Figure 5-7 Project operational footprint - Map 6

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Figure 5-8 Project operational footprint - Map 7

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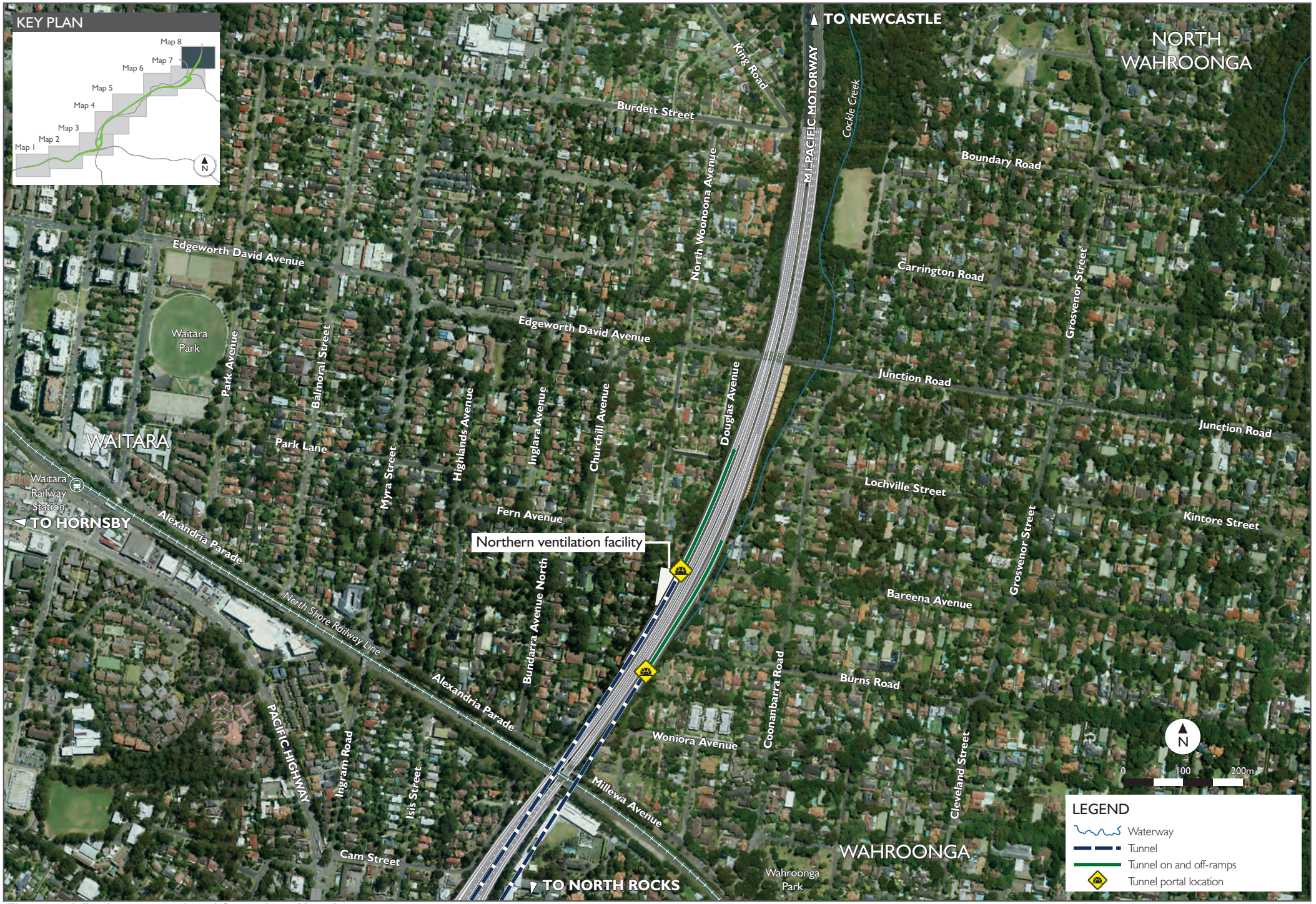

Figure 5-9 Project operational footprint - Map 8

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5.2.1 Corridor and project footprint

The preferred project corridor is defined as the zone on the surface equal to a distance of 50 metres from the outer edge of the underground tunnels.

The construction footprint (the area required to construct the project) would include the main alignment tunnels, the on and off-ramp tunnels, connections, tie-ins and integration works with existing surface roads, surface support infrastructure (refer to **Section 5.3.1**), and temporary ancillary construction facilities. Temporary ancillary construction facilities including construction compounds, sediment control basins and stockpile sites are described in **Section 5.3.12**.

Once operational the project would consist of the main alignment tunnels (comprising twin motorway tunnels), on-ramp and off-ramp tunnels connecting the main alignment tunnels to existing surface roads at the northern and southern interchanges, modifications to existing surface roads, and surface support infrastructure. These facilities are referred to as the operational footprint.

5.2.2 Tunnel alignment

The main alignment tunnels would consist of twin motorway tunnels around nine kilometres in length with separate northbound and southbound carriageway tunnels.

The main alignment tunnels would vary in size and shape to accommodate local geology. However, these tunnels would generally have an excavated cross-sectional area of around 110 square metres, with a height of around eight metres and a width of around 14 metres. After tunnel lining and fit-out, the cross-section area would be around 75 square metres. **Figure 5-10** provides an indicative cross-section of the main alignment tunnels. The design of the main alignment tunnels and on and off-ramp tunnels is described further in **Section 5.3.5**.

The main alignment tunnels would extend from the southern connection with the Hills M2 Motorway around the existing Pennant Hills Road / Hills M2 Motorway interchange (the southern interchange) to the northern connection with the M1 Pacific Motorway at Wahroonga (the northern interchange).

From the Hills M2 Motorway the main alignment tunnels would dive from the motorway shoulders beneath Pennant Hills Golf Course. The tunnel would continue on the southern side of Pennant Hills Road before crossing beneath Pennant Hills Road near Observatory Park. From here the tunnel would continue on the northern side of Pennant Hills Road before crossing back near the Trelawney Street intersection. The tunnel would then remain on the southern side of Pennant Hills Road before crossing under the Pacific Highway and following the M1 Pacific Motorway alignment northwards to emerge onto the shoulders of the M1 Pacific Motorway north of the North Shore railway line and Alexandria Parade, Wahroonga.

On-ramps and off-ramps for the northern and southern interchanges would include sections of tunnel to provide connections from the main alignment tunnels to existing surface roads. On and off-ramp tunnels would also vary in size and shape in response to local conditions. However, these tunnels would generally have a cross-sectional area of around 80 square metres, with a height of around eight metres and a width of around ten metres. Connections to existing surface roads, tie-ins, and integration works are described in further detail in **Sections 5.2.4** and **5.2.9**.

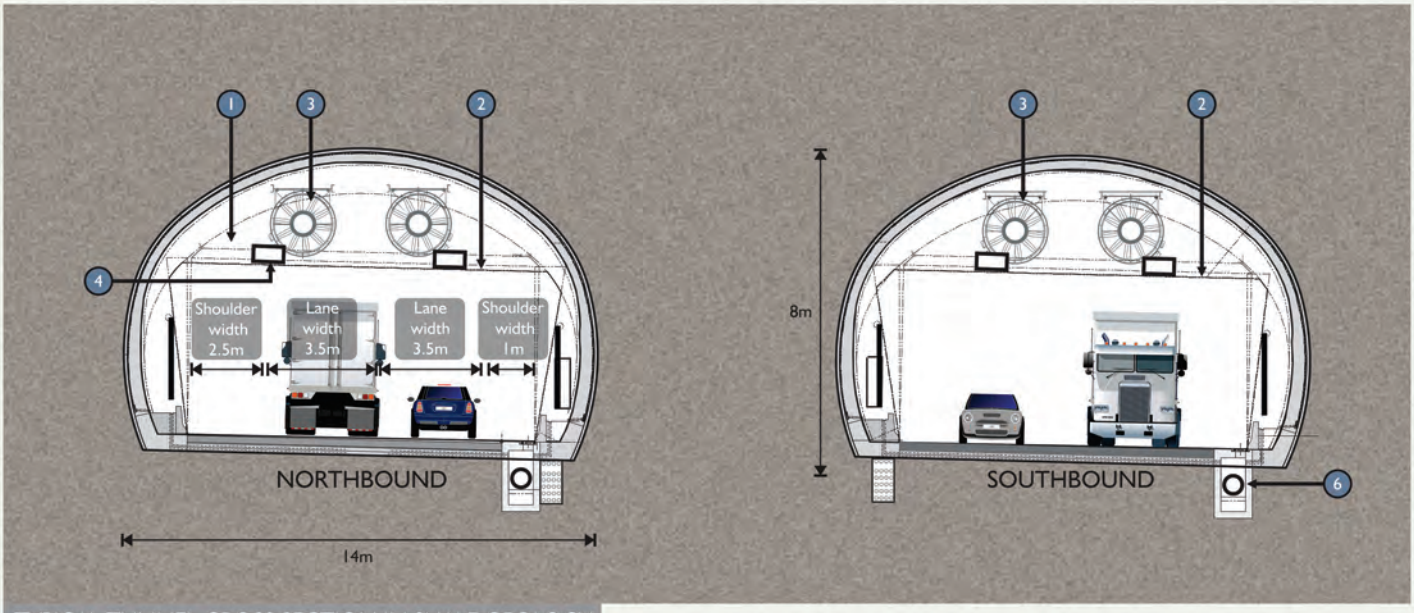
5.2.3 Road grade and lane widths

Each main alignment carriageway would consist of two lanes with a posted speed limit of 80 kilometres per hour. Each lane would be 3.5 metres wide with the shoulder on the left hand side being 2.5 metres wide and the shoulder on the right hand side being one metre wide. Although each carriageway would be line marked for two lanes, the motorway tunnels would be constructed to enable retrofitting to three lanes if required in the future. The minimum vertical clearance of each tunnel would be 5.3 metres.

On-ramps and off-ramps would have a lane width of 3.5 metres, a left side shoulder of two metres, and a right side shoulder of one metre. Surface ramps would have a lane width of 3.5 metres. Lane widths of surface roads proposed to be altered by the project would be as existing, or as per Austroads and Roads and Maritime design parameters.

The main alignment tunnels would generally have a maximum grade of 3.5 per cent to cater for consistent travel speeds. The absolute maximum grade of the main alignment tunnels would be four per cent, and the absolute minimum grade would be 0.5 per cent. Surface road grades would be compliant with standard Austroads and Roads and Maritime design parameters.

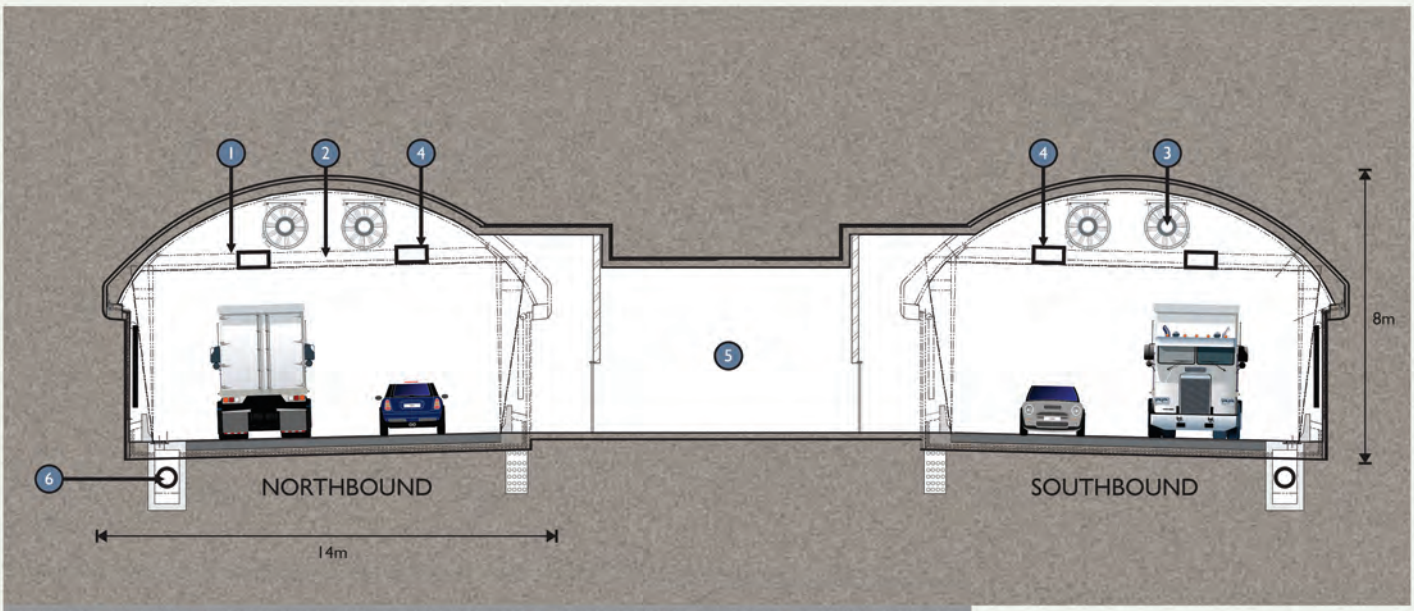
An indicative cross section and configuration of the main alignment tunnels is shown in **Figure 5-10**.



TYPICAL TUNNEL CROSS SECTION IN SHALE GEOLOGY

LEGEND

1. Services
2. Vehicle clearance - 5.3m
3. Jet fan
4. Signage
5. Tunnel drainage



TYPICAL TUNNEL CROSS SECTION IN SANDSTONE GEOLOGY AT TUNNEL CROSS PASSAGE

LEGEND

1. Services
2. Vehicle clearance - 5.3m
3. Jet fan
4. Signage
5. Cross passage
6. Tunnel drainage

Figure 5-10 Indicative cross section of main alignment tunnels

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5.2.4 Intersections and interchanges

A northern and a southern interchange would be constructed at either end of the main alignment tunnels to enable connections to and from the M1 Pacific Motorway, Pennant Hills Road and the Pacific Highway in the north and the Hills M2 Motorway and Pennant Hills Road in the south.

Southern interchange

The southern interchange would be located near the existing intersection of the Hills M2 Motorway / Pennant Hills Road at West Pennant Hills (refer to **Figure 5-11**). The interchange would provide connections to and from the project with the Hills M2 Motorway and Pennant Hills Road. Existing movements catered for at the Hills M2 Motorway intersection with Pennant Hills Road would be maintained. To enable these new connections, surface road works along Pennant Hills Road immediately north of the Hills M2 Motorway would be required. Works along the Hills M2 Motorway for connection to the project tunnel portals would also be required, as described in **Section 5.2.9**.

Portals to the northbound on-ramp and southbound off-ramp along Pennant Hills Road would be located south of Eaton Road. Motorists exiting the main alignment tunnels at this location would be able to continue travelling south along Pennant Hills Road or turn left onto the eastbound carriageway of the Hills M2 Motorway.

Motorists travelling north along Pennant Hills Road or exiting the westbound carriageway of the Hills M2 Motorway would be able to utilise the on-ramp to travel north on the project.

The main alignment tunnel portals would emerge adjacent to the shoulders of the Hills M2 Motorway to the west of Pennant Hills Road providing an uninterrupted connection between the Hills M2 Motorway.

Northern interchange

The northern interchange would be located near the intersection of the M1 Pacific Motorway and Pennant Hills Road at Wahroonga (refer to **Figure 5-12**). The northern interchange would connect the project with the M1 Pacific Motorway and Pennant Hills Road to enable traffic to travel north, south or east. In addition to this, the northern interchange would provide connections for traffic on or from Pennant Hills Road and the Pacific Highway to continue travel via these existing roads.

Portals to the southbound on-ramp and northbound off-ramp for Pennant Hills Road would be located to the east of Pennant Hills Road within the median of the Pennant Hills Road / M1 Pacific Motorway connector. This would require a widened section of road between these portals and Pennant Hills Road. This design approach has been adopted to minimise the need for permanent alterations to existing roadways and traffic arrangements.

Motorists exiting the main alignment at this location would be able to turn right at the M1 Pacific Motorway / Pennant Hills Road signalised intersection and access the Pacific Highway northbound or eastbound at Pearce's Corner.

Motorists travelling along Pennant Hills Road northbound or southbound would be able to access the main alignment southbound or the M1 Pacific Motorway northbound by turning at the M1 Pacific Motorway / Pennant Hills Road intersection.

Access to the main alignment from the Pacific Highway southbound and westbound would be facilitated by joining Pennant Hills Road at Pearce's Corner, then turning left at the M1 Pacific Motorway / Pennant Hills Road intersection where the portal and ramp would merge with the southbound tunnel.

The portals of the main alignment tunnels would emerge in the shoulders of the M1 Pacific Motorway to the north of Alexandria Parade in the vicinity of Bareena Avenue, Wahroonga.

Figure 5-11 Southern interchange operational layout

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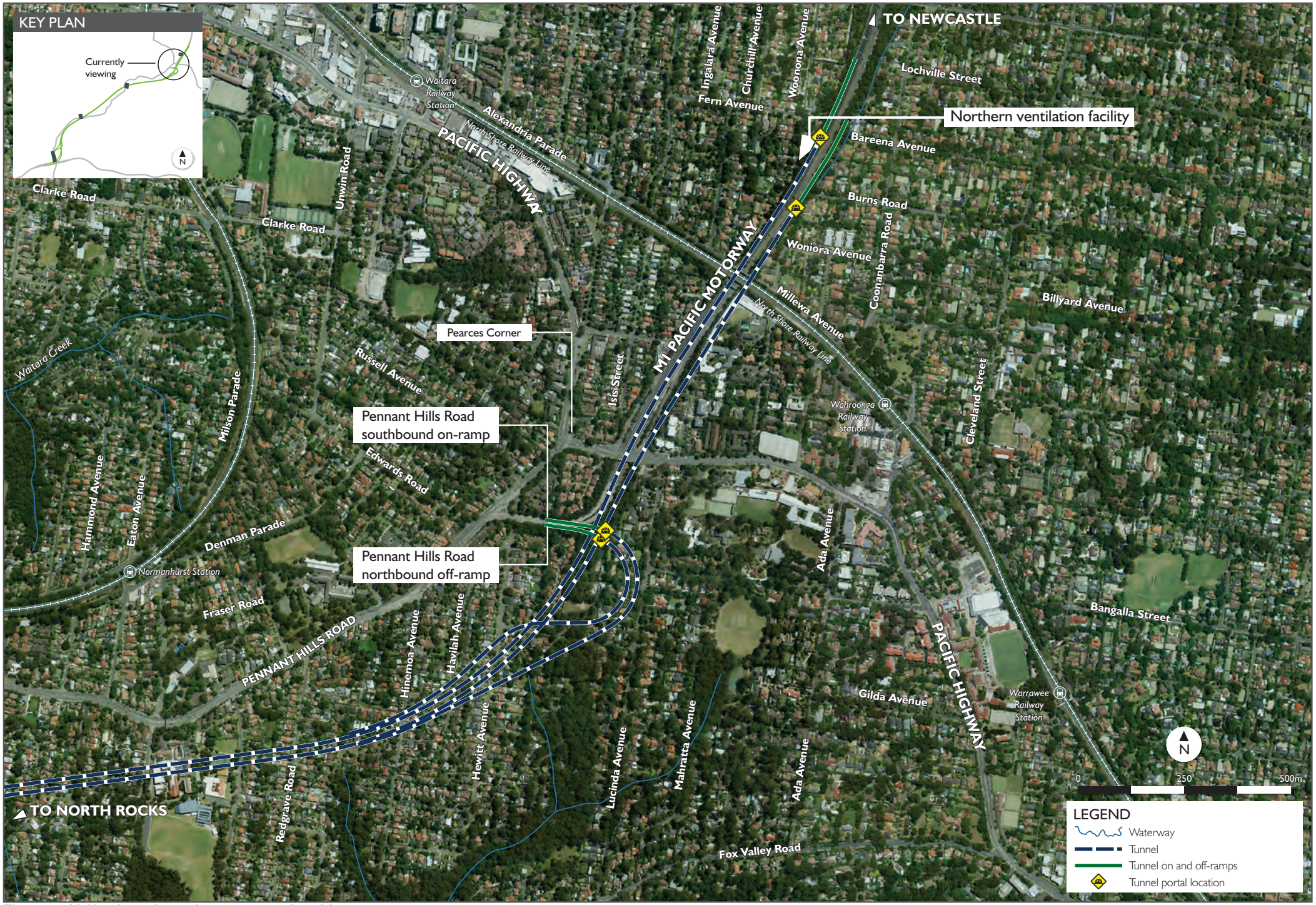

Figure 5-12 Northern interchange operational layout

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5.2.5 Ventilation system and facilities

The tunnel ventilation system would maintain appropriate air quality that is protective of the health and amenity of motorists within the tunnels during normal operation and emergency conditions. The tunnel ventilation system would comprise jet fans, two emergency smoke extraction outlets and two ventilation facilities.

During operation, the ventilation system would draw fresh air into the tunnels and emit air from within the tunnels via two ventilation facilities. One of the ventilation facilities would be located near the northern tunnel portal and one would be located near the southern tunnel portal (refer to **Figure 5-13**). The project does not currently propose portal emissions from the main alignment tunnels, however this approach may be considered in future and would be subject to appropriate assessment and approval.

During emergency conditions, depending on the location of the incident, the ventilation system would extract smoke from the tunnel which would be emitted from one or more of the following locations:

- The southern ventilation facility.
- Wilson Road tunnel support facility.
- Trelawney Street tunnel support facility.
- The northern ventilation facility.
- The tunnel portals.

Two emergency smoke extraction facilities would be required, with one located on the corner of Wilson Road and Pennant Hills Road (at the Wilson Road tunnel support facility), and one on the corner of Trelawney Street and Pennant Hills Road (at the Trelawney Street tunnel support facility) (refer to **Figure 5-13**).

Key components of the project's ventilation system are described in **Table 5-2**.

Table 5-2 Key components of the project's ventilation system

Ventilation system component	Description
Jet fans	• Jet fans would be mounted in pairs, with each pair separated by a distance of around 90 metres. • A total of around 65 jet fans would be installed in the northbound tunnel and ramps and around 60 jet fans in the southbound tunnel and ramps. • Jet fans would be located throughout the tunnel and would operate on an as required basis to maintain in tunnel air quality requirements.
Emergency smoke extraction outlets	• Two emergency smoke extraction outlets would be required, one located on the corner of Wilson Road and Pennant Hills Road (at the Wilson Road tunnel support facility), and one on the corner of Trelawney Street and Pennant Hills Road (at the Trelawney Street tunnel support facility) (refer to **Figure 5-13**). • Each tunnel support facility would have a maximum exhaust capacity of around 400 cubic metres per second to generate a net flow of around five metres per second along the tunnel. • Each tunnel support facility would consist of four horizontally mounted bidirectional axial fans, each with an exhaust capacity of around 135 cubic metres per second. • Emergency smoke extraction requirements could be achieved with three fans, with the fourth fan on standby. • During low traffic conditions, the tunnel support facilities would be used to supply additional fresh air to the tunnels.
Ventilation facilities	• Two ventilation facilities would be required – one near the northern and the other near the southern main alignment tunnel portals (refer to **Figure 5-13**). • Each ventilation facility would have a maximum exhaust capacity of around 700 cubic metres per second. • Ventilation facilities would consist of five horizontally mounted axial fans, each with an exhaust capacity of around 175 cubic metres per second. • Total ventilation requirements could be achieved with four fans, with the fifth fan on standby. However, during normal operation it is possible that all five fans could be operated at reduced capacity. • Both the southern ventilation outlet and the northern ventilation outlet would each be around 15 metres in height.

The tunnel ventilation system would be operated in three principal modes:

- Normal traffic conditions.
- Low speed traffic conditions.
- Emergency conditions.

Operation of the ventilation system under each of these conditions is detailed in the following sections and shown in **Figure 5-14**. Indicative layouts of the Wilson Road and Trelawney Street tunnel support facilities are provided in **Figure 5-15** and **Figure 5-16** respectively. Indicative layouts of the northern and southern ventilation facilities are provided in **Figure 5-17** and **Figure 5-18**.

Further details regarding external and in-tunnel air quality are provided in **Section 7.3** (Air quality).

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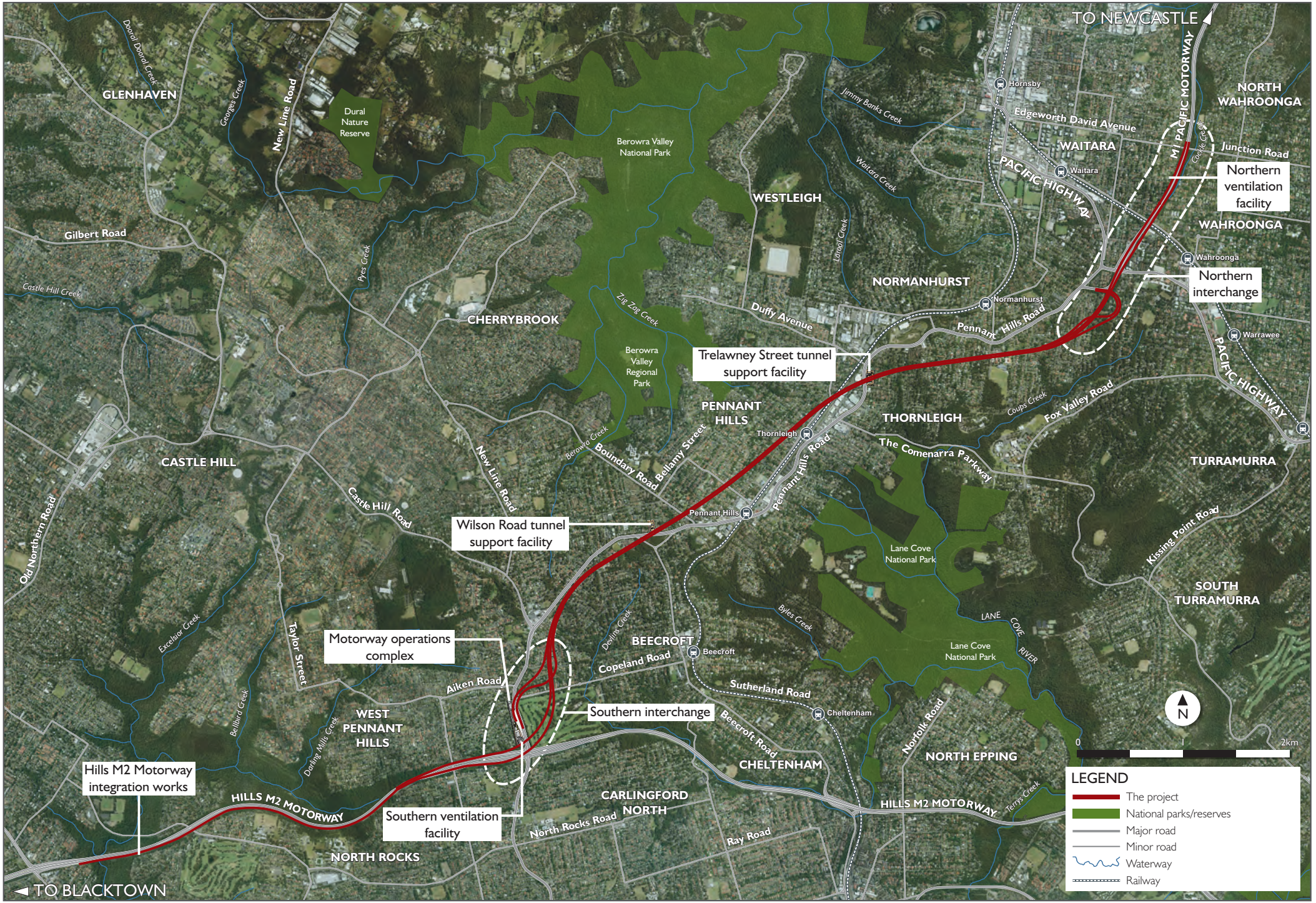

Figure 5-13 Ventilation and tunnel support facilities

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