, Hume Highway to Moorebank Avenue (October 2015), SLR Consulting Australia Pty Ltd
Attachment 1

Summary of Long Listed Options
### Option 1B - Collector Ramp with Underpass at Moorebank Avenue

- M5 motorway westbound traffic for the Hume Highway exits east of Moorebank Avenue in a two lane shared exit with westbound traffic for Moorebank Avenue.
- Westbound traffic for Moorebank Avenue diverges from the shared exit and connects to the existing exit ramp to the Moorebank Avenue Interchange.
- **Westbound traffic for the Hume Highway on a new separate two lane carriageway passes under Moorebank Avenue on a 70m bridge south of the Moorebank Avenue interchange with a pier in the median of Moorebank Avenue.**
- The new two lane carriageway then merges from 2 lanes to 1.
- Moorebank Avenue westbound traffic for the Hume Highway separates from the Moorebank Avenue westbound traffic entering the M5 and joins the new carriageway in an added lane.
- The existing Moorebank Avenue westbound entry to the M5 remains open.
- The new two lane carriageway crosses the Georges River and the railway on a 315m bridge with similar pier spacing to the existing M5 Georges River bridges.
- The new carriageway connects the M5 and Moorebank Avenue traffic to the existing Hume Highway exit ramp.
- The existing exit from the M5 Motorway westbound to the Hume Highway is closed.
- A new shared path is provided along the southern side of new carriageway and proposed bridge between Moorebank Avenue and the Hume Highway.
- Modifications are made to the Moorebank Avenue/M5 Interchange TCS allowing pedestrian and cyclist crossing of the southern leg of the intersection.
Option 2B-Collector Ramp with Overpass at Moorebank Avenue

- M5 motorway westbound traffic for the Hume Highway exits east of Moorebank Avenue in a two lane shared exit with westbound traffic for Moorebank Avenue.
- Westbound traffic for Moorebank Avenue diverges from the shared exit and connects to the existing exit ramp to the Moorebank Avenue Interchange.
- **Westbound traffic for the Hume Highway on a new separate two lane carriageway climbs at approximately six per cent and passes over Moorebank Avenue on a 70m bridge south of the Moorebank Avenue interchange with a pier in the median of Moorebank Avenue.**
- The new two lane carriageway then falls back down at approximately six per cent to the same level as the existing M5 where it merges from two lanes to one.
- Moorebank Avenue westbound traffic for the Hume Highway separates from the Moorebank Avenue westbound traffic entering the M5 and joins the new carriageway in an added lane.
- The existing Moorebank Avenue westbound entry to the M5 remains open.
- The new two lane carriageway crosses the Georges River and the railway on a 315m bridge with similar pier spacing to the existing M5 Georges River bridges.
- The new carriageway connects the M5 and Moorebank Avenue traffic to the existing Hume Highway exit ramp.
- The existing exit from the M5 Motorway westbound to the Hume Highway is closed.
- A new shared path is provided along the southern side of new carriageway and proposed bridge between Moorebank Avenue and the Hume Highway.
- Modifications are made to the Moorebank Avenue/M5 Interchange TCS allowing pedestrian and cyclist crossing of the southern leg of the intersection. Existing M5 westbound Hume Highway exit is closed.
Option 3-Braided Ramps East of Georges River

- M5 westbound traffic for Hume Highway exits east of the Georges River and west of Moorebank Avenue
- Moorebank Avenue bridge span over the M5 requires widening
- New two-three lane bridge over Georges River and railway connects M5 and Moorebank Avenue traffic to Hume Highway.
- Moorebank Avenue traffic to the M5 westbound spans the proposed Hume Highway exit with a 145m bridge and crosses the Georges River on a separate one lane bridge and joins the M5 west of the Georges River.
- Existing M5 westbound Hume Highway exit is closed.
- Existing M5 westbound Moorebank Avenue entry is closed.

Option 4-Braided Ramps West of Georges River with Overpass at Hume Highway Exit Ramp

- Moorebank Avenue traffic for Hume Highway and Moorebank Avenue traffic for the M5 cross the Georges River on 2 separate 1 lane bridges
- Moorebank Avenue traffic for Hume Highway joins the existing exit to the Hume Highway
- Moorebank Avenue traffic for the M5 westbound spans the existing Hume Highway exit with a continuation of the Georges River Bridge and then grades down to pass under the existing Hume Highway and joining the M5 with an entry ramp.
- Existing M5 westbound Moorebank Ave entry is closed.
Option 4B – Braided Ramps West of Georges River with Overpass at Hume Highway Exit Ramp and Overpass of Hume Highway

- Moorebank Avenue traffic for Hume Highway and Moorebank Ave traffic for the M5 cross the Georges River on 2 separate 1 lane bridges
- Moorebank Avenue traffic for Hume Highway joins the existing exit to the Hume Highway
- Moorebank Avenue traffic for the M5 westbound spans the existing Hume Highway exit with a continuation of the Georges River bridge and then spans the Hume Highway before joining the M5 with an entry ramp west of the Hume Highway
- Existing M5 westbound Moorebank Ave entry is closed.

Option 5 - Braided Ramps West of Georges River with Underpass at Hume Highway Exit Ramp

- Moorebank Avenue traffic for Hume Highway and Moorebank Ave traffic for the M5 cross the Georges River on two separate one lane bridges
- Moorebank Ave traffic for Hume Highway joins the existing exit to the Hume Highway
- Moorebank Ave traffic to the M5 westbound underpasses the existing Hume Highway exit and underpasses the Hume Highway before joining the M5 with an entry ramp west of the Hume Highway
- Existing M5 westbound Moorebank Avenue entry is closed.
Option 6-Braided Ramp West of Georges River with Underpass of Collector Ramp

- M5 westbound traffic for Hume Highway exits east of the Georges River and west of Moorebank Avenue requiring widening of the Moorebank Avenue southern bridge span over the M5.
- M5 westbound traffic for Hume Highway and Moorebank Avenue traffic join a new three lane bridge over Georges River and railway
- Moorebank Avenue traffic to the M5 westbound underpasses the proposed Hume Highway exit and joins the M5 requiring widening of the Hume Highway bridge span over the M5
- Existing M5 westbound Hume Highway exit is closed.
- Existing M5 westbound Moorebank Avenue entry is closed.

Option 7-Exit Loop Ramp at Hume Highway

- Existing M5 westbound Hume Highway exit is closed.
- New two lane M5 westbound Hume Highway exit is created west of the Hume Highway requiring widening of the Hume Highway bridge span over the M5 and a 40km/h design speed loop to connect the exit to the western side of the Hume Highway at a new intersection.
- The weave conflict is not removed but the distance between the entry and exit ramps is increased from 460m to 1000m.
Option 8-Distributor Ramp with At-Grade Intersection at Hume Highway

- Moorebank Avenue traffic for Hume Highway and Moorebank Avenue traffic for the M5 cross the Georges River on a 1 lane bridge
- Intersection of Hume Highway and westbound M5 exit ramp upgraded to allow a movement straight ahead to join the M5 westbound
- New east facing entry ramp from Hume Highway to M5 westbound constructed
- Existing M5 westbound Moorebank Avenue entry is closed.
Attachment 2

Option 1B Strategic Design Plan– Collector Ramp with Underpass at Moorebank Avenue (Recommended Option)
M5 Motorway westbound traffic upgrade

- Existing exit from M5 Motorway to Hume Highway to be closed.
- New shared path from Moorebank Avenue to exit at Hume Highway.
- New shared exit for Hume Highway and Moorebank Avenue.
- New bridge over Georges River and T2, T3 and T5 railway lines.
- Existing entry ramp from Moorebank Avenue to the M5 Motorway.
- Eliminates issue of traffic weaving.
- Connects to existing exit at Hume Highway.
- New shared path.
- New Moorebank Avenue underpass for traffic exiting at Hume Highway only.
- New exit at Moorebank Avenue.
- New or upgraded road surface.
- Bridge/underpass.
- Cycle path.
- Shared path.

5 September 2019
In restricted situations, if appropriate interchange spacing cannot be achieved for satisfactory operation of adjacent ramps, one of the following solutions may need to be considered:

- Choosing a form of interchange that increases separation - eg using a loop ramp rather than diamond ramps (shown below), subject to volume, capacity and space considerations

- Providing a single interchange with a second diverge off the initial exit ramp, and/or combining two entry ramps to enter the mainline as a single entry
- Providing separate collector-distributor roads parallel to the mainline between two interchanges, which provide one entry and one exit ramp in each direction to service two or more interchanges, as shown below.

- Braiding of ramps (grade separation), as shown below.