STATE SIGNIFICANT INFRASTRUCTURE ASSESSMENT:
NorthConnex M1 – M2 Project
SSI 6136

Secretary's
Environmental Assessment Report
Section 115ZA of the
Environmental Planning and Assessment Act 1979

January 2015

Cover Photograph: Artists impression of the proposed NorthConnex tunnel

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EXECUTIVE SUMMARY

The Proposal

Roads and Maritime Services (the Proponent) proposes to construct and operate NorthConnex which comprises twin tunnels each at nine kilometres in length containing separate northbound and southbound carriageways. NorthConnex is to link the M1 Pacific Motorway at Wahroonga and the Hills M2 Motorway at West Pennant Hills and would generally follow the alignment of Pennant Hills Road. To support the tunnels, the construction of road interchanges within the existing road network and ventilation facilities are necessary. The project is located within the Hills, Hornsby and Ku-ring-gai Local Government Areas.

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 that is not of a motorway standard.

Need and Justification

NorthConnex would contribute towards the national objective of connecting Melbourne to Brisbane via a duplicated highway. Specifically, the objectives of the Proponent in delivering the NorthConnex are to:

- reduce traffic congestion and travel times within the corridor;
- deliver a high standard motorway that improves safety;
- provide efficiency and reliability for all road users;
- ensure integration of the proposal with the regional transport network;
- provide opportunities for improved public transport;
- provide excellence in design and sustainability; and
- ensure affordability.

The proposal would result in a safer and more efficient link between the M1 Pacific Motorway and the Hills M2 Motorway and would relieve traffic congestion along Pennant Hills Road. The key benefit is major travel time savings for road users. Morning peak savings are predicted to be in order of 22 minutes (77%) in 2019 and 34 minutes (87%) in 2029, while the evening peak savings are predicted to be in order of 25 minutes (81%) in 2019 and 40 minutes (87%) in 2029. This will result in productivity gains for business and industry through improved connectivity and improved freight distribution efficiency.

In addition to the above there will be other benefits for the community, including improved air and noise outcomes, and a safer and more amenable environment along Pennant Hills Road.

The NorthConnex proposal is also consistent with key State Government planning and transport strategies which seek to improve the State's transport infrastructure, including:

- NSW 2021 A plan to make NSW number one (2011);
- State Infrastructure Strategy Update (2014);
- NSW Long Term Transport Master Plan (2012);
- A Plan for Growing Sydney (2014); and
- NSW Freight and Ports Strategy (2013).

Assessment and Approvals Process

The proposal is 'State Significant Infrastructure'. It has also been declared 'Critical' State Significant Infrastructure as it has been deemed essential for the State for economic, environmental or social reasons. The Minister for Planning is the approval authority.

The Environmental Impact Statement was publicly exhibited from the 15 July 2014 to 12 September 2014 (a total of 60 days). A total of 1170 submissions were received including 8 submissions from public authorities. No submissions from public authorities objected to the

proposal however each raised key issues for consideration. The Department also referred the proposal to the Government's Advisory Committee on Tunnel Air Quality for advice on the assessment of air quality.

Of the 1170 public submissions received, 86% objected to the proposal, 4% supported the proposal and 10% did not object but raised concerns. Key concerns raised include: air quality; the project design and route selection; the Environmental Impact Statement methodology and consultation; traffic; noise and vibration; and other issues. All of the submissions received during the exhibition period were referred to the Proponent for further consideration.

The public and agency submissions, along with the findings of the Advisory Committee on Tunnel Air Quality, were considered in the Proponent's Response to Submissions Report and its Preferred Infrastructure Report which were submitted to the Department and subsequently placed on the Department's website on 11 December 2014.

Recommendation

The Department is satisfied that the project is in the public interest and would not result in any long term adverse or irreversible effects. The Department recommends that the project be approved subject to strict conditions.

Key Assessment Issues

Environmental Impact Statement Methodology and Consultation

The proposal has been assessed in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* as State Significant Infrastructure and Critical Infrastructure.

Exhibition and receipt of submissions on the proposal followed the statutory requirements stipulated in the *Environmental Planning and Assessment Act 1979*. The Department continued to accept and consider submissions received following the close of the formal exhibition period. As such, the Department considers that adequate opportunity was provided for community, agency and other stakeholder involvement in the assessment of the proposal.

Project Development and Route Selection

The Department acknowledges that a connection between the M1 and the M2 road networks has long been recognised by the NSW Government and the community as an important freight and commuter link in Sydney's local and regional road network. A thorough and robust route selection process for the proposal commenced in 2002 and included opportunity for consultation, and analysis of road corridor types and route options to meet the proposal's objectives. The route selection process also underwent a review in 2007 which validated this process and its outcomes.

The process of identifying and evaluating a route alignment for the purpose of such a critical piece of public infrastructure is a complex task, especially in the highly urbanised setting of the project which contains existing roads operating beyond or close to capacity. Based on the evidence, the Department considers that the Proponent has undertaken a comprehensive route selection process.

Air Quality

The consideration of air quality issues has been the subject of ongoing discussions with and advice from the Ministry of Health and Environment Protection Authority (EPA). The Department appointed an independent air quality expert to help inform its assessment of the proposal. The Department also sought advice from the Government's Advisory Committee on Tunnel Air Quality which appointed two independent international air quality experts to review the air quality assessment that supports the proposal.

The Department's assessment has carefully considered both in-tunnel and external air quality impacts associated with the project.

In Tunnel Air Quality

The Department considers that nitrogen dioxide (NO_2) is now the key pollutant of concern for in-tunnel air quality. While carbon monoxide has historically been the basis for in-tunnel criteria in NSW and internationally, improvements in modern vehicle technology mean that NorthConnex will comply with existing health based carbon monoxide standards. By contrast, vehicle emissions of NO_2have fallen less quickly, and uptake of diesel vehicles (which produce more NO_2than petrol based vehicles) has risen.

The Department acknowledges concerns raised by the Ministry of Health and the wider community about in-tunnel exposure to NO_2 and, in particular, the potential for sensitive individuals to experience adverse effects during transit. As a part of its assessment the Department has reviewed international trends and health based guidelines. The Department considers that best practice favours adopting a precautionary approach to in-tunnel exposure to NO_2, and has therefore recommended that the approval be subject to a compliance based criteria for in-tunnel NO_2 that better reflects health-based concerns. The Department's recommendation differs and is more stringent to that originally proposed by the Proponent as shown in the table below:

Proposed Average NO_2 over 15 mins	**Department's Recommendation**
0.5ppm (60/80km/hr)	0.5ppm
0.8ppm (40km/hr)	0.5ppm
1ppm (0-20km/hr)	0.5ppm

Accordingly, it is recommended that the Proponent's design criteria for NO_2 of 0.5ppm (averaged over 15 minutes) be applied as an average across the tunnel under all operating conditions.

The Department acknowledges that the community may question the Proponent's ability to meet this requirement. However, the Department is confident that given the level of conservatism in the Proponent's modelling, coupled with the Department's ability to require further design refinements, either through the recommended conditions or under the Government's new penalty regime, that there is sufficient ability and incentive for the design criteria to be consistently met.

The Department has also recommended a strict air quality monitoring regime including real time monitoring. The regime requires full accountability from operators for emission levels along the alignment of the tunnel. Any readings above the design criteria must be reported to the Department and other relevant authorities within 24 hours. Subject to performance criteria relating to nature, frequency, and severity of the readings, the Department will consider whether further tunnel design refinements are necessary to ensure that the design criteria is met continuously. Enforcement action would also be considered at that time.

The Department's recommendation is based on a precautionary approach to human health. The Department acknowledges that there is no internationally accepted limit for NO_2 but considers that there is a clear international trend towards adopting precautionary in-tunnel limits on NO_2 concentrations.

In its final report on the proposal, the Advisory Committee on Tunnel Air Quality Committee concluded that the project 'will bring a net improvement of the local air quality along substantial parts of the Pennant Hills Road corridor,' and any impacts on sensitive receptors would be very small.

External Air Quality

The proposal involves the construction of two ventilation outlets, with one at the northern end and one at the southern end of the tunnels. These ventilation outlets are located within or adjacent to established residential areas which have resulted in heightened community concern. While the proposal is expected to meet the relevant ambient air quality assessment goals in the vicinity of the outlets, these emissions will result in an increase to ground level concentrations over existing levels of key pollutants in the vicinity of the ventilation outlets.

The Department noted and considered the desirability of locating the ventilation outlets at the alternate locations outlined in many of the submissions. The Department has also considered the Proponent's response to these alternatives, including the constraints and associated costs. While the Department acknowledges that there are likely to be advantages associated with alternate locations, the Department is required to consider the acceptability of the project as proposed.

The Department's assessment concludes that the proposed ventilation outlets can be supported at the current locations given the following:

- The air quality parameters for all pollutants within the vicinity of the ventilation outlets comfortably meet relevant ambient State and National Standards;
- Discharge limits recommended by the EPA for all pollutants at the ventilation outlets have been set well below the ambient goals to ensure that the tunnels, contribution to air quality does not increase over time;
- A condition enabling the tightening of these limits in response to improvements in fuel efficiency and vehicle technology;
- Adherence to the recommended in tunnel air quality design criteria is likely to result in lower emission levels at the ventilation outlets as stated in the Preferred Infrastructure Report; and
- The recommended conditions require strict compliance with the discharge limits and rectification in the unlikely event that exceedences occur.

The Department has also recommended a condition that requires the Proponent to demonstrate how the tunnel ventilation system could be modified in the future should it be required. These modifications could include installation and operation of additional fans, air intakes, conversion of the Wilson Road and Trelawney Street emergency smoke extraction facilities to ventilation outlets, or filtration.

The Department has recommended a comprehensive air quality monitoring and reporting regime that includes community involvement similar to other major tunnel projects in Sydney. It has been recommended that an Air Quality Community Consultative Committee be established to inform the location of the monitoring stations, and review and provide advice on monitoring and other operational air quality requirements.

Noise and Vibration

The Department acknowledges that construction noise is a key concern for the community. Noise impacts associated with infrastructure projects in an urban setting are unavoidable and are sometimes required to be managed, rather than completely mitigated. The Department has recommended a suite of management measures which include: ongoing communication and involvement with the affected community; construction respite periods; specific mitigation measures (such as noise enclosures and barriers); monitoring and auditing regimes; and strict adherence to EPA requirements and the Conditions of Approval.

However, the Proponent is seeking to carry out certain works outside standard construction hours. While the Department is supportive of these works, there has been insufficient assessment relating to the associated impacts. Specifically, the magnitude and duration of potential impacts and the proposed measures to mitigate these impacts is inadequate. This is especially the case for spoil removal.

Subsequently, the Department has recommended that the Proponent must develop an 'out of hours work protocol' which details the impacts and specific noise mitigation works including at-receiver treatments for the most highly affected receivers in addition to other standard mitigation measures. The Protocol also must include community notification requirements.

In terms of operational noise, the Department concurs that the project is expected to provide benefits in terms of reduced noise to the section of Pennant Hills Road bypassed by the tunnel. Those locations impacted by the proposal, particularly the residential areas near to the southern

and northern interchanges would be the subject of at-source, intermediate and at-receiver mitigation measures commensurate with the level of impact experienced. This is common practice for major road projects in NSW.

Traffic

The Department acknowledges that there will be considerable construction traffic impacts commensurate with the scale of the proposal. Standard management techniques are available and can be applied to minimise these impacts as far as practicable. A series of plans including road safety audits; a detailed construction traffic management plan; and a spoil management plan will be guided by a series of performance criteria, including recommendations to avoid use of heavy vehicles on local roads.

The Department is satisfied that the Proponent's traffic modelling has demonstrated that operation of the project would improve traffic speeds and safety for road users between the M1 Pacific Motorway and the Hills M2 Motorway and the network in general. The Department concludes that the proposal would satisfy the strategic need for a key efficient and safe link in the Sydney motorway network.

Other issues

Other issues raised include soil and water management, urban design and visual impacts, biodiversity, heritage and socio-economic impacts. The assessment concludes that relevant impacts can be appropriately managed through the implementation of mitigation measures and safeguards, as proposed in the Environmental Impact Statement, recommended in the Departments Conditions of Approval and refined in the relevant management plans.

Conclusion

The Department is satisfied that NorthConnex would contribute towards the national objective of connecting Melbourne to Brisbane via a duplicated highway and is consistent with key State Government planning and transport strategies.

The project will result in a significant decrease in travel times particularly during the morning and evening peaks within the corridor. This will reduce congestion on the road network and improve freight distribution efficiency, contributing to the productivity of NSW.

Air quality was identified as the key assessment issue. The Department has adopted a precautionary approach to in tunnel air quality by recommending a stricter average design criterion for NO_2 of 0.5ppm (averaged over 15 minutes) be applied across the tunnel under all operating conditions. The Department's assessment also found that the proposed external air quality outcomes could be supported given they meet relevant ambient air quality goals. The ventilation outlets would be subject to strict pollutant limits.

The Department's assessment identified a number of other key areas for detailed consideration, including, noise and vibration and traffic. The assessment concluded that impacts were acceptable subject to a range of conditions to manage residual impacts. Specific details of these conditions are provided on the following pages.

The Department concludes that the project's benefits are substantial and the proposal will not result in any long term adverse or irreversible effects. It is therefore in the public interest and should be approved.

Key Recommended Conditions of Approval

Issue: In-tunnel air quality and health impacts of exposure.
Stage: These conditions will come into effect during the operational phase.

Stricter (than that proposed by the Proponent) average design criterion nitrogen dioxide (NO_2) of 0.5ppm (averaged over 15 minutes) must be applied across the tunnel under all operating conditions. Any readings above the design criteria must be reported to the Department and other relevant authorities within 24 hours.

Subject to performance criteria relating to nature, frequency, and severity of the readings, the Department will enforce further tunnel design refinements if necessary to ensure that the design criteria is continuously met.

Tunnel ventilation system must be designed and operated to be compliant with identified in-tunnel carbon monoxide (CO), visibility and NO_2 concentrations and limits.

(See conditions: E2 — In-tunnel air quality average concentrations, E3 — In-tunnel air quality single point CO concentration limit, E4 — In-tunnel visibility limit, E5 — In-tunnel air quality notification and reporting and E6 — Tunnel Air Quality Management Systems Effectiveness Report, including ability to require improvements to the air quality management system)

Issue: External Air Quality.
Stage: These conditions will come into effect during the operational phase.

Strict limits on in-stack pollutant concentrations of particulate matter, nitrogen dioxide, carbon monoxide, volatile organic compounds, and polycyclic aromatic hydrocarbons. An independent person must verify that these limits are being met.

Conditions set external ground level concentration goals based on the National Environment Protection Measures.

The Proponent must report on any recordings over these limits and goals and rectify where required.

To ensure continuous improvement in air quality management, the limits can be tightened subject to demonstrable air quality improvements in fuel efficiency and vehicle technology.

(See conditions E8 — External air quality goals, E9 – External air quality notification and reporting, E11 — Ventilation outlet limits, E12 – Review of ventilation outlet limits, including tightening of limits where air quality improvements in vehicles, E13 — Ventilation outlet concentrations — notification and reporting, and E13 — requirement to demonstrate options to ensure compliance with limits, and ability to enforce improvements)

Issue: Concern regarding robustness and validity of air quality modelling.
Stage: These conditions will come into effect during the construction and operational phases.

A suite of conditions to govern air quality monitoring, including real time monitoring in the tunnels, ventilation outlets and outside the tunnel.

External independent auditing of results.

Community involvement in the monitoring process, with an Air Quality Community Consultative Committee to be established to inform monitoring locations, and review management plans and monitoring results.

(See conditions B8 — Establishment of Air Quality Community Consultative Committee and selection of monitoring station locations, E1 — In-tunnel air quality monitoring, E7 — External air quality monitoring, E10 — Ventilation outlet monitoring, E12 — Air Quality - verification and validation of compliance, E17 — Air quality — general reporting requirements, E18 — Public access to monitoring results and E19–E21 — Air quality auditing and quality assurance)

Issue: Concern with construction impacts, particularly around compound sites.
Stage: These conditions will come into effect prior to and during the construction phase.

A comprehensive set of requirements for construction environmental management.

Plans to describe best practice safeguards and environmental controls for construction traffic and access, construction noise and vibration, Aboriginal and non-Aboriginal heritage, construction air quality, and construction soil and water management.

A management plan to specifically guide the set up and operational of compound sites, including measures to reduce noise, dust and visual impacts. Road Safety Audits would be required for key site access routes.

An out of hours protocol must be established for night time activities, setting out the key noise controls to reduce impacts on sleep.

(See conditions B34 — Minimise impact to third property, B35 — Minimising light spill to adjacent properties, D1 — Appointment of Environmental Representative, D9-D29 — Noise and vibration requirements, D30-D34 — Aboriginal and Non Aboriginal heritage requirements, D35-D42 — Construction transport and access requirements, D49 — Requirements for boundary screening at compound sites, D51-D55 — Ancillary facilities criteria and management, D50 —Ancillary facilities management plan, D56- D57 — Construction Environmental Management Plan, D57(a) — Construction Traffic and Access Management Plan, D57(b) — Construction Noise and Vibration Management Plan, D57(c) — Construction Heritage Management Plan, D57(d) — Construction Flora and Fauna Management Plan, D57(e) — Construction Air Quality Management Plan and D57(f) — Construction Soil and Water Management Plan

Issue: Concern with the impacts of 24/7 spoil haulage.
Stage: These conditions will come into effect prior to and during the construction phases.

A Spoil Management Strategy to guide the process of disposing of excavated material. The Strategy would inform the safeguards and environmental controls.

A condition requiring additional approval/s for spoil disposal.

(See conditions A7 — Additional approval required for spoil disposal, D9-D17 — Construction noise requirements, D18 — Construction traffic noise requirements, D35-D39 — construction transport and access requirements, D40 — Spoil Management Strategy, D41 — Ancillary facility road safety audits, D42 — Amenity, traffic and safety considerations for heavy vehicle construction traffic on local roads, D50 — Ancillary Facilities Management Plan, D56 – D57 — Construction Environmental Management Plan and D57(b) — Construction Noise and Vibration Management Plan (Out Of Hours Work Protocol).

Issue: Concern with subsidence impacts.
Stage: These conditions will come into effect prior to, during and after the construction phases.

A rigorous process for monitoring and rectifying any impacts caused by subsidence. The Proponent must inspect properties, set criteria for maximum subsidence levels and rectify any impacts.

(See conditions B34 — Rectification of damage to property, D5-D8 — Mitigation of settlement associated with tunnelling and excavation and D21 — Blast Management Strategy)

Issue: Concerns with water impacts from groundwater dewatering and discharge.
Stage: These conditions will come into effect prior to and during the construction phase and during the operational phase.

A comprehensive Water Quality Plan and Monitoring Program to ensure the proposal contributes to improved water quality in local streams. Ongoing groundwater impacts to be verified and any impacts on groundwater bores are to be rectified.

(See conditions B9 — Prohibition of pollution of waters, B13 — Flood Mitigation Strategy, B15-B16 — Water Quality Plan and Monitoring Program, D3-D4 — Construction Soil and Water Management measures and D57(f) — Construction Soil and Water Management Plan)

Issue: Concern with visual and amenity impacts, particularly around operational facilities.
Stage: These conditions will come into effect during the operational phase.

A detailed Urban Design and Landscape Plan to ensure structures integrate with their receiving environments. The plan would set out architectural and landscape design opportunities to improve the design of the proposal.

The Proponent would be required to reduce light spill impacts around operational sites.

(See conditions B35 — Minimising light spill to adjacent properties and B33 — Urban Design and Landscape Plan)

Issue: Concern with general operational impacts, and the validity of modelling predictions.
Stage: These conditions will come into effect during the operational phase.

Comprehensive requirements for operational environmental management including air quality, noise and vibration, and traffic.

Verification of noise modelling, based on traffic numbers, and monitoring to determine if any additional control measures are required.

Review of traffic performance, including review of measures to remove heavy vehicles from Pennant Hills Road and facilitate public transport improvements.

Independent auditing of overall operational environmental impacts of the proposal within 12 months of operation, and as otherwise requested by the Department.

(See conditions E30 — Operational Environmental Management Plan, E24-E25 — Operational Noise Management Plan, E26 — Operational noise monitoring and verification, E27 Operational Traffic Management Plan, E28 — Road Network Performance Review Plan and E31 — Independent Environmental Audit)

1. BACKGROUND

Roads and Maritime Service (RMS) proposes to construct and operate NorthConnex and associated road improvements. NorthConnex comprises twin tunnels each at nine kilometres in length and containing separate northbound and southbound carriageways. NorthConnex would link the M1 Pacific Motorway at Wahroonga and the Hills M2 Motorway at West Pennant Hills and would generally follow the alignment of Pennant Hills Road. The location of the proposal is shown in **Figure 1.**

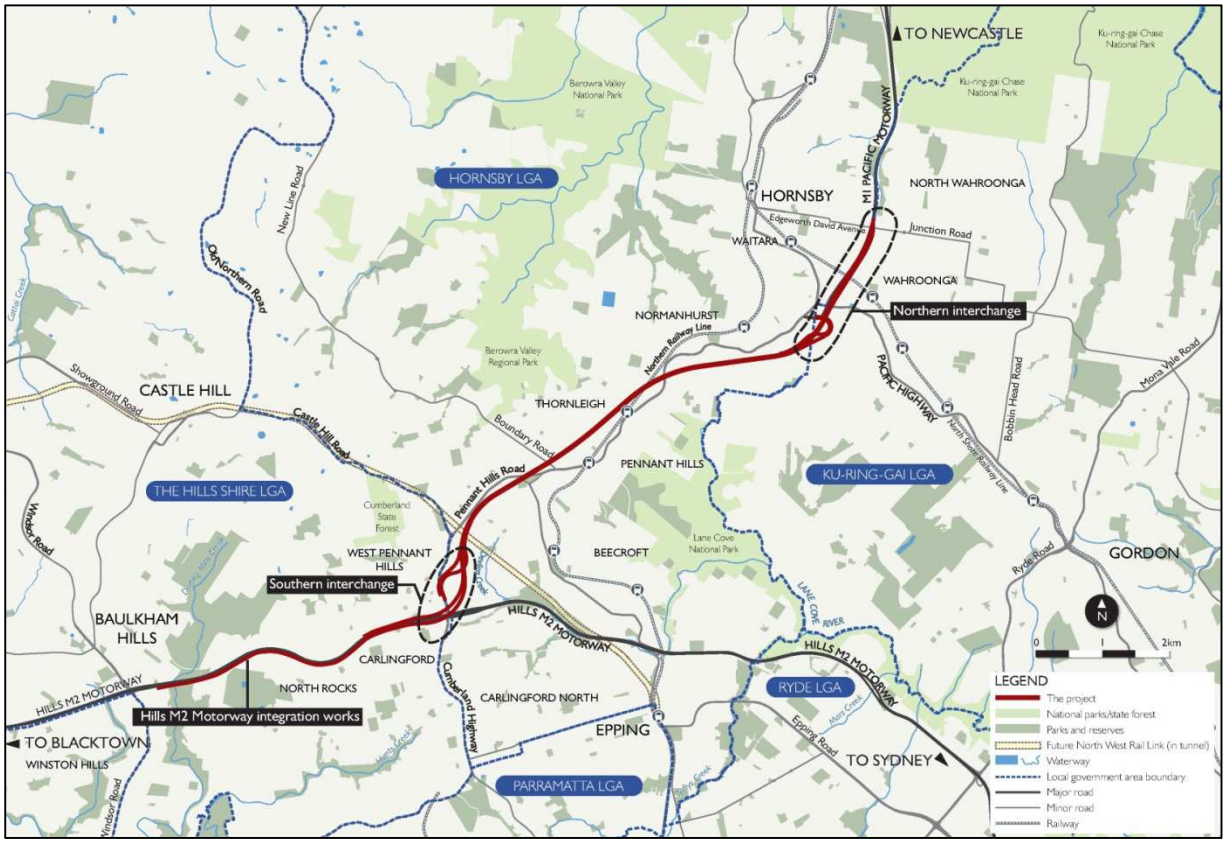

Figure 1: Project location *Source: Environmental Impact Statement*

The proposed tunnels would traverse the suburbs of Wahroonga, Normanhurst, Thornleigh, Pennant Hills, Carlingford, North Rocks, Westmead and Baulkham Hills. The proposal is located within the Hills, Hornsby and Ku-ring-gai Local Government Areas.

The missing link between the M1 Pacific Motorway and the Hills M2 Motorway is one of the key constraints of the national road network. At a national scale, Pennant Hills Road is currently used as the key arterial link to provide a connection between Sydney, the NSW north cost, regional northern NSW and onwards to Brisbane, in lieu of any motorway. The Pennant Hills Road missing link between the M1 Pacific Motorway and the Hills M2 Motorway forms part of the National Land Transport Network (refer **Figure 2**), and is one of the two remaining sections of the network that is not of a motorway standard. Following commencement of operation, vehicles would be able to travel between the Hunter Region and the Victorian border without encountering traffic lights.

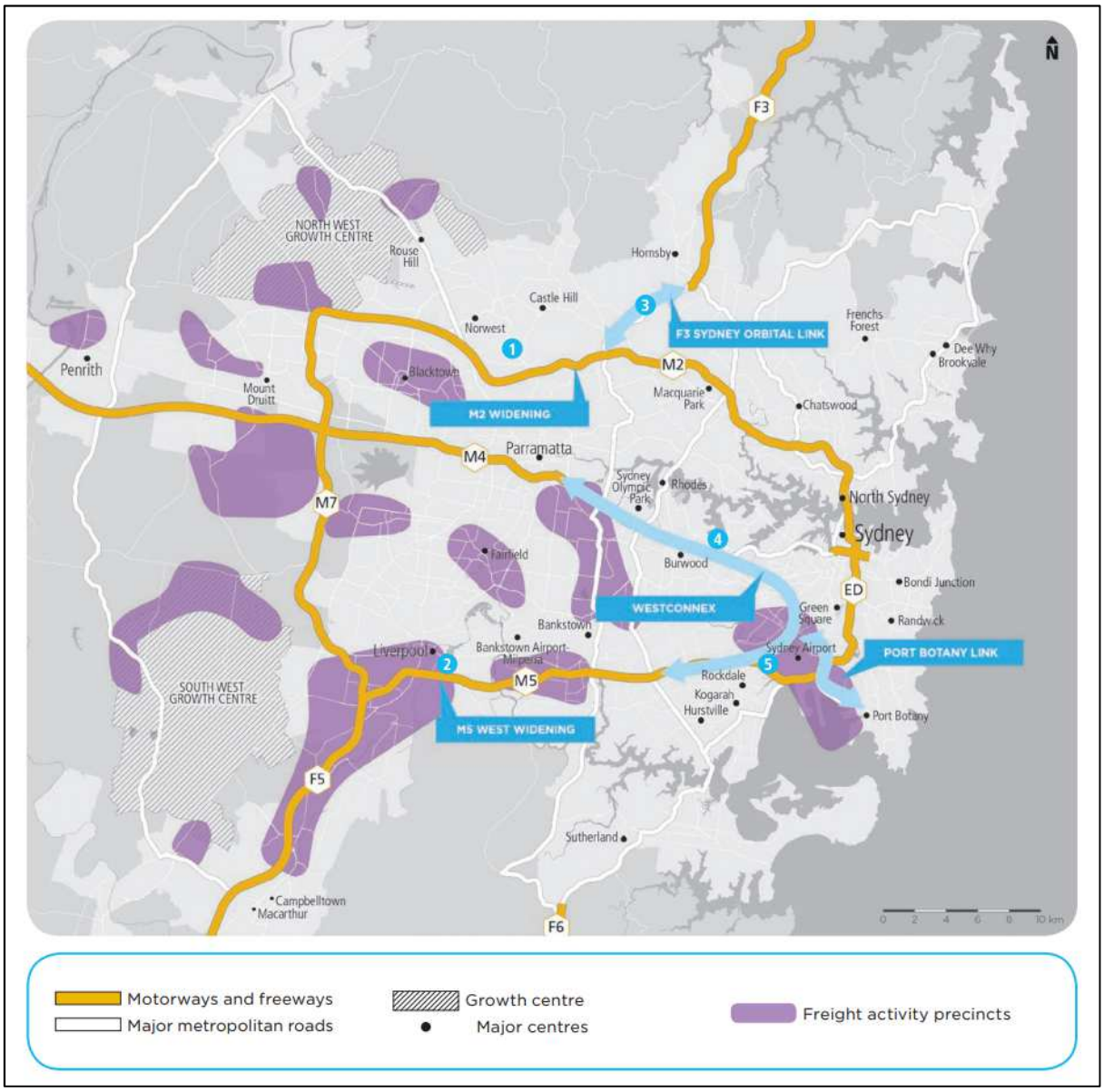

Figure 2: Motorway network. ***Source: Environmental Impact Statement***

At a regional scale, Pennant Hills Road provides a connection between Sydney and the NSW north coast, regional northern NSW, Newcastle and Hunter regions. At a local scale, Pennant Hills Road provides a connection for commuters, freight and local traffic travelling between Sydney's north-west suburbs, Sydney's central business district, North Sydney and Macquarie Park.

Pennant Hills Road currently carries large volumes of traffic. Two-way average annual daily traffic in 2011 was estimated at approximately 80,000 vehicles per day. A significant proportion, 14.4%, of the vehicles using Pennant Hills Road is heavy vehicles due to the corridor's importance as a national freight corridor. As a result, the corridor is currently operating at or beyond capacity during the peak with cars and cyclists sharing the road with heavy vehicles.

NorthConnex would be located in an established suburban area for which Pennant Hills Road forms a subregional focal point. The presence of major roadways including Pennant Hills Road, M1 Pacific Motorway and the Hills M2 Motorway create a barrier to community cohesion, as high heavy vehicle usage increases road traffic noise, impacts on road user and pedestrian safety, and discourages traffic from stopping at local centres along the route. However, some vehicle and pedestrian linkages are provided across these barriers to assist in cohesion but fall short of enabling a safe, effective and attractive community environment.

The area surrounding the northern interchange with the M1 Pacific Motorway and Pennant Hills Road generally consists of low rise residential development and educational facilities. The proposed tunnel support facility located at Wilson Road is situated amongst residential development while the proposed tunnel support facility at Trelawney Street is amongst residential and commercial land uses associated with Pennant Hills Road.

The proposed southern interchange is bound by residential land uses and the Pennant Hills Golf Club. The project incorporates integration and widening works with the Hills M2 Motorway, which are situated among remnant bushland and low density residential areas.

Surrounding land uses vary along the alignment and include:

- residential, recreation and educational in the vicinity of the proposed M2 integration works between Windsor Road and Pennant Hills Road;
- residential to the west and recreation to the east of the southern interchange at Pennant Hills Road and the M2 Motorway;
- residential around the Wilson Road tunnel support facility;
- mixed industrial, commercial and residential around the Trewlaney Street tunnel support facility;
- mixed low and medium density residential around the northern interchange at Pennant Hills Road and Pacific Highway/Motorway; and
- residential around the northern ventilation facility.

Land uses above the tunnel alignment are primarily residential, except at Thornleigh where the alignment is beneath mixed industrial and commercial uses and the Northern railway line. Recreational (Pennant Hills Golf Course and Observatory Park) and educational (Loreto School at Normanhurst) uses are also located above the tunnel.

Significant land uses and destinations within or near the project area include the Ku-ring-gai Chase National Park, Lane Cove National Park, Berowra Valley Regional Park, Bidigal Reserve, Pennant Hills Golf Course, Muirhead Golf Course, private and public schools (Abbotsleigh, Loreto, Mount Saint Benedict, Royal Institute of Deaf and Blind Children, Muirhead High School and Our Lady of Lourdes), and shopping centres at Hornsby and North Rocks.

Significant topographical features include Darling Mills Creek and Blue Gum Creek near the M2 integration works and Cockle Creek at North Wahroonga.

2. PROPOSED DEVELOPMENT

2.1. Description of the Proposal

NorthConnex comprises twin tunnels each at nine kilometres in length, containing separate northbound and southbound carriageways which link the M1 Pacific Motorway (formerly F3 Freeway) at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at West Pennant Hills. The motorway tunnels each include two lanes in each direction and provision for a third lane in each direction if required in the future. Vehicles will travel within the tunnel for about six minutes. The location, horizontal and vertical alignment of the tunnel has been determined taking into consideration traffic efficiency engineering design limitations, cost and environmental and social impacts.

A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, will facilitate access to and from the Pacific Highway. Tie-in works with the M1 Pacific Motorway will also extend to the north of Edgeworth David Avenue. A southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of on-ramps and off-ramps will also be constructed.

Additional integration work on the Hills M2 Motorway would provide an extra 3.5 km lane and bridge widening works from Pennant Hills Road to the Windsor Road interchange. Local road works would also occur near both the southern and northern interchanges.

Operation and maintenance activities for the tunnel will be provided by a new motorway control centre near the southern interchange, as well as the southern ventilation facility. The northern ventilation facility would be located primarily above the northbound main alignment, near the connection with the M1 Pacific Motorway. The siting of each ventilation facilities within close proximity to the end of the tunnels has been determined taking into consideration ventilation efficiency.

Two tunnel support facilities located directly above the main alignment, generally mid-way at Pennant Hills and Thornleigh would provide air intake systems, emergency smoke extraction outlets and substations.

The Capital Investment Value (CIV) of the proposal is $3.2 billion and the proposal will create up to 1250 construction jobs. The project alignment including proposed tunnel and integration works is shown in **Figure 3**. The key components of the proposal are listed in **Table 1**.

Figure 3: Project alignment, configuration of interchanges and location of operational facilities. ***Source: Environmental Impact Statement***

Table 1: Key Components

Aspect	*Description*
Project Summary	• construction and operation of two road tunnels for traffic travelling north - south between the M1 Pacific Motorway and the Hills M2 Motorway; • M2 integration works; • construction of access points and improvements to intersections and interchanges in the vicinity of NorthConnex; • construction of ventilation facilities; • motorway control centre; and • 11 temporary construction facilities to support the construction of the proposal.
Tunnels	• construction of twin motorway tunnels nine kilometres in length with separate northbound and southbound carriageway tunnels; and • each carriageway tunnel would be line marked for two lanes, with provision for upgrading to three lanes if require in the future (subject to further assessment and approval).
Interchanges	• northern interchange between Pennant Hills Rd and M1 Pacific Hwy; and • southern interchange between Pennant Hills Rd and Hills M2 Motorway.
Integration works	• integration with the Hills M2 Motorway, including alterations to the eastbound carriageway to the west of the southern interchange; • new 3.5 kilometre westbound lane along the Hills M2 motorway between the southern interchange and the Windsor Road off-ramp • widening of the M1 Pacific Motorway adjacent to the existing road shoulder to provide for northbound and southbound entrance to the tunnel; • widening of Eaton Rd near the southern interchange; • repositioning of the Hewitt Ave cul-de-sac close to the northern interchange; • construction of access points and improvements to intersections and interchanges in the vicinity of NorthConnex; • modification to the Yale Close and Barclay Road overbridge and Darling Mill Creek viaduct; and • further local road changes and reconfigurations would be envisaged resulting from the detailed design. Such changes would be detailed in the Construction and Environment Management Plan.
Ventilation	• northern ventilation facility, adjacent Bareena and Woonona Avenues, Wahroonga, comprising a 20 metre high ventilation outlet and surface buildings (including housing for axial fans); • southern ventilation facility, in the Motorway Operations Complex on Pennant Hills Road, West Pennant Hills, comprising a 20 metre high ventilation outlet and surface buildings (including housing for axial fans); and • installation of a longitudinal ventilation system (with no portal emissions) comprising of 125 jet fans within both tunnels.

Ramps	• four on and off ramps at the northern interchange, including:
	  • southbound on-ramp and northbound off-ramp to the M1 Pacific Motorway, north of the Pacific Highway overpass;
	  • eastbound on-ramp and westbound off-ramp to the Pennant Hills Road, south of the Pennant Hills Road/Pacific Highway intersection; and
	• four on and off ramps at the southern interchange, including:

Aspect	Description
	• eastbound on-ramp and westbound off-ramp to the Hills M2 Motorway, west of the Pennant Hills Road overpass, and • northbound on-ramp and southbound off-ramp to the Pennant Hills Road, north of the existing Pennant Hills Road//Hills M2 Motorway interchange.
Cycling Facilities	• construction of two new cycleway bridges at the southern interchange; and • construction of a new cycleway at the northern interchange.
Tolling Infrastructure	• construction of electronic tolling infrastructure at the southern and northern interchanges; and • construction of tolling gantries on Pennant Hills Road for truck regulation.
Water Quality Controls	• construction of a sump near the southern interchange; • construction of spillage containment tanks; • construction and alteration of draining infrastructure including detention basins, pits and pipes for surface and tunnel works; • construction of water quality treatment plants at the 4 tunnelling launch and support construction compounds; and • construction of an operational water treatment plant near the southern interchange.
Signage	• construction of traffic, locational, directional, warning and variable message signs within the tunnel and at the surface connections approaching the tunnel; • provision of tunnel way finding signage in the tunnel to provide motorists with a sense of place during the journey through the tunnel; and • emergency signage providing direction towards emergency exits.
Ancillary Facilities	• deluge systems; • fire and life safety systems; • installation of CCTV in the tunnel and the approaches; • height detection systems; • tunnel barrier gates to prevent access in the event of tunnel closure; • vehicle cross passages for emergency use; • pedestrian cross passages between the two main alignment tunnels; • vehicle breakdown bays on the Hills M2 Motorway and the M1 Pacific Motorway; • drainage infrastructure; • mechanical and electrical equipment; • incident response systems; and • ventilation infrastructure.
Construction Compounds	• 11 construction compound facilities providing earthworks support and workforce amenities including 4 tunnel launch and support facilities including workshops and spoil management facilities at the Southern Interchange, Northern Interchange, Wilson Road and Trelawney Street compounds; and • a parking and staff transfer compound for 600 light vehicle parking spaces, bus transfer area, employee change rooms and showers, and first aid station at the Pioneer Avenue compound.
Maintenance and Operation Facilities	• a 24 hour staffed motorway control centre near the southern interchange; • fire and life safety systems including emergency evacuation

Aspect	Description
	infrastructure; • two emergency smoke extractions outlets at the Wilson Road and Trelawney St support facilities; and • installation of power, communications, traffic control, lighting and operations management and control systems.

Construction of NorthConnex is anticipated to take 48 months with the tunnel open to traffic in late 2019. Construction is to be undertaken by the private sector in accordance with an unsolicited proposal submitted by Transurban and the Westlink M7 Motorway shareholders. The project would be operated as a tollway, with the same tolling structure as implemented on the Hills M2 Motorway.

Construction above ground is proposed to be carried out between 7:00 am and 6:00 pm weekdays and 8:00 am to 1:00 pm Saturdays. Tunnelling would operate continuously 24 hours a day, 7 days a week. Tunnelling includes the construction of the main tunnels and additional tunnels for on and off ramps, enlargement of emergency bays, pedestrian cross passages, deluge systems, drainage infrastructure, mechanical and electrical equipment, incident response and ventilation infrastructure.

Construction Compounds

There are 11 construction compounds along the length of the project corridor. **Figure 4** shows the proposed functions to be carried out at each compound site. A construction compound would be established at each of the four locations where excavation is to be undertaken, including the Southern Interchange Compound, Northern Interchange Compound, the tunnel support facility at the Wilson Road Compound, and the tunnel support facility at the Trelawney Street Compound. During excavation, spoil from the tunnel would be extracted and transported offsite 24 hours a day. Out of hours spoil handling and truck loading would occur within acoustic sheds outside standard construction hours. Spoil extraction sites would be located immediately adjacent to arterial roads to reduce the impact of spoil haulage and other heavy vehicle movements.

The remaining seven construction compounds would be used for a variety of purposes during construction, including construction staff parking, office space, mechanical workshops and materials storage, and construction of the northern ventilation facility at the Bareena Avenue compound.

No.	Site	Temporary facilities							Permanent facilities				
		Site offices	Staff amenities	Stores and laydown	Workshop and maintenance	Tunnelling launch and support	Spoil management	Water treatment plant	Ventilation outlet	Emergency smoke outlet	Substation	Motorway control centre	Water treatment plant
C1	Windsor Road compound	✓	✓	✓									
C2	Darling Mills Creek compound		✓										
C3	Barclay Road compound		✓	✓									
C4	Yale Close compound		✓										
C5	Southern interchange compound	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓
C6	Wilson Road compound	✓	✓	✓	✓	✓	✓	✓		✓	✓		
C7	Trelawney Street compound	✓	✓	✓	✓	✓	✓	✓		✓	✓		
C8	Pioneer Avenue compound	✓	✓										
C9	Northern interchange compound	✓	✓	✓	✓	✓	✓	✓					
C10	Bareena Avenue compound	✓	✓	✓					✓		✓		
C11	Junction Road compound	✓	✓										

Figure 1: Construction compounds and their function. ***Source: Environmental Impact Statement***

2.2. Alternative Design

Following exhibition of the Environmental Impact Statement and in response to submissions received, the Proponent amended the proposal and prepared a Preferred Infrastructure Report. The Preferred Infrastructure Report amends the proposal as follows:

- increase the height of ventilation outlets by five metres;
- increase bus movements per hour from the Pioneer Avenue compound;
- amend of construction haulage routes for the Southern Interchange, Trelawney Street and Northern Interchange compounds;
- inclusion of additional uses at the Junction Road Compound; and
- acquisition of additional property at the Wilson Road Compound.

The Proponent has also updated its mitigation measures in response to issues raised in submissions and to reflect amendments made to the proposal. Some of the mitigation measures include:

- the development of specific noise mitigation measures;
- the development of a comprehensive operational air monitoring plan, including monitoring in schools;
- the development of a three dimensional ground water model; and
- the provision of funding for research into air quality conditions for motorists.

2.3. Strategic Need and Justification

Sydney's road and motorway network supports economic growth across NSW by connecting people to jobs, facilitating trade between businesses and providing the required infrastructure for efficient freight movements. As Sydney's population and economy continue to grow, efficient transport systems become increasingly important in servicing future growth.

Infrastructure NSW has noted that 80 per cent of passenger and freight movements in Sydney are made by road, and that traffic and congestion on key corridors is growing. By 2030, Sydney will be moving 18 million tonne-kilometres of road freight each year, an increase of more than 67 percent.

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 that is not of a motorway standard. NorthConnex is a key piece of road infrastructure for the Sydney road network and would result in the completion of this outstanding section. The importance of a connection between the M1 and the M2 road networks has long been recognised by the NSW Government and the community. The growing demand for efficient and timely freight and commuter access between regional and local centres and Sydney has exacerbated the need for this connection.

Heavy traffic flows and congestion along Pennant Hills Road during commuter peak periods and business hours results in low average travel speeds, unreliable travel times and disruptions to inter-regional traffic movements. The average speed during the morning peak is 31 kilometres per hour. The average AM peak hour travel times in 2013 along Pennant Hills Road between M1 Pacific Highway interchange and Hills M2 Motorway Interchange was 14 minutes northbound and 28 minutes southbound. The average PM peak hour travel times in 2013 were 19 minutes northbound and 13 minutes southbound.

Transport modelling indicates that based on a 'without project' scenario, by 2019 mid-block traffic volumes on some sections of Pennant Hills Road would experience traffic volumes at peak times which would exceed theoretical design, increasing congestion at intersections and causing longer travel times. Transport modelling indicates that based on a 'without project' scenario by 2029, average AM peak travel times along Pennant Hills Road would be 18 minutes northbound and 39 minutes southbound. During the PM peak travel times would be 46 minutes northbound and 19 minutes south bound. With an average travel period of 5-6 minutes in the tunnel, traffic modelling for 2029 indicates that NorthConnex would result in an average travel time improvement of 87% for northbound travel and 87% for southbound travel.

Without NorthConnex, by 2029 the increase in traffic would also be expected to result in an increase in crash frequencies on Pennant Hills Road. Pennant Hills Road experienced 980 crashes, with one fatal and 342 injury crashes between 1 July 2008 and 1 June 2013. Should traffic continue to grow with no modification to the road network, the frequency of crashes on Pennant Hills Road would be expected to increase from an average of 196 to 245 per annum. Due to its connecting role within the National Road Network, such deterioration in performance has adverse, undesirable implications for inter-regional traffic movements and freight efficiency.

In providing an alternative route for freight and other road users NorthConnex would provide a safer and more efficient link between the M1 Pacific Motorway and the Hills M2 Motorway, improving access, connectivity and reliability of inter-regional freight across the greater Sydney area. By encouraging the transfer of freight traffic underground, the project would also contribute towards reducing the number of heavy vehicles that currently travel on Pennant Hills Road resulting in improvements in travel conditions, including congestion and safety for all road users including motorists, cyclists and pedestrians. This would also provide opportunities for improved public transport.

The reduced interaction between heavy vehicles and other road users and the associated improvements in travel conditions on Pennant Hills Road, would also have consequential

improvements in amenity for people who live and work in the surrounding area. From a social perspective, the presence of major roadways can create a barrier to community cohesion. Heavy traffic, in particular high volumes of heavy vehicle along Pennant Hills Road, results in social impacts such as community severance, isolation, and safety issues. There are also current impacts associated with traffic noise and exhaust emissions from heavy vehicles and congested vehicles along Pennant Hills Road.

NorthConnex would benefit the amenity of the surrounding area by reducing congestion and the number of heavy vehicles using Pennant Hills Road. It is anticipated that reductions in heavy vehicle road traffic would reduce noise and improve amenity air quality along substantial parts of the Pennant Hills Road corridor, making the area more attractive and accessible for local residents and other members of the community. Reduction in congestion and traffic numbers would also contribute to improved connectivity and cohesion along the project corridor improving the suburban environment for business and the local community, including opportunities for urban renewal along Pennant Hills Road.

In its Environmental Impact Statement, the Proponent has outlined the following objectives for NorthConnex:

- to provide a high standard access controlled motorway that integrates with the regional transport network;
- to minimise adverse social and environmental impacts in the local area during construction and operation;
- to provide opportunities for improved public transport in the area around Pennant Hills Road;
- to assist in a reduction in traffic congestion, particularly along Pennant Hills Road, and provide shorter travel times for road users;
- to provide a motorway that is safe and reliable for road users;
- to contribute towards the national objective of connecting Melbourne to Brisbane via a duplicated highway in order to improve the efficient movement of state and national freight, and in doing so, reduce costs for freight operators and carriers;
- to contribute towards a reduction in the number of heavy vehicles using Pennant Hills Road and as a result improve local air quality and noise amenity along that corridor;
- to demonstrate excellence in design and environmental sustainability; and
- to be economically justified and affordable to government.

The proposal has been justified in the Environmental Impact Statement on the basis that it meets these objectives.

The NorthConnex proposal represents a $3.2 billion investment in road infrastructure that is expected to create up to 1250 jobs during construction.

The Department considers that NorthConnex is also supported by a strong strategic planning framework and is consistent with the Government's key priorities and high level planning framework including:

NSW 2021: A plan to make NSW number one (2011) - NorthConnex is consistent with the strategic transport and land use objectives of *NSW 2021: A plan to make NSW number one (2011).* NSW 2021 aims to rebuild the economy, provide quality services, renovate infrastructure, restore government accountability and strengthen local environment and communities. The plan has as key goals to reduce travel time, improve road safety and invest in critical infrastructure. The goal to reduce travel time has a target of improving the efficiency of the road network during peak times on Sydney's road corridors and priority actions to achieve this target by delivering road infrastructure to relieve congestion, improve safety and enhance and expand capacity on road corridors. The proposal is wholly consistent with these goals of *NSW 2021* as it would deliver key infrastructure that relieves congestion, improves safety and expands capacity on a priority road corridor and improves safety and efficiency along Pennant Hills Road.

State Infrastructure Strategy Update (2014) - The proposal is identified by Infrastructure NSW as a priority project for the completion of the Sydney Strategic Road Network. The strategy update notes the progress that has been achieved to implement Infrastructure NSW's long term vision for the Sydney Strategic Road Network in the 2012 Strategy. The Strategy noted the F3 – M2 link (now NorthConnex) was highly desirable as it would bring connections North of Sydney to motorway standards. The link would provide a key component of Sydney's motorway network and would improve traffic flows, relieve congestion and facilitate freight movement. The proposal is the key measure in completing the missing link and addressing congestion and access problems currently experienced along Pennant Hills Road. The Strategy update notes the NSW Government's in-principle agreement to a planning framework and funding for private delivery of NorthConnex (this proposal).

NSW Long Term Transport Master Plan (2012) - The Master Plan presents the NSW Government's direction for transport planning and investment for the next twenty years and identified actions to support the State's economic performance and transform the transport system. A high priority is to create a connected motorway network in Sydney, which includes connecting the gap between the F3 (M1) and the M2. This gap means that arterial roads are at capacity during peak periods which causes congestion and delays which adversely impacts business productivity and the national, state and local economy. The proposal has been identified by the Master Plan as a key measure to fill the missing links and improve road capacity and traffic and transport efficiency, in particular for road freight movements.

A Plan for Growing Sydney (2014) - the Plan sets out the Government's vision for Sydney and includes goals to achieve the vision of Sydney being a strong global city. These goals include the creation of a competitive economy with world class services and transport. To achieve the goal of a world class transport network the Government would preserve future transport and road corridors to support future growth. The NorthConnex motorway is identified by the Plan as a key transport corridor. The Plan notes that a key priority for the North subregion is the movement of people and freight through the subregion to the Central Coast, Newcastle, Hunter and Northern NSW regions and Brisbane. The delivery of the proposal is critical to the achievement of this priority.

NSW Freight and Ports Strategy (2013) – the proposal assists in the meeting of the Governments long term freight needs of NSW by assisting in the completion of Sydney's motorway network.

2.4. Project Development and Alternatives

The route selection and design process commenced with the F3 to Sydney Orbital Link Study (SKM Study) in 2004. This study provided four key project objectives that would govern the overall outcome including:

- to provide a high standard link that integrates with the regional transport network;
- to minimise social and environmental impacts during construction and operation;
- to provide opportunities for improved public transport; and
- to be economically justified and affordable to the government.

The study then undertook a comprehensive assessment that began with the identification and assessment of broad corridor types and route options within these corridors. The study identified that the Purple Option within Type A corridor was the preferred route alignment (refer **Figures 5** and **6**).

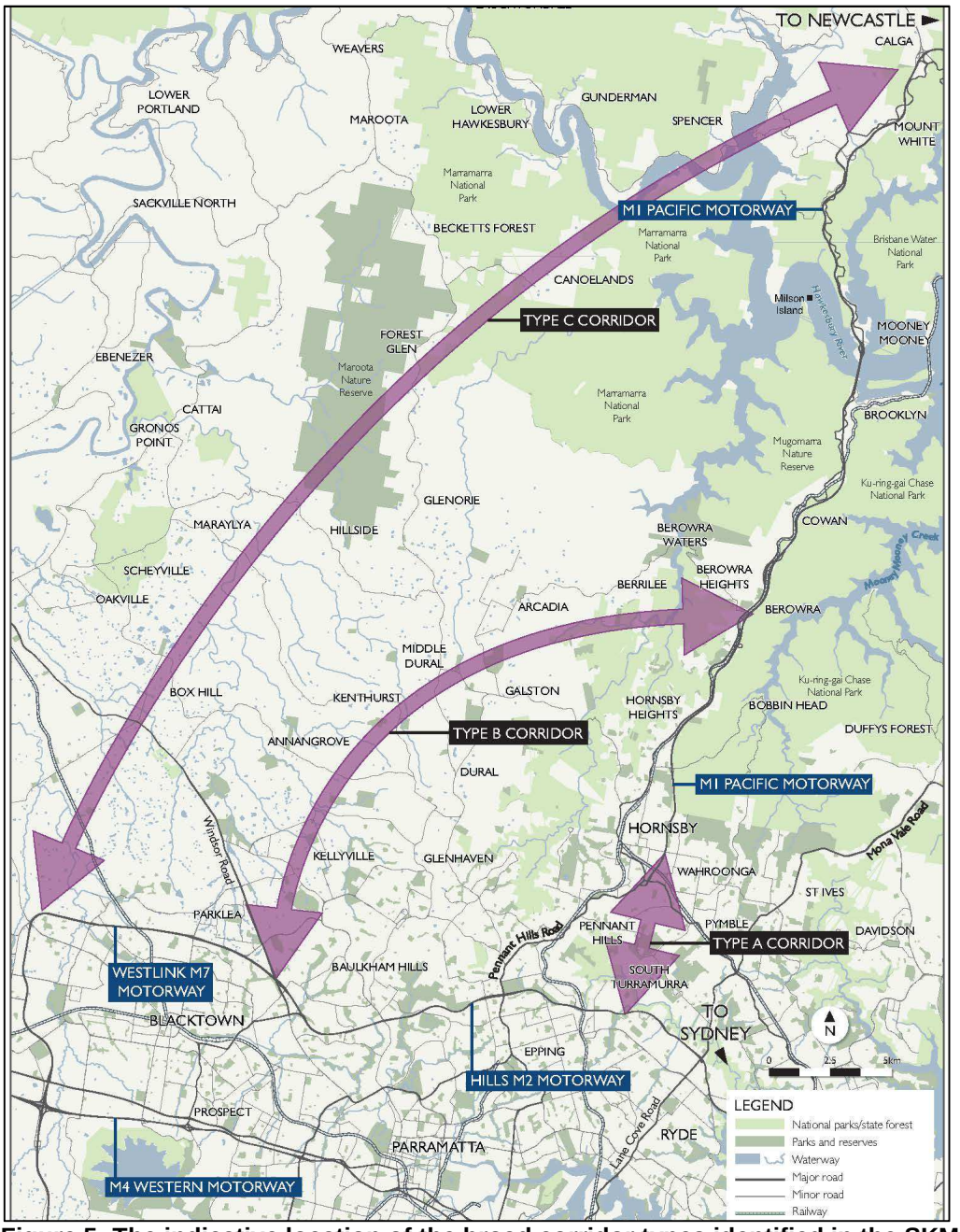

Figure 5: The indicative location of the broad corridor types identified in the SKM Study
Source: Environmental Impact Statement

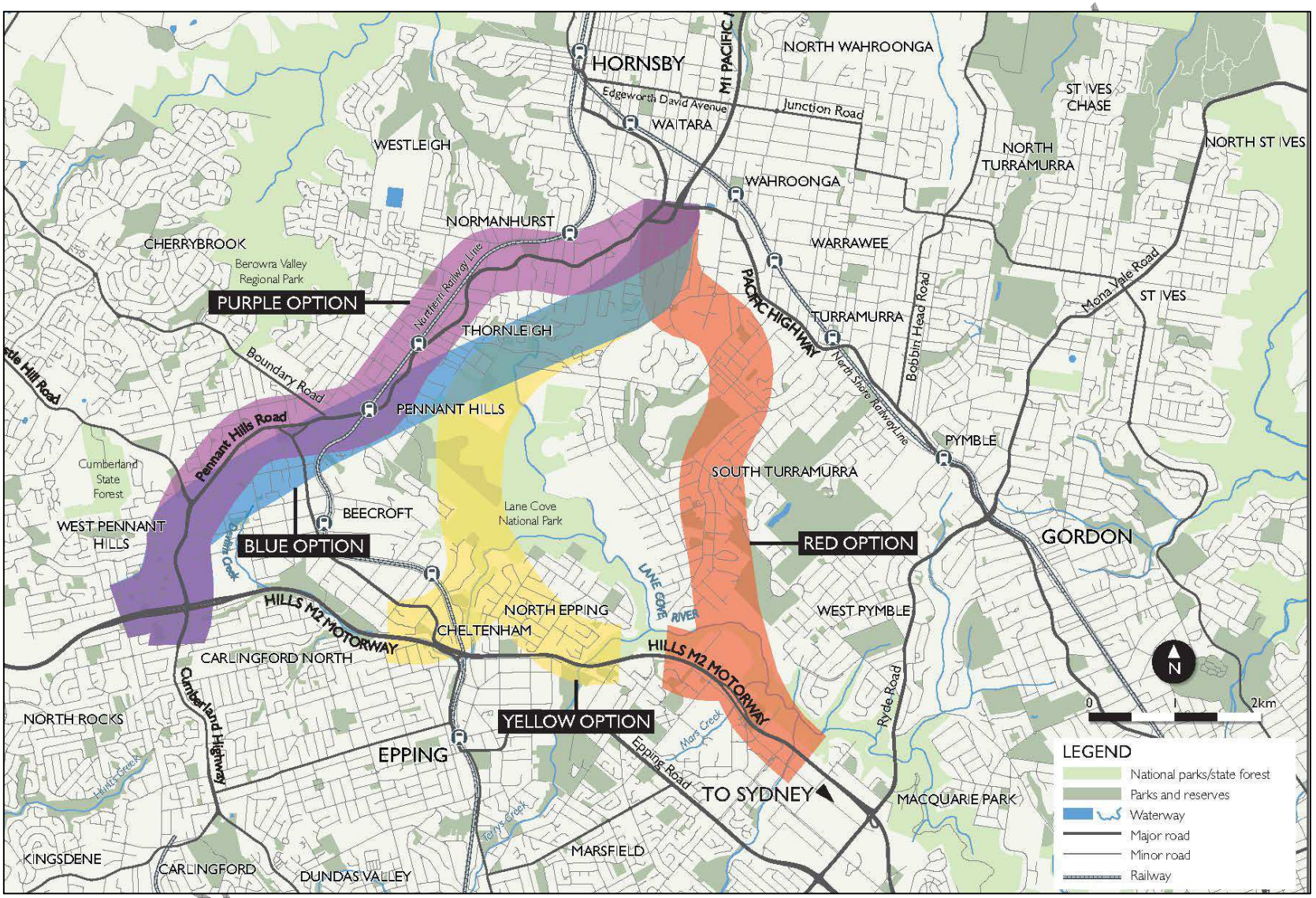

Figure 6: Indicative location of Route Options within Corridor Type A. ***Source: Environmental Impact Statement***

The Type A corridor outperformed the other options across all strategic, transport, social, environmental and economic criteria by:

- providing greater relief to Sydney's arterial roads, including Pennant Hills Road;
- better meeting the commercial needs of the region;
- more direct access to Sydney's Ports;
- greater improvements to annual crash rates along Pennant Hills Road;
- potentially reduce community severance;
- less required property acquisitions;
- less impact on bushland and threatened fauna species;
- greatest improvement to air quality; and
- lower capital cost and the best benefit to cost ratio.

The Honourable Mahla Pearlman AO, undertook a review of the SKM Study in 2007 and determined that the assumptions and data used remained valid and that the conclusions reached remained appropriate since the time of the study. The Pearlman Review also recommended that:

- the preferred route follows a Type A corridor Purple Option and that this be progressed to the next stages of investigation including detailed concept design, economic and financial assessment and environmental impact assessment; and
- the Type C corridor be planned for (Pearlman AO, 2007).

In 2012 an unsolicited proposal for the corridor was made by Transurban. Due to the unsolicited proposal process and the intellectual property rights involved in the tender process, the Department does not have access to any of this specific quantitative or qualitative data used to assess alternative options. However, progression through the unsolicited proposal and tender processes resulted in further refinement of the route alignment and design including:

- preclusion of an intermediate interchange;
- preclusion of east facing access to the Hills M2 Motorway;
- providing the in-tunnel capacity for three lanes but marked for two lanes;
- the adoption of a 'long' tunnel option reducing the need for property acquisition and community and environmental impacts;
- maximising the amount of tunnel intersecting Hawkesbury Sandstone resulting in greater ease of tunnelling; and
- ancillary surface facilities including the northern and southern interchanges, ventilation facilities, tunnel support facilities, motorway control centre, operational water management facility and construction facilities.

It is understood that, in formulating the the horizontal alignment, consideration was given to key factors such as topography, avoiding long term community and environmental costs and the provision safe lines of sight distances. The vertical alignment was chosen based on the avoidance of steep vertical grades in order to minimise heavy vehicle disruptions and emissions and providing a 0.5% grade for drainage purposes.

The final alignment, interchange configuration and the locations of the operational facilities is shown in **Figure 3.**

Specific details of the public exhibition of the NorthConnex proposal is provided in **Section 4** of this report. However, of the submissions received from the public during exhibition of the NorthConnex proposal (refer to **Section 4**), 355 submissions (30.50%) were in relation to project design and route selection. The most common issues raised in these submissions included support for the Type C corridor (27.61% of project design submissions), support for changes to the design through other proposals (18.59% of project design submissions), general comments in relation to route selection and process (18.87% of project design submissions), concerns and discussions regarding in-tunnel design and grades (12.68% of project design submissions), and

support for an alternative proposal known as the Equilibria Proposal (10.42% of project design submissions).

The Department has considered the processes and framework involved in the evaluation of the corridor types and has reviewed the merits of each corridor. The Department concludes that the process was rigorous and comprehensively demonstrated the suitability of the Type A corridor. The Department acknowledges that a significant proportion of the public submissions supported the Type C Corridor. In this regard, the Department is of the view that the development of a motorway link within the Type A corridor does not necessarily preclude development of a link within the Type C corridor.

The next process of route assessment demonstrated that in most cases the Purple Option had a superior performance when compared to the criteria and by comparison to the other options within the Type A corridor. The Purple Option represents the alignment that provides the best outcomes for traffic, urban design, environment, cost and social outcomes.

A number of submissions suggested that the Purple Option would discourage the use of the tunnel for those who require access between the M1 and the northern suburbs of Sydney, to the east of Pennant Hills Road and the Sydney CBD. Primarily, there was concern that the Pacific Highway within this sub-region would not experience any real benefit from this development. The Department agrees that the Pacific Highway corridor will experience less benefit than the Pennant Hills Road corridor due the alignment and interchange designs, however the proposed alignment is of strategic importance as a direct link between the M1 Pacific Motorway and the Hills M2 Motorway forming part of the National Highway route, and within the broader public interest.

A number of public submissions discussed the absence of an east facing connection from the tunnels to the Hills M2 Motorway at the southern interchange. Such a connection was recognised in both the SKM Study and the Pearlman Review and is a recommendation that the Department supports. The Proponent discounted this recommendation from the current proposal, by concluding that there were significant engineering constraints in this location and that there were only minor travel time benefits to motorists. The Department concludes that such a design feature is not vital at the present time and notes that there is alternate access via Pennant Hills Road. The Department also acknowledges the commitment made by the Proponent in considering the development of these access ramps in the future. To support this commitment, the Department has included a condition in the instrument of approval to ensure the project is designed and built so as not to preclude the addition of a direct west bound access route from the Hills M2 Motorway for northbound traffic along the SSI and a direct south bound access route from the SSI for east bound traffic along the Hills M2 Motorway.

The Department notes the issues raised by the Hills Shire Council, Hornsby Council and public submissions relating to the lack of an intermediate interchange. The Department disagrees with the Proponent's position that an intermediate interchange would be little benefit to motorists especially given the amount of traffic activity near Comenarra Parkway and other major intersections as evidenced in the traffic assessments undertaken for the Environmental Impact Statement.

However, the vertical alignment of the tunnel at this location is 90m below the surface, requiring significant cost and greater environmental impacts to engineer a solution. Whilst the Department concludes the Proponent has underestimated the benefit to motorists of an intermediate interchange, the economic and environmental costs involved in such a design feature would outweigh this benefit at this time.

Summary

The Proponent considered alternatives including three broad corridor types between the M1 Pacific Highway and the Sydney Orbital Network. The corridor which best satisfies the planning and project outcomes was analysed with consideration of four detailed options within the preferred corridor.

The process of identifying and evaluating a route alignment for the purpose of such a critical piece of public infrastructure is a complex and difficult task. This is especially pertinent in highly urbanised regions that consist of roads operating beyond or close to capacity. The balancing of the local impacts and the benefits to the public interest are always a key consideration in an assessment of this process.

The Department considers that the Proponent has undertaken a comprehensive route selection process to arrive at the alignment and project design that is the subject of this infrastructure proposal. The route selection process also underwent a review in 2007 which validated this process and its outcomes. The strategic and detailed level of design necessary at this stage of the development proposal is considered adequate. As a result, the Department concludes that the selected Purple Option within the Type A corridor is the most appropriate general route alignment for the proposal.

3. STATUTORY PLANNING REQUIREMENTS

3.1. State Significant Infrastructure

Section 115U(4) of the *Environmental Planning and Assessment Act 1979* (EP&A Act), provides that specified development on specified land may be declared to be State Significant Infrastructure (SSI). The Minister declared the proposal to be State Significant Infrastructure on 25 October 2013.

3.2. Critical State Significant Infrastructure

Section 115V of the EP&A Act, provides that State Significant Infrastructure development can be declared by the Minister to be Critical State Significant Infrastructure by an order of the Minister, if the proposal is deemed essential for the State for economic, environmental or social reasons.

On 5 September 2014, the Minister declared the proposal a Critical State Significant Infrastructure through an amendment to Schedule 5 of the State Environmental Planning Policy (State and Regional Development). This declaration modified an earlier declaration, issued on 25 October 2013, and included the M2 integration works area within the scope of the Critical State Significant Infrastructure proposal. As Critical State Significant Infrastructure, the Minister may not delegate her approval role for the proposal.

3.3. Permissibility

The proposal is for the purpose of a road carried out by a public authority that is permissible without consent under clause 94 of State Environmental Planning Policy (Infrastructure) 2007.

3.4. Environmental Planning Instruments

The environmental planning instruments that apply to the carrying out of the proposal include:

- State Environmental Planning Policy (State and Regional Development) 2011;
- State Environmental Planning Policy (Infrastructure) 2007;
- State Environmental Planning Policy No. 19 – Bushland in Urban Areas;
- State Environmental Planning Policy No. 33 – Hazardous and Offensive;
- State Environmental Planning Policy No. 44 – Koala Habitat Protection;
- State Environmental Planning Policy No. 55 – Remediation of Land;
- Sydney Regional Environmental Plan No 20 – Hawkesbury-Nepean River; and
- Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2002;

A number of other environmental planning instruments have relevance to the proposal including Ku-ring-gai Planning Scheme Ordinance 1971, Draft Ku-ring-gai Local Environmental Plan 2013, Hornsby Local Environmental Plan 2013 and The Hills Local Environmental Plan 2012.

Whilst these Environmental Planning Instruments do not apply to the proposal by reason of section 115ZF(2) of the EP&A Act, the assessment has considered the proposal for consistency with the requirements of relevant environmental planning instruments. The Department considers that the Proposal is consistent with the aims, objectives and provisions of these Environmental Planning Instruments, subject to the safeguards and management measures discussed in **Section 5**.

3.5. Objects of the Act

Decisions made under the Act must have regard to the objects of the Act, as set out in Section 5 of the Act. The relevant objects are:

(a) to encourage:
- *(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment,*
- *(ii) the promotion and co-ordination of the orderly and economic use and development of land,*
- *(iii) the protection, provision and co-ordination of communication and utility services,*
- *(iv) the provision of land for public purposes,*
- *(v) the provision and co-ordination of community services and facilities, and*
- *(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats, and*
- *(vii) ecologically sustainable development, and*
- *(viii) the provision and maintenance of affordable housing, and*

(b) to promote the sharing of the responsibility for environmental planning between the different levels of government in the State, and

(c) to provide increased opportunity for public involvement and participation in environmental planning and assessment.

The Department has given due consideration to the objects of the Act including:

- how the proposal would impact on the management, development and conservation of the area, with reference to the management of air quality, noise and vibration, and soils and water (refer to **Section 5**);
- the strategic justification of the proposal in terms of the orderly and economic use and development of land (refer to **Section 2.3**), and how the proposal would affect traffic and access throughout the region and beyond (refer to **Section 5.4**);
- protection of the environment by assessing the effectiveness of proposed management and mitigation measures. In particular, the Department has considered the impact of the proposal on biodiversity and how the provision of offsets for affected threatened species and communities would contribute to the protection of the environment (refer to **Section 5.7**);
- the principles of ecologically sustainable development (refer to **Section 3.6**); and
- public involvement and participation in the assessment of the proposal by placing the proposal documents on exhibition at community locations in the local area (Council offices and libraries) for 60 days and on the Department's website. The Response to Submissions Report was also made publicly available on the Department's website (refer to **Section 4**).

3.6. Ecologically Sustainable Development

The EP&A Act adopts the definition of Ecologically Sustainable Development (ESD) found in the *Protection of the Environment Administration Act 1991.* Section 6(2) of that Act states

that ESD requires the effective integration of economic and environmental considerations in decision – making processes and that ESD can be achieved through the implementation of:

(a) the precautionary principle,
(b) inter-generational equity,
(c) conservation of biological diversity and ecological integrity,
(d) improved valuation, pricing and incentive mechanisms.

One of the key objectives of NorthConnex is to reduce traffic congestion along Pennant Hills Road and provide shorter travel times for road users. The Proponent has considered the principles of ESD in its assessment of the proposal. The assessment has considered the environmental impacts of the proposal in terms of the objectives of the proposal. The Environmental Impact Statement has considered the precautionary principle through the selection of the route which minimises impacts on National Parks and other ecologically sensitive areas. The proposed route avoids impacts to known areas or items of environmental value, and in terms of the M2 integration works, minimises impacts to biodiversity, and where impacts cannot be avoided, then a biodiversity offset would be required to compensate these impacts in perpetuity.

The operation of NorthConnex is expected to:

- improve local air quality along the Pennant Hills Road corridor by removing through traffic, in particular heavy vehicles, to the tunnel, and bypassing 21 sets of traffic lights;
- improve the noise amenity for residences and businesses along the Pennant Hills Road corridor by removing through traffic, in particular during the evening and night-time periods;
- improve road safety along the Pennant Hills Road corridor by removal of high traffic volumes to the tunnel and reduction in potential collisions at intersections, and improvement in safety for pedestrians and cyclists; and
- reduction in operational greenhouse gas emissions when compared to the project not being built.

The Department considers that the proposal will provide benefits for current and future generations and is in the public interest. The Proponent has committed to address residual impacts through the implementation of management and mitigation measures, including impacts on noise and vibration, biodiversity, air quality, heritage and soil and water. The Department considers these measures are appropriate and would ensure the impacts of the construction and operation of the proposal are minimised. The assessment of the proposal has considered the principles of ESD, including impacts on future generations and biodiversity and ecological impacts and pricing, in terms of user pays principle. The application of a toll on the operation of the project would ensure the road users make a contribution being the user of the service provided. In conclusion, the Department considers that sustainability targets and measures committed to in the Environmental Impact Statement are acceptable and that the proposal is consistent with the principles of ESD.

4. CONSULTATION AND SUBMISSIONS

4.1. Exhibition of the Environmental Impact Statement

Under Section 115Z(3) of the EP&A Act, the Department is required to make the Environmental Impact Statement publicly available for at least 30 days. The Department publicly exhibited the proposal from 15 July 2014 to 12 September 2014 (a total of 60 days) on the Department's website, and at the following exhibition locations:

- Department of Planning and Environment, Information Centre;
- Roads and Maritime Services (Head Office), North Sydney;
- Ku-ring-gai Municipal Council and Turramurra Library;
- Hornsby Shire Council, Hornsby Central Library; Pennant Hills Library and Epping Library;
- The Hills Shire Council and Baulkham Hills Library; and
- Nature Conservation Council.

The Department also advertised the public exhibition in the Sydney Morning Herald, the Daily Telegraph, Hills News and Hills Shire Times on 15 July 2014, the North Shore Times, Northern District Times and Parramatta Advertiser on 16 July 2014 and Hornsby Advocate on 17 July 2014, and notified State and local government authorities directly in writing.

The exhibition of the Environmental Impact Statement resulted in 1170 submissions including 8 submissions from public authorities. A copy of all submissions is contained in **Appendix B** Post exhibition 61 further representations were received by the Department in relation to the Environmental Impact Statement. The issues raised in these representations were the same as those raised during the exhibition. The issues raised in the submissions are summarised in **Sections 4.2, 4.3 and 4.4.** A further 6 submissions referring specifically to information contained in the Proponent's Preferred Infrastructure Report were received and are addressed in **Section 4.5**.

4.2. State and Local Government Agency submissions

No public authority objected to the proposal, however each raised key issues for consideration. The issues raised in the public authority submissions are summarised in **Table 2**. Details of the issues raised are provided below.

EPA recommended further evaluation of options for reducing predicted ground level concentrations of air pollutants and the preparation of detailed noise mitigation measures for affected receivers due to the predicted impacts at sensitive receptors. Additional clarification was recommended of several key assumptions used in the air quality and noise modelling, and further assessment recommended for regenerated noise and impacts from fixed facilities and construction road traffic. EPA also recommended the adoption of more stringent water quality requirements for construction discharges. The requirements for an Environmental Protection Licence, which is required for construction of the proposal, were detailed.

Department of Primary Industries provided a submission on behalf of a number of its agencies.

Fisheries NSW supported the implementation of the mitigation measures for aquatic biodiversity, hydrogeology and soils and surface water.

Agriculture NSW were satisfied with the Proponent's commitment to manage weeds.

NSW Office of Water recommended the provision of additional information relating to impacts to groundwater and surface water, including hydrogeological investigations completed to support project design, and assessments of groundwater behaviour and impacts associated with dewatering, and impacts on base flow in tributaries of the Hawkesbury and Lane Cove Rivers. While no licensing would be required for the proposal at present under the *Water*

Management Act 2000 requirements for consultation on construction and operational management plans and ongoing groundwater take were recommended.

OEH recommended further assessment to clarify the relationship between the groundwater regime impacted by the proposal and the aquatic and terrestrial biodiversity in affected water catchments. Guidance was also provided on the finalisation of an offset package. While the recommendations of the Aboriginal cultural heritage assessment were supported, a lack of information about the selection of Aboriginal representatives was identified. Further consideration of extreme flood impacts and climate change effects on tunnel portal inundation and emergency management was requested.

Heritage Council of NSW (by its delegate, OEH) supported the conclusion of the heritage assessment and recommended preparation and implementation of specific mitigation and management measures. It was recommended that any acoustic treatments on heritage items be developed with advice from an appropriately experienced and qualified heritage consultant. A set of requirements for archaeological test excavation at the Thornleigh Maltworks was provided.

Ministry of Health requested further consideration of the in-tunnel and external air quality implications of alternative traffic scenarios and all feasible and practical impact avoidance and mitigation measures. Guidance was provided on health effects of in-tunnel air quality, and context for national and international in-tunnel air quality guidelines. Avoidance of portal emissions was supported as in keeping with good design. Ministry of Health advised that the Human Health Risk Assessment had been generally undertaken in an appropriate manner.

The Hills Shire Council recommended further consideration of an intermediate interchange along the tunnel alignment and requested that alternate roads to local roads be sought for the purpose of heavy vehicle construction traffic.

The Hills Shire Council also requested that detailed design of key facilities be certified as compliant by an independent acoustic consultant and that post-commencement monitoring is undertaken to assess effectiveness of mitigation measures.

The relocation of the southern ventilation outlet was also requested to be evaluated along with the advanced planting of trees prior to the occupation of the southern interchange facility.

The Hills Shire Council requested further information regarding surface impacts to waterways and catchments and recommended that the drainage system design needed to be undertaken with an understanding of the local flood regime and upgrades made where negative impacts are found to occur.

The Hills Shire Council noted that an alternative site for the Windsor Road construction compound would need to be found due to the proposed site being used as a commuter car park. Consultation with emergency services and ongoing consultation with the community was also recommended and copies of relevant construction management plans were requested.

The Hills Shire Council also requested an economic impact assessment be undertaken for the Carmen Drive neighbourhood centre and that RMS dedicate existing parcels of land located on carriageway or footway areas be dedicated as public road.

Hornsby Shire Council requested further information on future portal emissions and raised a number of questions regarding air quality data and methodology in the modelling undertaken for the proposal. Hornsby Shire Council also requested clarification relating to the frequency of use of the emergency extraction outlets and recommended real time air-quality monitoring in the tunnel. The incorporation of air quality treatment systems was recommended and it was noted that retrofitting such systems in the past had been shown to be inefficient.

Hornsby Shire Council raised a number of issues regarding surface water impacts, management and mitigation measures including issues relating to cumulative and point source pollution into creeks and waterways. Hornsby Shire Council specifically requested that a 95% protection level be achieved in discharge quality of water into waterways and that further information be provided regarding erosion and ecological impacts downstream of discharge points.

Hornsby Shire Council noted their support for the use of Hornsby Quarry as a potential spoil receiver site but advised that a waste classification and liaison with Council would be required.

It was also recommended that archival recordings at the Thornleigh Maltworks be undertaken and submitted to Council's Local Studies Library catalogue prior to construction.

In addition, the relocation of two locally listed Canary Island Palm Trees was requested to be investigated.

Hornsby Shire Council also requested that future residual land uses be investigated in consultation with Council and that a mechanism be implemented within current legislation to enable potential landowners to identify the location of future works associated with the proposal.

Finally, Hornsby Shire Council requested that the Department satisfy itself that issues associated with construction traffic can be managed through construction traffic management plans and that a number of conditions relating to environment management measures be included in any conditions of consent.

Ku-ring-gai Council raised concerns including the potential need for another outlet along the alignment of the tunnel to relieve air quality issues. In addition, Ku-ring-gai Council discussed the opportunity to relocate the northern ventilation outlet to an industrial area whilst also extending the tunnel to the north. The potential visual impacts from the ventilation outlets were also raised along with issues relating to air quality modelling and methodology. Ku-ring-gai Council recommended that consent conditions include a requirement to monitor air quality over a five year period during operation.

Ku-ring-gai Council raised a number of construction related issues including limiting construction work hours near specific residential areas whilst also requesting for road dilapidation surveys of local roads prior to construction. Ku-ring-gai Council requested consultation during the preparation of construction traffic management plans prior to approval of the project and that construction noise management be covered within a construction noise and vibration management plan. Ku-ring-gai requested clarification regarding the allocation of lanes north of the northern interchange and noted safety concerns for construction traffic associated with construction compounds.

Ku-ring-gai Council also raised concerns regarding biodiversity offsets for ecological impacts, particularly Blue Gum High Forest clearance, and noted certain reservations relating to the heritage impact assessment. Ku-ring-gai held particular concerns for heritage related impacts stemming from vibration, settlement, visual and acoustic impacts associated with the project.

Ku-ring-gai also requested clarification and further information relating to the noise assessment and proposed mitigation measures that also address cumulative noise impacts. Ku-ring-gai Council also requested dilapidation surveys be conducted on properties that may be impacted by vibration as a result of tunnelling activities and also requested tunnelling only occur during standard construction work hours.

Table 2: Summary of the representations from Commonwealth, State and local government agencies

Issues Raised/Agency	EPA	DPI/NOW	OEH	Ministry of Health	NSH Heritage	Hills Shire Council	Hornsby Shire Council	Ku-ring-gai Council	Total
Mitigation measures for surface and groundwater management, discharge, direct and indirect impacts	√	√	√			√	√		5
Adequacy and appropriateness of air quality modelling and methodology	√			√			√	√	4
Air quality modelling, methodology, mitigation measures and ongoing monitoring	√			√			√	√	4
Consultation during development of management plans for construction and operation						√	√	√	3
Interchange and in tunnel road designs including lane widths, numbers and lack of an intermediate interchange						√	√	√	3
Offsets for biodiversity assets and calculations	√		√					√	3
Heritage assessments and proposed mitigation measures including at the Thornleigh Maltworks				√			√	√	3
Noise and vibration modelling, methodology, mitigation measures and ongoing monitoring	√					√		√	3
Adequacy of mitigation measures proposed for surface and groundwater management and discharge			√			√	√		3
Consultation during development of management plans for construction and operation						√	√	√	3
Adequacy of interchange and in tunnel designs including lane widths, numbers and lack of intermediate interchange						√	√	√	3
Aboriginal community consultation and ongoing community consultation throughout detailed design and delivery			√			√			2
Recommendations for a Ground and Surface Water Management Plan for construction and operation	√	√							2
Construction work hours	√							√	2
Future portal emissions and avoidance				√			√		2
Environmental management measures including reuse or relocation of trees, weed management and rehabilitation						√	√		2
Risk and hazard assessment including localised flooding and in-tunnel fires						√	√		2
Requests for higher protection levels and hydrocarbon and biocide treatment of discharged water	√						√		2
Recommendations for a Ground and Surface Water Management Plan for construction and operation	√	√							2

Issues Raised/Agency	EPA	DPI/NOW	OEH	Ministry of Health	NSH Heritage	Hills Shire Council	Hornsby Shire Council	Ku-ring-gai Council	Total
Restriction to construction work hours unless further justification is given especially near residential areas	√							√	2
Adequacy and appropriateness of noise and vibration modelling and methodology	√							√	2
Requests for further details regarding noise mitigation measures and their effectiveness	√							√	2
Requests for re-assessment and provision of information regarding offsets for biodiversity assets and calculations			√					√	2
Concerns regarding impacts to creeks and waterway regimes and ecology resulting from treated groundwater discharge			√				√		2
Recommendation for preparation and implementation of heritage item-specific mitigation and management measures					√		√		2
Provision of archaeological test excavation requirements for Thornleigh Maltworks and request for archival recordings					√		√		2
Clarification regarding potential future portal emissions and support for avoidance of portal emissions				√			√		2
Recommended environmental management measures including reuse or relocaton of trees, weed management and rehabilitation						√	√		2
Offset impacts to Blue Gum High Forest and other native flora and fauna species	√						√		2
Concerns regarding adequacy or risk and hazard assessment including localised flooding and in tunnel fires						√	√		2
All reasonable measures to be taken to minimise exposure to air pollution inside and outside of tunnel including filtration				√			√		2
Early formation of environmental review group	√								1
Assessment of off road diesel equipment emissions during construction	√								1
Need for strategy to deal with regenerated noise from tunnelling impacts	√								1
Open Graded Asphalt to be used on motorway ramps	√								1
Flora and Fauna Management Plan to be extended until vegetation conditions reach pre-construction condition			√						1
Requests for clarification regarding Aboriginal community consultation			√						1

Issues Raised/Agency	EPA	DPI/NOW	OEH	Ministry of Health	NSH Heritage	Hills Shire Council	Hornsby Shire Council	Ku-ring-gai Council	Total
Recommendation for emergency management plan to manage extreme local flooding and increased rainfall intensity due to climate change			√						1
Condition of consent to groundwater inflows to 1L/s/km over the entire tunnel		√							1
Use of Hornsby Quarry as a spoil receiver site							√		1
Requests for consultation during detailed design of water treatment and management systems							√		1
Requested amendments to legislation to allow for future land owners to identify the project on maps prior to it being built							√		1
Requests for further information regarding future uses of land acquired for the construction of the project							√		1
Adequacy and appropriateness of construction and operation traffic modelling and methodology							√		1
Resistance to use of local roads for spoil haulage and heavy vehicle construction traffic						√			1
Detailed design phase of ventilation and ancillary facilities to be certified as compliant by an independent noise consultant						√			1
Post-commencement acoustic assessment to assess accuracy of modelling and effectiveness of mitigations						√			1
Notification of the need for an alternate site for the Windsor Road compound due to its use for a commuter car park						√			1
Emergency services to be consulted during detailed design						√			1
Ongoing community consultation and engagement throughout construction and project delivery						√			1
Request for existing parcels of land in RMS' ownership within road reserve to be dedicated as public road following construction						√			1
Economic impact assessment and mitigation measures for Carmen Drive neighbourhood centre						√			1
Consideration of at least one more outlet along the tunnel alignment								√	1
Relocate northern ventilation outlet to the north from residential area and extend the tunnels to the north								√	1
Concerns raised regarding the visual impacts of the 15 metre high outlets								√	1
Ongoing air quality monitoring during operation of the tunnels over a five year period								√	1

Issues Raised/Agency	EPA	DPI/NOW	OEH	Ministry of Health	NSH Heritage	Hills Shire Council	Hornsby Shire Council	Ku-ring-gai Council	Total
Road dilapidation surveys to be undertaken to ensure damage to Council's roads are identified and repaired								√	1
Adequacy of heritage assessments and proposed mitigation measures								√	1
Dilapidation surveys on properties that may be receive vibration impacts as a result of tunnelling works								√	1
Early formation of environmental review group	√								1
Flora and Fauna Management Plan to be extended until vegetation conditions reach pre-construction condition			√						1
Emergency management plan to manage extreme local flooding and increased rainfall intensity due to climate change			√						1
Use of Hornsby Quarry as a spoil receiver site							√		1
Requests for further information regarding future uses of land acquired for the construction of the project							√		1
Construction and operation traffic modelling and methodology							√		1
Resistance to use of local roads for spoil haulage and heavy vehicle construction traffic						√			1
Need for an alternate site for the Windsor Road compound due to its use for a commuter car park						√			1
Request for existing parcels of land in RMS' ownership within road reserve to be dedicated as public road following construction						√			1
Economic impact assessment and mitigation measures for Carmen Drive neighbourhood centre						√			1
Ventilation outlet locations, heights and quantity								√	1
Road dilapidation surveys and property dilapidation surveys to be conducted prior to construction								√	1

The Department referred the proposal to the Government's ***Advisory Committee on Tunnel Air Quality*** who undertook a review. Following this review the Committee made a number of recommendations including that the Environmental Impact Statement and Preferred Infrastructure Report be "redrafted to produce a single, coherent, transparent and legible document featuring a traceable analysis".

The Committee also recommended that the rationale for using new design NO_2 criteria be explained as well as the need to recalculate the in-tunnel concentrations based on plausible and representative contribution from concentration in the tunnel air intakes.

In addition, further assessment of air quality impacts of alternative worst case operational traffic scenarios was recommended in addition to quantifying the likelihood of each alternative operational traffic scenario.

The Committee requested resubmission of the cumulative impact assessment and a revision of the assessment of the impact of changes to surface road traffic. A reassessment of the background air quality using data from project monitoring stations was also requested. The advisory committee recommended the provision of more data relating to emission rates, factors and fleet composition as well as the use of up-to-date Australia and NSW data instead of World Road Association data.

In response to the Committee's review, the Proponent revised its Preferred Infrastructure Report to provide additional information and assessment.

The Committee then conducted a review of the revised Preferred Infrastructure Report. This final review noted that not all issues with the Proponent's air quality assessment had been addressed to its satisfaction. However, the Committee concluded that, based on the Proponent's assessment and results from operational tunnels, the project 'will bring a net improvement of the local air quality along substantial parts of the Pennant Hills Road corridor', and any impacts on sensitive receptors would be very small.

4.3. Submissions from the General Public, Businesses and Interest groups

The Department received a total of 1170 public submissions, including 1164 during the exhibition period up to 12 September 2014. Of these submissions, 43 supported the proposal, 116 did not state a position, and 1007 objected to the proposal on various grounds.

The public submissions consisted of 511 individually prepared pieces of correspondence from local residents, local businesses, and special interest groups, as well as 658 form letters and one petition signed by 176 people. The 658 form letters received were in objection to the components of the proposal, in particular the two ventilation facilities. A number of the opposing submissions identified their objection to the locations of the ventilation outlets and the need for filtration.

Special interest groups that made a submission to the Department included the Asthma Foundation of NSW, Doctors Against Pollution, NRMA Motoring, West Pennant Hills Progress Association, Community Against Pollution Outlets, Southern Community Against Pollution Outlets, Pennant Hills District Civic Trust, Friends of Ku-ring-gai Environment Inc, Thornleigh Neighbourhood Residents Group, Action for Public Transport, Beecroft-Cheltenham Civic Trust, Residents of Blacktown and Seven Hills Against Further Traffic, church groups and cycling groups.

Figure 7 outlines the issues raised by the general public, businesses and interest groups.

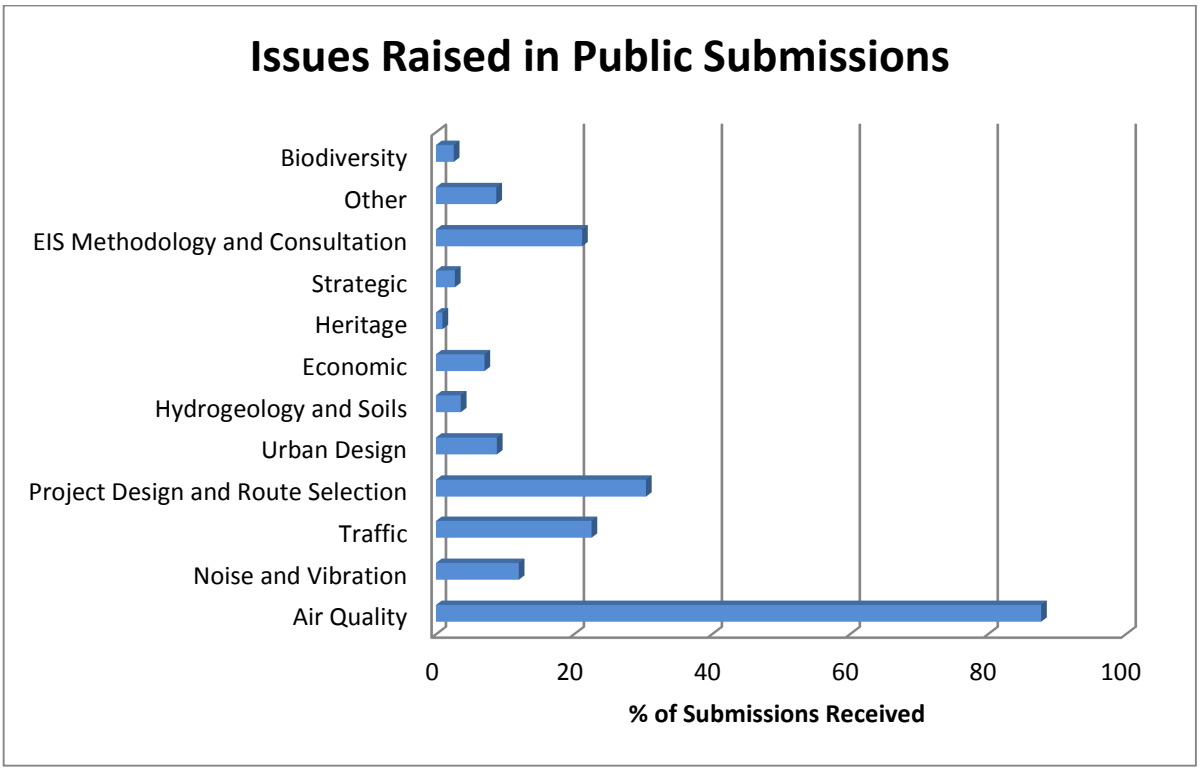

Figure 7: Percentage of main issues raised in public submissions

4.5 Key issues raised in submissions

Key issues raised in the submissions are summarised below and addressed in the following **Section 5** of this report.

Air Quality

- known impacts to human health and the number of sensitive land uses in the locality;
- location of the northern and southern ventilation outlets with areas of conflicting land use;
- potential relocation of the ventilation outlets and potential redesign opportunities;
- failure to consider alternate tunnel designs and the efficiencies that could be achieved;
- failure to consider and provide filtration to the proposal when it is demonstrated to work;
- poor consideration of emission control impacts and inadequate resolution of concerns;
- potential reliance on portal emissions in the future, if not already;
- ventilation outlet heights failure to enable adequate dispersion;
- incorrect and inadequate modelling and methodology used; and
- requirement for operational monitoring and accountability.

Project Design and Route Selection

- disagreement with the selected route and the selection process;
- failure to sufficiently consider the Corridor C option and outer orbital alternatives;
- failure to sufficiently consider alternative proposals;
- location and number of required construction compounds;
- location and number of operational compounds;
- design and potential impacts of the northern and southern interchanges;
- potential impacts to pedestrian and cyclist access and safety;
- in-tunnel design and gradients are inefficient and poorly designed;
- failure to provide intermediate interchanges and ventilation outlet quantities; and
- lack of improvements to Pennant Hills Road and resolution of community severance.

Traffic
- heavy vehicle and spoil haulage routes and potential impacts to surrounding areas;
- parking of construction vehicles on local and surrounding streets;
- subsequent damage to local and surrounding roads due to construction vehicles;
- operational impacts to traffic on Pennant Hills Road and feeder roads;
- management of traffic in-tunnel when operating;
- changes to Pennant Hills Road, including lane configurations; and
- failure to consider public transport impacts and investigate future opportunities.

Noise and Vibration
- potential impacts from construction and operational noise and vibration;
- methodology used to determine noise and vibration impacts;
- provision of monitoring for noise and vibration impacts;
- proposed construction hours; and
- provision of noise mitigation at construction compounds and surrounding areas.

Urban Design
- impacts on solar access currently provided to nearby residences;
- removal of existing landscaping and requirement for streetscape improvements;
- impacts on visual amenity for residences and properties;
- disturbance caused by light spill from construction compounds and vehicles; and
- architectural design and treatments of all associated structures.

Economic Impacts
- potential negative impact on property values and a call for compensation;
- cost of tolls for use of NorthConnex and the potential impacts of toll avoidance;
- overall cost of the proposal and the accuracy of the figure provided; and
- cost of mitigating the impacts outside of those committed to by the Proponent.

Hydrology and Soils
- potential impacts to the natural flow of ground and surface water;
- negative effects on waterway health including Blue Gum Creek and Darling Mills Creek;
- proposed treatment and potential discharge of collected water;
- soil erosion during construction and requirement for rehabilitation post construction; and
- ground movement / subsidence by the proposal particularly during construction.

Strategic Considerations
- inadequate justification for the proposal and the route selected; and
- failure to adequately consider alternatives.

Heritage
- identification of indigenous aboriginal heritage in the region and potential impacts; and
- potential impacts on the significance of the Wahroonga Heritage Conservation Area.

Other Concerns
- waste removal during construction and ongoing waste management during operation;
- provision for utilities to service the development and impacts on existing utilities;
- use and subsequent potential impacts on public land and facilities;
- general impacts on land use, particularly in relation to those land uses that are sensitive;
- contribution of vehicle usage on climate change and greenhouse gases;
- adequate provision for emergency services access;
- potential impacts on the regions biodiversity and existing vegetation communities; and
- hazards and risks associated with the use of the tunnel and during construction.

Post exhibition, 61 further representations were received by the Department in relation to the Environmental Impact Statement. The issues raised in these representations were the same as those raised during the exhibition. A number of the opposing submissions identified their objection to the Trelawney Street compound and impacts on the amenity of adjoining residents, placement of the northern ventilation outlet in the centre of Wahroonga, noise and vibration impacts, health impacts, amenity impacts and privacy impacts during construction. Similar ongoing issues were raised regarding the operation of the proposal, particularly with the in-tunnel emission levels. Other issues raised related to how the health and vehicle emissions were examined and concerns in terms of the air quality assessment methodology. Suggestions provided to the project included alternative compound sites and retention of trees where possible.

4.4. Proponent's Response to Submissions

The Proponent provided a Submissions Report and Preferred Infrastructure Report, which included a response to the issues raised in submissions. The Report was made available on the Department's website on 11 December 2014 and was forwarded to agencies and councils within the project area who made a submission during the exhibition for comment.

A total of 3 submissions were received in relation to the Submissions Report from the general public and special interest groups. All raised objections to the proposal and the issues raised were the same as those raised during the exhibition. Further submissions were also received in relation to the Submissions Report from **OEH**, **Department of Primary Industries** and **Ministry and Health** providing further discussion in relation to issues raised in their original submissions and providing further recommendations.

The Department has considered the issues raised in all submissions in its assessment of the proposal as detailed in **Chapter 5**.

5. ASSESSMENT OF KEY ISSUES

5.1. Air Quality

Issue
Air quality in the Sydney region is good by international standards and complies with the National Environmental Protection Measures for external air quality set under the *National Environment Protection Council Act 1994* (Cth). However, existing levels of atmospheric pollutants can be heavily influenced at a localised level by road traffic.

The proposal would be constructed in a highly developed urban environment, generally along an existing heavily trafficked road corridor. The proposal would change how road traffic emissions are dispersed on and around Pennant Hills Road by diverting a substantial proportion of vehicle traffic to the proposed twin tunnels. Emissions generated from the tunnels would be vented to the atmosphere from two ventilation outlets. The first is located at West Pennant Hills and the other at Wahroonga. The location of the ventilation outlets has been primarily based on engineering requirements and efficiency being located as close to the tunnel portals as possible. No emissions are proposed from the entrances and exits (portals) to the tunnel.

Whilst inter-related, the assessment looks separately at the in-tunnel and external air quality issues, the latter being the most significant concern raised in public submissions.

In-tunnel (road user)
In tunnel air quality would be controlled through a longitudinal ventilation system. This system works by moving air through the tunnel, along with the direction of traffic, to a ventilation outlet. A diagram of the basic ventilation system is provided in **Figure 8**.

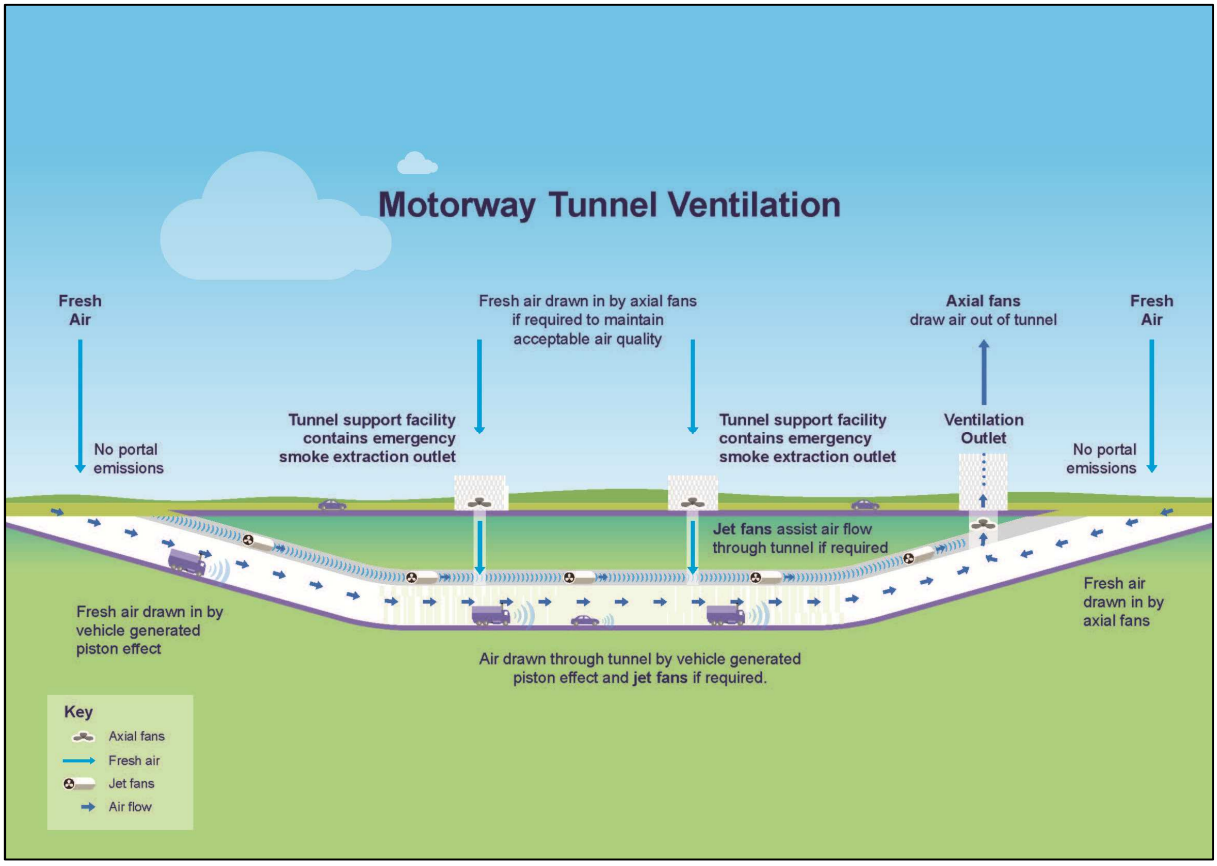

Figure 8: Tunnel Ventilation System diagram. ***Source: Preferred Infrastructure Report***

The in-tunnel concentrations of key pollutants (CO, NO_2, PM_{10}, $PM_{2.5}$, PAH and VOC) were calculated by the Proponent, and were predicted to meet the Proponent's adopted tunnel design criteria. Of these pollutants, NO_2 concentrations were predicted to be the closest to the design criteria (which was based on a recommendation by the Permanent International Association of Road Congresses (PIARC)). This indicated that in-tunnel NO_2 is likely to be the controlling factor affecting the design and operation of the project's ventilation system. Provided the design criterion for NO_2 is met, the design criteria for all other pollutants would also be met.

It is noted that the PIARC design standard for NO_2 is not a health based goal, nor has it been formally adopted by the NSW Government as the appropriate exposure standard for road users. Further discussion is provided in the Department's consideration.

The Environmental Impact Statement commits to establishing an in-tunnel management framework to ensure that significant congestion is effectively managed and that acceptable in-tunnel air quality is maintained at all times. The framework includes:

- in-tunnel monitoring of carbon monoxide, nitrogen dioxide and/or visibility;
- monitoring of traffic conditions and traffic speeds within the main alignment tunnels, and upstream and downstream of the project;
- measures to limit and manage traffic entering the project tunnels in the event of significant congestion conditions that may lead to unacceptable in-tunnel air quality such as lane closures, rapid responses to incidents/breakdowns, and broader traffic network management;
- operational requirements to ensure of the project's ventilation system reflects traffic volumes and in-tunnel air quality requirements;
- provision for the review of the management framework after a period of operation, once sufficient actual in-tunnel air quality and traffic data have been gathered;
- contingency measures in the event of elevated, unexpected in-tunnel air quality (including measures to manage emergency situations);
- provision for publication of relevant in-tunnel air quality performance data; and
- review of the performance of smoky vehicle regulation / enforcement and whether additional or amended measures may be required.

Notably, the Proponent states that in-tunnel air quality would be equivalent to or better than other road tunnels around the world.

External (Community)

The air quality impact assessment was conducted in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (EPA 2005).

The proposal is expected to lead to an overall net benefit to air quality, based on improved efficiency of the broader transport network and localised re-distribution of pollution from the road-side to higher in the atmosphere (through the ventilation outlets). In particular, it is expected that the proposal would improve air quality for residents along Pennant Hills Road by diverting heavy vehicles into the twin tunnels.

Whilst the Environmental Impact Statement predicts increases in pollution levels at local residential location from the ventilation outlets, these increases would not exceed the EPA's impact assessment criteria. This includes for a worst case scenario with respect to a fully congested tunnel. However, whilst the ground level concentrations are expected to meet the assessment criteria, it is the contribution from tunnel emissions that remains a major significant concern to the community.

Submissions

Air quality was raised in some 87% of all public and agency submissions. The specific issues raised are summarised **Table 3** and **Figure 9.**

Table 3: Air quality issues raised in submissions

Air Quality Issues Raised	Instances Issue Raised	% to Submissions
Northern Outlet Location	764	65.64
Southern Outlet Relocation to Pennant Hills Golf Course	73	6.27
General Southern Outlet Location	46	3.95
Southern Outlet Connectivity	27	2.32
Outlet Filtration	752	64.60
Portal Emissions	621	53.35
Outlet Heights	52	4.47
In Tunnel	115	9.88
Construction Air Quality	28	2.41
Health and Air Pollution	882	75.77
Operational Air Quality Monitoring	505	43.38
Air Quality Methodology and Modelling	582	50.00

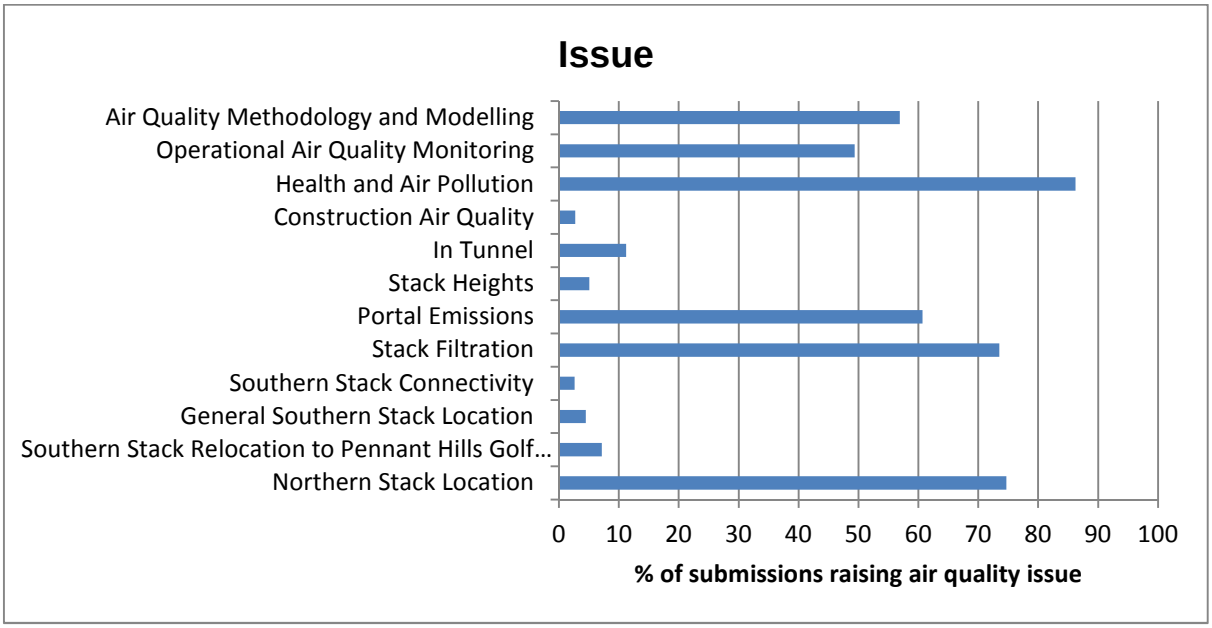

Figure 9: Air quality issues raised in submissions

In-tunnel

Issues of particular concern raised in public submissions relating to in-tunnel air quality were:

- Underlying assumptions in the modelling particular background air quality, vehicle emission estimates factors and NOx to NO_2 conversion rates;
- Underestimation of traffic volumes in the tunnel;
- Lack of in-tunnel air quality criteria/guidelines; and
- Lack of conservatism in assumed travel speed in the tunnel – only considered 80km/hr and no breakdown scenarios.

Of particular and critical relevance to the Department's assessment are the submissions from government agencies established to provide technical advice on the issues - EPA and the Ministry of Health. Those submissions and non-government organisations with expertise in air quality as it relates to public health are summarised below.

EPA's review was primarily focussed on external air quality (that is, not in-tunnel air quality). The submission indicated that the assessment was generally conducted in accordance with EPA's

Approved Methods for the Modelling and Assessment of Air Pollution in New South Wales. Of particular relevance to the in-tunnel air quality assessment, EPA raised concerns about vehicle emission estimates (based on fleet composition and traffic mix) and conversion factors for NOx to NO_2 – both of which impact on the in-tunnel air quality predictions. Based on these issues and others relating to external air quality impacts the EPA requested additional information and further evaluation of options to reduce impacts.

The primary concern raised by the **Ministry of Health** was that PM2.5 and PM10 levels may be equal or higher than other tunnels in operation in Australia and overseas. In particular, it had concerns that predicted NO_2 levels in the tunnel would exceed levels as identified in reports by National Health and Medical Research Council that show a significantly increased allergenic response for asthmatics after exposure of 0.3mg/m3 for 30 minutes and also exceed levels (0.5mg/m3) where motorists start to experience adverse health effects. It also raised concerns about the under-estimation of traffic volumes and also not considering the potential for motorists to spend much longer times in the tunnel due to congestion or breakdowns – as was considered in the external air quality assessment. The Ministry of Health recommended that additional information be provided about modelling assumptions and that further consideration be given to ventilation capacity, especially for scenarios with higher traffic congestion.

The Asthma Foundation of NSW raised concerns primarily about in-tunnel air quality. Concerns included: lack of appropriate monitoring and reporting of in tunnel air quality, lack of guidelines for in-tunnel air quality particularly with respect to particulate matter and the lack of data on health impacts of in-tunnel air quality. The Foundation made a number of recommendations – a key one being for enforceable guideline values or health based exposure limits for priority pollutants based on realistic estimates of transit times to capture both normal and congested conditions.

The Public Health Association of Australia raised concerns about the assumptions that the tunnel intake would be fresh-air and about the in-tunnel concentrations of particulate matter.

External

External air quality was the most significant concern raised in public submissions. Whilst there is general support for the tunnel, the community raised concerns that the air quality outcomes would not be acceptable. The main issues raised were:

- Opposition to the location of the northern ventilation outlet due to health impacts of emissions on the local community and particular the most sensitive population such as children, elderly and people with respiratory issue;
- The need to treat particulate matter and to locate the ventilation outlets away from residential areas; and
- Concerns with the lack of assessment for ultra-fine particles – less than 1 micron (PM1) (the assessment only considered larger particle sizes (ie PM_{10} and $PM_{2.5}$)).

The Department acknowledges the comprehensive submission from the **Community Against Polluting Stacks (CAPS)**. CAPS supports the concept of NorthConnex, but believes there are feasible alternatives to the location of the northern ventilation outlet and portals that will minimise health risk. Key air quality issues raised were:

- Portals and ventilation outlet locations presented in the Environmental Impact Statement - different to those identified in the State Significant Infrastructure Assessment Report for which DGRs were issued;
- Lack of real consideration of alternative locations for the northern portal and northern ventilation outlet;
- Data inputs to the modelling – particularly vehicle emission data, terrain data, background meteorology and external air assumptions; and
- Community engagement and consultation not being in accordance with best practice.

CAPS consider that the current location of the ventilation outlet would result in unacceptable impacts on local residents and should be moved away from residential areas. The submission

suggests moving the northern ventilation outlet north-east into Ku-ring-gai Chase National Park. CAPs has also sought that an independent study be carried out which includes; whole of life-cycle costs; a full assessment of the advantages and disadvantages of filtration of particulate matter (PM), as well as provisions for installation of such systems at a later date if required.

The **Southern Community Against Polluting Stacks** (SCAPS) support the tunnel. However it raises major concerns that there was no detailed description of how and where the southbound tunnel would be connected to the ventilation facility at the southern interchange. It also raised concerns about the location and operation of the southern ventilation outlet. It supports moving the ventilation outlet into the Pennant Hills Golf Course and that it include filtration.

Key issues raised by **Hornsby Council** were portal emissions, vehicle emission data, frequency of the use of the emergency extraction outlets, requirement for filtration preferably in the design (i.e. not as a retro-fit).

Submissions from key government and non-government organisations with expertise in air quality are summarised below.

Whilst the **EPA** is generally satisfied that the project is likely to comply with air quality assessment criteria, it raises concerns about the significant contribution to the background levels (particularly NO_2) at sensitive receptors. It also raises a number of specific technical issues with respect to the dispersion modelling and the analysis of vehicle emission estimation data and techniques. Being critical inputs to the air quality modelling, EPA sought that these issues be resolved to demonstrate that it would not significantly change the results of the impact assessment.

The Ministry of Health indicated that it was satisfied that the Human Health Risk Assessment (HHRA) was generally undertaken in an appropriate manner – though this was contingent upon the EPA's confirmation of the modelling. The Ministry of Health identified that there is predicted to be a very small increased risk of hospitalisation and mortality for residents who experience an increase in $PM_{2.5}$ exposure. Accordingly it recommended further exploration of all feasible and reasonable measures to reduce ground level concentrations of pollution.

The Public Health Association of Australia objected to the NorthConnex proposal in its current form indicating that it would be contrary to its new national environmental protection framework for population exposure reduction. It recommends the relocation of the ventilation outlets to higher ground and extending the height of the outlets. It also recommends the installation of an efficient filtration systems and operating procedures to ensure the filtration remains switched on.

Consideration

To assist with the Department's assessment of air quality, the Department engaged Todoroski Air Sciences to undertake a specialist review of the air quality assessment. The full report is provided in **Appendix D**.

In-tunnel

Carbon monoxide (CO) has historically been a good marker for motor vehicle emissions, and to date has been the basis of in-tunnel air quality criteria. This has been recognised in the assessment of all road tunnels in Sydney – the most recent being the Cross City Tunnel and the Lane Cove Tunnel. For both projects, it was recognised that time spent in the tunnel could be longer than optimal travel speed conditions and a more stringent CO requirement for a potential 30 minute exposure was required. It is notable that this change in air quality criteria resulted in requiring a separate air-tunnel – a change from the design of the M5 East tunnel. Since construction, the separate air-tunnel has rarely been used; however, it is also recognised that the traffic volumes predicted that formed the basis of the assessment/approval have also rarely occurred.

Due to improved vehicle technology, CO levels are falling—making other pollutants such as NO_2 the main determinants for the protection of health. In contrast to CO, there are no in-tunnel health based air quality guidelines established in NSW for NO_2. There are external health based air quality guidelines for NO_2, but the one hour averaging period does not correlate with the expected travel times through the tunnel (6 minutes, 45 seconds at 80 km/h).

PIARC recommends an NO_2 threshold limit for healthy people as 1 ppm in its paper *Pollution by Nitrogen Dioxide in Road Tunnels* (PIARC 2000). This paper states that 'in the absence of precise conclusions concerning sensitive people, it is up to each country to define its own policy, taking into account that the adoption of an excessively onerous design standard could increase tunnel construction costs to an unacceptable level in the face of public health concerns.'

Different jurisdictions have applied different criteria for in-tunnel NO_2 many citing the PIARC (2000) recommendations as the basis. A summary is provided in **Table 4**.

Table 4: In-tunnel criteria/guidelines

Jurisdiction/Project	In-tunnel NO_2 criteria	Period
NorthConnex design criteria (Preferred Infrastructure Report)	0.5ppm (60/80km/hr) 0.8ppm (40km/hr) 1ppm (0-20km/hr)	Design criteria – 15 minute
Brisbane City Council- Clem 7 (2007)/ LegacyWay (2010) tunnels	1ppm	Design criteria - Average
New Zealand	1ppm	Design criteria
Norway (tunnel midpoint)	0.75ppm	15-minute
Norway (tunnel end-point)	1.5ppm	15-minute
Belgium	0.5ppm	20-minute
Belgium	0.2ppm	1-hour
France (from 2010)	0.4ppm	15-minute
Hong Kong	1ppm	5 -minute
Sweden	0.2ppm	1-hour

The most demanding limits are adopted in France, Belgium and Sweden, based on a precautionary approach in view of the increasing evidence of the susceptibility of asthmatics to shorter exposure periods.

The NSW Government's Advisory Committee on Tunnel Air Quality does not provide a recommendation for NO_2; rather it suggests that 'a duly considered NO_2 limit would ensure an appropriate level of protection in the medium to long-term' and development of such a limit 'has been identified as an area for further investigation'. It does note, however, international in-tunnel NO_2 limits are 'not consistent, reflecting scientific uncertainties and different precautionary stances'.

Neither the EPA or the Ministry of Health has recommended air quality criteria for in-tunnel NO_2. The Ministry of Health has however noted the results of a 2000 study indicating increased allergenic response in asthmatics after exposure to low levels of NO_2 for 30 minutes – noting however that transit times are expected to be less than 30 minutes.

For this project, the Proponent has adopted a NO_2 15-minute exposure design criteria of 0.5ppm (for travel speeds in the tunnel of above 60km/hr) and 1ppm for travel speeds below 20km/hr.

In considering in-tunnel NO_2 limits for the Proposal, the Department has pursued the Proponent's commitment that 'in-tunnel air quality would be equivalent to or better than other road tunnels around the world'. The Department notes that the Proponent has set design criteria that allow higher concentration of NO_2 in tunnel at lower speeds. The Department does not consider that this is a satisfactory approach, given that motorists and passengers would be exposed to in-tunnel air for longer periods at lower speeds. The Department acknowledges that international in-tunnel air

quality limits are not consistent, and that there is no internationally accepted limit for NO_2 (as there is for CO). However, the Department considers that the clear international trend is towards adopting in-tunnel limits on NO_2 that take a precautionary approach to human health.

Without clear guidance on the effects of NO_2 exposure on tunnel users, the Department has considered health based guidelines used for other types of exposures. For instance, the Department's consideration of an appropriate in-tunnel NO_2 limit was also informed with reference to the Acute Exposure Guideline Levels (AEGLs) adopted in industry. AEGLs represent threshold exposure limits for the general public. AEGL-1 is the airborne concentration above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. For AEGL-1, a concentration of 0.5 ppm was adopted for averaging periods from 10 minutes and higher.

The importance of in-tunnel air quality limits to the overall air quality impact of the proposal is critical. As identified in the independent review, in-tunnel air quality is the limiting factor on ventilation outlet emissions. As such, the Department has considered the broader implications of setting such a limit, including:

- NO_2 becoming the main determinant for protection of health inside the tunnel;
- the absence of a clear policy on an appropriate in-tunnel compliance guideline for NO_2;
- the strong concerns expressed by the Ministry of Health with respect to adverse health effects for motorists that may spend longer periods in the tunnel;
- developments in international best practice in-tunnel NO_2 air quality standards;
- the commitment in the Environmental Impact Statement that in-tunnel air quality would be equivalent to or better than other road tunnels around the world;
- the length of the NorthConnex tunnel – being the longest road tunnel in Australia and hence a real potential for longer exposures (an average travel speed of 18km/hr would result in a 30 minute travel time);
- the project's location in a part of the Sydney road network where high congestion levels could be realistically expected on more than just rare occasions;
- experience with long travel times and congestion in other road tunnels in Sydney, particularly the M5 East and the Eastern Distributor;
- the absence of a clear education strategy at a policy level to potentially dissuade people with respiratory issues (such as asthma) to use the tunnel and how such a policy may impact in the longer term in disadvantaging sections of the community from using tunnels
- the Proponent's requirement that truck drivers (including potentially those with respiratory issues) being directed to use the tunnel; and
- the potential emerging cumulative impact with multiple tunnel use.

Given the implications above, the Department has considered it necessary to impose a more stringent NO_2 criteria on this project than that proposed by the Proponent. The Department considers that the Proponent's two tiered approach for an in-tunnel NO_2 limit is not acceptable. The Department considers that the proposal should provide a safe environment for motorists at all travel speeds, and therefore recommends that a precautionary approach is adopted. Based on the evidence considered, this would favour a limit on the lower end of the Proponent's design criteria.

The Department considers that the Proponent's high speed design criteria for NO_2 of 0.5ppm over a 15-minute averaging period should be applied as an average across the tunnel for all conditions in the tunnel (including congested and low speed conditions). This limit would be monitored and results provided online in real time. The Department considers that enforcing compliance with this limit better reflects a health based exposure criteria.

It is also critical that the Proponent responds to any exceedance of the in-tunnel limits. In the event of an exceedance, the Department's conditions would require the Proponent to notify relevant agencies and explain its causes. Where requested, based on the nature of the exceedance, the Proponent would have to prepare a Tunnel Management Systems Effectiveness

Report to demonstrate how further exceedances would not occur. This demonstration would necessarily include consideration of any necessary alterations to the ventilation system, from extra fans to filtration. Further discussion of the latter is provided below.

Overall, the Department considers that adopting a precautionary approach to NO_2 would provide confidence that in-tunnel air quality would be managed effectively, and in line with developing international practice.

External

Strategic/regional air quality

The project is expected to provide a net overall improvement to regional air quality by dispersing vehicle emissions from the ventilation outlets, rather than to the roadside along Pennant Hills Road. In particular, substantial reductions (up to 35%) in pollution concentrations are anticipated along Pennant Hills Road. However, these reductions would be dependent on the prohibition of heavy vehicle through traffic from Pennant Hills Road, minimal induced traffic occurring in the corridor, and maintaining predicted traffic efficiency improvements over the long term. A review by the NSW Government Advisory Committee on Tunnel Air Quality suggests that, whilst not fully proved, a net improvement of local air quality would be anticipated along substantial parts of the Pennant Hills Road corridor. The Department notes that, while regional air quality would be influenced by the proposal, this issue must necessarily be considered as a broader based issue for government as this relates to longer term improvements to the efficiency of the broader freight public transport network particularly to the rail and bus network.

Localised air quality impacts

Whilst the Environmental Impact Statement argues that emissions from the ventilation outlets would not exceed EPA assessment criteria, the community is concerned that any level of increase would have an adverse health impact and therefore is not acceptable. This concern has been exacerbated by the community's lack of confidence in the Environmental Impact Statement assumptions, data and modelling as well as assessment of ultra-fine particles.

In response to the concerns raised, the Proponent has revised a number of the key assumptions and modelling input data. The key modelling changes were:

- Increased resolution in the receiver grid applied around each ventilation outlet;
- Application of higher resolution topographic;
- Revision of future projections of vehicle fleet fuel mix, to reflect an increased use of diesel fuel in the future; and
- Amendment to the NO_2 assessment methodology applying the Ozone Limiting Method.

In addition, the Proponent has also increased the height of both ventilation outlets by five metres.

These adjustments and the subsequent revised air quality impact assessment have been independently reviewed by the Advisory Committee on Tunnel Air Quality. The review concludes that the traffic, emission and meteorological modelling, data sources and assumptions have been now addressed satisfactorily in the Preferred Infrastructure Report. The main residual issue identified in the review related to changes to the ratio of $PM_{2.5}$ to PM_{10} used in the air quality modelling; however, the review noted that the Proponent's modelling continued to predict compliance with the relevant external air quality goals with an increase to the ratio.

The Preferred Infrastructure Report indicates that, with the proposed changes to the project, the contribution levels from both ventilation outlets would be reduced for all ground level pollutants in 2019 and 2029. Similar to the findings in the Environmental Impact Statement:

- most project contributions would remain less than 5% of the goals for all pollutants with the exception of $NO_{2\ (1\text{-hour max})}$, $PM_{2.5\ (24\ Hour\ max)}$ and Total VOC $_{(1\ –hour\ 99.9th\ percentile)}$;
- For $NO_{2\ (1\text{-hour max})}$, the highest project contributions are predicted to be between 54 µg/m^3 (22.1% of the goal) to 92 µg/m^3 (37% of the criterion) – the highest occurring around the southern ventilation outlet;

- For $PM_{2.5\ (24\ Hour\ max)}$ the highest project contributions are predicted to be 1.82 µg/m^3 or 7.3% of the reporting standard near the northern ventilation outlet (worst case design analysis); and
- For Total VOC (1 –hour 99.9th percentile) the highest project contribution is estimated to be 5.4 µg/m^3 or 18.5% of the criterion – occurring around the northern ventilation outlet.

However the revised assessment indicates a number of exceptions - these are shown in **Table 5.**

Table 5: Highest predicted increases in project concentrations after revisions to modelling and heightening of the ventilation outlets by 5 metres

Year	Criteria	Vent outlet location	Environmental Impact Statement (µg/m^3)	Revised (µg/m^3)	% Increase compared to Environmental Impact Statement	% of assessment criteria
2019	PM_{10} (24 hour max)	Northern	0.95	1.02	7	2
	$PM_{2.5}$ (24 Hour max)	Northern	0.9	0.96	7	4
	CO (1hour max)	Northern	86.6	181.8	110	<1
	CO (8hour max)	Northern	32.4	36	11	<1
	NO_2 (1hour max)	Southern	61.8	69	12	28
2029	CO (1hour max)	Northern	107.4	217.5	103	<1
	NO_2 (1hour max)	Southern	65	76	17	31

The exceptions are explained in the Preferred Infrastructure Report as a result of a combination of adjustments to inputs to the modelling and, in the case of NO_2, outlet downwash conditions. The Preferred Infrastructure Report indicates that such increases are expected to be rare — these elevated results only apply for a few hours across a multiple year modelling period — and are not likely to result in regular ongoing elevated pollutant concentrations. Indeed, with the implementation of the higher ventilation outlet, NO_2 concentrations at sensitive receivers are reduced (generally substantially) for the majority of the modelled period. With respect to CO, the percentage increases are very high but the contributions would still be very small in absolute terms and as a percentage of the criterion – and would not be of major concern.

The Department accepts that, in all events, the project is likely to meet the external air quality assessment criteria. Therefore, the Department has recommended a set of conditions to govern the air quality impacts of the proposal. These include:

- Adopting ventilation outlet limits that correspond with the in-tunnel limits and ensure compliance with the modelled air quality impacts presented by the Proponent; and
- Adopting external air quality goals based on the National Environmental Protection Measures for NO_2, CO and PM_{10}, and the draft National Environmental Protection Measure for $PM_{2.5}$.

In order to set the ventilation outlet limits, the Independent Review included an analysis of how in-tunnel limit impacts on external air quality and ventilation outlet limits, the modelled predictions of the Proponent's air quality assessment, and the need to ensure acceptable external air quality outcomes. The limits were then confirmed in consultation with the EPA. Ultimately, the recommended conditions taken together ensure that the Proponent would be held to its modelled air quality impacts, and provide confidence that the proposal would perform as well as or better than that presented in the Environmental Impact Statement and Preferred Infrastructure Report.

The Department notes that the external air quality goals also apply to regional air quality more broadly, and that Sydney's air quality readily complies with these goals. The requirements for in-outlet limits mean that the Proponent could not increase its emissions if emissions from other

sources in the community decrease. The Department has also recommended conditions that provide the ability to tighten the in-outlet limits over time, based on improvements in vehicle emissions) pollutants. This would ensure that, as background conditions improve over time, there is an expectation that the proposal would continue to reduce its emissions too.

Notwithstanding, it is critical that the design is future-proofed, to ensure that any air quality issues arising through operation of the tunnel can be readily rectified. The Department has therefore recommended a condition requiring the Proponent to demonstrate how the tunnel ventilation system can be modified in the future in the unlikely event of systemic failure. These modifications could include installation and operation of additional fans, air intakes, conversion of the Wilson Road and Trelawney Street emergency smoke extraction facilities to ventilation outlets, or filtration; the latter is discussed further below.

Elevated receptors

The Environmental Impact Statement was found to be incomplete in regard to predicted impacts at elevated receptors in the vicinity of each of the outlets. Elevated receptors include the upper levels of multistorey buildings. The *Approved Methods for the Modelling and Assessment of Air Pollution in New South Wales* requires the assessment to be made at all existing and likely future sensitive receptors. There are presently elevated receptors in the vicinity of the outlets and it is likely that there will be new elevated receptors in the vicinity of the outlets in future.

An analysis by the independent reviewer indicates that for planning purposes, there is no significant constraint on receptors up to 12 metres high (~4 storeys), but beyond this height elevated receptors several hundred metres away may experience some tangible effect. Overall, the application of good planning practice indicates that it in the interim, it would be preferable to limit the upper height of new receptors to:

- 2 storeys high within 60m of the ventilation outlets;
- 12m high (~4 storeys) within 300m of the ventilation outlets;
- 36m high (~12 storeys) within 500m of the ventilation outlets;

To ensure impacts on elevated receptors is considered for future development in the area, the Department has recommended that the Proponent assist councils in setting out an assessment process for new development near the ventilation outlets.

Alternative ventilation outlet locations

A number of submissions identified relocating the outlet as a potential solution to community concerns about ground level pollution impacts. The submission by CAPS suggested moving the northern ventilation outlet north-east into Ku-ring-gai Chase National Park – providing a significant buffer to residential areas. Another alternative location for the northern ventilation outlet identified was the Asquith Industrial area. An alternative location identified for the southern ventilation outlet was in the south-west corner of the Pennant Hills Golf Course (PHGC).

Comparative assessment was undertaken in the Preferred Infrastructure Report for the Asquith industrial area location (northern ventilation outlet) and for the southern ventilation outlet located in Pennant Hills Golf Course.

The Department is not satisfied that the proposal to move the northern ventilation outlet to the Asquith site is justified, or would result in an improved environmental outcome over the proposal. The Proponent's modelling indicates that air quality impacts at surrounding residential receivers are predicted to be equivalent to the receivers around the Environmental Impact Statement location. Human health impacts associated with the relocated northern ventilation outlet are expected to be comparable, though marginally lower than predicted for the Environmental Impact Statement location. The assessment by the Proponent indicates that the Asquith site would have reduced visual, noise and land use impacts, but would be relatively worse in terms of constructability and construction impacts. The Proponent has argued that the additional costs would be in the order of $300- $500 million dollars with additional operating costs of $2 million per

year due to the need to construct an additional tunnel linking the main line tunnel to the ventilation outlet. It is not considered that the substantial additional cost involved would produce significant improvements in environmental impacts.

The Department acknowledges that relocation of the southern ventilation outlet to the Pennant Hills Golf Course site would result in some air quality improvements, but would cause a number of other social and construction impacts. The Department acknowledges that Proponent's modelling shows a reduction in 20% maximum annual average ground level concentrations, and slightly lower human health impacts than the proposed location at the Motorway Operations Complex. Overall, however, the predicted air quality impacts surrounding the Motorway Operations Complex site are considered to be small, and health effects are within normal variability. As such, any improvements over the predicted impacts are also anticipated to be small when compared to the applicable air quality criteria. For instance, the Proponent advises that a 20% reduction in concentration of $PM_{2.5}$ would reduce average annual project emissions from 0.55% of the criteria to 0.44%. The Department notes that an equivalent reduction was achieved by raising the ventilation outlet height as part of the Preferred Infrastructure Report.

The Pennant Hills Golf Course location would also result in some reduction of noise and property acquisition impacts, but would have some land use impacts and increase the visual impact of the ventilation outlet. The proposed relocation would also present some constructability challenges, requiring construction of a suitable platform on the existing embankment to allow construction of the ventilation outlet and future safe access. The Proponent has advised that the associated ventilation facility, which contains the majority of the ventilation machinery, would probably not be able to be relocated to the golf course site, and would need to remain part of the Motorway Operations Complex.

The Department considers that, while relocation of the southern ventilation outlet to the Pennant Hills Golf Course site would result in some improvement over modelled air quality outcomes, relocation would add some additional engineering complexity and would have additional visual impacts which have not been clearly assessed. The Department is satisfied that the proposed location would have environmental and social impacts that can be acceptably managed in accordance with the recommended conditions.

The Department notes that the moving the northern ventilation outlet north-east into Ku-ring-gai Chase National Park would likely result in considerable improvements to localised air quality impacts. However, it is likely to require substantial additional costs and energy use.

While noting the desirability of locating ventilation outlets in non-urban areas, the limitations of the corridor and the ability to meet the standards justify the current locations. Therefore, the Department is satisfied that the proposal would result in acceptable air quality impacts, subject to compliance with the air quality limits set out in the recommended conditions.

Filtration Systems

The Department also acknowledges community support for filtration of tunnel air, primarily for the purpose of improving external air quality outcomes. The Department maintains its position, as it has for other major road tunnels in Sydney, that installation of pollution treatment technologies is not likely to be a long term focus for managing emissions from tunnels.

Whilst the provision for retro-fitting of treatment technologies has been included in the planning conditions of approval for all road tunnels in Sydney since the M5 East tunnel in 1997/1998, the requirement for retrofitting has never been triggered. Improvements to tunnel and ventilation design, higher vehicle emissions standards and overall fleet renewal continues to provide the most cost effective improvements to in-tunnel and external air quality. Similarly, greater improvements in air quality can be achieved through investment in programs targeting other emission sources that contribute to higher levels of pollution — for example the smoky vehicle regulatory measures as applied to the M5 East Motorway have resulted in significant reduction in

pollution levels inside the tunnel. On this point, the Department has recommended conditions to guide measures for smoky vehicle enforcement in the areas surrounding the tunnels.

However, as noted above, the Department considers it appropriate that the tunnel design should allow for retrofit of ventilation system modifications, and has recommended conditions requiring this allowance to be demonstrated.

Monitoring, Reporting and Response to Exceedences

The Department considers that effective monitoring of external air quality would be critical. The Department has therefore recommended a suite of conditions that require the proponent to:

- Establish a series of monitoring stations, with the agreement of an air quality community consultative committee;
- Provide real time data on air quality levels recorded at these monitoring stations;
- Report to the Department and relevant agencies on any exceedance of external air quality goals, or ventilation outlet emissions limits;
- Ensure appropriate quality assurance and quality control measures are applied to monitoring data; and
- Appoint an external auditor to audit air quality monitoring.

These requirements are consistent with past approvals for major road tunnels in NSW.

As with in-tunnel air quality, it is critical that the Proponent respond effectively to any exceedance of the external air quality goals and limits that could be attributable to the proposal. In the event of an exceedance, the Proponent would be required to report on the options available to ensure such an exceedance would not reoccur. Where the exceedance is caused by the proposal, the report would need to consider how the tunnel management system could be improved. This may require further consideration of additional ventilation management facilities. The report would be submitted to the Department for determination of what measures would be necessary.

Conclusion

In-tunnel

The Ministry of Health has expressed strong concerns about in-tunnel exposure to NO_2 and, in particular, the potential for sensitive individuals to experience adverse effects during transit. Neither the Ministry of Health or the EPA has recommended air quality criteria for in-tunnel NO_2. The NSW Government's Advisory Committee on Tunnel Air Quality has not provided a recommendation for an in-tunnel NO_2 criterion, but rather suggests a precautionary approach to standard setting that considers the both potential health benefits and costs.

Internationally, different authorities have applied different criteria for in-tunnel NO_2. While a number of jurisdictions have applied the PIARC recommendation of 1ppm, that recommendation is not a health based exposure criteria but rather a threshold limit for healthy people. PIARC indicates that in the absence of precise conclusions concerning sensitive people, it is up to each country to define its own policy. For this project the Proponent has adopted a NO_2 15-minute exposure design criteria of 0.5ppm (for travel speeds in the tunnel of above 60km/hr) and 1ppm for travel speeds below 20km/hr.

The Department considers that in-tunnel air quality should reflect other road tunnels around the world. The Department sees a clear trend emerging internationally towards precautionary in-tunnel limits for NO_2. It is therefore recommended that a precautionary approach is adopted and a compliance based criteria for in-tunnel NO_2 be established that better reflects a health based exposure criteria. Accordingly, it is recommended that the Proponent's high speed design criteria for NO_2 of 0.5ppm (over a 15-minute averaging period) be applied as an average across the tunnel, across all traffic conditions. In conjunction with this limit, a process for considering all possible measures to prevent any exceedences has been recommended in the event the limit is reached.

External
The project is expected to meet the external air quality assessment criteria, and result in significant improvements in external air quality along Pennant Hills Road. However, increases in pollutant concentrations would be anticipated at some sensitive receptors. It is problematic to specify what contribution level would be 'acceptable' – particularly given health specialists and community concerns that no increase (however small) would be acceptable. Notwithstanding, health impacts in affected areas are anticipated to be very small.

The Department considers that there should be continued improvement in the proposal, and consistent with the commitment that the Proponent has made with respect to in-tunnel air quality, the design should be at least equivalent to, but preferably better than, other approved road tunnels. As such, the Department has recommended conditions to ensure that the Proponent is held to its predicted contributions to air quality external to the tunnel, must comply with or improve on its predicted impacts on external air quality. The conditions are in line with practice for past projects, and would ensure that the Proponent actively pursues the objective of providing an equivalent or better outcome for external air quality than predicted for other approved tunnel projects in Sydney.

The Department has recommended a comprehensive suite of monitoring measures to ensure the community has input to and confidence in reporting, and can verify the modelled impacts of the proposal. In the event of any exceedence of ventilation outlet limits, it is recommended that the Proponent undertake further consideration of design options to reduce the contribution of emissions to background air quality. The Department considers that this process would ensure the proposal performs as well or, more likely, better than that predicted in the Proponent's assessment.

5.2. Construction Noise and Vibration

Issue
The existing noise environment varies along the length of the corridor, though is predominately low density residential with pockets of retail, commercial and industrial development. There are also a number of sensitive receivers including schools, churches and child care facilities. Construction of the project is expected to take up to 5 years, including three years of tunnelling. Both tunnelling activities and haulage of spoil is proposed 24 hours a day, 7 days a week.

Key elements of the proposal with the potential to have impacts on noise and vibration during construction include:
- tunnelling operations (ground borne noise particularly in relation to sleep disturbance);
- removal of spoil by trucks particularly on local and regional roads;
- construction compound sites; and
- other major permanent ancillary components (such as the air intake and ventilation outlets).

The noise associated with the construction of the proposal has been assessed in accordance with the noise management levels identified in the *Interim Construction Noise Guideline ICNG* (DECC, 2009). Vibration from construction was assessed in accordance with the ICNG (regenerated noise), *Assessing Vibration: A Technical Guideline (DEC, 2006*) (tactile vibration) *and German Standard DIN4150-3 Structure Vibration – effects of vibration on structures* (for structural damage).

Airborne noise
Major surface activities would occur at:
- the southern interchange including connection to the Hills M2 Motorway;
- the northern interchange including connection to the M1 Motorway; and
- the 11 construction compound sites.

During standard daytime construction hours, noise levels are predicted to exceed the noise management levels established via the ICNG at all locations assessed. The greatest impact would be construction works associated with the southern interchange and associated compound site, with some 445 receivers above the noise management levels. The highest exceedances would be around 15dB(A) above the criteria, also associated with construction of the southern interchange and the associated compound site, with 27 residences highly noise affected around this site.

Out-of-hours activities would include integration works at the northern (M1) and southern (M2) interchanges, tunnel support works at the Southern Interchange, Northern Interchange, Wilson Road and Trelawney Street compounds. The M2 motorway integration works would have the highest predicted impacts, with some 437 receivers above the noise management levels, including 2 receivers identified as highly affected.

Ground-borne noise

Tunnelling works are expected to result in vibration and regenerated noise (noise generated within a room as a result of the vibration) through the operation of the tunnelling machinery (road headers). Ground-borne noise levels are expected to exceed the criteria by up to 5dB(A) during the day and up to 10dB(A) during the night time period. The exceedances would impact up to 90 receivers. However, it is anticipated that the worst case ground-borne noise impacts along the majority of the alignment would be apparent for a relatively short period of time (i.e. several days) whilst the tunnelling works are directly beneath a particular receiver. The Environmental Impact Statement does not outline any specific mitigation measures relative to ground borne noise.

Vibration

Vibration levels are predicted to exceed human comfort criteria for up to 64 receivers. The exceedance would be for a short period (i.e. less than 5 days). Vibration levels are not predicted exceed structural damage criteria. The Environmental Impact Statement does not specify any specific mitigation measures relative to surface and tunnel vibration other than safe working distances for vibration intensive plant.

Blasting

Blasting is identified several times throughout the Environmental Impact Statement as a means of tunnel and cavern excavation. There is however no assessment of potential blast impact in the Environmental Impact Statement.

Construction road traffic noise

Whilst the majority of construction traffic would use the arterial road system, the Environmental Impact Statement proposes a number of local roads to be used for access to and from compound sites and for trucks removing tunnel spoil material. Very high noise level increases of between 5 and 16dB(A) have been predicted for a number of local streets. The greatest impacts would be associated with spoil removal at the Southern Interchange, Northern Interchange, Wilson Road and Trelawney Street compounds.

Proponent's general approach to managing construction noise impacts

The Environmental Impact Statement identifies a number of generic mitigation measures, with resolution for the most part proposed to be through the detailed design stage particularly through the preparation a Construction Noise and Vibration Management Plan.

With respect to airborne noise, the Environmental Impact Statement states that 3 metre barriers have been assumed on the perimeter of ancillary construction compounds where residential development is located adjacent to the construction compound. The Environmental Impact Statement also states that acoustic sheds will cover all tunnelling operations and loading of trucks with tunnel spoil.

No specific measures have been identified or assessed in terms of ground borne noise, vibration or construction road traffic.

Submissions

Noise and vibration was raised in over 10% of the submissions received. In particular, submissions from the general public raised concerns over the noise impacts associated with construction sites, including truck movements through local streets, and in particular the possibility of a 24hour/7 day a week construction timeframe. Public submissions generally expressed concern about deferring impact assessment to management plans and questioned whether the project could meet the criteria with mitigation.

The **EPA** raised a number of concerns about the robustness of the assessment, and based on the information provided in the Environmental Impact Statement recommended that all construction works should be restricted to standard construction hours until adequate justification is provided for longer hours. It recommended that mitigation measures should be chosen based on reasonable worst case scenarios for all components of the project and that further detail be provided on the effectiveness of reducing noise levels.

Hornsby Shire Council and The Hills Shire Council raised no particular concerns regarding construction noise but requested to be involved in further detailed design phases. **Ku-ring-gai Municipal Council** held a community consultation workshop in August 2014 to assist in identifying the key areas of concern for the community. It also engaged acoustic consultants Renzo Tonin and Associates to undertake an independent review.

Key construction noise issues are considered in the assessment below.

Consideration

The Department also engaged Renzo Tonin to undertake a specialist review of the noise assessment. The full report is provided in **Appendix D**. Key issues raised by the review in relation to construction noise and vibration were:

- poorly representative noise catchment areas. There areas should be further subdivided to ensure that impact areas have a more representative background acoustic environment;
- selection of noise monitoring locations are not representative of the potentially impacted receivers;
- the adopted sound power levels for the construction equipment are potentially 10 dB(A) lower than typical levels adopted by RMS for similar construction noise assessments;
- the low sound levels adopted for trucks could be significantly under predicting noise impacts, by an order of 10 dB(A), in particular during the night period;
- there is no quantification of the number of spoil truck movements proposed to occur during the daytime, evening and night-time for the northern interchange;
- there are no details regarding the excavation methodology for the construction of the tunnels near portals. Due to the close proximity of these works to residential receivers, this stage of construction may cause significant noise impacts; and
- there are significant noise exceedances for the tunnelling support sites which will be operating as short term industrial type sites, potentially operating 24 hours per day, 7 days per week for the duration of the works. The Environmental Impact Statement does not specify what operations cause the exceedances, how many truck off-site truck movements are proposed and why increasing the perimeter barrier heights or adopting other on-site management strategies was not investigated.

<u>Baseline noise assessment</u>

The Department has recommended a number of conditions to improve the reliability and veracity of the noise impact assessment. This relates to more refined articulation of the noise catchment areas and more detailed land-use surveys. This is considered important to enable a more comprehensive acoustic baseline for the establishment of required mitigation measures.

Construction site access

Access to construction sites using local streets was one of the most significant concerns raised by the community in terms of both noise and safety. The Department notes that there are feasible options for site access, particularly direct access to arterial roads (that is Pennant Hills Road). Whilst such access may be necessarily restricted to left in/left-out only, the potential local community benefits in terms of reduced noise and safety would be substantial.

Based on concerns raised in public submissions the Proponent has made a number of changes to the access arrangements to several construction compounds. This has included alternative heavy vehicle access arrangements to the southern interchange compound, the Trelawney Street compound, and the Northern Interchange Compound. The Department acknowledges that the Proponent has committed to avoiding heavy vehicle access on local roads for spoil haulage outside of the standard construction hours. This has resulted in a significant reduction in potential traffic noise increases during the more sensitive night time period (for instance, a 17.2 dB(A) decrease on Phyllis Avenue adjacent to the Trelawney Street Compound, and a 4.9 dB(a) decrease on Eaton Avenue adjacent to the Southern Interchange Compound). These alternative access arrangements are supported by the Department.

It is noted that heavy vehicles would need to use local roads to access a number of the compound sites during standard construction hours, including construction work sites and spoil haulage from the Trelawney Street Compound and the Southern Interchange Compound. The Department accepts the Proponent's position that these arrangements would enable efficient access to these sites, and substantially reduce the need for long diversions for spoil haulage routes along Pennant Hills Road. Before these arrangements can be used, however, the Department has recommended that the Proponent prepare detailed plans that demonstrate how those impacts would be mitigated. These include:

- an Ancillary Facilities Management Plan, to detail the final access arrangements to each site;
- a Construction Traffic and Access Management Plan, to detail the required spoil truck movements, and procedures to minimise traffic impacts; and
- a Construction Noise and Vibration Management Plan to demonstrate how noise impacts would be controlled effectively.

Construction activities and hours

Construction noise impacts are likely to be significant during the day and night-time, where potential noise levels of around 10-15dBA above the criteria are predicted. The potential for sleep disturbance of particular concern, with over 170 receivers above the criteria, including one receiver above the awakening criteria.

It is critical that the Proponent minimises the noise impacts of the proposal. The Department acknowledges the independent reviewer's concerns with the Proponent's description of some of the construction activities, including excavation methodology and spoil haulage, and the sound levels of associated with each activity. To ensure that the noise implications of all construction activities are reviewed based on up-to-date construction methodology and that the noise controls for the proposal effectively address the impacts, the Department has recommended the Proponent prepare a detailed Construction Noise and Vibration Management Plan, consistent with past practice on other major infrastructure projects.

The large scale of construction work required for a significant infrastructure project located in close proximity to residential receivers means that it would be difficult to minimise construction noise to levels that achieve the noise criteria in all cases. Whilst the Proponent has stated commitments to minimising noise impacts and for developing and implementing feasible and reasonable noise mitigation, further development of specific noise controls is required to determine whether or not outcomes acceptable to the community would be achievable. The Department is satisfied that the Construction Noise and Vibration Management Plan is the appropriate mechanism to finalise the site-specific mitigation measures. The process of preparing and implementing Construction Noise

and Vibration Management Plans is well established practice in the delivery of major projects, and is a rigorous and effective way to ensure that noise impacts are acceptable managed.

The Department also acknowledges the overall potential environmental benefits of 24/7 spoil haulage (e.g. reduced traffic congestion). However based on the current level of assessment undertaken by the Proponent and the high level of noise impact predicted, further resolution of reasonable and feasible management and mitigation measures are required with respect to construction activities (with the exception of tunnelling) outside of standard hours.

Therefore, both the Department and EPA recommend that standard construction hours apply to the project (with the exception of tunnelling) until such times that the Proponent can satisfactorily demonstrate to the agencies what specific mitigation measures and protocols would be employed to reduce impacts when working 'out of hours' . This requirement is identified in the conditions detailing construction hours and the condition requiring a Construction Noise and Vibration Management Plan which includes development of an 'out of hours work protocol'. The protocol would detail the noise mitigation works specific to each out of hours activity, and how the community would be notified of any such work.

The Proponent would be obliged to implement all measures approved in the protocol before it could work outside standard construction hours. The Proponent would also need to strictly comply with the specific construction activities and hours approved in the Protocol. The Construction Noise and Vibration Management Plan would also include comprehensive monitoring system. It is critical that the Proponent respond to exceedances of the construction noise and vibration goals by adapting work methods and employing additional mitigation measures where possible, and continuing to communicate with both the community and the agencies throughout the construction period.

Further, given the relatively long construction period, the industrial type nature of the major construction compounds and those community members that have already endured significant infrastructure projects (such as the M2 Upgrade project), the Department expects the Proponent's Construction Noise and Vibration Management Plan (including the 'out of hours work protocol') would include at-receiver treatments for the most highly affected receivers in addition to other standard mitigation measures. This is of particular importance in the most affected areas around the tunnelling support sites that are proposed to operate 24/7.

The Department is confident that employing a broad range of measures such as at receiver treatments, will reduce noise impacts and lead to acceptable community outcomes. To further ensure that noise impacts at affected residences are reduced during construction, the Department has recommended a condition that would require the Proponent to implement operation phase noise mitigation at the start of the construction period. The Department considers that the final mitigation measures developed through detailed design and implemented before noise intensive works commence, would result in acceptable construction noise and vibration outcomes.

Blasting

The Environmental Impact Statement identifies the potential for blasting but makes no assessment of potential impacts. The Department accepts that blasting, should it proceed, would take place at depth to provide for cross passages between the tunnels, and may provide an efficient approach to excavation with the potential to reduce the duration of impacts. However since the impacts of blasting have not been fully considered in the Environmental Impact Statement, a precautionary approach in relation to blast management is appropriate. The Department has recommended conditions of approval that provide for a number of controls on blasting should it be pursued. This includes a restriction on blasting to day-time only and a limit of six blasts unless otherwise approved.

Further details required would include details of blasting activities, justification of the need to blast, identification of potential impacts, details on storage and handling arrangements for explosives,

determining the risks associated with blasting and detail community consultation procedures. The Department has also recommended that the Proponent conduct trial blasts at reduced scales to determine site specific blast characteristics and define the maximum allowable charge size to meet EPA criteria.

Conclusion

The Department acknowledges that construction noise is a key concern for the community. Noise impacts associated with such significant infrastructure projects in an urban setting are unavoidable and are required to be managed, rather than completely mitigated.

As has been identified for other major infrastructure projects, flexibility and a degree of compromise will be required from both the community and the Proponent for the proposal to be constructed expediently. In particular, effective communication with, and appropriate management responses to the concerns of, the affected community, respite periods, strengthened mitigation measures (such as noise enclosures and barriers and at-receiver treatments in certain cases), comprehensive monitoring and auditing regimes, and strict adherence to EPA requirements and the conditions of approval, will be critical to achieving an acceptable outcome for the affected community. The Department has recommended detailed requirements for a Construction Noise and Vibration Management Plan to ensure that the Proponent reacts efficiently and effectively to resolve acute noise impacts during the construction period.

The current assessment is limited in addressing the expected major issues of night time sleep disturbance associated with major surface activities particularly the construction compounds and truck noise associated with spoil removal. The Proponent has suggested that such measures would be resolved in the Construction Noise and Vibration Management Plan and this is generally supported and has been an approach used successfully for many other major infrastructure projects. However, given the magnitude of the impacts for this project, in terms of both number of people affected and the predicted exceedances above the criteria, the duration of impact and at this stage the generic nature of mitigation and management measures identified by the Proponent, detailed noise mitigation measures are required to be identified and approved before out of hours work can commence.

For instance, while the Department recognises the potential broader environmental benefits of 24/7 spoil haulage such as reduced traffic congestion, the Department considers further resolution of reasonable and feasible management and mitigation measures is required with respect to construction activities (apart from tunnelling) outside of standard hours. Therefore, both the Department and EPA recommend that construction be limited to daytime only (apart from tunnelling) until such times that the Proponent has an approved 'out of hours work protocol'. The Department is confident that requiring an approved out of hours protocol for any out of hours work would ensure that these works are conducted with appropriate and tailored noise controls in place.

5.3. Operational Noise and Vibration

Issue

The project is located in a highly developed urban environment with the majority of the alignment located within an established road transport corridor. Key elements of the proposal with the potential to have impacts on noise and vibration during operation include:

- changed traffic conditions along surface roads;
- new ramps and portal noise; and
- permanent tunnel support infrastructure such as the northern and southern portals (ventilation jet fan noise), northern and southern ventilation facilities, motorway operations complex, Trelawney Street and Wilson Road tunnel support facilities and the Coral Tree Drive Switching Station.

The operation of the proposal has been assessed in accordance with the EPA's *NSW Road* Noise Policy (RNP, NSW Department of Environment, Climate Change and Water 2011) and the Roads and Maritimes' Environmental Noise Management Manual (ENMM, NSW Roads and Traffic Authority 2001). The Environmental Impact Statement appropriately applies the RNP's 'redeveloped road' to receivers along the M1 Pacific Motorway, Pacific Highway and Pennant Hills Road. For the permanent support infrastructure the EPA's *NSW Industrial Noise Policy* (INP, EPA 2000) would apply.

Whilst noise levels are expected to fall substantially along Pennant Hills Road (as bypassed by the tunnel) increases in noise levels would occur near to the new northern and southern interchanges. A total of 82 residential receivers are identified as eligible for consideration of additional noise mitigation measures. St Pauls Church, located on Pearces Corner, was also identified as being eligible for noise treatment. For the southern interchange, some 47 residential receivers were identified for noise treatment. The Early Childhood Intervention facility was also identified as being eligible for noise treatment.

The assessment of the permanent tunnel support facilities indicates compliance with the criteria and no noise treatment is required for any receivers.

Submissions

Operational noise issues were also raised in community submissions. Community concerns included the inappropriate choice of the year 2029 (i.e. 10 years after opening) for the purposes of assessing noise impacts (not the worst case), limited review on the effectiveness of existing noise barriers, limited information on the location and design of noise walls, no assessment of noise impacts on the 2nd or higher storey of residential buildings.

The **EPA** raised a number of technical issues with respect to modelling assumptions. It also raised concerns about the lack of identification and commitment to specific mitigation measures.

Hornsby Shire Council raised no particular concerns regarding operation noise though requested to be involved in further detailed design phases of the project. **The Hills Shire Council** raised no particular issues though sought that permanent support facilities be certified by an acoustic consultant. It also sought that a post commencement acoustic assessment be carried out to verify the findings of modelling and/or identify any further acoustic treatment required to protect the acoustic amenity of the neighbourhood around the southern interchange facility.

As stated previously **Ku-ring-gai Municipal Council** engaged acoustic consultants Renzo Tonin and Associates to undertake an independent review. The review raised concerns about the northern ventilation facility, the northern interchange, noise walls and the application of noise criteria to the 2nd storey of residential buildings. It also raised concerns about vibration impacts on the heritage property at 11A Lucinda Avenue (Hindfell) – being of potential State significance. Please refer to **Section 5.8** for consideration of heritage matters.

Consideration

The Department also engaged Renzo Tonin to undertake a specialist review of the noise assessment. The full report is provided in **Appendix E**. Key issues raised by the review in relation to operational noise and vibration were:

- inconsistent application of correction factors and conflicts with the Proponent's own preference for applying corrections;
- it is unclear how portal noise would affect the overall predicted road traffic noise levels;
- it is unclear whether second storey premises have been accounted for; and
- that a reasonable and feasible noise barrier analysis was not conducted for Lucinda Avenue properties (located north east of the on and off-ramp portals).

<u>Tunnel vibration and regenerated noise</u>

The project would not result in any major vibration and ground-borne noise issues during operation. Compared to underground railways on fixed tracks, rubber tyre motor vehicles generate relatively very low intensity vibration.

Road traffic noise and direct impacts generated by the proposal

The Environmental Impact Statement provides an assessment of the changes in traffic noise during operation and identifies receivers that are predicted to be above the noise criteria as established in the relevant government guidelines. Operational mitigation measures in the form of low noise road pavement, noise barriers and at-property acoustic treatment have been identified accordingly. The project would be required through conditions, to implement all of these measures as appropriate.

However issues concerning the veracity of the assessment could have the potential to underestimate the impacts and to overlook potentially impacted receivers. To ensure that the identification of potentially impacted receivers is robust, it is recommended that an operational noise mitigation review be undertaken that would:

- confirm the operational noise predictions of the project based on detailed design;
- review the suitability of the operational noise mitigation measures; and
- investigate additional feasible and reasonable noise mitigation measures.

The scope and location of specific noise mitigation measures would necessarily be reviewed during detailed design to ensure that reasonable and feasible noise mitigation measures are provided, including noise barriers where appropriate, to meet the guideline requirements.

Road traffic noise and indirect impacts generated by the proposal

The Environmental Impact Statement does not assess the potential implications of noise as a result of changes to traffic volumes on a number of roads that would be affected by the project. In particular truck traffic is expected to increase on North Rocks Road (westbound 2019 - 38% increase), Abbott Road (westbound 2019 - 52% increase), Cowpasture Road (northbound - 75% increase). Consideration of whether noise mitigation is required should be completed in accordance with the appropriate guidelines prior to operation. The Department has recommended a condition that requires the Proponent to prepare a detailed Operational Noise Management Sub Plan. As part of this Sub Plan, the Proponent would be required to identify appropriate mitigation measures for all potentially affected residences.

To ensure that noise affected residences are effectively ameliorated against road noise impacts the Department has also recommended a Condition of Approval that requires the Proponent to monitor operational noise in accordance with the Operational Noise Management Sub Plan within 12 months of operation. Should this monitoring indicate a clear trend in traffic noise levels which are higher than the predictions made and exceed EPA noise criteria, the Proponent would be required to implement further mitigation measures including but not limited to inclusion of noise barriers and insulation of buildings.

Permanent facilities to support tunnel operation

The assessment indicates that the permanent facilities to support tunnel operation would all meet the noise assessment criteria and/or would have the ability to employ further management and mitigation controls if required. This requirement would be confirmed through Operational Noise and Vibration Management Plan.

Conclusion

The project is expected to provide significant benefits in terms of reduced noise to the section of Pennant Hills Road bypassed by the tunnel. Although a number of residual locations would be impacted by the proposal, particularly the residential areas near to the new southern and northern interchanges. Appropriate mitigation measures have been identified to address these impacts and have been reinforced by Conditions of Approval to be imposed by the Department.

In addition, further detail on the specific impacts will be identified through a comprehensive review during the detailed design stage. It is expected that this review will further identify the scope and location of specific noise mitigation measures required for the proposal.

5.4. Traffic and Transport

Issue
NorthConnex would reconfigure travel patterns along the corridor between the M1 Pacific Motorway and the Hills M2 Motorway by shifting regional and interstate road freight as well as commuter and passenger traffic from surface arterial roads to a separated high speed motorway. It is intended that the proposal would free capacity on surface roads for traffic accessing Pennant Hills Road and surrounding residential, commercial, and industrial land.

The Proponent has undertaken detailed modelling to assess traffic impacts during both construction and operation, as outlined below, and developed measures to avoid or reduce those impacts. Further detailed information about the results of the traffic modelling is provided in the Proponent's Environmental Impact Statement and the Response to Submissions Report.

Construction
It is expected that NorthConnex would adversely impact traffic in and around Pennant Hills Road and parts of the Hills M2 Motorway during construction. These impacts would be primarily caused by vehicles required for construction staff access to and from work sites and the movement of spoil from tunnelling. It is expected that construction traffic would increase travel times and intersection waiting times on and in the vicinity of Pennant Hills Road. The introduction of heavy vehicles to local roads would require modifications to some intersections, and create potential for road dilapidation. New site access points and proposed heavy vehicle routes would require diversions of bicycle and pedestrian paths.

Operation
The operation of NorthConnex is predicted to provide significant improvements in travel times and intersection performance on Pennant Hills Road as well as providing a contiguous motorway between the M1 Pacific Motorway and the Hills M2 Motorway. The share of heavy vehicles as a percentage of total traffic on Pennant Hills Road would decrease as a function of proposed regulatory measures and improved travel times. It is anticipated that this would also improve safety along the corridor.

Submissions
Submissions on traffic issues primarily related to construction haulage routes and operational traffic outcomes. In relation to construction traffic routes, the community raised particular concern with heavy vehicle access to the Southern Interchange Compound, and the Wilson Road and Trelawney Street support facilities.

The Hills Shire Council asserted that the heavy vehicle access route for the Southern Interchange Compound, as presented in the Environmental Impact Statement was unacceptable and should be replaced by access via Pennant Hills Road or the Hills M2 Motorway. Council also requested consideration of allowing future construction of access ramps to and from the tunnels between the M1 Pacific Motorway and Hills M2 Motorway. Council requested consultation on construction traffic management plans.

Hornsby Shire Council raised concerns about the consideration of construction traffic impacts at ancillary sites, and how these impacts would be addressed in detail in construction traffic management plans. Council also identified potential merging issues for traffic exiting the tunnel northbound at peak times. Further, Council sought a commitment to monitoring operational traffic flows, and a series of road network upgrades on surface roads, including progressing the Type C corridor.

Ku-ring-gai Council noted the importance of consulting with Council and the community about traffic management measures, particularly given road safety issues. On this point, Council expressed opposition to 24/7 light vehicle access at the Northern Interchange Compound, and any heavy vehicle access to that site via local roads (which is proposed during site establishment). Council also requested consideration of entrance and exit ramps east of the proposed interchange between the project, the Hills M2 Motorway, and Pennant Hills Road. Council also identified the potential for distance based tolling to incentivise use of the tunnel.

EPA and **OEH** provided general comment about how traffic modelling affected their assessment of the proposal. Ultimately, agency assessments of the noise and air quality impacts of the proposal were finalised on the assumption that the Proponent's traffic modelling provides an accurate depiction of operational traffic.

A summary of the specific traffic issues raised in the submissions received by the general public is provided in **Figure 10.**

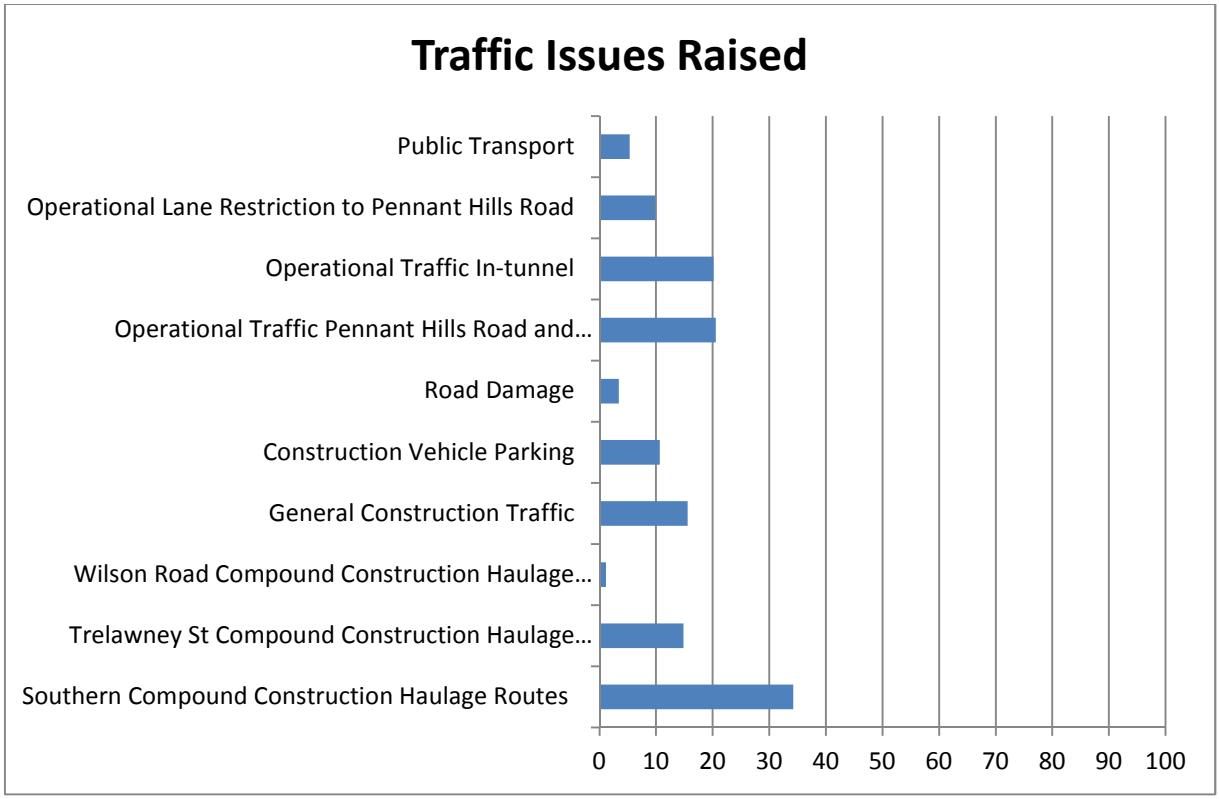

Figure 10: Summary of traffic issues raised in public submissions.

Consideration

Construction

The Department considers that adverse traffic impacts are unavoidable during construction, given the need to efficiently remove a significant quantity of excavated material from tunnelling and construct a number of large civil works, including new viaducts, ventilation facilities and other operational facilities. The Proponent has provided a series of alternate traffic routes and mitigation strategies that would ensure that these impacts can be acceptably managed.

Access to and from the ancillary facilities is the primary construction traffic impact of the proposal. Construction traffic can be divided into three main purposes: construction staff access, construction of operational ventilation facilities and other infrastructure, and the transport of tunnelling spoil. The latter would generate the greatest impact on road network performance.

The Department supports the Proponent's proposal to continuously transport construction spoil from the site (24 hours a day, 7 days a week), subject to final approval of an 'Out of Hours Protocol' for haulage outside standard construction hours. The Department accepts the principle of 24/7 haulage for the following reasons:

- continuous spoil removal allows the Proponent to better use the available capacity of Pennant Hills Road and the motorway network. The proposal reduces traffic impacts during day-time hours, when spare road capacity is low, and allows heavy vehicles to use arterial roads and motorways during night time hours, where those vehicles are currently permitted;
- continuous spoil removal avoids the need for large on-site material stockpiles. This reduces the land needed for spoil storage, and minimises the environmental, including visual and dust impacts of stockpiles; and
- continuous spoil removal allows for reduction in the time taken to complete tunnelling. The Department accepts the Proponent's assertions that 24/7 tunnelling works is the most effective way of reducing the duration of construction impacts. The Department also agrees that removal of spoil should be continuous to avoid situations where tunnelling must stop to allow removal of a backlog of stockpiled material.

The Department is mindful of the community's concerns with the proposed site accesses. In response, the Department notes that the Proponent has developed a number of alternative access arrangements for the main ancillary facilities. The Department's consideration of access arrangements to each of the five main compounds is provided below.

Southern Interchange Compound

The Southern Interchange Compound is the largest of the five main compounds, is the major spoil extraction point during tunnelling and is also the site of the proposed motorway operations complex. As such, the largest daily traffic numbers (up to 740 heavy vehicles) of any ancillary site are anticipated at this site.

Following exhibition of the Environmental Impact Statement, the Proponent withdrew the proposed heavy vehicle access route to the site, which comprised a loop through West Pennant Hills via Aiken Road, Oakes Road, Eaton Road and Karloon Road. The Department supports the Proponent's undertakings to avoid that route, which had significant local and residential amenity impacts. The Proponent provided five alternative access arrangements outlined in **Table 6** below:

Table 6 — Southern Interchange Compound — proposed access arrangements

C5-1	All directions access via signalised intersection on Pennant Hills Road between the Hills M2 Motorway and the Eaton Road intersections.
C5-2	Left-in, left-out access via Hills M2 Motorway eastbound off ramp.
C5-3	Left-in, left-out access via Pennant Hills Road.
C5-4	Left-in, left-out access via Pennant Hills Road; right out via Eaton Road.
C5-5	Left-in, right-out access via Eaton Road. Vehicles would be able to turn both left and right at the existing Eaton Road/Pennant Hills Road signalised intersection.

The Department concludes that access arrangements C5-1 (refer **Figure 11**) and C5-3 (refer **Figure 12**) are suitable for heavy vehicle use, and that the impacts of those arrangements can be appropriately managed through the recommended Construction Traffic and Access Management Plan and the Ancillary Facilities Management Plan for the proposal.

Figure 11: Southern interchange compound access arrangement C5-1. ***Source: Response to Submissions Report***

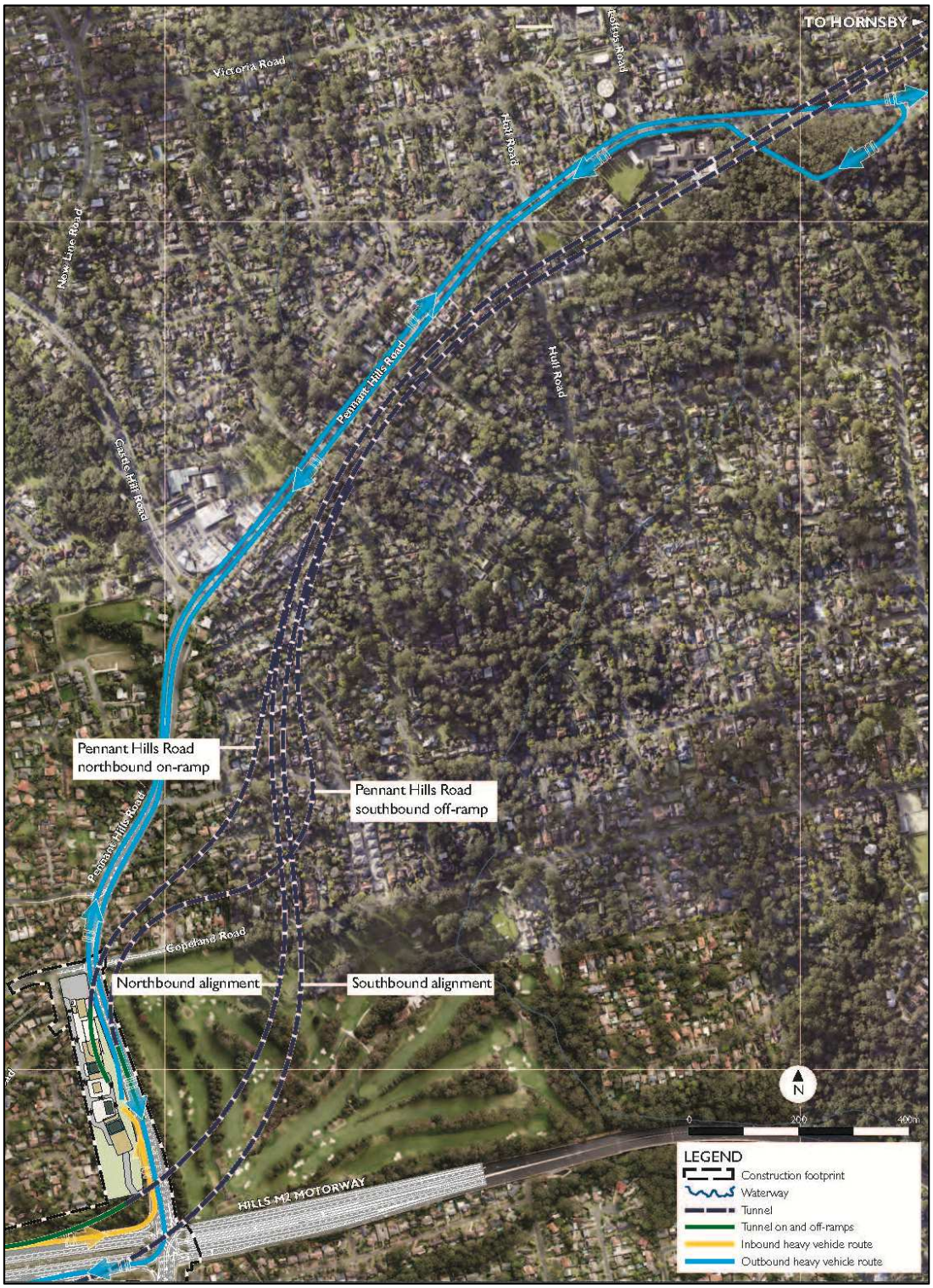

Figure 12: Southern interchange compound access arrangement C5-3. ***Source: Response to Submissions Report***

The Department acknowledges community concern with the proposal to use Eaton Road for site access as part of access arrangements C5-4 (refer **Figure 13**) and C5-5 (refer **Figure 14**). The Department supports the Proponent's commitment to avoid local roads, but notes that these arrangements retain access via Eaton Road south of the Karloon Road intersection.

Figure 13: Southern interchange compound access arrangement C5-4. ***Source: Response to Submissions Report***

Figure 14: Southern interchange compound access arrangement C5-5. ***Source: Response to Submissions Report***

The Department further acknowledges that community concern with the access arrangements includes traffic noise, cyclist and pedestrian safety impacts. The Proponent has committed to avoiding local road use outside standard construction hours and the Department has recommended a condition to that effect. The Department has also recommended conditions requiring the Proponent to maintain safe pedestrian and cyclist access, including provision of permanent footpaths where access during construction would otherwise require us of grassed verges. The Department is satisfied that the impacts of site access via Eaton Road would be appropriately managed through these conditions and the overarching Construction Environmental Management Plan and the Ancillary Facilities Management Plan. As a result, the Department is satisfied that access arrangements C5-4 and C5-5 can be implemented and appropriately managed.

The Department has residual concerns about access arrangement C5-2 (refer **Figure 15**), particularly the safety of the route for trucks leaving the site. The proposed route entails the following:

- left-out from site west of Pennant Hills Road intersection;
- cross northbound (left turn) off-ramp lane;
- enter either of two southbound (right turn) off-ramp lanes; and
- on green right turn signal, perform U-turn and enter westbound on-ramp.

The Department considers that the Proponent must demonstrated that this traffic movement can be performed without impacts on intersection performance or road safety and has therefore recommended conditions requiring a road safety audit be conducted, in addition to the general review requirements of the Construction Traffic and Access Management Plan and the Ancillary Facilities Management Plan, before that arrangement can be implemented.

Figure 15: Southern interchange compound access arrangement C5-2. ***Source: Response to Submissions Report***

*Wilson Road (refer **Figure 16**)*
Access to the Wilson Road site is located between the intersections of Beecroft Road (northbound and southbound) and Pennant Hills Road. It is anticipated that 600 heavy vehicles will enter and exit the site daily during mainline tunnelling.

Whilst it is noted that southbound exiting traffic will result in relatively poor traffic performance, the Department is overall satisfied that site access traffic impacts can be managed effectively, with appropriate measures such as signage, traffic speed restrictions, and scheduling traffic movements in periods of lower traffic volumes. The Department has recommended the Proponent prepare and implement a Spoil Management Strategy that clearly identifies the measures to reduce the impacts of spoil movements. This strategy would inform the development of the construction traffic and access management plan, in consultation with Council, and would include traffic management measures to avoid heavy vehicle queuing on Pennant Hills Road between the Beecroft Road intersections. While impacts cannot be totally avoided, the Department believes they have been satisfactorily considered and are commensurate with the scale of construction proposed.

Figure 16: Wilson Road construction compound *Source: Environmental Impact Statement.*

*Trelawney Street (refer **Figure 17**)*

In response to concerns about the access arrangement presented in the Environmental Impact Statement, the Proponent has proposed two substantially revised vehicle access points at the Trelawney Street support facility, as shown in **Table 7** below:

Table 7 — Trelawney Street Compound — proposed access arrangements

C7-1	Left-in, left-out access via new access points on Loch Marie Avenue. Heavy vehicles would be able to turn both left and right at the existing Loch Marie Avenue/Pennant Hills Road signalised intersection.
C7-2	Left-in, left-out access via new access points on Pennant Hills Road. This access arrangement caters primarily for southbound spoil destinations, and requires long diversions for heavy vehicles entering from the south or exiting towards a northern destination.

The Department accepts that the location of site access must strike a balance between road safety, constructability, and minimising impacts on adjacent residents. It is the Department's position that heavy vehicle access via local roads should be avoided and has recommended a condition stating that position. However, it is noted that C7-1 (refer **Figure 18**) avoids impacts on Pennant Hills Road intersections between Loch Marie Avenue and Beecroft Road, which would be impacted by traffic diverted south under C7-2 (refer **Figure 19**). It is also noted that access arrangement C7-1 would not be used outside standard construction hours. The Department recommends that the Proponent further evaluate both access arrangements C7-1 and C7-2, and prepare a detailed Ancillary Facilities Management Plan and a Construction Environmental Management Plan that specify which access arrangements would be adopted for the site. This process would consider the requirement to avoid local road access where feasible.

Figure 17: Trelawney Street construction compound *Source: Environmental Impact Statement*

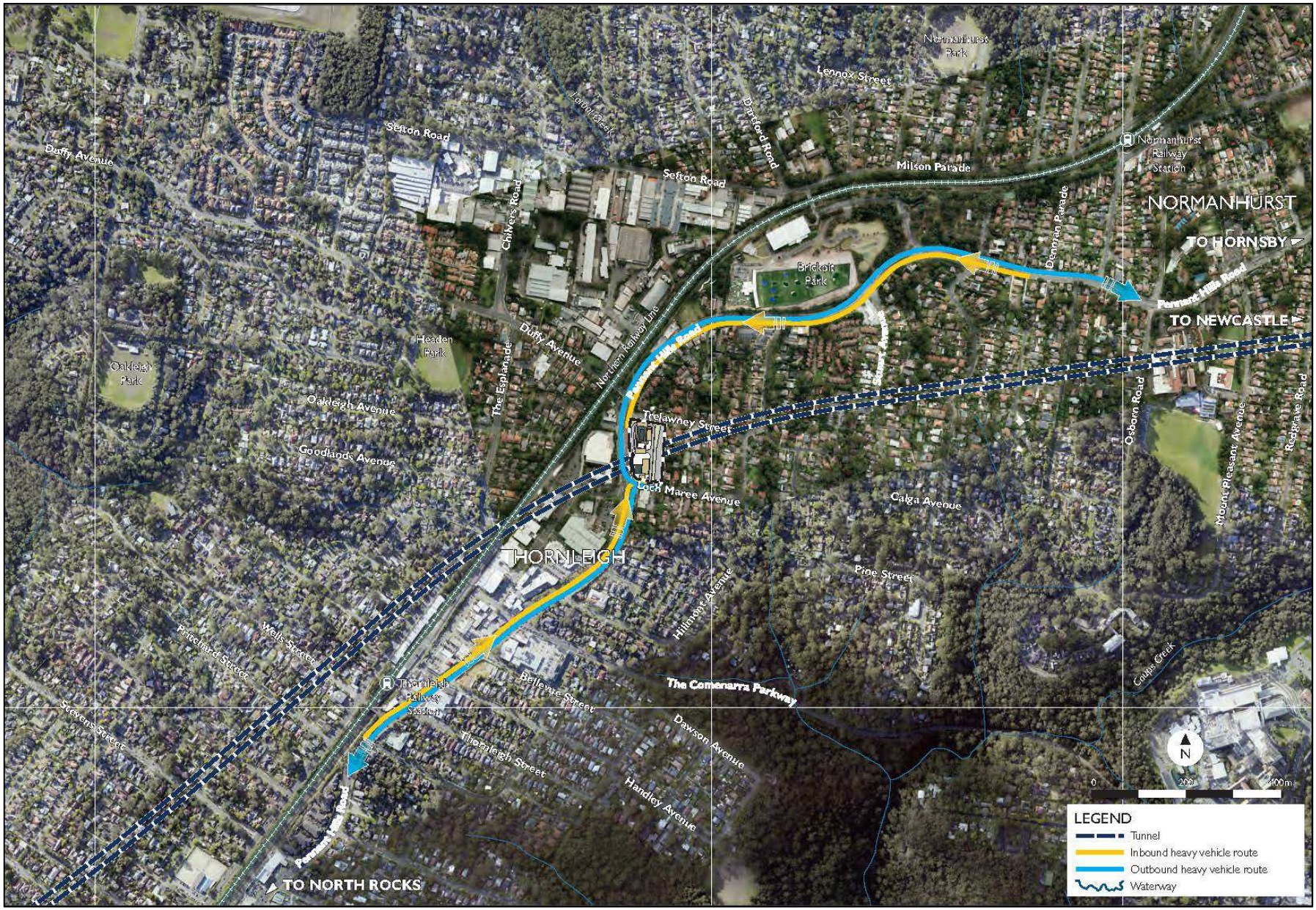

Figure 18: Trelawney Street compound access arrangement C7-1. ***Source: Response to Submissions Report***

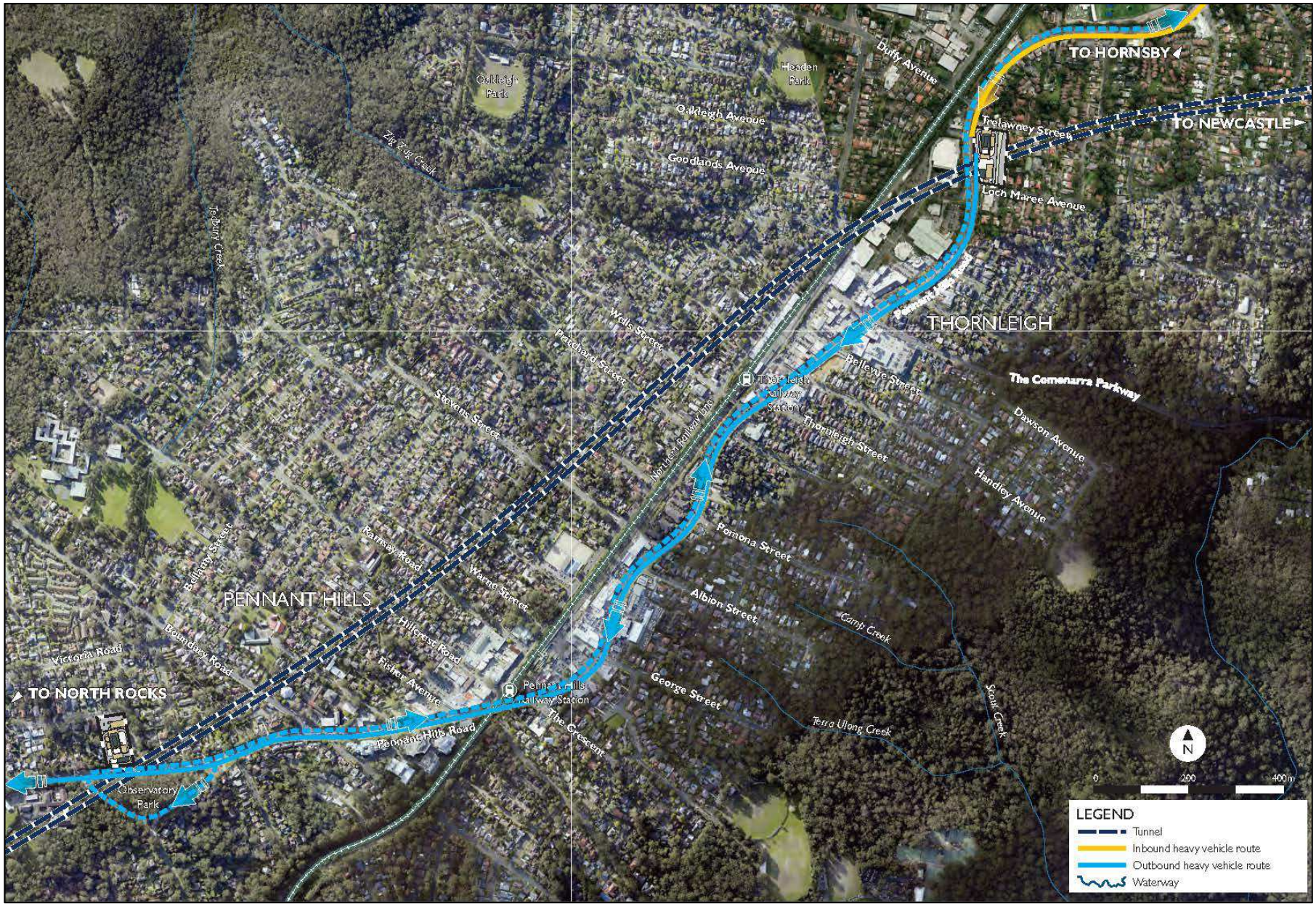

Figure 19: Trelawney Street compound access arrangement C7-2. ***Source: Response to Submissions Report***

The Department acknowledges community concern with the number of car parking spaces at the Trelawney Street Compound. The Pioneer Avenue site remains the primary construction parking site, and it is accepted that the Proponent would maximise use of that site for construction staff (consistent with its commitments in the Environmental Impact Statement and Response to Submissions Report). The Department considers that the major site compounds require some car parking for construction staff, to allow for construction efficiencies. The Department notes the Proponent's commitment to engage with Council about controls for street parking on Trelawney Street and Loch Marie Avenue. The Department is satisfied that the traffic and amenity impacts of onsite parking would be managed effectively through the recommended Ancillary Facilities Management Plan and Construction and Environmental Management Plan.

Pioneer Avenue

The Proponent intends to operate the Pioneer Avenue site as a central construction parking facility, with 600 spaces for construction staff vehicles and shuttle bus services to each ancillary facility. The Department supports use of central onsite parking and inter-compound transport, as a means to significantly reduce impacts on intersection and midblock performance on the roads around each ancillary facility, and the overall demand for on-street parking surrounding other construction compounds.

Notwithstanding, the Department is concerned with the use of the Lymoore Avenue exit as the primary access point from the compound given its proximity to Normanhurst West Community Pre-School and Normanhurst West Public School and that Lymoore Avenue can be congested due to on street parking from local businesses.

The Department acknowledges that the Proponent has committed to upgrading the Lymoore Avenue access (including potential use of traffic controllers) and is considering temporary pedestrian and cyclist diversions, and staggering shift changes outside school hours and peak times. To strengthen these commitments, the Department has recommended conditions requiring the Proponent consider signalising the Lymoore Avenue and Sefton Road intersection. The Department concludes that these commitments are sufficient to underpin development of a construction traffic management plan and ancillary facility management plan for the site, which would be prepared in consultation with Hornsby Shire Council.

Northern Interchange Compound

Tunnel spoil would also be extracted and transported from the Northern Interchange Compound. Light and heavy vehicle access would be via separate access points with light vehicles access via local roads (Eastbourne Avenue) and heavy vehicles via the southbound carriageway of the M1 Pacific Motorway at Pearces Corner. The Proponent has provided the two proposed access arrangements for heavy vehicles listed in **Table 8** below:

Table 8 — Northern Interchange Compound — proposed access arrangements

C9-1	Left-in, left-out access via access roads connecting to the southbound carriageway. This access arrangement caters primarily for southbound spoil destinations, and requires long diversions for heavy vehicles entering from the south or exiting towards a northern destination.
C9-2	All directions access via new signalised intersection at Pearces Corner. Heavy vehicles would be able to enter and exit the site turning both left and right.

The Department considers that the safety implications of access arrangement C9-2 (refer **Figure 20**) require further consideration. The Proponent has indicated that placing a signalised intersection approximately 150 metres east of the existing intersection would be potentially impeded by queuing by M1 Pacific Motorway traffic entering Pennant Hills Road and suggests its operation would be restricted by the curved nature of the approach. The Proponent has suggested that traffic management measures may need to include safety measures such as 'advanced signal warnings' and 'queuing ahead' signage.

The Department considers that access arrangement C9-2 must be audited from a safety perspective before it can be implemented. Therefore, the Department has recommended a condition requiring a road safety audit of C9-2 before it can be implemented. While the Department acknowledges that a southbound diversion is required for northbound construction traffic from C9-1 (refer **Figure 21**), the Department considers that the safety and traffic impacts are known with sufficient certainty and can be managed effectively subject to final review in the Ancillary Facilities Management Plan.

The Department notes the concerns about use of local roads, including Eastbourne Avenue, particularly by heavy vehicles during site establishment. The Department has recommended conditions requiring the Proponent to avoid local roads where feasible; however, it is accepted that 24/7 light vehicle access can be managed appropriately. The Department also accepts that heavy vehicle access is likely to be required during site setup within standard construction hours. The Department is satisfied that the Construction Traffic Management Plan is the appropriate forum to determine the appropriate routes for vehicles during short-term site establishment period, and has recommended a requirement that the Proponent consult closely with Council in setting these routes.

Operation

The Department considers that the proposal would considerably improve the way traffic enters and exits the Sydney Orbital network in Sydney's north-west. The key drivers for the proposal are commonly accepted by key stakeholders and the community. The Department notes that, while the majority of submissions objected to the proposal, many community members have expressed their in-principle support for a link between the existing Sydney orbital network and the M1 Pacific Motorway. The Department's consideration of the route selection process (refer **Section 2.4**), concludes that this proposal takes an appropriate alignment to satisfy this need.

The Department considers that the proposal would improve the efficiency of freight access as it would bypass one of the key bottlenecks for road freight movements in the State and following commencement of operation, vehicles would be able to travel between the Hunter region and the Victorian border without encountering traffic lights.

The Department accepts that the freight mode split is an important issue to industry and the community, and notes community submissions on this point. The desirability of increasing the mode share of rail freight is acknowledged and increasing the use of rail to move goods throughout the State is a strategic policy objective of the NSW Government. On this point, it is noted that improvements to the Northern Sydney Freight Line between Epping and Thornleigh are at an advanced stage of construction. However, this does not negate the need to continually improve the safety and efficiency of the road-based transport network.

The predicted 80km/h travel speed through the tunnel between the M1 Pacific Motorway and the Hills M2 Motorway would substantially reduce peak hour travel times. Currently peak time travel speeds on Pennant Hills Road range between 14-39km/h, and are consistently among the slowest speeds recorded in Sydney's arterial road network. The proposal would reduce average times between the M1 Pacific Motorway and the Hills M2 Motorway by between 10 and 40 minutes in 2029 (when compared to a no upgrade scenario). The predicted travel time savings are presented below in **Figure 22**.

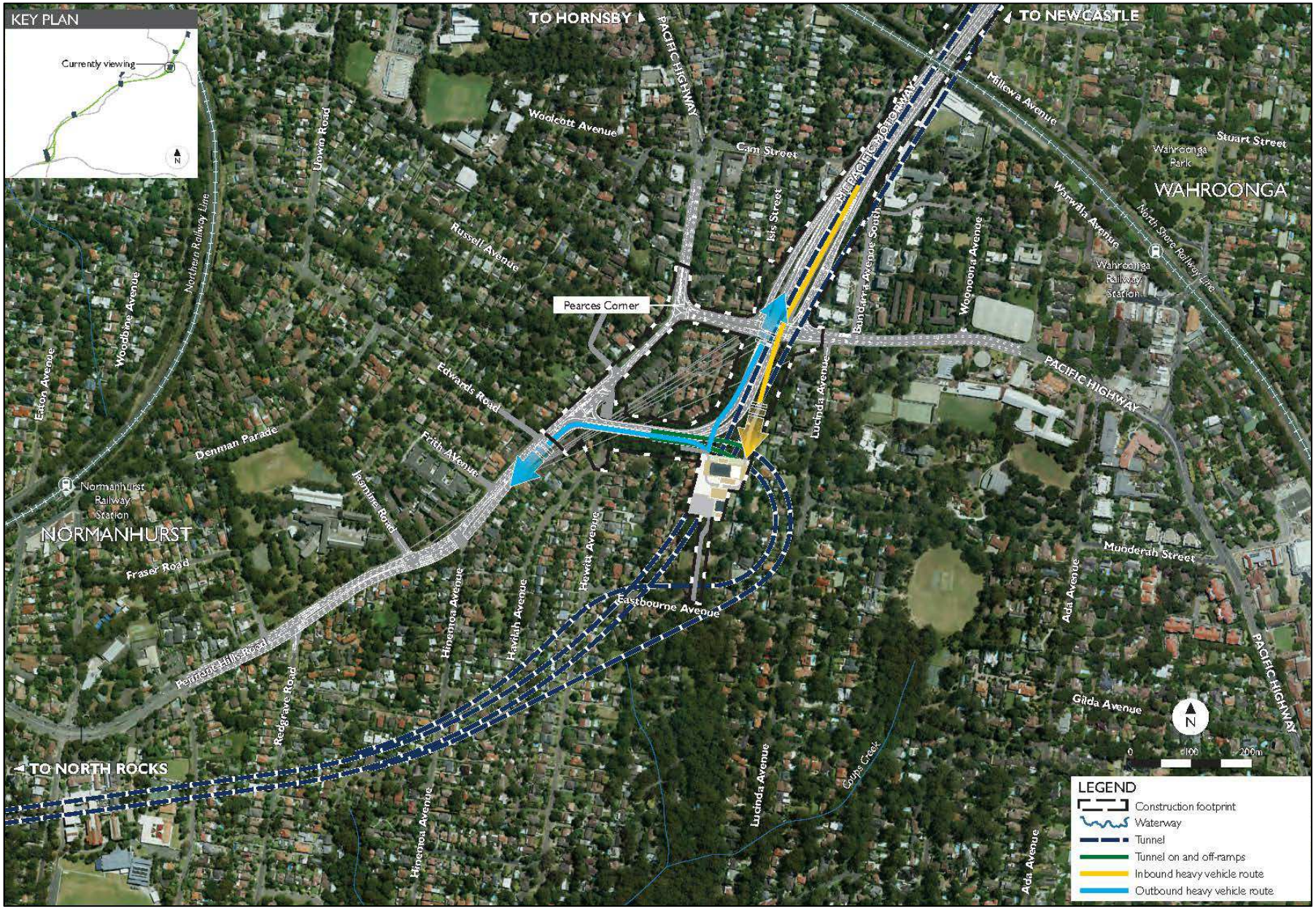

Figure 20: Northern Interchange Compound access arrangement C9-2. *Source: Response to Submissions Report*

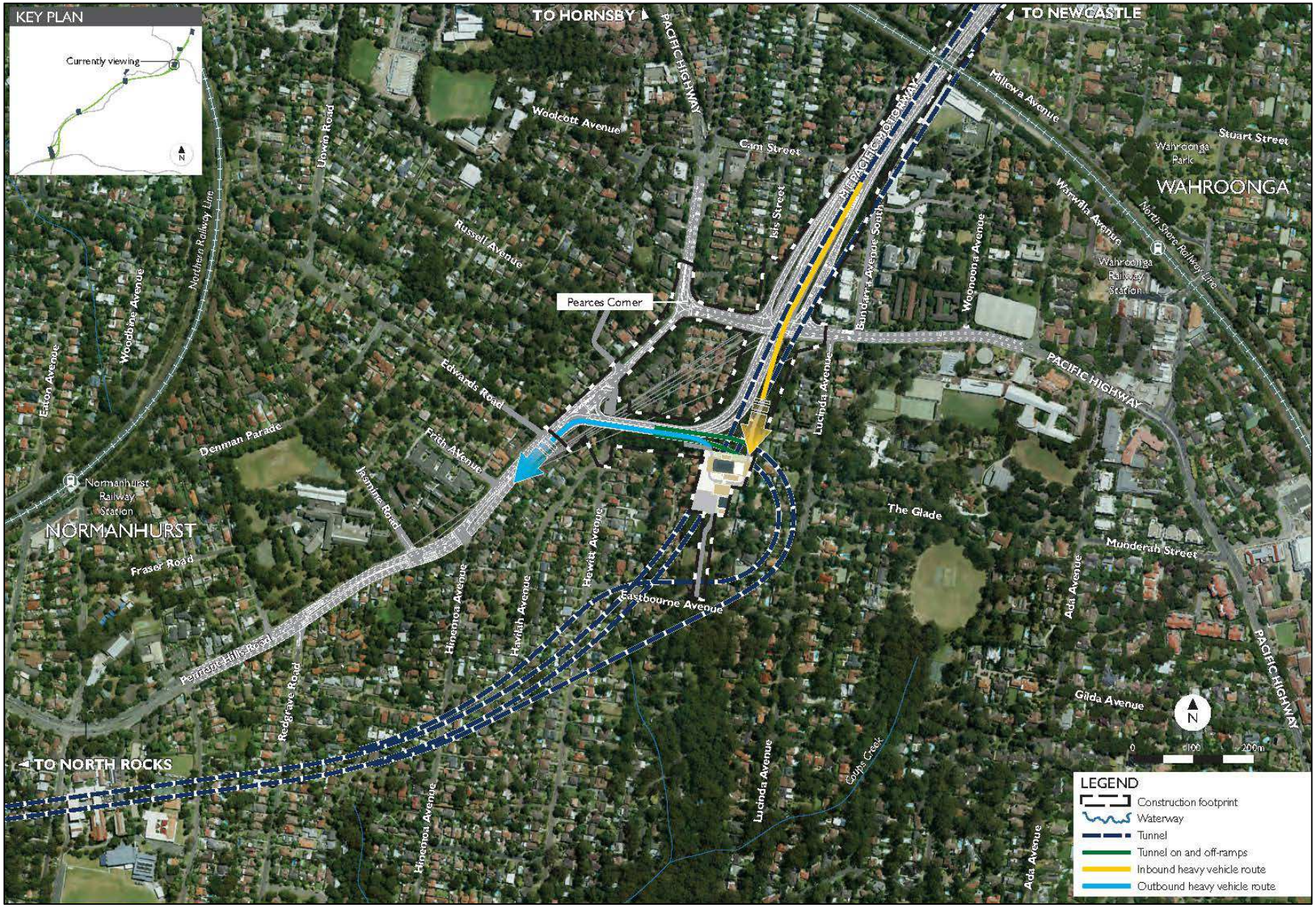

Figure 21: **Northern Interchange Compound access arrangement C9-1.** ***Source: Response to Submissions Report***

Table 8-12 Comparison of average travel time and speed (2013 / 2029) – NorthConnex Tunnel versus Pennant Hills Road (PHR) corridor, between M1 Pacific Motorway interchange and Hills M2 Motorway interchange, without the project

Direction	AM Peak Hour Average Travel Time (min)				PM Peak Hour Average Travel Time (min)			
	PHR 2013	Tunnel 2019 & 2029	PHR 2019 without	PHR 2029 without	PHR 2013	Tunnel 2019 & 2029	PHR 2019 without	PHR 2029 without
Northbound	14	6	16	18	19	6	31	46
Southbound	18	5	27	39	13	5	16	19

(Source: Strategic transport model; 2014)

Figure 22: Predicted travel time savings. *Source: Environmental Impact Statement*

In addition, the Department acknowledges the Proponent's commitments to 'future proof' the tunnel, by providing sufficient space for a future upgrade to three lanes either direction to meet future traffic demand. While extra lanes would require further approval, the Department has recommended conditions to ensure the tunnel ventilation system would be upgradable to maintain acceptable air quality outcomes in that event. The Department considers it is also important to consider the need for any additional future access arrangements for the tunnel, consistent with Ku-ring-gai Council's submission. The Department recommends that the tunnel design allows for the future installation of new on and off ramps on the Hills M2 Motorway east of Pennant Hills Road.

The Department also notes The Hills Shire Council's recommendation that the design should not preclude the installation of mid-tunnel access ramps. The Proponent has advised that the depth of the tunnel means any on- or off-ramps would be too steep for efficient heavy vehicle access, or of such a length, that substantial additional tunnelling work would be needed and not economically feasible. The Department accepts the Proponent's position that providing mid-tunnel access would not be feasible.

Ultimately, the traffic benefits of the project partially rely on a number of financial and regulatory measures. These include the final toll applied to use of the tunnel, and the mechanism by which heavy vehicles are compelled to use the tunnel. The Department notes comments from Ku-ring-gai Council and the community about the desirability of different tolling regimes and has recommended the Proponent prepare an Operational Traffic Management Plan that would assist in delivering or satisfactory traffic outcomes, taking into consideration the proposed tolling structure.

The Proponent has also demonstrated that the Project would improve driving conditions between the M1 Pacific Motorway and the Hills M2 Motorway, and would improve road user safety. The Department accepts that crash rates in the Pennant Hills Road corridor would substantially reduce with operation of the project. The Proponent predicts that the 2029 combined total crash rate in the tunnel and on Pennant Hills Road would reduce from 95.2 crashes per 100MVKT (existing) to 68.4 crashes per 100MVKT (with operation of the project). The Department has noted, with approval, the improved safety records associated with motorway upgrades on the Sydney Orbital Network, the Hume Motorway, and completed sections of the Pacific Highway upgrade. The poor safety record of Pennant Hills Road is a key concern to the community, and the Department is satisfied that the proposal would substantially improve driving conditions.

The Department acknowledges that the traffic model underpins the assessment of a range of other environment impacts: for instance, the predicted air quality and noise impacts are based on modelled traffic numbers and routes. In this respect the Department notes the potential conservative nature of the model and it is critical that the community has ongoing confidence in

the veracity of the traffic assessment. Therefore, the Department has recommended that the Proponent verify existing and predicted traffic numbers at various stages, including:

- prior to construction to confirm the sources of existing traffic noise levels; and
- following opening of the project to traffic to verify how actual traffic noise compares to predicted noise impacts.

The recommended conditions will facilitate, where relevant, the adaptation of additional management measures to any unpredicted changes in traffic numbers or composition.

Conclusion
The Department's assessment concludes that, while there would be considerable construction traffic impacts, those impacts are commensurate to the scale of the proposed work and can be managed effectively through a range of measures including construction scheduling, upgraded pedestrian and cyclist facilities and traffic control measures such as signage, temporary barriers, and traffic signal phasing. To ensure this, the Department has recommended the Proponent prepare a comprehensive suite of traffic management controls, to be set out in a Construction Traffic and Access Management Plan, Spoil Management Strategy, and Ancillary Facilities Management Plans. These plans are to be guided by a series of performance criteria, including recommendations to avoid use of heavy vehicles on local roads where relevant.

The Department considers that the Proponent's traffic modelling has demonstrated that operation of the project would improve traffic speeds and safety for road users between the M1 Pacific Motorway and the Hills M2 Motorway. The Department considers that the proposal would satisfy the strategic need for a key efficient and safe link in the Sydney motorway network. To provide confidence in the modelled traffic outcomes, the Department has recommended the Proponent verify the model inputs and monitor actual traffic counts, at key stages in the delivery and operation of the proposal.

5.5. Soils and Water

Issue
NorthConnex would require extensive excavation of material, and would have impacts on both groundwater and surface water quality in and around the project area.

Spoil removal and disposal
The proposal requires the excavation of primarily sandstone and shale rock formations, to allow construction of the twin tunnels, on and off ramps, and access shafts. The alignment of the tunnel generally maximises the volume of tunnel in the Hawkesbury sandstone rock formation, which is considered most suitable for tunnelling. Overall, the Proponent advises that over 2.6 million cubic metres of spoil would require off-site disposal.

The Proponent has considered a number of alternative spoil disposal locations, and assessed the general traffic implications of disposal at sites north and south of the proposal. The Proponent has not selected a final disposal site; the spoil disposal site will require separate approval.

Contamination and pollution
The proposal would require works at three sites with moderate potential for contamination based on past land uses including the Pioneer Avenue and Trelawney Street ancillary facilities and the Southern Interchange Compound.

During operation, runoff from within the tunnel (including any hydrocarbon spills) and water used for washing and fire suppression, would be treated at a water treatment plant at the Motorway Operations Complex. The water treatment plant would have a maximum capacity of 40L/s, which the Proponent states is sufficient for all but rare rainfall events.

Groundwater

The proposal is likely to intercept aquifers associated with Hawkesbury Sandstone and Ashfield Shale geological formations, and will require dewatering during both construction and operation. Tunnelling during construction would pass through aquifers, requiring collection and treatment prior to discharge to surface streams. The majority of aquifer drawdown, though, is associated with operation of the project. The tunnel is to be built as a drained tunnel; that is, the tunnel would not be lined, and would require continuous management of water draining into the tunnel from subsurface rock layers.

While dewatering rates would decrease substantially after completion of construction, groundwater inflow to the tunnels is expected throughout the operational life of the proposal. The Proponent has advised that inflow during operation is anticipated to be up to one litre per second for each kilometre, and that measures would be implemented to ensure flows are lower than this.

Groundwater inflows would be pumped to water treatment facilities at the four tunnel support facilities during construction, and the Motorway Operations Complex during operation.

Settlement

The Proponent has indicated that construction of the twin tunnels is unlikely to cause any significant settlement issues. Based on its past experience delivering major road tunnel projects, the Proponent has indicated that minor cosmetic damage (for instance, hairline cracks in building facades) may be expected, but no structural damage would be likely.

Surface water

The proposal is likely to require discharge of large volumes of water to surface watercourses throughout construction and operation.

Construction of the project is likely to generate 2.22GL of water, which would be treated at water treatment plants located at each of the main four tunnel support facilities. The Proponent has committed to treating construction water and, where on-site reuse is not possible, discharging to adjacent waterways under an Environment Protection Licence.

The operation of the project would generate large and ongoing outflows. Water from the operational tunnels would be collected and treated at the Motorway Operations Complex, before being discharged to Blue Gum Creek via The Hills Shire stormwater system.

The large rate of water discharge would change the nature of the receiving watercourses. The volume and rate of water would change Blue Gum Creek from an ephemeral stream to permanent watercourse. The changes to Blue Gum Creek would also impact on Darling Mills Creek; Blue Gum Creek flows into Darling Mills Creek and increased flows would potentially impact the stability of the channel in the latter.

Runoff from the road network would increase due to the larger area of impermeable road surface. To maintain existing water management regimes, augmented detention basins and drainage lines would be built along the M2 integration works to manage flow into the Darling Mills Creek catchment, and additional culverts and water treatment measures (for example, gross pollutant traps) would be provided at and around the northern interchange.

Submissions

A number of submissions discussed groundwater and surface water impacts, including particular focus on impacts to Darling Mills Creek.

The Hills Shire Council raised concern about impacts on flood prone land near the Hills M2 Motorway and reiterated the importance of ensuring the proposal reduce or maintain the impacts of existing flood regimes.

Hornsby Shire Council provided clarification on water quality in local watercourses, requested further consideration of a higher construction discharge water quality standard, considering cumulative impacts in the area, and sought ongoing consultation on water management measures during delivery of the proposal.

Ku-ring-gai Council raised water quality issues in the context of biodiversity and the need to rehabilitate ancillary sites following construction.

EPA provided information about applicable water quality objectives, and stated that the proposed construction water quality objectives (i.e. treatment to the 80% protection level under the *Australian and New Zealand guidelines for fresh and marine water quality* (Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council 2000)) be made more stringent.

NSW Office of Water raised concern with the level of assessment undertaken for the proposal. In response, the Proponent provided an initial memorandum providing additional requested information; this memorandum was attached as part of the submission and provided additional information to the satisfaction of the NSW Office of Water, including commitment to a numerical groundwater model. NSW Office of Water also provided clarification regarding licencing for the proposal.

OEH raised water quality issues in the context of biodiversity impacts.

Consideration

Spoil removal and disposal

The Department acknowledges that the proposal would require removal and disposal of a significant volume of spoil. The nature of the material and the quantity from this project is such that its reuse potential is limited. The Department also accepts that it has not been possible to finalise one or multiple spoil disposal site(s), and has therefore recommended conditions that reiterate that any disposal must be covered by a separate approval. It is the Department's position that the impacts of spoil removal and transport within the project footprint have been assessed as far as practicable and are acceptable, but that the environmental impacts of disposal must be further considered as part of a separate application. This approach is consistent with that taken for other large infrastructure projects.

The Department acknowledges, however, that the spoil removal (and ultimately disposal) is integral to the successful delivery of the proposal. The Department has recommended the Proponent prepare a Spoil Management Strategy that covers in detail the process of spoil handling and transport, as updated with information about the ultimate spoil disposal location(s).

Contamination

The Department notes that three sites are anticipated to have moderate risk of contamination; however, the Proponent indicates that contamination is unlikely to be a major issue with the implementation of appropriate safeguards. To ensure the appropriate safeguards are implemented, the Department has recommended a condition requiring the Proponent to undertake further investigations prior to construction. This requirement is consistent with legislation governing the management of contaminated land, and reiterates the Proponent's existing commitments to manage these sites safely.

Groundwater

The Department considers that the predicted level of groundwater drawdown is an acceptable consequence of the tunnel design, given the scale of the proposal and its surrounding geology, provided the Proponent implement a Soil and Water Management Plan that pro-actively manages risks encountered during delivery of the project.

The Department accepts that the proposal is based on a drained tunnel design, which would cause ongoing drawdown from surrounding water table. The Department notes the distinction drawn in submissions between drained tunnels, and tanked or sealed tunnels (such as the North West Rail Link tunnel). The choice of tunnel design is a consequence of a number of factors, including geology, construction methodology, available machinery, and cost. The Department has not interrogated the choice of a drained design over a sealed design in great detail, but rather has focused on the level of assessment undertaken and the acceptability of impacts resulting from the proposed design.

The Department considers that the level of assessment undertaken has been sufficient to identify the impacts of the proposal. The Department notes that the submission from the NSW Office of Water questioned the rigour and detail of the Proponent's groundwater modelling. In response, the Proponent provided a memorandum containing additional information, which was attached to the final NSW Office of Water submission, as well as further detail in the Response to Submissions Report. The memorandum provided additional information about the groundwater investigations conducted for the Environmental Impact Statement and committed to development of a numerical groundwater model, similar to those prepared for major underground mining projects. The NSW Office of Water acknowledged that the information contained in the memorandum was sufficient to address its concerns, and particularly supported development of the numerical groundwater model as a means of verifying the predicted outcomes of the modelling. The Department also supports this commitment.

The proposal's predicted groundwater (and, to a lesser extent, surface water) impacts are predicated on achieving a groundwater inflow along any given kilometre of tunnel under one litre per second. This rate has been adopted as a design standard, based on the Proponent's experiences building other tunnels in the Sydney basin. While 1L/s/km may be a fairly typical inflow for a tunnel in the Sydney basin, it may also be necessary for the Proponent to pro-actively manage flow rates to achieve this rate. The Proponent's experience dictates that there are a series of measures it can implement to minimise groundwater inflow, such as grouting along sections of the tunnel that produce more water. While other Sydney road tunnels have different geology, the Department is satisfied that these measures could effectively be used to restrict groundwater inflow to the desired rate. To confirm this design standard, the Department has recommended that the 1L/s/km rate of inflow be adopted as a performance criterion in the conditions of approval.

The management of groundwater impacts should be adaptive, based on a detailed evaluation of the risks that could arise during construction and operation. For this reason, the Department has recommended the Proponent prepare a comprehensive Water Quality Plan and Monitoring Program. This plan and program would use the results of detailed design investigations (such as the modelling above) to confirm the site specific impacts of the proposal, set the process for ongoing monitoring, and commit to contingency and ameliorative measures in the event that adverse impacts to water quality are identified.

The process for managing impacts on groundwater bores is an example of how this process would be implemented. While the Proponent predicts no impacts on groundwater users, the Department has recommended conditions requiring the Proponent to verify these findings with detailed groundwater modelling, identify the risks of any impacts (that is, reduction in bore levels) and build-in 'make good' provisions, as part of the soil and water management plan. This process provides a rigorous framework for the Proponent to pro-actively avoid and minimise groundwater impacts of the proposal.

Settlement

The Department acknowledges community concern about the potential for settlement, and impacts on property as a result of the proposal. On this point, it is important to note that the Department accepts the likelihood of structural damage is negligible and that the Proponent has committed to rectifying any damage as a result of the proposal. However, to reiterate the importance of this commitment, the Department has recommended a series of conditions that require the Proponent to monitor and address any settlement issues experienced during construction or operation and provide for appropriate dispute resolution mechanisms.

Surface water

The Department notes that the Proponent proposes to treat construction water before discharge to local creeks. It is also noted, that the proposed treatment of discharged construction water to the 80% protection level under the *Australian and New Zealand guidelines for fresh and marine water quality* (ARMCANZ/ANZECC 2000 — the ANZECC guidelines) is not supported by the EPA. The Department considers that the Proponent must further develop water quality objectives for surface water discharges, in accordance with the ANZECC guidelines. To ensure that the guidelines are interpreted and applied satisfactorily, the Department proposes that the EPA should endorse the final water quality objectives before implementation. This process is consistent with general practice for the issuing of Environmental Protection Licences.

The Department acknowledges that the proposal is unlikely to significantly alter overland flows across the majority of the alignment, but notes representations from The Hills Shire Council and the community about particular impacts along Darling Mills Creek. The Department also notes historical flood issues along the section of Cockle Creek east of the M1. The Department has recommended that the Proponent prepare a flood mitigation strategy for those areas, to ensure that the detailed design reduces the potential to affect flow paths and flood levels in those areas.

The impacts of discharge water on Blue Gum Creek and Darling Mills Creek would require active management throughout the operational life of the proposal. The Department accepts the Proponent's commitment to further investigating the exact discharge location based on detailed design, and implementation of other measures such as outlet scour protection and bed and bank stabilisation where required. The Department is satisfied that these impacts would be appropriately managed in accordance with the recommended water management framework for the project.

Water management framework

The Department considers that the project must take a holistic approach to groundwater and surface water management. As such, the Department has recommended the Proponent prepare a series of Water Management Plans. The plans would:

- detail construction and operational water measures;
- integrate groundwater and surface water management measures;
- provide reactive management processes to ensure that unexpected impacts can be managed in a timely and rigorous manner; and
- incorporate the results of consultation with relevant agencies and Councils, including ongoing consultation with NSW Office of Water about relevant licencing issues.

The Department considers that the proposed plans would form part of an overarching water quality plan and monitoring program, and provide certainty to the community that the Proponent implements an adaptive approach to water management throughout delivery of the proposal.

Conclusion
While the proposal is likely to impact both groundwater and surface water flows during construction and operation, these impacts would be acceptably managed through the implementation of the water management framework envisaged in the Department's recommended conditions of approval. To confirm the Proponent's commitment to the suite of management measures presented in the Environmental Impact Statement and Preferred Infrastructure Report, the Department has recommended that this framework encompass detailed information about construction and operational impacts developed during detailed design of the project.

5.6. Urban Design and Visual Impacts

Issue
NorthConnex generally follows the steep ridge line of Pennant Hills Road with a number of elevated peaks and terrain generally falling to the south-east and north-west away from the ridge line. There are patches of relatively dense vegetation, residential properties, existing transport infrastructure and urban development along Pennant Hills Road with the M1 and M2 Motorways dominating the northern and southern portions of the project.

Adjacent to the southern interchange of the M2 Hills Motorway and Pennant Hills Road is the location of the motorway operations complex (refer **Figures 23-25**), including the southern ventilation outlet and southern portal. The proposed site currently consists of vegetated land which adjoins the western edge of Pennant Hills Road and is flanked by low density residential housing on landform which slopes away from Pennant Hills Road to the west.

The northern ventilation facility (refer **Figures 26-28**) is situated adjacent to the M1 Pacific Motorway immediately above the northern portal and within the M1 Pacific Highway road reserve. The proposed site is currently well vegetated with remnant bushland and adjoins low density housing within a heritage conservation area.

Figure 23: Motorway Operations Complex (Eaton Road and Kartoon Road). ***Source: Response to Submissions Report***

Figure 24: Motorway Operations Complex (Hills M2 Motorway and Pennant Hills Road). ***Source: Response to Submissions Report***

Figure 25: Motorway Operations Complex (Pennant Hills Road and Copeland Road). ***Source: Response to Submissions Report***

Figure 26: Northern Ventilation Facility (M1 Pacific Motorway). ***Source: Response to Submissions Report***

Figure 27: Northern Ventilation Facility (Woonona Avenue). *Source: Response to Submissions Report*

Figure 28: Northern Ventilation Facility (Woonona Avenue). *Source: Response to Submissions Report*

As a majority of the project is underground, the assessment has focused on the components of the project visible during construction and operation. These components have been grouped into five landscape character zones.

The assessment undertook an analysis of the landscape character and visual impact of the proposal within these character zones using a method combining the 'sensitivity' of the existing landscape character zone and 'magnitude' of change to that zone or view by grading these changes from low to high. The Department accepts this method of classification to evaluate visual impact.

Construction Visual Impact

Construction of the project will result in structures, equipment and construction activities being visible from surrounding locations including acoustic sheds, equipment and machinery including cranes, office buildings and operation of construction compounds. While construction would be temporary it would cause visual impact of varying magnitude. The Proponent would undertake restoration works and revegetation at each site following completion.

Operational Visual Impacts

Operation of the proposal will see the introduction of four principle sites of ongoing built form including the motorway operations complex, Wilson Road tunnel support facility, Trelawney Street tunnel support facility and northern ventilation facility. Visual impact to motorists would be generally be low due to introduction of built elements within a motorway context. Visual impact to some residents however is considered high due to the nature of the elements within a generally residential setting.

Urban Design Objectives

The stated objectives for NorthConnex include demonstrating excellence in design. Key urban design and landscape objectives include providing landmarks to contribute to legibility, aesthetically enhancing the road facility and associated works and structures, integrating new elements with existing work in as seamless a way as possible, enhancing the existing landscape and integrating new landscape across and into the corridor.

Heritage

Several heritage conservation areas are located within the project area including the Beecroft-Cheltenham Heritage Conservation Area and the Wahroonga North Heritage Conservation Area. The Wilson Road and northern ventilation facility are located in these areas, respectively. The proposal aims to integrate project elements within its immediate context and generally has an overall moderate rating of impact to landscape character with the Wilson Road landscape character zone experiencing a high to moderate impact.

In-Tunnel Design

The assessment has provided a concept for in-tunnel urban design with consideration of features to ensure the tunnel meets safety standards and provides a high quality driver experience. Central to in-tunnel design would be introduction of 'visual events' at third points or at two minute intervals within the tunnel as shown in **Figure 29.** The Department supports the concept design which aims to contribute to tunnel safety, avoidance of driver fatigue, improve orientation and limit distraction within a relatively long tunnel.

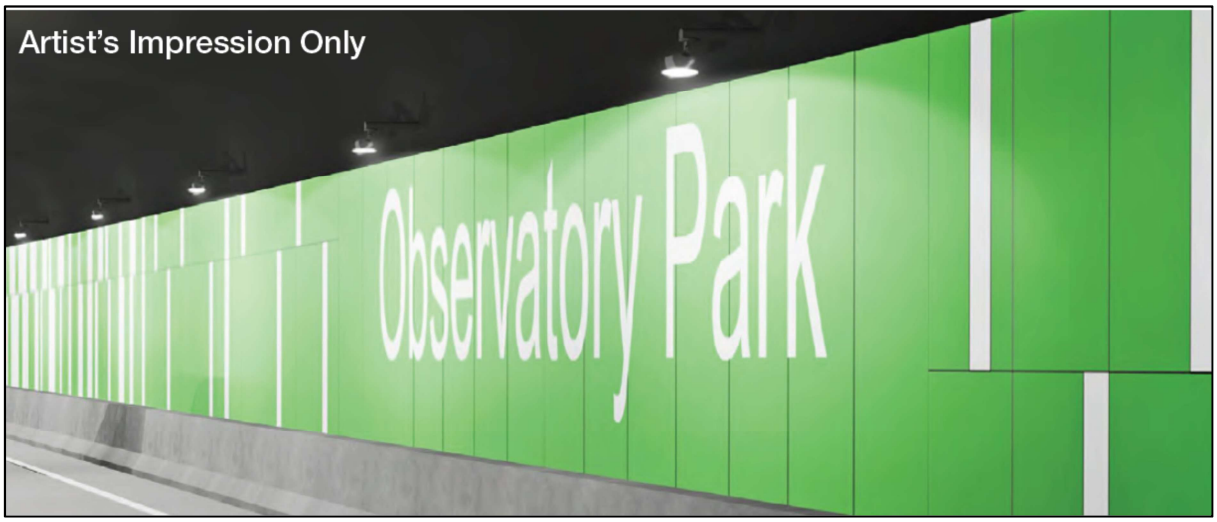

Figure 29: **Tunnel Visual Event Pattern.** ***Source: Environmental Impact Statement***

Submissions

Submissions on urban design and landscaping impacts focussed on light spill, landscape character impacts and urban design (visual amenity) and landscaping impacts. The Local Councils raised a number of issues in relation to urban design and landscaping, including in relation to interfaces with residential areas and property value impacts.

Consideration

Construction Visual Impacts

The assessment has identified that there will be significant overall visual impact during construction activities at five sites including the Southern Interchange Compound, Wilson Road Compound, Trelawney Street Compound, Northern Interchange Compound and Bareena Avenue Compound. These sites have an overall rating of moderate to high or high impact to residential visual amenity. Due to the nature of works to be undertaken at these sites, equipment, including gantry and crawler cranes (approximately 15-20 metres high), excavators (arm extent approximately 10 metres), acoustic sheds (approximately 15 metres high) and office buildings (approximately 6 metres high), would be particularly visible to residential receivers.

Those residents situated adjacent to construction compound boundaries would be particularly affected with construction elements being visible. The Proponent has committed to retaining vegetation around the perimeter of construction sites as much as possible and would investigate early implementation of noise walls and landscape planting to provide visual screening during the construction phase. Due to the high impact to residents and long duration of construction the Department recommends that the Proponent provide full screening at all construction sites consistent with the surrounding context. Mitigation measures should also be undertaken in consultation with affected receivers.

Residents adjacent to construction compounds would additionally experience high to moderate night lighting impacts during construction due to the highly constrained nature of construction sites. The Southern Interchange Compound is located at the top of a ridge line with residential dwellings located downslope to the west. The Proponent has committed to the use of directed and cut-off lighting to minimise glare and light spill. The Department considers the mitigation measures should be strengthened and recommends that the Proponent provide at receiver treatment in consultation with adjoining properties to mitigate night lighting impacts.

Northern Ventilation Facility

A number of submissions raised concerns over the visual impact of the northern ventilation facility on the Wahroonga North Heritage Conservation Area and adjoining residential area. Residential development adjoining this site is generally one or two story structures on large blocks with mature tree cover and substantial street and garden planting. This area includes two local heritage

listed properties located immediately opposite the northern ventilation facility. The structure would be visible to surrounding properties as existing vegetation buffer between residents and the motorway would be removed during construction and replaced with a structure which contrasts with the heritage nature of the area. The Proponent has committed to retain vegetation at the site where possible.

The ventilation building and substation would be located at the corner of Bareena Avenue and Woonona Avenue North with fire deluge tanks located at the northern part of the site. The building would be situated within the cut and cover of the northbound exit portal and is therefore situated to take advantage on the level change between the M1 carriageway and the surrounding residential neighbourhood. The main building would be 7-9 metres high in relation to Woonona Avenue North presenting a relatively low scale appearance to the residential side.

The northern outlet is situated approximately 21 metres above the existing ground level. The Proponent has undertaken assessment of visual impact of the outlet to surrounding areas. A combination of existing vegetation, cuttings and noise walls largely screen significant views of the main structure into the corridor. Residential areas greater than 100 metres from the site are unlikely to have substantial views of the structure.

In order to reduce the visual impact on the residential neighbourhood the Proponent has provided concept designs of architectural treatments to the façade of the northern ventilation building, including the outlet. Sandstone planter boxes, 'timber look' battens and glazed openings provide reference to the residential nature of the area and mitigate visual impact on surrounding receivers. Noise barriers and re-introduced vegetation which would mature over time would further reduce visual impact.

The Department supports the Proponent's concept design and its commitments to reduce the visual impacts of the structures and has reinforced these commitments, including undertaking further detailed design in consultation with the community as recommended conditions. However, with the increased height of the ventilation outlet, the Department considers that the visual impacts of the project require further mitigation through detailed design to respond with the residential character of the area. To address this matter, the Department has recommended that the Proponent implement further landscaping and building design opportunities that, when implemented, would ensure the facility design would integrate as far as possible with its setting.

Motorway Operations Complex

The motorway operations complex contains a grouping of buildings arranged north to south adjacent to Pennant Hills Road including the motorway control centre, southern ventilation and outlet, workshop groupings and miscellaneous parking and surface structures. The operation complex building is located at the northern high point of the site and is highly visible to surrounding receivers; however, the building fits within the context of Pennant Hills Road.

The assessment identifies the building as a visual marker and has been designed to be a gateway to the urban point of the corridor. Whilst submissions have raised concern about the context and visual impact of the buildings, architectural treatments would reduce the visual bulk of the building and landscaping strategies, including street planting would soften visual impact over time as vegetation matures.

In relation to other structures, the built form has been arranged to take advantage of the topography of the site with the southern ventilation building cut into the land to present a smaller visible structure to surrounding receivers. However, due to the constrained nature of the site and the topography of the land the complex would be substantially visible from adjoining residents. The built form would step up to the east away from adjacent residents with the closest building (the lower substation) being 6.5 metres high, the main ventilation building is 15.5 metres high with the outlet reaching 30.5 metres tall. The buildings have therefore been organised to place the bulk

of the built form within the cut and closest to Pennant Hills Road and has been set back behind a ten metre perimeter landscape planting area and an internal road from adjoining residents.

Despite this, the southern ventilation building would be a dominant feature for those residents adjoining the site at Gum Grove Place with the built form providing a silhouette to the sky line which would be unable to be diminished though screen landscaping. Even though the Proponent has attempted to reduce the visual impact of the building the Department considers the impact to be highly intrusive. Accordingly the Department has recommended a condition requiring the Proponent implement further landscaping and building design opportunities detailed in the urban design and landscape plan, including retention of deep soil zone for vegetation, breaking up of building massing, articulation of buildings and fences, and use of variations in materials and finishes.

Wilson Road Facility

The Wilson Road tunnel support facility is located within the Beecroft-Cheltenham Heritage Conservation Area with the site fronting onto Pennant Hills Road, opposite Observatory Park, and surrounded by low density residential housing, tree lined streets and substantial garden planting.

The facility has been designed to minimise visual impact on surrounding receivers by utilising large setbacks with a separation of 25 metres provided between the rear of the facility and the wider residential area. This part of the site would be landscaped to provide visual screening which would mature over time. The facility would be most visible to the residents adjoining the side boundary, however the building would be similar in scale to adjoining dwellings being five to seven metres high and setback 15 metres. Vegetation along Wilson Road as shown in **Figure 30** would be retained and the Proponent has committed to re-planting vegetation to provide visual screening to adjacent properties. While the new element would contrast with the surrounding residential setting, the Department is satisfied the Proponent has provided a built form which can blend with the existing environment, with visual impact further minimised by vegetation screening.

Figure 30: Wilson Road Tunnel Support Facility. *Source: Environmental Impact Statement*

Conclusion

The Department is generally satisfied with how the Proponent has responded to site parameters to minimise potential visual impact on landscape character by operational elements. Operational elements would be articulated with finishes of pattern and fine grain scale which would reduce bulk and provide visual interest.

The Department notes that operational sites incorporate a consistent architectural language and have been set back where possible with vegetation and landscape buffers introduced to provide shielding and minimise visual conflict to neighbouring receivers where possible. The bulk and scale of buildings are generally in keeping with surrounding structures resulting in limited overshadowing of adjacent properties with the exception of some properties closest to the motorway operations complex and Coral Tree Drive switching station during the morning of winter months. To reinforce the proposal's design and landscape initiatives, the Department has

recommended a condition which requires the Proponent to develop an Urban Landscape and Design Plan that presents an integrated urban and landscape design for the proposal.

The Department recognises that visual elements of proposal would change the local character at a number of locations, particularly at the Motorway Operations Complex and northern ventilation facility sites. The Department has considered these impacts in the context of a highly constrained urban area, and weighed them against the potential benefit from the development of a new motorway connection. The Proponent's mitigation measures, together with the Department's recommended conditions would minimise visual impact ain the short to medium term. As a result the visual impact of the proposal is considered to be acceptable.

5.7. Biodiversity

Issue

NorthConnex is substantially located within the Sydney Basin Bioregion in an urbanised setting. The northern interchange is within the Pittwater Bioregion which is close to the Ku-ring-gai Chase National Park to the north. Throughout the corridor there are pockets of remnant vegetation which are common in gullies, local riparian corridors and vegetation adjacent to existing motorway corridors, with much of the vegetation highly disturbed to varying extents.

The corridor intersects a number of tributaries at the top of the catchment due to the location of the Pennant Hills Road ridge line. These tributaries have been impacted by development to varying degrees and are largely urbanised, with surface water collected by urban infrastructure including stormwater channels, kerbs and gutters. Generally, the tributaries located at the northern portion of the project discharge to the Hawkesbury-Nepean catchment area, with the southern portions discharging to the Sydney Metropolitan catchment area.

Eight vegetation community types were recorded in the assessment area including Blue Gum High Forest, Hinterland Sandstone Gully Forest, Coastal Enriched Sandstone Moist Forest, Coastal Enriched Sandstone Sheltered Forest, Coastal Sandstone Gallery Rainforest, Coastal Shale-Sandstone Forest, Cumberland Riverflat Forest and Sydney Turpentine-Ironbark Forest. Landscaped vegetation, regrowth of disturbed land, weeds and exotics were also identified.

Submissions

Submissions on biodiversity impacts focussed on vegetation clearing, endangered ecological species, the aquatic environment and changes to hydrology and biodiversity offsets.

OEH requested the revision of vegetation impacts following detailed design, the implementation of a biodiversity offset strategy, the preference for the implementation of a translocation plan for *Epacris purpurascens* var. *purpurascens*, the need to prepare a Microbat Management Plan and the extension of the Construction Flora and Fauna Management Plan to address translocation and rehabilitation matters.

NOW and **OEH** raised the matter of impacts to both groundwater and surface water resources including those associated with groundwater drawdown and discharge on receiving environments. This included the values and importance of the various ecosystems which may be affected by potential baseflow losses (including spring discharges) arising from tunnel groundwater inflows, whether any potential biodiversity impacts would be of concern if realised, and appropriate mitigation and response measures to address potential impacts.

Hornsby Shire Council raised a number of management matters, but in particular a desire to have offsets within close proximity to impacts within Hornsby Shire.

Consideration

Vegetation Clearing

The Proponent has undertaken a conservative assessment assuming that complete vegetation clearing within the construction footprint would be required under a 'worst case scenario'. Construction would result in total clearance of approximately 20.59 hectares of native and exotic vegetation, of which 0.71 is considered to be in good condition. Clearance of native vegetation would consist of 5.87 hectares.

Threatened Flora and Fauna

The Proponent's assessment identified five threatened flora species, 20 threatened fauna species and one endangered population that have the potential to occur within the project area. No threatened fauna species were recorded during field surveys within the study area and no critical habitat was identified. The assessment indicates there would be no significant impact to threatened fauna based on evaluation of vegetation communities and potential habitat for threatened flora and fauna species.

The assessment identified two threatened ecological communities occurring within the study area, being Blue Gum High Forest and Sydney Turpentine-Ironbark Forest / Turpentine Ironbark Forest. Both communities are critically endangered within the Sydney Bioregion under the *Threatened Species Conservation Act, 1995* (TSC Act). Blue Gum High Forest has been identified at the northern interchange, southern interchange and the M2 Hills Motorway integration works and compound, with works affecting 1.14ha, 0.13ha and 1.21ha respectively. Sydney Turpentine Ironbark Forest has been identified within the Wilson Road Compound.

The Proponent has calculated the required offsets using the Biobanking Assessment Methodology with calculations based on a worst case scenario of all vegetation cleared within the construction footprint. Offsets for Sydney Turpentine-Ironbark Forest and Blue Gum High Forest at the Wilson Road Compound have not been incorporated due to restricted site access. These would be calculated once access to the compound is obtained. The total offset requirements would be refined during detailed design.

The Department notes that it may be difficult to locate currently unprotected vegetation to satisfy the offset requirements, particularly for Blue Gum High Forest. The Proponent has outlined a range of supplementary measures to be implemented in the event that appropriate offset sites cannot be located including actions outlined in threatened species recovery programs, actions to contribute to threat abatement programs, biodiversity research and survey programs and rehabilitating degraded aquatic habitat. The Department has therefore recommended that the Proponent minimise the amount of vegetation to be cleared and prepare a biodiversity offset package to the satisfaction of OEH, which would include a review of final flora and fauna impacts.

Groundwater Dependent Ecosystems

The assessment identified three vegetation types which have high potential to be groundwater dependence ecosystems (GDEs) along the existing M2 Hills Motorway including, Hinterland Sandstone Gully Forest, Sandstone Riparian Scrub and Sydney Hinterland Transition Forest. The project would result in minor changes to local drainage however this is not expected to have a significant impact to GDEs which rely on a local shallow aquifer which would be recharged from rainfall and runoff.

Purpurascens var Purpurascens

The assessment has identified 180 Epacris purpurascens var. *purpurascens* threatened flora in vicinity of the M2 integration works with 106 individuals expected to be removed under the worst case scenario. The Proponent has committed to mitigation measures including relocation of species within the disturbance footprint to areas appropriate for biodiversity offset or where future disturbance is unlikely. Additionally, 1,767 species credits have been calculated under the scenario of full clearance being required. Further surveys would be undertaken by the Proponent to refine the extent of impacts during detailed design.

Hollow Bearing Trees

Hollow bearing trees are predominantly clustered around the M2 integration works and the northern interchange with 62 hollow bearing trees and 89 hollows within the study area. Hollow bearing trees provide potential habitat for bats, mammals and diurnal birds, with hollow bearing trees an important component in the life cycle of tree roosting bats. The construction footprint contains 34 hollow bearing trees which may be removed, lopped or trimmed, resulting in potentially 53 hollows being removed. The Proponent has developed mitigation measures to minimise the impact caused by the loss of hollow bearing trees including relocation or replacement of existing nest boxes impacted by project construction and the provision of nest boxes to replace hollow bearing trees impacted by construction.

Bat Habitat

The Proponent has committed to mitigation measures to minimise impact on threatened bat habitat including the development of a Microbat Management Plan. The management plan would include monitoring of existing buildings and culverts six months prior to construction, maintaining exclusion zones, managing night works through breeding and lactating periods in the vicinity of identified microbat habitat and minimisation of light spill and noise impacts to surrounding vegetation.

Weeds and Pathogens

There is a potential for construction of the project to disturb vegetation and create conditions which could be conducive to the spread of weeds and pathogens. The Proponent has committed to mitigation measures to minimise these risks including actively managing weeds within the construction footprint, including weed disposal to a facility licenced to receive green waste, cleaning machinery prior to entering construction sites, identification of pathogens during pre-clearing inspections and implementation of mitigation measures if pathogens are identified.

Aquatic Flora and Fauna Impacts

Two watercourse crossings at Darling Mills viaduct and Yale Close bridge would be widened as part of the project. While there is a potential for incremental degradation of riparian vegetation in the area, construction works would not encroach on the watercourse. The Proponent has committed to minimise adverse construction impacts to riparian zones and aquatic habitat by locating viaduct and structural elements out of waterways where feasible.

NorthConnex would require four existing culverts along the M2 Motorway to be extended consistent with the design and function of the existing infrastructure. A new culvert would additionally be constructed beneath the M1 Pacific Motorway / Pennant Hills Road connector to provide drainage relief for a probable maximum flood event. The construction of culverts is not expected to impact on the passage of fish or aquatic fauna.

Captured groundwater from tunnels would need to be pumped to four water treatment plants located at tunnel support sites with treated water being discharged into the local stormwater system. This has the potential to result in temporary and permanent impacts to hydrology and aquatic ecology. The assessment has identified that potentially 0.4 cubic metres per second of operational water volumes would be discharged permanently to Blue Gum Creek. While Blue Gum Creek is considered to have degraded aquatic habitat and riparian areas, the supply of discharged water would change the creek from its current ephemeral state, to having a continuous base flow, altering the creeks current flow regime This would result in changes to the condition of aquatic habitats downstream to Darling Mills Creek which are expected to alter from slightly modified to substantially modified.

No threatened aquatic fauna or flora has been identified in the study area and assessment of ecological values for Blue Gum Creek and Darling Mills Creek indicate that both are devoid of threatened or rare aquatic vegetation richness or abundance. Potential impacts resulting from the discharge of operational water include faster flows, bank erosion, pool sedimentation, transport of

weeds and increased nutrients. This is turn could lead to a decrease in habitat for microinvertabrates, while increased water volumes may provide benefits in relation to fish migration and may clean and oxygenate stagnant pools.

Conclusion
The Proponent has committed to a range of measures to minimise, mitigate and manage impacts on flora and fauna during construction including minimising disturbance, relocating and replacing hollow bearing tree capacity, weed management, using endemic habitat elements, cuttings or seed material for landscaping; and developing a biodiversity offset strategy.

The Department also recommends a number of conditions which aim to further ensure impacts are kept to an absolute minimum. These conditions include the following:

- minimising the amount of vegetation to be cleared and preparation of a flora and fauna management plan;
- application of a biodiversity offset package;
- remediation action requirements where land biodiversity offsets cannot solely achieve compensation for the loss of habitat,
- installation of nest boxes to replace or offset loss of hollow bearing trees;
- restoration and revegetation of riparian zones or vegetated buffers to pre-disturbance conditions in consultation with NOW and relevant Councils;
- design of water course crossings and culverts to be consistent with relevant guidelines; and
- watercourses affected by the proposal being rehabilitated to emulate the natural stream system.

The Department is satisfied that its recommendations would ensure that biodiversity impacts are appropriately mitigated and managed during all phases of the proposal ensuring that impacts are kept to acceptable levels. The implementation of the Applicant's commitments and the recommended conditions of approval would ensure that the proposal can be constructed and operated in a manner which minimises biodiversity impacts. Overall, the Department is satisfied that the potential biodiversity impacts associated with the project are acceptable.

5.8. Other Issues

A range of other issues have been considered in the Department's assessment. It is expected that these issues can be appropriately addressed through the implementation of best practice management and mitigation measures. Where required, supplementary management and mitigation measures have been identified through further recommended conditions of approval.

Aboriginal Heritage
The Proponent has conducted an assessment of Aboriginal heritage impacts in accordance with the Proponent's Procedure for Aboriginal Cultural Heritage Consultation and Investigation. The assessment identified two 'areas of archaeological sensitivity' north of the M2 (Archaeological Sensitive Area 1 and Archaeological Sensitive Area 2). These areas contain known and potential Aboriginal heritage items, and have been designated as management zones to be avoided during detailed design.

The Department acknowledges that the proposal is unlikely to directly impact Aboriginal heritage items. To reinforce the Proponent's commitments to monitor and avoid impacts, the Department has recommended a condition requiring the Proponent to take all reasonmable steps to avoid impacts on any Aboriginal heritage item associated with the management zones. The Department accepts that the Proponent may unexpectedly find heritage items during construction. As such, the Department recommends the Proponent implement a Construction Heritage Management Plan that includes an adaptive framework for dealing with any such find. The framework would ensure that work stops and specialist heritage advice is obtained.

Non-Aboriginal Historic Heritage

The Proponent has undertaken an assessment of historic heritage impacts associated with the project, including a desktop study and field survey. The project is located in the Beecroft Cheltenham and North Wahroonga heritage conservation areas.

NorthConnex is anticipated to have direct impacts on three locally listed heritage items. No direct impacts to State heritage listed items have been identified. The proposal requires demolition of the Manager's house and other fixtures of the locally significant Thornleigh Maltworks, during establishment of the Pioneer Avenue ancillary facility. The proposal also requires removal of significant Canary Island Palms from the garden at 1 Pacific Highway Wahroonga (to allow road widening at the Pennant Hills Road/Pacific Highway intersection), and a number of remnant canopy trees on Woonona Avenue (to facilitate construction site access). A number of other local heritage items require architectural treatment to reduce predicted noise impacts, including the St Pauls Church.

The Proponent has also identified the possibility for minor impacts on items in the North Wahroonga and Beecroft-Cheltenham heritage conservation areas as a result of subsidence and ground-borne noise and vibration associated with tunnelling works.

The Department notes that the Proponent has selected a preferred route that generally avoids direct and significant impacts on heritage items. It is considered that, while there is some potential for cosmetic façade damage across heritage conservation areas, any such impacts would be minor and can be appropriately covered by recommended conditions requiring rectification of damage at the Proponent's expense.

The Department acknowledges that there will be direct impacts on three locally significant heritage items. While the Department accepts that these impacts are necessary to the delivery of the project, and have generally been minimised through route selection and site design, it is recommended that the Proponent further investigate detailed design options to mitigate them, or ensure heritage values are appropriately recorded where unavoidable impacted. This process will include archaeological investigations and reporting the findings at the Thornleigh Maltworks, and investigating the potential to avoid or relocate affected street trees and heritage-listed Canary Island Palms. The Department is confident that this process will ensure the final design is acutely sensitive to the heritage significance of the project's surrounds.

The Department has further recommended implementation of a Construction Heritage Management Plan. The Department acknowledges that the Proponent predicts negligible impacts on unlisted heritage items, but has recommended the plan include an adaptive framework for dealing with any unexpected heritage finds.

The Department also acknowledges it is important that the Proponent installs sympathetic noise mitigation at heritage items, to ensure they can continue to be used in a way consistent with their heritage value. On this point, it has recommended a condition requiring any work be carried out on the advice of a built heritage expert.

Greenhouse Gas

Construction of the proposal would generate approximately 535,500t CO_2-e, which is equivalent to 0.10% of national emissions and 0.34% of NSW emissions for 2010-2011. This total is commensurate of the large scale of the construction works involved.

The Proponent has compared operational emissions from vehicle use against a base case 'do nothing' scenario, and estimates that the operational greenhouse emissions with the project at opening (2019) (243,500t CO_2-e) would provide a reduction of 16 percent against the 'do nothing' scenario reduced levels of congestion. This improvement in emissions would

result from improved traffic efficiency due to increased travel speeds and reduced travel distances.

The Department acknowledges, however, the large absolute scale of the greenhouse gases associated with the operation of the proposal (including tunnel ventilation systems and lighting). To ensure that greenhouse gas emissions are further minimised and that opportunities to use renewable energy sources are be explored, the Department has recommended conditions requiring the Proponent to design the project to achieve an excellent 'Design' and 'As built' rating in the Infrastructure Sustainability Council of Australia Infrastructure Sustainability Rating Tool, and review sustainability initiatives and greenhouse gas emissions regularly.

Social and Economic

The Proponent conducted a socio-economic impact assessment and a business impacts assessment, which identified construction and operational impacts on the community and local, regional and State economy. The Proponent estimates that NorthConnex would provide significant economic benefits during both construction and operation. Overall, the Proponent estimates that the proposal would create around 1,250 jobs during the peak construction period. Overall, construction activity would contribute $1.3 billion of value to the New South Wales economy yearly across the proposed four year construction period.

Improved connections between the M1 and the M2, facilitating increased road freight productivity and commuter efficiency, are anticipated to have considerable economic benefits. The Proponent estimates that the project would provide $16 million of value add per year of operation, associated with fuel use and wages, and improved freight productivity. In addition to this, amenity related improvements would result in including improvements in air quality, traffic noise and public safety.

The Proponent considers that the movement of trucks off Pennant Hills Road during operation would improve vehicle, pedestrian and cyclist accessibility to local community and commercial centres along the corridor.

The Proponent acknowledges that construction activities are likely to cause a temporary decrease in local amenity. Under a worst case scenario, this would result in foregone turnover of around $5.6 million annually during the construction period, with the potential loss of 18 jobs.

The Department considers that NorthConnex would provide significant economic benefits for the State throughout construction and operation. However, it is noted that the nature and duration of construction work would have a short to medium term negative impact on local residents and businesses. To this end, the Department has recommended a series of conditions to minimise the impacts associated with construction traffic, noise and vibration and air emissions.

The Proponent is committed to preparing and implementing a Community Involvement Plan. The plan would include detailed procedures to ensure appropriate and ongoing community consultation during construction. In addition to this, a business impact risk register and business stakeholder forum will be implemented to ensure that potential risks to businesses are identified and minimised or prevented. The Department is satisfied that these commitments are in line with best practice in the delivery of large infrastructure projects.

Land Use and Property

The Proponent conducted an assessment of existing and future land use patterns within and surrounding the proposal site. A total of 47 residential properties and 6 commercial properties would require full acquisition as part of the proposal, and a further 8 residential properties would require partial acquisition. Some land acquired for construction work zones

and ancillary facilities would not be required during operation. The Proponent would investigate options for the use of this residual land for community purposes or redevelopment, where appropriate.

The primary ongoing property impact of the proposal is associated with the construction and operation of the four operational facilities at Trelawney Street, Wilson Road, Bareena Avenue and at the Motorway Operations Complex. These facilities would operate throughout the life of the proposal as they are required for ongoing ventilation purposes.

To ensure the final design of these facilities responds to their respective receiving environment, the Department has recommended the Proponent implement an Urban Design and Landscape plan that mitigates the visual impacts. The Department has also recommended conditions that require the Proponent to limit light spillage and rectify any property damage from settlement.

It is also acknowledged that temporary changes may need to be made to property access during construction. The Department has recommended that any changes are made with the agreement of property owners or occupiers, and that access is reinstated unless otherwise agreed.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Need and Justification

NorthConnex contributes towards the national objective of connecting Melbourne to Brisbane via a duplicated highway. Specifically, the proposal seeks to provide a high standard motorway that improves safety, efficiency and reliability for all road users, integrate with the regional transport network, reduce traffic congestion and travel times, particularly along Pennant Hills Road. Other objectives include minimising adverse social and environmental impacts, demonstrating excellence in design and sustainability and being economically justified. A further objective of the proposal is to provide opportunities for improved public transport in the area around Pennant Hills Road.

The stated benefits of the proposal would be a safer and more efficient link between the M1 Pacific Motorway and the Hills M2 Motorway, realised in the form of road user benefits such as travel time savings, improved safety, reduced freight operating costs, better public transport and local community improvements by reducing the number of heavy vehicles using Pennant Hills Road, along with broader community benefits such as improved air and noise environment, improved access to facilities and provision of a safer and more amenable environment.

6.2. Key Considerations

Route Selection

The Department is satisfied that the selected route is the most suitable route for the northern connection of the Sydney orbital motorway network. The selected route has been the subject of extensive investigation, and it best meets the transport, social, environmental and economic objectives of the connection. The Department notes that a number of submissions advocate a motorway connection between the M1 and M7 to the west of the proposal along the 'Type C' corridor. This corridor is broadly consistent with the M9 corridor that has been identified as potential future infrastructure in strategic planning documents and is not precluded by the development of NorthConnex.

Air Quality

Once operational, the NorthConnex proposal would remove heavy vehicle through traffic from Pennant Hills Road, and improve traffic flows through the corridor between the M1 Pacific Motorway and the Hills M2 Motorway. It is anticipated that, by moving vehicles into the twin

tunnels and venting their emissions through the ventilation outlets, the external air quality across the area would improve, in some location quite significantly. It is critical, however, that air quality within the tunnel, and around the ventilation outlets and surrounding areas, is managed to acceptable levels.

With regard to in-tunnel air quality, the Department acknowledges concerns raised by Ministry of Health and the community about in-tunnel exposure to NO_2 and, in particular, there is the potential for sensitive individuals to experience adverse effects during transit. The Department has reviewed international trends in in-tunnel air quality, and health based guidelines for short term exposures. The Department considers that best practice favours adopting a precautionary approach to in-tunnel exposures to NO_2, and has therefore proposed a compliance based criteria for in-tunnel NO_2 that reflects health-based concerns. Accordingly, it is recommended that the Proponent's design criteria for NO_2 of 0.5ppm (averaged over 15 minutes) is applied as an average across the tunnel under all conditions. Where this limit is exceeded, the Department has recommended the Proponent provide information about how such exceedences would not occur again. This information may include further consideration of changes to the tunnel management systems.

The proposal is expected to meet the relevant external air quality assessment goals. However, it is critical that the conditions of approval ensure the Proponent meets and improves on its own modelled impacts. The Department has recommended ventilation outlet limits for all key pollutants which would provide stringent control of emissions from the outlet, and for which the Proponent would be accountable. The use of external goals in conjunction with proposed outlet emission limits would prevent the ability to "pollute-up" to the external goals. Any exceedences of these limits would also trigger the requirement to report on any necessary improvements to the proposal.

The Department considers that accurate and transparent monitoring of air quality impacts would ensure the community has confidence in the operation of the proposal. The Department has recommended comprehensive monitoring and reporting conditions. The Department considers that the community should be involved integrally in this process, and has recommended the Proponent establish an Air Quality Community Consultative Committee that must agree to the location of the monitoring stations, and review and provide advice on monitoring and other operational air quality requirements.

Noise and Vibration

The construction and operation of the proposal in an urban area with residential and other sensitive non-residential uses, such as schools, churches and recreation, close to the proposed road alignment, will result in noise impacts on the community. The Department acknowledges that noise impacts are unavoidable and will be required to be managed rather than completely mitigated.

The Department considers that an acceptable outcome can be achieved by the implementation of management and mitigation measures, which include an appropriate management response to the concerns of the affected community, respite periods, provision of noise enclosures and barriers, and comprehensive monitoring and auditing of noise levels. The Department notes that some aspects of the construction methods and activities have been assessed and that specific responses would be developed in the Construction Noise and Vibration Management Plan to mitigate and manage noise impacts.

The operation of the project is expected to provide benefits to the community along sections of Pennant Hills Road bypassed by the tunnel, including reduced noise levels, particularly during the peak periods and in the evening/night time. However, some locations would be impacted by the proposal, in particular residential areas near the southern and northern interchanges. The Proponent has identified mitigation measures (at source and at receiver) to address the operational noise impacts of the project. The Department acknowledges these commitments and recommends that further review of the scope and location of specific noise

mitigation measures be undertaken during detailed design, and that the effectiveness of the applied measures be reviewed, in terms of compliance with the operational noise goals.

Traffic and Transport

NorthConnex satisfies the strategic need for an efficient and safe link between the M1 and M2 Motorways, which is a missing link in the Sydney Orbital network. It will have clear benefits for motorists travelling between the M1 and M2 Motorways. Motorists using NorthConnex will enjoy modelled peak hour travel speeds of 80km/h. Current Pennant Hills Road peak hour travel speeds range from 14-39km/h, which are amongst the slowest experienced in Sydney's arterial road network. The proposal is expected to reduce the existing crash rate on Pennant Hills Road from 95.2 crashes per 100MVKT to 68.4 crashes per 100MVKT for the combined NorthConnex and Pennant Hills Road corridor in 2029. NorthConnex will improve travel speeds and road safety within the project corridor.

The proposal is likely to create considerable construction traffic impacts, particularly from continuous heavy vehicle spoil haulage traffic associated with tunnelling works. These impacts are anticipated on Pennant Hills Road and parts of the M2, particularly in the vicinity of construction compounds.

The Department concludes that construction traffic impacts are commensurate with the scale of work and can be managed effectively through conditions requiring a suite of traffic management controls, including a Construction Traffic Management Plan, Spoil Management Plan, and Ancillary Facilities Management Plan.

Soils and Water

The proposal has the potential to impact on the existing surface water regime by the discharge of water from the project site. Impacts to water quality from the discharge of construction water and operational water, particularly if untreated, and changes to the water regime of receiving waterways from the quantity of discharged water, for example, changing ephemeral flows to perennial flows.

The construction of the tunnel is likely to intercept groundwater, which will need to be collected, stored and treated prior to discharge. The groundwater assessment considered existing groundwater is not suitable for drinking water but could be used for domestic non-potable purposes. Operational groundwater impacts would be related to the draining of groundwater inflow into the unlined tunnel (and stormwater collection) and its discharge to surface watercourses.

Construction of the portals, interchanges and the M2 integration works would involve surface excavation and earthmoving, which would result in surface disturbance and the potential for erosion from the construction works and sedimentation impacts to downstream watercourses. Operation of the proposal would result in increased water runoff from impervious surfaces and discharge of treated water. The Proponent has identified environmental management measures to address construction and operational impacts on water quality and downstream receiving waters.

The Department considers the measures to mitigate and manage soil and a water impact of the proposal are appropriate and has recommended that a Water Quality Plan and Monitoring Program be developed to manage and monitor impacts on water quality and resources, and a Construction Soil and Water Management Plan to manage construction impacts on groundwater and surface water.

Urban Design

The urban design and visual impacts of the proposal relate to the main surface components, the tunnel portals, southern and northern interchanges, the motorway operations complexes and tunnel support facilities, and to a lesser degree, the M2 integration works. The

Department considers the motorway operations complex, Wilson Road tunnel support facility, Trelawney Street tunnel support facility and northern ventilation facility are likely to cause detrimental visual impacts to sensitive receivers due to the nature of the elements of these built forms within a residential setting.

The visual amenity impacts can be mitigated to some extent by full screening during construction and incorporating architectural treatments and good urban design. However, the Department acknowledges that there will be residual impacts on some residents that cannot be adequately mitigated. Other visual impacts are considered to be acceptable subject to compliance with mitigation measure identified in the Environmental Impact Statement and in the Department's recommended conditions.

Biodiversity

The proposal is likely to impact on the environment due to the clearance of native vegetation and potential occurrence of up to five threatened flora species within the project area, primarily associated with the M2 integration works. The Department requires the Proponent to minimise the amount of vegetation to be cleared and that a comprehensive biodiversity offset strategy and package be implemented which would include a review of final flora and fauna impacts. The potential for impacts on purpurascens var purpurascens, hollow bearing trees, bat habitat and weeds pathogens can generally be mitigated to current standards with best practice management strategies. The Department therefore recommends a condition requiring the preparation of a Construction Flora and Fauna Management Plan to manage and monitor construction impacts on flora and fauna in the area.

6.3. Conclusions

The Department is satisfied that the NorthConnex would contribute towards the national objective of connecting Melbourne to Brisbane via a duplicated highway and is consistent with key State Government planning and transport strategies.

The project will result in a significant decrease in travel times particularly during the morning and evening peaks within the corridor. This will reduce congestion on the road network and improve freight distribution efficiency, contributing to the productivity of NSW.

Air quality was identified as the key assessment issue. The Department has adopted a precautionary approach to in tunnel air quality by recommending a stricter average design criterion for NO_2 of 0.5ppm (averaged over 15 minutes) be applied across the tunnel under all operating conditions. The Department's assessment also found that the proposed external air quality outcomes could be supported given they meet relevant ambient air quality goals. The ventilation outlets would be subject to strict pollutant limits.

The Department's assessment identified a number of other key areas for detailed consideration, including, noise and vibration and traffic. The assessment concluded that impacts were acceptable subject to a range of conditions to manage residual impacts.

The Department concludes that the project's benefits are substantial and the proposal will not result in any long term adverse or irreversible effects. It is therefore in the public interest and should be approved.

Karen Jones 13.1.15
Director
Infrastructure Projects

13.1.15
Chris Wilson
Executive Director
Industry and Infrastructure

APPENDIX A ENVIRONMENTAL IMPACT ASSESSMENT

See the Department's website at:

http://majorprojects.planning.nsw.gov.au/page/project-sectors/transport--communications--energy---water/roads/?action=view_job&job_id=6136

APPENDIX B SUBMISSIONS

See the Department's website at:

http://majorprojects.planning.nsw.gov.au/page/project-sectors/transport--communications--energy---water/roads/?action=view_job&job_id=6136

APPENDIX C PROPONENT'S RESPONSE TO SUBMISSIONS

See the Department's website at:

http://majorprojects.planning.nsw.gov.au/page/project-sectors/transport--communications--energy---water/roads/?action=view_job&job_id=6136

APPENDIX D INDEPENDENT AIR QUALITY REVIEW

See the Department's website at:

http://majorprojects.planning.nsw.gov.au/page/project-sectors/transport--communications--energy---water/roads/?action=view_job&job_id=6136

APPENDIX E INDEPENDENT NOISE AND VIBRATION REVIEW

See the Department's website at:

http://majorprojects.planning.nsw.gov.au/page/project-sectors/transport--communications--energy---water/roads/?action=view_job&job_id=6136

APPENDIX F RECOMMENDED CONDITIONS OF APPROVAL