Transport for NSW

# Chapter 5
# Design development, alternatives and options

NSW GOVERNMENT

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# 5. Design development, alternatives and options

This chapter provides a summary of how the design for the project has developed, including the alternatives and options that have been considered and refined, in the context of the strategic need for the project described in Chapter 3 (Strategic context and need). The proposed approach to the next stages of design development is also described.

## 5.1 Overview of the design development process to date

### 5.1.1 Background

A range of strategies and plans have been prepared over the last 10 years to examine potential transport solutions to cater for current and future population growth in the Central River City and GPOP areas.

The project is the culmination of a process of reviewing and refining strategic transport mode and network alternatives, project corridors and alignment options, which has been informed by community and stakeholder feedback and sustainable design principles. This process is summarised in Figure 5.1 with further information on the key stages of design provided below.

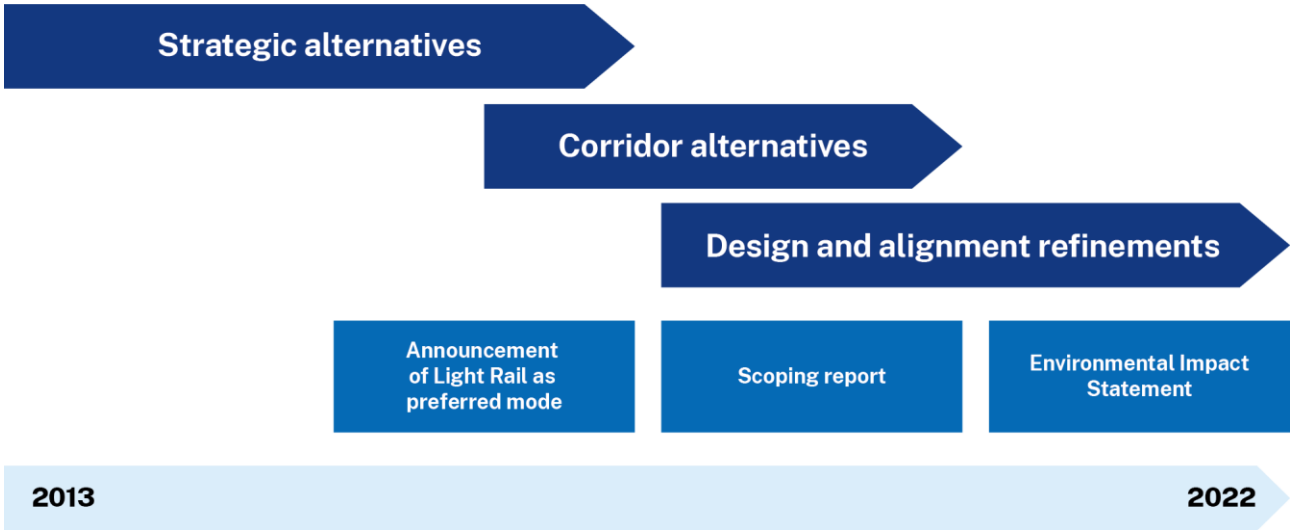


Figure 5.1 Project development process

### 5.1.2 Urban design-led

Following the NSW Government's announcement of the preferred light rail network (see section 5.2.2), a preliminary design was progressed through a multidisciplinary design process. The process commenced with a series of stakeholder 'visioning' workshops, which enabled all key stakeholders to share their aspirations for the GPOP area and the Parramatta Light Rail Stage 2 project. This resulted in the development of urban design principles and a shared vision for the project, which guided the design team in the early design process.

The multidisciplinary design team collaboratively developed a project design, in line with the urban design principles, through a process that included:

- consideration of planning strategies and policies
- collaboration with stakeholders on design concepts for precincts under development
- detailed site analysis, including site inspections and desktop review of site opportunities and constraints
- detailed review of placemaking, customer, and land use outcomes and opportunities
- review of proposed development master plans around the network
- consideration of bridge design and construction methods
- consideration of site constraints, such as environment, heritage, existing utilities, and potential property impacts
- consideration of views and vistas and potential impacts
- development of design solutions to maximise accessibility to the proposed stops via walking and cycling by integrating the project with the precincts through which it passes
- consultation with the Transport for NSW Design Review Panel (described further below).

A key consideration in the process was the need for urban design-led engineering to better drive placemaking, customer, and land use outcomes. As such, the design was developed through a process that included:

- design outcomes that prioritise the placemaking potential of the project
- collaboration with key stakeholders to maximise the benefits of the project
- consideration of environment and heritage opportunities and constraints
- development of an urban design vision and principles informed by consultation with the Transport for NSW Design Review Panel
- embedding the process of Designing with Country throughout design development
- integration of heritage interpretation and public art in design development
- design development that complements current and future development proposals for adjacent sites.

Future design development would continue to follow urban design led and Designing with Country processes, as outlined in section 5.6.

### Design Review Panel

Design review to date has been under the guidance of Transport for NSW's Design Review Panel (the Design Review Panel). The purpose of the Design Review Panel is to provide independent expert design review and advice on projects to Transport for NSW in accordance with industry best practice. The Design Review Panel aims to achieve well-designed projects that meet the needs of customers and communities and deliver high quality place outcomes.

The Transport for NSW Design Review Panel is chaired by the Director of Design Excellence from the office of the NSW Government Architect.

Sessions have been held with the Design Review Panel throughout the development of the design. Recommendations for improvements and endorsement of quality design outcomes have been considered in the alternatives and options evaluation process.

During future design development a project-specific Design Review Panel would be established to provide further advice and recommendations as the design progresses, as outlined in section 5.6.

## 5.2 Strategic alternatives

### 5.2.1 Mode alternatives

Following identification of the need for a new transport option for GPOP (see Chapter 3 (Strategic context and need)), a mode comparison was undertaken. The mode comparison considered the potential for different transport modes to meet the objectives of strategic transport and land use planning, provide a city-serving function, and complement Sydney Metro West. The following alternatives were considered:

- cars (including ride share and taxis)
- walking
- cycling
- buses in shared streets
- buses in bus lanes
- dedicated busway (bus rapid transit)
- light rail
- suburban trains
- metro trains
- ferry
- cable cars
- personal rapid transit
- monorail.

Buses and light rail were selected as the most feasible and were shortlisted for detailed assessment against a range of criteria. Light rail was preferred to support the NSW Government's vision for GPOP as a sustainable public transport mode that can support liveable communities.

### 5.2.2 Alternative light rail networks

Once light rail was identified as the preferred transport mode, alternatives for a light rail network were considered.

In June 2014, the NSW Government announced that it would investigate a longlist of potential light rail networks connecting to Parramatta. Of the 13 alternative networks identified by Transport for NSW, four networks were shortlisted for further investigation. In December 2015, the NSW Government announced the preferred network for Parramatta Light Rail, which included:

- Westmead to Carlingford via Parramatta, reusing the Sydney Trains T6 Carlingford Line
- Parramatta to Strathfield via Sydney Olympic Park.

The process followed to identify the preferred network is summarised in Figure 5.2.


Source: Transport for NSW, 2016

Figure 5.2 Process used to select the preferred light rail network

Further information on the development of the preferred network for Parramatta Light Rail is provided in *Parramatta Light Rail - How the preferred network was determined* (Transport for NSW, 2016) (available at: Parramatta Light Rail Options Report).

In February 2017, the NSW Government announced that Parramatta Light Rail would be delivered in stages, with Stage 1 connecting Westmead to Carlingford via Parramatta, and Stage 2 connecting the Parramatta CBD to Strathfield via Sydney Olympic Park (see Figure 5.3).

The construction and operation of Stage 1 was approved by the NSW Minister for Planning in May 2018. Construction is underway and Stage 1 is expected to start operating in 2024.

The general location of Stage 2 of Parramatta Light Rail network, connecting Camellia to Sydney Olympic Park, was identified in the EIS for Parramatta Light Rail Stage 1 (Transport for NSW, 2017). The preferred network connected Camellia and Sydney Olympic Park via Silverwater (see Figure 5.3). However, further analysis identified some challenges with this network, including:

- limited urban renewal opportunities between Camellia and Sydney Olympic Park along the network
- significant engineering challenges, including space restrictions, steep grades, property and utility impacts, and complex structures, particularly around Strathfield
- future integration with Sydney Metro West (see section 3.1.3), the route for which would largely duplicate the preferred network.

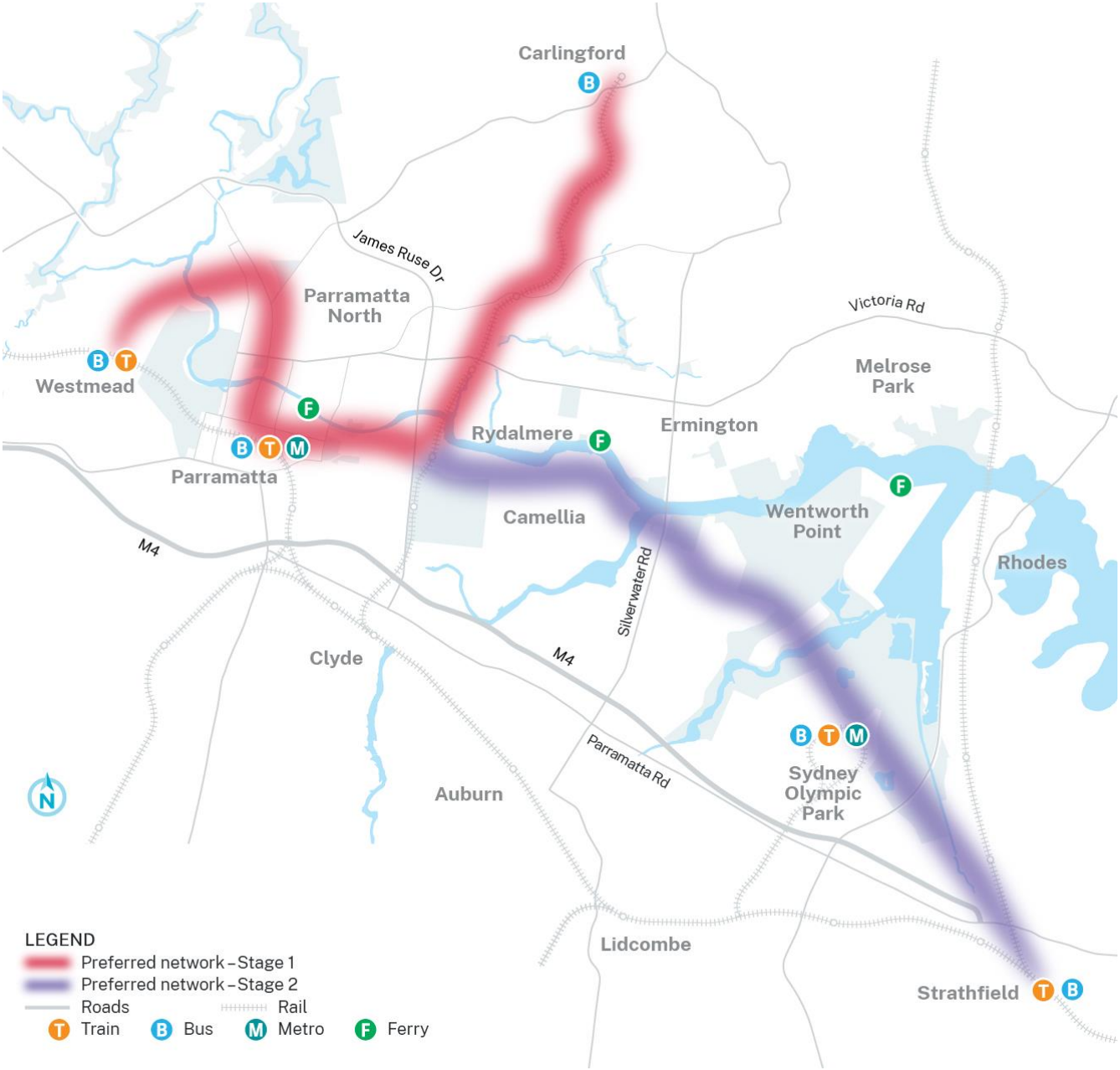


Figure 5.3 Preferred network for Stage 1 and Stage 2 of Parramatta Light Rail

## 5.3 Corridor alternatives

Given the challenges identified with the preferred Stage 2 network a two-phase assessment of corridor options was undertaken, with options scrutinised in greater detail as they advanced through each phase. The process sought to filter out lower performing options that did not meet the project objectives (see section 1.3) or address the strategic need (see Chapter 3 (Strategic context and need)).

The phases focused on refining the corridor to develop a project alignment, taking into consideration:

- current and future population growth and transport demand
- opportunities to service planned urban developments and land use change in GPOP
- existing and future traffic conditions and transport movements.

These phases are described in the following sections.

### 5.3.1 Phase 1 corridor assessment

Nineteen possible corridors were developed based on the NSW Government's priority to integrate the project with the planned Sydney Metro West, feedback from stakeholder consultation, the adequacy of current public transport supply, and the travel patterns of residents in the area surrounding the preferred Stage 2 network.

Key outcomes of stakeholder consultation highlighted the following:

- the need to explore options north of the Parramatta River through Rydalmere and Ermington
- the need for improved connections to key residential growth areas in Melrose Park and Wentworth Point
- engineering constraints associated with a corridor to Strathfield
- support for light rail connecting with Sydney Olympic Park.

Possible corridors focused on two geographical areas shown in Figure 5.4:

- Options between Camellia and Sydney Olympic Park – seven options north and south of the Parramatta River were identified.
- Options beyond Sydney Olympic Park – 12 options were identified to cater for forecast demand beyond Sydney Olympic Park and connections to Strathfield.

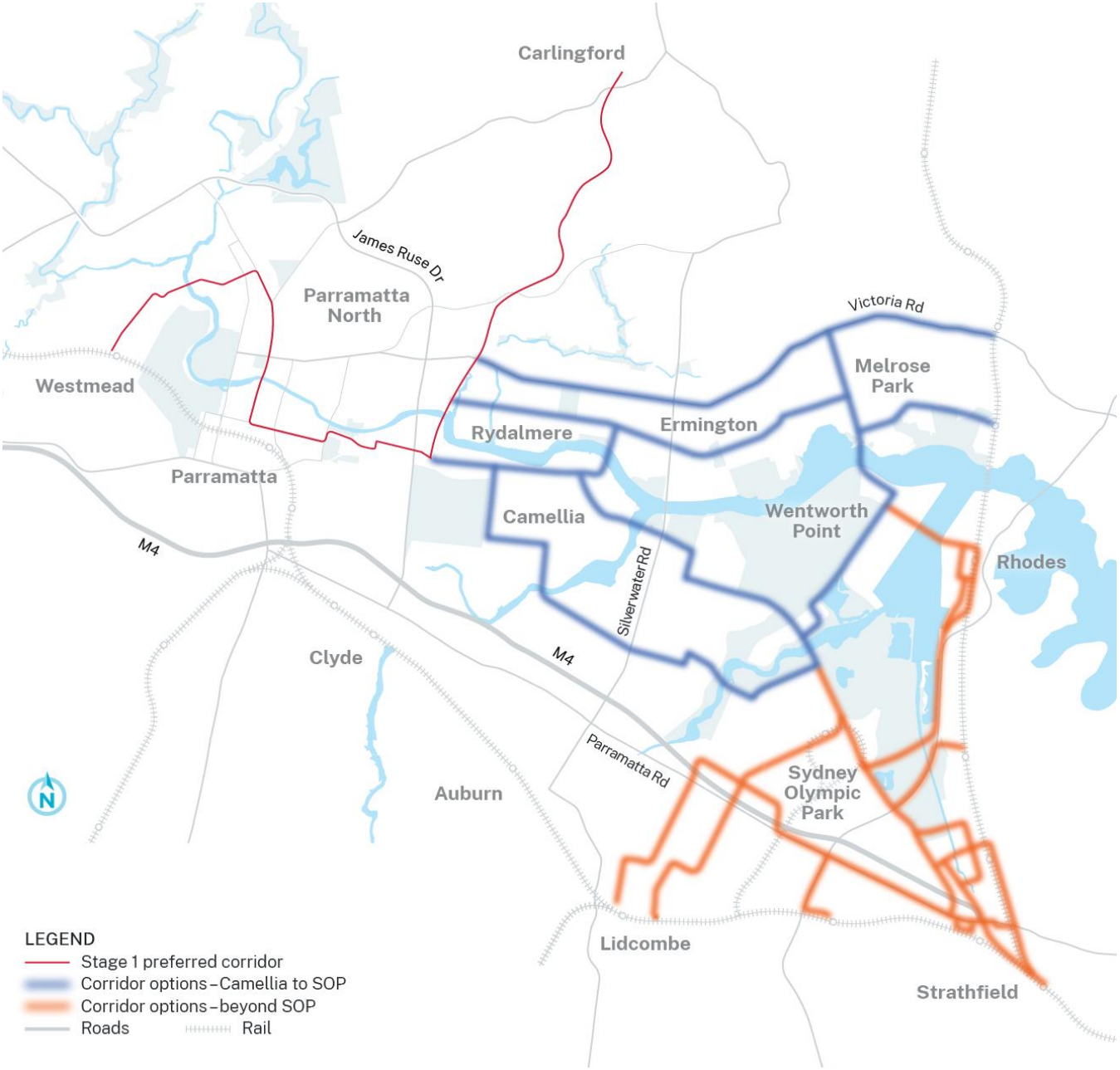


Figure 5.4 Phase 1 corridor options

An initial assessment of all potential corridor options against the project objectives (see section 1.3) resulted in the exclusion of 12 corridors. These corridors were not progressed as they had:

- unacceptable construction and traffic management challenges on major roads (such as Victoria Road)
- significant engineering complexities and costs associated with steep grades, space restrictions and complex structures
- poorer connection to Sydney Olympic Park
- duplicated existing bus or rail services
- unacceptable property impacts
- provided limited opportunity for growth or new residential development catchments.

### 5.3.2 Phase 2 corridor assessment

Seven corridor options were considered in the Phase 2 options evaluation as shown in Figure 5.5.

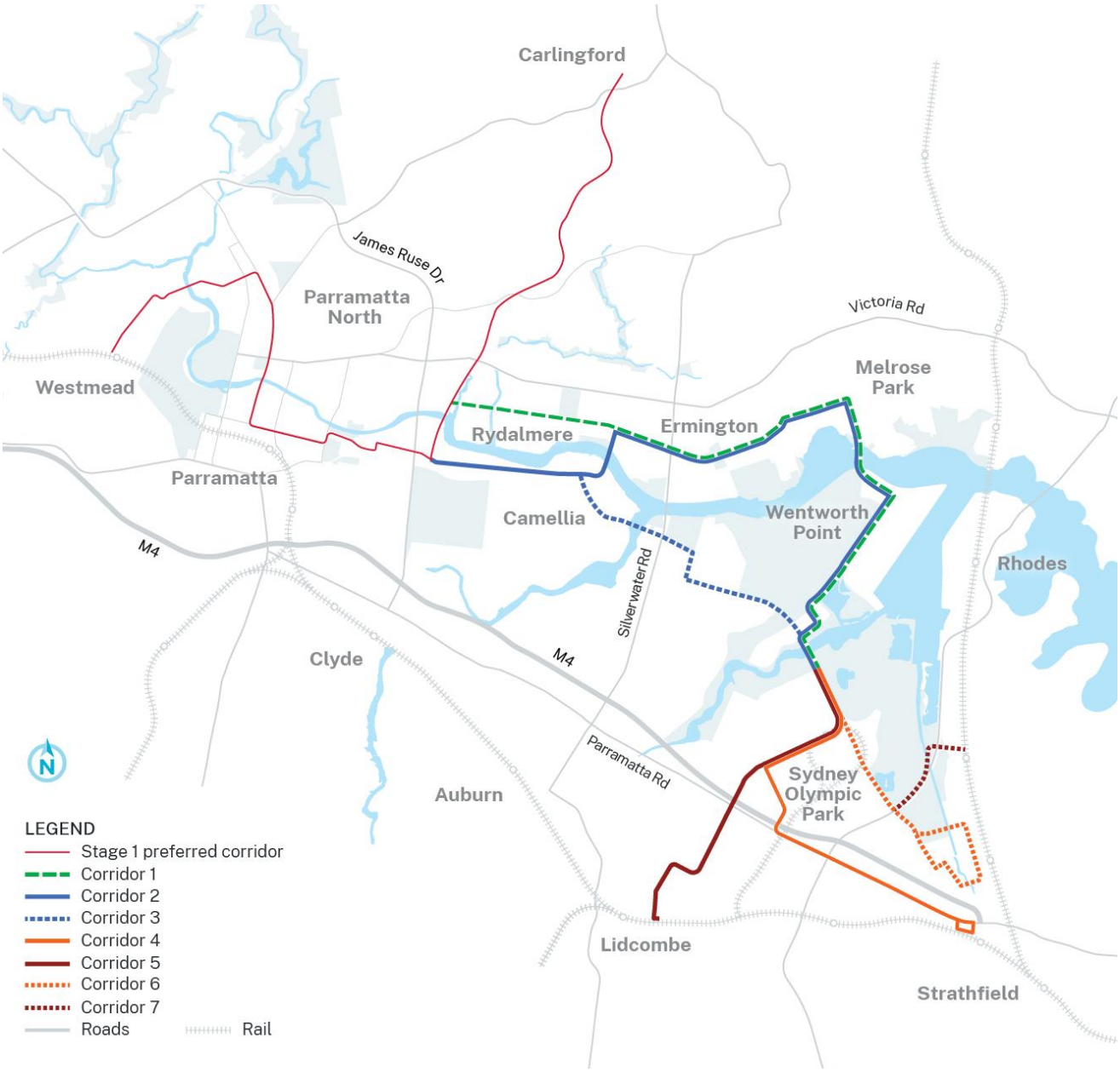


Figure 5.5 Shortlisted phase 2 corridor options

A set of project-specific criteria were developed based on the project objectives to assess the project corridors in Phase 2:

- alignment with government priorities
- city building and placemaking
- transport outcomes
- deliverability and risk, including environmental constraints
- affordability
- stakeholder and community support
- economic appraisal.

Scores for each criteria were determined using a range of inputs, including traffic, land use and transport modelling; potential impacts on utilities based on existing data and reports; the presence of biodiversity and heritage constraints; economic forecasting; and stakeholder feedback.

The Phase 2 corridors can also be grouped into two geographic areas, described further below.

### Corridors between Camellia and Sydney Olympic Park

Three corridors were evaluated between Camellia and Sydney Olympic Park (see Figure 5.5):

- Corridor 1 – commenced in Rydalmere and continued to Ermington on the northern side of the Parramatta River
- Corridor 2 – commenced in Camellia, crossed to the northern side of the Parramatta River at Rydalmere and then to Ermington
- Corridor 3 – commenced in Camellia and remained on the southern side of the Parramatta River.

Analysis of the corridors against the project-specific criteria concluded that both Ermington corridors (Corridors 1 and 2) should be shortlisted for further analysis. Both corridors were considered to offer superior support for urban growth outcomes, catering to existing and future planned development, and supporting placemaking opportunities.

The Camellia corridor (Corridor 3) was the most cost-effective; however, it would likely attract the lowest customer demand as the corridor is similar to that of the planned Sydney Metro West and it would provide limited opportunity to support development due to industrial land use constraints in Silverwater.

### Corridors beyond Sydney Olympic Park

Four potential corridors were assessed that extended beyond Sydney Olympic Park (see Figure 5.5). The corridors considered would have extended the line to Homebush (Corridor 4), Lidcombe (Corridor 5), North Strathfield (Corridor 6) or Concord West (Corridor 7).

A key development during the corridor assessment process was confirmation by the NSW Government of the preferred route for Sydney Metro West, which will connect Greater Parramatta and the Sydney CBD (see section 3.1.3).

Corridors 4, 5, 6, and 7 all showed some benefits but also presented substantial technical and property acquisition challenges. Analysis showed that the introduction of Sydney Metro West would result in substantial changes to travel behaviour and movement patterns in these areas, with travel demand for the Concord West and North Strathfield options reduced by potentially up to 50 per cent.

The Lidcombe corridor would potentially attract the highest demand overall but required significant property acquisition south of the M4 Western Motorway. Therefore, a shortened Lidcombe corridor (Corridor 5) was identified as the preferred corridor option to maximise the benefits of the project by connecting Sydney Olympic Park and the Carter Street precinct. This corridor also had relatively low costs, enhanced the catchment of the proposed Sydney Metro West station at Sydney Olympic Park, and had community support, as described in the *Carter Street Precinct Development Framework* (Department of Planning, Industry and Environment, 2020).

### 5.3.3 Project corridor

#### Melrose Park options

In October 2017, the NSW Government announced a corridor for Parramatta Light Rail Stage 2 that provided an alignment along Hope Street then south onto Wharf Road. Following this announcement Transport for NSW sought feedback on the proposed corridor. Residents and stakeholders in Melrose Park provided feedback on the original corridor along Wharf Road (see Figure 5.6). Issues raised included safety of students at the primary school on Wharf Road as well as the traffic congestion that occurs in peak periods along this road. In response to this feedback, in July 2018 the NSW Government proposed a corridor along Waratah Street.

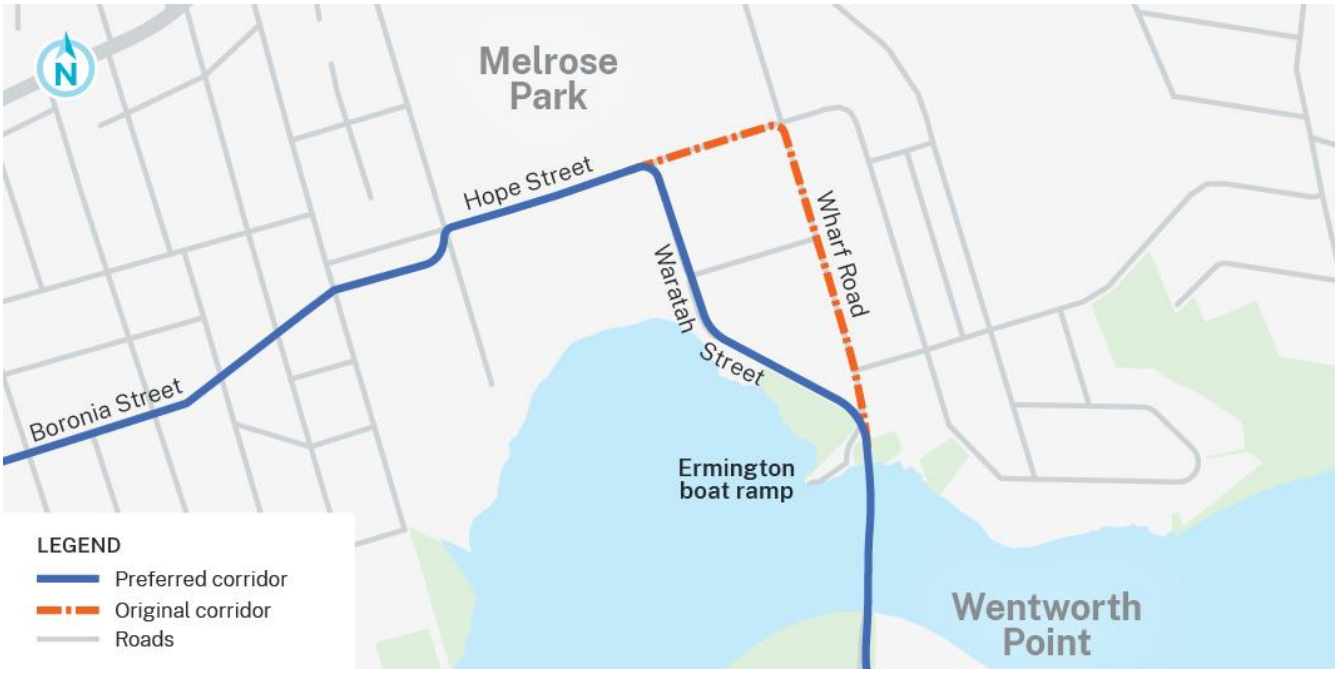


Figure 5.6 Waratah Street and Wharf Road corridor options

#### Scoping Report options

The Scoping Report for the EIS (Transport for NSW, 2019d) confirmed that the Waratah Street corridor was preferred. The document identified two corridor options at Rydalmere (Option 1) and Camellia (Option 2), and a further two options at Wentworth Point (Option 3 and Option 4) as shown in Figure 5.7.

Following submission of the Scoping Report, further analysis of the Rydalmere (Option 1) and Camellia (Option 2) corridors and the Wentworth Point (Options 3 and 4) corridors was undertaken as outlined below.

##### Camellia and Rydalmere options

Analysis of the Camellia and Rydalmere options (Option 1 and Option 2 in Figure 5.7) focused on land use outcomes, constructability, affordability and connectivity. The Camellia corridor (Option 1) was selected as preferred, as it would provide better placemaking and city-serving outcomes, including:

- meeting the public transport demands of the future community of the Camellia-Rosehill precinct and the development of the Camellia town centre (as proposed by the *Draft Camellia Town Centre Master Plan* (Department of Planning and Environment, 2018)
- connecting with Parramatta Light Rail Stage 1 within Camellia.

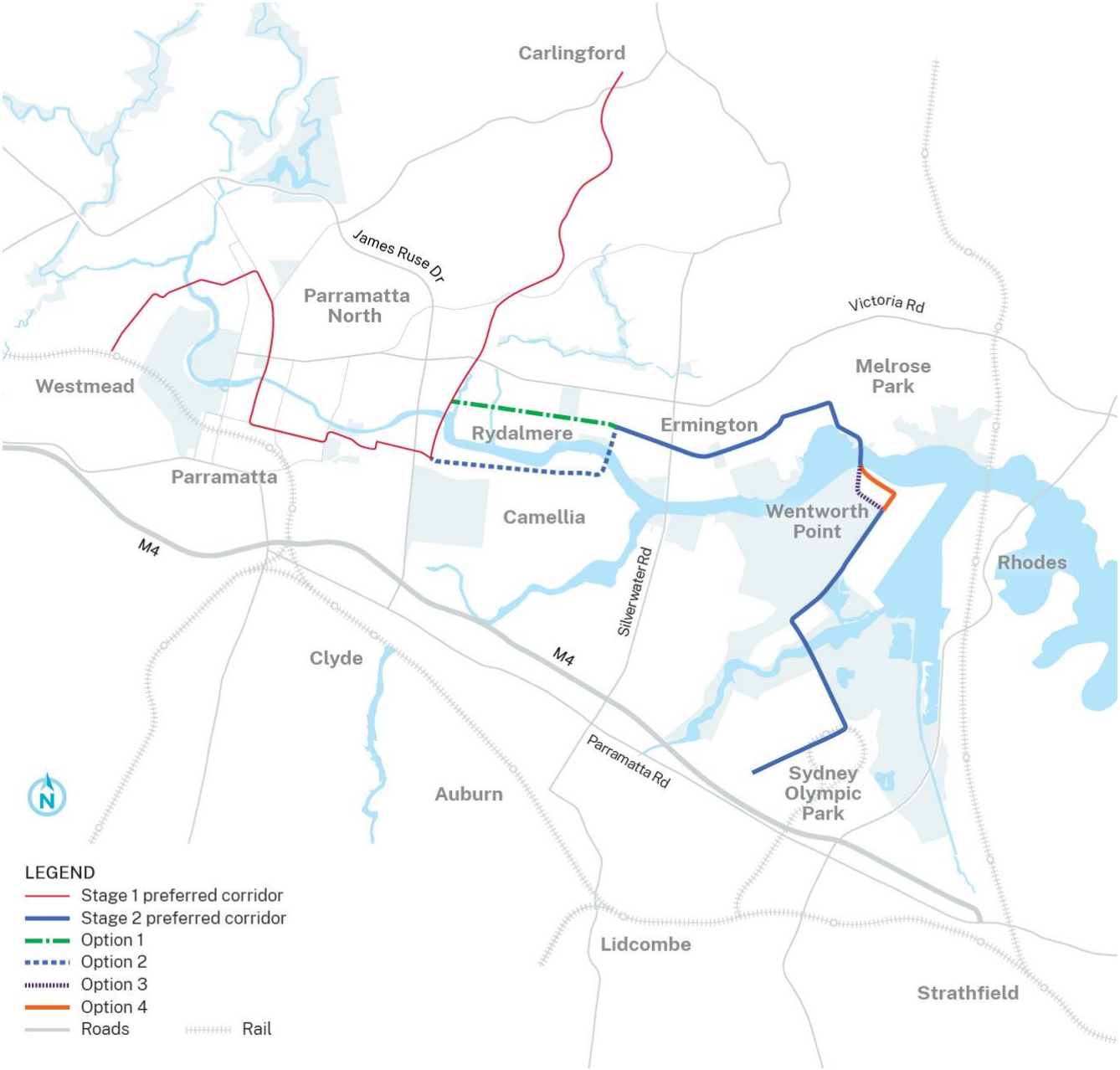


Figure 5.7 Project corridor and options identified in Scoping Report

The Rydalmere option (Option 2) did not offer the advantages of integration with areas proposed for future urban development and population growth. This option also had higher costs, potential property impacts, and construction constraints associated with narrow sections of South Street and the presence of complex utilities.

### Wentworth Point options

Substantial development is ongoing and planned for Wentworth Point, including a new public primary school and planned high school to the east of Hill Road, and Sanctuary Wentworth Point, a mixed residential, commercial and retail development to the west of Hill Road.

Two corridor options at Wentworth Point were considered. After crossing the bridge from Melrose Park to Wentworth Point, Option 3 would extend around the western and southern perimeter of the Sanctuary Wentworth Point development, whereas Option 4 would extend east along Foreshore Boulevard through the development (see Figure 5.8 ). Both options would turn onto Hill Road and extend south.


Figure 5.8 Wentworth Point options

Operational, safety and design assessments of the options at Wentworth Point identified several issues with Option 4, including the following:

- The steep grade from Melrose Park to Wentworth Point over the proposed bridge, followed by the tight curve onto Foreshore Boulevard, would require the installation of infrastructure such as barriers and fences in the public domain to mitigate the risk of derailment. This would create a barrier for pedestrians accessing the river foreshore and moving around the area.
- There would be greater amenity and access impacts on the river foreshore and River Walk.
- A complex traffic system would be required for combined bus, traffic, pedestrian and light rail operations along Foreshore Boulevard and Hill Road to provide a safe environment for all transport modes.
- The tight curve of the track turning from Foreshore Boulevard onto Hill Road would increase the potential for wheel squeal adjacent to open space and the proposed Sanctuary Wentworth Point buildings, including residences.
- The light rail track would be close to (within two metres of) proposed Sanctuary Wentworth Point buildings resulting in poorer safety and amenity outcomes.
- The alignment would require the relocation or protection of utilities on Hill Road, increasing cost and construction complexity.

Option 3 (see Figure 5.8) was identified as the preferred corridor at this location as it would:

- provide a gentler grade from Melrose Park to Wentworth Point over the bridge and a wider curve, which would avoid the need for barriers and fences in the public domain
- improve amenity and enhance placemaking benefits along Foreshore Boulevard
- minimise direct and indirect impacts to the river foreshore, including the River Walk
- improve pedestrian access and overall connectivity to the river foreshore
- avoid the need for adjustments to utilities that have been recently installed.

Compared to Option 4, Option 3 would result in potentially greater biodiversity impacts due to its location partially within the Millennium Parklands. These impacts have been considered in the EIS (see Chapter 16 (Biodiversity)) and mitigation measures have been proposed to manage the impacts. Option 3 would provide a light rail stop at Hill Road near Foreshore Boulevard (about a four-minute walk to Sydney Olympic Park Wharf), which would be further than the stop proposed as part of Option 4. Modelling has indicated the interchange between the wharf and light rail is not anticipated to have large customer volumes.

### Project corridor

Following analysis of the Camellia, Rydalmere and Wentworth Point options, the Camellia option (Option 1) and Wentworth Point Option 3 were preferred. The project corridor is shown in Figure 5.9.

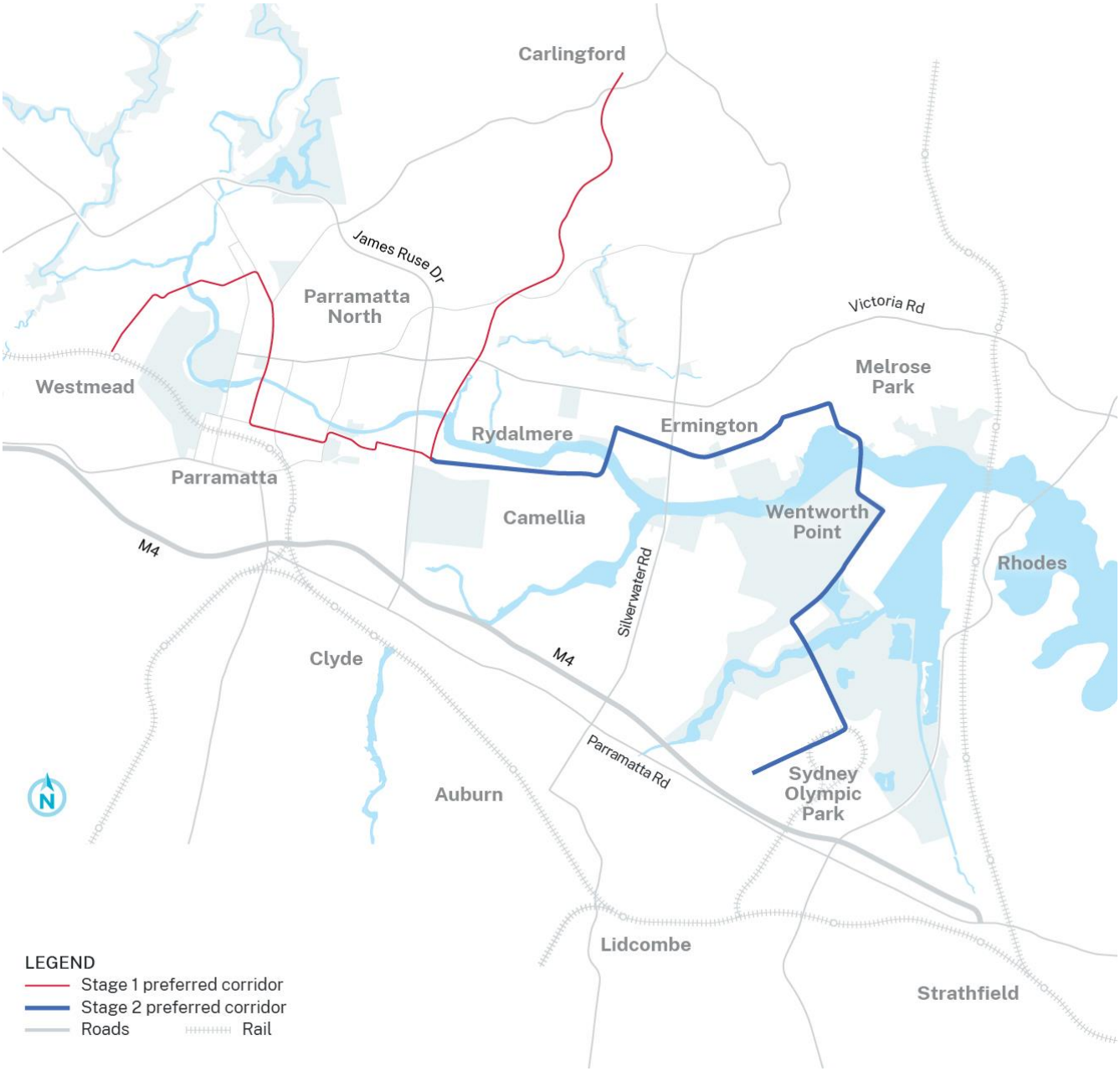


Figure 5.9 Project corridor

## 5.4 Design and alignment refinements

Following selection of the project corridor, a process of precinct-focused refinement of the alignment was undertaken. These alignment and associated design refinements, which focused on the Parramatta CBD, Camellia, Rydalmere, Ermington and Melrose Park precincts, are described in the following sections. No key alignment or design refinements in Wentworth Point, Sydney Olympic Park or the Carter Street precinct were undertaken beyond those already described in this chapter.

### 5.4.1 Parramatta CBD

The project would operate on about three kilometres of track delivered as part of Parramatta Light Rail Stage 1 between Parramatta Square in the Parramatta CBD and Camellia. Parramatta Square stop was selected as the terminus location for the project to integrate with other transport services and provide access to the Parramatta CBD.

To facilitate operation of light rail services, a turnback facility is required to enable light rail vehicles to switch tracks and run in the opposite direction. Six options for the turnback facility location (as shown in Figure 5.10) were considered:

- Macquarie Street turnback (Turnback option 1) (preferred)
- Market Street turnback adjacent to Prince Alfred Square (Turnback option 2)
- Church Street turnback adjacent to Prince Alfred Square (Turnback option 3)
- Church Street turnback adjacent to Factory Street (Turnback option 4)
- Fennell Street Loop (Turnback option 5)
- Westmead turnback (Turnback option 6).

Considerations for the turnback facility locations included:

- potential environmental impacts, including heritage impacts
- integration with the Parramatta Light Rail Stage 1 infrastructure and operations
- amenity outcomes and integration with surrounding land uses in the Parramatta CBD
- service efficiency, including light rail vehicle travel time and the number of light rail vehicles required in the fleet to run at the required frequency.

Following detailed analysis, the Macquarie Street turnback (Turnback option 1) was selected as the preferred solution utilising the existing Parramatta Square stop as the terminus for vehicle operations, with a new turnback facility to the west on Macquarie Street between Church and Marsden streets. With the shortest travel time for light rail vehicles between the Parramatta CBD and Sydney Olympic Park, this option would provide the best service efficiency and would need the fewest light rail vehicles to run the service.

Further benefits of Turnback option 1 include fewer potential impacts on the operation of Parramatta Light Rail Stage 1 compared to other options, and the amenity benefits of avoiding additional light rail movements through Eat Street, which was made a shared light rail and pedestrian zone as part of Parramatta Light Rail Stage 1. This option would also avoid additional impacts around the heritage listed Prince Alfred Square associated with Turnback options 2 and 3.


Figure 5.10 Parramatta CBD turnback facility options

### 5.4.2 Camellia

#### Alignment options

The Camellia precinct is an industrial area targeted as an urban growth area in the *Draft Camellia Town Centre Master Plan* (Department of Planning and Environment, 2018) and the recently released *Draft Camellia–Rosehill Place Strategy* (DPIE, 2021c). Three alignment options through Camellia were assessed considering these future plans for the Camellia precinct (see Figure 5.11):

- Camellia option 1 (preferred) – this option would extend east along the Sandown Line corridor and Grand Avenue in Camellia, and north across the Parramatta River to Rydalmere.
- Camellia option 2 – this option would extend east along the Sandown Line corridor (along the Parramatta River foreshore) and then east along the river foreshore, before crossing the Parramatta River to Rydalmere slightly west of the proposed option 1 crossing.
- Camellia option 3 (the Camellia foreshore to Rydalmere option) – this option would extend east along the Sandown Line corridor along the river foreshore before extending north across the Parramatta River to Rydalmere (west of the proposed option 1 and 2 crossings) and east through Eric Primrose Reserve.

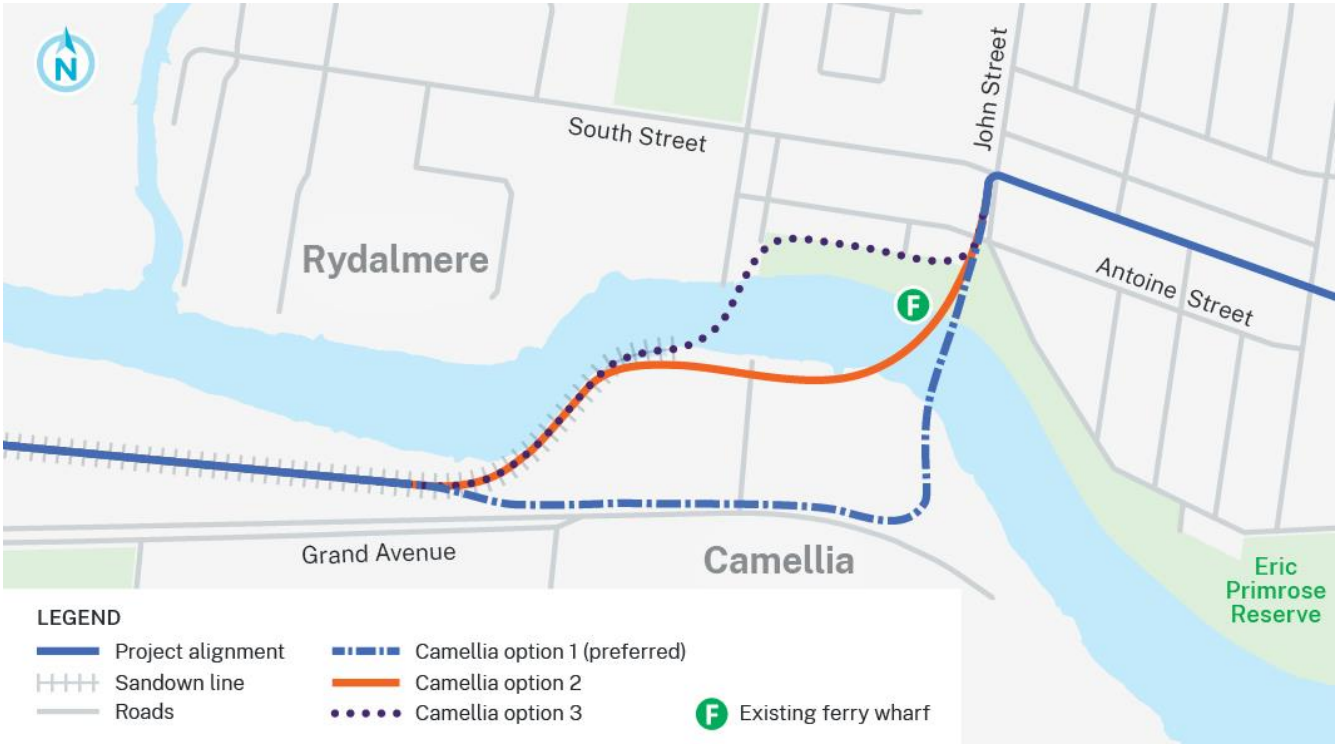


Figure 5.11 Camellia alignment options

Camellia options 1 and 2 were identified as viable options in response to the *Draft Camellia Town Centre Master Plan* (Department of Planning and Environment, 2018). The Master Plan provided for a town centre close to the Parramatta River supported by mixed land uses, including residential development and new community and recreation spaces.

Camellia option 1 would provide the shortest river crossing, and the straight bridge alignment would enable a simpler construction process. This option would provide a stop north of the river, on the western side of John Street, to provide access to Rydalmere Wharf. A challenge for Camellia option 1 is that the alignment along Grand Avenue would have potential impacts to access, traffic and safety during construction and operation, which would be avoided with options 2 and 3. To minimise impacts on underground utilities and interactions with heavy vehicles, the alignment would run on the northern side of Grand Avenue.

Camellia option 2 was not progressed due to the larger impacts to mangroves along the foreshore, and increased property impacts.

Camellia option 3 (also known as the Camellia to Rydalmere foreshore option) was identified in response to the September 2021 release of *Directions for Camellia–Rosehill Place Strategy* (DPIE, 2021b), which refined the structure and land use planning for this area. This option is considered to have some advantages over Camellia option 1 for the following reasons:

- Camellia option 3 would have fewer interactions with industrial properties, heavy vehicles and property access in Camellia than for options 1 and 2.
- Impacts to ferry services during construction would be reduced, as the Rydalmere Wharf could remain operational during construction of the bridge.
- Less clearing of mangroves adjacent to Parramatta River would be required to construct Camellia option 3 and fig trees in Eric Primrose Reserve would be avoided.
- Camellia option 3 would avoid several major utilities.

As Camellia option 3 was identified more recently than options 1 and 2, investigations and engagement to further consider this option are ongoing.

Camellia option 1 was determined to be the preferred solution and has been assessed in the EIS. This option was identified as compatible with the 2018 *Draft Camellia Town Centre Master Plan*; however, the 2021 *Draft Camellia–Rosehill Place Strategy* no longer proposed a road bridge between Thackeray Street and Park Road, removing a constraint that informed the options process.

Design development and engagement, including that undertaken during public exhibition of the EIS, may identify that a project design incorporating Camellia option 3 (the Camellia foreshore to Rydalmere option) would better meet the project objectives and offer improved outcomes for the community and environment. An initial scoping of how the potential impacts of a project incorporating the Camellia foreshore to Rydalmere option would differ from the potential impacts of the project described in the EIS is provided in Appendix D (Camellia foreshore to Rydalmere option – preliminary environmental scoping).

### Camellia to Rydalmere bridge options

When assessing the bridge structures crossing the Parramatta River the project sought to achieve an economical and low environmental impact outcome. The outcome needed to balance the increased cost of longer spans with a potentially greater impact associated with a larger number of supporting piers, while meeting technical, functional and aesthetic criteria. This included consideration of:

- superstructure options (for example, the number of spans/piers, overall bridge length and the vertical clearance for vessel navigation)
- substructure options (for example, the number of piers and horizontal clearance for vessel navigation)
- constructability considerations (for example, location of plant and access to construct piers and structure)
- integration with the surrounding landscape and minimising impact to mangroves.

Three structure types were considered for the bridge between Camellia to Rydalmere:

- box girder bridge (preferred)
- super-T bridge
- steel tied-arch bridge.

Examples of these different bridge structures are shown in Figure 5.12 to Figure 5.14.

Figure 5.12 Example of box girder bridge

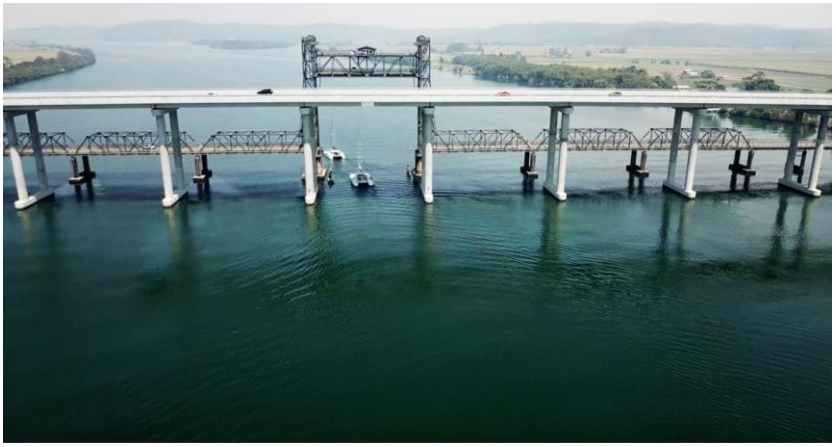

Figure 5.13 Example of a super-T bridge

Figure 5.14 Example of a tied-arch bridge

When the three options were compared, the following was noted:

- A box girder bridge could achieve a longer span and require fewer piers, which would achieve an appropriate navigable width and result in less construction impacts within the river.
- A super-T bridge would provide a more cost-effective solution. However, it would have smaller spans and require more piers, which would limit the width of the navigation channel and involve more construction impacts within the river.
- A steel tied-arch bridge would have a smaller maximum span than the box girder option and would likely require a larger quantity of steel, resulting in increased frequency of inspection and/or maintenance.

A box girder bridge was determined to be the preferred bridge type for the crossing between Camellia and Rydalmere. It is considered to provide a strong urban design outcome with multiple examples referenced by *Bridge Aesthetics: Design guideline to improve the appearance of bridges in NSW* (Roads and Maritime Services, 2019). The Transport for NSW Design Review Panel supported this option, noting that compared to the steel tied-arch bridge, the box girder bridge would be an elegant structure from all views, have less environmental impacts, and present a lower profile that sits more comfortably in the environment. By comparison, the super-T bridge option was not supported by the Design Review Panel as it would not meet the bridge design principles, and would be more visually complex and compete with the mangroves as a visual element.

During the optioneering process, the northern pier was designed to be located on land (rather than in the water), with improved environmental and constructability outcomes. Careful consideration has been, and would continue to be, given to pier detailing, structural depths and the form of the deck during design development.

### 5.4.3 Rydalmere

#### South Street alignment

South Street in Rydalmere undulates along its length, particularly in the vicinity of the proposed Nowill Street stop. Light rail tracks should minimise undulation to maintain passenger comfort. To address this issue, and integrate with the alignment to the east and west, the alignment was set to be at or below the existing undulating road surface levels along South Street. This introduced the need for a retaining wall between the road and adjacent residential properties, which would have prohibited access to South Street from about 18 properties on the northern side.

A design review focused on reducing property access impacts was undertaken. The refined design raised the light rail and the eastbound road lane, relocating the retaining wall to between the westbound road lane and the edge of the track form. This design change reduced the length of the retaining wall and integrated it with the stop platform, maintaining existing access to properties from South Street.

Adjustments would be required to existing informal access and parking arrangements for around eight properties on the northern side of South Street. Property impacts are considered in Chapter 13 (Land use and property) and would be confirmed during design development.

#### Silverwater Road bridge options

A crossing over Silverwater Road is required to link the light rail and active transport between South Street, Rydalmere and South Street, Ermington. An existing pedestrian bridge with stairs and lifts at each end crosses Silverwater Road adjacent to South Street at a slight angle.

Four options were considered for the bridge across Silverwater Road:

- Silverwater Road Option 1 – would involve a combined light rail and six metre wide active transport link and would have required the existing bridge to be removed.
- Silverwater Road Option 2 – would involve a light rail only bridge, which would be constructed about three metres north of option 1. The existing pedestrian bridge would be retained and widened to five metres. The lifts would be retained, and new stairs and accessible ramps would be added.
- Silverwater Road Option 3 – would involve a combined light rail and 3.5 metre wide cycleway bridge on the northern side, about 1.5 metres north of option 1, retaining the existing pedestrian bridge, lifts and stairs.
- Silverwater Road Option 4 (preferred) – would be located on the same alignment as option 2, with a combined light rail and five metre wide active transport link on the southern side of the bridge. This option would provide new lifts, stairs and accessible ramps, and would require the existing pedestrian bridge to be removed.

A photo of the existing pedestrian bridge is provided in Figure 5.15.

Figure 5.15 Existing pedestrian bridge over Silverwater Road

Option 1 would have a more integrated structural arrangement and cleaner visual outcomes but would result in the largest number of property impacts. Option 2 would have reduced property impacts, a smaller footprint and achieve the required clearance from major utilities, but would result in a less integrated structure and greater construction impacts to pedestrians. Option 3 would maintain the existing pedestrian bridge, allowing access over Silverwater Road during construction, but would not achieve the required clearance from major utilities, and would have a less integrated structure and more cluttered visual outcome.

As a result, Option 4 was determined to be the preferred solution as it would have the following advantages:

- improved visual outcomes with the structure appearing as a single, integrated element
- simpler construction process than options that retained and widened the existing pedestrian bridge
- achieved required clearance from major utilities
- opportunities for better passive surveillance of the active transport link due to the simplified structure providing better ramp grades and greater buffer widths to adjoining residential properties.

The Transport for NSW Design Review Panel noted that the proposed Silverwater Road bridge should integrate the ramps for the active transport link into either the design of the bridge or landscape, not as isolated structures, and that the structure should be combined to reduce land take and minimise visual impact. This would be achieved by Option 4.

### 5.4.4 Ermington

#### Ken Newman Park bridge options

Ken Newman Park is a highly valued public open space that contains a playground, native vegetation, a wetland, numerous footpaths and sweeping views to the south over the Sydney Basin. As such, it is critical that the light rail alignment, bridge design and structures integrate with the park, support functional spaces and add value for the community. The following constraints were considered when designing the light rail alignment and bridge structures at this location:

- The park slopes steeply from north to south and undulates from east to west, with a vegetated gully at the eastern edge of the park.
- The grassed easement at the western end of the park is narrow and bordered by residential properties.

- Three Sydney Water pipelines (trunk mains) run underground through the easement and the park between Hilder Road and Boronia Street.

Given the limitations associated with the grade that light rail vehicles can operate at, bridge options were considered to span the steep and undulating topography, with the two main options being:

- A viaduct (see Figure 5.16) – this would be about 155 metres long and would connect Hilder Road to Boronia Street, carrying the light rail and active transport link over the drainage gully at the eastern end of the park, and remaining elevated along a section of Boronia Street.
- An at-grade bridge (see Figure 5.17) (preferred) – this would be a two-span, concrete or steel bridge about 36 metres long, carrying the light rail and active transport link over the drainage gully, with no piers required in the gully.

Figure 5.16 Artist's impression of viaduct in Ken Newman Park

Figure 5.17 Artist's impression of at-grade bridge in Ken Newman Park

While the viaduct structure would provide a more consistent grade for the light rail it would involve a large structure and associated construction footprint resulting in substantial property impacts. Additionally, due to the height and length of the structure, the viaduct would have greater visual impacts within the park and along Boronia Street, and greater privacy and overshadowing impacts on the adjacent residents. The western abutment would substantially impact connectivity between the northern and southern sections of the park.

By comparison, the at-grade option would involve a smaller structure over the drainage gully and, as such, would have a reduced impact on visual and physical connections between the north and south sections of the park, and substantially less property impacts. A cutting in Boronia Street, with retaining walls on each side of the light rail alignment, would be required to facilitate light rail operations due to the steeper grades resulting from this option. The cutting was considered to have fewer negative impacts than the viaduct above Boronia Street.

The Transport for NSW Design Review Panel supported the at-grade bridge option, noting that the design of the park should lead the bridge design, rather than the structure driving the design. The at-grade bridge option would enable open space improvements within Ken Newman Park, which are outlined in section 6.8.2.

The at-grade bridge in Ken Newman Park was the preferred solution.

### 5.4.5 Melrose Park

#### Atkins Road stop and integration with Willowmere

Two options were considered for the alignment between Atkins Road and Hughes Avenue, in the vicinity of Hope Street and the locally listed heritage item, Bulla Cream Dairy (Willowmere):

- Option 1 (see Figure 5.18) – would continue north-east from Boronia Street crossing Atkins Road onto private land where the Atkins Road stop was proposed. The alignment would then continue east parallel to Hope Street, passing immediately to the north of Bulla Cream Dairy (Willowmere) before crossing to the northern side of Hope Street at the intersection with Hughes Avenue.
- Option 2 (see Figure 5.19) (preferred) – would turn east from Boronia Street crossing Atkins Road onto private land where the Atkins Road stop was proposed. The alignment would then continue east, passing immediately south of Bulla Cream Dairy (Willowmere), and turning north-east before crossing to the northern side of Hope Street.

Option 1 had several shortcomings. The track would be substantially lower than the existing ground level, which would require retaining structures affecting property access and access for active transport. Both options would encroach on the heritage curtilage of Bulla Cream Dairy (Willowmere); however, the Option 1 alignment would pass within one metre of the main structure, and direct impacts to the structure were identified as a construction risk. The depth of the track across Atkins Road would affect vehicular access in both directions, requiring a new road for westbound traffic between Hughes Avenue and Atkins Road and severing Atkins Road at Boronia Street. The alignment for Option 1 would also cross the intersection of Hope Street and Hughes Avenue at an acute angle, which is undesirable for cyclist safety.

By comparison, Option 2 would reduce potential impacts to properties on Hope Street, improve the angle of the alignment in relation to cyclist travel paths, provide an improved opportunity for open space to connect the stop to the Bulla Cream Dairy (Willowmere) building and generally retain the existing roadways, including Atkins Road connectivity across Boronia Street. While Option 2 would impact on the curtilage of Bulla Cream Dairy (Willowmere), direct and indirect impacts to the main building would be minimised compared with Option 1. Impacts to Bulla Cream Dairy (Willowmere) are discussed further in Chapter 12 (Non-Aboriginal heritage). Option 2 was therefore the preferred solution.

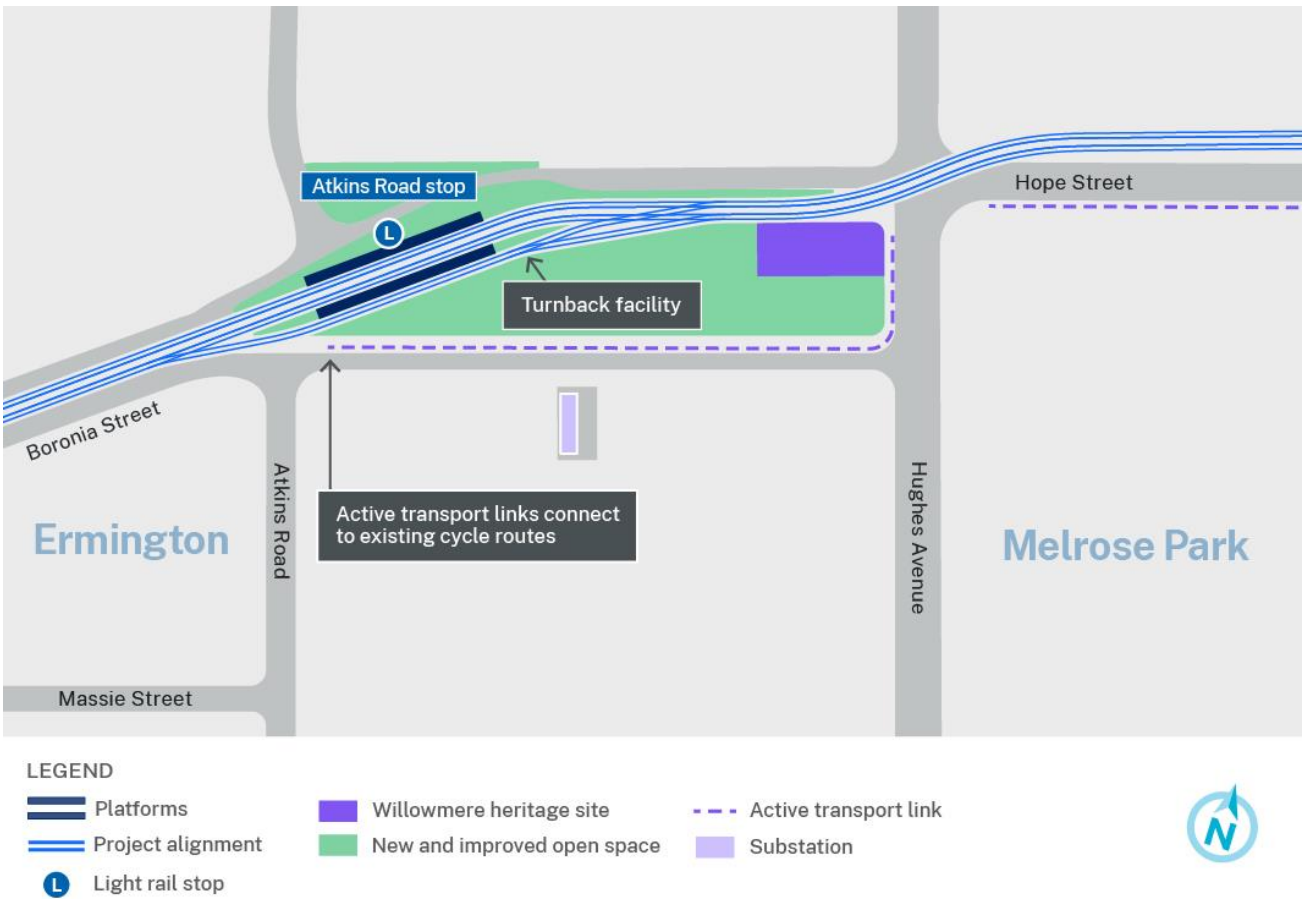


Figure 5.18 Alignment between Atkins Road and Hughes Avenue – Option 1

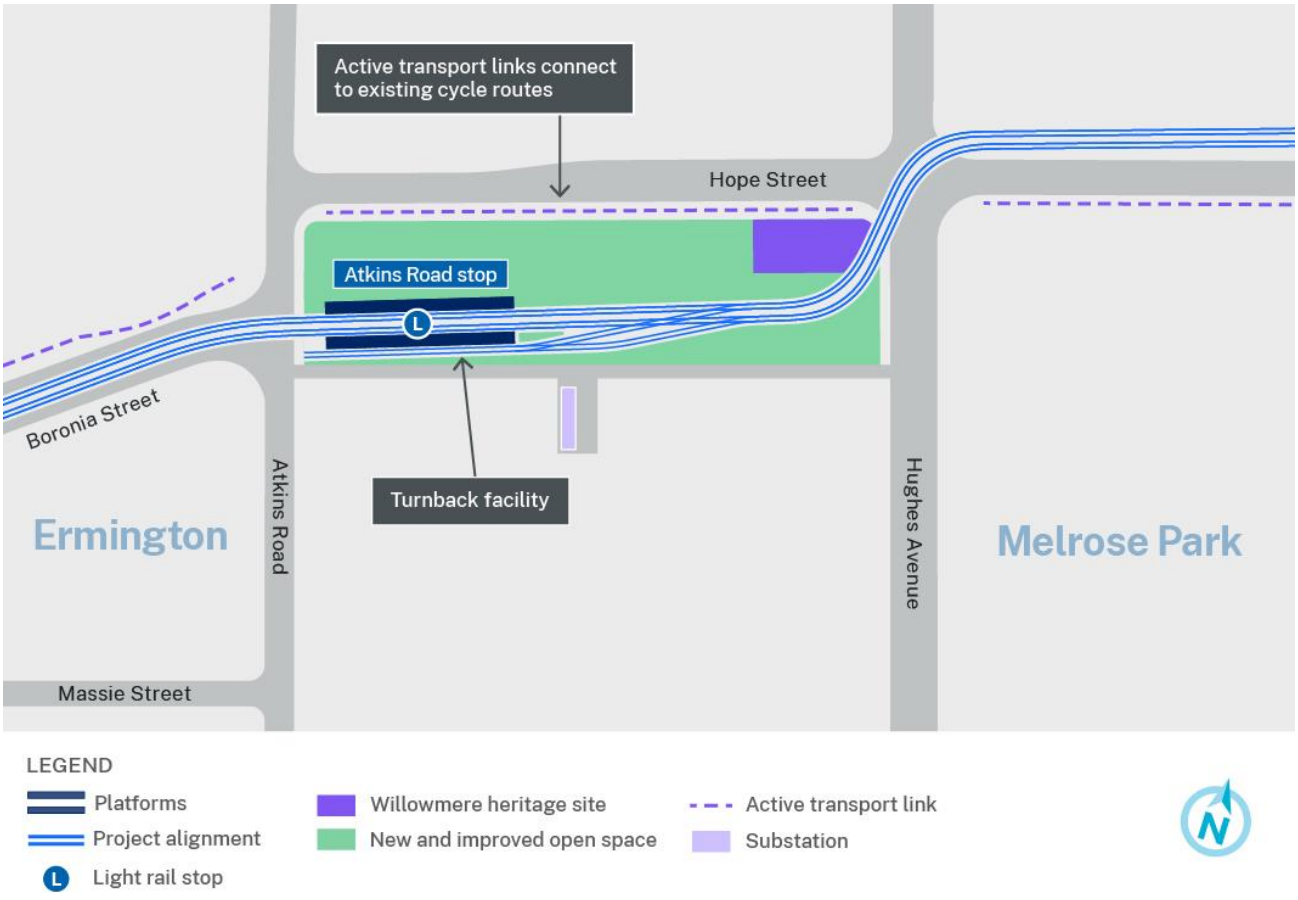


Figure 5.19 Alignment between Atkins Road and Hughes Avenue – Option 2

### Melrose Park to Wentworth Point bridge options

The following bridge superstructure options were considered for the bridge between Melrose Park and Wentworth Point, taking into consideration the objectives and criteria outlined in section 5.4.2:

- box girder bridge (preferred)
- super-T bridge
- steel tied-arch bridge
- steel truss bridge
- cable-stayed bridge.

Examples of a box girder bridge, super-T bridge and steel tied-arch bridge are shown in Figure 5.12 to Figure 5.14, respectively, while examples of a steel truss bridge and cable-stayed bridge are shown in Figure 5.20 and Figure 5.21, respectively.

Figure 5.20 Example of a steel truss bridge

Figure 5.21 Example of a cable-stayed bridge

When the five options were compared, the following was noted:

- A box girder bridge would have a longer span and require fewer piers, which would achieve a suitable navigable width and result in less construction impacts within the river.
- A super-T bridge would provide a more cost-effective solution but would have smaller spans and therefore require more piers. This would limit the navigable width and involve more construction impacts within the river.
- A steel tied-arch bridge would have a smaller maximum span than the box girder option and would likely require a larger quantity of steel, resulting in increased frequency of inspection and/or maintenance.
- A steel truss bridge would involve more complex construction processes and would likely require a larger quantity of steel, potentially resulting in an increased construction lead time, and increased frequency of inspection and/or maintenance. It may also restrict the alignment design depending on the construction method.
- A cable-stayed bridge would have longer spans but would be a higher cost option and have more construction complexity. It may also result in an increased frequency of inspection and/or maintenance.

A box girder bridge with five intermediate piers was determined to be the preferred bridge type for the crossing between Melrose Park and Wentworth Point. A box girder bridge is considered to provide better value and a good design outcome consistent with examples referenced by *Bridge Aesthetics: Design Guideline to improve the appearance of bridges in NSW* (Roads and Maritime Services, 2019). However, the Transport for NSW Design Review Panel recommended consideration of alternative bridge design options, and these are being further investigated as outlined in section 5.6. Careful consideration has been, and would continue to be given, to pier locations, structural depths and the form of the deck during design development.

## 5.5 Construction methods for high-risk activities

During design development, construction methods and impacts were considered to ensure that an option is constructable and that impacts are minimised. Key considerations included potential environmental and community impacts, safety, sufficient access for heavy vehicles and plant, availability of necessary construction expertise, and location of suitably sized areas for laydown and construction equipment.

During the design development and alignment refinement process, alternative construction methods were considered, particularly in areas with the potential for environmental and community impacts. Alternative construction methods were considered in relation to increasing stabling capacity at the stabling and maintenance facility, constructing the proposed bridges over the Parramatta River, and strengthening of the bridge over Haslams Creek on the Holker Busway. The options considered in relation to these aspects are described below. Further information on the proposed construction methodology is provided in Chapter 7 (Project description – construction).

### 5.5.1 Construction methods within the stabling and maintenance facility at Camellia

The Parramatta Light Rail stabling and maintenance facility is being constructed as part of Parramatta Light Rail Stage 1 on the southern side of Grand Avenue, in Camellia.

Modifications are proposed to increase the capacity of the facility to support the project. The construction method for installing additional tracks to increase stabling capacity is the focus of this option analysis.

### Constraints and issues

Significant remediation and ground improvement work was undertaken at the stabling and maintenance facility during construction of Parramatta Light Rail Stage 1 to increase the capacity of the ground support and manage contaminants from historical land uses. A capping layer was established across the site to separate the contaminated materials below from the clean material above. Where required, the ground was also strengthened prior to the capping layer being installed.

### Options considered

Two main options to support the additional stabling tracks were investigated:

- Option 1 – installation of slab tracks with subsurface ground strengthening
- Option 2 – installation of ballasted tracks with no subsurface ground strengthening.

Option 1 would require the capping layer to be penetrated to install ground strengthening measures deep into the ground. This option would provide appropriate support for concrete slab tracks like those installed for Parramatta Light Rail Stage 1, and would require less maintenance work. However, construction of Option 1 would be more complex and introduce greater environmental and safety risks. Penetrating the capping layer would result in interaction with contaminated material, introducing additional remediation and safety requirements. Option 1 would also pose a greater risk of temporarily interrupting the operations of Stage 1.

Option 2 would not require ground improvement as ballasted track would be constructed directly on the ground without impacting the capping layer. While this option would provide a flexible track solution on a lower performance ground support, this can be adequately managed through maintenance. Option 2 would involve a simpler construction methodology that would avoid interaction with contaminated material.

### Preferred construction method

Option 2 (installation of ballasted track with no subsurface ground strengthening) was determined to be the preferred option. This option would reduce environmental and safety risks, as the existing capping layer, which protects and contains contaminated subsurface materials, would be maintained during construction.

## 5.5.2 Constructing bridges across the Parramatta River

Construction access into the Parramatta River is required to build the two new bridges for the project (between Camellia and Rydalmere, and between Melrose Park and Wentworth Point). The proposed bridges span the Parramatta River at locations where there are existing constraints to access, environmental considerations and a range of surrounding land uses.

### Constraints and issues

There are several constraints associated with the existing environment of the Parramatta River that influence how the bridges would need to be constructed. Key constraints include:

- Transport – the section of river between Wentworth Point and Parramatta is used by the F3 Parramatta River ferry service, and by recreational users downstream of Silverwater Road. Bridge works have the potential to affect navigation and access within the river (see Chapter 9 (Transport and traffic)).
- Active transport and open space – these facilities include the Parramatta Valley Cycleway on the northern bank at Rydalmere and Melrose Park, Eric Primrose Reserve at Rydalmere, Archer Park at Melrose Park, and Louise Sauvage Pathway and River Walk at Wentworth Point. Bridge works have the potential to affect these facilities (see Chapter 9 (Transport and traffic) and Chapter 14 (Socio-economic impacts)).

- Biodiversity – the Parramatta River is a large, tidal estuary. Many areas along the foreshores are vegetated with native estuarine mangroves and Swamp Oak forest. Construction has the potential to disturb these vegetation communities (see Chapter 16 (Biodiversity)).
- Contamination – bed sediments within the Parramatta River are contaminated because of historical industrial uses. Construction has the potential to disturb and mobilise these sediments, affecting water quality (see Chapter 18 (Soils and contamination)).

### Options considered

Several design and construction methods were considered to minimise impacts on sensitive areas, including bed sediments, vegetation and foreshore areas of the Parramatta River.

Bridge construction generally involves building of the piles and piers (substructure), and the deck (superstructure). The choice of bridge deck (superstructure) and span length influences the construction method and bridge design, including the number and type of piers. Each design option was assessed in the context of the most practical and feasible construction method and the associated impacts, including the method of construction access.

The construction access methods considered are described below.

#### Option 1 – Barges (preferred in combination with Option 3)

Barges can support the large equipment required for bridge construction, and can float and attach to anchors, or they can use retractable piles that fix into the riverbed during use. Barges can either be transported by road and assembled onsite or floated to site. Barges come in variable sizes, and can be self-propelled or require moving by tugboats. An example of the use of a barge in bridge construction is provided in Figure 5.22.

Figure 5.22 Example of bridge construction using a barge

Barges are confined platforms that need to be supported by cranes, boats and a land connection such as a temporary platform.

Compared to other access options, barges would generally have a lesser impact on flooding and on the riverbed, which would minimise the disturbance of contaminated bed sediments.

A shortcoming of this method is that it can be slower – the barge platform is a limited working area and is affected by tide, flow, and wind conditions. Barges have a minimum operating water depth, typically around three or four metres. Barges may interrupt or limit the use of the navigation channel, depending on the construction arrangement. For the project, barges can offer only a partial solution due to the navigational uses of the river and areas of shallow water.

### Option 2 – Causeway

A causeway is an embankment built from rock and earth that connects the land to marine working environments. A causeway often incorporates sheet pile walls to retain the rock. An example of bridge construction using a causeway is shown in Figure 5.23.

Figure 5.23 Example of bridge construction using a causeway

This option would provide a robust access point and has several construction advantages. The causeway platform is capable of supporting large construction equipment such as cranes and piling rigs, and can provide a faster construction program as it allows for multiple activities to occur on the working platform at the same time.

Considerable disadvantages of this option include the larger area of disturbance to the riparian zone (including mangroves), river flow and flood impacts, and the large footprint of riverbed impact. More heavy vehicle movements to deliver and then remove the rock would be required, and the removal of materials following construction would involve more substantial safety risks and environmental impacts on the waterway due to the disturbance of contaminated riverbed sediments, compared with Options 1 and 3.

### Option 3 – Temporary platforms (preferred in combination with Option 3)

Temporary platforms (jetties) are built using prefabricated steel and concrete piles, headstocks and bridge decks. These structures can be transported to site then installed from the land out into the water using cranes and piling rigs to install driven or bored steel and concrete piles into the riverbed, followed by headstocks and decks. The platforms can be designed to support cranes and piling rigs.

Temporary platforms would enable access to the Parramatta River at the new bridge locations with a smaller impact footprint than Option 2. This option can be used in conjunction with option 1 (barges) if needed to facilitate construction in areas of shallow water and to provide a land connection for materials and equipment movement to barges. An example of bridge construction using a temporary platform is shown in Figure 5.24.

Figure 5.24 Example of bridge construction using a temporary platform

This access option is considered to have lesser environmental impacts than Option 2 (causeway). A smaller area of riparian vegetation (mangrove) removal would be required. The installation and removal of temporary piles would cause localised riverbed disturbance; however, the extent of this impact would be smaller than for Option 2. The temporary platform option would allow for flood waters to flow under the temporary platform but would still have some impact on flood waters and flow velocities during construction.

#### Preferred construction method

Option 3 (temporary platforms) was preferred to provide the access required for bridge construction, with some use of Option 1 (barges) as needed. Option 2 (causeway) was not preferred because of the impacts to flooding, and the extent of disturbance to the riverbed and riparian vegetation.

However, as part of construction planning, Transport for NSW is continuing to review construction methods and associated land and waterway requirements associated with the preferred bridge design and alignment. Selection of the most appropriate methods would include consideration of potential environmental impacts, such as impacts to maritime facilities and waterway operations, and disturbance of contaminated bed sediments and associated impacts to water quality. Selection of the preferred bridge construction approach would aim to balance considerations including cost effectiveness, construction program and environmental impacts.

### 5.5.3 Holker Busway bridge

The project follows the Holker Busway between Hill Road and Australia Avenue. There is an existing bridge for the Holker Busway over Haslams Creek, which carries vehicles, pedestrians and cyclists. The project would install light rail tracks over this bridge. Once works are complete the bridge would carry the light rail, vehicles, pedestrians and cyclists.

#### Constraints and issues

The key constraints in this location are as follows:

- Environment – water quality and sensitive ecology are important considerations. Mangroves line Haslams Creek, providing important ecosystem services. Green and Golden Bell Frog habitat, including breeding ponds, are present close to the bridge to the south-east.
- Transport – the existing bridge is a critical part of bus operations in Sydney Olympic Park and facilitates the movement of pedestrians and cyclists. Management during construction and operation is required to safely facilitate these movements and minimise disruption.

### Options considered

The options considered are described below.

#### Option 1 – Retaining and strengthening the bridge (preferred)

This option would require reconfiguration of bridge space to optimise operation of existing transport modes as well as light rail. Option 1 would require the use of strengthening mechanisms to enhance the performance of the structure. Depending on the final design, there is the potential for short-term, lower risk intrusions into the surrounding environment. A shortcoming of this option would be the more complex construction staging required to manage ongoing access for vehicles, pedestrians and cyclists during the works.

#### Option 2 – Duplicating the bridge by building an additional adjacent structure

The benefit of this option is that it would provide a wider bridge to avoid the need for shared space between light rail and buses by segregating transport modes. There are various shortcomings of this option, particularly the potential impacts associated with constructing a new bridge, including new piers, in the sensitive ecological environment surrounding Haslams Creek. Vegetation, including mangroves, would need to be removed for construction and access. Construction of the south-east bridge abutment would likely involve direct impacts within Green and Golden Bell Frog habitat. This option would also involve permanent impacts, including additional overshadowing.

#### Option 3 – Removing and replacing the bridge with a wider structure

The benefits and shortcomings of this option are the same as option 2. Option 3 would involve the greatest number of new piers, as well as removal of existing piers. This option would also potentially require construction of a temporary bridge, or it would have substantial temporary impacts on access for vehicles, pedestrians and cyclists.

### Preferred construction method

Option 1 (retain and strengthen the bridge) was determined to be the preferred method. Strengthening activities would be undertaken on the superstructure of the bridge and would not be expected to involve ground disturbance or work in Haslams Creek. This option would have less impacts on the sensitive ecology of the area than the alternative options.

## 5.6 Design development

### 5.6.1 Focus areas for ongoing design consideration

As part of the design development process, further refinements to minimise environmental impacts and improve outcomes and project value are anticipated. Focus areas subject to further refinements are outlined in the following sections.

Section 23.3.2 describes the process that would be followed where design refinements result in a final design that varies from that described in the EIS.

### Alignment between Camellia and Rydalmere across the Parramatta River

As described in section 5.4.2, investigation of an alternative alignment between Camellia and Rydalmere is ongoing in parallel with the EIS. The release of the *Draft Camellia-Rosehill Place Strategy* in September 2021 led to the identification of new opportunities and constraints for the project. Investigation of whether the alternative alignment may better meet the project objectives and offer improved outcomes for the community and environment is ongoing. An initial scoping of the alternative alignment is provided in Appendix D (Camellia foreshore to Rydalmere option – preliminary environmental scoping).

### Potential relocation of the transmission tower at Wharf Road, Melrose Park

The project alignment at Melrose Park is constrained by the Parramatta River and adjacent mangroves, the Ermington Boat Ramp and associated car park and access, private property and a high voltage transmission pylon and power lines that cross from Melrose Park to Wentworth Point. An options analysis is being undertaken in consultation with the utility owner (Ausgrid) to consider the viability of relocating the high voltage transmission pylon and power lines. One potential benefit is that relocation may enable design adjustments to reduce property impacts.

A comparison between the project alignment and a potential alternate alignment that may be enabled by relocating the transmission tower is shown in Figure 5.25.


Figure 5.25 Example of potential alternate alignment at Melrose Park

### Hill Road bridge

The bridge on Hill Road (referred to as the 'Hill Road bridge' for the purposes of the EIS) is located about 250 metres south-west of the intersection with Bennelong Parkway. It crosses over the water channel that connects Haslams Creek (to the east of Hill Road) with Narawang Wetland and Green and Golden Bell Frog habitat area (to the west of Hill Road).

The Hill Road bridge would be duplicated on the western side to carry the light rail vehicles and maintain sufficient space on the existing bridge for road lanes and pedestrian and cycle paths (see section 6.5.4). Opportunities to reduce the footprint in this area, and therefore minimise the impact on Narawang Wetland, are being investigated.

### Holker Busway bridge

The bridge on the Holker Busway (referred to as the 'Holker Busway bridge' for the purposes of the EIS) is located about 330 metres south-east of the intersection with Hill Road, over Haslams Creek.

The Holker Busway bridge would be strengthened to support the load of light rail vehicle operations and infrastructure (see section 6.5.4). A range of feasible strengthening methods have been identified. Selection of the most appropriate method(s) would involve further consideration of construction staging to minimise access impacts during construction and minimise impacts on the surrounding environment.

### Integration with the URBNSURF development on Hill Road

The URBNSURF development is being constructed on the corner of Hill Road and the Holker Busway. Consultation with the developer has commenced and will continue to enable suitable integration of the project with the operation of URBNSURF. Some adjustments to the project may be required during design development to facilitate this integration.

### Melrose Park to Wentworth Point bridge

The Transport for NSW Design Review Panel recommended certain investigations and processes focus on striving for design excellence, including refinement of the bridge design between Melrose Park and Wentworth Point. Bridge architects and Designing with Country specialists have been engaged to inform this process.

Where opportunities are identified to improve the design, by reducing impacts or improving outcomes, these would be considered during design development and through the establishment of key urban design requirements with bridge architects and the project-specific Design Review Panel.

### Wire-free operations

The project has committed to wire-free light rail operations between Jacaranda Square and Carter Street stops, where there would be no overhead wiring to power the light rail vehicles, which would charge at stops. There are a range of other areas along the alignment where wire-free operations could be beneficial if it is feasible, including areas of open space, around urban centres, and adjacent to areas of biodiversity value.

As the design progresses, further studies will be carried out to investigate the feasibility of additional areas with wire-free running, taking into consideration operational and electrical power requirements.

### Parramatta CBD terminus and turnback facility

There is ongoing consultation with the relevant stakeholders within Parramatta CBD with respect to the best terminus and/or turnback facility location. As the consultation and design refinement process continue, there may be opportunities to reconsider the turnback and/or terminus locations if this would result in improved environmental and community outcomes.

### 5.6.2 Approach to achieving good design outcomes

The urban design vision and objectives (see Figure 5.26) express the design intent for the project and provide the guiding principles for ongoing design development. The vision and objectives have been developed in response to the strategic context, need and objectives of the project (described in Chapter 3 (Strategic context and need)).

Design development involves a process of evolution, whereby the design is refined from an initial concept level, progressively becoming more detailed and refined as further analysis and assessment is undertaken and feedback from stakeholders and the community is received. Design development also seeks to further mitigate the impacts of the project, including on views and vistas.

Design development will continue through the preparation of the project's urban design requirements, which will provide detailed urban design guidelines and key requirements for the project that will guide future design, procurement and delivery phases of the project. Technical Paper 1 (Design, Place and Movement) forms the basis for the future development of the urban design requirements for the project, which will be developed in consultation with stakeholders, the operator, and the rail regulator, and with the advice from the project-specific Design Review Panel. Ongoing design development will be carried out by design experts with input from a multidisciplinary team.

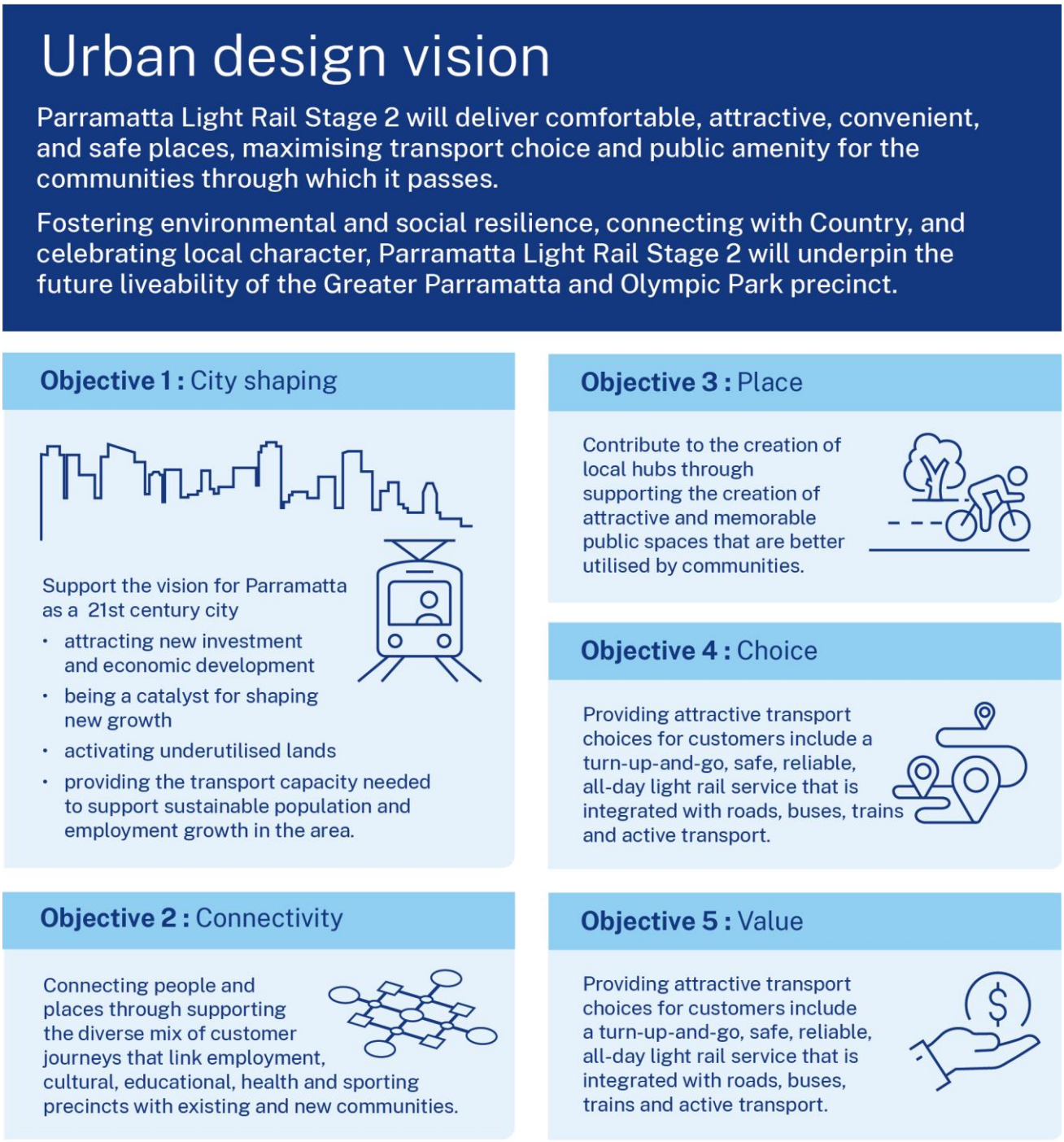


Figure 5.26 Urban design vision and objectives

### Design excellence

Design excellence is 'the highest standard of architectural, urban and landscape design' (Government Architect NSW, 2017).

Continued achievement of design excellence would be centred around an urban design-led process to achieve better placemaking, customer and land use outcomes while incorporating identified opportunities for improvement. To date, all phases of the project have been presented to the Transport for NSW Design Review Panel and feedback has been incorporated into the design, as described in section 5.1.2. Design review by independent experts is a recognised best practice process for elevating design quality.

Consultation with key stakeholders and design workshops, such as with the City of Parramatta Council and Sydney Olympic Park Authority, has allowed for continuous design review throughout the development of the definition design. Consultation will be ongoing through design development.

For the next stages of design Transport for NSW is committed to:

- embedding expertise and adopting an Aboriginal co-design approach as part of Transport for NSW's commitment to Country-led collaboration (described further below)
- development and implementation of a Green Infrastructure Strategy
- ongoing consultation with stakeholders and the community, including City of Parramatta Council, City of Ryde Council, Sydney Olympic Park Authority, NSW Department of Planning and Environment, utility providers, landowners of current and planned large developments, and various divisions within Transport for NSW
- establishing a project-specific Design Review Panel to continue providing design excellence advice.

### Designing with Country

The project would traverse many complex, diverse and sacred areas of cultural significance, providing opportunities to connect with, care for, and read Country.

Transport for NSW has developed Aboriginal co-design principles to ensure Country-led collaboration and design is embedded into the ongoing development of the project. These principles are summarised below and would guide design development:

- Early and ongoing engagement – Aboriginal co-design should occur as early as possible in the life-cycle of the project.
- Connection with people and Country – there should be allocated time to walk on Country with Aboriginal knowledge holders and hear stories that belong to the place.
- Embedding – co-design should be a normal part of project development in the same manner as engineering design, surveying, community engagement and environmental planning.
- Partnership – effective co-design should require that roles, responsibilities, and mutually beneficial outcomes are clearly defined and established at the outset.
- Aboriginal empowerment – Aboriginal co-design should require the empowerment and inclusion of Aboriginal people to participate in the work of the project and there should be consideration of how the finished project or service would meet the needs of both the Aboriginal and non-Aboriginal community.
- Two-way sharing and capacity building – Aboriginal co-design should require the two-way sharing of knowledge, capacity, and capability between Aboriginal people and Transport for NSW staff.

Aboriginal design consultancy, Bangawarra, has provided commentary on the Designing with Country process in Technical Paper 1 (Design, Place and Movement) which identifies opportunities for project elements within each precinct to be designed to reflect the nuanced and specific character of each place. These opportunities would continue to be developed as the design progresses and would form part of the project's urban design requirements with Bangawarra embedded as part of the design team. Engagement with relevant Aboriginal stakeholders would also be undertaken to continue the project's commitment to Transport for NSW's co-design principles.