

# Cambridge Avenue upgrade

## Options Evaluation Report

Transport for NSW | September 2020



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# Executive summary

Transport for NSW has identified a recommended option to upgrade the connection between Moorebank Avenue (Moorebank) and the M31 Hume Motorway (Glenfield) via Cambridge Avenue, following an intensive process of investigations, planning, design work and stakeholder consultation based on strategic designs prepared by Transport for NSW over the past two years.

The primary purposes of the Cambridge Avenue upgrade proposal are to provide secondary access to the Moorebank Logistics Park and address the growth in Liverpool, Glenfield and Moorebank. This will relieve access constraints between the Moorebank precinct and the surrounding motorway network for the high volumes of both light and heavy vehicle traffic forecast from operation of Moorebank Logistics Park, as well as: the South West Growth Centre; Western Sydney Airport at Badgerys Creek; Western Sydney Employment Area; and future growth areas within the Liverpool and Campbelltown local government areas.

The Cambridge Avenue upgrade would provide a dual carriageway between the bridge over the East Hills Rail Line on Moorebank Avenue and the M31 Hume Motorway, as well as an improved crossing of the rail corridors at Moorebank and Glenfield. It would also include new connections to the M31, M5 and M7 motorways, and widening of Campbelltown Road between Ingleburn Gardens Drive and Parkers Farm Place.

Cambridge Avenue is an important future transport corridor linking Moorebank Avenue and the M31 Hume Motorway (M31), supporting economic and residential growth in the region. The Cambridge Avenue upgrade proposal aims to complement adjoining projects and proposals, allowing road users to realise the full benefit from network upgrades in the vicinity.

The potential benefits of this proposal include:

- Improved road safety
- Improved traffic flow and efficiency for both light and heavy vehicles
- Improved connectivity to the surrounding road network
- Improved and reliable secondary access between Moorebank Logistics Park and the surrounding State Road Network
- Improved access to surrounding growth areas

The recommended option was selected over other short-list options as it would provide the best traffic improvements to support future growth with the least impact to the environment and local community.

The recommended option is described further in Section 7.

## ***Purpose of the report***

The purpose of this report is to support the public exhibition of the recommended option. It describes 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 access and traffic efficiency between Moorebank Avenue and the M31, M5 and M7 motorways via Cambridge Avenue.

## **Background**

Western Sydney is Australia's third largest economy and the population is expected to grow from two million to three million people over the next 20 years. The NSW Government is planning for this growth by planning for transport corridors to serve future residential and employment lands.

Transport for NSW developed the Moorebank Intermodal Terminal Road Access (MITRA) Strategy as a plan to address increasing traffic and freight movements in the Liverpool, Glenfield and Moorebank area over the next 10-20 years. The MITRA Strategy identified road infrastructure improvements to meet the forecast growth of Liverpool CBD and regional traffic, together with development of the Moorebank Logistics Park.

The Moorebank Intermodal Terminal, now known as Moorebank Logistics Park, is forecast to generate over 6,600 heavy vehicle trips and 10,000 light vehicle trips per day. The road network surrounding Moorebank Logistics Park needs to be improved to efficiently distribute truck traffic from logistics centres and businesses to the nearby motorway network.

These infrastructure improvements aim 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.

The Cambridge Avenue upgrade proposal is one of the road infrastructure improvements identified in the MITRA Strategy to improve movement efficiency, as well as provide reliable access to the Moorebank Logistics Park and surrounding State road network.

## **Scope summary**

The proposal extends between the bridge over the East Hills Rail Line on Moorebank Avenue and the M31 Hume Motorway.

The corridor along Moorebank Avenue and Cambridge Avenue includes a four-lane configuration between the bridge over the East Hills Rail Line and Canterbury Road and a six-lane configuration between Canterbury Road and Campbelltown Road.

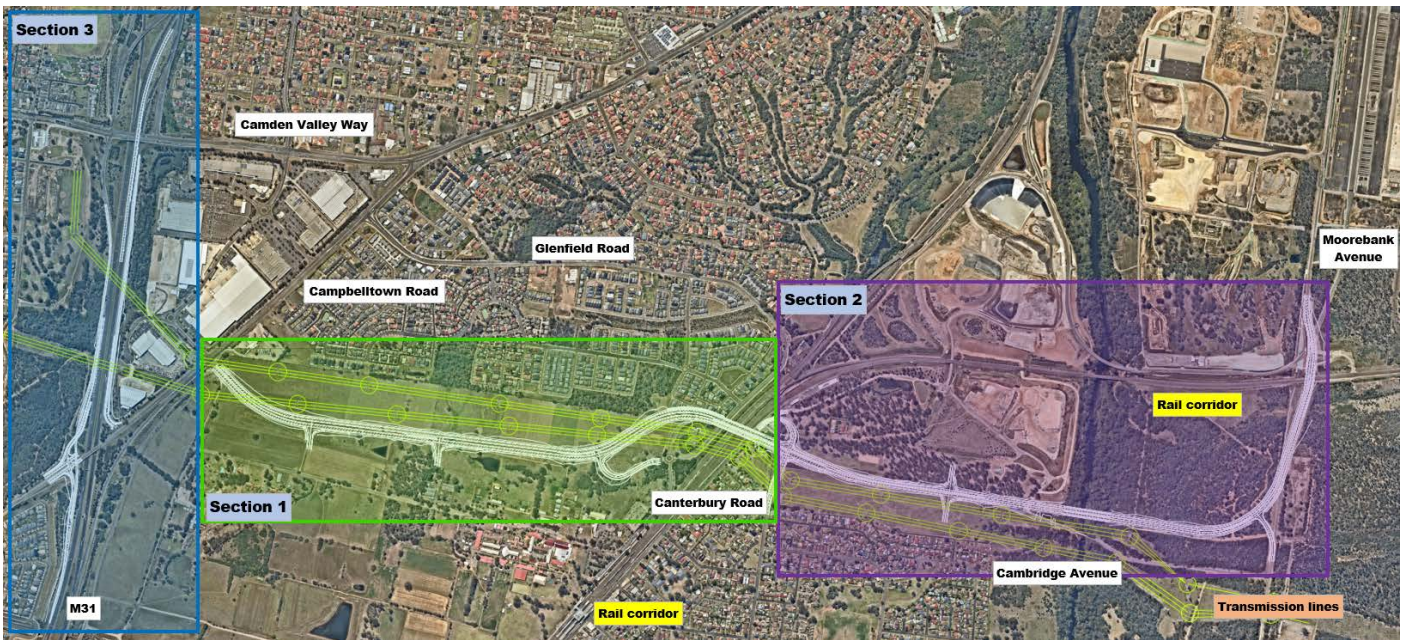
Campbelltown Road would be widened between Ingleburn Gardens Drive and Parkers Farm Place and new ramps would provide access to and from the M31, M5 and M7 motorways.

The main features of the recommended option, shown in Figure 1, are:

- Dual carriageways between the bridge over the East Hills Rail Line on Moorebank Avenue and Campbelltown Road would separate opposing traffic flows
- An improved crossing of the rail corridor, Glenfield Road and Railway Parade on the northern side of the existing bridge
- An improved crossing of the East Hills Rail Line, on the eastern side of the existing bridge
- Traffic signals at the following intersections would provide safe and controlled access:
  - Canterbury Road/Railway Parade
  - Glenfield Road
  - Glenfield West Services land
  - Department of Education land
  - Department of Defence land
- New ramps to connect Campbelltown Road with the M31, M5 and M7 motorways
- Provision for active transport with local connections would support walking and cycling.



**Figure 1: Recommended option**



### ***Recommended option selection process***

The study area was separated into three main sections, each operationally independent of one another, to simplify option evaluation. These were the 'greenfield' section between Canterbury Road and Campbelltown Road, the section along the existing Cambridge Avenue (east of Canterbury Road), and the motorway ramps section.

Strategic alignment options were identified and evaluated against broad criteria leading to a shortlist of options. The recommended option was then identified through an extensive option evaluation process, which more closely examined constraints and assumptions, potential impacts and benefits.

Transport for NSW engaged a multidisciplinary team including external stakeholders and specialists in the identification, development, evaluation and assessment of numerous options for the Cambridge Avenue upgrade proposal. This was an iterative process involving desktop and field investigations, engineering design and analysis, traffic modelling, stakeholder consultation and technical workshops.

Key stakeholders attended various workshops in 2018 and 2019 to examine risk, constructability, health and safety in design and value for money against the project objectives. Workshop participants agreed on the criteria to effectively evaluate each long-list option to meet the project objectives. This workshop agreed on the assessment criteria and methodology to determine the recommended corridor option.

The recommended option was considered as the most viable based on the balance of potential impacts on community, the environment and visual amenity, value for money and response to the identified risks. The other short-list options had higher estimated construction costs, safety concerns and steep grades unsuitable to heavy vehicle movement.

The recommended option for the alignment in the 'greenfield' section was chosen to minimise high cost and high risk impacts by keeping to the south and clear of the high voltage transmission lines for the majority of its length. This also offers the benefits of maximising the separation to the majority of established residential property to the north although it would limit the yield of developable land to the south.

The recommended option for the alignment along the existing Cambridge Avenue is the shortest of four alignment options. Other benefits of this option include fewest impacts on public utilities, particularly the high voltage transmission lines, most easily constructed, and most cost effective option.

The 'greenfield' and existing Cambridge Avenue sections are separated by a transport corridor consisting of three Sydney Trains' lines, the Southern Sydney Freight Line, Glenfield Road, and Railway Parade which run either side of it. There is a two lane bridge in place today that connects Cambridge Avenue and Glenfield Road.

The recommended option involves a new bridge to the north of the existing bridge across this transport corridor. A new bridge to the north of the existing bridge has a considerably lower impact on public utilities both inside, and beyond, the rail corridor. It would not require relocation of the high voltage transmission line stanchions, a high cost, and high risk exercise and the number of services in the rail corridor on the southern side of the existing bridge where a pier would be required is considerably higher than on the northern side.

This position for a new bridge would also provide the option to retain the existing bridge in service for a period of time. It is proposed that at least three lanes would be provided eastbound on Cambridge Avenue to provide a dedicated right turn to Canterbury Road. The existing bridge does not offer this capacity. However its two lanes would have the necessary capacity for westbound traffic at the date of opening.

### ***Next steps***

The recommended option will be displayed publicly and the community and stakeholders will be encouraged to examine it and provide feedback. Transport for NSW will use this information to further refine and confirm the preferred option for the next phase of development.

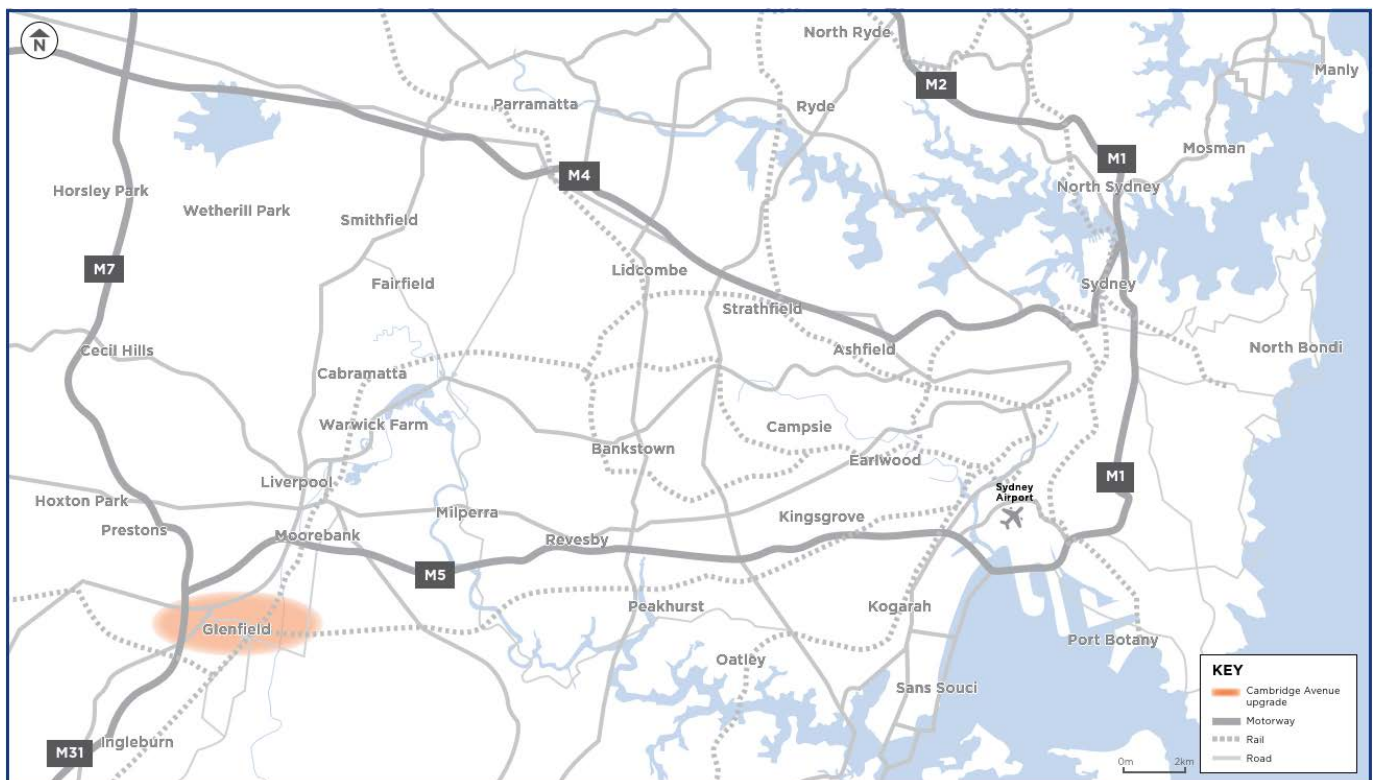


# 1 Introduction

## 1.1 Project location

The proposal to upgrade the connection between Moorebank Avenue (Moorebank) and the M31 Hume Motorway (Glenfield) via Cambridge Avenue (Cambridge Avenue upgrade proposal, or the proposal) is located in Moorebank and Glenfield and touches the suburbs of Holsworthy, Bardia, Edmondson Park and Casula within the Campbelltown City Council and Liverpool City Council local government areas as shown in Figure 2 below.

**Figure 2: Cambridge Avenue Upgrade - Locality Map**

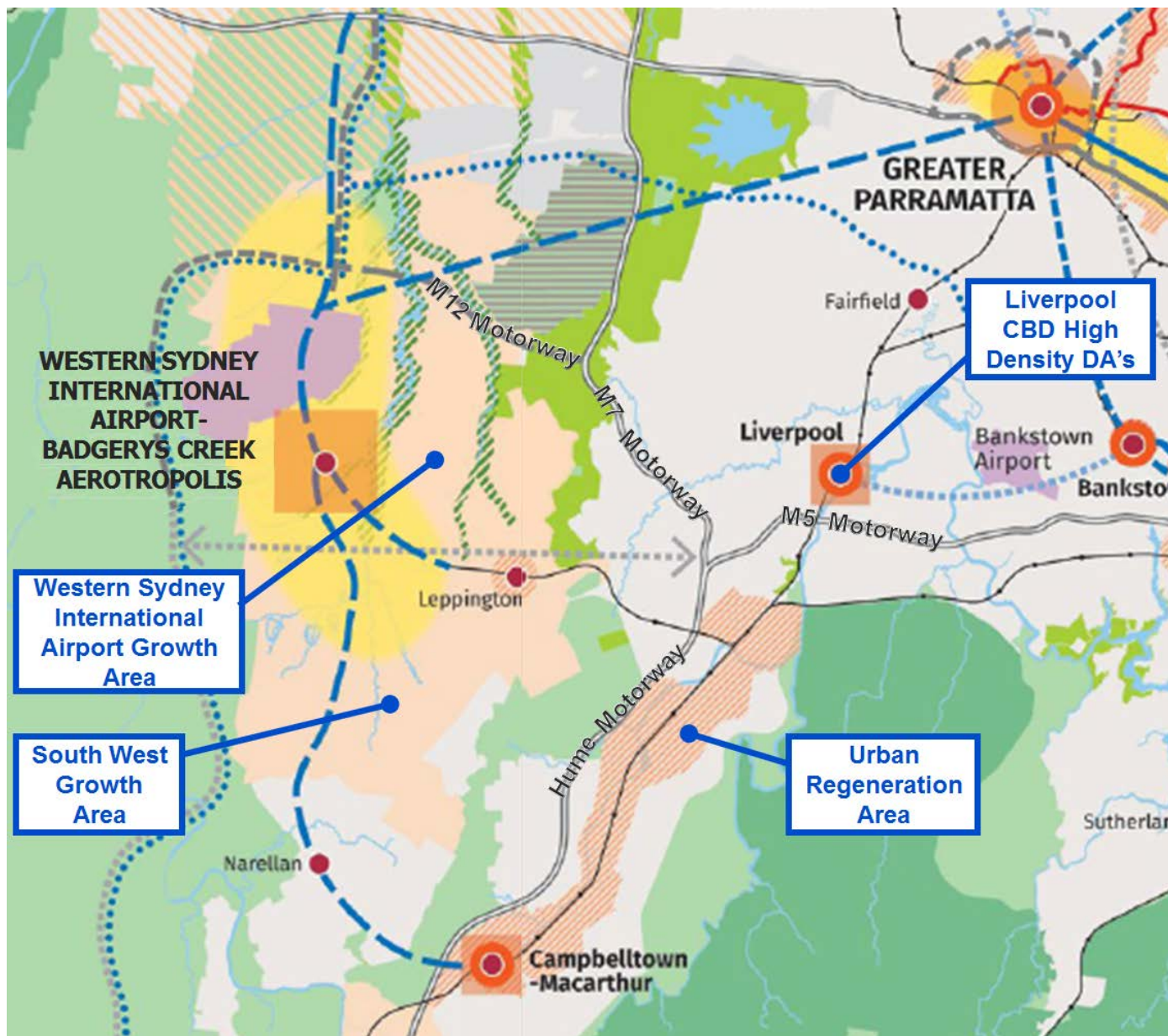


## 1.2 Project context

Western Sydney is Australia’s third largest economy and the population is expected to grow from two million to three million people over the next 20 years. The NSW Government is planning for this growth by planning for transport corridors to serve future residential and employment lands.

As part of its planning, Transport for NSW has developed an enabling roadworks strategy (Moorebank Intermodal Terminal Road Access (MITRA) Strategy) 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. The Moorebank Logistics Park is forecast to generate over 6,600 additional heavy vehicle trips per day and 10,000 additional light vehicle trips per day. While substantial, the additional traffic from the Moorebank Logistics Park 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 3 below:

Figure 3: Greater Sydney Structure Plan 2056 – the three cities



Source: The Greater Sydney Strategy Plan, Greater Sydney Commission (DPE 2017)

As part of the MITRA Strategy, three medium to long-term initiatives were recommended. These included 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 Cambridge Avenue upgrade would link Moorebank Avenue at the bridge over the East Hills Rail Line in the east with the M31 Hume Motorway in the west, improving connectivity between existing centres and growth areas as well as the surrounding road network. It would also provide alternative southern access between Moorebank precinct and the motorway network.



### 1.3 Proposal scope

The recommended option proposes duplication and extension of Cambridge Avenue from Moorebank Avenue at Moorebank Logistics Park westward to the Hume Motorway to include:

- An upgrade of Moorebank Avenue to a four-lane dual carriageway between Moorebank Logistics Park and Cambridge Avenue
- A duplication and realignment of Cambridge Avenue to a four-lane dual carriageway between Moorebank Avenue and Canterbury Road
- An extension of Cambridge Avenue as a new six-lane dual carriageway between Glenfield Road and Campbelltown Road
- New ramps to provide improved access at the intersection of Campbelltown Road and the Hume Motorway for motorists:
  - Travelling north from the Hume Motorway to Campbelltown Road
  - On Campbelltown Road to travel north on the Hume Motorway
  - Travelling south on the M7 Motorway to Campbelltown Road.

Campbelltown Road would also be upgraded between Ingleburn Gardens Drive and Parkers Farm Place. The Cambridge Avenue upgrade corridor is illustrated in Figure 4.

**Figure 4: Cambridge Avenue upgrade**



The completed upgrade would provide better connectivity between existing centres and growth areas as well as alleviate pressure off the existing and planned road network.

## 1.4 Project objectives

The project objectives are to:

- Maximise efficiency of the higher order road network
- Provide efficient and reliable secondary access to Moorebank Intermodal Terminal Precinct and the State Road Network
- Contribute to strategic land use outcomes in Glenfield by supporting the growth and providing additional access
- Incorporate active transport to contribute to the connectivity and performance of the modes
- Provide solutions that contribute to road safety outcomes.

## 2 Strategic context

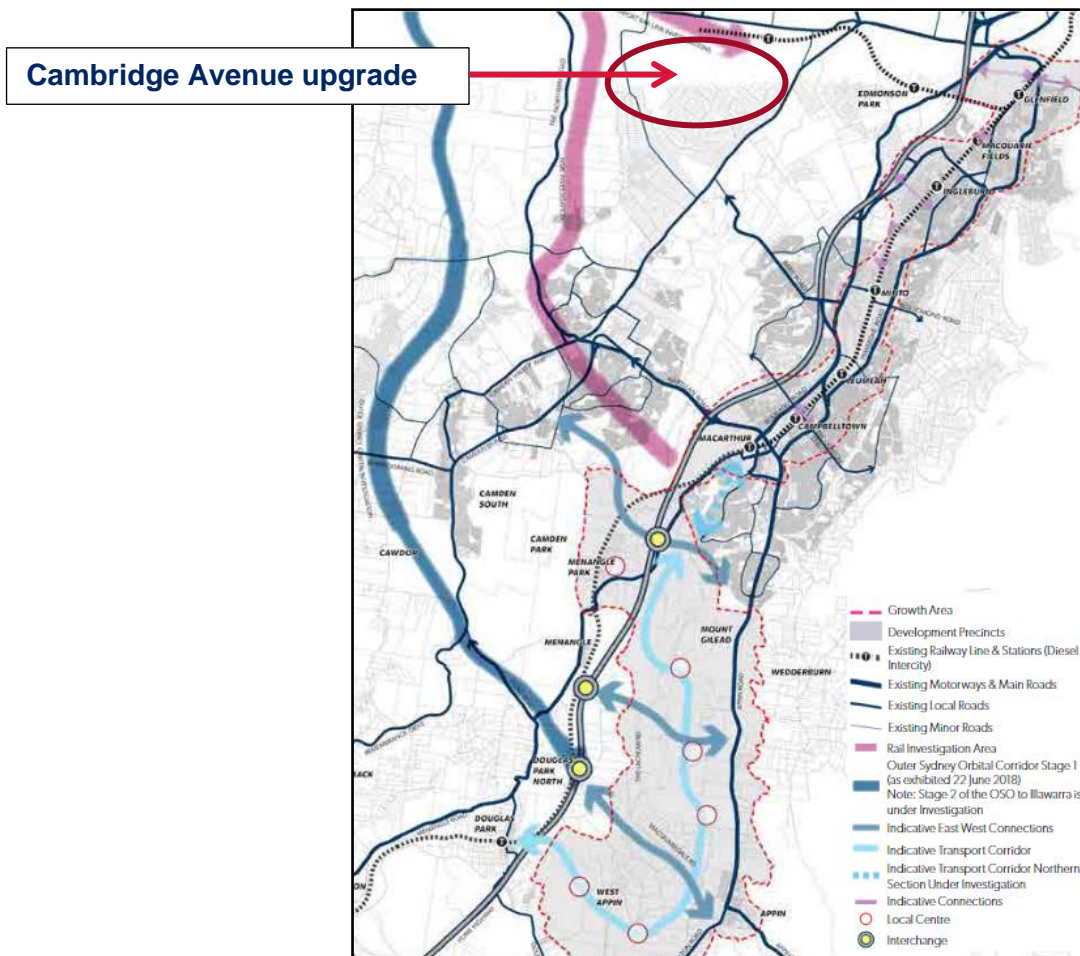
The Cambridge Avenue corridor will ultimately serve a movement function with high volumes of both light and heavy vehicle traffic forecast from development of the South West Growth Centre, Western Sydney Airport at Badgerys Creek, Western Sydney Employment Area, the Moorebank Intermodal Terminal and future growth areas including the Department of Education land where Hurlstone Agricultural High School sits, Georges River Precinct in East Liverpool, and miscellaneous sites within Liverpool Central Business District.

Cambridge Avenue is an important future transport corridor linking Moorebank Avenue and the M31, M5 and M7 motorways, supporting economic and residential growth in the region. This project will complement adjoining projects, allowing road users to realise the full benefit from a network of projects in the vicinity.

### ***Greater Macarthur 2040***

Greater Macarthur is a proposed growth area incorporating Glenfield to Macarthur urban renewal precincts and the land release precincts to the south of Campbelltown. The Department of Planning, Industry and Environment has prepared *Greater Macarthur 2040: An Interim Plan for the Greater Macarthur Growth Area* which sets out the strategic planning framework for the growth area. When finalised, *Greater Macarthur 2040* will guide precinct planning within the growth area.

**Figure 5: Glenfield Land Use and Infrastructure Plan**



The Greater Macarthur 2040 report specifically identifies the extension of Cambridge Avenue as an indicative connection required in the Greater Macarthur Growth Area (see pages 72-73). The Greater Macarthur Structure Plan is shown in Figure 5.

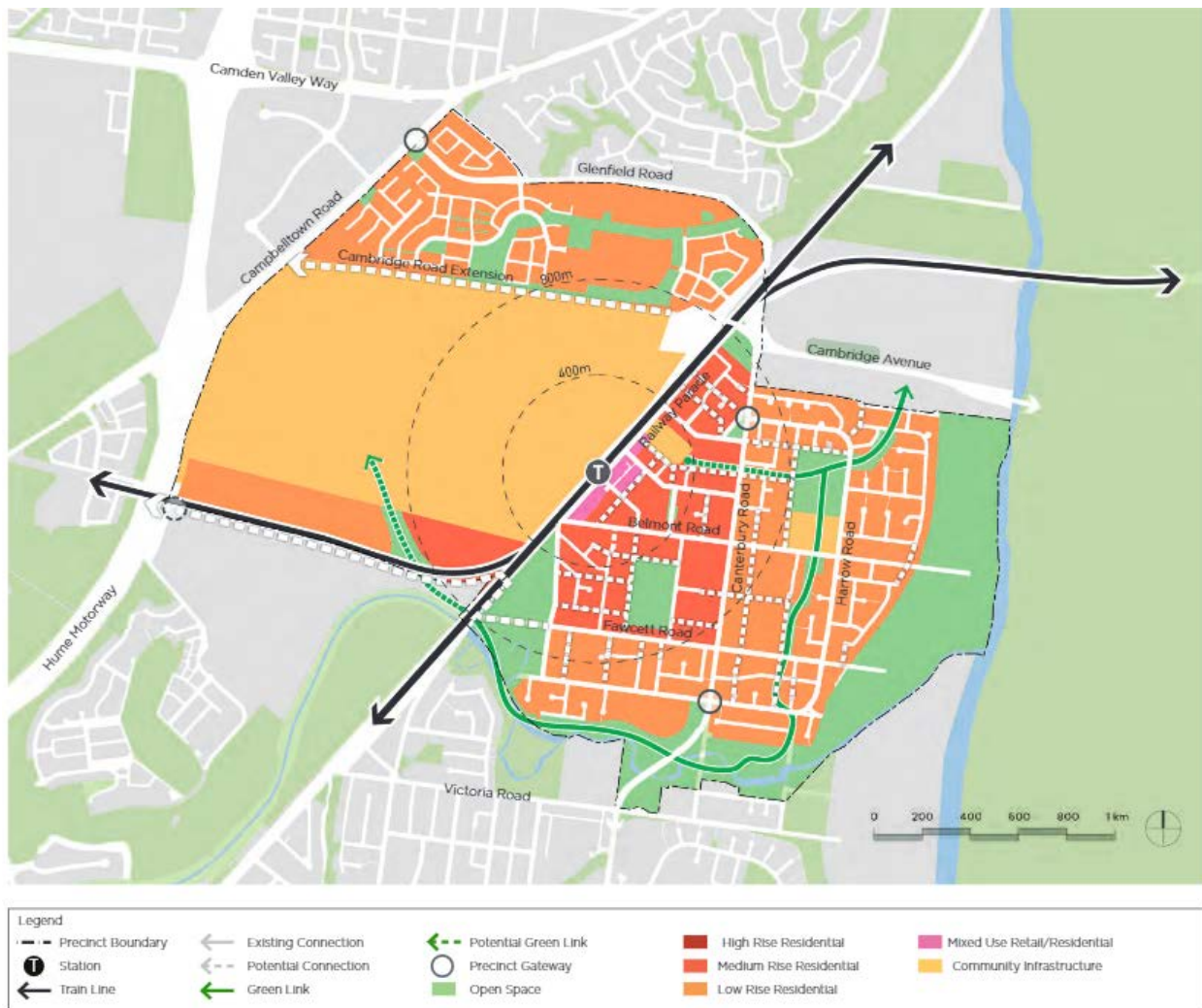
Source: Greater Macarthur 2040 report

***Glenfield to Macarthur Urban Renewal Precinct***

The Department of Planning and Environment has developed a strategy to improve the connectivity between jobs, homes and open spaces in the Glenfield to Macarthur area, the *Glenfield to Macarthur Urban Renewal Corridor Strategy 2015*, which is illustrated in Figure 6.



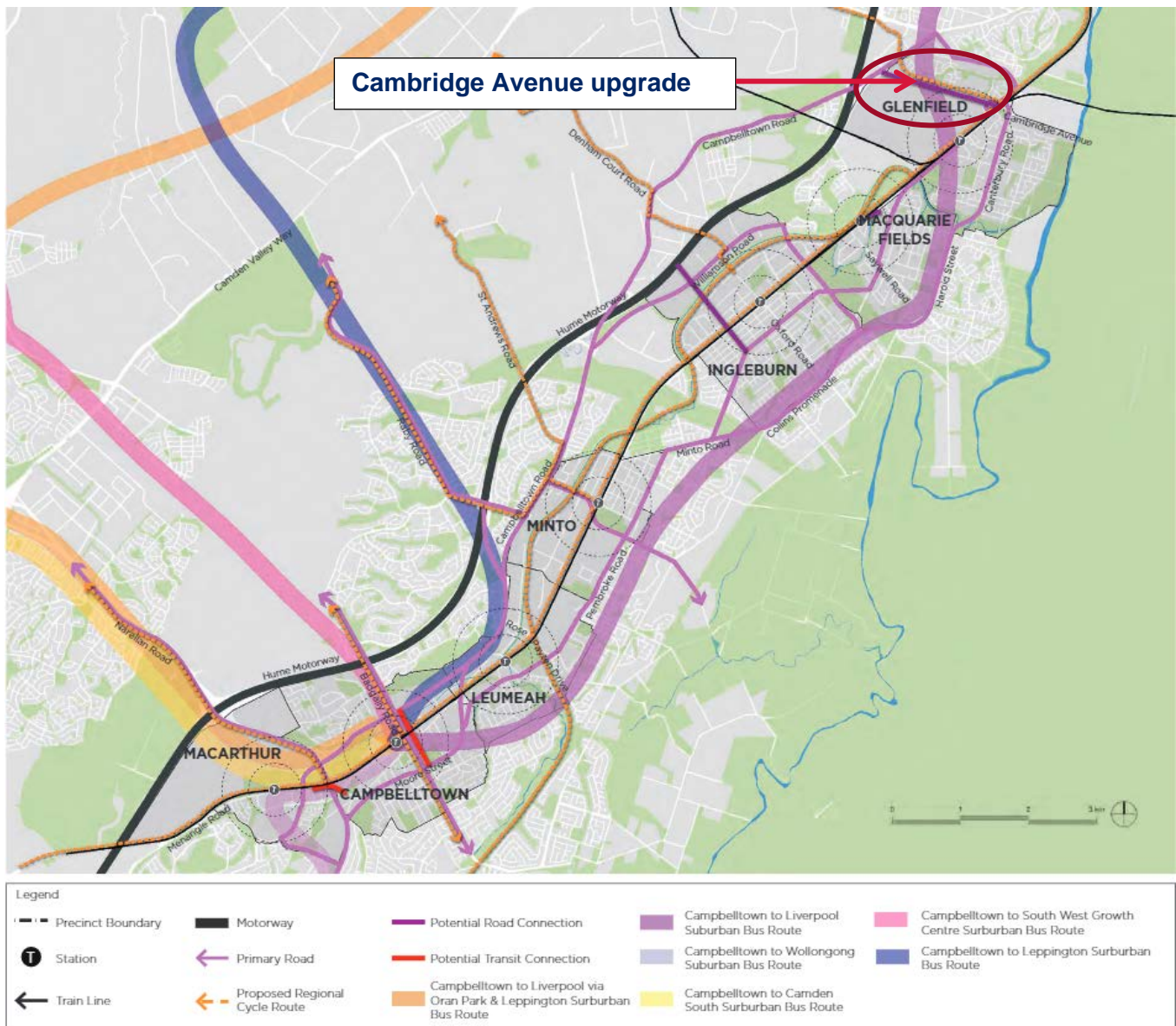
**Figure 6: Glenfield Land Use and Infrastructure Plan**



The Glenfield to Macarthur urban renewal corridor is located in the south-west subregion. Over the next 20 years, it is predicted that there will be a demand for an additional 664,000 homes and 689,000 jobs. To support growth, planning for additional housing and jobs is needed. The plan aims to accelerate urban renewal in transport corridor areas and close to major centres.

The Land Use and Infrastructure analysis is supported by an Integrated Transport Strategy, a strategic transport assessment commissioned by Transport for NSW. The land use and infrastructure plan for the Glenfield to Macarthur Urban Renewal corridor strategy has identified extension of Cambridge Avenue, illustrated in Figure 7, as a priority road upgrade to improve road network connections.

**Figure 7: Proposed transport infrastructure**



Source: Extract from Glenfield to Macarthur Urban Renewal Corridor – Land Use and Infrastructure Strategy Figure 12

Source: Extract from Glenfield to Macarthur Urban Renewal Corridor – Land Use and Infrastructure Strategy Figure 14

**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 providing additional access to the Moorebank Intermodal Terminal (MIT).



## Moorebank Logistics Park

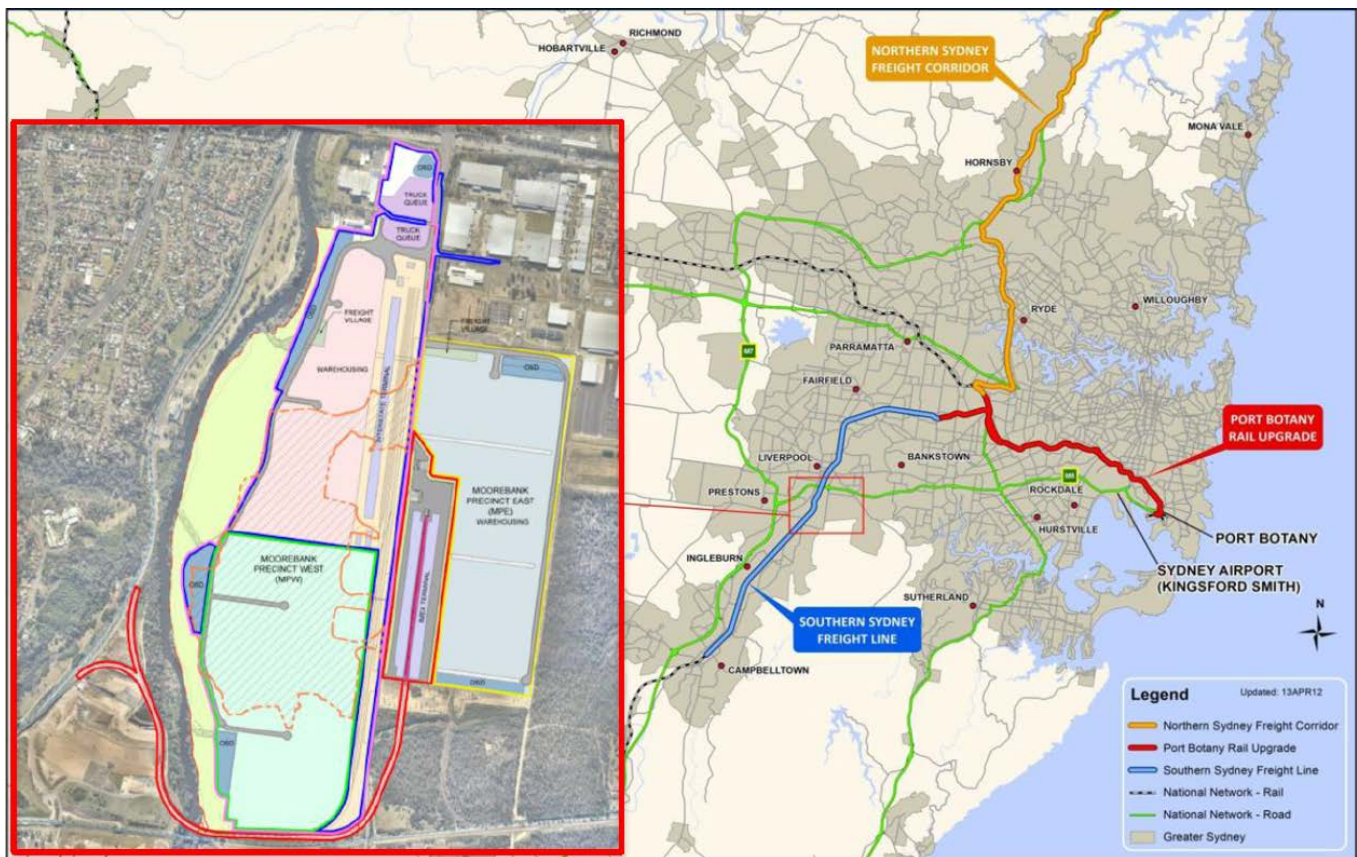
Moorebank Logistics Park, formerly Moorebank Intermodal Terminal, will provide a rail 'port shuttle' between Port Botany and the Moorebank precinct for import/export freight, with a separate terminal for interstate freight and warehousing. Freight will be carried via rail from and to Port Botany and re-distributed by truck to warehouses and businesses throughout Western Sydney and regional NSW. It is planned to have a throughput of 0.5 million Interstate containers, 1.2 million import-export containers, freight village and 850,000 m<sup>2</sup> of warehousing.

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 proposal aims to assist with the improvement of traffic flow and efficiency to and from Moorebank Logistics Park, which is estimated to generate over 6600 heavy vehicle trips per day and 10,000 light vehicle trips per day.

The location of the MIT is shown in Figure 8 below:

**Figure 8: Location of Moorebank Intermodal Terminal**



## Moorebank Intermodal Terminal Road Access Strategy (MITRA), RMS / Enabling Roadworks MITRA Strategy

Transport for NSW has developed a 10 year enabling roadworks strategy called Moorebank Intermodal Terminal Road Access (MITRA) Strategy for the Liverpool sub-region in south-west Sydney. This was 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*.

Upgrading the connection between Moorebank Avenue (Moorebank) and the M31 Hume Motorway (Glenfield) via Cambridge Avenue is an initiative recommended in the MITRA Strategy to assist with access to the Moorebank Logistics Park and surrounding growth centres.

### ***Freight and Ports Plan 2018-2023, Transport for NSW (TfNSW)***

The *Freight and Ports Plan 2018-2023* was developed by TfNSW 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 safer. The key objectives of the plan are to:

- Drive economic growth
- Increase efficiency, connectivity, and access for freight
- Deliver greater capacity by investing in, 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 the Moorebank Logistics Park.

The MITRA Strategy 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 the MITRA Strategy is to provide road infrastructure to support the Moorebank Logistics Park and address forecast increases in traffic. Cambridge Avenue upgrade would directly support this by providing additional access to the Moorebank Logistics Park.

## **3 Stakeholder involvement**

The recommended option was developed in consultation with major stakeholders including planning and approval agencies, local councils, State and Commonwealth government departments, public utility owners and railway operators.

### **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 and mitigations; options; evaluation criteria; and recommendations.

### **3.2 Stakeholders**

Transport for NSW consulted with a large range of stakeholders throughout the development of the recommended option.

The stakeholders listed below include those Transport for NSW identified as being expected to have an interest in, or potentially be affected by, the Cambridge Avenue upgrade proposal:

- Transport Management Centre (TMC)
- Liverpool City Council (LCC)
- Campbelltown City Council (CCC)
- Federal and State Government
- Moorebank Intermodal Company (MIC)

- QUBE (Moorebank Logistics Park developer)
- Tharawal Local Aboriginal Land Council
- Gandangara Local Aboriginal Land Council
- Department of Infrastructure and Regional Development
- NSW Department of Planning, Industry and Environment
- Department of Defence
- NSW Department of Education
- Property NSW
- Greater Sydney Commission
- Urban Growth NSW
- NSW Office of Environment and Heritage
- Water NSW
- Infrastructure NSW
- NSW Environment Protection Authority
- Australian Rail Track Cooperation
- TransGrid Energy
- Australian Power & Gas (APA) Group
- Endeavour Energy
- Jemena
- Sydney Water Corporation
- Hurlstone Agricultural High School
- Glenfield Waste Services
- Glenfield Scout Activity Centre
- Telstra Corporation Limited
- Optus
- NBN Co (National Broadband)
- Sydney Trains
- ARTC
- Interlink (M5 Motorway Operator)
- NorthWestern Roads (Westlink M7 Motorway Operator)

Stakeholders will be consulted further where relevant throughout the development process.

### 3.3 Workshops

Transport for NSW consulted stakeholders during identification of the recommended option through a series of workshops held in 2018 and 2019. Workshops with Transport for NSW and key stakeholders were conducted for the section through the 'greenfield' section (Department of Education land) in August 2018 and for the other sections in August 2019.

All workshops involved participation of 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 Cambridge Avenue upgrade.



**Table 1: Workshops conducted by Transport for NSW**

Workshop	Date Held	Purpose	Attending Stakeholders
Risk Management	18 May 18	Identify risks associated with the options under consideration for the section between Campbelltown Road and Canterbury Road.	<ul style="list-style-type: none"> <li>• Transport for NSW (Sydney Division, Bridges, Environment, Technical and Project Services, Utilities, Active Transport, WHS, Road Design)</li> <li>• Sydney Water</li> <li>• ARTC</li> <li>• NSW Planning</li> <li>• ARUP</li> <li>• Sydney Trains</li> <li>• Tierney Page Kirkland (Facilitator)</li> </ul>
Constructability and Health & Safety in Design	11 Jun 19	Optimise the design to ensure the project can be constructed and maintained practically and efficiently and ensure that construction flexibility and innovation are not unnecessarily constrained by design.	<ul style="list-style-type: none"> <li>• Transport for NSW (Sydney Division, Bridges, Environment, Technical and Project Services, Utilities, Active Transport, WHS, Property, Road Design)</li> <li>• Turnbull Engineering (Constructability Specialist)</li> <li>• Sydney Water</li> <li>• Sydney Trains</li> <li>• SDR Solutions (Facilitator)</li> </ul>
Risk Management	18 Jun 19	Identify potential risks and establish appropriate mitigation / management strategies to ensure that the agreed project objectives are realised.	<ul style="list-style-type: none"> <li>• Transport for NSW (Sydney Division, Bridges, Environment, Technical and Project Services, Utilities, Active Transport, WHS, Property, Road Design)</li> <li>• ARTC</li> <li>• Department of Industry and Planning (DPIE)</li> <li>• Sydney Water</li> <li>• ARUP</li> <li>• Tierney Page Kirkland (Facilitator)</li> </ul>
Value Management	14 Aug 19	To obtain a common understanding of the work undertaken to date, align on assessment criteria; and identify a recommended option to focus on for further development.	<ul style="list-style-type: none"> <li>• Transport for NSW (Sydney Division, Bridges, Environment, Technical and Project Services, Utilities, WHS, Property, Road Design, Spatial Services, Network Operation)</li> <li>• TfNSW (Freight Strategy and Planning)</li> <li>• Design Inc (Urban Design)</li> <li>• SDR Solutions (Facilitator)</li> </ul>

## 3.4 Community consultation and communication

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

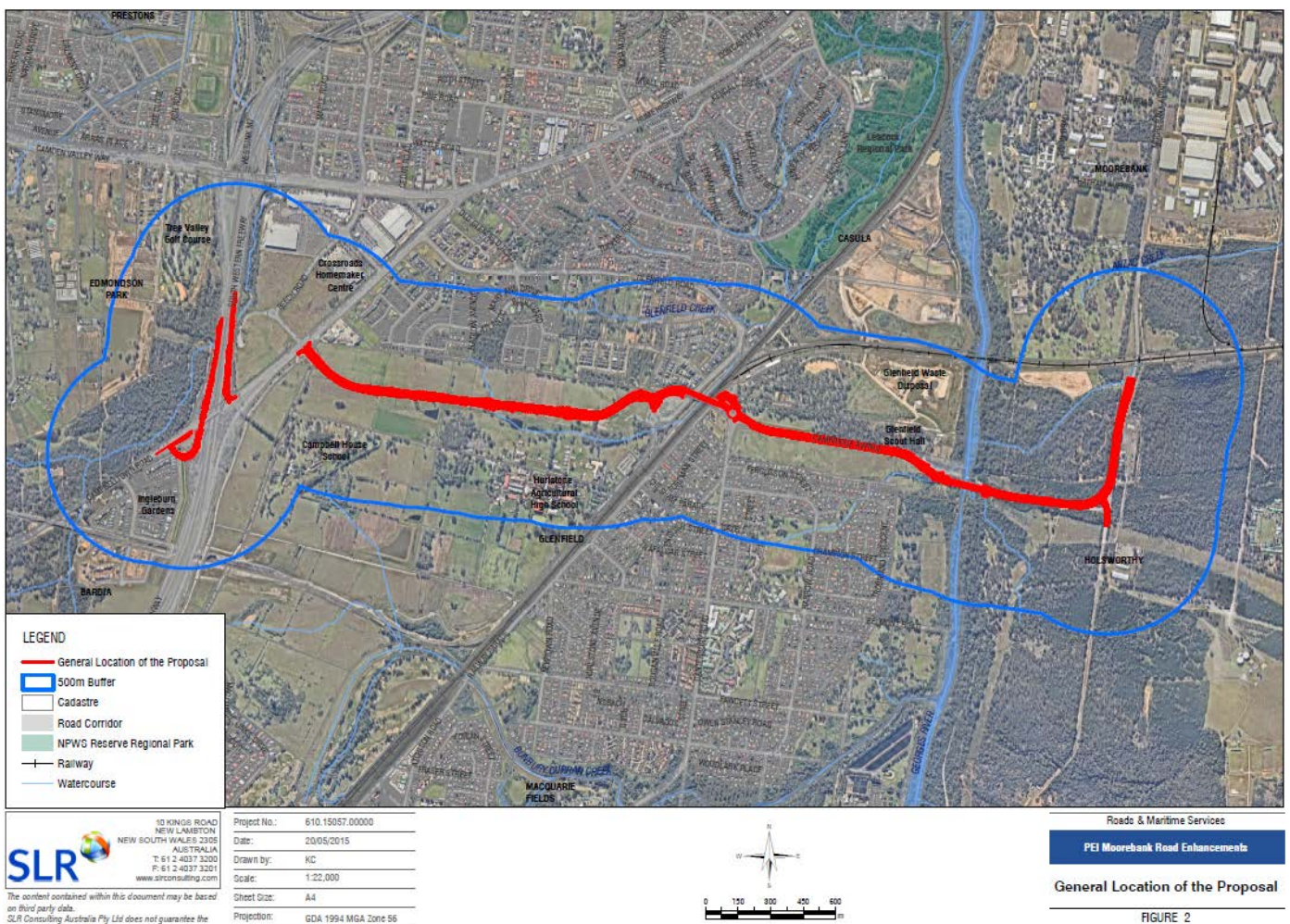
Communication will be via printed materials, a project website, media releases, Government announcements, advertising and public information sessions and a continuation of stakeholder engagement meetings and workshops.

The recommended option is described in Section 7 and will be displayed for community comment between 9 December 2020 and 15 February 2021.

## 4 Preliminary environmental investigation

A preliminary environmental investigation (PEI) of the study area, shown in Figure 9, was prepared for Transport for NSW by SLR Consulting Australia Pty Ltd in 2015. Its purpose is to identify environmental constraints, inform economic and social concerns and provides potential opportunities to guide the development of options for the proposal.

**Figure 9: PEI Study Area**



Source: Cambridge Avenue Preliminary Environmental Investigation, SLR Consulting Australia Pty Ltd 2015

## 4.1 Environmental constraints

A constraints analysis was completed to identify the existing conditions in the study area and guide development of the proposal. It involved mapping of environmental information, major utilities, existing and proposed land uses.

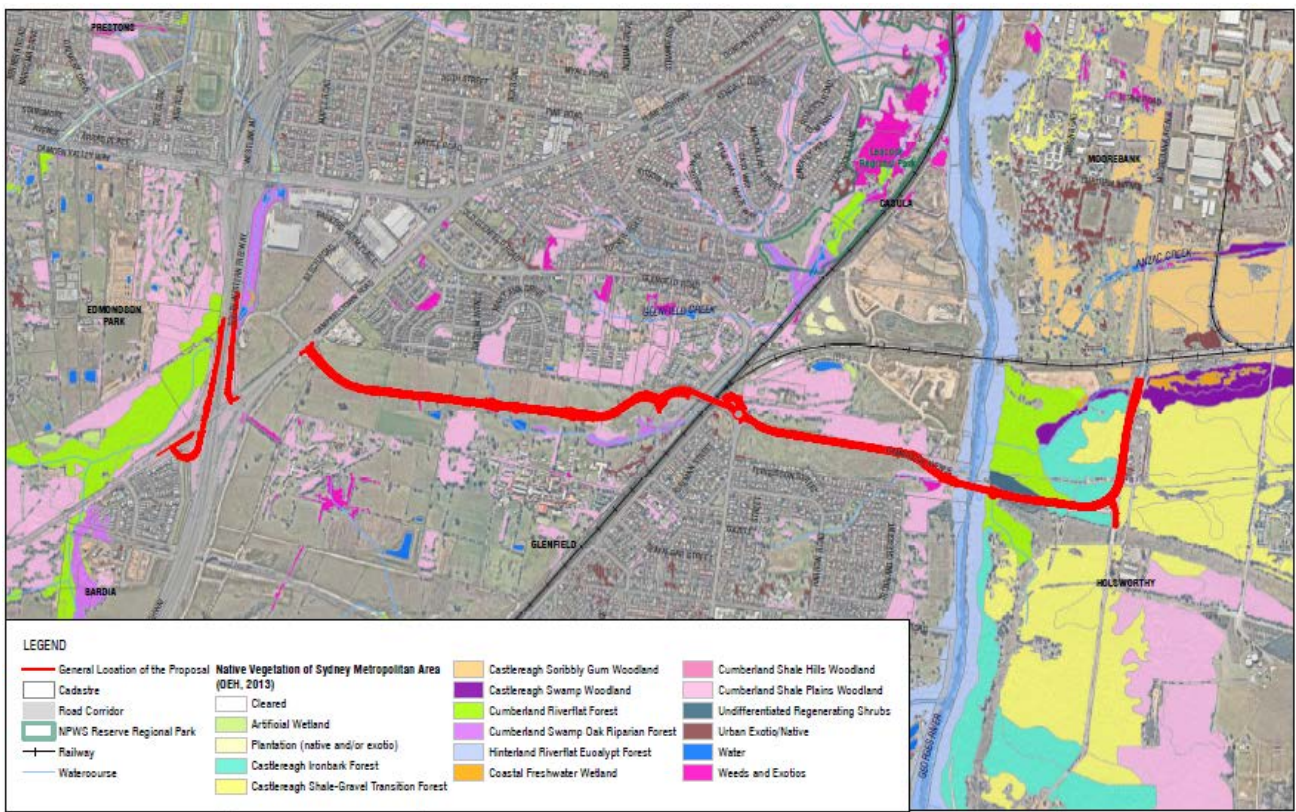
The constraints analysis was based on readily available data and field investigation carried out.

### **Key constraints**

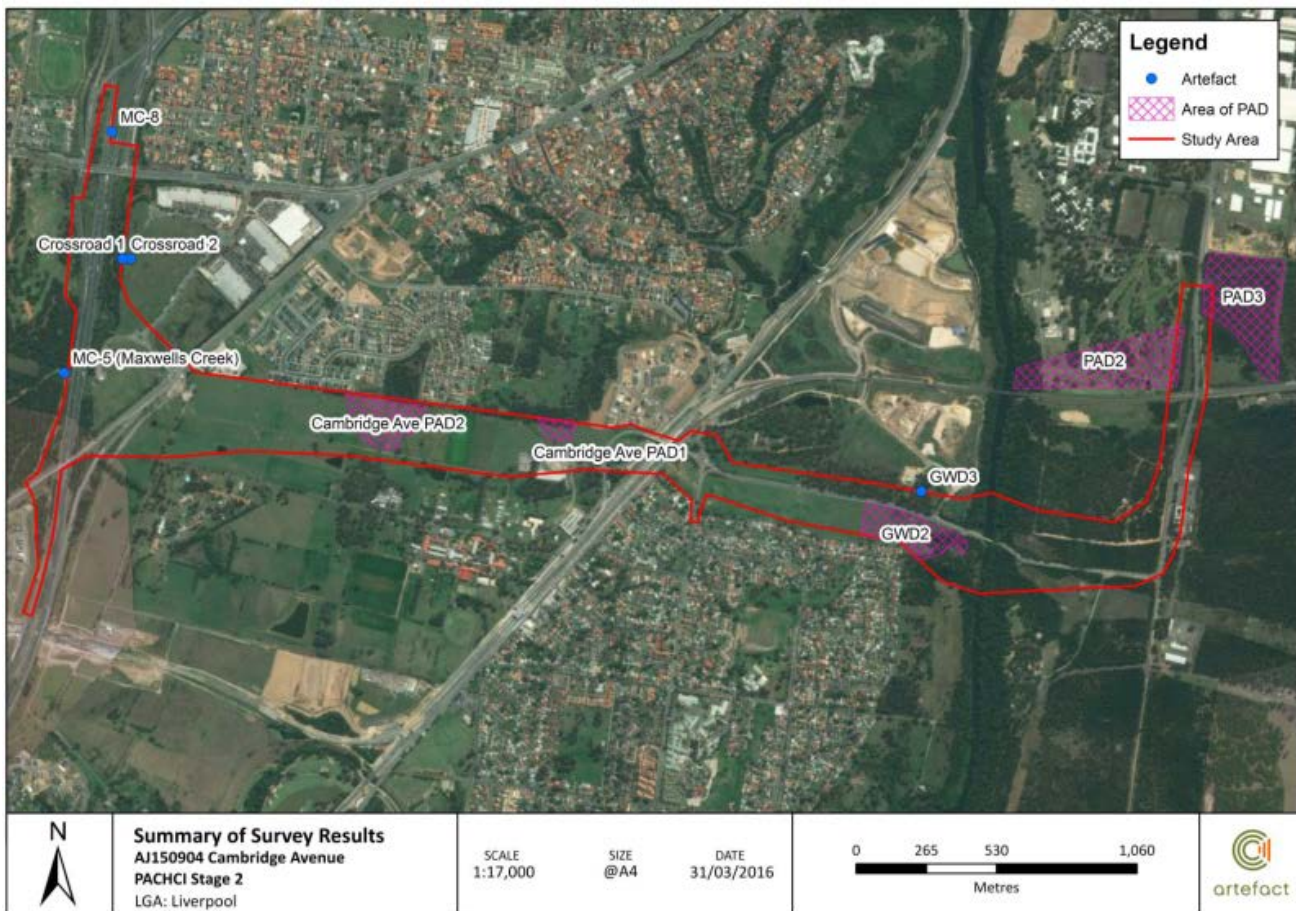
- Traffic and transport. All current traffic movements to and from Canterbury and Glenfield roads are to remain during construction, and be provided for in the proposal
- Threatened ecological communities. The majority of the remnant vegetation communities within the study area are listed as Threatened Ecological Communities (TECs) as shown in **Figure 10**. In summary, the Castlereagh Shale-Gravel Transition Forest, Castlereagh Ironbark Forest, Cumberland Shale Plains Woodland and Cumberland Riverflat Forest are impacting the proposed road alignment
- Threatened species. Threatened species have been recorded within a 10 kilometre radius of the study area. A total of 73 listed species or species habitat under the NSW *Biodiversity Conservation Act 2016*, and 28 listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* are potentially within the project area
- Aboriginal heritage. There are five Potential Archaeological Deposits (PAD) and five previously recorded artefacts with the potential to be impacted by the project as shown in **Figure 11**
- Non-Aboriginal heritage, two locally listed heritage items with the potential to be impacted comprising of Hurlstone Agricultural High School and the Holsworthy Group
- Socio-economic impacts. A large number of sensitive receivers adjacent to the corridor including residential property are potentially affected directly and/or indirectly through property acquisition and amenity (for example noise, visual, and air quality)
- Existing biodiversity offset land to the west of the M31 Hume Motorway and Campbelltown Road
- Flood plains adjacent to Georges River and Department of Education land.



**Figure 10: Vegetation Communities**



**Figure 11: Aboriginal heritage constraints**





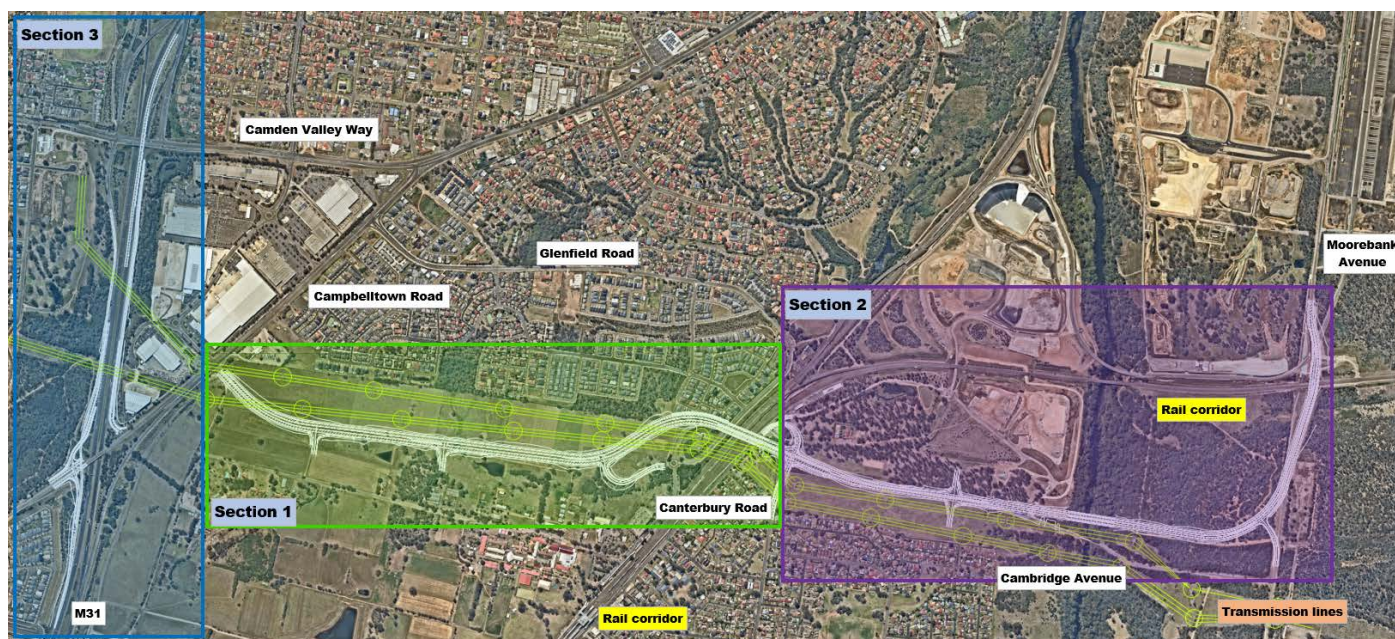
## 5 Process to select the recommended option

Transport for NSW led a multidisciplinary team in the identification, development, evaluation and assessment of numerous options for the Cambridge Avenue upgrade proposal.

The study area was separated into three main sections, each operationally independent of one another, to simplify the processes of evaluation and elimination of less favourable or unfeasible options or sub-components of options by the project team. This enabled the prioritisation of Section 1, between Campbelltown Road and Glenfield Road, to align with land rezoning investigations by the NSW Department of Planning, Industry and Environment.

The three sections are illustrated in Figure 12 and described below. This neither represents nor precludes the construction staging strategy.

**Figure 12: Cambridge Avenue upgrade – Sections used for proposal development**



**Section 1** would involve extension of Cambridge Avenue from Canterbury Road, in a westerly direction through ‘greenfield’ (Department of Education) land, to Campbelltown Road.

**Section 2** includes of the duplication and realignment of Cambridge Avenue and Moorebank Avenue between Canterbury Road and Moorebank Logistics Park.

**Section 3** includes three new ramps connecting Campbelltown Road and the M31, M5 and M7 motorways.

If the proposal proceeds to implementation, a section of Campbelltown Road, between Ingleburn Gardens Drive and Parkers Farm Place, would be upgraded in line with proposals prepared separately by Transport for NSW.

The project team identified numerous alignment options for each section, and multiple structure options for crossing two rail corridors and Georges River in response to the recommendations in the MITRA Strategy. Referred to as ‘long-list options’, they were evaluated against major constraints, clear impacts and ability to satisfy relevant design criteria. The long-list options are described in **Attachment 1**.

Several options were discarded as being impractical or undesirable for any of the following reasons: departure from design standards (for example geometrically non-compliant vertical or horizontal geometry or grades), unrealistic or uneconomical bridge spans, proximity to existing structures, proximity to critical and major utilities, potential impact on community and property, potential impact on adjacent road network and complex traffic staging requirements.

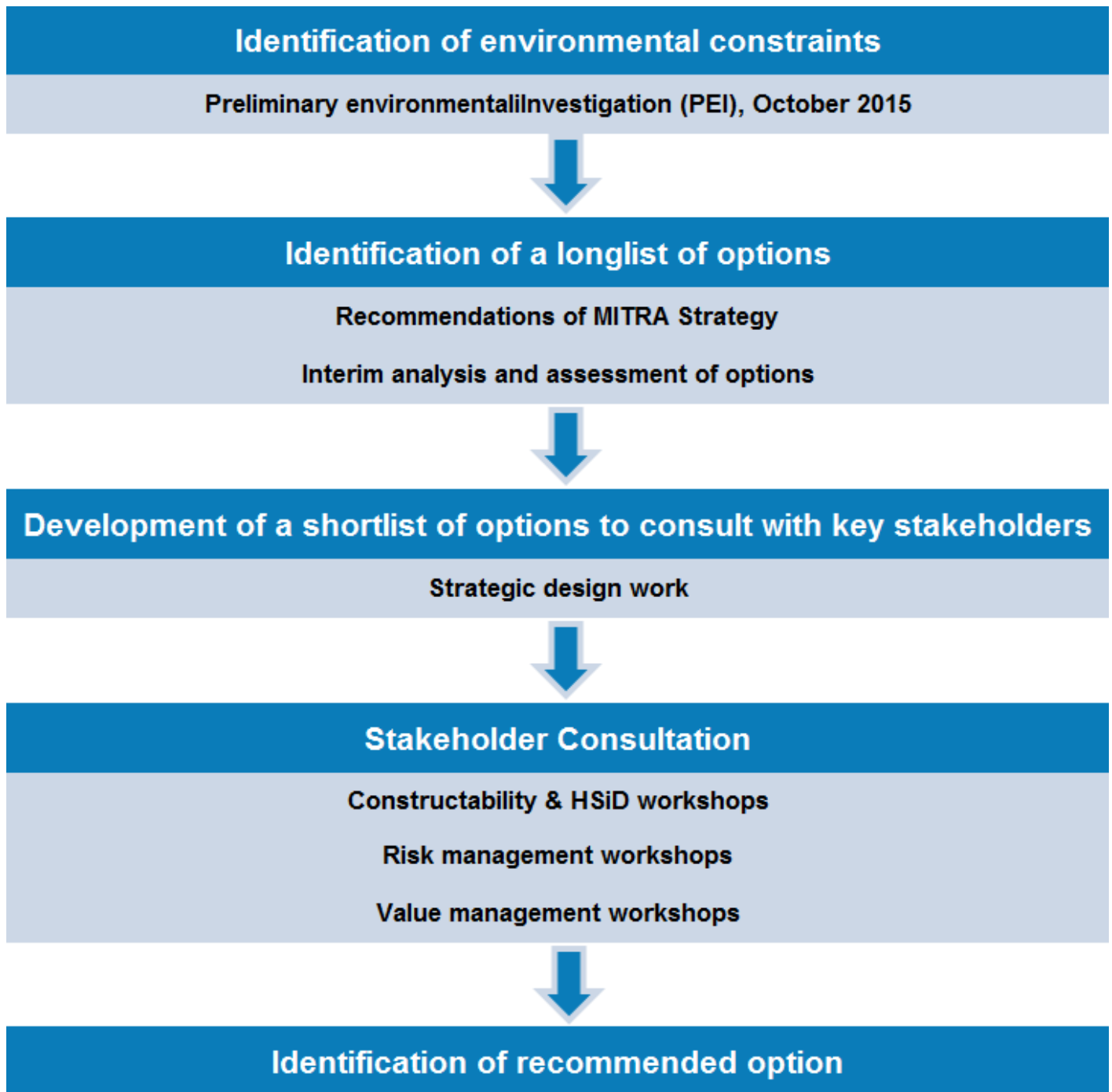


The remaining options were considered to be potentially viable and formed the 'short-list options'.

Short-list options were further developed to better understand them in greater detail so that they could be examined more closely against a larger range of, and more specific measures.

All sections underwent a similar iterative development process, illustrated in Figure 13, where strategic design work included desktop and field investigations, engineering design and analysis, traffic modelling, stakeholder consultation and technical workshops.

**Figure 13: Process to select the recommended option**



Value management workshop participants assessed the short-list options based on the qualitative assessment against criteria which reflected what the project must achieve and the comparative strategic cost estimates of each option for each section. Options were then recommended for each section and the combination of these results in the recommended option.

Although sections were created for the purposes of project development and options assessment, the recommended option for the Cambridge Avenue upgrade between Moorebank Avenue and the M31 Motorway was still identified through a routine staged project development process.

## 6 Evaluation of options

### 6.1 Section 1

Section 1, extension of Cambridge Avenue in a westerly direction to Campbelltown Road, was established to enable Transport for NSW to progress its development activities in parallel with the NSW Department of Planning, Industry and Environment's timeline for its proposed rezoning of Department of Education land.

Ten 'long-list' options were identified and evaluated based on key constraints and compliance with relevant design criteria. Five of these options were eliminated and strategic designs were further developed for the remaining short-list options.

The short-list options are described below.

- Option 2 proposes a road alignment to the south of the high voltage transmission lines with a new bridge over the rail corridor to the north of the existing bridge
- Option 5 proposes a road alignment to the south of the high voltage transmission lines with a new bridge over the rail corridor to the south of the existing bridge
- Option 8 proposes a road alignment through the middle of the high voltage transmission lines easement with a new bridge over the rail corridor to the north of the existing bridge
- Option 9 proposes a road alignment that would have its eastbound and westbound lanes split to run, generally, either side of the high voltage transmission lines with a new bridge over the rail corridor to the north of the existing bridge
- Option 10 proposes a road alignment to the north of the high voltage transmission lines, adjacent to the southern boundary of the residential development with a new bridge over the rail corridor to the north of the existing bridge.

The short-list options were compared using a multi-criteria analysis based on the following set of established criteria:

- Complexity, impacts and cost of avoiding, relocating, protecting public utility assets
- Environmental impacts
- Property impacts (acquisition, social)
- Traffic network performance and regional and local connectivity
- Constructability
- Optimising the developable land
- Estimated capital and operational cost

A common alignment for a dual-carriageway, to the south of the high voltage transmission lines, was established while further investigations and consideration of the options for the crossing of the rail corridor, between Canterbury Road and Glenfield Road, based on options 2 and 5 were undertaken.

The bridge described in Option 5 to the south of the existing bridge would not enable retention of access between Railway Parade and Cambridge Avenue. Therefore the design was refined and a 'southern' bridge

option close and parallel to the existing bridge was developed. Transport compared the 'northern' bridge (Option 2 in the long-list) with a modified Option 5.

A comparative assessment identified the biggest differences in two options as being network operations, utilities related impacts, comparative property impacts and constructability.

- A southern bridge option would require relocation of several transmission towers. There is not sufficient space between the transmission cables and the existing bridge for an additional structure. Therefore each set of transmission cables would have to be relocated which would require the acquisition of residential property east of the railway, south of the study area which is a major disadvantage of the southern bridge option
- The northern bridge option would require relocation of a Sydney Water pump station and associated sewer mains infrastructure. However this is more achievable and has considerably less impact and risk
- Either option would require the construction of a bridge column in the rail corridor. However there are many more utilities to the south of the existing bridge than to the north, therefore the southern bridge option would have a greater impact and be more difficult to construct
- In terms of traffic capacity, a northern bridge would enable retention of the existing bridge for westbound traffic until sometime into the future. A southern bridge would not provide this flexibility because of the need for more eastbound than westbound lanes, to accommodate the right turn movement to Canterbury Road. Therefore a southern bridge would require replacement of the existing bridge at the same time.

Therefore the recommended option for the rail corridor crossing is a northern bridge (long-list Option 2).

## 6.2 Section 2

Section 2 would involve duplication and realignment of Cambridge Avenue (and Moorebank Avenue) between Canterbury Road and the bridge over the East Hills Rail Line on Moorebank Avenue. It would include bridge crossings of Georges River and the East Hills Rail Line.

Four road alignment options and two bridge options were identified and evaluated based on key constraints and compliance with relevant design criteria.

The four road alignment options are described briefly below and in more detail in **Attachment 2**.

- Option 1 is the southernmost alignment with two large radius curves and a 144 metre long skewed bridge on the curve over Georges River and separate large culvert.
- Option 2 is the second-most southern alignment, further from residential property, with two large radius curves, and a 166 metre long skewed bridge over Georges River and separate, large culvert.
- Option 3 generally follows the existing road alignment on the western side of the river. It includes a 188 metre long skewed bridge and two curves. It is the second most northerly alignment.
- Option 4 is a straight re-alignment of Cambridge Avenue with a 160 metre long bridge that crosses Georges River normal to it. It has a single curve with the smallest radius of all options and is the northernmost alignment.

The four road and two bridge options were compared at the 2019 value management workshop based on the criteria of: network operation; utility impacts; environmental impacts; social impacts; constructability; road safety.

A comparative assessment of the four options is summarised below. The value management workshop participants recommended Option 4 as it was found to be superior in almost all aspects of the evaluations. Option 4 would:

- Provide the shortest route and therefore would provide the least travel time of the four options while most other aspects of network performance were common to each option
- Would have the fewest impacts on public utilities as it would not require adjustments to the high voltage transmission towers
- Would have the second smallest direct impact on vegetation and animal habitat
- Would have the fewest social impacts due to it being located furthest from existing homes south of the corridor
- Is considered to offer the safest and most easily constructed option, partly on the basis of being the shortest route and partly due to the shorter and simpler bridge over Georges River and no requirements for additional large culverts
- Require land acquisition from Glenfield Waste Services.

Three options for a duplicate bridge over the East Hills Rail Line are listed below. Both options would enable northbound traffic to use the existing bridge and southbound traffic to use the new bridge.

- Option 1 proposed a duplicate bridge parallel and adjacent to the eastern side of the existing bridge
- Option 2 proposed a duplicate bridge about 35 metres to the east of the existing bridge
- Option 3 proposed a duplicate bridge parallel and adjacent to the western side of the existing bridge

Option 3 was confirmed as unfeasible following the construction of a new rail spur as part of the Moorebank Logistics Park.

Option 2 would require a considerably greater land take from the Commonwealth which means Option 1 is the recommended.

## 6.3 Section 3

Section 3, new access ramps to and from M31, M5 and M7 are designed to meet roads standards.

One option for each of the northbound ramps was identified and adopted as standard practice for ramps. However there were two options identified for the southbound off ramp from M7 to Campbelltown Road to resolve the complex traffic movements associated with the converging of the M7 and M5 lanes at the same location as the proposed off ramp to Campbelltown Road. This traffic convergence is the reason for the off ramp only catering for southbound M7 traffic, and not accessible from the M5.

Option 1, the recommended option proposes widening the median of the M5 to facilitate the M7 off-ramp on the left. Option 2 proposed constructing the ramp between two of the Camden Valley Way bridge columns. Option 2 was found to have too many constructability and structural risks to be further considered.

## 6.4 Consultation with key stakeholders

A series of workshops with key stakeholders were held in both 2018 and in 2019. These workshops were designed to identify the main project risks, constructability constraints, and examine safety in design and undertake a value management analysis.

A description of these workshops is given in Table 2 below:



**Table 2: Workshop purpose and outcomes**

<b>Constructability – May 2018</b>	
<p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>▪ Identify potential opportunities to optimise the design and eliminate complexities for construction, operation and/or maintenance of short-list options to provide confidence that the project could be constructed, operate, and be maintained efficiently and effectively.</li> <li>▪ Ensure that construction flexibility and innovation are not unnecessarily constrained by design.</li> </ul>	<p><b>Outcome:</b></p> <p>Issues identified include:</p> <ul style="list-style-type: none"> <li>▪ Track possessions</li> <li>▪ Infrastructure in rail corridor</li> <li>▪ High voltage transmission lines</li> <li>▪ Traffic management</li> <li>▪ Sewer pump station</li> <li>▪ Cranage clearances</li> <li>▪ Existing bridge capacity</li> <li>▪ Road grades</li> </ul>
<b>Health &amp; Safety in Design (HSiD) – May 2018</b>	
<p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>▪ Identify the HSiD issues and any consequential impacts and their relative importance through the infrastructure lifecycle</li> </ul>	<p><b>Outcome:</b></p> <p>Issues identified include:</p> <ul style="list-style-type: none"> <li>▪ Interface with high voltage transmission lines</li> <li>▪ Interface with rail lines during bridge construction</li> <li>▪ Interface with utilities in the rail corridor</li> <li>▪ Interface with local traffic during bridge construction</li> <li>▪ Staging of works and tie-ins to existing road networks</li> <li>▪ Cranage clearances (construction)</li> <li>▪ Damage to existing services in ground (construction)</li> <li>▪ Interface with public and roundabouts</li> </ul>
<b>Risk Management – May 2018</b>	
<p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>▪ Identify risks associated with the options under consideration for the section between Campbelltown Road and Canterbury Road.</li> </ul>	<p><b>Outcome:</b></p> <p>The main risks identified were:</p> <ul style="list-style-type: none"> <li>▪ Impacts on rail &amp; road traffic</li> <li>▪ Property acquisition</li> <li>▪ High voltage transmission lines</li> <li>▪ Track possessions</li> <li>▪ Existing bridge capacity</li> <li>▪ Interface with developers of adjacent land</li> </ul>

## Constructability – June 2019

### Purpose:

- Identify potential opportunities to optimise the design and eliminate complexities for construction, operation and/or maintenance of short-list options to provide confidence that the project could be constructed, operate, and be maintained efficiently and effectively.
- Ensure that construction flexibility and innovation are not unnecessarily constrained by design.

### Outcome:

The main issues to focus on were:

- Ensuring practical and safe clearance from hazards outside the road carriageway including bridge column construction in the rail corridor 1.03); and
- Ensuring the option selected minimises the need for costly utility adjustments

## Health & Safety in Design (HSiD) – June 2019

### Purpose:

- Identify the HSiD issues and any consequential impacts and their relative importance through the infrastructure lifecycle

### Outcome:

The participants recommended:

- Widen the M5 into the median to segregate the M7 off ramp to Campbelltown Road.
- A new bridge to the north of the existing bridge at Glenfield provides for better construction safety and avoids relocation of HV transmission towers
- The northernmost alignment for the carriageway between Canterbury Road and Moorebank Avenue avoids relocation of, and crane interactions with, HV transmission towers, enable a simpler crossing of Georges River and avoid crossing a large sewer line.

## Risk Management – Jun 2019

### Purpose:

- Assess the options under consideration for the section between Glenfield Road and Moorebank Avenue as well as the motorway ramps.
- Establish consensus agreement on the optimum solutions to form a recommended option.
- Identify the risks associated with the recommended option.

### Outcome:

The participants recommended:

- A new bridge to the north of the existing bridge at Glenfield due to its reduced impacts on TransGrid infrastructure and associated risks
- The northernmost alignment for the carriageway between Canterbury Road and Moorebank Avenue on balance impacts and benefits

## Value Management – August 2019

### Purpose:

- To obtain a common understanding of the work undertaken to date
- To align on assessment criteria
- To identify a recommended option to focus on for further development

### Outcome:

The participants recommended:

- A new bridge to the north of the existing bridge at Glenfield on the basis that it offers better traffic operational outcomes and has lesser overall impact on utilities and more easily constructed.
- The northernmost alignment for the carriageway between Canterbury Road and Moorebank Avenue on the basis that it offers better traffic operational outcomes and has lesser overall impact on utilities, fewer social impacts and would be more easily constructed.
- No clear preference for either option for a duplicate bridge to the east of the existing bridge on Moorebank Avenue.
- Widening the M5 into the median to segregate the M7 off ramp to Campbelltown Road as the only viable option.

The Value Management workshop held in August 2019, to review and evaluate strategic options against agreed assessment criteria led to the identification of a recommended option.

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-list corridor options and key constraints of the project corridor. The group was then introduced to the short-list 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 are detailed in Table 3 below:

**Table 3: Value Management Assessment Criteria**

## Assessment Criteria

### Network Operation:

- Enhance connectivity to local road network
- Facilitates appropriate access to adjacent developable land
- Connectivity to existing and proposed road network
- Compatibility with proposed active transport network
- Ease of maintenance (safety, efficiency (including avoidance of bespoke systems) and traffic impact)
- Performance for freight. Design vehicle is B-Double, with an A-triple at Department of Defence compound access
- Travel time performance of the links.

### Utilities:



## Assessment Criteria

- Impact on TransGrid network and assets
- Impact on Sydney Water network and assets
- Impact on telecommunication network and assets
- Impact on APA gas pipeline
- Impacts on rail utilities
- Impacts on Jemena gas pipeline

### Environment:

- Potential impact on biodiversity (threatened species, vegetation community and sensitive environmental land)
- Potential impact on biodiversity (koala)
- Potential impact on Aboriginal heritage. Potential impact on non-aboriginal heritage
- Potential impact on Georges River
- Potential impact on other (excluding Georges River) watercourses

### Social:

- Property acquisition
- Potential impact on businesses
- Potential impact of construction noise
- Air quality impacts
- Vibration impacts on adjacent buildings
- Potential impact of operational noise
- Impacts on adjacent properties/lands and flood impacts
- Visual impact

### Constructability:

- Simplicity of construction (technical and staging), including construction off-line versus under traffic
- Requirement for track possessions
- Potential impact on connected road network (M5 and M7 primarily but also Campbelltown Road, Canterbury Road, Glenfield Road, and Moorebank Avenue)
- Impacts on Railway Parade
- Potential impact on traffic during construction

### Road Safety:

- Geometry (e.g. horizontal & vertical curves, superelevation, stopping sight distance).
- Distance between TCS controlled intersections
- Capacity for left and right turn auxiliary lanes
- Legibility of final arrangement
- Ease of navigation
- Avoidance of weave movements over short distances

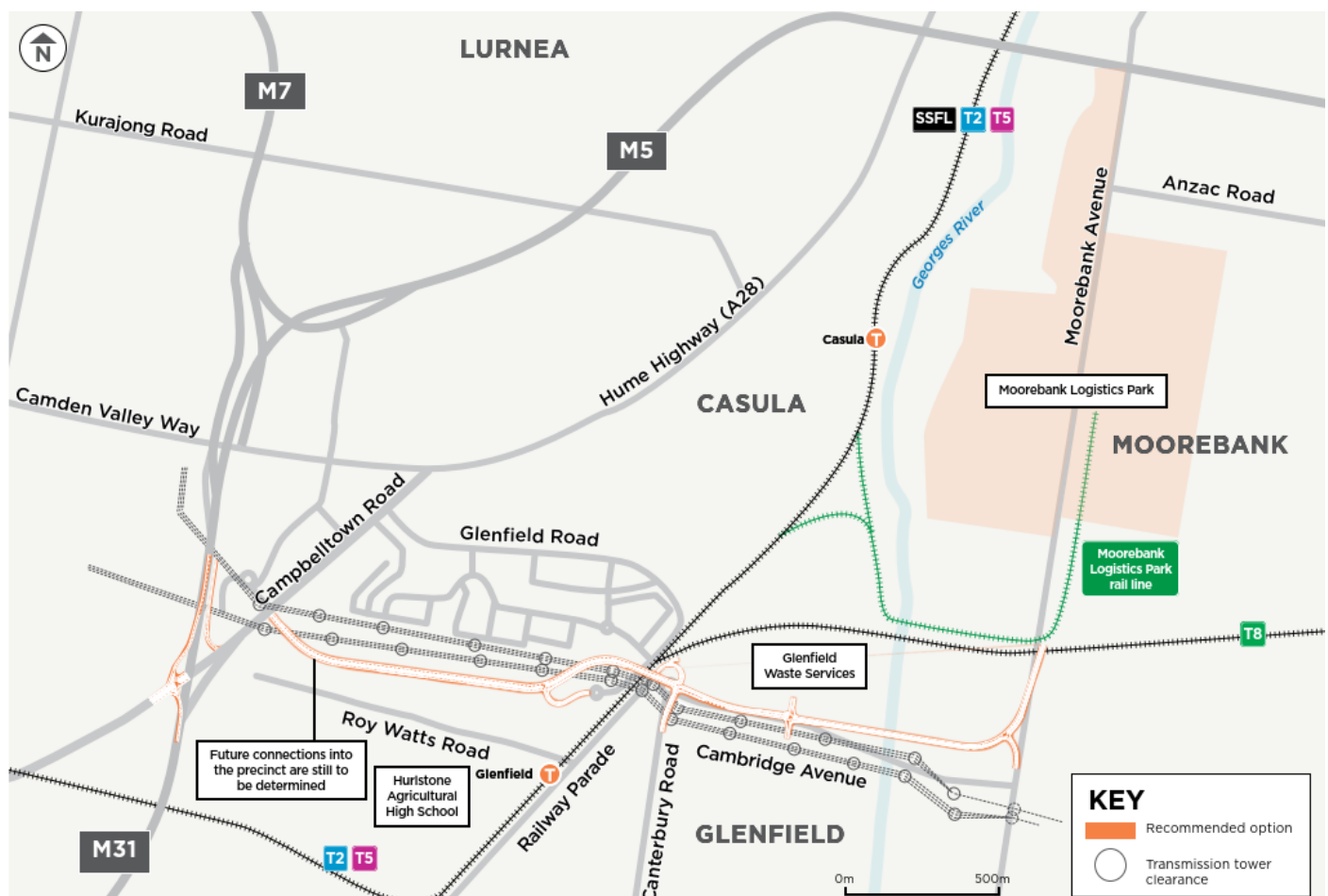
## 7 Recommended Option

After considering all the aspects of options described in Section 6, the recommended option for the Cambridge Avenue upgrade demonstrates the best value for money and suitability to the project needs.

Main features of the recommended option, shown in Figure 14, are:

- Dual carriageways between the bridge over the East Hills Rail Line on Moorebank Avenue and Campbelltown Road would separate opposing traffic flows
- An improved crossing of the rail corridor, Glenfield Road and Railway Parade on the northern side of the existing bridge
- An improved crossing of the East Hills Rail Line, on the eastern side of the existing bridge

**Figure 14: Recommended option**

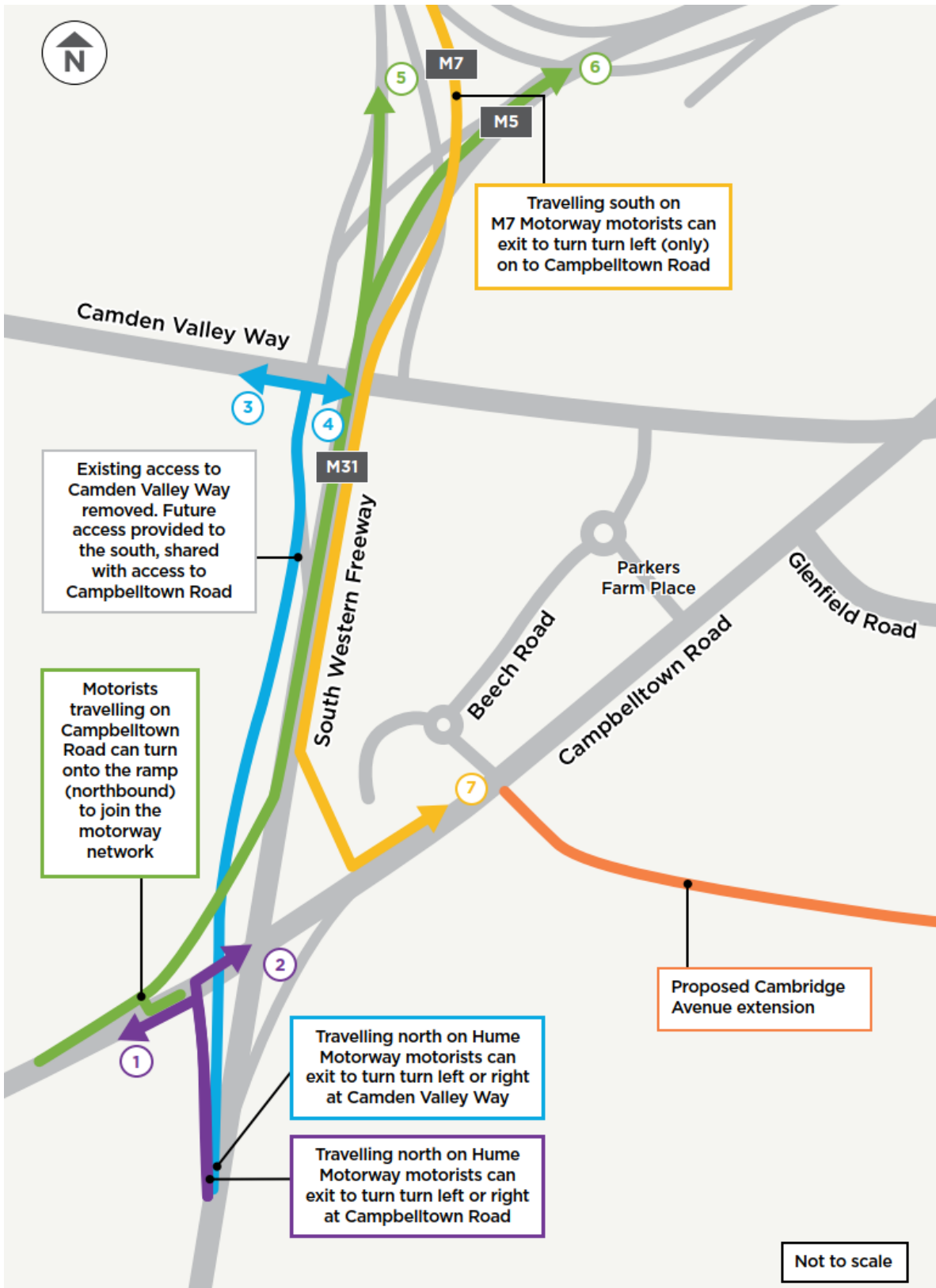


- Traffic signals at the following intersections would provide safe and controlled access:
  - Canterbury Road/Railway Parade
  - Glenfield Road
  - Glenfield Waste Services land
  - Department of Education land
  - Department of Defence land
- New ramps to connect Campbelltown Road with the M31, M5 and M7 motorways offering the following traffic movements as illustrated in Figure 15:
  1. Travelling north on the Hume Motorway to turn left on to Campbelltown Road
  2. Travelling north on the Hume Motorway to turn right on to Campbelltown Road

3. Travelling north on the Hume Motorway to turn left on to Camden Valley Way
  4. Travelling north on the Hume Motorway to turn right on to Camden Valley Way
  5. Travelling north on Campbelltown Road to veer left and travel north on the M7 Motorway
  6. Travelling north on Campbelltown Road to veer left and travel east on the M5 Motorway
  7. Travelling south on the M7 Motorway to turn left on to Campbelltown Road.
- Provision for active transport with local connections would support walking and cycling.

**Figure 15: Ramp access traffic movements**





Cambridge Avenue is an important future transport corridor linking Moorebank Avenue and the M31, M5 and M7 motorways, supporting economic and residential growth in the region. This proposal aims to complement adjoining proposals and projects, allowing road users to realise the full benefit from a network of projects in the vicinity.

The potential benefits of this project include improved:

- road safety
- traffic flow and efficiency for both light and heavy vehicles
- connectivity to the surrounding road network
- reliable secondary access to Moorebank Logistics Park and the surrounding State Road network
- access to surrounding growth areas

The recommended option was selected over other short-list options as it would provide the best traffic improvements to support future growth, with the least impact to the environmental and local community.

## 8 Next steps

The recommended option will be displayed publicly from 9 December 2020 until 15 February 2021. This will provide an opportunity for the community to review the proposal and provide feedback. Transport for NSW will use this information to refine and confirm a preferred option for further development.

Subject to acceptance of the recommended option, the Cambridge Avenue upgrade proposal would be subject to environmental impact assessment under Part 5 of the *Environmental Planning and Assessment Act 1979* administered by the NSW Government and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) administered by the Australian Government. If approved, and subject to funding, Transport for NSW would proceed with implementation of Cambridge Avenue upgrade project. Environmental impact assessment requires the proponent, Transport for NSW in this case, to carry out various detailed investigations including those identified in the PEI.

## 9 References

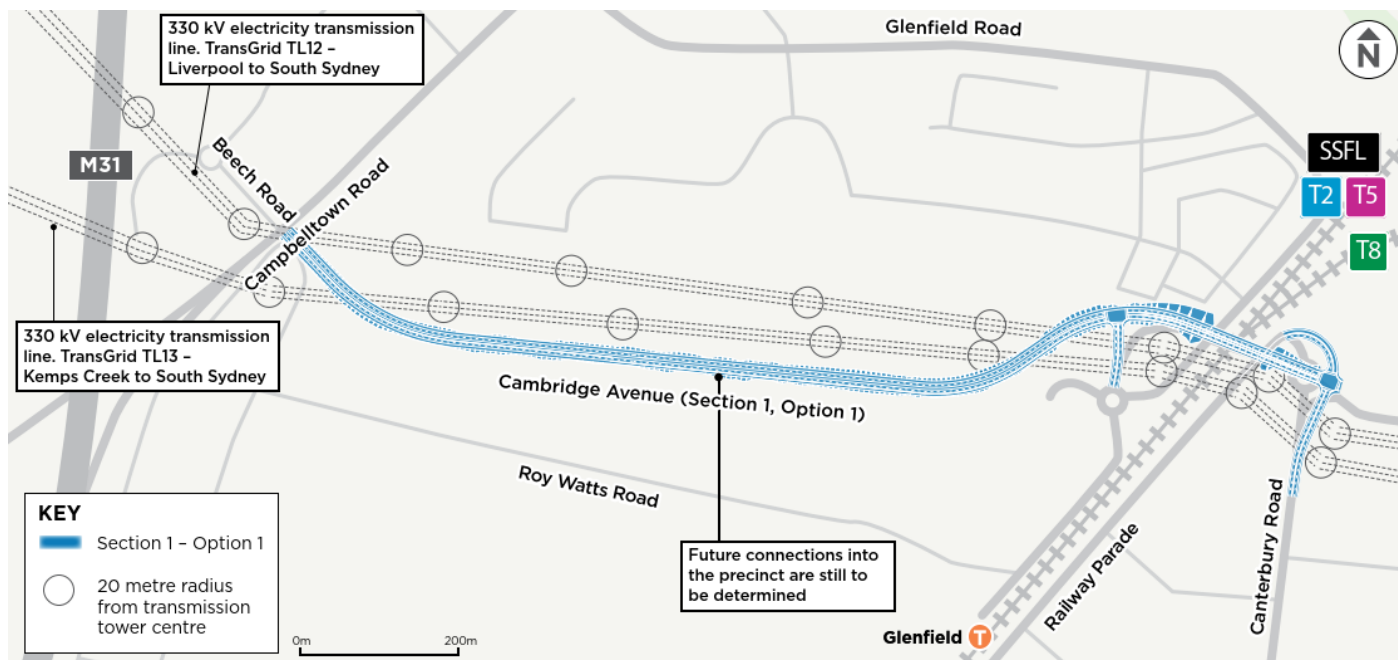
- Greater Macarthur 2040 (2018)
- Glenfield to Macarthur Urban Renewal Corridor Strategy 2015
- The Western Sydney City Deal (March 2018), Australian Government and NSW Government
- Moorebank Intermodal Company website - <http://www.micl.com.au/>
- Moorebank Intermodal Terminal Road Access Strategy (MITRA) Strategy (RMS 2015)
- NSW Freights and Ports Plan 2018-2023 (September 2018), Transport for NSW
- Preliminary Environmental Investigation for Cambridge Avenue Upgrade (June 2015), SLR Consulting Australia Pty Ltd

## **Attachment 1 - Long-list options for Section 1**



# Long-list options for Section 1

## Option 1



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge
- A traffic signal controlled intersection with Glenfield Road about 100 metres west of the bridge
- A traffic signal controlled intersection with Canterbury Road and Railway Parade about 100 metres east of the bridge
- A road alignment that runs generally to the south of the transmission lines crossing beneath them to the west of Glenfield Road and to the east of Campbelltown Road.

### Advantages

- The existing bridge would provide for westbound traffic for a number of years
- Would only have a relatively minor impact on the clearance requirements of TransGrid
- Would avoid high value biodiversity land
- Would retain local road connectivity (Canterbury Road and Glenfield Road).

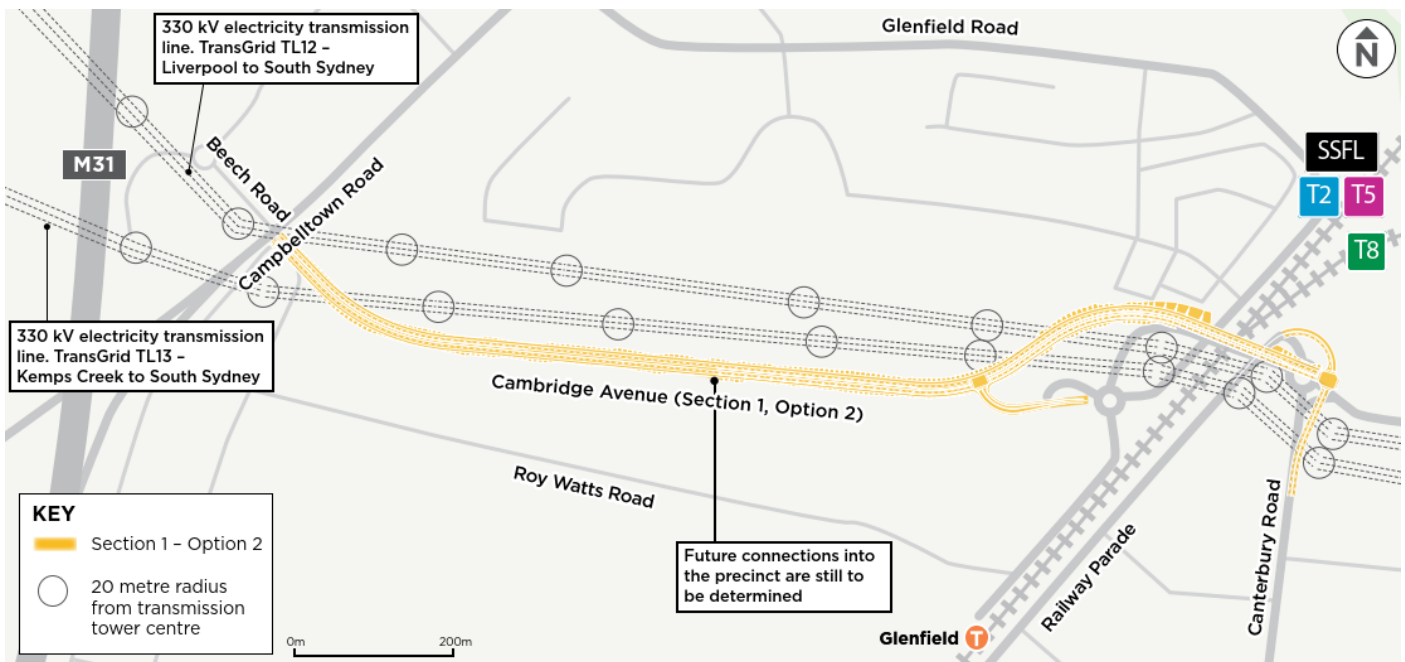
### Disadvantages

- Glenfield Road intersection would be very close to the bridge (Constructability, safety, traffic flow)
- Would require acquisition of 13 residential properties
- Would require transverse drains to manage stormwater run-off
- Would provide only one access road to the Department of Education land to the south.

### Status

The option was discarded, noting that Option 2 shares the same main features and was shortlisted.

## Option 2:



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge
- A traffic signal controlled intersection with Glenfield Road about 400 metres west of the bridge
- A traffic signal controlled intersection with Canterbury Road and Railway Parade about 100 metres east of the bridge
- A road alignment that runs generally to the south of the transmission lines crossing beneath them to the west of Glenfield Road and to the east of Campbelltown Road.

### Advantages

- The existing bridge would provide for westbound traffic for a number of years
- Would only have a relatively minor impact on the clearance requirements of TransGrid
- Would avoid high value biodiversity land
- Would retain local road connectivity (Canterbury Road and Glenfield Road).

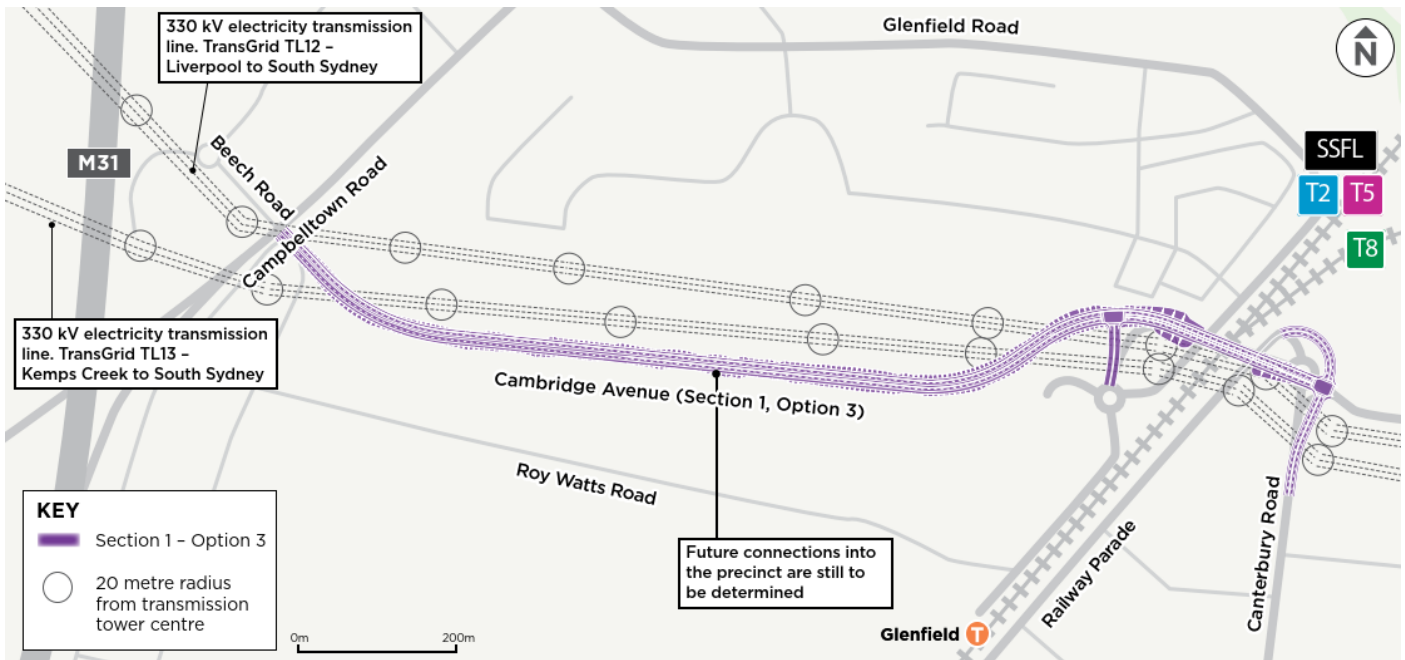
### Disadvantages

- Would require acquisition of 13 residential properties
- Would require transverse drains to manage stormwater run-off
- Would provide limited access road to the Department of Education land to the south.

### Status

The option was short-listed, noting that all options would impact residential property, drainage is manageable and additional access Department of Education land could be negotiated.

### Option 3:



### Distinguishing features:

- A duplicate bridge on the southern side of the existing bridge
- A traffic signal controlled intersection with Glenfield Road about 100 metres west of the bridge
- A traffic signal controlled intersection with Canterbury Road and Railway Parade about 100 metres east of the bridge
- A traffic signal controlled intersection midway along the road would provide access to the Department of Education land to the south
- A road alignment that runs generally to the south of the transmission lines crossing beneath them to the west of Glenfield Road and to the east of Campbelltown Road.

### Advantages

- Relatively minor impact on the clearance requirements of TransGrid
- Would retain local road connectivity (Canterbury Road and Glenfield Road)
- Would avoid high value biodiversity land.

### Disadvantages

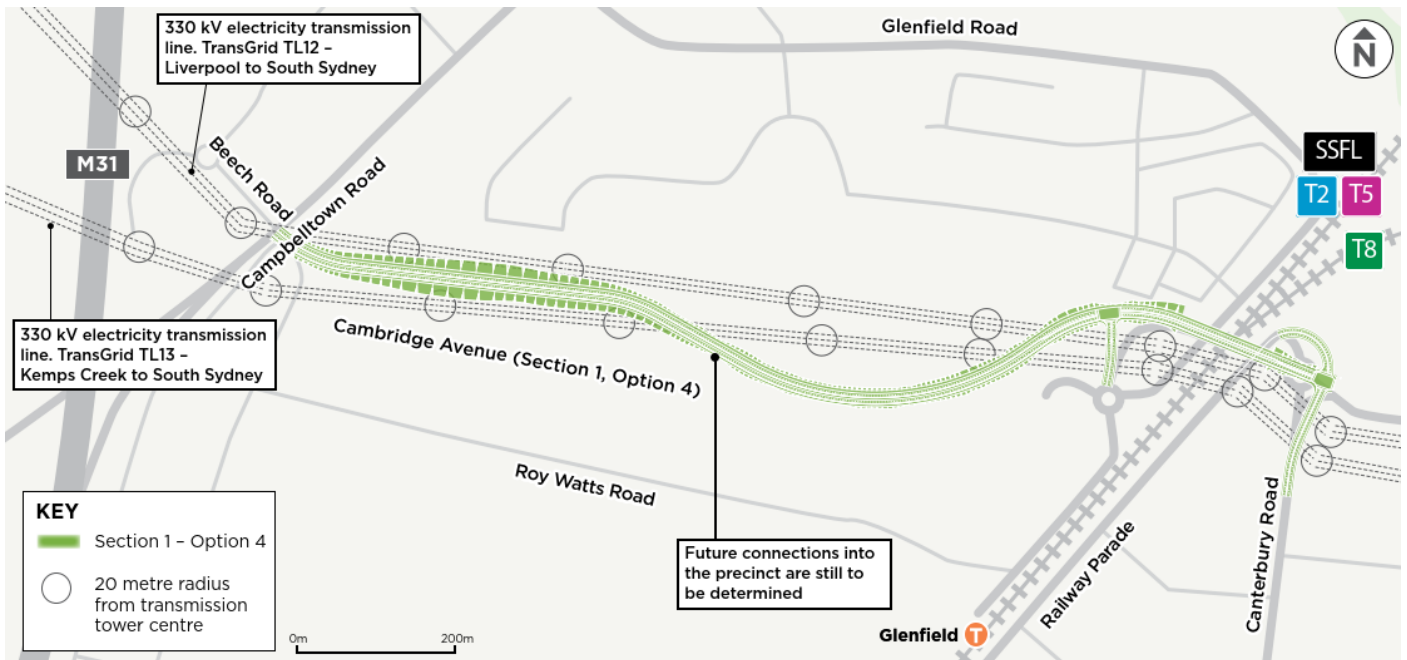
- Would require transmission towers to be relocated
- Would limit yield of developable land (relocation of transmission towers)
- Would require acquisition of 13 residential properties
- Glenfield Road intersection would very close to the bridge (Constructability, safety, traffic flow).
- Would require considerable transverse drains to manage stormwater run-off.

### Status

The option was discarded due to the major impact on transmission towers as well as for the same reasons as Option 1.



### Option 4:



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge
- A traffic signal controlled intersection with Glenfield Road about 100 metres west of the bridge
- A traffic signal controlled intersection with Canterbury Road and Railway Parade about 100 metres east of the bridge
- A road alignment within the TransGrid easement between pylons for about half its length at the western end and a large curve to the south at the eastern end that returns northward, passing back beneath the transmission lines, and connects with the bridge.

### Advantages

- Would avoid high value biodiversity land
- Would retain local road connectivity (Canterbury Road and Glenfield Road).

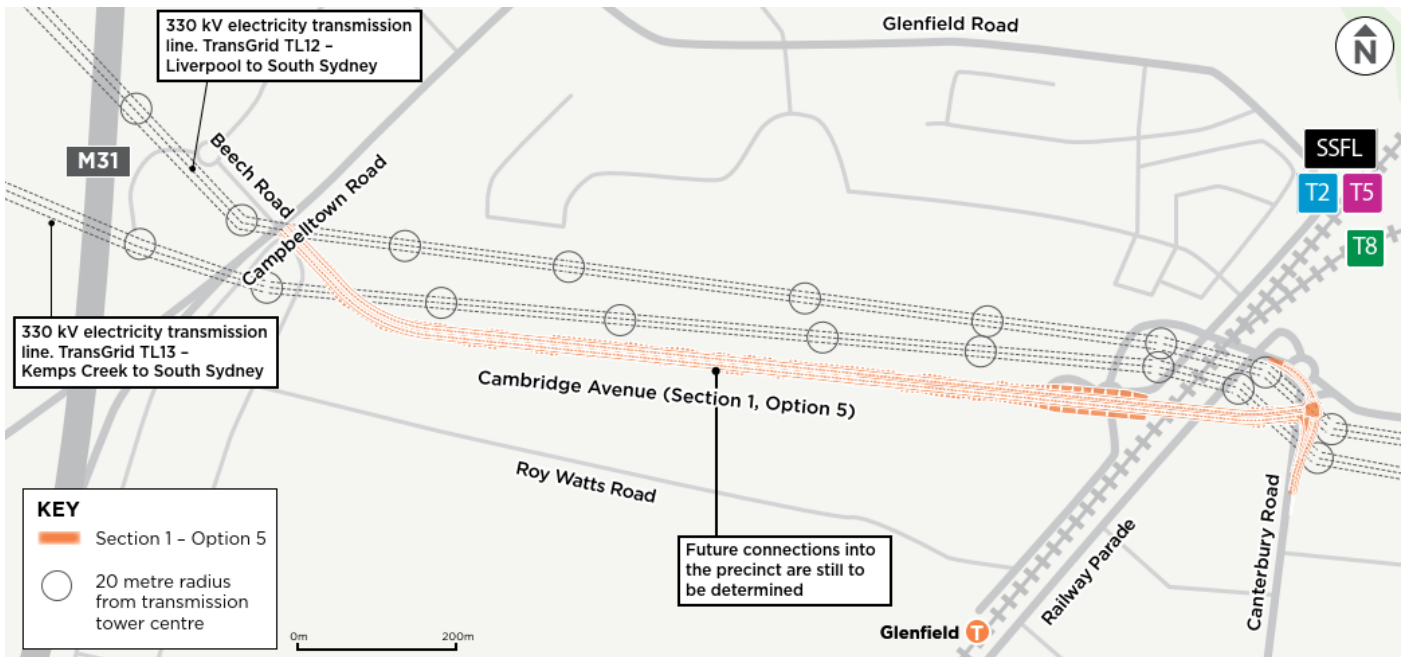
### Disadvantages

- Would require transmission towers to be relocated
- Would limit yield of developable land (relocation of transmission towers)
- Would require acquisition of 13 residential properties
- Glenfield Road intersection would very close to the bridge (Constructability, safety, traffic flow).
- Would require considerable transverse drains to manage stormwater run-off.

### Status

The option was discarded due to the major impact on transmission towers as well as for the same reasons as option 1 and 3.

### Option 5:



### Distinguishing features:

- A four-lane bridge spanning the rail corridor to the south of the existing bridge
- Connection of Glenfield Road to the east of the bridge at a traffic signal controlled intersection that includes a realigned Canterbury Road
- A traffic signal controlled intersection with Canterbury Road about 100 metres east of the bridge
- A road alignment to the south of the TransGrid easement which crosses beneath the transmission lines at the western end to connect to Campbelltown Road
- A traffic signal controlled intersection midway to provide access to the Department of Education land.

### Advantages

- Would avoid construction within the rail corridor
- May not require transmission towers to be relocated
- Would provide a straight alignment for further
- Would maximise distance from established homes in Glenfield.

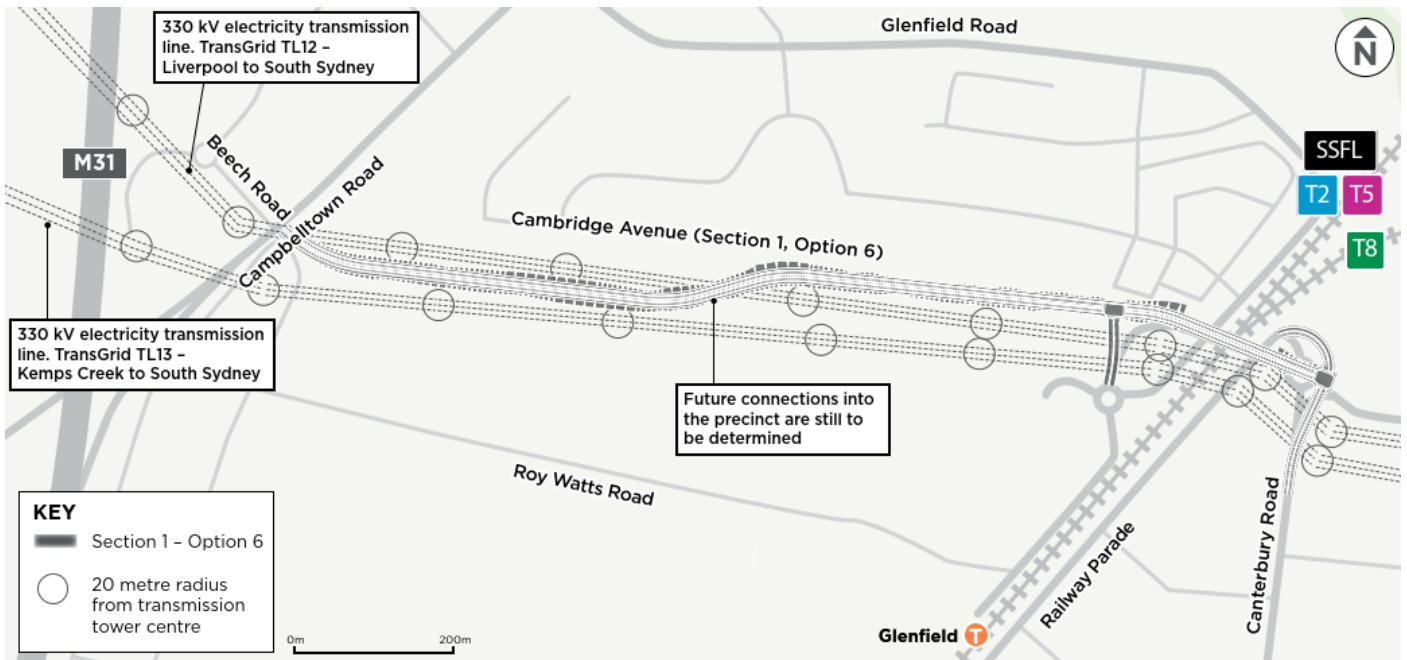
### Disadvantages

- Would not retain local road connectivity (Canterbury Road and Glenfield Road)
- Would require transmission towers to be relocated
- Would require clearing of high value biodiversity land
- Would result in a signalised intersection on the eastern side being directly beneath transmission lines (does not comply with TransGrid requirements)
- Would require acquisition of residential properties (12 units and at least two houses)
- Would require a larger bridge at higher cost

### Status

The option was discarded due to the severance of local access via Railway Parade and the impacts on TransGrid transmission towers.

### Option 6:



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge
- A traffic signal controlled intersection to provide access to Glenfield Road about 100 metres west of the bridge
- A traffic signal controlled intersection with Canterbury Road and Railway Parade about 100 metres east of the bridge
- A road alignment within the TransGrid easement for about half its length at the western end and a pair of small radius curves that takes the carriageways beneath the transmission lines where it runs on the northern side of the TransGrid easement at the eastern end, connecting with the bridge
- A left in/left out intersection about 400 metres from Campbelltown Road would provide access to the Department of Education land to the south.

### Advantages

- Would avoid high value biodiversity land
- Would retain local road connectivity (Canterbury Road and Glenfield Road)
- Would provide sufficient access to the Department of Education land to the south.

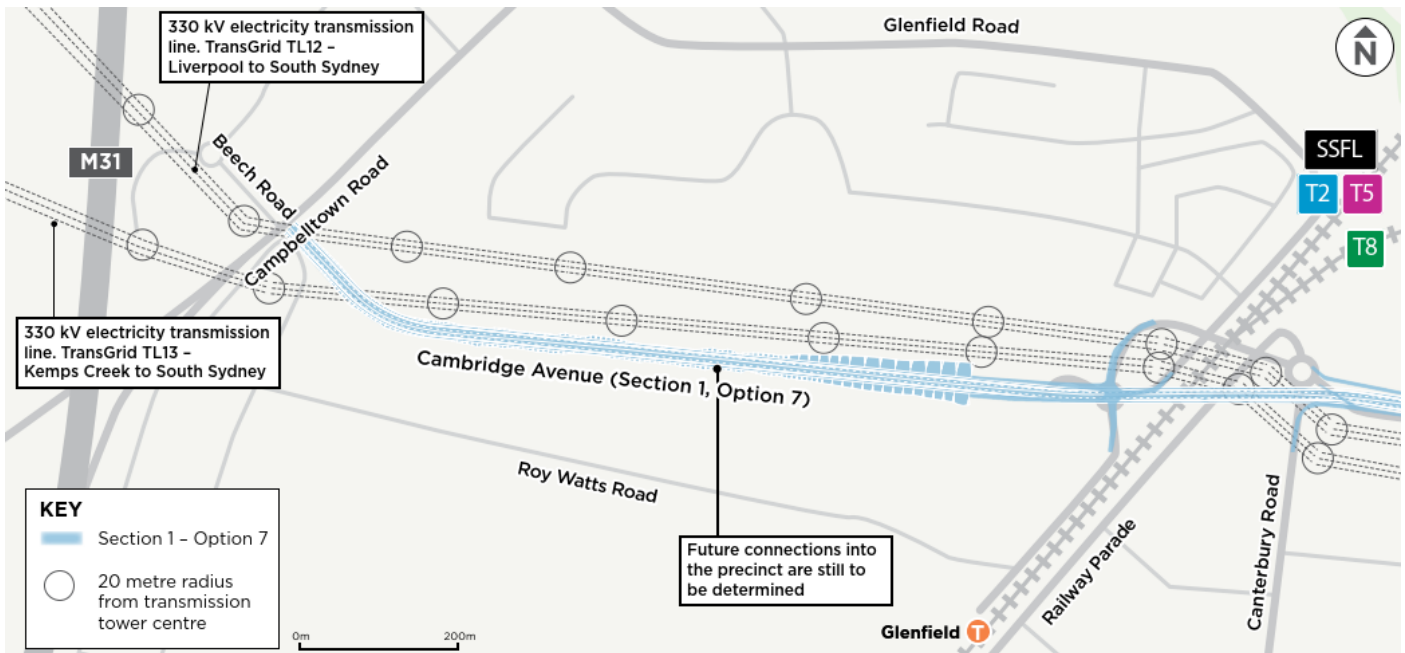
### Disadvantages

- Would require relocation of transmission towers.
- Would limit yield of developable land (relocation of transmission towers)
- Would run close to from established homes in Glenfield
- Would require acquisition of about 13 residential properties
- Glenfield Road intersection would very close to the bridge (Constructability, safety, traffic flow).

### Status

The option was discarded due to the major impact on transmission towers as well as for the same reasons as option 1.

## Option 7:



### Distinguishing features:

- A tunnel beneath the railway corridor
- A road alignment to the south of the TransGrid easement which crosses beneath the transmission lines at the western end to connect to Campbelltown Road
- A traffic signal controlled intersection, off the main carriageway to provide access to Glenfield Road
- Retained access to Railway Parade and Canterbury Road via the existing roundabout
- A left in/left out intersection about 400 metres from Campbelltown Road would provide access to the Department of Education land to the south.

### Advantages

- Fewer signalised intersections along Cambridge Avenue
- Would not require property acquisition on the northern side
- Would retain local road connectivity (Canterbury Road and Glenfield Road)
- Would provide sufficient access to the Department of Education land to the south.

### Disadvantages

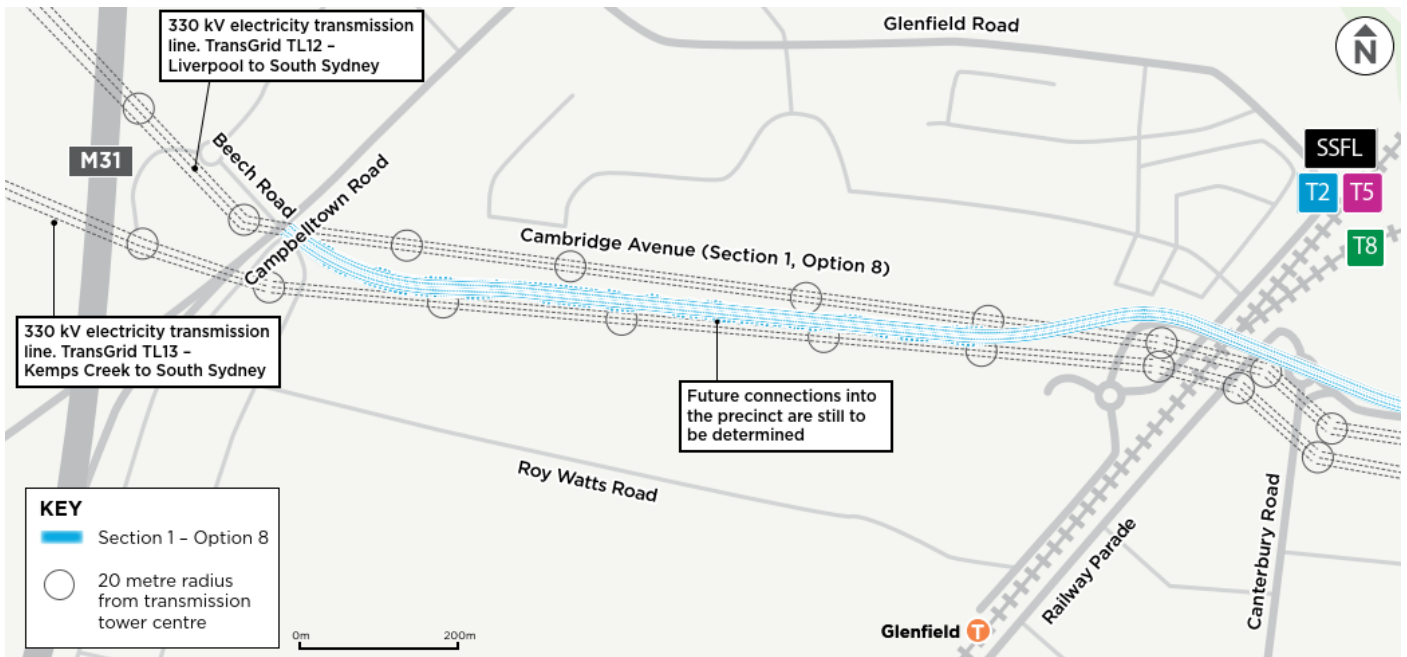
- Would require at least one transmission tower to be relocated
- Ground conditions are poor and the land is flood prone. Tunnel construction and operation would be difficult and high risk
- Maintenance and operational obligations would be very high
- Would require acquisition of 12 residential units on the southern side (for transmission lines)
- Would complicate local road connectivity (Canterbury Road and Glenfield Road)
- Would limit yield of developable land (relocation of transmission towers)
- Would run close to from established homes in Glenfield
- Would require clearing of high value biodiversity land.

### Status

The option was discarded due to the difficulty and risk of construction, the impact on transmission towers as well as for the complexity of traffic connections to local roads.



### Option 8:



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge that spans the rail corridor
- A road alignment within the TransGrid easement between pylons most of its length
- A left in/left out intersection about 400 metres from Campbelltown Road would provide access to the Department of Education land to the south.

### Advantages

- Would avoid high value biodiversity land
- Would maximise yield of developable land (relocation of transmission towers)
- Would have fewer intersections (traffic operations).

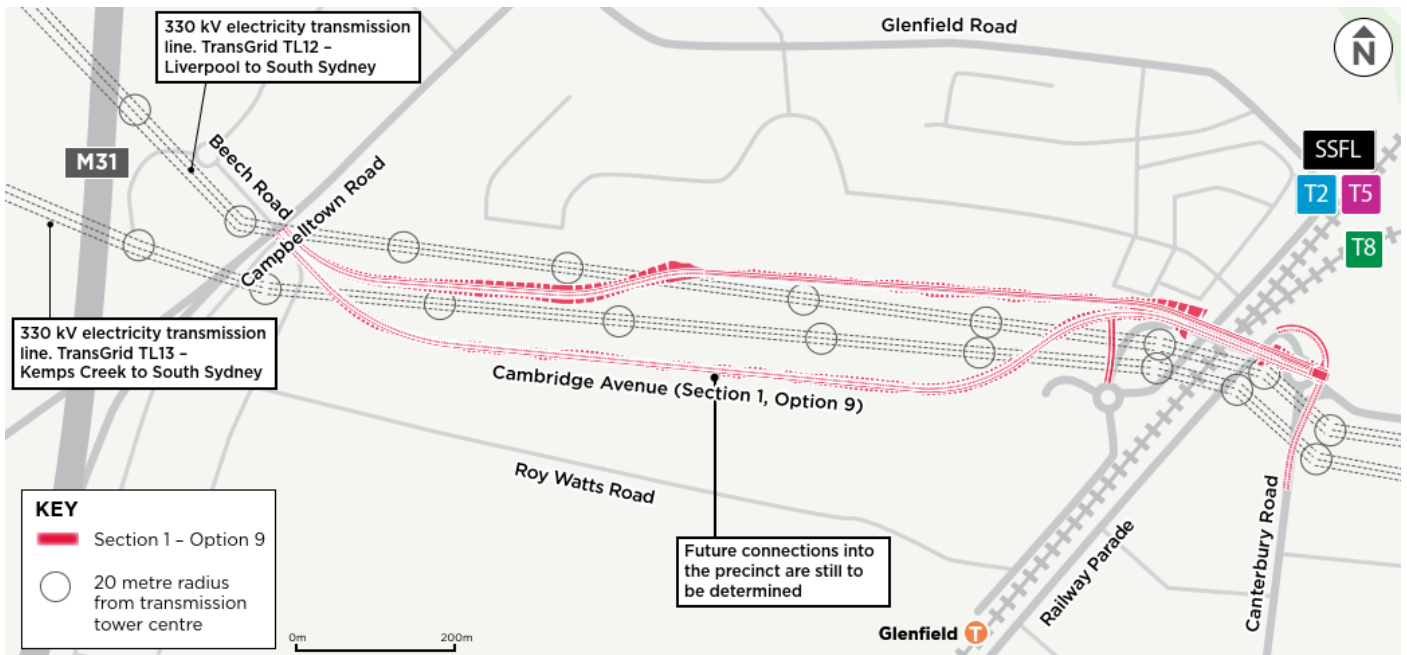
### Disadvantages

- Would require relocation of transmission towers.
- Would not provide access to Glenfield Road, Canterbury Road or Railway Parade from Cambridge Avenue
- Would not provide sufficient access to the Department of Education land to the south
- Would require acquisition of about 13 residential properties.

### Status

The option was discarded due to the major impact on transmission towers as well as the impact on local access.

### Option 9:



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge that spans the rail corridor entirely
- A traffic signal controlled intersection with Glenfield Road about 100 metres west of the bridge
- A separated road alignment. Eastbound lanes within the TransGrid easement for about half its length at the western end and a pair of small radius curves that takes the carriageways beneath the transmission lines where it runs on the northern side of the TransGrid easement at the eastern end, connecting with the bridge. Westbound lanes cross the TransGrid easement at two locations and travel predominantly along the southern side of the easement.
- A traffic signal controlled intersection with Canterbury Road and Railway Parade about 100 metres east of the bridge
- A left in/left out intersection about 800 metres from Campbelltown Road would provide access to the Department of Education land to the south.

### Advantages

- Would avoid construction within the rail corridor
- Would have a lesser impact on TransGrid assets
- Would have fewer intersections (traffic operations).

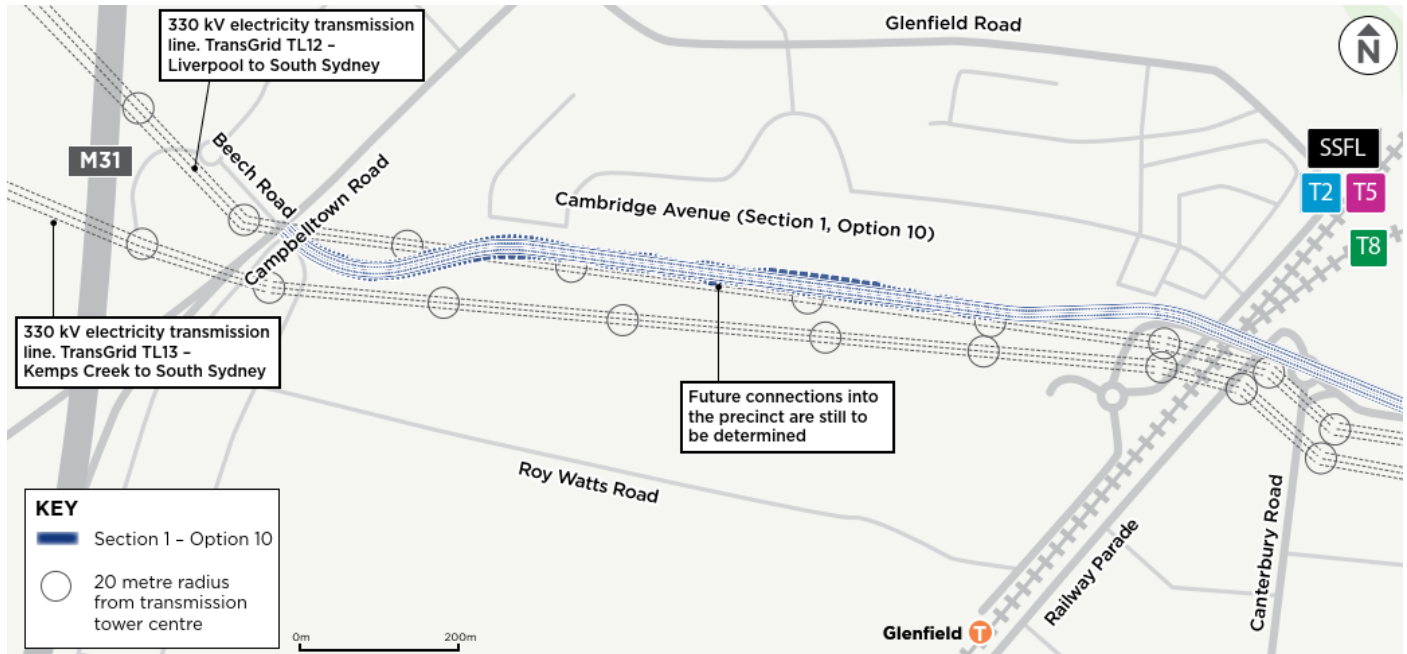
### Disadvantages

- Would impact high value biodiversity land
- Would minimise separation to residential property in Glenfield north of the corridor (noise, visual, amenity)
- Would not provide efficient access to the Department of Education land to the south from the eastbound carriageway
- Would require acquisition of about 13 residential properties
- Would sever local access to Canterbury Road and Railway Parade
- Would have higher capital and maintenance costs
- Would have flooding issues.

## Status

The option was discarded due to the impact on local access, greater cost and does not offer sufficient benefits in comparison to other options.

### Option 10:



### Distinguishing features:

- A duplicate bridge on the northern side of the existing bridge that spans the rail corridor entirely
- A road alignment along the northern side of the corridor with a crossing beneath the transmission lines at the western end at the connection to Campbelltown Road.

### Advantages

- Would avoid construction within the rail corridor
- Would have fewer intersections (traffic operations).

### Disadvantages

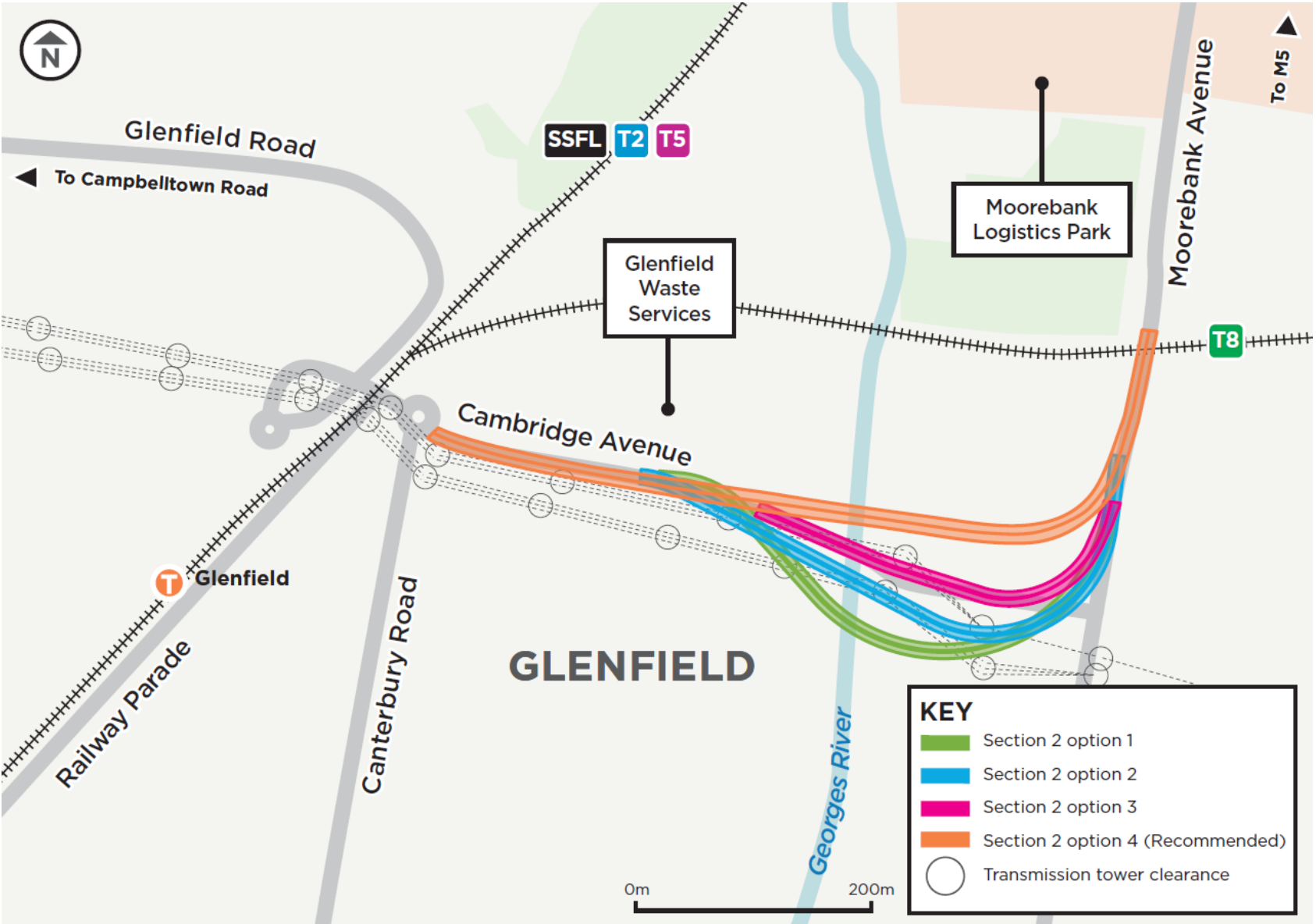
- Would require relocation of transmission towers.
- Would minimise separation to residential property in Glenfield north of the corridor (noise, visual, amenity)
- Would not provide efficient access to the Department of Education land to the south from the eastbound carriageway
- Would require acquisition of about 13 residential properties
- Would impact on high value biodiversity land
- Would sever local access to Glenfield Road, Canterbury Road and Railway Parade
- Would have flooding issues
- Would maximise yield of developable land.

## Status

The option was discarded due to the impact on TransGrid assets, local access and does not offer sufficient benefits in comparison to other options.

## **Attachment 2 – Options for Section 2**







[nswroads.work/cambridgeave](https://nswroads.work/cambridgeave)



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