

Figure 5-22 Southern interchange surface road works

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Figure 5-23 Northern interchange surface road works

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5.2.11 Public transport opportunities

A number of public transport services currently operate along the Pennant Hills Road corridor. Numerous bus services operate along Pennant Hills Road in between the M1 Pacific Motorway and Hills M2 Motorway, with frequent services operating during peak hours. The corridor is serviced by the high-frequency, high-capacity metrobus service M60, as well as numerous services connecting the corridor to the central business district, Castle Hill and Dural.

The Northern Railway Line stations at Pennant Hills, Thornleigh and Normanhurst are also located along the corridor. North West Rail Link, although close in proximity to the Pennant Hills Road corridor, is expected to service a separate catchment area. As a result, strong demand for integrated bus and rail services along Pennant Hills Road will continue beyond the delivery of the North West Rail Link in 2019.

The project is expected to attract through-traffic away from Pennant Hills Road and into the tunnels, including a large number of heavy vehicles. This is expected to reduce congestion and free up road space, providing opportunities to implement improvements to the operation of bus services and local traffic movements.

Roads and Maritime and Transport for NSW have carried out a preliminary assessment of the public transport improvements that could be delivered due to a reduction in traffic congestion on Pennant Hills Road.

Sydney's Bus Future

Sydney's Bus Future (Transport for NSW, 2013a) is a 20 year bus plan that sets out to deliver a simpler, faster and better bus network for customers. Specific to Pennant Hills Road, Sydney's Bus Future targets the corridor as part of a bus rapid route between Hornsby and Baulkham Hills (via Castle Hill).

Pennant Hills Road has been targeted for bus priority treatment to address bus pinch points along the road, including around Boundary Road. In conjunction with this, Sydney's Bus Future includes an action to investigate opportunities for improved bus public transport along Pennant Hills Road, consistent with the project objective.

Sydney's Bus Future proposes that bus rapid routes would form a backbone to the new bus network in Sydney, offering fast and reliable bus travel for customers between major centres. The bus rapid routes would include 'turn up and go' services that would operate at least every ten minutes between 6 am and 7 pm on weekdays and every 15 minutes on weekends. Bus stops would be placed around every 800 metres to one kilometre.

As part of a bus rapid route, Pennant Hills Road would provide high quality public transport services which would support growth areas, be integrated with the North West Rail Link, and give the road greater integration in the cross-metropolitan network.

Public transport opportunities on Pennant Hills Road

Specific actions to improve bus services along Pennant Hills Road may include:

- Signal re-phasing, or changing the pattern of traffic signals at key intersections, to ease traffic flows across Pennant Hill Road by focusing on longer stopping time for through traffic and increased entry time for side traffic.
- Bus stop relocations along the corridor to be closer to intersections, taking advantage of the additional stopping time created by signal re-phasing to reduce overall journey time.
- Bus priority measures at key intersections to provide better bus reliability.
- More frequent bus services on Pennant Hills Road in the event that congestion levels are lowered following the delivery of the project.

Preliminary work has identified a number of traffic control improvements that could be made at specific intersections along Pennant Hills Road.

These intersections tend to contribute to slow peak speeds, and hence would benefit from treatments to deliver bus priority measures and improve cross traffic flows across Pennant Hills Road. Cross traffic is not expected to change greatly with the delivery of the project. Targeted intersection improvements could help improve public transport services along the corridor as well as local traffic movements. These improvement opportunities have been identified in **Table 5-3**.

Table 5-3 Summary of public transport improvement opportunities

Location	Opportunities identified
Along Pennant Hills Road	<ul style="list-style-type: none">• Signal re-phasing.• Additional bus services.• Relocation of bus stops.
Boundary Road	<ul style="list-style-type: none">• Longer right-turn phase for buses turning right from Pennant Hills Road onto Boundary Road.• Bus queue jump' for buses turning left onto Pennant Hills Road.
Beecroft Road	<ul style="list-style-type: none">• 'Bus queue jump' for buses travelling south on Pennant Hills Road.
Cardinal Avenue	<ul style="list-style-type: none">• Longer right-turn phase for buses turning right onto Pennant Hills Road.• Longer right-turn phase for buses turning right onto Cardinal Avenue.
Castle Hill Road	<ul style="list-style-type: none">• 'Bus queue jump' for through buses travelling south on Pennant Hills Road.• Longer right-turn phase for southbound buses turning right onto Castle Hill Road.• 'Bus queue jump' for through buses travelling north on Pennant Hills Road.
Railway Street	<ul style="list-style-type: none">• Longer right-turn phase for buses turning right onto Pennant Hills Road.
Aiken Road	<ul style="list-style-type: none">• Longer right-turn phase for buses turning right onto Pennant Hills Road.
Phyllis Avenue	<ul style="list-style-type: none">• 'Bus queue jump' for buses travelling north on Pennant Hills Road.
Comenarra Parkway	<ul style="list-style-type: none">• 'Bus queue jump' for buses travelling south on Pennant Hills Road.

A number of other transport improvements along Pennant Hills Road could be delivered in the medium- to long-term. Such opportunities could include:

- Reconfiguring the bus route network to take advantage of easier crossing of the corridor at junctions, in alignment with Sydney's Bus Future strategy
- Linking the wide transport network better with railway stations in the area
- Improving walking and cycling infrastructure along and across the corridor.

Next steps

These options for improving public transport are at a preliminary stage. More detailed work would be undertaken by Roads and Maritime and Transport for NSW to investigate public transport improvements and intersection treatments that could be delivered on Pennant Hills Road after the opening of the project. These potential public transport improvements do not form part of this project and would be subject to separate planning processes and approvals as appropriate.

5.2.12 Heavy vehicle regulation

As is discussed in **Chapter 3**, Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway forms part of the National Land Transport Network, and is one of the two remaining sections of the Network within Sydney that is not of a motorway standard. Vehicles using Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway share the road with heavy vehicles transporting freight to, from or through Sydney to major cities and regional centres such as the Central Coast, Newcastle, Brisbane and Melbourne. As Sydney's population and economy continue to grow, there will be greater pressure to improve the efficiency of the National Land Transport Network to service expanding commercial centres and cater for local and district freight transport demands.

One of the key objectives of project is to contribute towards a reduction in the number of heavy vehicles using Pennant Hills Road and as a result improve amenity along this corridor. This objective goes hand-in-hand with improving freight efficiency around and through Sydney, as well as providing opportunities for improved public transport in the area.

The project would be an alternative and more efficient route for travel between the M1 Pacific Motorway and the Hills M2 Motorway, improving access, connectivity and reliability of inter-regional freight across the greater Sydney area. It is expected that this would be an incentive for heavy vehicle operators to use the project rather than Pennant Hills Road to travel between M1 Pacific Motorway and the Hills M2 Motorway.

Measures may also be implemented to achieve the objectives of the project. These may take the form of regulatory measures on the surrounding road network, including introducing, or changing the operation of existing, traffic control facilities, advisory and / or regulatory signage, route designations, notices, application of permits, or other traffic measures. Any regulatory measures that have the effect of regulating heavy vehicles would need to be consistent with the objectives of the National Heavy Vehicle Law, where applicable.

Some of these options may attract a penalty for non-compliance, for certain classes of heavy vehicles using the surrounding road network. Where these options are under consideration, this would need to include consideration of the appropriate method of enforcement. Enforcement measures might include structures, upon which equipment associated with enforcement, may need to be mounted (such as cameras or other equipment).

The project may include provision of gantries, for measurement of vehicular traffic. Where feasible, consideration would be given to integrating the equipment in the motorway operations complex. Possible locations for these gantries are likely to be at the southern end (near Hannah Street around 850 metres north of the Hills M2 Motorway) and northern end of Pennant Hills Road to the east of Dartford Road, adjacent to Kenley Park. These locations minimise light impacts from vehicle detection systems on adjacent properties. The final locations of gantries or other regulatory measures would be determined during detailed design based on the outcomes of detailed site investigations.

5.2.13 Provisions for pedestrians and cyclists

The introduction of new infrastructure would necessitate the permanent alteration of pedestrian foot paths, cycle lanes and bus stops. However, all existing functionality and available movements would be retained during the operational phase of the project.

The design of the project has included specific provision for grade separated cycle infrastructure on the Hills M2 Motorway and the M1 Pacific Motorway at the main alignment tunnel connections. This would provide a safe cycling environment by removing the need to cross two traffic lanes. Minor adjustment may also be required around existing intersections.

Adjustments to bus stops would include:

- Relocation of an existing bus bay along the northbound carriageway of Pennant Hills Road as a result of the proposed configuration of the Pennant Hills Road northbound on-ramp at the southern interchange.
- Minor alterations to facilities at the existing Oakes Road and Barclay Road bus stops along the Hills M2 Motorway as a result of the integration works.

The need for changes to pedestrian, cyclist, and bus facilities at each interchange would be reviewed during detailed design.

5.2.14 Cuttings and embankments

Sections of cutting and embankments would be required for the surface works in order to facilitate connections to the existing road alignments at the Hills M2 Motorway and the M1 Pacific Motorway, as well as for the tunnel dive structures.

Cuttings

The project would require multiple cuttings including the dive structures for the main alignment tunnels and on and off-ramp tunnels at the northern and southern interchanges, and to facilitate the Hills M2 Motorway integration works and the M1 Pacific Motorway tie-in. Areas of cutting would range in depth up to a maximum of around 16 metres.

Embankments

The project would also require multiple embankments or areas of fill, mainly associated with the Hills M2 Motorway integration works and the M1 Pacific Motorway tie-in, and for on and off-ramps at the northern and southern interchanges. The Hills M2 Motorway integration and M1 Pacific Motorway tie-in works would also require areas of fill behind reinforced soil walls. In order to match the height of existing fill along the Hills M2 Motorway, areas of fill would range in height up to around 35 metres.

5.2.15 Utility services

A number of utilities are located within or near the project including electricity, telecommunications (including optic fibre cables), sewer and water mains. Utilities would need to be relocated, adjusted or protected where they may be affected by the construction of the project. Further work would be carried out during detailed design to confirm the exact impacts on utilities, and permanent relocations that may be required.

The project would require connection to mains power and water supply for the safe and efficient operation of the tunnel.

Electricity

Electricity supply infrastructure would be installed to supply power to the main alignment tunnels and associated mechanical and electrical equipment. It is essential that electrical power to tunnels be uninterrupted for ventilation and other safety reasons. As such, two sources of supply would be required; each rated to supply the full load of the tunnel electrical system. The power supply would be two 66 kilovolt feeders supplied via a new switching station that would be located on the south-west side of the Pennant Hills Road / Hills M2 Motorway interchange. The feeders would connect to a project supply substation on the other side of the motorway where the power supply would be stepped down to 22 kilovolt. From the project supply substation, power would be reticulated to another six substations along the project. Of the total seven project substations, three would be located underground and four would be located aboveground (incorporated into other operational ancillary facilities).

In the event that both services of supply are not available, a power system comprising batteries or backup diesel generators would provide power for essential loads for at least 30 minutes. Essential loads would include:

- Communications and monitoring equipment.
- Computer facilities.
- Tunnel signage.
- Emergency power outlets.
- Closed circuit television.
- Emergency lighting evenly distributed along the tunnel.

Water

Mains water supply would be required during operations for the deluge system and for the maintenance of landscaping associated with the surface facilities. The primary water source for fire suppression would include two water tanks, each with a capacity of 1220 cubic metres located at the northern end (within the northern ventilation facility) and a third water tank of 450 cubic metres at the southern end of the project (within the motorway operations complex). The operational layout of the northern ventilation facility including the location of water tanks is show in **Figure 5-18**. The operational layout of the motorway operations complex including the location of water tanks is show in **Figure 5-17**.

5.2.16 Roadside furniture and lighting

Lighting

Lighting would be provided along the length of the main alignment tunnels, in accordance with relevant Austroads and Roads and Maritime standards. Lighting at portals would consider differing light conditions external to the tunnel, and would be zoned to allow sufficient time for the eye to adjust.

Emergency lighting would be installed to provide adequate illumination for evacuation in the event that the primary source is made inoperable.

Lighting on surface roads would be as existing or as per relevant Austroads and Roads and Maritime standards.

Signage

The project would incorporate traffic, locational, directional, warning and variable message signs within the tunnel and at the surface connections approaching the tunnel.

The directional signage would be in accordance with Austroads and Roads and Maritime standards with the focus on providing clear and unambiguous direction to motorists travelling through complex interchanges. Some of the key design principles would include:

- Advanced and multiple warnings of the tunnel and toll road.
- Directional signs to provide direction on appropriate lane use at complex locations.
- Use of diagrammatic advanced warning signs.
- Focal point signage around the interchanges consistent with existing Roads and Maritime signage in the Sydney region.

A signage strategy would be developed during the detailed design stage of the project. Consultation with the surrounding community would occur during the development of this signage strategy in relation to the location of signage and associated impacts.

The project would also include tunnel way finding signage. This would be further refined during the detailed design stage, however currently this consists of:

- Place names on the tunnel walls to provide motorists with a sense of place during the journey through the tunnel.
- Emergency signage providing direction towards emergency exits.

Further details are provided within **Section 7.5** (Urban design, landscape character and visual amenity).

Heavy vehicle regulation

Based on the proposed solution discussed in **Section 5.2.12**, the equipment necessary to ensure eligible trucks use the tunnels may include regulatory and advisory signage, vehicle detection, classification and video equipment.

Gantries may be integrated with equipment in the motorway operations complex to enable provision of enforcement information to Roads and Maritime. These gantries may be located at the southern and northern ends of Pennant Hills Road.

The southern gantry would be located on Pennant Hills Road near Hannah Street around 850 metres north of the Hills M2 Motorway. The northern gantry would be located on Pennant Hills Road to the east of Dartford Road, adjacent to Kenley Park. These locations have been chosen to minimise light impacts from vehicle detection systems on adjacent properties and to discourage truck drivers from using alternative routes to avoid the gantries.

5.2.17 Property access and acquisition

The project has been designed to restrict land acquisition and limit the severance of private properties. The project would require the permanent acquisition of around 56 properties (comprising private properties, and properties owned by Hornsby Council or the Hills Shire Council) over and above land already owned by Roads and Maritime. A further four private properties would be required temporarily to facilitate construction of the project.

Where partial acquisitions are required, private property fencing would be realigned as part of preliminary construction work.

The total area and number of properties that would be acquired for the project may change as the project is refined during the detailed design stage of the project, or in response to changes resulting from the exhibition of this environmental impact statement and conditions of approval that may be applied by the Minister for Planning.

All partial and full property acquisition would be undertaken in accordance with the *Land Acquisition Information Guide* (Roads and Maritime, 2012c) and the *Land Acquisition (Just Terms Compensation) Act 1991*. Consultation with affected property owners has commenced (refer to **Section 8.1** Land use and property) and would continue to occur during detailed design.

Alterations to local roads would result in some changes to property access arrangements for a number of properties located in the following streets:

- Pennant Hills Road, Wahroonga.
- Woonona Avenue, Wahroonga.
- Bareena Avenue, Wahroonga.

Further details of property acquisitions and alterations to property access are provided in **Section 8.1** (Land use and property).

5.2.18 Emergency or incident facilities

Operational emergency systems would be included in the design of the project, such as emergency shoulders, breakdown bays, fire suppression and firefighting systems, egress for pedestrians and access for emergency services. Emergency incident facilities would include:

- Deluge systems.
- Fire and life safety systems.
- CCTV throughout the tunnel and approaches.
- Height detection system prior to the tunnel portals.
- Tunnel barrier gates to prevent access in the event of tunnel closure.
- Vehicle cross passages between the two main alignment tunnels around the Wilson Road tunnel support facility and the Trelawney Street tunnel support facility.
- Pedestrian cross passages between the two main alignment tunnels at 120 metre intervals.
- Vehicle breakdown bays on the Hills M2 Motorway and the M1 Pacific Motorway prior to and after the main alignment tunnel portals.

5.2.19 Detailed design

This environmental impact statement seeks approval for the project elements described in this chapter. The environmental impact statement has been prepared based on the preferred design. If approved, a further detailed design process would follow which may include variations to the preferred design. This approach is consistent with the approach taken in other environmental impact assessments for major infrastructure projects.

The detailed design process would seek to further minimise impacts and optimise traffic efficiency. In doing so it is likely to necessitate changes to a number of project elements but would not affect the key project elements described in this environmental impact statement. Any proposed changes to the project resulting from the detailed design would be assessed for consistency with the impacts described in this environmental impact statement.

5.2.20 Urban design principles and objectives

The visual impacts of the project would be dependent on the design features of the interchanges and other surface infrastructure, landscape treatments and the exploration of opportunities to integrate the surface infrastructure elements with the surrounding features of the area. Design of the portals, interchanges and surface infrastructure would take into consideration their visibility and landscape to ensure an appropriate design response. Tie-in works with the M1 Pacific Motorway and the Hills M2 Motorway integration works would also take into account the visual design elements of these existing roads to ensure an appropriate visual transition to and from the project in accordance with the Roads and Maritime guideline Beyond the Pavement: Urban design policy, procedures and design principles (Roads and Maritime, 2011a).

Urban design principles and objectives developed specifically for this project are:

- Provide a safe facility for traffic, pedestrians, cyclists and disabled persons.
- Provide landmarks at selected places as a contribution to legibility.
- Maintain existing neighbourhood connectivity and local access for local traffic.
- Aesthetically enhance the road facility and associated works and structures.
- Integrate new elements with existing work as seamlessly as possible to fulfil the urban design requirements.
- Improve existing environmental sustainability wherever possible.
- Enhance the existing landscape and integrate the new landscape both across and into the corridor.
- Continue the family of road elements and built forms already established.
- Enhance driver experience and the visual contribution to the built environment.

Additional Roads and Maritime guidelines have been considered, where applicable, during the design development process and the preparation of this environmental impact statement:

- Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW (RTA, 2012).
- Noise wall design guideline: Design guidelines to improve the appearance of noise walls in NSW (RTA, 2006a).
- Landscape guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seed (RTA, 2008b).
- Shotcrete Design Guidelines: Design guidelines to avoid, minimise and improve the appearance of shotcrete (RTA, 2005c).

Further details of urban design and visual impacts are provided in **Section 7.5** (Urban design, landscape character and visual amenity).

5.2.21 Landscape framework

Detailed landscape plans have been developed for the southern interchange, the northern interchange and the operational ancillary facilities. These have taken into account the local context and aimed to visually integrate the project into the surrounding environment.

Details of landscape plans are provided in **Section 7.5** (Urban design, landscape character and visual amenity) and **Appendix I** (Technical working paper: Urban design).

5.3 Construction works

5.3.1 Construction footprint

The majority of the construction footprint is located underground within the main alignment tunnels, however surface areas would be required to support tunnelling activities, and to construct the interchanges, tunnel portals, the Hills M2 Motorway integration, the M1 Pacific Motorway tie-in, the motorway operations complex, north and south ventilation buildings, tunnel support facilities and ancillary operations buildings and facilities.

The surface construction footprint generally aligns with the operational footprint, with the location of future operational ancillary facilities being utilised to support construction activities. Despite this, additional construction support sites would be required around the northern interchange. Additionally, in order to facilitate construction access and construction traffic management, additional areas adjacent to the operational footprint would be required around the portals, on and off-ramps the Hills M2 Motorway integration and the M1 Pacific Motorway tie-in. The total area required to facilitate the construction of the project is referred to as the construction footprint. This is anticipated to require the clearing of around 21 hectares of vegetation (both native and exotic). Further information relating the vegetation clearance and ecological impacts is provided in **Section 7.6** (Biodiversity)

An overview of the construction footprint is shown on **Figure 5-24** and also in **Figure 5-25** to **Figure 5-32**.

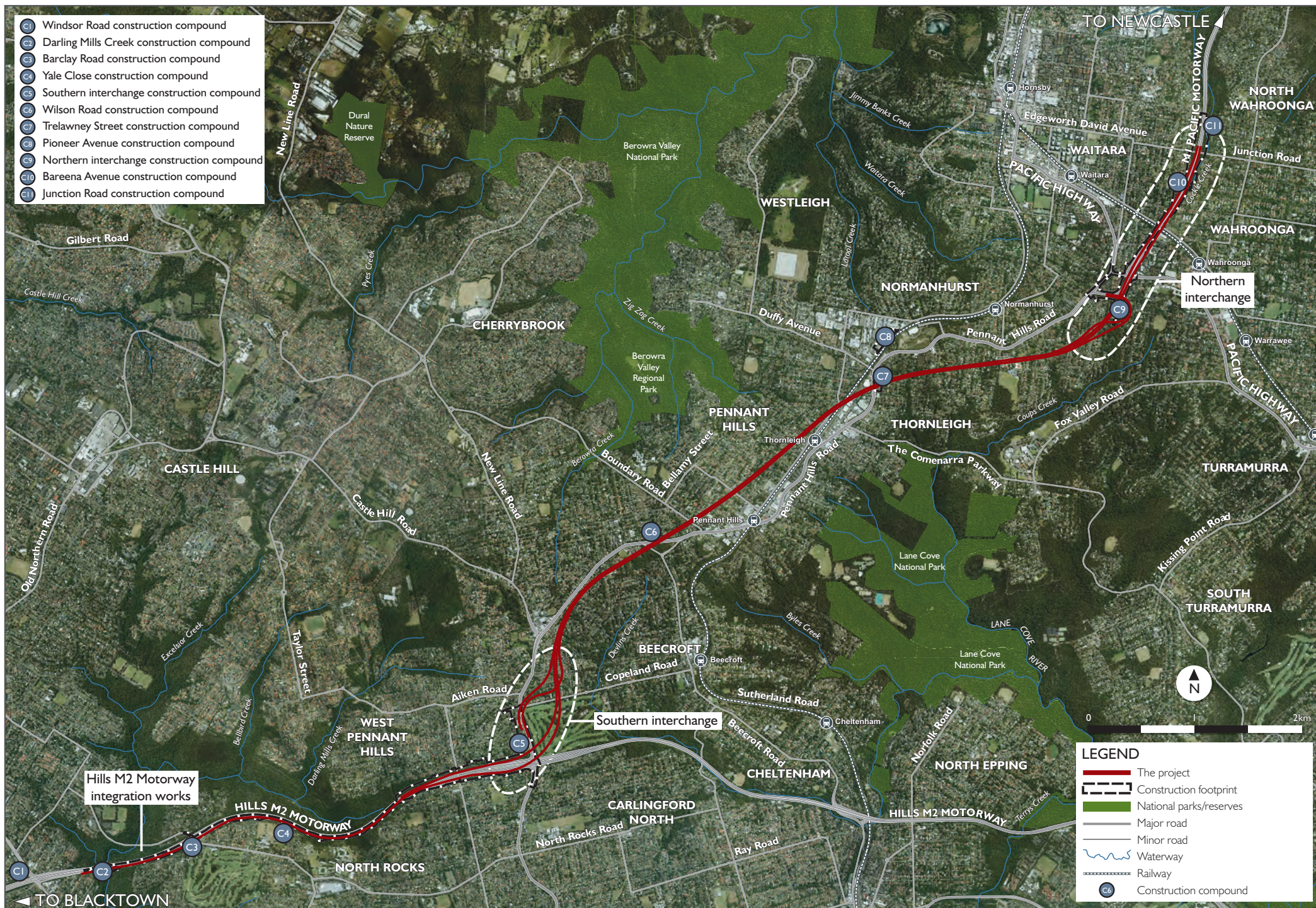


Figure 5-24 Overview of construction footprint and ancillary facilities

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Figure 5-25 Project construction footprint - Map 1

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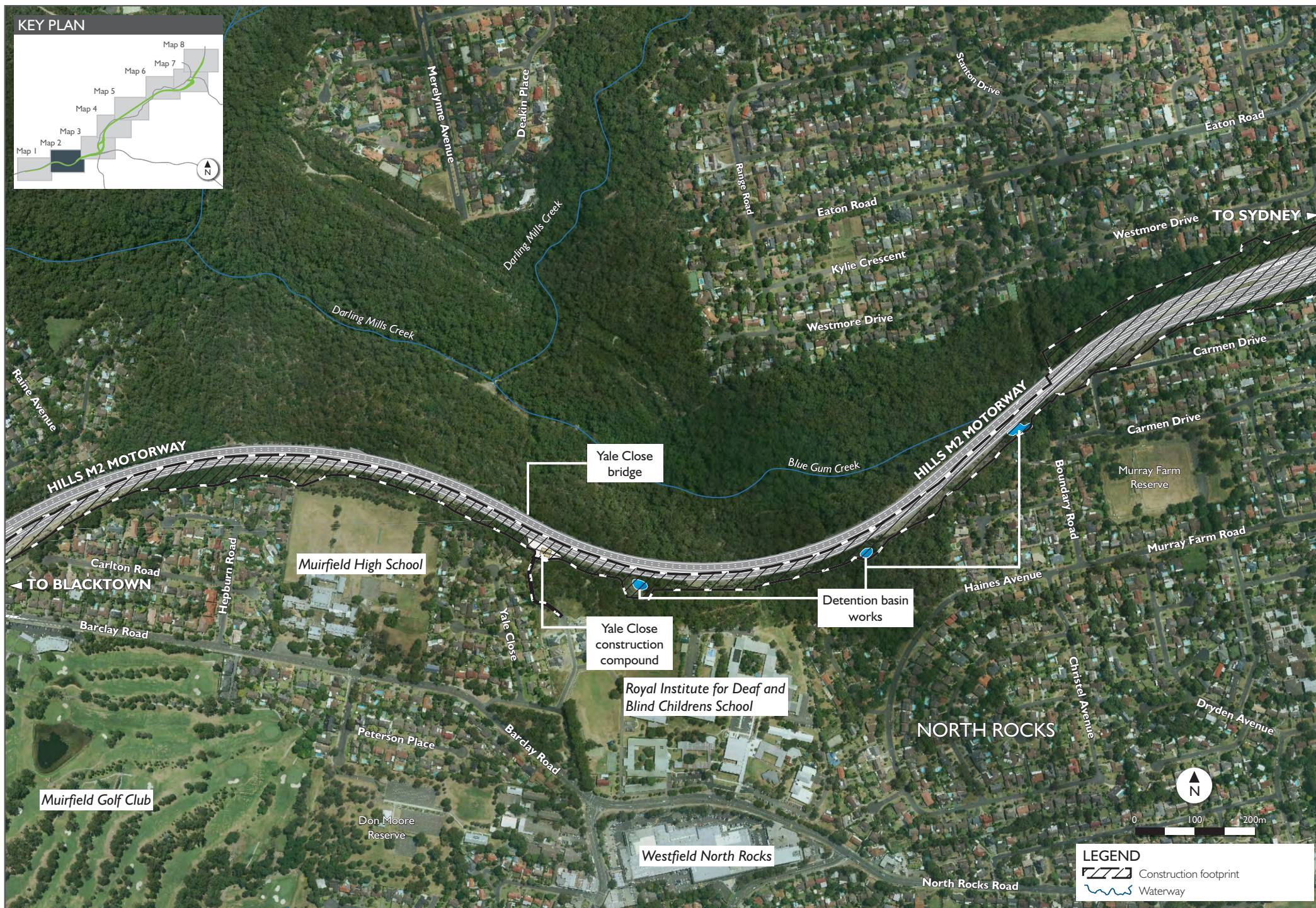


Figure 5-26 Project construction footprint - Map 2

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