NorthConnex

Building for the future

Australian Government

NSW NOW The new state of business

transurban

Volume 1A

Environmental Impact Statement - Volume 1A

Main Volume Chapters 1 to 6

July 2014

RMS/Pub: 14.187 ISBN 978-1-925093-60-5

In 2012, the NSW Government received an unsolicited proposal from Transurban and the Westlink M7 Shareholders (Sponsors) to design, construct, operate, maintain and finance a tolled motorway linking the M1 Pacific Highway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange at West Pennant Hills, known as NorthConnex.

Roads and Maritime Services is the Proponent for the environmental impact statement and lodgement of an application for environmental and planning approval. Roads and Maritime is working with the Sponsors on the community consultation and public exhibition of this environmental impact statement.

Roads and Maritime Services

NorthConnex

Environmental impact statement

July 2014

Prepared by
AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

(Blank page)

Contents

(Blank page)

Certification

Submission of environmental impact statement
Prepared under Part 5.1 of the *Environmental Planning and Assessment Act 1979*

Environmental impact statement prepared by:

Name:	Scott Jeffries	Todd Brookes
Qualifications:	Bachelor of Chemical Engineering Master of Environmental Law	Bachelor Environmental Management
Address:	AECOM, Level 21 420 George Street Sydney NSW 2000	AECOM, Level 21 420 George Street Sydney NSW 2000
Responsible person:	Ken Kanofski Director Journey Management Roads and Maritime Services NSW	

Address of the land to which the statement relates:

Land within The Hills, Hornsby and Ku-ring-gai local government areas as described within this environmental impact statement.

Description of the infrastructure to which this statement relates:

Construction and operation of a tolled motorway (known as NorthConnex) linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills, including operational ancillary facilities for the control and management of the road.

Environmental impact statement:

An environmental impact statement is attached addressing all matters in accordance with Part 5.1 of the *Environmental Planning and Assessment Act 1979* and Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

Declaration:

I certify that I have prepared this environmental impact statement in accordance with the Director-General's Requirements dated 11 April 2014. The environmental impact statement contains all available information that is relevant to the environmental assessment of the infrastructure to which the statement related. To the best of my knowledge, the information contained in the environmental impact statement is neither false nor misleading.

Signature:

Name:	Scott Jeffries	Todd Brookes
Date:	02 July 2014	02 July 2014

(Blank page)

Glossary of terms and abbreviations

Term	Meaning
$\mu g/m^3$	Micrograms per cubic metre.
A	
AADT	Average annual daily traffic. The total volume of traffic passing a roadside observation point over a period of a year, divided by the number of days per year. It is calculated from mechanically obtained axle counts.
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, songlines, places) cultural practices and traditions associated with past and present day Aboriginal communities.
Aboriginal object	Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW.
Aboriginal place	Any place declared to be an Aboriginal place under s.94 of the *National Parks and Wildlife Act 1974*.
ABS	Australian Bureau of Statistics.
Abutment	An end support of a bridge.
Acid sulfate soils	Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen and may produce acidic leachate run-off that can pollute waters and liberate toxins.
Acute noise levels	Road traffic noise levels received at private dwellings that are predicted to be greater than $65dB(A)_{Leq(15hr)}$ (day) and $60dB(A)_{Leq(9hr)}$ (night), as presented in Practice Note IV, Step 3, Part (3) of the Roads and Maritime's Environmental Noise Management Manual.
Aggregate	A uniform sized material from sand, gravel, rock or metallurgical slag by screening, blasting or crushing. Used in concrete production and for bitumen sealing.
AHD	Australian Height Datum. The standard reference level used to express the relative height of various features. A height given in metres AHD is essentially the height above sea level. Mean sea level is set as zero elevation.
Airshed	Part of the atmosphere that shares a common flow of air and that is exposed to similar influences.
AHIMS	Aboriginal heritage information management system. A register of NSW Aboriginal heritage information maintained by Office of Environment and Heritage.
Alignment	The geometric layout (eg of a road tunnel) in plan (horizontal) and elevation (vertical).
Alluvial	Relating to, consisting of, or formed by sediment deposited by flowing water.
Ancillary	A subordinate part or element.
ANZECC	Australian and New Zealand Environment and Conservation Council.
Aquatic ecology	Flora and fauna that live in or on water for all or a substantial part of the life span (generally restricted to fresh / inland waters).
Aquifer	Geologic formation, group of formations, or part of a formation capable of transmitting and yielding quantities of water.
Archaeological site	A site with any material evidence of past Aboriginal or non-Aboriginal activity in which evidence of past activity is preserved.
Archaeology	The scientific study of human history, particularly the relics and cultural remains of the distant past.

Term	Meaning
ARI	Average recurrence interval. Used to describe the frequency or probability of floods occurring. (eg a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years (100:1)).
Arterial roads	The main or trunk roads of the State road network.
AS 14000	Australian Standards for environmental management. Of note: AS 14001: Environmental management systems – requirements for guidance for use. AS14004: Environmental management systems – general guidelines on principles, systems and supporting techniques.
AS 1940	Australian Standard: Guide to the Storage and Handling of Flammable and Combustible Liquids.
AS 2436	Australian Standard: Noise Control on Construction, Maintenance and Demolition Sites.
AS 2922	Australian Standard: Ambient Air Guide for Siting of Sampling Units.
AS 3580.10.1	Australian Standard: Methods for Sampling and Analysis of Ambient Air.
Asphalt	A dense, continuously graded mixture of coarse and fine aggregates, mineral filler and bitumen usually produced hot in a mixing plant.
ASS	Acid sulfate soils.
At grade	A road at ground level, not on an embankment or in a cutting.
B	
Backfill	Fill replaced in an excavation.
Background noise level	The ambient sound-pressure noise level in the absence of the sound under investigation exceeded for 90 per cent of the measurement period. Normally equated to the average minimum A-weighted sound pressure level.
Batter	The constructed slope of road embankments and cuttings usually expressed as a ratio of x horizontal to 1 (one) vertical. A fill batter is where the road is above the existing surface on a filled embankment and refers to the sloping sides of the embankment. A cut batter is where the road is below the existing surface.
Bedrock	Rock of a substantial thickness and extent underlying a relatively soft and variable surface.
Biota	All organisms including flora and fauna, in a given area considered as a unit.
Blasting	The use of explosives for excavating rock, demolition and other purposes.
BOM	Bureau of Meteorology.
Bore	A cylindrical drill hole sunk into the ground from which water is pumped for use or monitoring.
Borehole	A hole produced in the ground by drilling for the investigation and assessment of soil and rock profiles.
Box culvert	A culvert of rectangular cross section.
BTEX	Volatile organic compounds.
Bund	A small embankment designed to retain water.
C	
Cadastral	Showing the extent and ownership of land (generally on a map).
CALPUFF	Air quality monitoring models used to estimate pollutant concentrations, which include CALPUFF, CALMET and CALPOST.
CALRoads	An air quality modelling package used to predict pollutant concentrations along roads, which includes the CAL3QHCR model.

Term	Meaning
Carbon dioxide equivalent (CO_2-e)	The mass of a greenhouse gas that is emitted is multiplied by its global warming potential to convert greenhouse gas emissions to an equivalent quantity of CO_2 emissions, referred to as carbon dioxide equivalent. For simplicity of reporting, the mass of each greenhouse gas emitted is commonly translated into a carbon dioxide equivalent (CO_2-e) amount so that the total impact from all sources can be summed to one figure.
Carriageway	The portion of a roadway used by vehicles including shoulders and ancillary lanes.
Cast in-situ	Concrete which is cast directly into its final position.
Catchment	The area from which a surface watercourse or a groundwater system derives its water.
CEMP	Construction Environmental Management Plan. A site specific plan developed for the construction phase of a project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that environmental risks are properly managed.
CH_4	Methane.
Chainage	Any point on a control line selected to provide more detailed information about the cross-section or any other feature mentioned in the drawings. Also known as a station.
CMA	Catchment Management Authority
CNVMP	Construction Noise and Vibration Management Plan
CO	Carbon monoxide.
CO_2	Carbon dioxide.
CO_2-e	Carbon dioxide equivalent.
Colluvial soils	Stony clays which have been moved downslope by soil creep and slopewash but may include a proportion of windblown red clay (parna) and higher terrace alluvium.
Compaction	An increase in density of a soil material by mechanical means such as rolling the surface layers or for deep compaction, driving sand piles, vibration or impact methods.
Compound site	Facilities used to support the operation of a construction site including (but not limited to) site offices, workshops, delivery areas, storage areas, staff vehicle parking, materials, plant and equipment.
Concentration (air quality)	Vehicles emit pollutants to the air, which are transported and diluted resulting in a volume of pollutant per volume of ambient air. Ambient air quality goals are expressed in terms of concentrations, which are measured in parts per million or micrograms per cubic metre.
Confluence	A point at which streams combine.
Constructability	The ease with which structures can be built.
Construction footprint	The area required to construct the project, including underground components, above ground components and temporary ancillary construction facilities.
Critical habitat	The habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species.
CSIRO	Commonwealth Scientific and Industrial Research Organisation.
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact considered alone.
Cut	The material excavated from a cutting.
Cutting	Formation resulting from the construction of the road below existing ground level – the material is cut out or excavated.

Term	Meaning
D	
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	NSW Department of Environment and Conservation (now OEH and the EPA).
DECC	NSW Department of Environment and Climate Change (formerly DEC and now OEH and EPA).
DECCW	NSW Department of Environment, Climate Change and Water (formerly DEC, DECC and now OEH and the EPA).
Decibel	A scale unit used in the comparison of powers and levels of sound energy. Used for measuring noise.
Dewatering	The removal of water from solid material or soil by wet classification, centrifugation, filtration or similar solid-liquid separation processes.
DEWHA	Australian Government Department of Environment, Water, Heritage and the Arts (now the Department of the Environment).
DGRs	Director-General's Requirements. Requirements and specifications for an environmental impact statement prepared by the Director-General of the then Department of Planning and Infrastructure under section 115Y of the *Environmental Planning & Assessment Act 1979*.
DIPNR	The NSW Department of Planning and Natural Resources (now part of DP&E and NOW).
Discharge	The volumetric rate of water flow.
DLWC	NSW Department of Land and Water Conservation (now part of DPI)
DoP	NSW Department of Planning (now Department of Planning and Environment).
DP&E	NSW Department of Planning and Environment (formerly DIPNR and DoP).
DP	Deposited Plan. A plan of land deposited in Land and Property Information (part of the Land Management Authority) and used for legal identification purposes. They most commonly depict a subdivision of a parcel of land.
DPI	The NSW Department of Primary Industries, which includes Fisheries NSW, Agriculture NSW and NOW.
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
DSEWPaC	Australian Government Department of Sustainability, Environment, Water, Population and Communities (now the Department of the Environment).
DUAP	NSW Department of Urban Affairs and Planning (now DP&E)
E	
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock.
Ecosystem	A functional unit of energy transfer and nutrient cycling in a given place. It includes all relationships within the biotic community and between the biotic components of the system.
Edge effects	A change in species composition, physical conditions or other ecological factors at the boundary between two ecosystems or the ecological changes that occur at the boundaries of ecosystems (including changes in species composition, gradients of moisture, sunlight, soil and air temperature, wind speed and other factors).

Term	Meaning
EEC	Endangered ecological community. An ecological community identified by relevant legislation that is likely to become extinct or is in immediate danger of extinction.
EEO Act	*Energy Efficiency Opportunities Act 2006* (Commonwealth)
Embankment	An earthen structure where the road (or other infrastructure) subgrade level is above the natural surface.
Emission factor (EF)	Emission factors convert an indicator of activity into estimated greenhouse gas emissions.
Emission source	Source from which greenhouse gases are released.
EMP	Environmental management plan. A plan used to manage environmental impacts during each phase of project development. The plan outlines all proposed mitigation, management and monitoring actions, set to a timeline with defined responsibilities and follow up actions.
EMS	Environmental management system. A quality system that enables an organisation to identify, monitor and control its environmental aspects. An EMS is part of an overall management system, which includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy.
Emergency smoke extraction facility	A facility that is designed to maintain air quality in the tunnels in the unlikely event of an emergency. As a secondary feature, these facilities would also supply fresh air the tunnels during low speed, congested traffic conditions.
ENMM	Roads and Maritime's Environmental Noise Management Manual.
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW).
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000* (NSW).
EPA	NSW Environment Protection Authority.
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).
Ephemeral creek	A creek that only exists for a short duration of time following rainfall.
EPL	Environment Protection Licence.
Escarpment	A long, cliff-like ridge of rock commonly formed by faulting or fracturing of the earth's crust.
ESCP	Erosion and sediment control plan.
ESD	Ecologically sustainable development. As defined by the *Protection of the Environment Administration Act 1991*, requires the effective integration of economic and environmental considerations in decision making processes including: • The precautionary principle. • Inter-generational equity. • Conservation of biological diversity and ecological integrity. • Improved valuation, pricing and incentive mechanisms (includes polluter pays, full life cycle costs, cost effective pursuit of environmental goals).
F	
Fill	The material placed in an embankment.
FM Act	*NSW Fisheries Management Act 1994*.
Footprint	The extent of impact that a development makes on the land.
Fragmentation	The breaking up of continuous sections of ecosystems or landscape features.

Term	Meaning
Frequency (sound)	Similar to the pitch of a musical note in sound pressure fluctuations of cycles per second (Hertz). Most sounds comprise a composite of frequencies of varying sound-pressure levels in the range of 20 Hertz to 20,000 Hertz.
G	
GDE	Groundwater Dependent Ecosystems.
Grade	1. The degree of inclination of a road or slope. 2. To trim or smooth an earth, gravel or other surface using a grader or similar implement.
Grade separation	The separations of road, rail or other traffic so that crossing movements at intersections are at different levels. Opposite to at grade.
Greenhouse gas (GHG)	Greenhouse gases are those gases which reduce the loss of heat from the earth's atmosphere by absorbing infrared radiation. Six greenhouse gases are regulated by the Kyoto Protocol: Carbon dioxide (CO_2), Methane (CH_4), Nitrous oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6). The emissions of greenhouse gases are reported in carbon dioxide equivalents (see above).
Ground vibration	The combined speed of ground oscillation at a point from a source of vibration such as a blast or vehicle.
Groundwater	Water that is held in the rocks and soil beneath the earth's surface.
Grubbing	The removal of roots or stumps from below ground level.
H	
ha	Hectare/s.
Habitat	The place where a species, population or ecological community lives (whether permanently, periodically or occasionally). Habitats are measurable and can be described by their flora and physical components.
Haul road	A designated road, often temporary, used for moving materials (often used when new infrastructure is being constructed).
Heavy vehicle	A vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System.
HFCs	Hydrofluorocarbons.
Hills M2 Motorway integration works	The works to join the project to the Hills M2 Motorway extending from the southern interchange to Windsor Road interchange.
Hydrocarbon	Any organic compound — gaseous, liquid or solid — consisting only of carbon and hydrogen.
Hydrogeology	The science of the distribution and movement of groundwater.
Hydrology	The study of rainfall and surface water runoff processes.
Hydromulching	A procedure to establish grass over a large area. A mixture of grass seed, chopped straw and fertiliser is sprayed over the area to be grassed.
I	
ICNG	Interim Construction Noise Guideline (DECC, 2009).
INP	NSW Industrial Noise Policy (EPA, 2000).
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways.
Intersection at-grade	An intersection where carriageways cross at a common level.
Integration works	Works to join existing roads to the project.
IPCC	Intergovernmental Panel on Climate Change.
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*.

Term	Meaning
L	
L_{A10}	The noise level which is exceeded for 10 per cent of the sample period. During the sample period, the noise level is below LA_{10} level for 90 per cent of the time. The LA_{10} is a common noise descriptor for environmental noise and road traffic noise.
L_{A90}	The noise level which is exceeded for 90 per cent of the sample period. During the sample period, the noise level is below LA_{90} level for 10 per cent of the time. This measure is commonly referred to as background noise level.
L_{Aeq}	The equivalent continuous sound level. This is the energy average of the varying noise over the sample period and is equivalent to the level of constant noise which contains the same energy as the varying noise environment. This measure is a common measure of environmental noise and road traffic noise.
LALC	Local Aboriginal Land Council.
L_{Amax}	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
Landscape character.	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features.
LEP	Local Environmental Plan.
LGA	Local government area.
Light vehicle	A vehicle is classified as a Class 2 vehicle or smaller, in accordance with the Austroads Vehicle Classification System.
Local road	A road or street used primarily for access to abutting properties.
LoS	Level of service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and / or passengers.
Lot	A parcel of land defined by measurement as a lot in a deposited plan (DP) or as a Crown portion or allotment.
M	
Macroinvertebrates	Macroinvertebrates are fauna with no backbone that can be seen with the naked eye (ie without the aid of a microscope or magnifying glass). Aquatic macroinvertebrates are those that spend all or part of their life cycles in water.
Macrophytes	Macrophytes are aquatic plants that can be seen with the naked eye. They can grow below, within or on top of the water.
Main alignment tunnels	The two underground tunnels forming the principal carriageways of the project.
Median	1. The central reservation which separates carriageways from traffic travelling in the opposite direction. 2. The ‘middle number’ in a sorted list of numbers.
Micron	One millionth of a metre (abbreviation µ).
Midblock	A general location on a road between two intersections.
Mode	A type or method of transport movement – including for the road corridor: cars, buses, bikes and pedestrians.
Motorway	Fast, high volume controlled access roads. May be tolled or untolled.
Motorway control centre	A centre with facilities necessary for the monitoring, maintenance and control of tunnel services. Also known as a tunnel control centre facility.

Term	Meaning
Motorway operations complex	The combined facility near the southern interchange comprising the motorway control centre, workshops, the water treatment plant and the southern ventilation facility.
Mt	Million tonnes.
MVKT	Million vehicle kilometres travelled.
N	
N_2O	Nitrous oxide.
NCA	Noise Catchment Areas.
NES	Matters of national environmental significance (from the Commonwealth *Environment Protection and Biodiversity Conservation Act 1995*).
NGA	National Greenhouse Accounts
NGER Act	*National Greenhouse and Energy Reporting Act 2007* (Commonwealth).
NML	Noise Management Level
NO	Nitrogen monoxide.
NO_2	Nitrogen dioxide.
Northern interchange	The connections of the project with the M1 Pacific Motorway (formerly known as the F3 Freeway) and Pennant Hills Road.
Northern ventilation facility	A component of the ventilation system located near the northern portal of the project for the extraction of in-tunnel air from the northbound tunnel.
Notifiable weed	A noxious weed that is classified as a Class 1, 2 or 5 under the *Noxious Weed Act 1993*.
NOW	NSW Office of Water
NO_x	Oxides of nitrogen.
Noxious weeds	A weed declared to be a noxious under section 7 of the *Noxious Weed Act 1993*.
NPWS	NSW National Parks and Wildlife Service (now OEH).
NSW	New South Wales
O	
O_3	Ozone
OEH	NSW Office of Environment and Heritage.
Off-ramp	A section of road which allows vehicles to exit the motorway or project.
OH&S	Occupational health and safety.
On-ramp	A section of road which allows vehicles to enter the motorway or project.
Operation footprint	The area required to accommodate the permanent features of the project, including underground components, above ground components and ancillary facilities associated with motorway operations.
P	
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime Services, 2011).
PAD	Potential archaeological deposit. Any location considered to have a moderate to high potential for subsurface archaeological material.
PAH	Polyaromatic hydrocarbons.
PASS	Potential acid sulfate soils.
PCB	Polychlorinated biphenyls.
Peak oil	The predicted time when oil extraction reaches its maximum.

Term	Meaning
pH	A measure of acidity or alkalinity of a solution, numerically equal to 7 for neutral solution, increasing with increasing alkalinity and decreasing with increasing acidity. Originally stood for the words potential of hydrogen.
PIARC	Permanent International Association of Road Congress.
Piezometer	Device used to measure the pressure of groundwater, or static pressure of a liquid.
PM	Particulate matter.
$PM_{2.5}$	Particulate matter less than 2.5 microns in diameter.
PM_{10}	Particulate matter less than 10 microns in diameter.
POEO Act	*NSW Protection of the Environment Operations Act 1997*.
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment.
Portal	Where a tunnel emerges to the surface, being the entrance or exit of the main alignment tunnels, off-ramps or on-ramps.
Preferred project corridor	A zone on the surface equal to a distance of 50 metres from the outer edge of the underground tunnels.
Proponent	The person or organisation that proposes carrying out the project or activity.
(The) project	NorthConnex
Putrescibles	Material that is able to be broken down or decay.
Q	
Quadrats	A small plot of land in which a plant or animal population study is conducted.
Quarry	An open pit from which stone, sand, gravel or fill is taken.
R	
RBL	Rating background level. The median value of the assessment background levels value for the period over all of the days measured. There is therefore an RBL value for each period — daytime, evening and night-time.
Receiver	An environmental modelling term used to describe a map reference point where the impact is predicted. A sensitive receiver is a home, work place, school or other place where people spend some time.
Remnant native vegetation	Small patches of native vegetation that remain after land use changes to the surrounding area.
REP	Regional Environmental Plan. All regional environmental plans are now deemed State environmental planning policies.
Revegetation	To revegetate an area by direct seeding with non-native species or cover crops and / or native species using manual or mechanical means such as hydromulching, strawmulching and tractor seeding.
Riffle	Areas in a waterway of broken water with rapid current.
Riparian	Relating to the banks of a natural waterway.
RNP	NSW Road Noise Policy (DECCW, 2011).
Roads and Maritime	Roads and Maritime Services of New South Wales.
Road furniture	A general term covering all signs, street lights and protective devices for the control, guidance and safety of traffic and convenience of road users.
Road reserve	A legally defined area of land within which facilities such as roads, footpaths and associated features may be constructed for public travel.
RTA	Roads and Traffic Authority of NSW (now Roads and Maritime Services).

Term	Meaning
Runoff	That part of the rainfall on a catchment which flows as surface discharge past a specified point.
S	
Scour	The erosion of material by the action of flowing water.
Section 170 register	A register established in accordance with section 170 of the *Heritage Act 1977* to record all heritage items in the ownership or under control of the Roads and Maritime (or other state government agency).
Sediment	Material, both mineral and organic, that is being or has been moved from its site of origin by the action of wind, water or gravity and comes to rest either above or below water level.
Sediment / sedimentation basins	An area where runoff water is ponded to allow sediment to be deposited.
Sedimentation	Deposition of sediment usually by water.
Sensitive receiver	A sensitive receiver, such as a residence, work place, school or other place where people spend some time. An elevated sensitive receiver is a point above ground level.
SEPP	State Environmental Planning Policy.
Severance of land	The creation of a physical barrier between a property and an existing road access to that property, or between two sections of the same property.
Site establishment works	Preliminary works carried out prior to the commencement of construction, including installation of environmental controls, demolition of existing structures, vegetation clearing and establishment of temporary construction facilities.
Shotcrete	Concrete applied to a surface through a pressure hose.
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to and flush with the surface of the pavement.
Southern interchange	The connections of the project with the Hills M2 Motorway and Pennant Hills Road.
Southern ventilation facility	A component of the ventilation system located near the southern portal of the project for the extraction of in-tunnel air from the southbound tunnel.
Spoil	Surplus excavated material.
State heritage register	A register kept by the NSW Heritage Council which lists places, buildings, works, relics, moveable objects or precincts that the Minister for Planning considers are of State heritage significance.
Sterilisation of land	The project severs a property into fragments of a size or shape that causes the existing land use to become unviable. This would result in a change in land use.
Stockpile	Temporarily stored materials such as soil, sand, gravel and spoil / waste.
Stratum	Layers of rock in the ground.
Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape.
Sustainability	Considering present and future needs and costs.
Swale	A shallow, grass-lined drainage channel.
SWMP	Soil and Water Management Plan.
T	
TAGG	Transport Authorities Greenhouse Group.
Terrestrial	Living or growing on land (ie a terrestrial plant or animal).
Threatened	As defined under the *Threatened Species Conservation Act 1994*, a species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.

Term	Meaning
Tie-in works	The works to join the project to existing roads, such as the M1 Pacific Motorway.
TMP	Traffic Management Plan.
Tributary	A river or stream flowing into a larger river or lake.
TSC Act	*NSW Threatened Species Conservation Act 1995*.
TSP	Total suspended particulates.
TSS	Total suspended solids.
Turbidity	A measure of light penetration through a water column containing particles of matter in suspension.
U	
UNFCCC	The 'Kyoto Protocol to the United Nation Framework Convention on Climate Change', which was signed in 1997. Australia ratified the protocol in December 2007.
Urban design	The process and product of designing human settlements, and their supporting infrastructure, in urban and rural environments.
V	
VENM	Virgin excavated natural material.
Ventilation facility	Facilities for the mechanical removal of air from the main alignment tunnels, or mechanical introduction of air into the tunnels.
Verge	That portion of the formation not covered by the carriageway, the median or the footpath.
Viewshed	The area visible from a fixed point.
Vulnerable	As defined under the *Threatened Species Conservation Act 1995*, a species that is likely to become endangered unless the circumstances and factors threatening its survival or evolutionary development cease to operate.
W	
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*.
Water table	The surface of saturation in an unconfined aquifer at which the pressure of the water is equal to that of the atmosphere.
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent).
Wetland	A swamp or marsh in which the soil is frequently or permanently saturated with water, or under water.
Wildlife corridor	Linked sections of natural vegetation retained to assist in fauna movement and maintenance of local biodiversity.
X, Y, Z	
Zoning	Zoning regulates land use within an environmental planning instrument (usually by different colour codes on a map accompanying a local environmental plan). Land use tables set out the various purposes for which land may or may not be used or developed in each zone.

(Blank page)

Executive Summary

What is proposed?

Roads and Maritime Services (Roads and Maritime) is proposing to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills. The project would deliver a high standard motorway that integrates with the regional transport network.

The project would comprise the following key features:

- Twin motorway tunnels around nine kilometres in length with two lanes in each direction and provision for a third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road including sections of on-ramps and off-ramps.
- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect the project travelling northbound and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway control centre located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.
- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the project.

What are the project objectives?

The project objectives have been developed based on the objectives established during the options analysis. These objectives, which incorporate environmental, social and economic considerations, are as follows:

- Provide a high standard access controlled motorway that integrates with the regional transport network.
- Minimise adverse social and environmental impacts in the local area during construction and operation.
- Provide opportunities for improved public transport in the area around Pennant Hills Road.
- Assist in a reduction in traffic congestion, particularly along Pennant Hills Road, and provide shorter travel times for road users.
- Provide a motorway that is safe and reliable for road users.
- Contribute towards the achievement of 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.
- 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.
- Demonstrate excellence in design and environmental sustainability.
- Be economically justified and affordable to government.

Why is it needed?

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

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. These conditions result in social and environmental impacts, including community severance, traffic noise and exhaust emissions. Pennant Hills Road, which is already operating at or beyond capacity during peak periods, is expected to experience continued traffic growth in the future.

The project is needed to provide a safer and more efficient link between the M1 Pacific Motorway and the Hills M2 Motorway that would better service current and future road users.

How would the project satisfy this need?

The operation of the project would provide an alternative and more efficient route for travel between the M1 Pacific Motorway and the Hills M2 Motorway, improving access, connectivity and reliability of inter-regional freight across the greater Sydney area. In providing an alternative route the project would also reduce interaction between freight and other road users, thereby reducing congestion and improving safety and amenity along Pennant Hills Road.

The project would:

- Reduce heavy vehicle travel on Pennant Hills Road.
- Improve traffic flow and intersection performance.
- Reduce crash rates.
- Improve road safety for pedestrians, cyclists and motorists.
- Improve travel times for bus services and motorists.

Why is it a Part 5.1 project?

Clause 94 of *State Environmental Planning Policy (Infrastructure) 2007* permits development for the purpose of a road or road infrastructure facilities to be carried out on any land by or on behalf of a public authority without consent. The project is therefore permissible without development consent.

On the 25 October 2013 the project was declared by Ministerial Order to be State significant infrastructure and critical State significant infrastructure under sections 115U (4) and 115V of the *Environmental Planning and Assessment Act 1979*. As such, Roads and Maritime is seeking approval for the project under Part 5.1 of that Act.

What alternatives were considered?

The project has a long history of identification and evaluation of alternatives and options commencing with the F3 to Sydney Orbital Link Study (SKM, 2004) (the 2004 report) through to the recent design and construct tender process for the project.

Alternatives

Strategic alternatives assessed as part of the project have included:

- Base case or 'do nothing / do minimum'.
- Road link between the M1 Pacific Motorway and the Sydney Orbital Network.
- Rail and public transportation upgrades.

A road link between the M1 Pacific Motorway and Sydney Orbital Network was identified in the 2004 report as the preferred option that would best meet the project objectives as it would:

- Provide a high standard access controlled motorway that would integrate with the regional transport network.
- Improve the travel conditions, road safety and efficiency of Pennant Hills Road for motorists, road based public transport and cyclists.
- Support local and regional economic development.
- Provide opportunities for improved public transport in the area around Pennant Hills Road.
- Provide a motorway that is safe and reliable for road users.

Corridor options

Three broad corridor types were identified in the 2004 report that provided feasible connections between the M1 Pacific Motorway and the Sydney Orbital Network. These broad corridor types were:

- Type A corridors were more easterly alignment options which generally formed an extension of the M1 Pacific Motorway to connect to the Hills M2 Motorway.
- Type B corridors connected the Sydney Orbital between Pennant Hills Road and Dean Park to the M1 Pacific Motorway between Wahroonga and the Hawkesbury River.
- Type C corridors included more westerly options which connected the Sydney Orbital between Windsor Road and Dean Park with the M1 Pacific Motorway north of the Hawkesbury River.

Analysis conducted as part of the 2004 report determined that broad corridor type A best satisfied the planning and project objectives.

Further detailed investigations subsequently developed four more detailed options within the broad corridor type A, being:

- The red corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at Macquarie Park.
- The yellow corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway near North Epping.
- The blue corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange.
- The purple corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange and generally followed the alignment of Pennant Hills Road.

An evaluation of all four type A corridor alignment options concluded that the purple corridor was preferred based on social, environmental and economic grounds.

Options review

A review of the options analysis presented in the 2004 report was undertaken in 2007 by the Honourable Mahla Pearlman AO (former Chief Judge of the NSW Land and Environment Court) at the request of the Australian Government.

The 2007 review concluded that the purple corridor alignment option should be the preferred route and should progress to the next stage of design and development.

Tender process

A competitive design and construct tender process was undertaken in order to identify an innovative, cost effective and environmentally-responsive design within the purple corridor option as identified and endorsed by the 2004 report and the 2007 Pearlman Review respectively.

The preferred tenderer was chosen after a thorough evaluation of the three tender submissions. The tender evaluation process provided a balanced consideration of engineering design requirements, project cost (including upfront capital expenditure and ongoing operational expenditure), and environmental and social impacts.

How did the community participate in development of the preferred project?

Community participation has been an important part of the development of the project since 2002.

Identification and analysis of project alternatives and corridor alignment options as part of the 2004 report was informed by extensive community consultation and engagement activities, including:

- During 2002 and 2003, publication of a series of community newsletters, media releases and a project website to provide information on the identification and analysis of alternatives and corridor alignment options.
- The establishment of three Community Focus Groups that met during 2002 to provide comments and feedback on alternative and options.
- Public information days held at five locations during May 2002 to provide information to interested stakeholders and community members, and to solicit comment on alternative and options. It was estimated that some 2,000 people visited the displays.
- Route options displays held at four locations during August 2003 to provide information on identified route options, and to receive comments on those options from the community and stakeholders. It was estimate that more than 2,500 people attended these events.

Feedback received from the community and stakeholders was summarised and addressed in the 2004 report. The outcomes and recommendations of the 2004 report were informed by community and stakeholder views on alternatives and corridor alignment options.

Further opportunity was provided for interested parties to provide input into the assessment of corridor alignment options through the Pearlman Review in 2007. As part of the review, the public was invited to make submissions on the 2004 report. A total of 53 submissions were received in early 2007, and each submitter was invited to present its submission at one of three public meetings before the Hon Mahla Pearlman AO in June 2007. Issues raised in submissions and through the public meeting were considered in formulating the recommendations of the 2007 Pearlman Review.

In October and November 2013, four community information sessions were held to provide up to date information about the status of the project and the design and construct tender process. The sessions were used to gather submissions and comments on the community's key issues and concerns, which were summarised and provided to the three design and construct tenderers to be taken into account as part of their respective project designs.

Following announcement of the preferred project tender design in March 2014, a further series of four community information sessions were held to provide more detailed information about the project. At these sessions, more detailed project design information was provided with community comment on key issues of interest and concern. Through feedback obtained during those sessions, and in subsequent public submissions, key community issues have been identified and responded to in this environmental impact statement and as part of the ongoing design development for the project.

What benefits would the project provide?

The project would provide the following benefits:

- Providing the missing link in Sydney's motorway network and the National Land Transport Network between the Sydney orbital road network and the M1 Pacific Motorway.
- Travel time savings at opening of up to 15 minutes during peak hour periods (when compared to without the project) with larger time savings in the future.
- Bypassing of 21 sets of traffic lights.
- Improving the efficiencies of intrastate and interstate freight movements through travel time saving and reduced operating costs.
- Improving safety of motorists, cyclists and pedestrians on Pennant Hills Road through the reduction in heavy vehicles.
- Improving local amenity and connectivity for people living, working and travelling along Pennant Hills Road.
- Providing opportunities for future public transport improvements and the reinvigoration of the Pennant Hills Road corridor.

What are the key issues associated with the project?

Traffic

During construction, local road works and the movement of heavy and light construction vehicles may affect the performance of the local road network. Construction methods and staging would be designed to ensure that disruptions to existing traffic are managed to minimise potential impacts on local amenity.

In the long term, the following beneficial traffic outcomes are expected:

- The provision of an efficient and effective National Land Transport Network connection through Sydney delivering improved efficiency for national freight carriers and long-distance transport operators.
- Improvements to travel conditions, road safety, and reliability of Pennant Hills Road for motorists, road-based public transport and cyclists.
- Improvements to local connectivity for people living, working and traveling along Pennant Hills Road due to decreases in traffic volumes.
- Serving the current and future growth needs of long-distance travel, particularly freight.

Noise and vibration

During construction there may be elevated noise impacts around construction sites, with construction noise management levels exceeded for some receivers during and outside standard construction hours. These construction noise impacts would be minimised and managed through the application of feasible and reasonable noise mitigation measures. Although vibration levels from tunnelling may exceed the 'preferred' criteria for human comfort at a limited number of receivers, the structural damage criteria would not be exceeded. Protocols for managing these construction impacts would be identified within the Construction Noise and Vibration Management Plan(s).

During operation, several properties around the northern and southern interchanges, and along Hills M2 Motorway integration works and the M1 Pacific Motorway tie-in works, would be affected by elevated traffic noise. Some of these properties are already affected by traffic noise. In some cases, the need for noise walls to be installed or upgraded has been identified. Several properties have also been identified as eligible for consideration of additional at-property acoustic treatments to mitigate operational road traffic noise.

Air quality

Construction of the project may generate dust and vehicle exhaust emissions. Most of these impacts would be effectively mitigated and managed through handling of spoil in acoustic sheds installed at tunnel support sites. This, and the implementation of standard construction dust mitigation measures, would ensure that potential air quality impacts during construction are minimised. The underground tunnels would be ventilated during construction in order to provide safe working environment for the construction workforce.

The project tunnels would capture vehicle emissions, which would then be released in a controlled and efficient manner via the tunnel ventilation outlets, facilitating effective pollutant dispersion. The results of the air quality assessment indicate that during operation, the project is expected to contribute very low concentrations of air pollutants to the local airshed. Contributions of pollutants from the project's ventilation outlets are calculated to be well below air quality criteria set by the Environment Protection Authority and well below background pollution levels.

In-tunnel air quality based on the expected traffic numbers has been calculated to be well below the design criteria which have been set based on a review of guidelines available from the World Health Organisation and the Permanent International Association of Road Congress.

The project would improve air quality along the Pennant Hills Road corridor as a result of heavy vehicles being diverted into the project tunnels. For $PM_{2.5}$ receivers along the Pennant Hills Road corridor are expected to benefit from improvements of between five to 20 per cent of the 24-hour average concentrations and between five to 35 per cent of the annual average concentrations.

Taking into account the significant improvements along the Pennant Hills Road corridor and the less extensive, very low levels of impacts around the northern and southern ventilation outlets, the project is expected to result in an overall net improvement in air quality.

Health

Based on a comparison of calculated levels of nitrogen dioxide, carbon monoxide volatile organic compounds and polycyclic aromatic hydrocarbons against relevant criteria, no adverse health outcomes around the ventilation outlets are expected in relation to these pollutants. Concentrations of these pollutants are likely to be well below the levels at which significant adverse health effects could be expected.

The assessment of fine particulate matter ($PM_{2.5}$) identified that the increased annual risk of the assessed health outcomes are within an acceptable range. The calculated increases in annual incidence of assessed health outcomes would be negligible.

The air quality improvements along Pennant Hills Road would result in benefits to human health. This results in an improvement to human health from the project when considering the net changes along the corridor.

Urban design, landscape character and visual amenity

The introduction of construction ancillary facilities and activities would result in visual impacts, particularly where night works would require night lighting. Facilities would be designed to ensure that visual impacts are managed to minimise amenity impacts for surrounding receivers.

Long term visual changes would be expected with the introduction of operational project elements and ancillary infrastructure. Project elements have been located adjacent to or within major transport corridors as much as possible. Operational facilities and buildings have been designed and landscaped to compliment and blend with their surroundings. The urban design and landscape approach for the project would be further developed during detailed design, with the aim of integrating the project into the surrounding landscape and visual setting.

Biodiversity

Construction of the project would involve clearance of around six hectares of native vegetation including around three hectares Blue Gum High Forest (an Endangered Ecological Community). Relocation of the threatened species *Epacris purpurascens* var *purpurascens* would also be required.

Impacts to endangered ecological communities and threatened species would be offset, and *Epacris purpurascens* var *purpurascens* identified within disturbance footprints would be relocated to areas where future disturbance is unlikely.

The project would involve operational wastewater discharge to Blue Gum Creek of up to 40 litres per second. A management plan would be developed and implemented to identify and mitigate associated potential ongoing impacts of this discharge.

Social and economic

Construction of the project would create 1,250 jobs at its peak, with an expenditure of around $2.9 billion and flow-on effects of around $1 billion. The project would also involve the full acquisition of 44 properties and the partial acquisition of ten properties to make way for road infrastructure and ancillary facilities.

Due to changes to passing trade, the project may result in a loss of economic output of around $5.6 million annually and loss in employment of 18 full-time equivalent positions. However, operation of the project would generate around 93 full-time equivalent jobs per year, and would generate around $32 million directly with flow-on effects of $17 million per year.

The project would involve permanent acquisition of five businesses, resulting in the potential loss of around 25 full-time equivalent employees.

Hydrogeology and soils

During construction, tunnelling works would intercept groundwater aquifers resulting in groundwater inflow into the tunnels of around 0.09 mega litres per day per kilometre of excavated tunnel. Settlement would generally be less than five millimetres, and ground movement is unlikely to result in any more than cosmetic damage (fine cracking up to five millimetres) at a limited number of structures.

During operation, there would be groundwater inflow into the tunnels of up to 700 mega litres per year. There may be localised groundwater drawdown, although it is unlikely that the project would impact on the viability of nearby bores.

Surface water

Temporary changes to surface water flow regimes and water quality may occur during construction, as a result of tunnel inflow water discharge, erosion and sedimentation, disturbance of contamination, and direct disturbance of water courses. Monitoring programs and control plans would be prepared and implemented to ensure surface water impacts are within acceptable limits.

During operation, tunnel water would be treated and discharged from the water treatment plant at the motorway operations complex. Discharge into surrounding waterways may result in increased potential for erosion and localised flooding. The need for additional mitigation measures to avoid erosion in these waterways would be investigated during the detailed design phase.

Heritage

The project would involve the demolition of parts of the heritage listed former maltworks site in Thornleigh, although the original germination building would be retained. An archival recording of this site would be undertaken.

Two locally listed Canary Island Palm Trees around the northern interchange would also be removed. Options for relocating the Canary Island Palms would be investigated.

Two areas of Aboriginal heritage sensitivity are located near the Hills M2 Motorway integration works. There would be no direct impacts to these areas. Monitoring would be conducted to ensure that indirect impacts, such as vibration, would not have adverse impacts on these areas.

Chapter 7 (Assessment of key issues) of this environmental impact statement provides further description of the potential impacts.

What are the other issues associated with the project?

Other issues associated with the project including impacts to land use and property, hazard and risk, resources and waste, and greenhouse gas and climate change were assessed as part of this environmental assessment.

Chapter 8 (Assessment of other issues) of this environmental impact statement provides further description of the potential impacts.

How will the likely impacts be managed?

This environmental assessment examines the likely consequences of the project. As part of this assessment measures to mitigate and manage each likely impact have been proposed. The mitigation measures developed for the project aim to remove or minimise potential impacts through design in the first instance. Where a potential impact is unable to be mitigated through design, additional mitigation and management measures are outlined.

The environmental, social and economic impacts and measures identified to minimise those impacts are described in **Chapter 7** (Assessment of key issues) and **Chapter 8** (assessment of other issues) of this environmental impact statement.

How can I comment on the proposal and/or the environmental impact statement?

The Department of Planning and Environment (DP&E) will make the environmental impact statement publicly available for a minimum period of 30 days. During this period, it will be available for inspection at:

- The Department of Planning and Environment website: http://majorprojects.planning.nsw.gov.au/.
- The NorthConnex project website: http://www.northconnex.com.au.
- Selected Roads and Maritime offices.
- Various staffed displays in the region.

Details of the location and opening hours of staffed displays would be provided through a community update, letters to interest groups who have registered for the project, emails notification to registered stakeholders, information on the project website and advertisements in the local and metropolitan media.

A community Information Centre for NorthConnex will be open three days per week during the exhibition period of the environmental impact statement. The community will be able to view the environmental impact statement and speak to members of the project team at the Community Information Centre. The Community Information Centre is located at 354-356 Pennant Hills Road, Pennant Hills. It will be open on Mondays and Thursdays 9am to 4pm and from 10am to 4pm on Saturdays.

Roads and Maritime will also be conducting community drop in sessions during the public exhibition period. A project information line will also be available throughout the exhibition period to answer questions from the community relating to the project – 1800 997 057 (toll free).

To provide feedback on the project, a person may make written submissions to the Department of Planning and Environment during the exhibition period. All submissions received will be placed on the Department of Planning and Environment website. Submissions can be made electronically through the Department of Planning and Environment website (http://majorprojects.planning.nsw.gov.au). Written submissions may also be directed to:

Director of Infrastructure Projects
Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

(Blank page)

1 Introduction

This chapter introduces the project, providing a brief outline of its need, scope, and location. It also outlines the structure of this environmental impact statement.

1.1 The proposed project

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* to construct and operate a tolled motorway, known as NorthConnex, linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney (the project). The project does not include ongoing motorway maintenance activities during operation. These would be subject to appropriate assessment and approval. The project would deliver a high standard motorway that integrates with the regional transport network.

The project is needed to provide a safer and more efficient link between the M1 Pacific Motorway and the Hills M2 Motorway that would better service current and future road users. The operation of the project would provide an alternative and more efficient route for travel between the M1 Pacific Motorway and the Hills M2 Motorway, improving access, connectivity and reliability of inter-regional freight across the greater Sydney area. The project would also reduce interaction between freight and other road users, thereby reducing congestion and improving safety and amenity along Pennant Hills Road.

Key features of the project would include:

- Twin motorway tunnels up to around nine kilometres in length with two lanes in each direction. The tunnels would be constructed with provision for a possible third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps.
- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect to the project travelling northbound, and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway operations complex located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.

- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the project.

The key benefits of the project would include:

- Provision of an efficient and effective National Land Transport Network connection through Sydney delivering improved efficiency for national freight carriers and long-distance transport operators.
- Improvements to travel conditions and reliability of Pennant Hills Road for motorists, road-based public transport and cyclists.
- Improvements to local amenity and connectivity for people living, working and travelling along Pennant Hills Road due to decreases in traffic volumes and the associated reductions in noise and air emissions.
- Improvements to road safety along Pennant Hills Road.
- Serve the current and future growth needs of long-distance travel, particularly for freight transport.

The project is based on an unsolicited proposal from Transurban and the Westlink M7 Shareholders to construct, operate and maintain the project. The Australian and State Governments have each committed up to $405 million to the project. The remainder of the cost of the project would be funded by Transurban and the Westlink M7 Shareholders and would be recouped from tolls on the project and changes to tolling for heavy vehicles on some Sydney motorways. The proposed toll on the project would be generally consistent with the tolling structure on the Hills M2 Motorway. This environmental impact statement has considered the presence of a toll on the project.

Subject to the project obtaining planning approval, construction of the project is anticipated to commence in early 2015 and is expected to take around four years to complete with an additional nine months of commissioning works.

The regional context of the project is shown in **Figure 1-1**. A detailed description of the project is provided in **Chapter 5**.

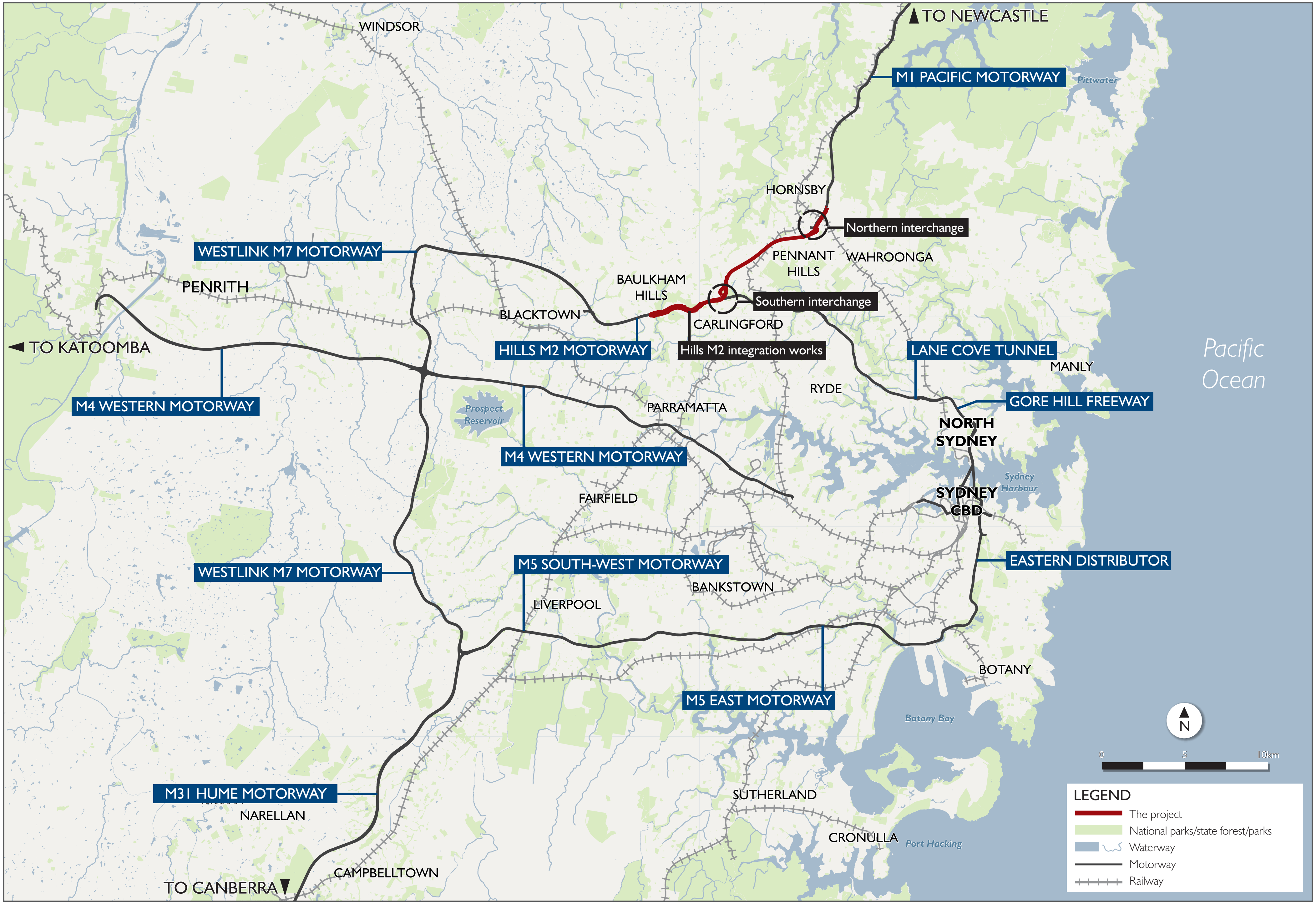


Figure 1-1 Regional context of the project

(Blank page)

1.2 Project location

The project would be located within The Hills, Hornsby and Ku-ring-gai local government areas about 20 kilometres north-west of the central business district of Sydney. The regional context of the project is shown in **Figure 1-1**. The local context of the project is shown in **Figure 1-2**.

The project would span the suburbs of Wahroonga, Normanhurst, Thornleigh, Pennant Hills, Beecroft, West Pennant Hills, Carlingford, North Rocks, Westmead and Baulkham Hills. The project would consist of underground tunnels generally following the alignment of Pennant Hills Road. At the northern and southern ends of the project, interchanges would connect the tunnels to the M1 Pacific Motorway, the Hills M2 Motorway and Pennant Hills Road, and would facilitate access to and from the Pacific Highway.

Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway forms part of the AusLink National Land Transport Network, a network of roads connecting the mainland states and territories of Australia. Light vehicles (commuters) using Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway share the road with heavy vehicles transporting freight to, from or through Sydney to major cities and regional centres such as the Central Coast, Newcastle, Brisbane and Melbourne.

This section of Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway is one of the two remaining sections of the urban National Land Transport Network within Sydney that is not motorway standard.

1.3 Structure of this environmental impact statement

This environmental impact statement has been prepared to address the requirements issued by the Director-General of the then Department of Planning and Infrastructure. The Director-General's environmental assessment requirements (DGRs) for the project were issued on 29 October 2013. The DGRs were re-issued on 11 April 2014 to include the Hills M2 Motorway integration works (refer to **Appendix A**). The environmental impact statement also addresses the relevant provisions of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

The environmental impact statement is divided into five volumes, with volume 1 divided into three parts.

Volume 1a has the following structure:

- Executive summary — summarises the findings of this environmental assessment.
- Introduction — provides a broad overview of the project and where it is located (**Chapter 1**).
- Assessment process — outlines the statutory requirements and explains the steps in the assessment and approval process (**Chapter 2**).
- Strategic justification and project need — provides the strategic context, explains the need for the project and identifies the project objectives (**Chapter 3**).
- Project development and alternatives — reviews the alternatives and options considered in developing the project including the consequences of not proceeding (**Chapter 4**).

- Project description — provides a detailed description of the project including the route alignment, design standards, key design features and construction methodologies and staging (**Chapter 5**).
- Consultation — outlines the consultation activities undertaken, issues raised and how these have been addressed (**Chapter 6**).

Volume 1b has the following structure:

- Assessment of key issues — identifies the key environmental issues, assesses the impacts and proposes environmental management measures (**Chapter 7**).

Volume 1c has the following structure:

- Assessment of other issues — identifies other environmental issues, assesses the impacts and proposes environmental management measures (**Chapter 8**).
- Summary of environmental management measures — collates all of the environmental management measures for the project identified through the impact assessment (**Chapter 9**).
- Environmental risk analysis — Details the risk analysis process by which the potential environmental issues for assessment were identified (**Chapter 10**).
- Project justification and conclusion — presents the justification for the project, including consideration of the principles of ecologically sustainable development and the objects of the *Environmental Planning and Assessment Act 1979* (**Chapter 11**).
- References.
- List of tables.
- List of figures.
- Appendix A — Director-General's environmental assessment requirements and checklist.
- Appendix B — *Environmental Planning and Assessment Regulation 2000* checklist.
- Appendix C — Geological long section.
- Appendix D — Community communications framework.

Volume 2 contains the following appendices:

- Appendix E — Technical working paper: Traffic and transport.
- Appendix F — Technical working paper: Noise and vibration.

Volume 3 contains the following appendices:

- Appendix G — Technical working paper: Air quality.
- Appendix H — Technical working paper: Human health risk assessment.

Volume 4 contains the following appendices:

- Appendix I — Technical working paper: Urban design.

Volume 5 contains the following appendices:

- Appendix J — Technical working paper: Biodiversity.
- Appendix K — Technical working paper: Business.
- Appendix L — Technical working paper: Non-Aboriginal heritage.
- Appendix M — Technical working paper: Aboriginal heritage.
- Appendix N — Greenhouse gas methodology and calculations.

(Blank page)

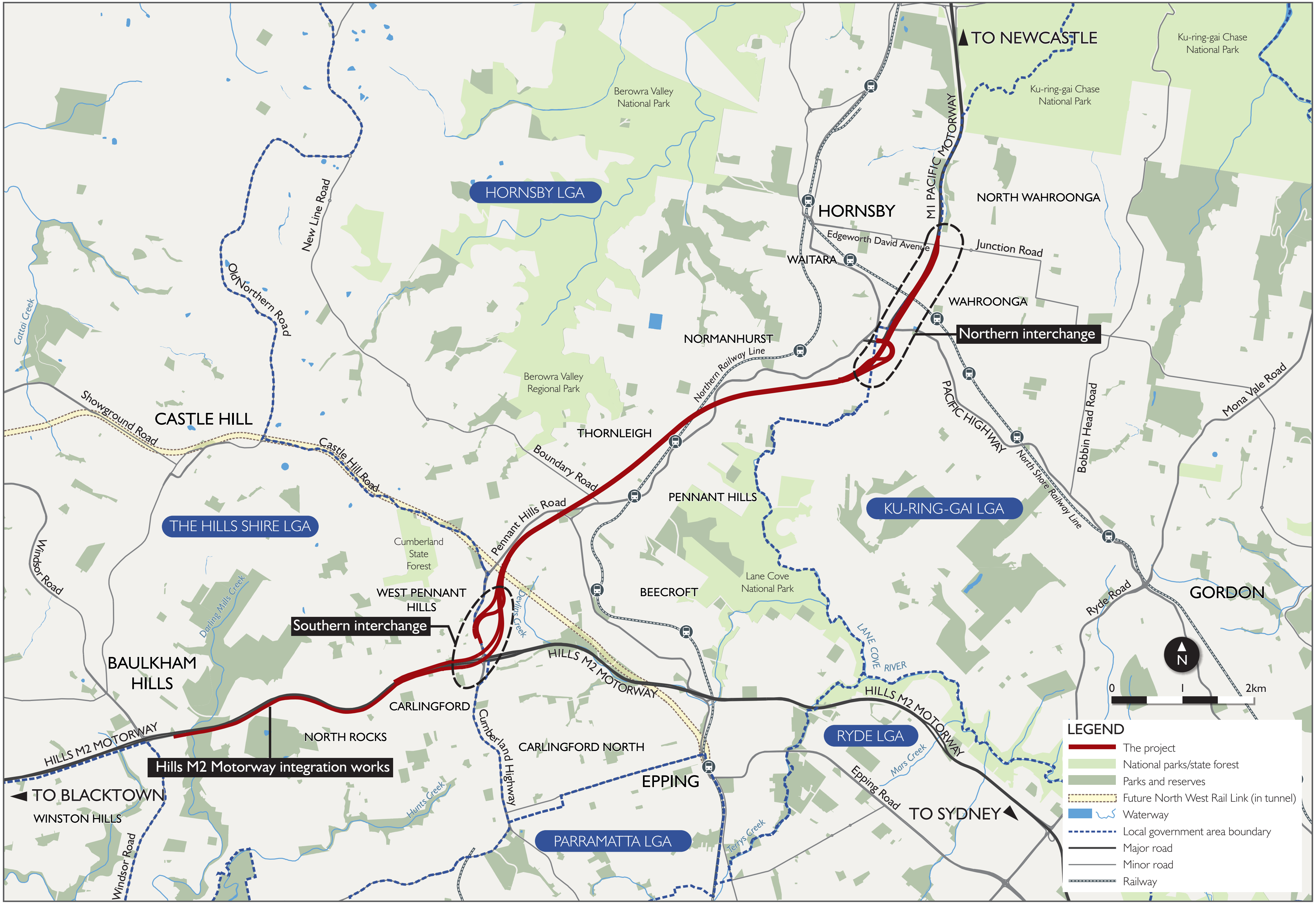


Figure 1-2 Local context of the project

(Blank page)

2 Assessment process

This chapter describes the planning approval process for the project as well as other relevant environmental planning and statutory approval requirements.

2.1 Approval framework

2.1.1 Environmental Planning and Assessment Act 1979

Roads and Maritime is seeking approval for the project under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). On 25 October 2013, the project was declared, by Ministerial Order, to be State significant infrastructure and critical State significant infrastructure under sections 115U (4) and 115V of the EP&A Act. The Order also amended Schedule 5 of *State Environmental Planning Policy (State and Regional Development) 2011*.

The Director-General's environmental assessment requirements (DGRs) for the project were issued on 29 October 2013. The DGRs were re-issued on 11 April 2014 to include the Hills M2 Motorway integration works. A copy of the DGRs is provided in **Appendix A**.

The assessment and approval process for State significant infrastructure under Part 5.1 of the EP&A Act is illustrated in **Figure 2-1**.

2.2 Environmental planning instrument

2.2.1 State Environmental Planning Policies

Section 115ZF of the EP&A Act excludes the application of environmental planning instruments to State significant infrastructure projects (except as they may apply to the declaration of infrastructure as State significant infrastructure or critical State significant infrastructure). However, consistent with good environmental assessment practice the provisions of the following relevant State Environmental Planning Policies (SEPPs) have been considered:

- *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP). The ISEPP aims to facilitate the effective delivery of infrastructure across the State. Clause 94 of the ISEPP permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. The project is therefore permissible without development consent.
- *State Environmental Planning Policy No 19 — Bushland in Urban Areas* (SEPP 19). SEPP 19 aims to protect and preserve bushland within urban areas including within the local government areas of Hornsby, Ku-ring-gai and The Hills. SEPP 19 is considered further in **Section 7.6** (Biodiversity).
- *State Environmental Planning Policy No 33 — Hazardous and Offensive Development* (SEPP 33). Although SEPP 33 is not strictly applicable to infrastructure projects, the provisions of the policy have been considered in **Section 8.2** (Hazard and risk) in relation to the storage of hazardous substances and dangerous goods during the construction and operation of the project.
- *State Environmental Planning Policy No 44 — Koala Habitat Protection* (SEPP 44). SEPP 44 aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas. SEPP 44 is considered further in **Section 7.6** (Biodiversity).

- *State Environmental Planning Policy No 55 — Remediation of Land* (SEPP 55). SEPP 55 aims to provide a Statewide planning approach to the remediation of land. SEPP 55 is considered further in **Section 7.8** (Hydrogeology and soils).
- *Sydney Regional Environmental Plan No. 20 — Hawkesbury-Nepean River* (No 2 1997) (SREP) (now a deemed SEPP). Part of the project is located within the Hawkesbury-Nepean River catchment. SREP 20 provides a number of general and specific planning policies and general strategies, primarily focussed around water quality, ecology and heritage management. These issues are considered further in **Section 7.9** (Surface water), **Section 7.6** (Biodiversity) and **Section 7.10** (Non-Aboriginal heritage) respectively.
- *Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005* (now a deemed SEPP), provides planning principles and development controls for the Sydney Harbour Catchment. Part of the project is located with the Sydney Harbour catchment, however it is not located within a foreshore and waterways area or within any strategic foreshore sites, and would not impact on any of the mapped heritage items or wetland protection areas. As such, these provisions do not apply to the project. Additionally, the project is considered unlikely to result in impacts to the existing qualities of Sydney Harbour.

2.3 Local Environmental Plans and draft Local Environmental Plans

Local environmental plans (LEPs) do not apply in respect of State significant infrastructure projects. The Minister for Planning may take into account the provisions of the LEPs when deciding whether to approve the project. The project lies within three local government areas (LGAs): the Ku-ring-gai LGA; the Hornsby Shire LGA and The Hills Shire LGA.

The relevant provisions of the following LEPs are considered in **Section 8.1** (Land use and property):

- *Ku-ring-gai Planning Scheme Ordinance 1971.*
- *Draft Ku-ring-gai Local Environmental Plan 2013.*
- *Hornsby Local Environmental Plan 2013.*
- *The Hills Local Environmental Plan 2012.*

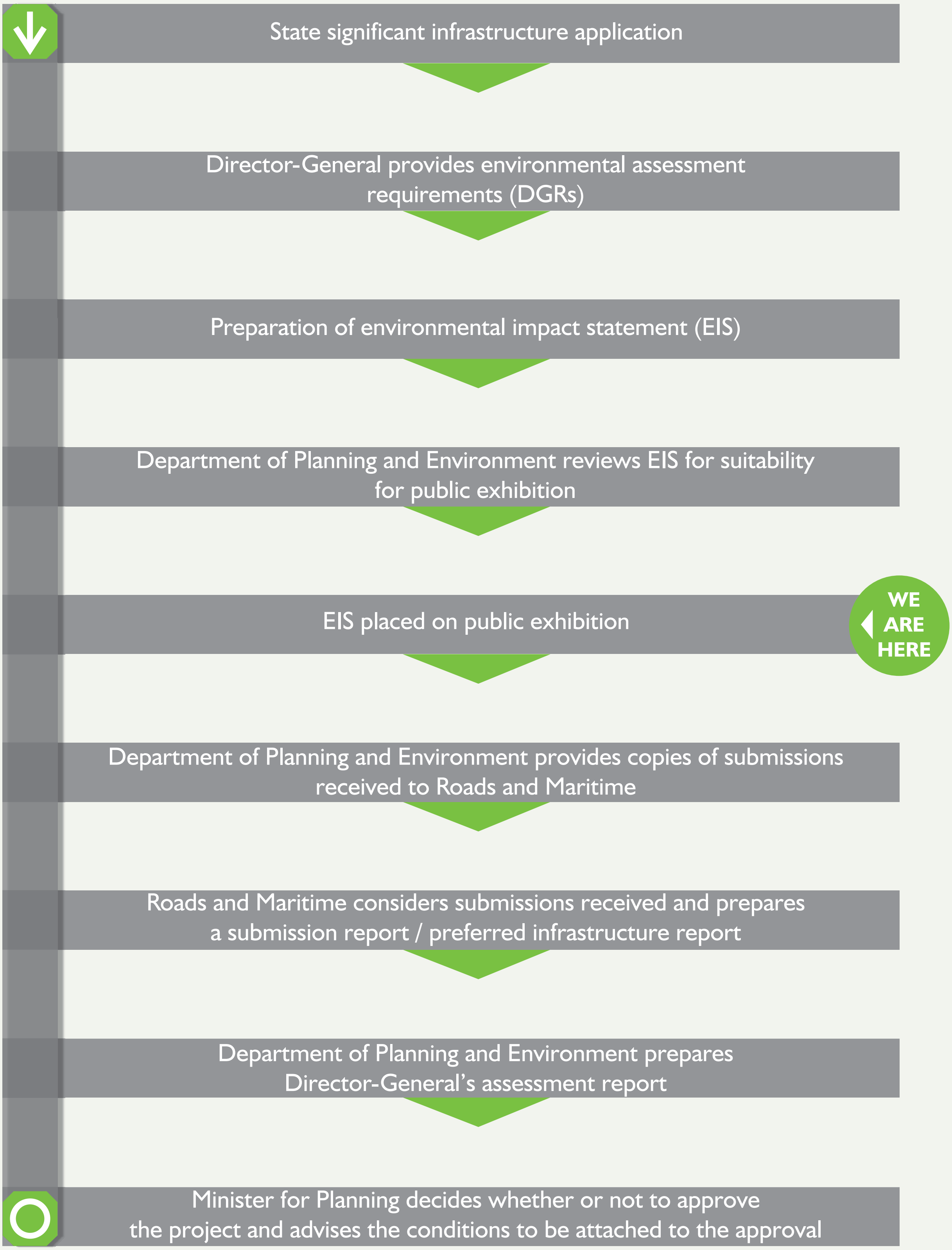


Figure 2-1 Assessment and approval process

(Blank page)

2.4 Other legislation

2.4.1 NSW legislation

Section 115ZG of the EP&A Act details the approvals under NSW legislation which are not required for a State significant infrastructure project approved under Part 5.1 of the EP&A Act. Additionally, section 115ZH details approvals under other legislation which must be applied consistently to an approved State significant infrastructure project.

Those approvals which are not required by virtue of section 115ZG of the EP&A Act but may ordinarily be required for a project of this sort are outlined in **Table 2-1**. Although these approvals are not required for the project, an assessment of the relevant potential impacts has been undertaken as part of this environmental impact statement.

Table 2-1 Relevant approvals which are not required for State significant infrastructure

Legislation	Approval	Requirement	Where addressed
Fisheries Management Act 1994	Section 201	Dredging and reclamation works	**Section 7.6** (Biodiversity)
	Section 219	Blocking fish passage	**Section 7.6** (Biodiversity)
Heritage Act 1977	Section 139	Potential impact on relics not listed on the State Heritage Register or protected by an Interim Heritage Order	**Section 7.10** (Non-Aboriginal heritage)
National Parks and Wildlife Act 1974	Section 90	Aboriginal heritage impact permit	**Section 7.11** (Aboriginal Heritage)
Water Management Act 2000	Section 89	Water use approval	**Section 7.9** (Surface water)
	Section 90	Water management work approval	**Section 7.9** (Surface water)

Those approvals relevant to the project which cannot be refused and must be substantially consistent with the State significant infrastructure approval (by virtue of section 115ZH of the EP&A Act) are outlined in **Table 2-2**.

Table 2-2 Relevant approvals which must be applied consistently with State significant infrastructure approval

Legislation	Approval	Requirement
Protection of the Environment Operations Act 1997	Chapter 3	Environment protection licence

An environment protection licence would be required for the scheduled activity of road construction, as the project involves the construction of a tollway greater than one kilometre in length in a metropolitan area.

The NSW Aquifer Interference Policy (Department of Primary Industries, 2012) document the NSW government's intention to implement the requirement for approval of 'aquifer interference activities' under the *Water Management Act 2000*. Although the project would affect a groundwater aquifer (the main alignment tunnels and on and off-ramp tunnels would intercept a groundwater source) the requirement for aquifer interference approvals has not yet commenced and as such, this approval is not required. Despite this, an assessment of potential groundwater impacts is provided in **Section 7.8** (Hydrogeology and soils).

The *Land Acquisition (Just Terms Compensation) Act 1991* would apply to the acquisition of land required for the project. Land acquisition requirements are further discussed in **Section 8.1** (Land use and property).

2.4.2 Commonwealth legislation

Environment Protection and Biodiversity Conservation Act 1999

Under the *Environment Protection and Biodiversity Conservation Act 1999*, proposed 'actions' that have the potential to significantly impact on matters of national environmental significance, the environment of Commonwealth land or that are being carried out by a Commonwealth agency must be referred to the Australian Government. Matters of national environmental significance include:

- World heritage properties.
- National heritage properties.
- Wetlands of international importance.
- Listed threatened species and ecological communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions.
- A water resource, in relation to coal seam gas development and large coal mining development.

If the Commonwealth Minister for the Environment determines that a referred project is a "controlled action", the approval of that minister would be required for the project in addition to any planning approvals required by State legislation.

There is no Commonwealth land within the footprint of the project.

An assessment of this project's potential impact on threatened species, ecological communities and migratory species (as discussed in **Section 7.6** Biodiversity) found that there is unlikely to be a significant impact on relevant matters of national environmental significance. The project would not significantly impact any other matter of national environmental significance or the environment of Commonwealth land. Accordingly, the project has not been referred to the Australian Government Department of the Environment.

Native Title Act 1993

The main objective of the *Native Title Act 1993* is to recognise and protect native title. Section 8 states the Native Title Act is not intended to affect the operation of any law of a State or a Territory that is capable of operating concurrently with the Native Title Act. Searches of the register maintained by the National Native Title Tribunal indicate there is one native title claim registered with respect to land within the area of the project. There is no Crown land within the footprint of the project and, as such the project would not directly affect any Crown land the subject of a native title claim.

(Blank page)

3 Strategic justification and project need

This chapter outlines the relationship of the project to the State and national strategic planning and policy framework and relevant specific planning and policy documents. It also identifies the need for the project within the context of existing transport networks, and presents the project objectives. The project objectives have been developed to align with the strategic objectives of relevant planning and policy documents, and relate directly to the key issues that demonstrate the need for the project. A statement of strategic need concludes this chapter.

Table 3-1 sets out the Director-General's Requirements as they relate to the strategic justification and project need, and where in the environmental impact statement these have been addressed.

Table 3-1 Director-General's Requirements – strategic justification and project need

Director-General's Requirement	Where addressed
A statement of the objectives of the project, including a description of the strategic need, justification, objectives and outcomes for the project, taking into account existing and proposed transport infrastructure and services within the adjoining subregions, and as relevant the outcomes and objectives of relevant strategic planning and transport policies, including, but not limited to, NSW 2021, NSW Government State Infrastructure Strategy, NSW Long Term Transport Master Plan (December 2012), draft Metropolitan Plan for Sydney (March 2013) and any other relevant plans;	Objectives of the project are identified in **Section 3.4**. The project need is provided in **Section 3.3** and a statement of strategic need is provided in **Section 3.5**. Consideration of the project against the outcome and objectives of strategic planning and transport policies is provided in **Section 3.1** and **Section 3.2**.
Justification for the preferred project taking into consideration the objects of the *Environmental Planning and Assessment Act 1979.*	The project justification is provided in **Section 3.3** and **Section 3.5**. Further justification is provided in **Chapter 11**.

3.1 NSW strategic planning and policy framework

In 2011, the NSW Government presented a broad strategic plan for development of the State in the form of NSW 2021 – A Plan to Make NSW Number One (NSW 2021) (NSW Department of Premier and Cabinet, 2011). In order to achieve key objectives of NSW 2021 relating to the provision of infrastructure the NSW Government formed Infrastructure NSW, an independent statutory agency. The primary task of Infrastructure NSW was to prepare the 20 year State Infrastructure Strategy 2012-2032 (Infrastructure NSW, 2012), which was used to inform the NSW Government's State Infrastructure Strategy (SIS) (NSW Department of Premier and Cabinet, 2012). The SIS is implemented through annual five year State Infrastructure Plans (refer to **Section 3.1.2**).

Infrastructure NSW's recommendations are intended to enable NSW Government decision making, and are considered in conjunction with the advice from other State agencies including:

- NSW Department of Planning and Environment, which is responsible for Sydney's Metropolitan Strategy and associated Subregional Strategies (refer to **Sections 3.1.3, 3.1.4** and **3.1.5**). These strategies present an integrated planning approach to meeting the housing, employment, transport, land and recreational needs of Greater Sydney over the next 20 years.
- Transport for NSW, which is responsible for the NSW Long Term Transport Master Plan (Master Plan) (Transport for NSW, 2012a). The Master Plan sets out an approach for delivering world class transport networks and services to the State's population.

The following sections describe the compatibility of the project with these key State strategic planning and policy documents.

3.1.1 NSW 2021 – A Plan to Make NSW Number One

NSW 2021 was released in September 2011 and is the NSW Government's strategic plan for the future. NSW 2021 is a 10 year plan for change in NSW, and it aims to rebuild the economy, provide quality services, renovate infrastructure, restore government accountability and strengthen local environment and communities.

Provided within NSW 2021 are 32 goals, including goals to increase expenditure on critical NSW infrastructure, improve the efficiency of the State road network, reduce travel times and improve safety. Priority actions are specified in NSW 2021 to achieve these goals. **Table 3-2** summarises relevant NSW 2021 goals and their application to the project.

Table 3-2 Relevant NSW 2021 goals

<table>
<tr><th>Goals</th><th>Description</th><th>Relevance to project</th></tr>
<tr><td>Goal 19</td><td>Recognises that investment in critical infrastructure is needed across the State, stating that the role of Infrastructure NSW over the next 10 years will be to prioritise and deliver infrastructure in true partnership with the private sector.</td><td>The project is consistent with the priority actions outlined under this goal, as it would demonstrate an infrastructure delivery partnership between the State and the private sector, utilising best practice procurement and funding models.</td></tr>
<tr><td>Goal 7</td><td>Focuses on the need to reduce travel times around Sydney and across NSW by delivering an efficient and effective transport system.</td><td rowspan="2">The delivery of road infrastructure that relieves congestion, improves safety, and enhances and expands capacity on road corridors is identified as a priority action for improving the State road network.

In achieving project objectives relating to improvements in safety and efficiency along Pennant Hills Road, the project would be consistent with priority actions for achieving goals 7 and 10.</td></tr>
<tr><td>Goal 10</td><td>Outlines the need to improve the safety of NSW roads through road development, upgrading, and reducing congestion.</td></tr>
</table>

3.1.2 NSW State Infrastructure Strategy

The State Infrastructure Strategy (NSW Department of Premier and Cabinet, 2012) outlines the State Government's short, medium and long term initiatives concerning infrastructure delivery and reform over the next 20 years. The State Infrastructure Strategy was developed following careful consideration of Infrastructure NSW's State Infrastructure Strategy 2012-2032 (Infrastructure NSW, 2012), which included 70 recommendations for reform or project priorities.

In addition to the 20 year strategy, Infrastructure NSW is also required under the *Infrastructure NSW Act 2011* to prepare and submit Infrastructure Plans to the Premier, to identify specific major infrastructure projects to be undertaken as a priority over the coming five years. The first of these plans, the State Infrastructure Plan, was made publically available through the NSW Budget 2013-14 in the form of Budget Paper No. 4 Infrastructure Statement 2013-14 (NSW Government, 2013). The SIP represents the NSW Government's funded infrastructure priorities for a five year period, being 2013-2014 to 2017-2018.

The State Infrastructure Strategy recognises 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. As travel speeds along major road corridors decrease, road freight productivity and commuter efficiency is being impacted, presenting an economic cost to the State. In order to boost productivity, grow the economy and create new jobs, the State Infrastructure Strategy and State Infrastructure Plan have identified strategic priorities that would deliver incremental improvements to the State's urban road network. One of these strategic priorities involves completing the 'missing links' on Sydney's motorway network, including a link between the M1 Pacific Motorway and the Hills M2 Motorway.

Additionally, the State Infrastructure Strategy commits to undertaking a review of the unsolicited private sector proposal for the delivery of the link between the M1 Pacific Motorway and the Hills M2 Motorway.

3.1.3 Metropolitan Plan for Sydney to 2036

The Metropolitan Plan for Sydney to 2036 (Metropolitan Plan) (Department of Planning, 2010) was released in December 2010. The purpose of the Metropolitan Plan is to guide Sydney's growth until 2036 and to coordinate efforts by the NSW Government and local councils to deliver a networked, liveable, affordable, and sustainable city. Integrating transport infrastructure and land use planning, the Metropolitan Plan emphasises the importance of creating a more connected, efficient city structure.

The Metropolitan Plan recognises that Sydney's road network is critical to its economy and to the lives of Sydneysiders, with 92 per cent of Sydney's 16.3 million average weekday trips undertaken by road (Department of Planning, 2010). It is acknowledged that in order to meet the aims of the Metropolitan Plan, there is a need to address road infrastructure challenges such as lack of capacity and increasing demand. The Metropolitan Plan commits to addressing these challenges, the strategy for which includes investment in strategic road upgrades and protection of key transport corridors. The project is identified as a key medium to long-term corridor under the Metropolitan Plan.

Objective C3 of the Metropolitan Plan emphasises the need to deliver a transport system that supports productivity through efficient movement of freight. The Metropolitan Plan also recognises that road freight movements in densely populated urban centres have the potential to create amenity issues for surrounding dwellings, and to compete for capacity with other traffic particularly during peak hours. In planning for centres, a balance must be struck between the needs of local residents and broader regional considerations. In achieving the objectives of improving freight efficiency, reducing congestion, and improving local amenity along Pennant Hills Road, the project would be consistent with the objectives of the Metropolitan Plan.

3.1.4 Draft Metropolitan Strategy for Sydney to 2031

The Draft Metropolitan Strategy for Sydney to 2031 (Draft Metropolitan Strategy) (Department of Planning and Infrastructure, 2013) was released for public comment in March 2013 and sets the strategic planning framework for Sydney's growth to 2031. Once the draft strategy is finalised in 2014, it would replace the current Metropolitan Plan for Sydney to 2036.

The Draft Metropolitan Strategy recognises that good transport infrastructure, high levels of accessibility and cross regional connectivity are crucial in supporting the growth of Sydney and enhancing liveability. In coordination with the State's infrastructure plans, the NSW Long Term Transport Master Plan and the State Infrastructure Strategy, the Draft Metropolitan Strategy outlines a series of transport objectives directed at achieving this vision.

Under Objective 28, the Draft Metropolitan Strategy identifies corridors for protection and sites for Sydney's long term transport needs. As with the Metropolitan Plan for Sydney to 2036 and State infrastructure plans, the corridor between the M1 Pacific Motorway and the Hills M2 Motorway is identified as a key corridor for protection. Investigation into the potential role, alignment and opportunities for this link is listed as an action under this objective.

Objective 27 of the Draft Metropolitan Strategy commits to incorporation of efficient freight infrastructure into Sydney's transport network. This includes actions to protect corridors and support investment in new infrastructure. Although the Draft Metropolitan Strategy focuses on strengthening the role of freight transport by rail, it also recognises the need to address competition for space on Sydney's road network and to balance the needs of freight with residents and other road users. Objectives for the project include reducing travel times for local users of Pennant Hills Road, improving freight efficiency and improving amenity for residents and businesses within the existing road corridor (refer to **Section 7.7** Social and economic). In addressing the needs of the freight industry and delivering benefits to other users of the corridor, the objectives of the project are consistent with those of the Draft Metropolitan Strategy.

3.1.5 Draft North Subregional Strategy

Due to the size and complexity of the metropolitan region, a series of draft Subregional Strategies were prepared to interpret the actions and objectives of the 2005 Metropolitan Strategy, City of Cities: A Plan for Sydney's Future (Department of Planning, 2005). These Subregional Strategies form an important intermediate step in guiding government investment at a local level and linking local and state planning issues. In 2014, new Subregional Delivery Plans will be drawn up in partnership with the community and local councils.

The project is located within the North Subregion, which stretches from Wisemans Ferry in the north to Roseville in the south, and from St Ives in the east to Carlingford in the west. Growth of the North Subregion is guided by the Draft North Subregional Strategy (Draft Subregional Strategy) (Department of Planning, 2007) which is structured around seven subject areas consisting of issue-specific objectives and actions. The ‘Transport’ strategy aims to address key issues facing the North Subregion including congestion, capacity constraints, and demand management.

Under a broad objective to improve existing transport systems in the North Subregion, the Draft Subregional Strategy includes an action to provide additional capacity at places across the network that experience high levels of congestion. As discussed in **Section 7.1** (Traffic and transport), the project is anticipated to reduce congestion along Pennant Hills Road through provision of an alternative route for through traffic, thereby contributing to achievement of this objective. The Draft Subregional Strategy also refers specifically to the provision of a link between the M1 Pacific Motorway and the Hills M2 Motorway as a key action under its objective to connect regions and economic gateways within the greater metropolitan region.

Actions D6 and D8 of the Subregional Strategy deal specifically with freight objectives, namely improving efficiencies for, and lowering adverse impacts from, all types of freight movement across the North Subregion. Under Action D6, Pennant Hills Road is identified as a corridor currently under pressure as a result of growing volumes and peak hour road freight movements. Provision of an alternative route between the M1 Pacific Motorway and the Hills M2 Motorway is anticipated to lead to improvements in the efficiency of freight movement and to improved traffic and amenity conditions along Pennant Hills Road. As such, the project would be consistent with the key transport objectives of the Draft Subregional Strategy.

3.1.6 NSW Long Term Transport Master Plan

The NSW Long Term Transport Master Plan (Master Plan) (Transport for NSW, 2012a), which was released in December 2012, presents the NSW Government’s direction for transport planning and investment for the next 20 years. It identifies the key challenges that the NSW transport system must address to support the State’s economic and social performance, and identifies a planned and coordinated set of actions to address those challenges.

The Master Plan emphasises the need for an integrated approach to land use and transport planning. It aims to strengthen State transport planning processes by taking into account future land use planning, particularly in areas where significant growth is anticipated to occur. It is recognised that in order to improve the performance of Sydney’s motorway network over the next 20 years, road investments need to integrate with land use planning as well as with Sydney’s wider public transport network.

In conjunction with the Draft Metropolitan Strategy for Sydney to 2031 (Department of Planning and Infrastructure, 2013), the Master Plan intends to shape Sydney’s transport network to support patterns of settlement, employment and economic activity. Key challenges identified in the Master Plan include sustaining growth in the Sydney metropolitan region and providing better connections and services to Sydney’s growth areas. In addressing this challenge, the Master Plan recognises the need for a network that supports growing centres such as North Sydney through provision of efficient links to labour, freight networks and emerging business hubs. In separating longer distance trips and freight transport from arterial and local roads, the project would increase available capacity for local road users.

This would improve the accessibility and efficiency of cross-city travel, and support the flow of goods and services within and between growing urban centres. Provision of an alternative route for freight transport between the M1 Pacific Motorway and the Hills M2 Motorway would also lead to improvements in the efficiency and reliability of Sydney's freight network, facilitating more efficient movement of goods through the supply chain and ultimately enhancing productivity.

Chapter 4 of the Master Plan addresses the need to alleviate congestion on Sydney's motorway network using an integrated package of solutions that tackle issues relating to both supply and demand. One of the key supply-related reasons for congestion on Sydney's motorways relates to the missing links between key components of the network. Investment in the construction of these missing links, with the aim of providing a fully connected, smoothly flowing motorway network, is included within the integrated package of solutions presented in Chapter 4 of the Master Plan. The completion of the motorway network is identified as a high priority in the Master Plan, including linking the M1 Pacific Motorway and the Hills M2 Motorway.

The Master Plan recognises that a missing orbital motorway connection exists between the M1 Pacific Motorway and the Hills M2 Motorway. In Chapter 7 of the Master Plan, this particular missing link is also identified as an important long term road freight corridor.

Chapter 9 of the Master Plan provides a list of measures and a timetable for action. This section identifies that planning would be progressed for future motorway links including the M1 Pacific Motorway to the Hills M2 Motorway link would occur as a medium to long term priority.

Sydney's motorway network is part of the primary freight network in Sydney and its efficient operation is critical to ongoing productivity. In providing an efficient link between the M1 Pacific Motorway and the Hills M2 Motorway, the project would improve freight access, connectivity and reliability across the greater Sydney area.

3.1.7 NSW Freight and Ports Strategy

The aim of the NSW Freight and Ports Strategy (Transport for NSW, 2013b) (the Freight Strategy) is to provide a transport network in NSW that allows the efficient flow of goods to the market.

The Freight Strategy identifies that the NSW road network carried 63 per cent of the total freight volume in 2011, with 33 percent of freight carried by rail in the same year. The role of heavy vehicles in moving freight across NSW is substantial and will continue to be for the foreseeable future. The Freight Strategy identifies the challenge of increasing the capacity of NSW roads to support the growth in freight task.

The Freight Strategy has two main objectives, being to deliver a freight network that efficiently supports the projected growth of the NSW economy and to balance freight needs with those of the broader community and the environment. The project is consistent with the three strategic action programs identified in the Freight Strategy, as follows:

- Network efficiency – the project would improve network efficiency, delivering travel time savings. This would provide more efficient movement of freight, thereby reducing operational freight costs.

- Network capacity – the project would provide increased road capacity between the M1 Pacific Motorway and the Hills M2 Motorway, a key section of road for freight movement which is currently heavily congested.
- Network sustainability – the removal of a large number of freight vehicles from the Pennant Hills Road corridor could contribute to a range of amenity related benefits for the local community. The provision of an alternative route and the resultant travel time savings and reduced vehicle hours travelled would also lead to long-term savings in greenhouse gas emissions.

The Freight Strategy identifies improvements to network capacity as strategic action program 2. Task 2A-1 under this program is to establish corridors to meet long term freight needs of NSW. The link between the M1 Pacific Motorway and the Hills M2 Motorway is specifically identified as a key link to be investigated and addressed as part of this task. Additionally, task 2B-1 (to connect and complete Sydney's motorway network) identifies key motorway connections with benefits for freight. This includes the construction of the connection between the Hills M2 Motorway and M1 Pacific Motorway which would provide the opportunity to streamline interstate movements around Sydney.

The Freight Strategy also identifies the project in its infrastructure program. In this section, the Freight Strategy identifies that the project would improve travel times and reduce operating costs for national freight carriers and long-distance transport operators.

3.1.8 Action for Air

Action for Air (DECCW, 2009a) aims to improve the air quality in the greater metropolitan region. Action for air identifies ozone and particles as the biggest air quality challenges for the region, and nominates actions and objectives specifically targeted towards reducing emissions from motor vehicles. The project would assist meeting this goal by reducing vehicle emissions through anticipated reduction in travel times. Further details regarding the calculated improvements to air quality are provided in **Section 7.3** (Air quality).

3.2 National strategic planning and policy framework

Several national planning strategies identify a need for a motorway standard link between the M1 Pacific Motorway and the Hills M2 Motorway, within the context of the National Land Transport Network. Most of these strategies refer to the role of this link in achieving improvements in national freight efficiency. This section outlines the relationship of the project to specific national strategies, including:

- The White Paper, AusLink: Building Our National Transport Future (Australian Department of Transport and Regional Services, 2004).
- The Nation Building Program (Commonwealth Department of Infrastructure and Transport, 2013).
- The 2011 National Land Freight Strategy discussion paper (Infrastructure Australia, 2011).
- The National Road Safety Strategy for Australia 2011 – 2020 (Road Safety Strategy) (Australian Transport Council, 2011).

3.2.1 The AusLink White Paper

The White Paper, AusLink: Building Our National Transport Future (Commonwealth Department of Transport and Regional Services, 2004), was released in 2004 as the Australian Government's formal policy statement on land transport. AusLink is a major Australian Government initiative designed to improve planning, decision-making and funding for national land transport infrastructure. A National Land Transport Plan is presented under AusLink which outlines the Australian Government's long term approach to tackling Australia's transport challenges.

In addition to the National Land Transport Plan, another core component of the AusLink initiative is the development of the AusLink National Network (National Land Transport Network). The AusLink National Network is comprised of a number of important road and rail infrastructure links, and is designed to improve national and interregional connectivity. Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway forms part of the National Land Transport Network and, as discussed further in **Section 3.3.1**, is one of the two remaining sections within Sydney that is not of a motorway standard.

AusLink presents eight strategic directions intended to guide investment by the Australian Government in land transport priorities. These include improving the capacity and reliability of interstate and interregional corridors, addressing congestion on key urban links, improving safety and security, and supporting regional and local economic growth. The project would assist in reducing congestion along Pennant Hills Road and the surrounding network, provide a safe and reliable motorway that integrates with the regional network, and improve the efficient movement of state and national freight. As such, the project would be consistent with the strategic direction of the AusLink initiative.

3.2.2 Nation Building Program

The Australian Government's Nation Building Program (Commonwealth Department of Infrastructure and Transport, 2013) assists national, regional economic and social development through provision of funding aimed at improving the performance of land transport infrastructure. Under the Nation Building Program the Australian Government has committed $23.3 billion for a range of key transport infrastructure projects in NSW.

The focus of the Nation Building Program is sound investment in nationally significant, productivity enhancing transport projects that deliver best value for funding. Linking the M1 Pacific Motorway with the Hills M2 Motorway is recognised as a priority project under the Nation Building Program. It is recognised that once completed, this link would greatly reduce traffic congestion through the northern suburbs and cut journey times for motorists travelling between Sydney and the Central Coast.

It is noted within the 2013-14 Commonwealth Budget that growing demands on transport infrastructure and increasing budget pressures mean that innovative approaches are required to fund and finance large scale transport projects under the Nation Building Program (Commonwealth Department of Infrastructure and Transport, 2013). Partnership of the State government and the private sector on the project would be consistent with the Australian Government's strategy of attracting infrastructure financing options and encouraging greater private sector investment.

3.2.3 National Land Freight Strategy Discussion Paper

Infrastructure Australia takes the view that there is considerable scope for improving Australia's productivity and international competitiveness through national thematic approaches to the provision and use of infrastructure. One of the national themes identified by Infrastructure Australia is a national land freight network strategy. The 2011 National Land Freight Strategy Discussion Paper (Infrastructure Australia, 2011) provides a case and priorities for a national land freight network strategy, and an indicative list of projects and programs that Infrastructure Australia has flagged for inclusion in a long term national land freight network plan.

One of the cases put forward for a national land freight network relates to the movement of freight onto already congested multi-use infrastructure. Currently, most of the transport infrastructure used by freight is also used for personal transport. Attempting to accommodate freight on such infrastructure, particularly in urban areas, often leads to congestion. Freight transport is a contributor to this congestion, but is also affected by it, as delays have a direct impact on productivity. Within the 2011 discussion paper, this interaction between freight and urban land uses is referred to as 'freight encroachment'.

The 2011 discussion paper notes that general freight is likely to grow near population centres. In addition, population growth and urban consolidation will place added pressure on routes used by freight vehicles. Given expected growth in both population and freight, especially in urban areas, the need to resolve issues around freight encroachment and interaction will become increasingly pressing.

The project would assist in addressing freight encroachment on Pennant Hills Road by providing an alternative motorway standard route for state and regional freight travelling between the M1 Pacific Motorway and the Hills M2 Motorway. In doing so, the project would assist in improving efficiency of freight movement, improving amenity along Pennant Hills Road, and reducing the interaction between freight and other road users. The project demonstrates effective integration of transport and land use planning, which is important in achieving optimal outcomes for productivity and amenity.

3.2.4 National Road Safety Strategy 2011-2020

The National Road Safety Strategy for Australia 2011 – 2020 (Road Safety Strategy) (Australian Transport Council, 2011) is based on the Safe Systems approach to improving road safety. This is an inclusive approach that caters for all road users, including drivers, motorcyclists, passengers, pedestrians, cyclists, and commercial and heavy vehicle drivers. The Safe Systems approach recognises that humans, as road users, are fallible and will make mistakes which will result in crashes. It requires that road infrastructure be designed to take account of these errors and vulnerabilities to reduce the risk of death or serious injury.

The Road Safety Strategy is framed by the guiding vision that no person should be killed or seriously injured on Australia's roads. As a step towards this long-term vision, the strategy presents a ten year plan to reduce the number of serious injuries and fatalities on Australian roads by 30 per cent. To achieve this target, four key road safety actions or interventions have been identified, supported by immediate and future steps. Of the four actions, 'safe roads' and 'safe speeds' are relevant to the project.

The ‘safe roads’ action aims to adopt improved standards for road design, construction and operation to reflect the Safe Systems approach, and to improve the manner in which road safety benefits are identified and implemented in road investment programs. The ‘safe speeds’ action aims to achieve a better balance between safety and mobility objectives, and to improve compliance with speed limits.

The project has been designed in accordance with current Roads and Maritime road design guidelines, safety and traffic efficiency requirements to address existing road safety concerns along Pennant Hills Road (refer to **Section 3.3.3**), and aims to deliver immediate benefits associated with the reduction in heavy vehicles using Pennant Hills Road.

The project would be consistent with the guiding vision of the Safe Systems approach, and would contribute towards achieving the aims of the Road Safety Strategy. Road safety requirements would continue to be considered during the detailed design, construction, and operation stages of the project.

3.3 Project need

3.3.1 Existing road network conditions

Sydney’s strategic road network, which includes Sydney’s motorway network, supports economic growth across the Sydney metropolitan area by connecting people to jobs, and facilitating trade between businesses (Infrastructure NSW, 2012). It also supports freight movements to, from and through Sydney. The majority of commercial transport demand in NSW and south-eastern Australia is serviced by road freight, with Sydney being the most common point of either origin or destination (SKM, 2004).

As Sydney’s population and economy continue to grow, efficient transport systems will become increasingly important in servicing future growth. The Draft Metropolitan Strategy recognises the importance of strengthening these connections within Sydney and beyond, including the need to improve these connections to the north for freight and passengers.

Following the completion of the Westlink M7 Motorway, the connection between the M1 Pacific Motorway and the Hills M2 Motorway represents an important ‘missing link’ in Sydney’s motorway network. This has required traffic travelling to, from or through Sydney to share the section of Pennant Hills Road between the M1 Pacific Motorway and Hills M2 Motorway. This includes traffic travelling to or from major cities and centres intrastate and interstate, such as the Central Coast and Newcastle, Brisbane and Melbourne.

Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway is part of the AusLink National Network (National Land Transport Network). This is a network of roads that provides connections between all mainland states and territories of Australia. The primary objectives of the National Land Transport Network are to facilitate overseas and interstate trade, support regional development and allow safe and reliable access to major population centres. Projects to improve road safety and freight efficiency have been completed or are being implemented along the network between Brisbane, Sydney, Canberra and Melbourne. This section of Pennant Hills Road is one of the two remaining sections of the National Land Transport Network within Sydney that is not of a motorway standard. The other is King Georges Road, located in southern Sydney.

Pennant Hills Road provides local access for residents and businesses along the route, and services bus connections for commuters accessing local destinations or train stations at Pennant Hills, Thornleigh and Hornsby. Cyclists and pedestrians also travel along Pennant Hills Road. As a result, Pennant Hills Road not only services a mix of trip purposes and functions, but also carries high volumes of traffic. Due to the combination of the topography, land use constraints, traffic volume and mix, and frequent traffic lights along Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway, the current Pennant Hills Road alignment is geometrically undesirable, compromising both safety and efficiency.

Sydney currently has a comprehensive rail network that could be enhanced to cater for some of the additional transport demand generated by its growing population. Significant investments in rail-based freight and passenger transport are required and have been proposed, such as the Epping to Thornleigh Third Track project and the North West Rail Link. Although these improvements will play an important role in servicing the corridor, public transport alone and in particular rail transport, is unlikely to satisfy future growth in transport demand (SKM, 2004). As traffic volumes grow, there will be greater pressure to improve the efficiency of the National Land Transport Network to service expanding commercial centres and cater for local and district freight transport demands and in doing so, support the State’s economy.

3.3.2 Existing traffic conditions

Between the M1 Pacific Motorway at Wahroonga and the Hills M2 Motorway at West Pennant Hills, Pennant Hills Road operates as an arterial road and currently has 21 signalised intersections, many of which are capacity constrained. Cars and cyclists share the road with heavy vehicles transporting freight to, from or through Sydney to major cities and regional centres such as the Central Coast, Newcastle, Brisbane and Melbourne.

Pennant Hills Road carries large volumes of traffic with two way average annual daily traffic (AADT) in 2011 of about 80,000 vehicles per day (Infrastructure NSW, 2012). A large proportion of these vehicles are heavy vehicles, given the corridor’s importance as a national freight corridor. Based on data from the Road Performance Report (Roads and Maritime, 2013c) travel speeds along Pennant Hills Road are:

- Between 23 kilometres per hour and 43 kilometres per hour with an average of 31 kilometres per hour during the morning peak. This compares to an average for Sydney arterial roads of 41 kilometres per hour.
- Between 30 kilometres per hour and 40 kilometres per hour with an average of 35 kilometres per hour during the evening peak. This compares to an average for Sydney arterial roads of 42 kilometres per hour.

This data indicates that congestion on Pennant Hills Road is leading to relatively low travel speeds when compared to other arterial roads.

Heavy traffic flows and congestion along Pennant Hills Road during commuter peak periods and business hours results in low average peak travel speeds, unreliable travel times and disruptions to inter-regional traffic movements. The resultant detrimental social and environmental effects, including community severance, traffic noise and exhaust emissions, are becoming increasingly unacceptable. Pennant Hills Road, which is already operating at or beyond capacity during peak periods, is expected to experience continued traffic growth in the future.

One of the desired outcomes of the project is to improve travelling conditions on Pennant Hills Road and the surrounding network. The project would provide an alternative route for travel between the M1 Pacific Motorway and the Hills M2 Motorway, especially for inter-regional freight traffic. As such, a number of traffic related benefits are anticipated along Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway including:

- Reduced heavy vehicle travel on Pennant Hills Road.
- Improved traffic flow and intersection performance.
- Reduced crash rates.
- Improved road safety for pedestrians, cyclists and motorists.
- Improved travel times for bus services and motorists.

Section 7.1 (Traffic and transport) and **Appendix E** (Technical working paper: traffic and transport) provide further description regarding the existing traffic conditions and potential traffic related improvement associated with the project.

3.3.3 Road safety

Traffic congestion is often associated with poor road safety performance.

Between 1 July 2008 and 30 June 2013, the section of Pennant Hills Road between the Pacific Highway and the Hills M2 Motorway had a total of 980 crashes, with one fatal and 342 injury crashes. The rate of crashes per kilometre of road was significantly higher on this stretch of road when compared to Sydney's motorways. Impacts associated with road accidents include economic costs, for example medical costs, property damage and vehicle costs; and social costs such as decreased quality of life and family pain and suffering.

One of the desired outcomes of the project is to improve travelling conditions on Pennant Hills Road and the surrounding network. Improvements in road safety would be delivered through the provision of a safe, reliable motorway that acts to reduce interaction between heavy vehicles and other road users.

Further information relating to existing road safety is provided in **Section 7.1** (Traffic and transport).

3.3.4 Public transport, pedestrian and cyclist facilities

A number of bus services currently operate along Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway, with bus stops at regular intervals in both directions. Efficiency of these services is currently limited by high levels of congestion along this section of Pennant Hills Road, particularly during peak commuter periods. In alleviating congestion along Pennant Hills Road, the project would result in improvements to the reliability and accessibility of public transport.

Pedestrian footpaths are provided along the length of Pennant Hills Road, with regular crossings via signalised intersections as well as four pedestrian overpasses. With the exception of a short section around the Pennant Hills Road / Castle Hill Road intersection and the Pennant Hills Road / Hills M2 Motorway interchange, there are no dedicated cyclist facilities along this section of Pennant Hills Road. Peak congestion, heavy traffic flows and the presence of large numbers of heavy vehicles reduces amenity and in turn reduces use of Pennant Hills Road by cyclists and pedestrians. The project would contribute towards a reduction in the number of heavy vehicles using Pennant Hills Road, resulting in improvements in local amenity. It is anticipated that these improvements in amenity would encourage greater use of existing infrastructure by pedestrians and cyclists.

3.4 Project objectives

A set of project objectives has been developed from the objectives established during the options analysis (refer to **Chapter 4** Project development and alternatives). These objectives respond to key issues that underlie the strategic need for the project, and are consistent with strategic objectives of State and national planning and policy documents discussed within this chapter. The project objectives, which incorporate environmental, social and economic considerations, are as follows:

- Provide a high standard access controlled motorway that integrates with the regional transport network.
- Minimise adverse social and environmental impacts in the local area during construction and operation.
- Provide opportunities for improved public transport in the area around Pennant Hills Road.
- Assist in a reduction in traffic congestion, particularly along Pennant Hills Road, and provide shorter travel times for road users.
- Provide a motorway that is safe and reliable for road users.
- Contribute towards the achievement of 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.
- 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.
- Demonstrate excellence in design and environmental sustainability.
- Be economically justified and affordable to government.

3.5 Statement of strategic need

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

Heavy traffic flows and congestion along Pennant Hills Road during commuter peak periods and business hours results in low average peak travel speeds, unreliable travel times and disruptions to inter-regional traffic movements. These conditions result in social and environmental impacts, including community severance, traffic noise and exhaust emissions. Pennant Hills Road, which is already operating at or beyond capacity during peak periods, is expected to experience continued traffic growth in the future.

The project is needed to provide a safer and more efficient link between the M1 Pacific Motorway and the Hills M2 Motorway that would better service current and future road users. The operation of the project would provide an alternative and more efficient route for travel between the M1 Pacific Motorway and the Hills M2 Motorway, improving access, connectivity and reliability of inter-regional freight across the greater Sydney area. In providing an alternative route the project would also reduce interaction between freight and other road users, thereby reducing congestion and improving safety and amenity along Pennant Hills Road.

Further justification for the project is provided in **Chapter 11** (Project justification and conclusion). **Chapter 11** also includes consideration of the objectives of the *Environmental Planning and Assessment Act 1979*, the environmental, social and economic impacts of the project, the suitability of the site and whether or not the project is in the public interest.

4 Project development and alternatives

This chapter describes the alternatives that were considered as part of the project development process and explains how and why the project was selected as the preferred option. Design refinements for particular elements of the project are also addressed.

Table 4-1 sets out the Director-General's Requirements as they relate to alternatives and options development, and where in the environmental impact statement these have been addressed.

Table 4-1 Director-General's Requirements - project development and alternatives

Director-General's Requirement	Where addressed
An analysis of alternatives/options considered having regard to the project objectives (including an assessment of the environmental costs and benefits of the project relative to alternatives and the consequences of not carrying out the project), and the provision of a clear discussion of the route development and selection process, the suitability of the chosen alignment and whether or not the project is in the public interest.	**Chapter 4**

The project has a long history in relation to the evaluation of alternatives and options commencing with the *F3 to Sydney Orbital Link Study* (SKM, 2004) (the 2004 report) through to the recent design and construct tender process.

Figure 4-1 shows the alternatives and options development process undertaken for the project.

(Blank page)

ONGOING COMMUNITY INVOLVEMENT

The 2004 report *(F3 to Sydney Orbital Link Study SKM, 2004)*

2002 to 2004

- Alternatives:
  - Strategic alternatives assessed included:
    - Base case or 'do nothing/do minimum'.
    - Road link between the M1 Pacific Motorway and the Sydney Orbital Network.
    - Public transportation upgrades.
  - Road link between the M1 Pacific Motorway and the Sydney Orbital Network selected as preferred strategic alternative.
- Broad corridor types development:
  - 17 corridor alignment options identified within three broad corridor types (A, B and C).
  - Broad corridor types assessed based on:
    - Planning and project objectives.
    - Technical assessments, including traffic, engineering, social, environmental and economic considerations.
    - Consultation with stakeholders and interest groups.
  - Broad corridor Type A selected as the preferred approach to providing a road link between the M1 Pacific Motorway and the Sydney Orbital Network.
- Preferred corridor development:
  - Identification of four detailed corridor alignment options (red, yellow, blue and purple) within broad corridor Type A.
  - Evaluation of corridor alignment options based on:
    - Technical criteria relating to engineering feasibility, land use impacts, urban design and regional development, urban design and landscape, and social and environmental grounds.
    - Value management workshop.

The Pearlman Review

2007

- A review of the 2004 report was undertaken by the Honourable Mahla Pearlman AO at the request of the Australian Government (the 2007 Pearlman Review).
- The 2007 Pearlman Review supported a road link based on the purple corridor alignment as the preferred option.

Unsolicited proposal

2012

- The NSW Government received an unsolicited proposal from a consortium made up of Transurban and the Westlink M7 Shareholders to design, construct, operate, maintain and finance a tolled motorway linking the M1 Pacific Motorway to the Hills M2 Motorway.

Preferred tenderer

2013 to 2014

- Competitive tender process.
- Selection of preferred tenderer.
- Refinement and technical review of the preferred tender option:
  - Identification and evaluation of design refinements to the preferred tender option through stakeholder consultantation, technical specialist input and costing reviews focusing on:
    - Interchange design options.
    - Portal locations and tunnel alignments.
    - Road network performance and road user access.
    - Environmental and land use impacts.

The project as described in this environmental impact statement

WE ARE HERE

Submissions report / preferred infrastructure report

Figure 4-1 Project development process

(Blank page)

4.1 F3 to Sydney Orbital Link Study

In 2002, the Australian Government commissioned an investigation to identify a preferred option for a new link through northern Sydney between the F3 Freeway (now the M1 Pacific Motorway) and the Sydney Orbital Network (being the Hills M2 Motorway and the Westlink M7 Motorway). The findings and recommendations of this investigation are detailed in the *F3 to Sydney Orbital Link Study* (SKM, 2004) (the 2004 report).

The 2004 report established project and planning objectives, alongside urban design principles, to guide the selection of a preferred corridor for the new road link. The planning and project objectives of the 2004 report were:

- Alleviate existing poor travelling conditions (traffic congestion and high number of road crashes) on the interim National Highway and the surrounding network.
- Improve local amenity (reduce traffic, air and noise emissions; reduce severance) for people living and working along Pennant Hills Road.
- Improve travel reliability and reduce operating costs of long-distance commercial and freight transport on the National Highway.
- Provide a high standard link that integrates with the regional transport network.
- Minimise social and environmental impacts during construction and operation.
- Provide opportunities for improved public transport.
- Be economically justified and affordable to government.

The 2004 report considered a range of strategic alternatives to providing a road link including ‘do nothing’ and a public transport upgrade. The investigation also identified and assessed a number of broad corridor types followed by an examination of options within the preferred corridor.

4.1.1 Strategic alternatives

The strategic alternatives assessed as part of the 2004 report were:

- Base case or ‘do nothing / do minimum’.
- Road link between the M1 Pacific Motorway and the Sydney Orbital Network.
- Rail and public transportation upgrades.

The base case or ‘do nothing / do minimum’

The theoretical base case or ‘do nothing’ alternative was defined as the minimum possible upgrade to the existing road network, with no major capital or operating expenditures on roads in the existing corridor.

It was determined that this alternative would not provide a desirable outcome in terms of road alignment. Therefore, it was concluded that the ‘do nothing’ alternative would not provide a suitable long term solution from a strategic, regional, local planning or transport perspective.

Up to date traffic modelling has been undertaken for the ‘do nothing’ scenario which is provided in **Section 7.1** (Traffic and transport).

Road link between the M1 Pacific Motorway and the Sydney Orbital Network

The 2004 report identified that, following the completion of the Westlink M7 Motorway, the connection between the M1 Pacific Motorway and the Sydney Orbital Network (being the Hills M2 Motorway and the Westlink M7 Motorway) would represent an important 'missing link' in Sydney's motorway network. This would require traffic travelling to, from or through Sydney to share the section of Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway. This would include traffic travelling to or from major cities and centres intrastate and interstate, such as the Central Coast and Newcastle, Brisbane and Melbourne.

Pennant Hills Road, between the M1 Pacific Motorway and the Hills M2 Motorway, services both local and regional trip purposes and functions, and carries high volumes of traffic. It experiences congestion during peak periods, resulting in low average peak travel speeds, unreliable travel times and disruptions to inter-regional traffic movements. In addition, between 1 July 2008 and 30 June 2013, the section of Pennant Hills Road between the Pacific Highway and the Hills M2 Motorway had a total of 980 crashes, with one fatal and 342 injury crashes

The 2004 report identified that a high standard link between the M1 Pacific Motorway and the Sydney Orbital Network would improve local amenity, and travel safety and efficiency.

Rail and public transportation upgrades

The 2004 report investigated four rail and public transport options, being:

- No further rail capacity enhancements.
- Rail capacity enhancements to maintain market share.
- Investment to increase rail market share.
- Public transport only option, which included investment to increase market share in passenger and freight rail, as well as replacing the investment in the new link with a new passenger rail service.

The first three scenarios were tested in conjunction with a proposed project, whilst the public transport only option was investigated as an alternative to the project. As such, this alternative is discussed below.

The public transport only option was based on the implementation of all planned rail (passenger and freight) infrastructure improvements plus additional investment in lieu of expenditure on a road link. These improvements included:

- Rail:
  - North West Rail Link (Epping to Rouse Hill).
  - Full Chatswood to Parramatta rail link.
  - Epping to Thornleigh Third Track.
  - Main North Line upgrade between Hornsby and Wyong.
  - Quadruplication of Strathfield to Hornsby line, including the Epping to Thornleigh Third Track.
  - Two completely new train services linking the Central Coast with Parramatta and Western Sydney were included in the 2021 network.

- Bus:
  - Completion of the bus Transitways listed in Action for Transport 2010.

As traffic volumes grow, there would be greater pressure to improve the efficiency of the National Land Transport Network to service expanding commercial centres and to cater for local and district freight transport demands and in doing so, support the State's economy. Although these improvements would play an important role in servicing the corridor, the 2004 report found that public transport alone and in particular rail transport would be unlikely to satisfy future growth in transport demand.

In relation to rail freight, the investigation found that the high rail freight growth scenario would only remove around ten per cent of trucks from Pennant Hills Road per day. A significant number of trucks would continue to utilise Pennant Hills Road under this scenario.

A number of projects identified above, such as the North West Rail Link and the Epping to Thornleigh Third Track, have either commenced construction or are in the final stages of planning. These projects would be undertaken concurrently with the project. However, as stated above they would be unlikely to satisfy future transport demand and would cater for different markets and objectives than the project. Both of these rail projects would enhance the existing rail infrastructure however they would not directly improve conditions on Pennant Hills Road or provide a much needed link between the M1 Pacific Motorway and the Sydney Orbital Network.

Preferred strategic alternative

Based on the preceding comparisons it was concluded in the 2004 report that a road link between the M1 Pacific Motorway and Sydney Orbital Network would best meet the project objectives and was the preferred alternative as it would:

- Provide a high standard access controlled motorway that would integrate with the regional transport network.
- Improve the travel conditions, road safety and efficiency of Pennant Hills Road for motorists, road based public transport and cyclists.
- Support local and regional economic development.
- Provide opportunities for improved public transport in the area around Pennant Hills Road.
- Provide a motorway that is safe and reliable for road users.

A road link between the M1 Pacific Motorway and the Sydney Orbital Network would provide a preferred solution from a strategic, regional, local planning and transport perspective. The development of this road link was seen to be in the public interest.

4.1.2 Corridor options development process

Following the identification of a road link between the M1 Pacific Motorway and the Sydney Orbital Network as the preferred strategic option, a corridor options development process was undertaken as part of the 2004 report. This began with consideration of broad corridor types followed by examination of alignment options within the preferred broad corridor type.

The options development and assessment process considered the options against transport capacity, efficiency and safety, social effects, environmental issues and economic factors.

Broad corridor types

The 2004 report identified 17 alignment options within three broad corridor types (A, B and C) that provided feasible connections to the M1 Pacific Motorway and to the Sydney Orbital Network (refer to **Figure 4-2**). A number of the alignment options within these broad corridor types were suggested by members of the community during the consultation process associated with the corridor options development.

Type A corridors included more easterly alignment options, which generally formed a southern extension of the M1 Pacific Motorway corridor to connect with the Hills M2 Motorway. All Type A corridor options would be mostly in tunnel under existing roads and / or residential areas. The Type A corridor options continued to use the M1 Pacific Motorway as the major road transport link between Sydney and the north.

Type B corridors included alignment options within the central study area that connected the Sydney Orbital between Pennant Hills Road and Dean Park to the M1 Pacific Motorway between Wahroonga and the Hawkesbury River. The Type B corridor options bypassed the developed areas of Hornsby and generally consisted of aboveground sections and tunnels under existing residential areas. Type B corridor options continued to use the M1 Pacific Motorway corridor as the major road transport link between Sydney and the north.

Type C corridors included more westerly options which connected the Sydney Orbital between Windsor Road and Dean Park with the M1 Pacific Motorway north of the Hawkesbury River. All Type C corridor options consisted of aboveground and tunnelled sections, and a major new crossing of the Hawkesbury River. It was also assumed that some tunnel sections would be required under Marramarra National Park. Type C corridor options formed a second major road corridor between Western Sydney and the north. The Type C corridor options continued to use the M1 Pacific Motorway corridor as the major transport link between Sydney and the north.

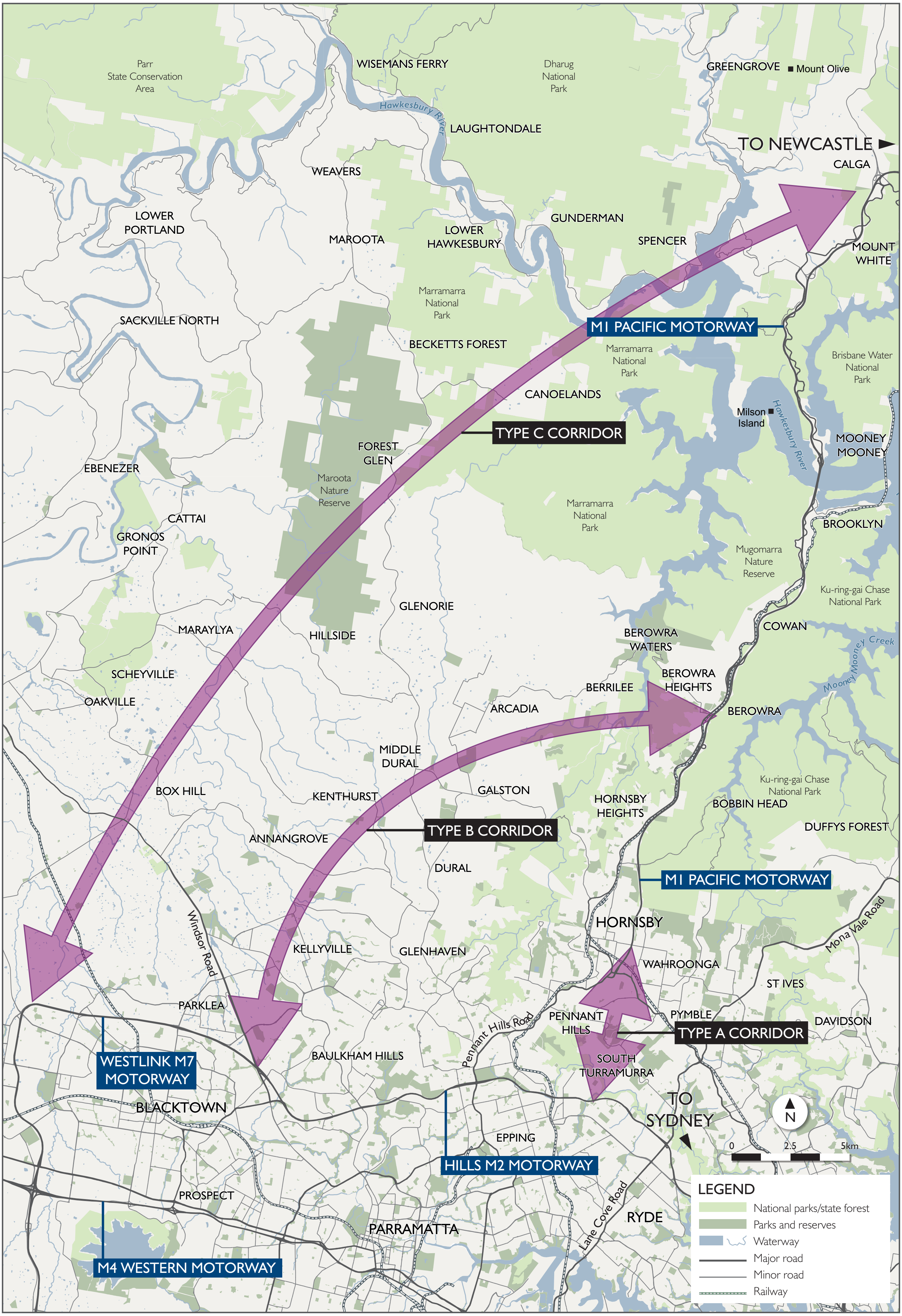


Figure 4-2 Broad corridor types (2004 report)

Source (SKM, 2004)

(Blank page)

Evaluation of the broad corridor types

The 2004 report assessed the broad corridor types based on consideration of a wide range of impacts, with the purpose of identifying a preferred option type to be taken forward for more detailed analysis. Key steps in the process included:

- Strategic assessment of broad corridor types against planning and project objectives.
- Technical assessments, including traffic and transport, strategic urban and regional development, engineering, social and environmental, urban design and landscape, capital costs and affordability, economic returns.
- Consultation with and feedback from stakeholders and interest groups.

The criteria used to assess the broad corridor types are shown in **Table 4-2**.

Table 4-2 Criteria to assess broad corridor types

Aspect	Criteria
Land use	• Avoidance of impacts on existing urban areas or areas in advanced stages of planning, particularly residential areas and property. • Avoidance of impacts on National Park, Nature Reserves, regional reserves and land zoned for environmental protection purposes.
Urban and regional development	• Support for regional, State and national development. • Access to ports, industrial and regional centres.
Engineering feasibility	• Constructability of tunnels, interchanges and bridges. • Terrain constraints. • Impact on existing roads. • Ability to stage construction of the project.
Urban design, landscape and visual factors	• Protecting existing built, natural, scenic and heritage values and views. • Fitting into Sydney's planned development areas. • Minimising severance and improving access including interconnectivity with the existing and planning transport network. • Minimising land form changes and visual impacts. • Regional and local land form and vidual assessment, including land form, structures, tree cover, activity, visibility.
Social and environmental considerations	• Potential for improving environment, especially conditions for local traffic, pedestrians and cyclists. • Social (including severance, accessibility, property impacts and regional access). • Environmental (including impacts on vegetation, reserves, fauna, habitat, water courses, water quality, heritage, and potential noise based on closeness to residential and employment land).

The analysis demonstrated that broad corridor Type A, which captured options that generally took the form of a southern extension of the M1 Pacific Motorway corridor to the Hills M2 Motorway, best satisfied the planning and project objectives.

The Type B corridor options would not satisfy the National Highway objectives on transport grounds and they would have a high capital and environmental cost. The Type B corridor options were also judged by the community to be unacceptable on environmental impact grounds.

While Type C corridor options were assessed as being able to provide more direct access to western Sydney for long distance travel (ie from outside of Sydney), analysis indicated that from an overall network assessment Type C options provided fewer transport benefits (including congestion relief and accident reduction for Pennant Hills Road) and would have higher construction costs and additional adverse community impacts (property and urban design impacts) compared to Type A corridors.

Type A corridor options

Following the identification of broad corridor Type A as the preferred approach to providing a road link between the M1 Pacific Motorway and the Sydney Orbital Network, further investigations developed four more detailed corridor alignment options that would be taken forward for further analysis, being:

- The red corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at Macquarie Park.
- The yellow corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway near North Epping.
- The blue corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange.
- The purple corridor alignment option, which extended from the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at the Pennant Hills Road interchange and generally followed the alignment of Pennant Hills Road.

The four Type A corridor alignment options are shown in **Figure 4-3**.

In assessing the four Type A corridor alignment options, it was assumed that all four options would be in tunnel for the majority of their length and that connections to the existing road network would be mostly built within existing road reserves. The corridor alignment options were assessed against technical criteria relating to engineering feasibility, land use impacts, urban design and regional development, urban design and landscape, and social and environmental grounds.

These Type A corridor alignment options were publicly exhibited between July 2003 and October 2003 and were the subject of a value management workshop held over two days in September 2003. The value management workshop was attended by representatives from the Department of Transport and Regional Services, NSW Roads and Traffic Authority (now NSW Roads and Maritime), Rail Infrastructure Corporation and State Rail (now Sydney Trains), Department of Infrastructure, Planning and Natural Resources (now Department of Planning and Environment), NSW Environment Protection Authority, and NSW National Parks and Wildlife Services.

The value management workshop was used to review and assess the alignment options against the above technical criteria to assist with the evaluation of the alignment options. The outcome of the workshop was a consensus that the purple corridor alignment option best satisfied the project objectives.

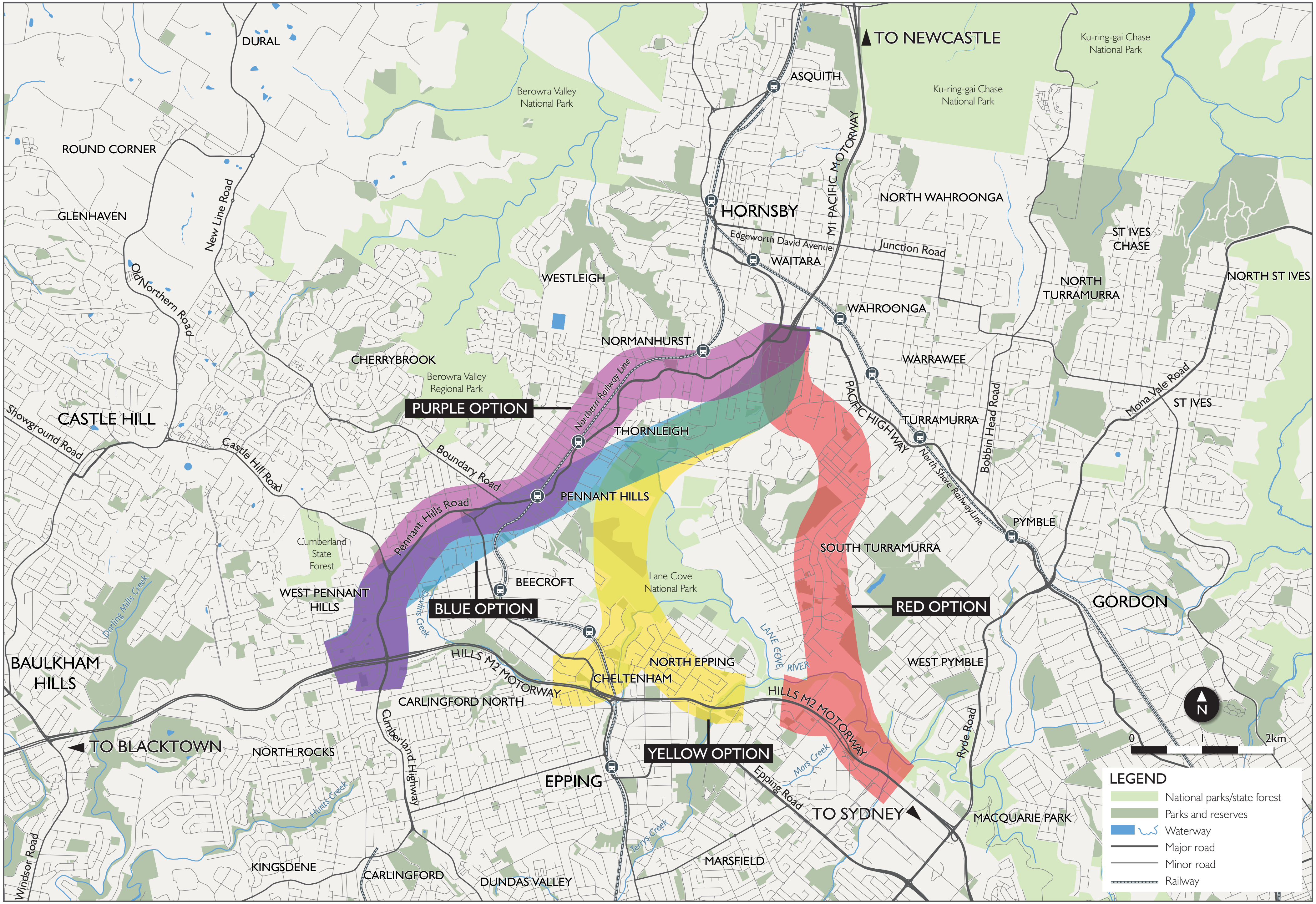


Figure 4-3 Type A corridor alignment options (2004 report)

Source (SKM, 2004)

(Blank page)

Evaluation of the Type A corridor alignment options

The evaluation of the Type A corridor alignment options in the 2004 report was informed by community feedback and a value management workshop. The evaluation concluded that:

- All four Type A corridor alignment options would provide similar road user benefits, however, the purple and blue corridor alignment options would provide the preferred route for trucks over the next 20 years. Further, it was acknowledged that the red corridor alignment option would provide similar benefits to the purple corridor alignment option in terms of network traffic effects. Overall, the purple corridor alignment option best satisfied the 2004 report transport objectives.
- The purple and blue corridor alignment options were preferred based on a consideration of social and environmental costs and benefits. These corridor alignment options would yield significant social benefits to people living and working along Pennant Hills Road as a result of the significant traffic relief along this corridor.
- On economic grounds, all corridor alignment options had relatively high capital costs. However, the purple corridor alignment option performed the best.

4.1.3 The 2004 report preferred corridor alignment option

The 2004 report concluded that the purple corridor alignment option was preferred as it satisfied the planning and project objectives better than the blue, yellow or red corridor alignment options. It was also concluded that the purple corridor alignment option performed best in terms of the technical criteria considered in the assessment and that the purple corridor alignment performed better than the other corridor alignment options in terms of social and environmental impacts based on the assessment conducted for the purpose of the study.

There have been amendments to the project objectives since the 2004 report in order to reflect current strategic planning policies. Despite this, the objectives are broadly consistent and the recommendations of the 2004 report remain sound and valid.

4.2 Review of the findings of the 2004 report

In 2007, a review of the 2004 report was undertaken by the Honourable Mahla Pearlman AO (former Chief Judge of the NSW Land and Environment Court) at the request of the Australian Government to confirm:

- The validity and reasonableness of the assumptions and data applied to the 2004 report.
- Whether the changes in the land use and transport assumptions since the 2004 report would alter the conclusions reached in the 2004 report.

The review process (the 2007 Pearlman Review) included a call for public submissions, public meetings, submissions analysis, obtaining data from relevant authorities and data analysis.

The 2007 Pearlman Review found that the assumptions and data used in the 2004 report were valid and reasonable based on:

- The standard approach adopted for the traffic modelling.
- The reinforcement of the assumptions about population growth and employment by the Transport Data Centre.
- The accuracy of the traffic volume forecasts with actual Roads and Traffic Authority (now Roads and Maritime) Average annual daily traffic (AADT) counts.
- The similarities between the distribution patterns of forecast car trips and the projections in the current Transport Data Centre data.
- The consistency of the commercial vehicle origin and destination projections with the Commercial Transport Study (DIPNR, 2003) origins and destinations.

The 2007 Pearlman Review also determined that the policy changes affecting land use and transport flows since the 2004 report reinforced the selection of the purple corridor alignment option for the following reasons:

- The shifting distribution of population and employment projected across the Sydney metropolitan region between 2001 and 2031, particularly within south-western and north-western Sydney.
- The lack of significant change from the person trips assumed in the 2004 report, based on a comparison of the 2001 data used in the 2004 report and the Transport Data Centre 2006 data. However, these changes reinforce the assumptions in the 2004 report regarding population growth in south-western Sydney, Inner Sydney and the Central Coast; and a shift in employment to western Sydney.
- The projection of more cars using the road network in 2021 than those forecast in the 2004 report.
- At the highest level, and speaking broadly, there is a similar pattern of distribution of car trips between the forecasts in the 2004 report and those projections in the Transport Data Centre 2006 data.
- The projection of car driver trip growth occurring in western and south western Sydney, as reflected in the Transport Data Centre 2006 data and the Metropolitan Strategy.
- The pattern of distribution of daily car trips from east to west across the Sydney metropolitan region rather than north to south.
- The minor changes in daily traffic counts since the opening of the Westlink M7 Motorway across all main roads and the motorways in the study area.
- The confirmation that the majority of heavy vehicles were travelling west of Pennant Hills Road rather than east.

The 2007 Pearlman Review also found that there was no case for altering the conclusions reached in the 2004 report and that a road link based on the purple corridor alignment option was preferred.

In summary, the 2007 Pearlman Review concluded that:

- The assumptions and data used in the 2004 report were valid and reasonable at the time of the study.
- There had been changes affecting land use and traffic flow assumptions since the 2004 report, but these changes reinforced the selection of the purple corridor alignment option.
- The purple corridor alignment option should be the preferred route and should progress to the next stage of design and development.
- Any future concept should consider east facing ramps at the Hills M2 Motorway to make the alignment option more attractive to motorists.
- A long term option, being the Type C corridor, should be planned for.

The 2007 Pearlman Review has since informed government strategic planning including documents such as the NSW Freight and Port Strategy (Transport for NSW, 2013b).

The Type C corridor, or the Outer Sydney Orbital, is a proposed road link of strategic significance to provide increased capacity and connectivity of the motorway network to meet the future demand of metropolitan Sydney, NSW and interstate transport. It is anticipated that the Outer Sydney Orbital will form part of a future north-south motorway link to bypass metropolitan Sydney to the west, connecting the Hume Highway in the south with the M1 Pacific Motorway in the north.

The Outer Sydney Orbital will provide increased capacity for the road network to improve accessibility to future housing and employment opportunities in Western Sydney. In particular it is expected to address the future demand from the South West and North West Growth Centres and the Western Sydney Employment Area, and provide a strategic link for both passenger and freight transport within the region.

Importantly, the Outer Sydney Orbital is anticipated to meet the demands of future transport requirements. The project would meet existing transport demands and relieve existing congestion issues on a key section of the National Land Transport Network.

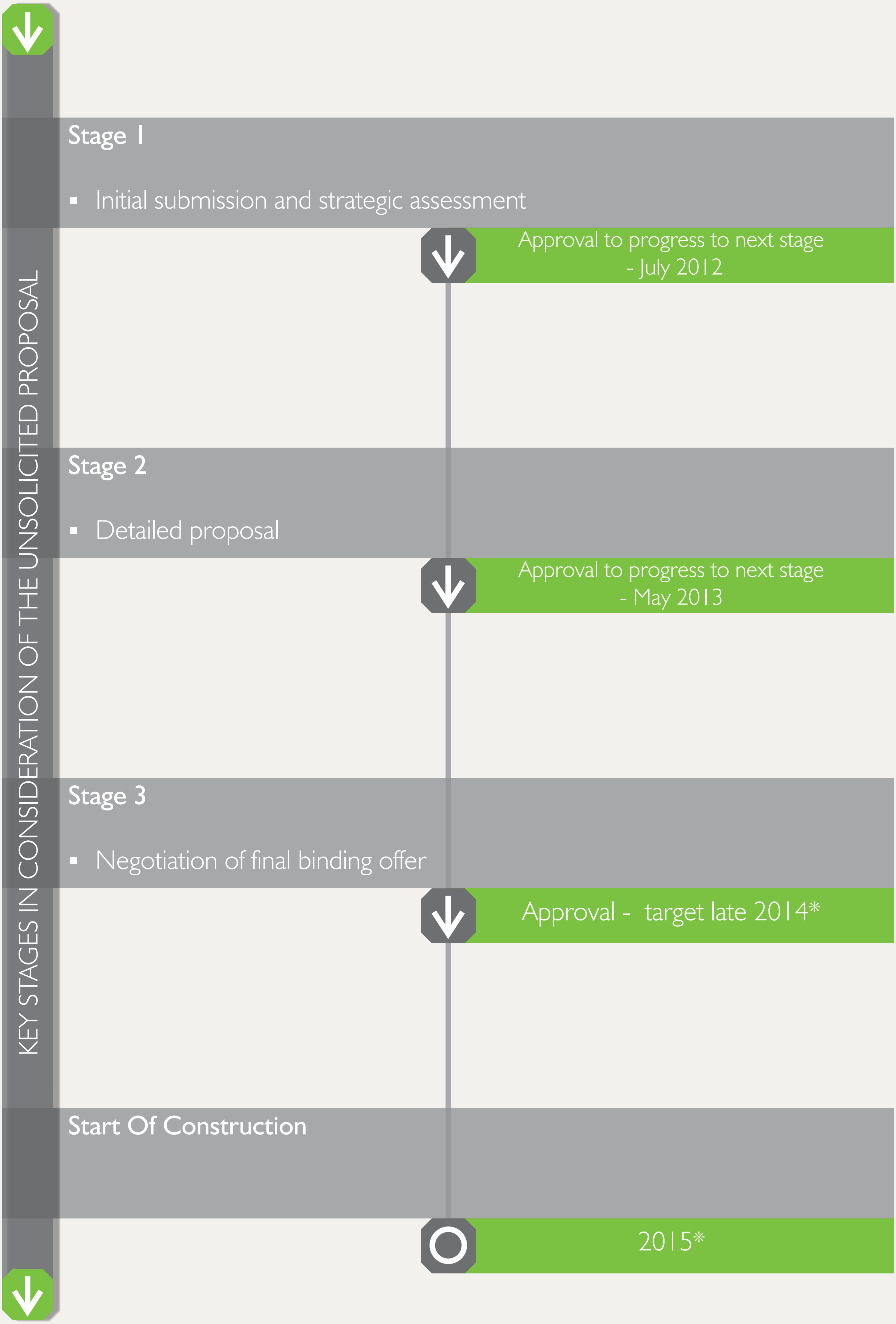
4.3 Unsolicited proposal design

In March 2012, the NSW Government received an unsolicited proposal from Transurban to design, construct, operate, maintain and finance a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney. The Westlink M7 Shareholders later joined Transurban to form a consortium to finance the project.

The proposal is currently being assessed by the NSW Government in accordance with the three stages specified in *The Guide for Submission and Assessment of Unsolicited Proposals* (NSW Government, 2012). The process and timeline for this specific project, is shown in **Figure 4-4**, and generally involves:

- ***Stage 1: Initial submission and strategic assessment*** – includes a comprehensive initial assessment of the proposal to identify the potential benefit to Government of further consideration and development with the Proponent. The outcome is advice to the Proponent of progression to Stage 2, or that the Government does not wish to proceed.
- ***Stage 2: Detailed proposal*** – requires the Proponent and Government to work cooperatively in the development and assessment of a Detailed Proposal. The outcome is advice to the Proponent of progression to Stage 3, or that the Government does not wish to proceed.
- ***Stage 3: Negotiation of final binding offer*** – involves the finalisation of all outstanding issues with a view to entering into a binding agreement, should the Government accept the final offer.

The process and associated timeframes are subject to the planning process under the *Environmental Planning and Assessment Act 1979*.



Note: Dates are subject to the planning process under the *Environmental Planning and Assessment Act 1979*.

Figure 4-4 NSW Government unsolicited proposal process

(Blank page)

4.3.1 Stage 1 unsolicited proposal

The submission of an unsolicited proposal in March 2012 was the first stage of the three stage assessment process. The unsolicited proposal submitted by Transurban and the Westlink M7 Shareholders was broadly based on the purple corridor alignment option discussed above, noting that this option would be subject to further detailed design and refinement through progression of Stages 2 and 3 of the unsolicited proposal process, and the outcomes of the environmental planning approvals process.

4.3.2 Stage 2 design development

Following progression to Stage 2 of the unsolicited proposal assessment process, further design development and due diligence investigations were conducted to enable submission of a more detailed proposal by Transurban and the Westlink M7 Shareholders. These investigations included further consideration of design issues and funding mechanisms for the project. Design development during Stage 2 of the unsolicited proposal process included consideration of three key design issues:

- The need for an intermediate interchange to connect the main alignment tunnels to the surface road network between the northern and southern interchanges.
- The need for east facing ramps to connect the main alignment tunnels to the Hills M2 Motorway east of Pennant Hills Road.
- The number of lanes within the main alignment tunnels.

Intermediate interchange location

As part of the 2004 report, a preliminary design was developed for the purple corridor alignment option which included an intermediate interchange to connect the main alignment tunnels to the surface road network. The intermediate interchange was in addition to and between the northern and southern interchanges.

The intermediate interchange contemplated in the 2004 report included tunnel access points at around the midpoint of the tunnel, at Thornleigh. Preliminary design of the interchange included north facing ramps surfacing at Pennant Hills Road, near the Pennant Hills Railway Station, and south facing ramps surfacing at Railway Parade. An intermediate interchange would provide access opportunities for additional motorists that would otherwise need to travel to either the northern or southern interchange to access the main alignment tunnels.

The preliminary design of the intermediate interchange was reviewed as part of the Stage 2 unsolicited proposal process. This review identified that:

- The difference in grade between the surface and the main alignment tunnels would likely result in environmental costs associated with significant additional lengths of tunnelling works to implement the intermediate interchange, or steep grades on the ramps resulting in operational inefficiencies and potential air quality impacts.
- Additional property acquisition would likely be required to facilitate the traffic arrangements around the interchange.
- The proximity of the works to the Northern Railway Line would introduce additional constructability challenges, engineering risks and project costs.

Further, a consideration of local and regional traffic conditions and forecast patronage of an intermediate interchange indicated there would only be limited traffic benefits associated with an interchange at this location.

On balance it was concluded that, although an intermediate interchange would provide some limited traffic benefits, these benefits were not sufficient to outweigh the additional impacts, the significant risks and the additional cost associated with constructing the intermediate interchange. The intermediate interchange was therefore removed from the scope of the project.

East facing ramps connecting to the Hills M2 Motorway

The 2007 Pearlman Review recognised that the purple corridor alignment option did not provide for a motorway standard east facing connection between the purple corridor and the Hills M2 Motorway. The 2007 Pearlman Review suggested that the provision of such a connection could make the purple corridor more attractive to motorists who might otherwise travel along the Pacific Highway. It was recommended that such a connection be examined in any future concept design.

A review of an east facing connection between the purple corridor and the Hills M2 Motorway was conducted as part of the Stage 2 unsolicited proposal design development process. Analysis of the traffic implications associated with east facing ramps indicated that:

- East facing ramps connecting to the Hills M2 Motorway would only provide minor travel time benefits for motorists, compared with requiring this traffic to emerge from the main alignment tunnels and use existing arrangements to access the Hills M2 Motorway east of Pennant Hills Road.
- The minor nature of incremental travel time benefits would not be sufficient to attract additional users and provide any further material congestion relief to the Pacific Highway.

In addition, significant engineering and environmental constraints were identified (including the presence of Pennant Hills Golf Course and Devlins Creek) that would need to be overcome at significant cost in order to provide east facing ramps. On balance, these constraints and the limited traffic benefits of east facing ramps supported exclusion of this design option from the scope of the project at this time.

Despite this, the project does allow for motorists travelling south on the project to continue their journey on the Hills M2 Motorway eastbound. Motorists would be able to leave the project via the southbound off-ramp to Pennant Hills Road and then join the Hills M2 Motorway using the existing Pennant Hills Road eastbound on-ramp.

It is acknowledged that traffic growth and a change in motorist demand for this movement may warrant construction of this direct connection in the future despite the constraints identified above. As such, the project has been designed to enable the future provision of these ramps.

Number of main alignment tunnel lanes

The capacity of the project was reviewed as part of design development during Stage 2 of the unsolicited proposal process. In particular, the need for two lanes or three lanes in each main alignment tunnel was reviewed.

Traffic analysis demonstrated that two lanes in each direction would provide adequate capacity for several decades based on expected traffic growth. On this basis, the project has been taken forward with a design involving two lanes in each direction at the time of opening.

Notwithstanding, it was considered prudent to future proof the project by designing and constructing the main alignment tunnels to be large enough to accommodate three lanes of traffic in each direction. If a third lane is required in one or both directions in the future, it would be subject to separate assessment and approvals processes.

4.3.3 Progression to Stage 3

A cross-agency committee was established and worked with Transurban and the Westlink M7 Shareholders to develop and assess the unsolicited proposal, culminating in the progression of the proposal to Stage 3 in May 2013.

The Stage 3 unsolicited proposal assessment involves the negotiation and submission of a final binding offer. The key steps include:

- Negotiations between Government, Transurban and the Westlink M7 Shareholders to finalise and agree commercial terms and conditions.
- Obtaining planning approval for the project.
- Obtaining a firm price for the project.
- Agreeing a program to deliver the project.

The Stage 3 assessment process is currently underway and is likely to progress until around late 2014. This environmental impact statement forms one component of the Stage 3 assessment process, and has been prepared to support obtaining planning approval for the project.

4.4 Design and construct tender process

Following agreement between the NSW Government, Transurban and the Westlink M7 Shareholders to proceed to Stage 3 of the unsolicited proposal process, a competitive design and construct tender process was undertaken in order to identify an innovative, cost effective and environmentally-responsive design within the purple corridor alignment option as identified and endorsed by the 2004 report and the 2007 Pearlman Review respectively.

Three separate tenders, including individual tender designs were received by Transurban and the Westlink M7 Shareholders on 29 November 2013. These tenders were subject to several stages of evaluation to arrive at the preferred tender design which has formed the basis of this environmental impact statement and the project going forward.

The tender evaluation was separated into categories including engineering design, environmental and social performance and project cost (including upfront capital expenditure and ongoing operational expenditure). Each of these categories was divided into a number of sub-categories to allow comparison between the tenders. Relevant technical specialists were used to undertake the tender evaluation. Guidance and technical input was also provided by Roads and Maritime throughout the evaluation process.

The evaluation of engineering design requirements involved an assessment of the tenders against a set of mandatory functional requirements, the performance of the engineering aspects of the tender designs and the identification of risks within the tender designs. This involved separate assessments for each engineering aspect such as road geometry, drainage, structural elements and ventilation systems.

The environmental and social category evaluation involved an assessment of the tenders for environmental and social performance (costs and benefits) and the identification of potential environmental and social impacts and risks. The environmental and social evaluation considered all relevant sub-categories including:

- Air quality and human health.
- Noise and vibration.
- Traffic and transport.
- Land acquisition and land use.
- Urban design and visual amenity.
- Biodiversity.
- Aboriginal and non-Aboriginal heritage.
- Groundwater, soils and contaminated land.
- Surface water.
- Social and economic impacts.
- Resource consumption and waste generation.
- Hazard and risks.

The performance of each sub-category was considered for both the construction and operational phases of the project.

Each sub-category was scored according to how well the minimum requirements were met or exceeded. The score for each evaluation category was then weighted to provide an overall score and ranking of each tenderer.

The preferred tenderer was chosen based on the outcome of this thorough evaluation of the three tender submissions. This process provided a balanced consideration of engineering design requirements, project cost (including upfront capital expenditure and ongoing operational expenditure), and environmental and social impacts.

4.4.1 Design refinements

Various options within the purple corridor were considered in order to balance cost, engineering design, environmental and social outcomes. The key factors in arriving at the preferred tender design included:

- Safety in design, delivery, and operation and maintenance.
- Financial viability.
- Minimising environmental and community impacts.
- Traffic functionality and integration with the road network.
- Sympathetic architectural and landscape design.
- Continuity of access, connectivity and amenity for local residents, visitors, pedestrians and cyclists.
- Minimising impacts on existing motorways during construction.
- Maximising the long term sustainability of the asset throughout design, construction and operation.
- Minimising whole of life costs.
- Maximising durability and safety for optimum operations and maintenance.
- A positive and safe customer experience that delivers value and encourages repeat patronage.

The options considered included tunnel length and alignment, the locations of surface infrastructure, and the tunnel construction methodology.

Two tunnel construction options were considered, being excavation by tunnel boring machines and excavation by road headers. Although tunnel boring machines would have a faster excavation rate, tunnel boring machines would, when compared to a road header option, result in:

- A larger tunnel cross section and, subsequently, increased spoil generation.
- Greater volumes of material required for tunnel lining.

Additionally, the cross section required for the road tunnel varies due to features such as maintenance bays and cross passages. Unlike road headers, tunnel boring machines are unable to alter their excavation cross section to accommodate these features.

Due to the above, excavation by road header was selected as the preferred option.

Tunnel length

Two tunnel length options were developed and examined including a ‘long’ tunnel option and a ‘short’ tunnel option in relation to the tie-in point to the M1 Pacific Motorway.

It was determined that the 'short' tunnel option would result in a reduction in capital cost compared to the 'long' tunnel option whilst resulting in workable traffic arrangements around the northern interchange. The 'short' tunnel option however, would result in increased adverse environmental and planning impacts. These impacts would primarily relate to the extent of land acquisition and associated land use and property implications during construction and operation. Taking into account a balanced assessment of these factors, it was concluded that the capital cost savings that may result from pursuing the 'short' tunnel option would be insufficient to offset increased environmental and planning impacts.

As a result, the 'long' tunnel option has been pursued as the preferred design configuration. Although this option would involve a higher capital cost, the benefits in terms of reduced property acquisition and the associated reduction in adverse community impacts were seen to provide a superior outcome overall.

Tunnel alignment

Design factors considered when determining the location of the main alignment tunnels and on and off-ramps included:

- Avoidance of surface disruption to Pennant Hills Golf Course.
- Avoidance of the defined zone of the North West Rail Link.
- Avoidance of impacts on the Northern or North Shore railway lines.
- Avoidance of land reserved under the *National Parks and Wildlife Act 1974*.
- Constructability issues.
- Minimisation of disruption to existing road users.
- Minimisation of property acquisition and property impacts.

The options identification and assessment process undertaken for the tunnel alignment specifically considered safety, traffic operations and performance, public transport operations, environmental costs and benefits, future proofing and constructability.

Horizontal alignment

The key factors that were considered in the design of the main alignment tunnels with respect to horizontal geometry were:

- Provide the shortest tunnel length for both northbound and southbound carriageways, taking into account the interchange layouts and the location of ventilation sites.
- Follow topography that provides optimal vertical geometry in terms of length and vertical grade, and cover to surface.
- Provide access to surface shaft locations.
- Avoid identified constraints, including unfavourable geology near Pennant Hills Railway Station, the North West Rail Link tunnel alignment and the landfill contamination underlying Brickpit Park in Thornleigh.

- Avoid long term community and environmental costs associated with the removal of community facilities, the exposure to operational traffic noise and the removal of Blue Gum High Forest as a result of the open cut section at Brickpit Park / Kenley Park.
- Integrate with the northern and southern interchange arrangements.
- Provide appropriate horizontal curves to maintain safe line of sight distances.

Vertical alignment

The key factors that were considered in the design of the main alignment tunnels with respect to vertical geometry were:

- Avoid steep vertical grades which would cause heavy vehicles to decelerate.
- Limit lengths of roadway with grades above 2.5 per cent as much as practicable.
- Provide minimum grades of 0.5 per cent to facilitate drainage.
- Maximise the extent within competent rock.
- Ensure sufficient cover to the surface in order to minimise settlement impacts.
- Provide clearance to the North West Rail Link tunnel.
- Reduce overall life cycle cost for ventilation purposes.
- Water inflow issues.

Optimum vertical geometry is beneficial to heavy vehicles using the tunnel as it minimises the speed differentials between trucks and cars and limits the vehicle emissions generated by heavy vehicle traffic on long and steep uphill grades.

The geology of the area was influential in determining the tunnel vertical alignment. Hawkesbury Sandstone is considered an excellent tunnelling and excavation medium as it is high strength with relatively widely spaced defects. In comparison, Ashfield Shale is also of high strength but has a deeper soil profile, closer spaced defects (commonly affected by faulting) and the fresh shale can readily deteriorate on exposure. As a result, the tunnel has been designed to maximise the length of tunnel within Hawkesbury Sandstone and minimise the length within Ashfield Shale.

The main alignment tunnels have been located to cross below the alignment of the North West Rail Link tunnel, based principally on geotechnical considerations in this area. Specifically, crossing underneath the North West Rail Link maximises the amount of tunnel in the more favourable Hawkesbury Sandstone.

Surface infrastructure

Surface infrastructure required for the project would include the northern and southern interchanges, as well as operational ancillary facilities such as ventilation infrastructure and the motorway control centre. The locations of these facilities have been carefully considered during the development of the design, including consideration of the following factors:

- Minimise impacts on property and the surrounding environment.
- Minimise impacts on the existing Hills M2 Motorway and M1 Pacific Motorway.
- Limit impacts at the currently congested M1 Pacific Motorway / Pacific Highway interchange and the Pacific Highway / Pennant Hills Road intersection.
- Retain existing bus lanes, bus interchanges and cycle access along the Hills M2 Motorway.
- Minimise the need for property acquisition.

Interchanges

As well as the general considerations for surface infrastructure listed above, key factors that were considered in the design of the southern and northern interchanges were:

- Optimise traffic performance.
- Maximise safety.
- Minimise impacts on existing infrastructure and properties.
- Minimise impacts during construction on existing traffic on the Hills M2 Motorway and Pennant Hills Road (southern interchange).
- Minimise impacts during construction on existing traffic on the M1 Pacific Motorway, Pacific Highway and Pennant Hills Road (northern interchange).
- Ensure constructability within geotechnical and topographical constraints.
- Environmental impacts such as noise and visual effects.
- Maintain pedestrian and cyclist access.

Land acquisition at the southern interchange has been limited by utilising properties already owned by Roads and Maritime. Only a limited number of additional properties would be required in this area. Property acquisition has also been limited at the northern interchange by designing the main alignment tunnels and ramps to emerge within existing road corridors.

Ventilation facilities

The primary drivers when considering the location of ventilation facilities were minimising local and regional air quality impacts and maximising the operational efficiency of the tunnel ventilation system. Vehicles travelling through the tunnels create a piston effect which draws air in the direction of travel. Consequently, the most efficient location for ventilation facilities is as close to the tunnel exit portals as possible. This minimises the length of tunnel where the air flow must be forced, by jet fans within the tunnels, against traffic flow back to the ventilation point. The reduced use of tunnel ventilation fans increases the performance of the tunnels, reduces operational power consumption and reduces the cost associated with operation.

The southern ventilation facility has been located on land currently owned by Roads and Maritime on the north-western corner of the current Hills M2 Motorway / Pennant Hills Road interchange. This facility has also been co-located with other operational ancillary facilities further reducing the amount of land acquisition required.

The northern ventilation facility has been located primarily above the cut and cover section of the northbound main alignment, near the connection with the M1 Pacific Motorway. This location provides optimal ventilation performance, eliminates the need to construct additional shafts and tunnels between the tunnel and the ventilation facility and has reduced the amount of land acquisition required.

Tunnel support facilities

Safe tunnel operation requires specific infrastructure and equipment. A key aspect is a facility to efficiently remove smoke should there ever be a fire incident in the tunnel. For this length of tunnel two tunnel support facilities are required. Due to the constrained nature of the corridor, limited opportunities exist along the alignment for the location of the facilities. For operational and safety reasons these facilities are required to be located at around third points along the main alignment tunnels and preferably directly above the main alignment tunnels for operational efficiency and to minimise spoil generation.

Two options have been investigated for the location of the southern tunnel support facility, being on Lilla Road and on Wilson Road, in Pennant Hills. Both options provide similar benefits in relation to location directly above the main alignment tunnels. Both site options also provide access directly from the arterial road network, which is important during construction and for access during operation. The Lilla Road site option, however contains a non-Aboriginal heritage item and heritage listed street trees. As such, Wilson Road was chosen as the preferred site for the southern tunnel support facility.

Two options have also been investigated for the northern tunnel support facility, being Terra Street and Trelawney Street, in Thornleigh. The Terra Street site would provide some benefits in terms of limiting impacts associated with land acquisition, however this site is not located directly above the tunnel and is located immediately adjacent to a known contaminated site. Although use of the Trelawney Street site would result in additional land acquisition requirements, this site has been identified as the preferred location of the northern tunnel support facility due to avoiding potential interactions with known contaminated land and being located directly above the main alignment tunnels.

Motorway control centre

The proposed location for the motorway control centre is predominately on land currently owned by Roads and Maritime. Its location near the southern interchange allows shorter distances for tolling equipment and cabling between the motorway control centre and the tolling points around the southern interchange. This location, in close proximity to the southern interchange, also provides efficient access to the tunnels for emergency and incident response.

Operational water management

Wherever feasible and reasonable, collected groundwater and surface water could potentially be re-used for operational activities such as landscape maintenance. However, expected groundwater inflow into the main alignment tunnels is likely to exceed operational requirements (refer to **Section 7.8** Hydrogeology and soils). As such, there would be surplus water generated during operation of the project above what is necessary for everyday operation and maintenance activities. Several options have been considered in relation to the management of surplus operational water, including re-injection of the water into the groundwater aquifer, tankering of untreated water off-site, discharge to sewer and treatment and disposal of water to the local stormwater system (with subsequent discharge to the environment).

Re-injection of the water into the groundwater aquifer would be a cost intensive and technically challenging option. This option would typically only be adopted as a last resort where maintenance of existing groundwater levels is required to mitigate potential groundwater drawdown impacts. Because the project involves drained tunnels, re-injected water would be eventually drawn back into the tunnels and would not result in beneficial mitigation of groundwater drawdown impacts. As a result, this option was not considered a necessary, appropriate and viable water management approach for the project.

Tankering of untreated water off-site for disposal would generate significant heavy vehicle traffic impacts (around 190 vehicles a day) on the local road network, and would generate amenity impacts for surrounding residential receivers. This option would also require capital investment in on-site infrastructure for tanker loading and additional water storage capacity, as well as the ongoing operational cost associated with tanker operations. This option was discounted based on the cost of tankering water off-site and the environmental costs of this approach, relative to other water management options.

Discharge of water to the local sewerage system, with or without treatment, was discounted based on the ongoing cost of a trade waste licence and the potential need to invest in augmentation of the sewerage system. It was also considered undesirable to consume part of the capacity of the local sewerage system and processing capacity of regional sewage treatment plants with water generated by the project.

In comparison to tankering and discharge to sewer, management of surplus operational water on-site was identified as a preferable approach in terms of cost and overall environmental impact. The option of treatment and disposal of water to the local stormwater system or environment would provide a long-term solution for water management. Although this option would result in increased flows within local watercourses, it has been adopted as the most viable long-term solution for the project, coupled with potential beneficial re-use on the site and / or off-site within the local community (eg Pennant Hills Golf Club, playing fields or parks). The potential impacts arising from increased flows in the local watercourses are assessed in **Section 7.6** (Biodiversity) and **Section 7.9** (Surface water).

The proposed location of the operational water treatment plant is near the southern interchange and would be co-located with the motorway control centre and other operational ancillary facilities. This land is currently owned by Roads and Maritime which limits the amount of land acquisition required. The southern interchange is also the lowest topographical point along the project alignment, which would allow the main alignment tunnels to be drained via gravity to a sump located at the tunnel low point, thereby reducing operational water pumping costs.

Temporary ancillary construction facilities

Several temporary ancillary construction sites would be required for the project. The primary driver for the location of these sites is the objective of minimising environmental and community impacts. Wherever possible, ancillary construction facilities have been co-located within the footprint of the future operational ancillary facilities to minimise the overall land acquisition requirements, as well as impacts on heritage items and ecologically sensitive areas.

Where temporary ancillary construction facilities could not be co-located within the footprint of the future operational ancillary facilities, following was considered when selecting the location of these facilities:

- Locating the facilities within existing road reserves or other land owned by Roads and Maritime in order to minimise land acquisition requirements.
- Locating the facilities in previously disturbed areas, such as the footprint of compounds previously utilised as part of the recently completed Hills M2 Motorway Upgrade project.
- Locating spoil extraction sites immediately adjacent to the arterial road network to reduce the impacts of spoil haulage and other heavy vehicle movements.
- Avoiding known heritage items and significant ecologically sensitive areas as far as possible.

The project design incorporates a shaft in lieu of a decline to access the tunnels at the Wilson Road and Trelawney Street compounds. This has resulted in a reduction in land required and the minimisation of associated impacts on property. In general, the use of a vertical shaft with the spoil extracted via cranes requires less surface land than a decline which allows trucks to drive into the tunnels.

4.5 Ecologically sustainable development

Ecological sustainable development (ESD) is development that improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends. The principles of ecological sustainable development have been considered throughout the development of the project.

The *Environmental Planning and Assessment Act* (EP&A Act) recognises that ecological sustainable development requires the effective integration of economic and environmental considerations into decision making processes. The EP&A Act identifies four principles to assist in the achievement of ecological sustainable development:

- The precautionary principle.
- Inter-generational equity.
- Conservation of biological diversity and ecological integrity.
- Improved valuation and pricing and incentive mechanisms.

Precautionary principle

If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The precautionary principle has been applied throughout the design and development of the project.

The alternatives and options analysis as part of the 2004 report considered environmental impacts, evident through the selection of an option which minimised surface disturbance and potential impacts to National Parks and other ecologically sensitive areas.

The design has first aimed to avoid, to the greatest extent practicable, known areas or items of environmental value. Where avoidance was not possible, mitigation measures have been identified to manage the identified risks (as detailed in each impact assessment chapter).

This environmental impact statement details the evaluation of environmental impacts associated with the project and has been undertaken using the best available technical information and adoption of best practice environmental standards, goals and measures to minimise environmental risks. The environmental impact assessment has been undertaken in collaboration with key stakeholders and relevant statutory and agency requirements.

Inter-generational equity

The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

One of the key objectives of the project is to assist in a reduction in traffic congestion along Pennant Hills Road and provide shorter travel times for road users. The project is anticipated to:

- Improve local air quality along the Pennant Hills Road corridor. Further information on local air quality improvements are provided in **Section 7.3** (Air quality).
- Improve noise amenity along the Pennant Hills Road corridor. Further information on local noise amenity improvements is provided in **Section 7.2** (Noise and vibration).
- Improve road safety along the Pennant Hills Road corridor. Further information on road safety improvements are provided in **Section 7.1** (Traffic and transport).
- Result in reduced operational greenhouse gas emissions when compared to the project not being built. For the year 2029 the savings in greenhouse gas emissions with the project are predicted to be around 68,600 tonnes CO_2-e when compared to the without project scenario. Further information on greenhouse gas emissions and savings are provided in **Section 8.1** (Greenhouse gas and climate change).

As a result the project would provide benefits for current and future generations and is considered to be in the public interest.

Conservation of biological diversity and ecological integrity

Conservation of biological diversity and ecological integrity is a fundamental consideration of the project.

The alternatives and options analysis as part of the 2004 report considered ecological integrity, evident through the selection of an option which minimised potential impacts to National Parks and other ecologically sensitive areas.

The design avoids impacts to areas of high ecological value as far as practical. This environmental impact statement provides a detailed ecological assessment (**Section 7.6** Biodiversity) which identifies flora and fauna impacts and provides a range of mitigation measures to further avoid and minimise these potential impacts. For example, the design has avoided impacts to the Blue Gum High Forest at Kenley Park and Brickpit Park.

Improved valuation and pricing of environmental resources

Environmental factors should be included in the valuation of assets and services. Such as:

- Polluter pays (ie those who generate pollution and waste should bear the cost of containment, avoidance, or abatement).
- The users of goods and services should pay prices based on the full life cycle of costs of providing the goods.
- Environmental goals, having been established, should be pursued in the most cost effective ways.

The value placed on the environment is evident in the development of design features and also in the extent of environmental investigations. In addition the costs associated with the planning and design of measures to avoid or minimise adverse environmental impacts and the costs to implement them have been built into the overall project costs. For example, the long tunnel option, despite its high capital cost, has been selected over the short tunnel option, which would have resulted in increased environmental and social impacts associated with land acquisition (refer to **Section 4.4.1**).

The provision of a toll on the project supports the concept of users of goods and services paying prices based on the full life cycle of costs of providing the goods. Whilst the upfront capital costs would be provided by a combination of private funding and a contribution from the NSW and Australian Governments, this funding would be recouped through a toll to cover the upfront construction, and ongoing operation and maintenance costs.

4.6 The project

The project would include the following elements:

- Twin motorway tunnels up to around nine kilometres in length with two lanes in each direction. The tunnels would be constructed with provision for a possible third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps.
- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect to the project travelling northbound, and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway operations complex located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.
- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the project.

5 Project description

This chapter describes the proposed scope of work, including the route alignment, corridor width, main project elements, ancillary facilities, design standards and construction activities.

The project description presented in this environmental impact statement represents the preferred tender design. Sufficient flexibility has been provided in the design to allow for refinement during detailed design, to respond to submissions received during the exhibition of the environmental impact statement, or to minimise environmental impacts. The final design may therefore vary from the project described in this chapter.

Table 5-1 sets out the Director-General's Requirements as they relate to the project description, and where in the environmental impact statement these have been addressed.

Table 5-1 Director-General's Requirements – project description

Director-General's Requirement	Where addressed
The Environmental Impact Statement (EIS) must be prepared in accordance with, and meet the requirements of, Part 3 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (the Regulation), including: • A detailed description of the project and its relationship and/or interaction with the existing public transport service (rail and bus), bus stops, passenger facilities, location of routes, operator amenities, cyclist facilities, the proposed removal of trees and the location and operational requirements of construction compounds.	Existing public transport, bus stops and cyclist facilities addressed in **Section 3.3.4** with further details provided in **Section 7.1** (Traffic and transport) and **Section 7.7** (Social and economic). Removal of trees addressed in **Section 5.3.1** with further details provided in **Section 7.6** (Biodiversity). Location and operational requirements of construction compounds addressed in **Section 5.3.12**.

5.1 Project scope

5.1.1 The project

Roads and Maritime is proposing the construction and operation of a multi-lane tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills (the project). The project would comprise twin road tunnels generally following the alignment of Pennant Hills Road (the main alignment tunnels), with interchanges at the northern and southern end of the project.

The project would comprise the following key features:

- Twin motorway tunnels up to around nine kilometres in length with two lanes in each direction. The tunnels would be constructed wide enough for a third lane in each direction if required in the future.
- A northern interchange with the M1 Pacific Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps, which also facilitate access to and from the Pacific Highway.
- A southern interchange with the Hills M2 Motorway and Pennant Hills Road, including sections of tunnel for on-ramps and off-ramps.

- Integration works with the Hills M2 Motorway including alterations to the eastbound carriageway to accommodate traffic leaving the Hills M2 Motorway to connect to the project travelling northbound, and the provision of a new westbound lane on the Hills M2 Motorway extending through to the Windsor Road off-ramp.
- Tie-in works with the M1 Pacific Motorway extending to the north of Edgeworth David Avenue.
- A motorway operations complex located near the southern interchange on the corner of Eaton Road and Pennant Hills Road that includes operation and maintenance facilities.
- Two tunnel support facilities incorporating emergency smoke extraction outlets and substations.
- Ancillary facilities for motorway operation, such as electronic tolling facilities, signage, ventilation systems and fire and life safety systems including emergency evacuation infrastructure.
- Modifications to service utilities and associated works at surface roads near the two interchanges and operational ancillary facilities.
- Modifications to local roads, including widening of Eaton Road near the southern interchange and repositioning of the Hewitt Avenue cul-de-sac near the northern interchange.
- Ancillary temporary construction facilities and temporary works to facilitate the construction of the project.

The project does not include ongoing motorway maintenance activities during operation. These would be subject to separate assessment and approval as appropriate.

Construction activities would generally include:

- Commencement of enabling and temporary works, including construction power, water supply, site establishment, demolition works, property and utility adjustments and public transport modifications (if required).
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure.
- Haulage of spoil generated during tunnelling and excavation activities.
- Fit-out of the road tunnels and support infrastructure, including ventilation and emergency response systems.
- Construction and fit-out of the motorway control centre and ancillary operations buildings.
- Realignment, modification or replacement of surface roads, bridges and / or underpasses.
- Implementation of environmental management and pollution control facilities for the project.

5.2 The completed project

The completed project is shown in overview in **Figure 5-1** and in **Figure 5-2** to **Figure 5-9** and described in detail in the following sections.

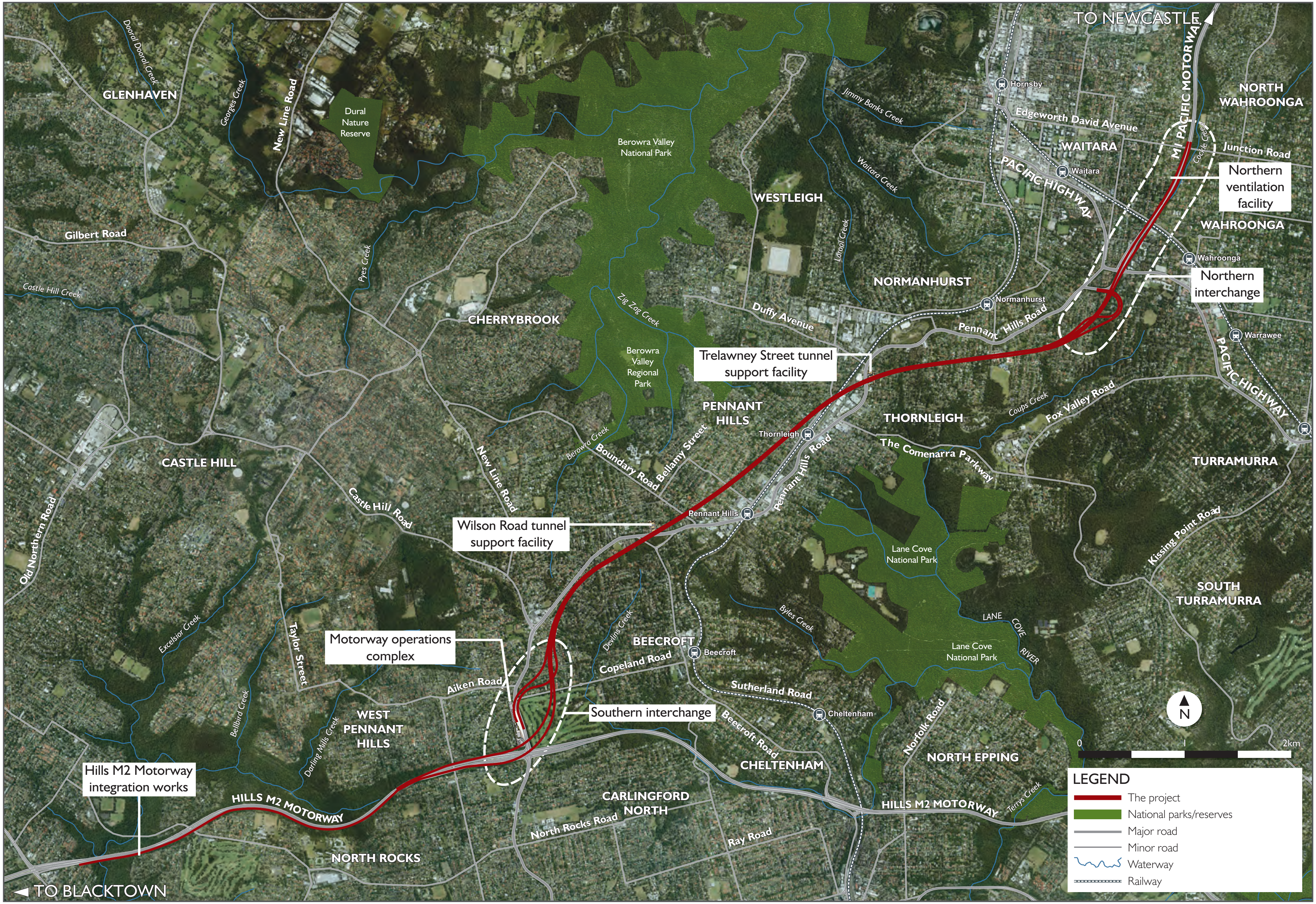


Figure 5-1 Overview of operational facilities

(Blank page)

Figure 5-2 Project operational footprint - Map 1

(Blank page)

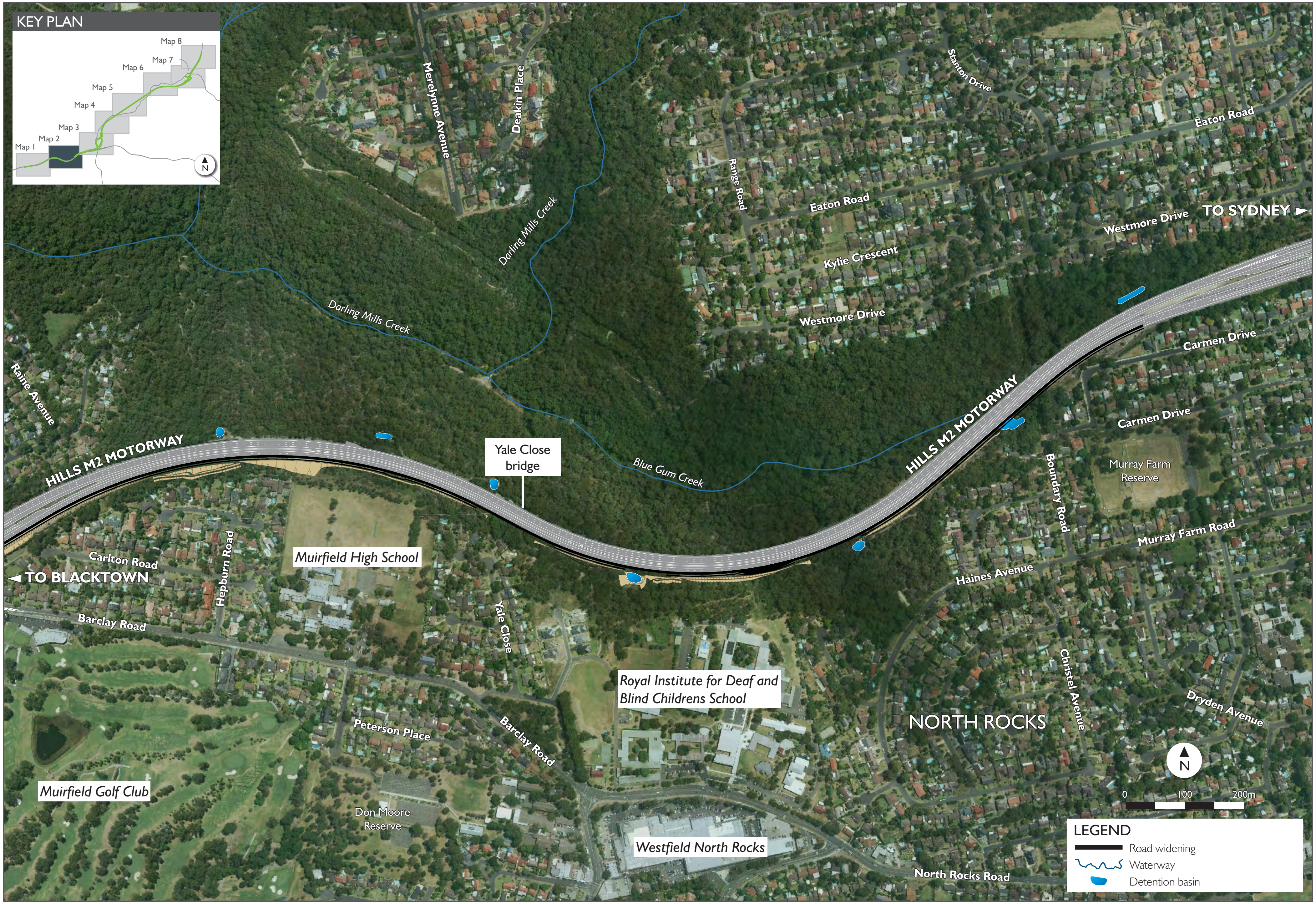


Figure 5-3 Project operational footprint - Map 2

(Blank page)

Figure 5-4 Project operational footprint - Map 3

(Blank page)

Figure 5-5 Project operational footprint - Map 4

(Blank page)

Figure 5-6 Project operational footprint - Map 5

(Blank page)

Figure 5-7 Project operational footprint - Map 6

(Blank page)

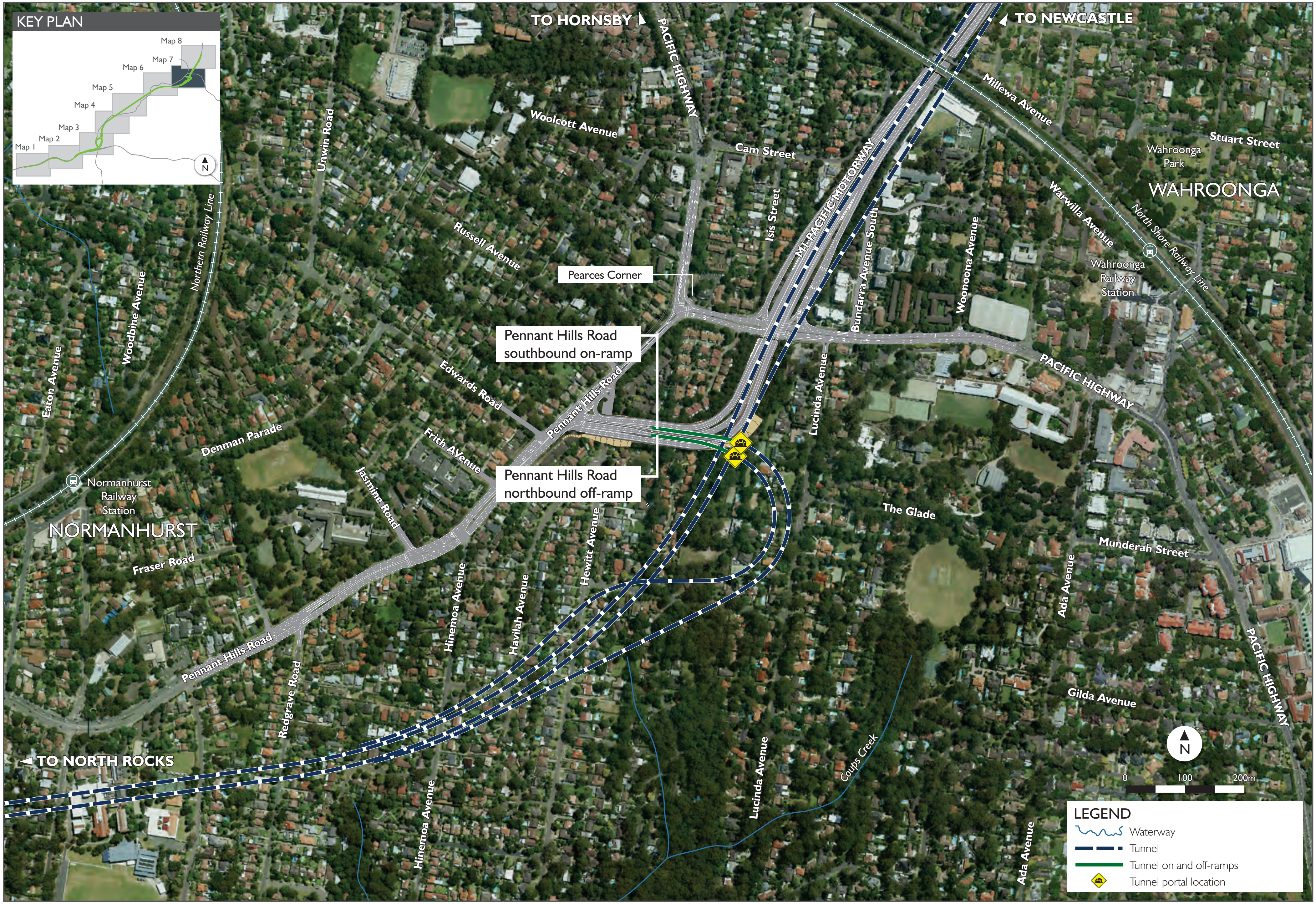


Figure 5-8 Project operational footprint - Map 7

(Blank page)

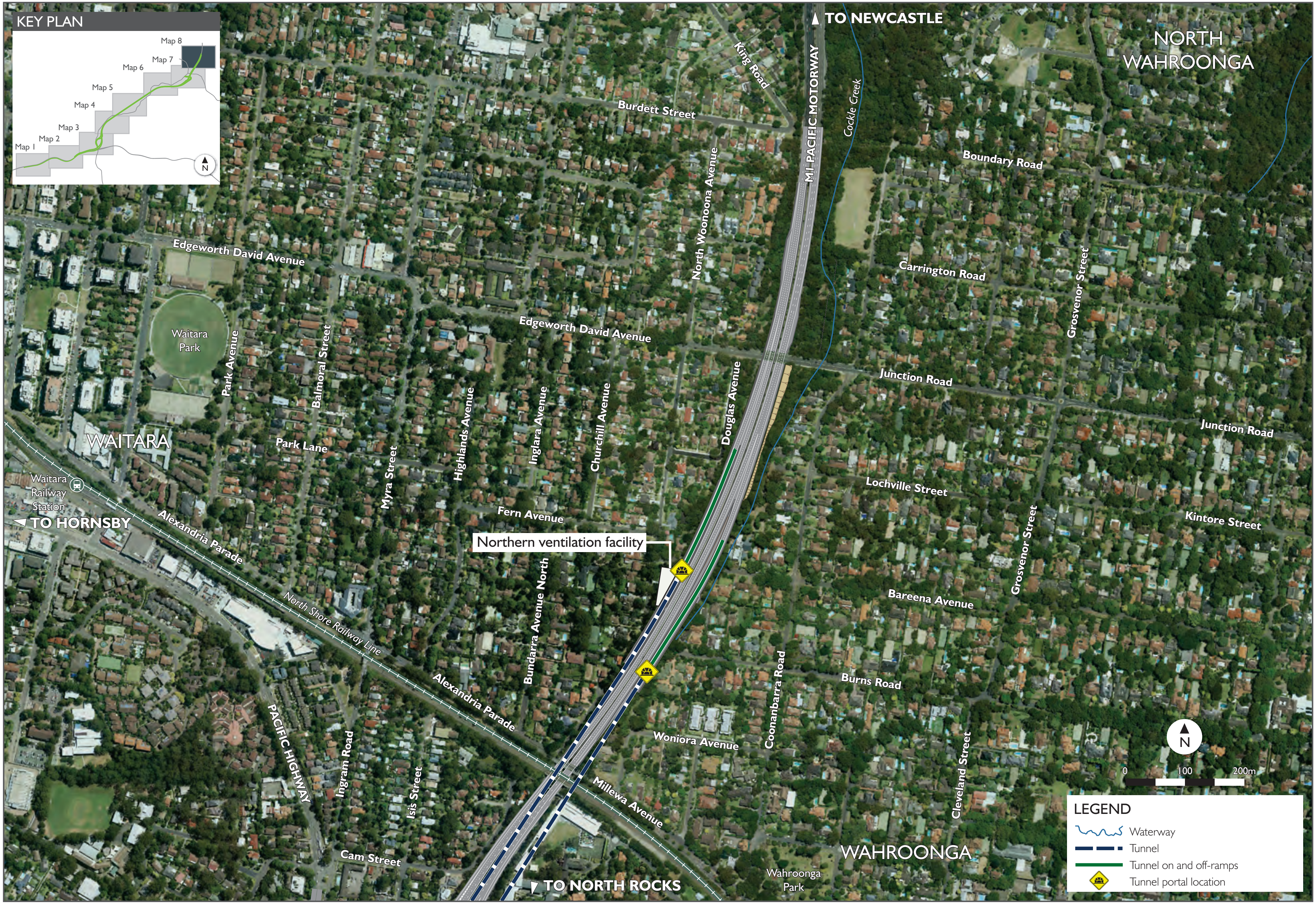


Figure 5-9 Project operational footprint - Map 8

(Blank page)

5.2.1 Corridor and project footprint

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

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

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

5.2.2 Tunnel alignment

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

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

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

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

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

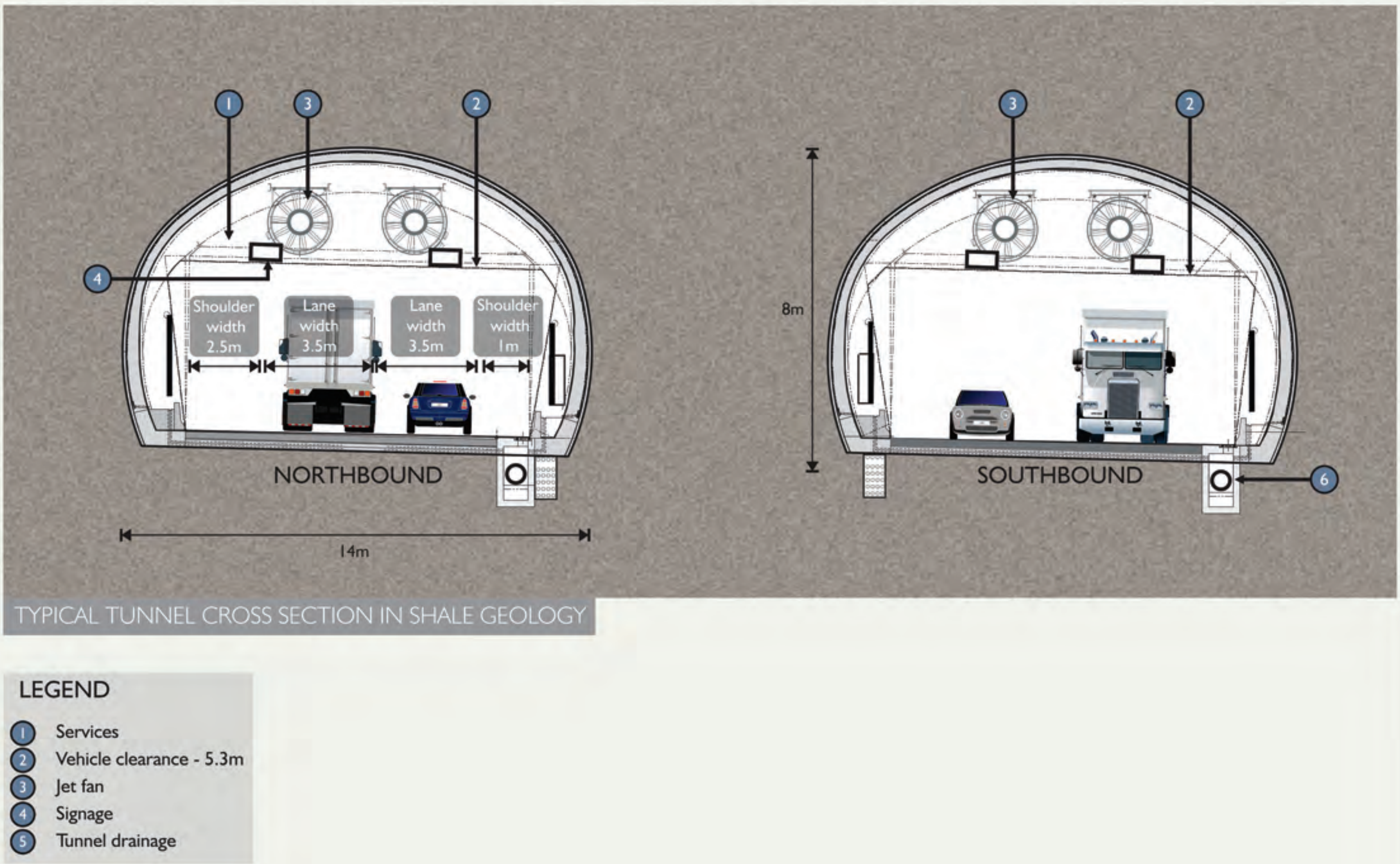
5.2.3 Road grade and lane widths

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

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

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

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



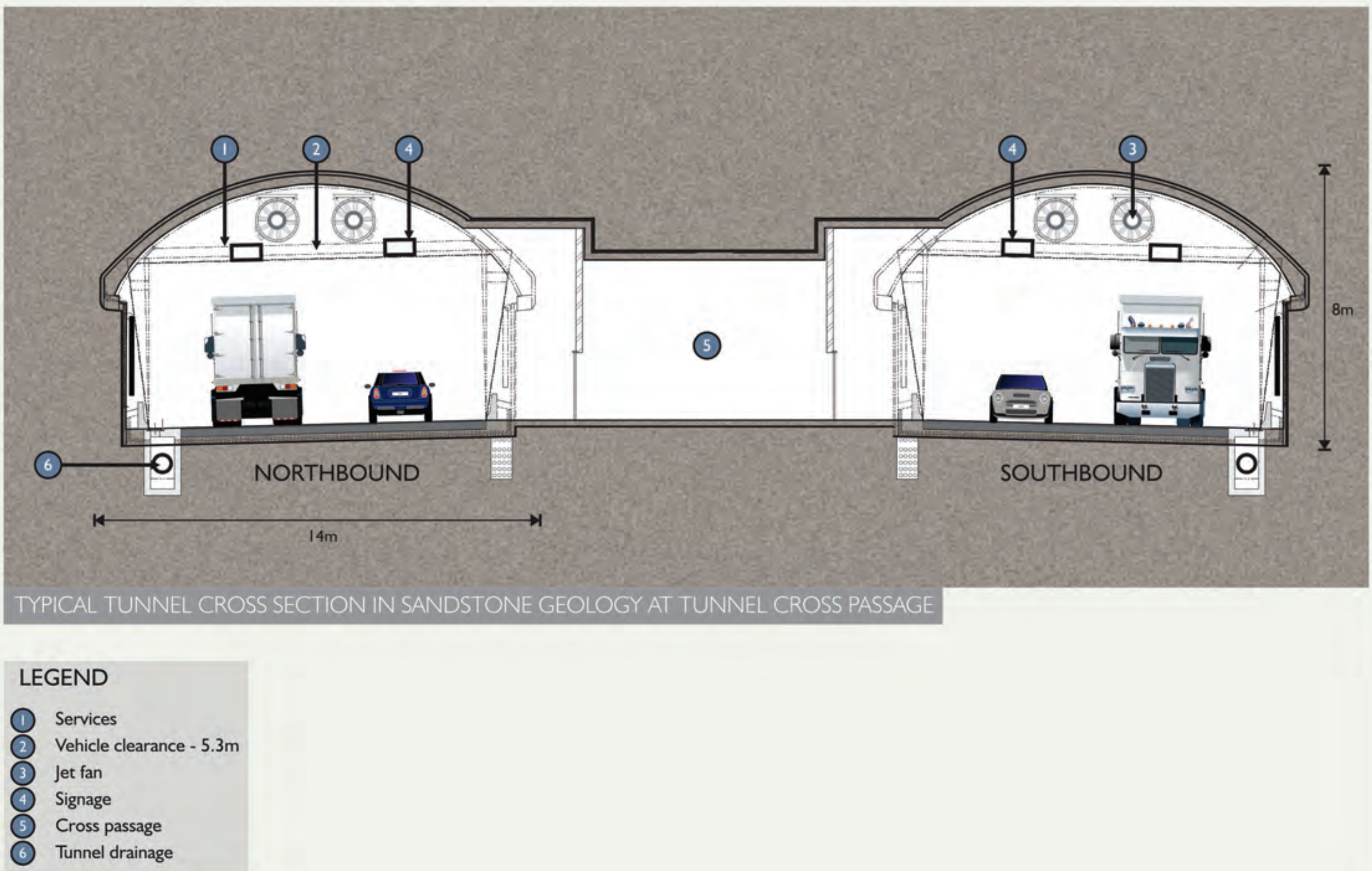


Figure 5-10 Indicative cross section of main alignment tunnels

(Blank page)

5.2.4 Intersections and interchanges

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

Southern interchange

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

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

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

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

Northern interchange

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

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

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

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

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

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

Figure 5-11 Southern interchange operational layout

(Blank page)

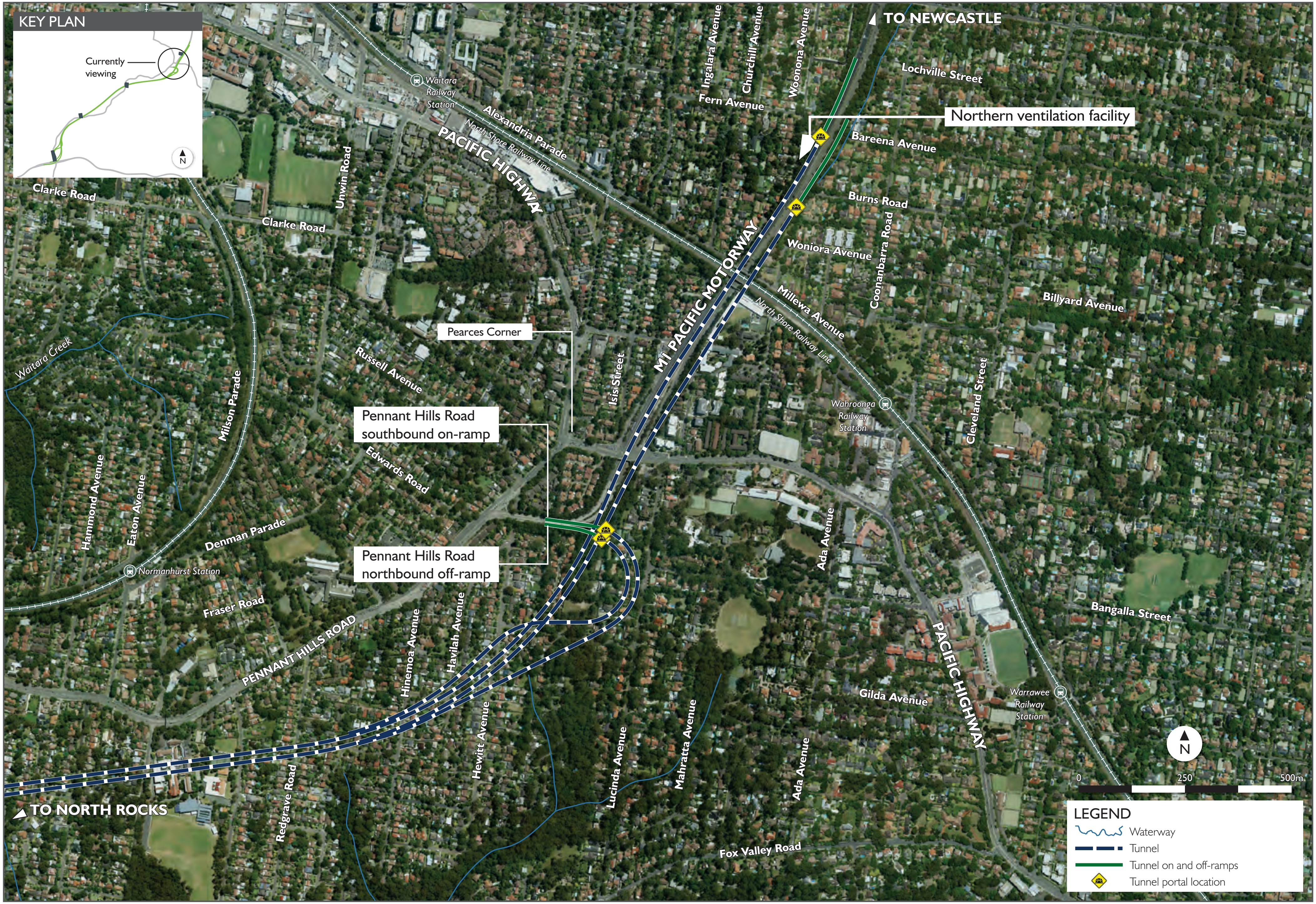


Figure 5-12 Northern interchange operational layout

(Blank page)

5.2.5 Ventilation system and facilities

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

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

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

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

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

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

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

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

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

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

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

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

(Blank page)

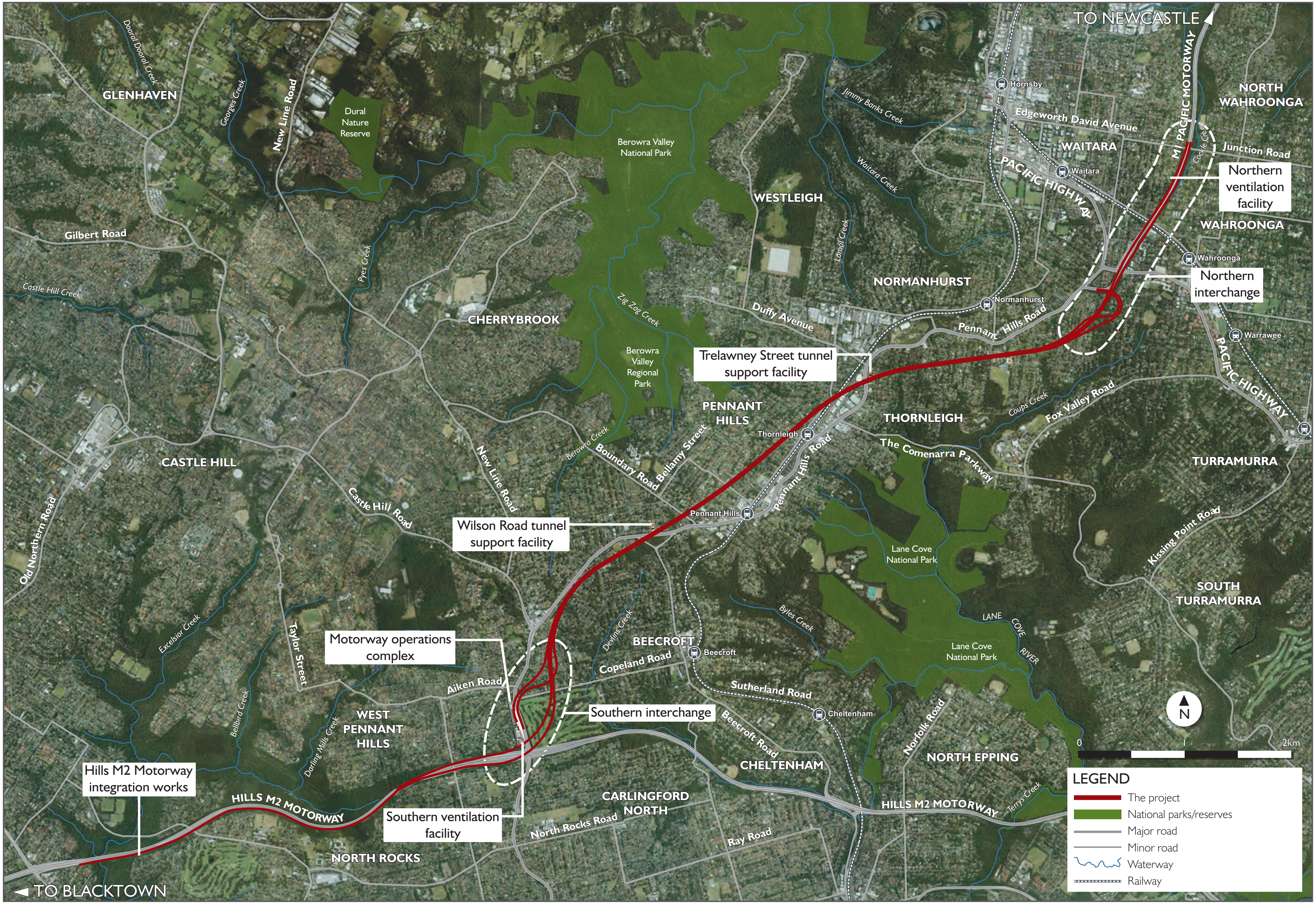


Figure 5-13 Ventilation and tunnel support facilities

(Blank page)

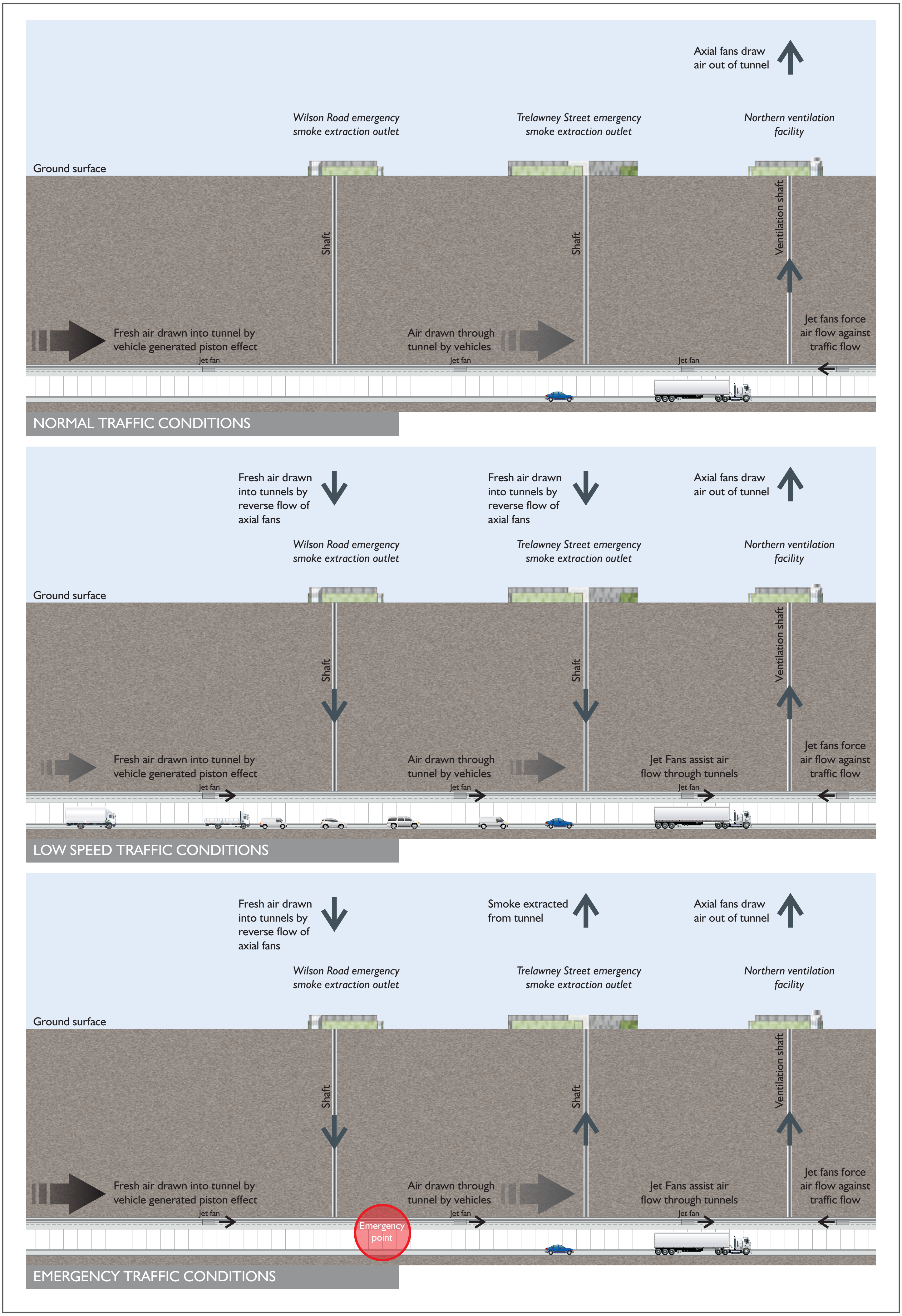


Figure 5-14 Indicative tunnel ventilation system (northbound tunnel arrangement)

(Blank page)

Figure 5-15 Indicative Wilson Road tunnel support facility operational layout

(Blank page)

Figure 5-16 Indicative Trelawney Street tunnel support facility operational layout

(Blank page)

Normal traffic conditions

During normal operation the tunnel would be longitudinally ventilated. That is, fresh air would be drawn in from the tunnel entry portals and through the tunnels by a vehicle generated piston effect (the suction created behind a moving vehicle which pulls air into and through the tunnel) and pushed towards the tunnel exit portals. Near the portals, tunnel air would be drawn upwards into ventilation facilities with ventilation fans prior to discharge to the environment via a 15 metre high discharge point.

For the tunnel off-ramps, air would be drawn back down the ramp for extraction via the ventilation facility. This would require jet fans (used to accelerate the movement of air through the tunnel) to maintain the air flow against the direction of traffic flow. A similar approach would be applied to parts of the main alignment tunnels close to the exit portals.

In-tunnel air, containing vehicle emissions, would be extracted from the tunnels prior to reaching the exit portals. Air would be exhausted via a ventilation take off (intake) and transferred to the ventilation facility via a vertical shaft (ventilation outlet). The air would then be discharged at high velocity from the ventilation facility to the atmosphere to achieve effective dispersion of the tunnel air.

Low speed traffic conditions

During low speed traffic conditions the vehicle generated piston effect would be lessened. In these situations the airflow may need to be assisted by the tunnel jet fans located throughout the tunnels. Under these conditions, additional fresh air may need to be supplied to the main alignment tunnels via the reverse flow operation of the axial fans in the two tunnel support facilities.

The operation of axial fans in the ventilation facilities would be increased to ensure that acceptable air quality is maintained in the tunnels and to achieve effective dispersion of tunnel air following discharge to the atmosphere.

Based on forecast traffic volumes (refer to **Section 7.1** – traffic and transport), low speed conditions are only likely to occur in the event of an incident within the tunnels.

Emergency conditions

The two emergency smoke extraction outlets at the tunnel support facilities would principally function to maintain air quality in the tunnels in the unlikely event of an emergency. As a secondary feature, these facilities would also supply fresh air to the tunnels during low speed traffic conditions (discussed above).

During smoke control, air would be extracted from the tunnel and transferred to the emergency smoke extraction outlet via a vertical shaft. The smoke would then be discharged from the outlet to the atmosphere.

The emergency smoke extraction outlets are expected to operate infrequently for the extraction of smoke during an emergency, and for a short duration while emergency services and tunnel fire and life safety systems bring the situation under control.

5.2.6 Motorway control centre

The project would involve construction and operation of a 24 hour staffed motorway control centre, located near the southern interchange on the corner of Pennant Hills Road and Eaton Road (refer to **Figure 5-17**). Around 30 full-time equivalent staff would work at the site, of which around 26 would be located at the motorway control centre on a full-time basis. The motorway control centre would include facilities necessary for the monitoring, maintenance and control of tunnel services including tunnel safety, ventilation, power, lighting and other road systems required for the safe and efficient operation of the main alignment tunnels. Facilities would include a tunnel control room, training and incident response room, workshop space, emergency vehicle depot, garage and parking facilities (around 30 spaces for staff and visitors).

Urban design principles and landscaping would be employed to integrate the motorway control centre into the surrounding streetscape and minimise its visual impact. Further details regarding urban design, landscaping and visual impacts are provided in **Section 7.5** (Urban design, landscape character and visual amenity).

Figure 5-17 Motorway operations complex

(Blank page)

Figure 5-18 Northern ventilation facility operational layout

(Blank page)

5.2.7 Drainage

The proposed drainage system has been designed to prevent additional adverse effects on private properties for the 100 year ARI storm event. Further details are provided in **Section 7.9** (Surface water) and **Section 7.8** (Hydrogeology and soils).

Tunnel drainage

As the main alignment tunnels are proposed to be drained tunnels, there would be an ongoing inflow of groundwater into the tunnel. This would require the project to accommodate the capture, removal, treatment and discharge of groundwater during the operational phase. The tunnel drainage system and treatment plant would also manage deluge system water (as part of the fire and life safety system) in the unlikely event of an emergency in the tunnels.

The tunnel drainage system would flow to a sump with a capacity of 420 cubic metres, located at the southern interchange. Water would then be pumped from the sump to a treatment plant for treatment and discharge to the local stormwater system. The sump would contain capacity for accidental spillage up to 50,000 litres. The final arrangement would be determined as part of the detailed design.

Further information on treatment and discharge of operational and emergency water is provided in **Section 7.9** (Surface water) and **Section 8.2** (Hazard and risk).

Surface drainage

Surface works at the portals, the Hills M2 Motorway integration and the M1 Pacific Motorway tie-in are located in areas managed by existing drainage infrastructure. The project would increase the amount of impervious surface and the catchment area of this drainage infrastructure. This would necessitate the following alterations and / or augmentations to the existing drainage infrastructure:

- Demolition and reconstruction of pits and pipes.
- Alterations to four existing operational detention basins adjacent to the Hills M2 Motorway.
- Alterations to the Pennant Hills Road drainage system to provide capacity for a 20 year ARI storm event, including increasing the size of the existing Pennant Hills Road detention basin and collection of the first flush for the one year ARI storm event.
- Extension of five transverse drainage culverts on the Hills M2 Motorway.
- Provision for water quality treatment of a one year ARI storm event around the northern interchange using gross pollutant traps and oil / water separators.
- Provision of spillage containment tanks around the northern interchange, with a capacity of 50,000 litres.
- A new transverse drainage culvert under the M1 Pacific Motorway / Pennant Hills Road connector to act as a relief culvert for a probable maximum flood event.

Additionally, surface ancillary facilities would require connections to third party stormwater systems.

5.2.8 Bridges and viaducts

Modifications would be required to the following three existing bridges to accommodate the Hills M2 Motorway integration:

- Yale Close overbridge would be widened by around 3.5 metres. The existing bridge is a single span bridge around 32 metres wide.
- Barclay Road overbridge would be lengthened by around four metres. The existing bridge is a two span bridge around 48 metres long.
- Darling Mill Creek viaduct would be widened by around 3.5 metres. The existing bridge is a five span bridge around 32 metres wide.

The location of the above bridges is shown on **Figure 5-19** and **Figure 5-20**.

Three cycleway bridges would be constructed as part of the project. The new cycleway bridges would provide a grade separated connection across the on and off-ramps of the main alignment connection to the Hills M2 Motorway and the on-ramp of the main alignment connection to the M1 Pacific Motorway. The cycleway bridges would be around 2.5 metres wide and would vary in number of spans depending on the location and local topographical conditions. The cycleway bridges would be located at:

- The southern interchange from the Hills M2 Motorway across the westbound off-ramp of the project.
- The southern interchange from the Hills M2 Motorway across the eastbound on-ramp of the project.
- The northern interchange from the M1 Pacific Motorway across the southbound on-ramp of the project.

A grade separated connection across the off-ramp of the main alignment connection to the M1 Pacific Motorway would also be provided at the northern ventilation facility.

5.2.9 Connections to existing roads

The Hills M2 Motorway

As part of the project, modifications to the Hills M2 Motorway would be undertaken west of Pennant Hills Road to enable southbound traffic from the project to merge safely with existing westbound traffic on the motorway (refer to **Figure 5-19** and **Figure 5-20**). These works would extend for a distance of around 3.5 kilometres west of the Pennant Hills Road interchange to the existing Windsor Road off-ramp. This would include:

- An additional westbound lane on the Hills M2 Motorway.
- Widening of Yale Close bridge and Darling Mill Creek viaduct.
- Lengthening of Barclay Road overbridge.

Minor alterations would also be required to allow eastbound traffic from the Hills M2 Motorway to leave the motorway and join the northbound carriageway of the project.

The M1 Pacific Motorway

To provide connection to the project, modifications to the M1 Pacific Motorway beyond the northern interchange would be required (refer to **Figure 5-21**). The works would extend around 200 metres north of Edgeworth David Avenue in Wahroonga. Surface works along the M1 Pacific Motorway would generally involve widening of the road surface for the merge and diverge to and from the main alignment tunnels.

(Blank page)

Figure 5-19 Hills M2 Motorway integration works - Map 1

(Blank page)

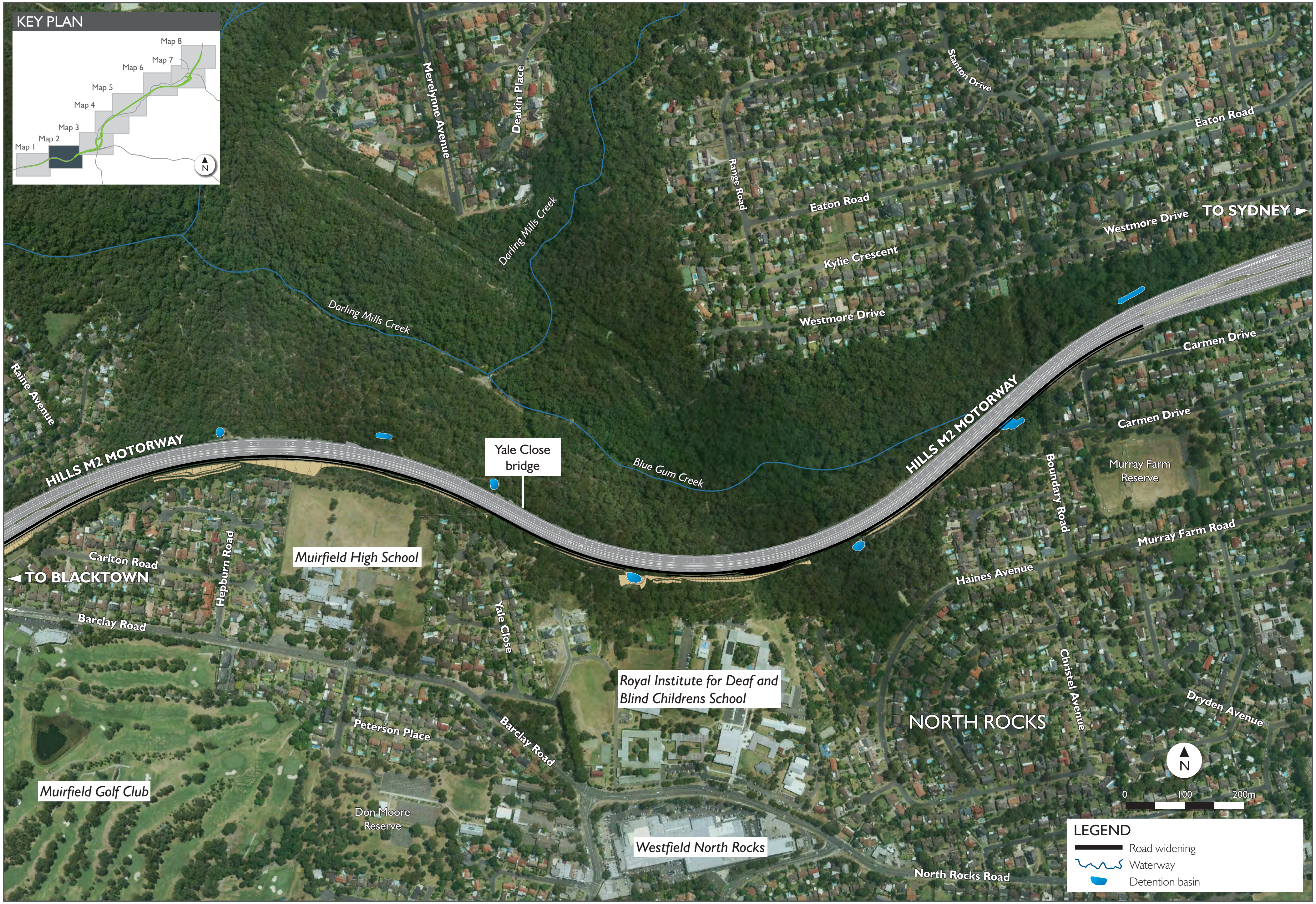


Figure 5-20 Hills M2 Motorway integration works - Map 2

(Blank page)

Figure 5-21 M1 Pacific Motorway tie-in works

(Blank page)

5.2.10 Changes to the local road network

A number of changes would be required to local roads to facilitate the surface works associated with the project. Changes to the local road network would be required at both the southern and northern interchanges. Surface road works at the southern and northern interchange are outlined below and shown in **Figure 5-22** and **Figure 5-23**.

Southern interchange

Local road changes around the southern interchange would include:

- Widening of Pennant Hills Road to accommodate the southbound tunnel off-ramp and the northbound tunnel on-ramp.
- Temporary provision of an additional right-turn lane at Eaton Road for the purpose of construction heavy vehicle traffic access to Pennant Hills Road. This would also involve adjustments to traffic signals at this intersection.

Northern interchange

Local road changes around the northern interchange would include:

- Widening of Pennant Hills Road northbound (at Pearce's Corner) to create a permanent additional right-turn lane onto the Pacific Highway.
- Widening of the M1 Pacific Motorway / Pennant Hills Road connector to accommodate tunnel on and off-ramps.
- Repositioning of the Hewitt Avenue cul-de-sac to accommodate the widened M1 Pacific Motorway / Pennant Hills Road connector.

(Blank page)

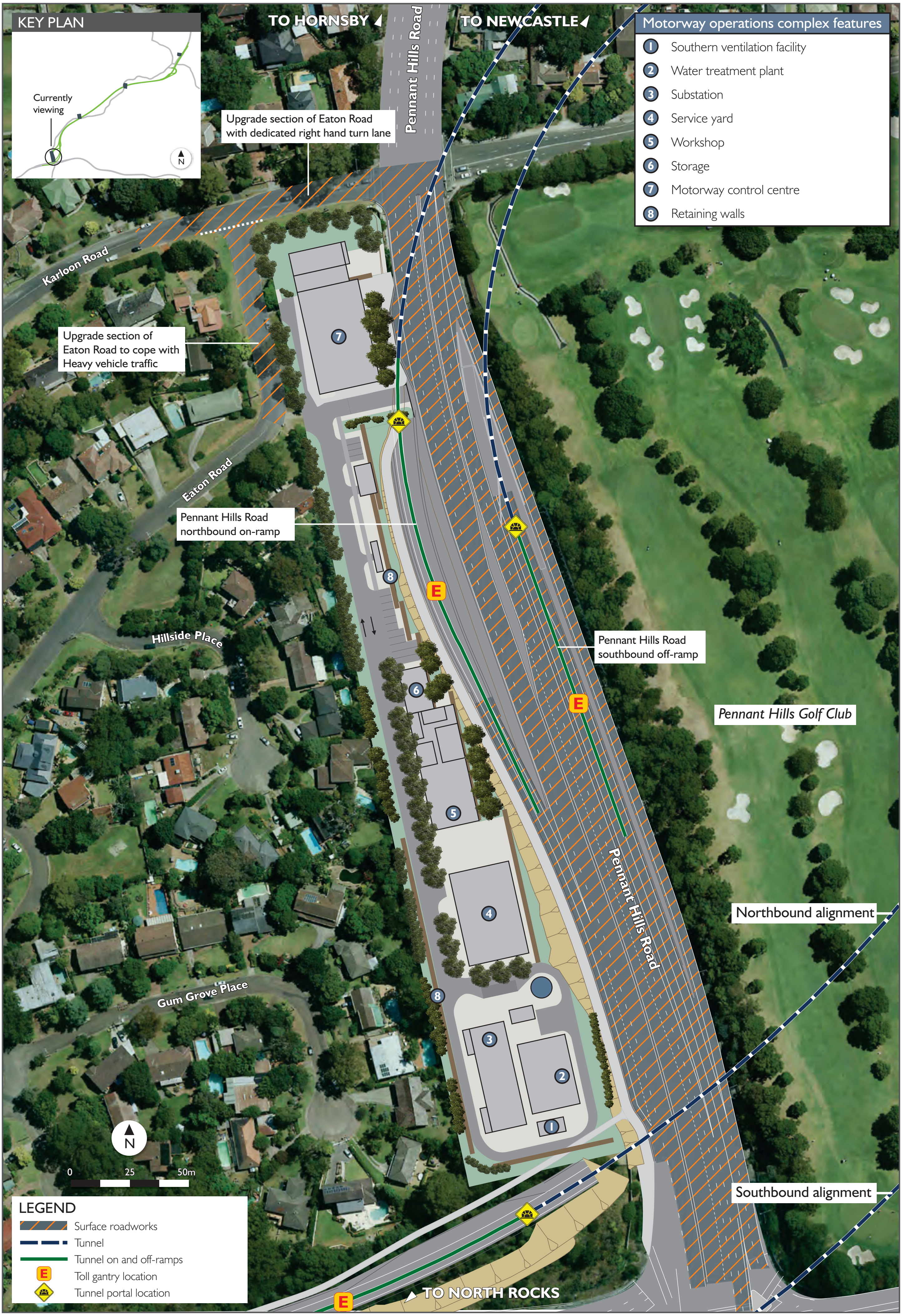


Figure 5-22 Southern interchange surface road works

(Blank page)

Figure 5-23 Northern interchange surface road works

(Blank page)

5.2.11 Public transport opportunities

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

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

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

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

Sydney’s Bus Future

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

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

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

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

Public transport opportunities on Pennant Hills Road

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

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

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

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

Table 5-3 Summary of public transport improvement opportunities

Location	Opportunities identified
Along Pennant Hills Road	• Signal re-phasing. • Additional bus services. • Relocation of bus stops.
Boundary Road	• Longer right-turn phase for buses turning right from Pennant Hills Road onto Boundary Road. • Bus queue jump' for buses turning left onto Pennant Hills Road.
Beecroft Road	• 'Bus queue jump' for buses travelling south on Pennant Hills Road.
Cardinal Avenue	• Longer right-turn phase for buses turning right onto Pennant Hills Road. • Longer right-turn phase for buses turning right onto Cardinal Avenue.
Castle Hill Road	• 'Bus queue jump' for through buses travelling south on Pennant Hills Road. • Longer right-turn phase for southbound buses turning right onto Castle Hill Road. • 'Bus queue jump' for through buses travelling north on Pennant Hills Road.
Railway Street	• Longer right-turn phase for buses turning right onto Pennant Hills Road.
Aiken Road	• Longer right-turn phase for buses turning right onto Pennant Hills Road.
Phyllis Avenue	• 'Bus queue jump' for buses travelling north on Pennant Hills Road.
Comenarra Parkway	• 'Bus queue jump' for buses travelling south on Pennant Hills Road.

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

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

Next steps

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

5.2.12 Heavy vehicle regulation

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

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

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

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

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

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

5.2.13 Provisions for pedestrians and cyclists

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

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

Adjustments to bus stops would include:

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

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

5.2.14 Cuttings and embankments

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

Cuttings

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

Embankments

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

5.2.15 Utility services

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

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

Electricity

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

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

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

Water

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

5.2.16 Roadside furniture and lighting

Lighting

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

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

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

Signage

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

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

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

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

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

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

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

Heavy vehicle regulation

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

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

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

5.2.17 Property access and acquisition

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

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

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

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

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

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

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

5.2.18 Emergency or incident facilities

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

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

5.2.19 Detailed design

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

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

5.2.20 Urban design principles and objectives

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

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

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

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

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

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

5.2.21 Landscape framework

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

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

5.3 Construction works

5.3.1 Construction footprint

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

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

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

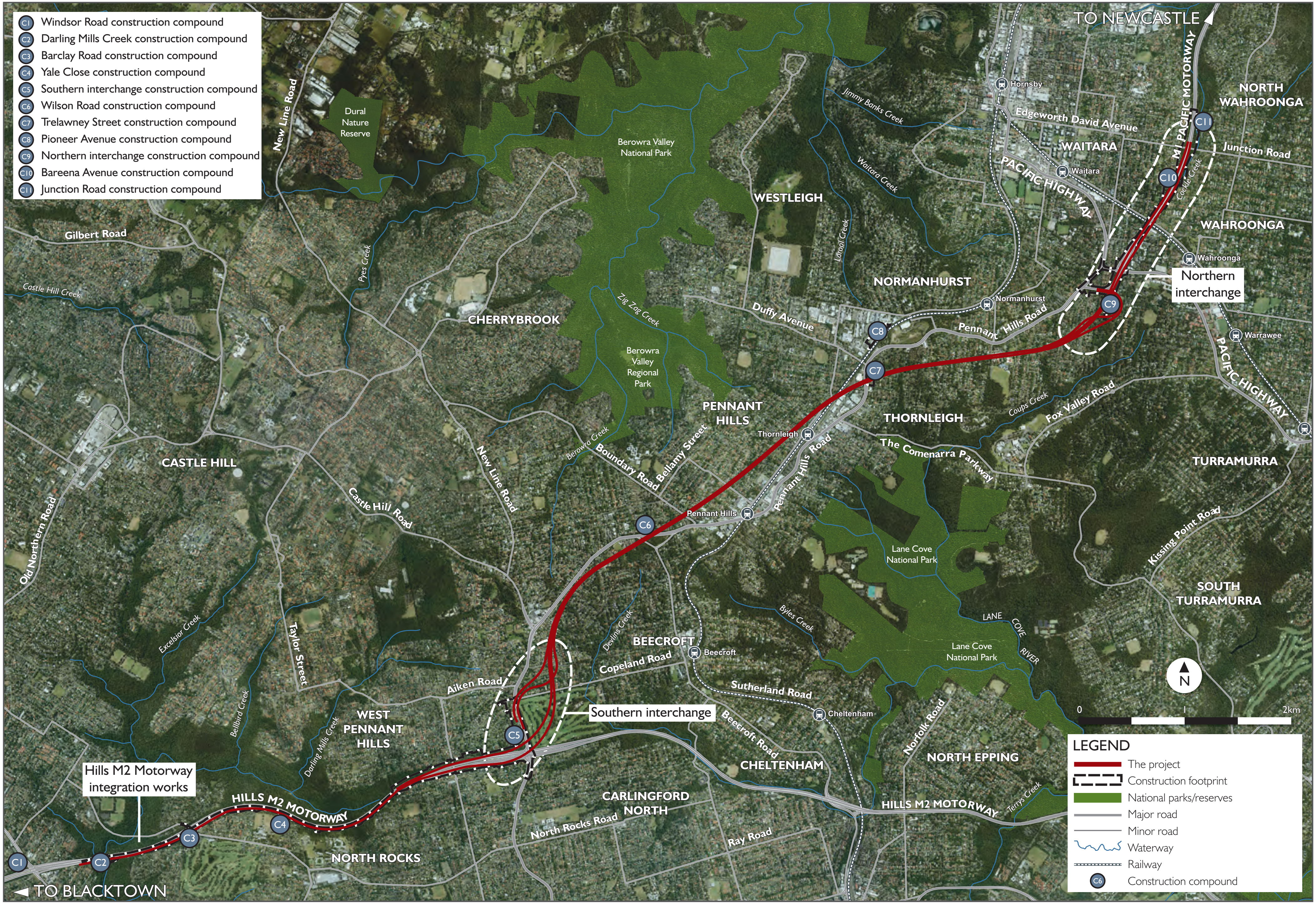


Figure 5-24 Overview of construction footprint and ancillary facilities

(Blank page)

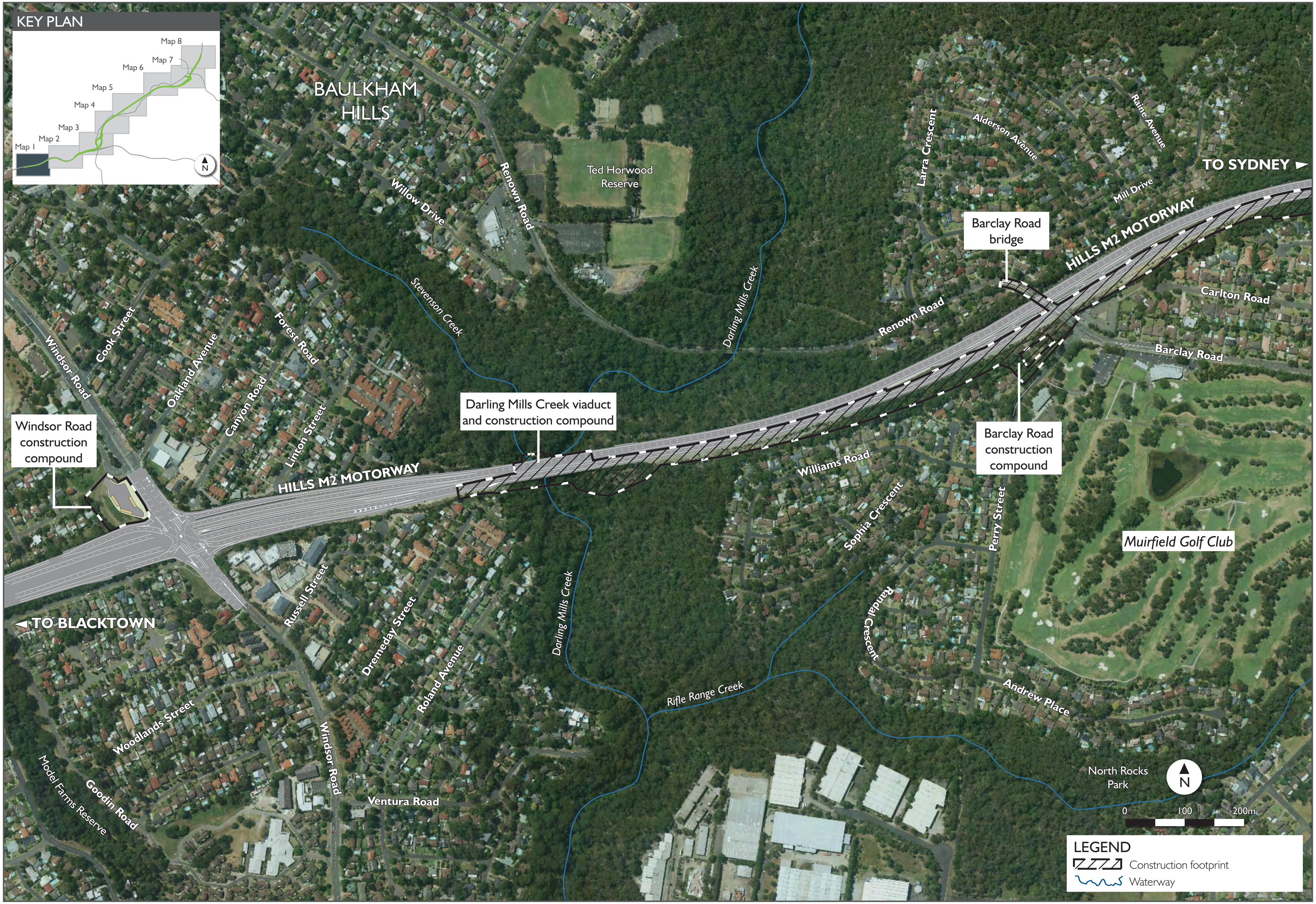


Figure 5-25 Project construction footprint - Map 1

(Blank page)

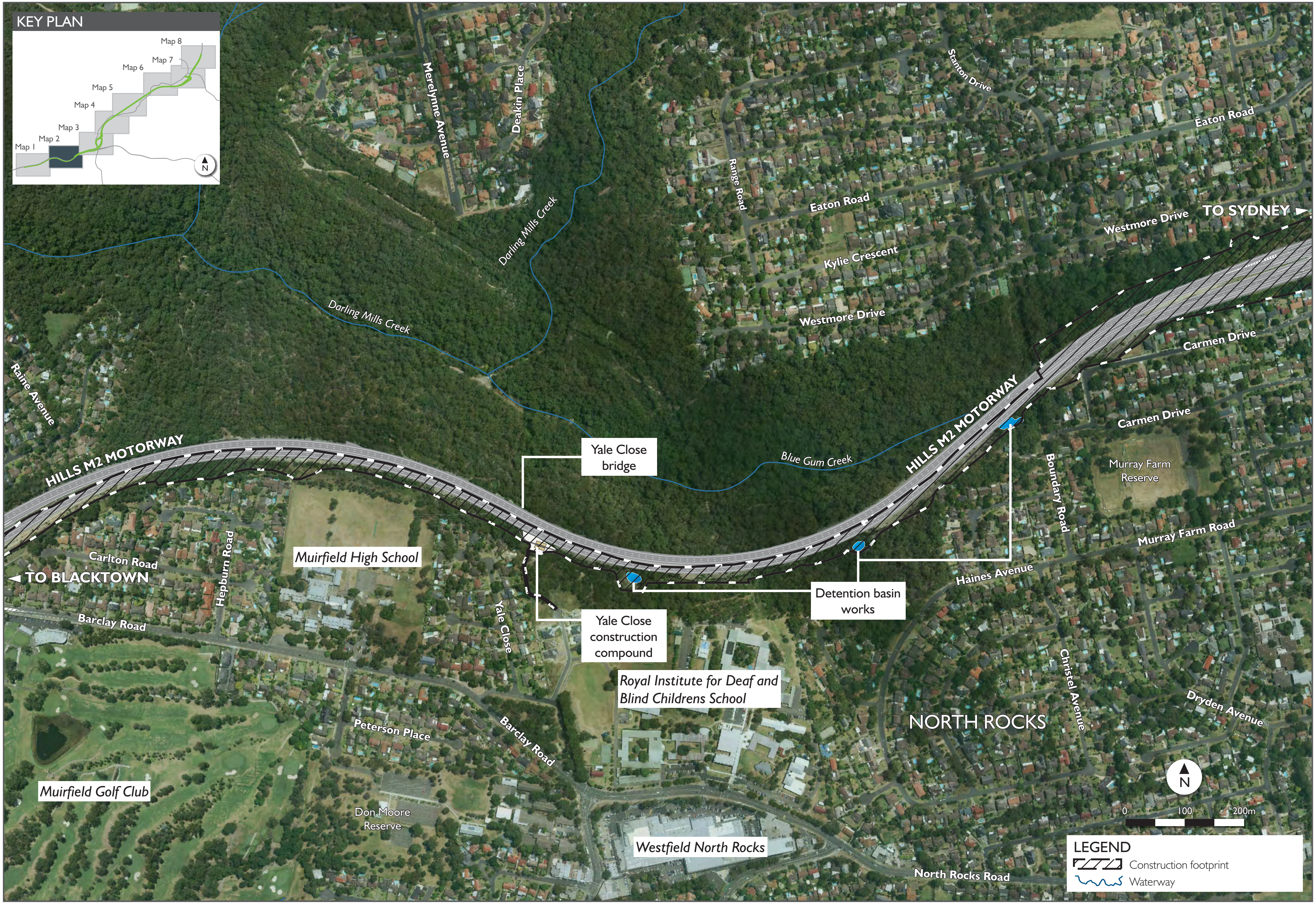


Figure 5-26 Project construction footprint - Map 2

(Blank page)

Figure 5-27 Project construction footprint - Map 3

(Blank page)

Figure 5-28 Project construction footprint - Map 4

(Blank page)

Figure 5-29 Project construction footprint - Map 5

(Blank page)

Figure 5-30 Project construction footprint - Map 6

(Blank page)

Figure 5-31 Project construction footprint - Map 7

(Blank page)

Figure 5-32 Project construction footprint - Map 8

(Blank page)

5.3.2 Overview of construction works

Details of the proposed early works and construction activities are provided in **Table 5-4**. Detailed descriptions of each construction activity are provided in sections which follow.

Table 5-4 Overview of construction works

Component	Typical activities
Early works	• Additional surveys and investigative works, including existing condition surveys of buildings and infrastructure, and geotechnical investigations. • Land acquisition. • Road and intersection modifications and installation of traffic controls. • Enabling works including public utility adjustments. • Supply of utilities to construction facilities. • Minor clearing works.
Site establishment works	• Installation of environmental controls. • Demolition of existing structures. • Vegetation clearing. • Establishment of construction facilities. • Traffic management measures.
Tunnelling works	• Excavation and temporary ground support. • Construction of declines and shafts. • Construction of cut and cover tunnel structures. • Construction of retaining walls. • Tunnelling for roads (including ramps). • Spoil management. • Finishing works in tunnel and provision of permanent tunnel services. • Concrete paving for road surface. • Installation of road furniture. • Architectural finishing. • Surface site rehabilitation and restoration.
Buildings and tolling gantries	• Tunnel support facilities and substations. • Motorway control centre. • Ventilation facilities and substations at the southern and northern interchanges. • Water treatment plants. • Motorway tolling infrastructure. • Gantries on Pennant Hills Road for truck regulation. • Landscaping.

Component	Typical activities
Southern interchange	• Earthworks. • Drainage structures. • Spoil management. • Paving. • Construction of integration roadwork. • Construction of Pennant Hills Road roadwork. • Installation of road furniture. • Installation of lighting and traffic lights. • Architectural finishes and landscaping. • Provision of temporary detour route for cyclists. • Installation of noise walls. • Construction of the switching station at Coral Tree Drive. • Traffic management to facilitate the works listed above including installation of temporary barriers.
Northern interchange	• Earthworks. • Drainage structures. • Spoil management. • Paving. • Construction of tie-in roadwork. • Construction of surface roadwork. • Installation of road furniture. • Installation of lighting and traffic lights. • Architectural design and landscaping. • Provision of temporary detour route for cyclists and associated signage. • Installation of noise walls. • Traffic management to facilitate the works listed above including installation of temporary barriers.
Testing and commissioning	• Testing of plant and equipment. • Commissioning of the project.
Site clean-up and demobilisation	• Removal of construction facilities. • Landscaping and rehabilitation of affected areas. • Post construction condition surveys. • Removal of construction environmental controls. • Removal of construction site related traffic signage.

5.3.3 Construction program

Subject to planning approval construction of the project is planned to commence in the first quarter of 2015, with completion of construction in the third quarter of 2019. The total period of construction works is expected to be around four years and around nine months of commissioning. The construction program is shown in **Table 5-5**.

Table 5-5 Indicative construction program

Construction activity	Indicative construction timeframe																							
	2014				2015				2016				2017				2018				2019			
Site establishment					■	■	■	■	■	■														
Shaft excavations							■	■	■	■	■	■	■	■	■									
Tunnelling							■	■	■	■	■	■	■	■	■	■								
Tunnel lining											■	■	■	■	■	■	■							
Concrete pavement													■	■	■	■	■	■						
Tunnel mechanical and electrical fit-out												■	■	■	■	■	■	■	■	■	■			
Southern portal					■	■	■																	
Hills M2 Motorway integration works								■	■	■	■	■	■	■	■									
Northern portal								■	■	■	■	■	■	■	■	■	■	■						
M1 Pacific Motorway tie-in works								■	■	■	■	■	■	■	■	■	■	■	■	■				
Wilson Road tunnel support facility													■	■	■	■	■	■	■	■	■			
Trelawney Street tunnel support facility													■	■	■	■	■	■	■	■	■			
Southern ventilation facility												■	■	■	■	■	■	■	■	■				
Northern ventilation facility														■	■	■	■	■	■	■	■			
Motorway control centre												■	■	■	■	■	■							
Commissioning																					■	■	■	

5.3.4 Early works

Early works are works that would generally take place early in the construction program in order to facilitate main construction activities. Early works would include:

- Property acquisitions.
- Demolition of properties.
- Adjustment, relocation and / or protection of utilities.
- Surveys and existing condition surveys of buildings and infrastructure.
- Investigative drilling.
- Traffic management changes to allow access to and egress from the construction sites.
- Installation of environmental control measures.
- Establishment of construction site fencing.
- Construction site establishment.
- Provision of power and other services to the construction sites.
- Heritage salvage or conservation works.
- Establishment of ancillary facility sites.
- Minor clearing works to facilitate other early works.

5.3.5 Tunnelling

Tunnel excavation

The project would involve the excavation of two tunnels around nine kilometres in length for the main alignment as well as additional tunnels for on and off-ramps at both the northern and southern interchanges. Tunnel depth would vary depending on geological constraints, however the tunnel crown (top of the tunnel) would vary up to a maximum depth of around 90 metres below ground level with shallower sections approaching the northern and southern portals.

Two standard cross sections for excavation would be used to accommodate the varying geology along the length of the project area. A fully arched profile would be used for excavations in Ashfield Shale and an arched roof profile with straight walls would be used for excavations in Hawkesbury Sandstone. Prior to tunnel fit-out, the main alignment tunnels would generally have an excavated width of around 14 metres, an excavated height of around eight metres and an excavated cross-sectional area of around 110 square metres. To accommodate 'line of sight' requirements and enlargements of egress tunnels and emergency bays, a number of sections would be widened beyond these standard widths.

The tunnels would not only provide space required for the traffic envelope, but would also provide space for required tunnel services including deluge systems, drainage infrastructure, communications cables, mechanical and electrical equipment, incident response infrastructure and ventilation infrastructure.

It is anticipated that tunnel excavation would be undertaken using a number of road headers and surface miners, supported from multiple sites. A road header is an excavation machine consisting of a boom-mounted rotating cutter head mounted on bulldozer-style tracks, a loader device usually on a conveyor, and a crawler travelling track to move the machine forward into the rock face. A surface miner is a mechanically driven excavation machine capable of cutting, crushing and loading in one continuous process. Localised blasting works may be carried out underground depending on the geological conditions encountered.

Ground support, involving tunnel lining, would be installed progressively following tunnel excavation. Two types of lining would be used for the project depending on the local geology. For the tunnels in Ashfield Shale or Class VI Hawkesbury Sandstone this would involve a full cast in-situ concrete lining, with a sprayed shotcrete lining used for the sections of tunnel in Class I to V Hawkesbury Sandstone.

The following have been identified as tunnelling launch and support sites (refer to **Section 5.3.12** for further details of these sites):

- The southern interchange compound (C5).
- Wilson Road compound (C6).
- Trelawney Street compound (C7).
- The northern interchange compound (C9).

Each of these sites would require support services for the tunnelling activity including power supply, ventilation, water supply, construction water treatment plants, workforce facilities and spoil handling and removal.

In addition to the main alignment tunnels and on and off-ramp tunnels, pedestrian cross passages would be excavated between the main alignment tunnels at 120 metre intervals and vehicle cross passages would be excavated around the Wilson Road and Trelawney Street tunnel support facilities. These cross passages would be excavated using small road headers, excavators with rock hammer, drilling and blasting

Tunnel civil finishing works

On completion of the tunnelling works, a variety of civil finishing works would occur including:

- Roadway drainage.
- Road pavement.
- Installation of road furniture.
- Electrical substations.
- Low point sumps.
- Cross passages including electrical rooms.
- Emergency smoke extraction outlets.

Tunnel fit-out

Following tunnel excavation and civil finishing works, the tunnels would be fitted out with required operational infrastructure. This would include power, ventilation, fire safety systems, communications, traffic control, tunnel lighting and the operations management and control systems.

This would be followed by a comprehensive commissioning process undertaken to validate the correct operation and integration of tunnel systems prior to road opening.

5.3.6 Earthworks

Earthworks would be required for the following above ground sections:

- The tunnel portals at the two interchanges.
- The Hills M2 Motorway integration works.
- The M1 Pacific Motorway tie-in works.

Earthworks would be completed using conventional methods of road construction. The general earthworks construction method would include:

- Vegetation clearance and topsoil stripping. Mulched vegetation and topsoil would be stockpiled for later re-use in site rehabilitation and landscaping works.
- Areas of new cut and fill to design levels, and widening of existing cuts and embankments. This may include the construction of retaining walls and reinforced soil walls.
- Installation of road drainage infrastructure.

5.3.7 Bridge works

The project would involve the construction of three new cycleway bridges and alteration of three existing road bridges along the Hills M2 Motorway. Alterations to existing bridge structures are summarised in **Table 5-6**.

Bridge works would generally include:

- Construction of the substructure, likely to be from cast in-situ concrete in the following sequence:
  - Piling works, such as bored piles.
  - Pile cap construction including localised excavation around the piles.
  - Pier or column construction.
- Headstock construction.
- Construction of the superstructure, likely to be through the placement of pre-cast concrete segments.

Table 5-6 Alterations to existing bridge structures

Location	Crossing type	Details
Yale Close	Hills M2 Motorway bridge over waterway	Widening of the overbridge by one additional lane (3.5 metres) to the south.
Barclay Road	Barclay Road bridge over Hills M2 Motorway	Extension of the overbridge by one additional lane (4 metres) to the south.
Darling Mills Creek	Hills M2 Motorway viaduct over Darling Mills Creek	Widening of the viaduct by one additional lane (3.5 metres) to the south.

5.3.8 Drainage

The project would require construction of new drainage infrastructure and alterations to existing drainage infrastructure. This would include:

- Construction of new pits and pipes for both surface and tunnel sections of the road.
- Construction of a sump near the southern interchange.
- Construction of an operational water treatment plant near the southern interchange.
- Adjustment of existing pits to suit new road alignments.
- Modification to four existing detention basins along the Hills M2 Motorway.
- Extension of five transverse drainage culverts under the Hills M2 Motorway by retrofitting of pre-cast concrete pipes or box segments.
- Alterations to the existing Pennant Hills Road drainage infrastructure.
- Construction of a new transverse drainage structure under the M1 Pacific Motorway / Pennant Hills Road connector.
- Construction of two spillage containment tanks around the northern interchange.

5.3.9 Pavement

Following tunnelling works, earthworks and bridge works, pavement works would be required. This would involve the construction of:

- Base and select layers of materials (in areas of earthworks only).
- Pavement layers.
- Pavement drainage, including kerb and gutter (where required).
- Concrete barriers, wire rope fencing and guardrails (where required).

5.3.10 Finishing works

Finishing works would be undertaken towards the completion of construction and would include:

- Line marking of new road pavement.
- Erection of directional signage and other roadside furniture such as street lighting.
- Erection of toll gantries at the southern interchange, including four new toll gantries for the project and the relocation of two existing Hills M2 Motorway toll gantries.
- Erection of truck regulatory gantries at the northern and southern ends of Pennant Hills Road.
- Landscaping works.
- Site demobilisation and rehabilitation of temporary ancillary facilities.

5.3.11 Construction of operational ancillary facilities

The project would involve the construction of a number of operational facilities including:

- The motorway control centre.
- Tunnel support facilities.
- Ventilation buildings and facilities near the southern and northern interchanges.
- Switching station located on Coral Tree Drive.

Motorway control centre

The motorway control centre (refer to **Figure 5-17**) would be fitted out with communications, security and electrical equipment to monitor and control all aspects of the tunnel, along with office space and worker amenities. Construction works would include:

- Excavation, footing and base slab installation.
- Erection of in-situ concrete columns and deck to the first floor.
- Erection of a precast concrete column to support the roof.
- Enclosure of the building with precast panels and curtain walls.
- Internal fit out of control rooms, computer rooms, offices and workshop and associated staff amenities.
- On-site maintenance and special vehicle sheds would be mainly constructed of light steel framing and roofs.
- Security fencing.
- Construction of an open storage and hardstand area for miscellaneous items.

Tunnel support facilities

Two tunnel support facilities would be constructed as part of the project, each comprising an emergency smoke extraction outlet and a substation.

The locations are shown in **Figure 5-13**.

The emergency smoke extraction outlet would be operated in the unlikely event of an emergency within the tunnels.

The construction methodology for the tunnel support facilities would involve:

- Bulk excavation and installation of retention piles to form a space for the fan chamber, intake and discharge plenum.
- Construction of footings and base slab for the structures.
- Installation of precast concrete panels and steel roof to expedite enclosure of the building (water tight).
- Internal fit out of plant areas, equipment installation and commissioning of the smoke plant rooms.
- Excavation of shafts to the main alignment tunnels.
- Construction of substations.

Ventilation facilities

Two ventilation facilities would be constructed as part of the project, with one facility situated at either end of the main alignment tunnels near the portals (refer to **Figure 5-13**). The southern ventilation facility would be located to the north-west of the Hills M2 Motorway / Pennant Hills Road interchange, with the northern ventilation facility located on the western side of the M1 Pacific Motorway on the corner of Bareena Avenue and Woonona Avenue, Wahroonga.

The construction methodology for the ventilation facilities would typically involve:

- Excavation to the main alignment tunnels.
- Backfilling or erecting a secondary floor to raise the plant as required to suit maintenance access requirements.
- Erecting precast concrete panels, block walls, steel roof to enclose the building.
- Erecting a facade supporting steel and cladding panels as per architectural design.
- Installing roof panels.
- Internal fit out of plant areas, equipment installation and commissioning.

Switching station

A switching station would be constructed on Coral Tree Drive adjacent to the Hills M2 Motorway (refer to **Figure 5-33**). The construction methodology for the switching station would typically involve:

- Excavation, footing and base slab installation.
- Erection of a precast concrete column to support the roof.
- Enclosure of the building with precast panels.
- Internal fit out electrical infrastructure.

(Blank page)

Figure 5-33 Coral Tree Drive switching station

(Blank page)

5.3.12 Construction ancillary facilities

Eleven construction ancillary facilities would be required as part of the project. This would include locations for road header and surface miner launch and support, earthworks support and workforce amenities.

The construction footprint and construction ancillary facilities are shown in overview in **Figure 5-24** to **Figure 5-32**, and described in detail in the following sections.

Table 5-7 outlines the proposed construction ancillary facilities and their uses during the construction of the project. Details of each of these facilities are provided in the following sections.

Table 5-7 Proposed construction ancillary facilities and activities

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	✓	✓										

Windsor Road compound (C1)

The Windsor Road compound would be located on the north-western side of the Windsor Road / Hills M2 Motorway interchange. The site was formerly utilised as a compound for recently completed Hills M2 Motorway Upgrade project and currently comprises vacant open space.

Site offices lunch rooms and staff amenities would be located in the eastern area of the site, with car parking located in the northern area of the site and storage in the western area.

An indicative construction site layout for the Windsor Road compound is shown in **Figure 5-34** and the proposed construction activities sequence is outlined in **Table 5-8**.

The site is proposed to be used as the main site office for the Hills M2 Motorway integration works. Site access and egress would be to and from Torr Street.

Table 5-8 Windsor Road compound indicative construction program

Construction activity	Indicative construction timeframe																			
	2014				2015				2016				2017				2018			
Site establishment								■												
Integration works support								■	■	■	■	■	■	■						
Site rehabilitation / landscaping														■	■					

Darling Mills Creek compound (C2)

The Darling Mills Creek compound would be located within the road reserve adjacent to the Darling Mills Creek viaduct. The site would generally consist of basic amenities for the workforce at the Darling Mills Creek viaduct. An indicative construction site layout for the Darling Mills Creek compound is shown in **Figure 5-35** and the proposed construction activities sequence is outlined in **Table 5-9**.

Primary site access would be provided from the Hills M2 Motorway westbound carriageway at the eastern bridge abutment by construction of a new access track. Access would also be provided from Ventura Road however this would be limited to the delivery and removal of drill rigs and excavation equipment.

Table 5-9 Darling Mills Creek compound indicative construction program

Construction activity	Indicative construction timeframe																			
	2014				2015				2016				2017				2018			
Site establishment								■	■	■										
Substructure									■	■	■	■	■							
Superstructure										■	■	■	■	■						
Finishing works												■	■	■						
Site rehabilitation / landscaping														■	■					

Barclay Road compound (C3)

The Barclay Road compound would be located on the southern side of the Hills M2 Motorway adjacent to Barclay Road and Perry Road. The site was formerly used as a construction compound for the recently completed Hills M2 Motorway Upgrade project and currently comprises open space, with some native and non-native vegetation.

The site would be used as a support site for the Barclay Road overbridge works and would comprise a laydown area and storage in the western area of the site, staff amenities in the southern area of the site and parking in the northern area of the site. An indicative construction site layout for the Barclay Road compound is shown in **Figure 5-36** and the proposed construction activities sequence is outlined in **Table 5-10**.

Vehicle access and egress would be to and from Perry Street.

Table 5-10 Barclay Road compound indicative construction program

Construction activity	Indicative construction timeframe																			
	2014				2015				2016				2017				2018			
Site establishment																				
Substructure																				
Superstructure																				
Finishing works																				
Site rehabilitation / landscaping																				

Yale Close compound (C4)

The Yale Close compound would be located within the road reserve adjacent to the Yale Close Bridge. The site would generally consist of basic amenities for the workforce at the Yale Close Bridge. An indicative construction site layout for the Yale Close compound is shown in **Figure 5-37** and the proposed construction activities sequence is outlined in **Table 5-11**.

Vehicle access and egress would be to and from the westbound carriageway of the Hills M2 Motorway.

Table 5-11 Yale Close compound indicative construction program

Construction activity	Indicative construction timeframe																			
	2014				2015				2016				2017				2018			
Site establishment																				
Substructure																				
Superstructure																				
Finishing works																				
Site rehabilitation / landscaping																				

Southern interchange compound (C5)

The southern interchange compound would be located to the north of the Hills M2 Motorway and to the west of Pennant Hills Road. The site currently comprises a number of residential properties, most of which are currently owned by Roads and Maritime, and one commercial property.

The construction works at the site would include:

- Excavation of two decline tunnels to the northbound on-ramp and the main northbound alignment tunnel. A shaft may also be excavated to the main northbound alignment tunnel.
- Support for tunnel excavation works, including power supply, ventilation, water supply, water treatment plant and workforce facilities.
- Removal of around 613,900 cubic metres of spoil.
- Construction of permanent operational facilities.

An indicative construction site layout for the southern interchange is shown in **Figure 5-38** and the construction activities sequence is outlined in **Table 5-12**.

Four road headers would be launched from this site and would excavate the tunnels in a northerly direction. Two acoustic sheds would be established in the middle of the site for the purpose of managing out of hours tunnelling and spoil handling. Heavy vehicle movements to and from the site, and on the site outside the acoustic sheds, would occur up to 24 hours per day and seven days per week. Spoil handling outside of the acoustic sheds would be limited to standard daytime construction hours only.

Heavy vehicle movements outside of standard construction hours associated with tunnel spoil removal would only occur via access and egress directly to and from Pennant Hills Road.

Spoil would be moved during the day where practical, and feasible and reasonable management strategies investigated to minimise the volume of heavy vehicle movements at night.

Car parking, site office and staff amenities would be located at the northern end of the site, with a workshop and general laydown area between the two acoustic sheds.

Following tunnel construction the permanent operational facilities would be constructed, including the southern ventilation outlet, the motorway control centre, a substation and the operational water treatment plant.

Heavy vehicle and light vehicle access and egress to and from the site would be from Eaton Road.

At the completion of construction, the areas surrounding the permanent operational facilities would be rehabilitated and landscaped.

Table 5-12 Southern interchange indicative construction program

Construction activity	Indicative construction timeframe 2014				2015				2016				2017				2018				2019			
Site establishment																								
Southern portals																								
Tunnelling																								
Tunnel lining																								
Pavement																								
Tunnel mechanical and electrical fit-out																								
Ventilation station																								
Motorway control centre construction																								
Motorway control centre fit-out																								
Site rehabilitation / landscaping																								

Wilson Road compound (C6)

The Wilson Road compound would be located on the corner of Wilson Road and Pennant Hills Road. The site is currently occupied by residential properties.

The proposed construction works at the site would include:

- Excavation of a shaft to main alignment tunnels.
- Support for tunnel excavation works, including power supply, ventilation, water supply, water treatment plant and workforce facilities.
- Removal of around 441,950 cubic metres of spoil.
- Construction of permanent operational facilities.

An indicative construction site layout for the Wilson Road compound is shown in **Figure 5-39** and the proposed construction activities sequence is outlined in **Table 5-13**.

Four large road headers and one smaller road header would be launched from this site. Large road headers would excavate the tunnels in both a northerly and southerly direction while the smaller road header would be used for cross passage excavation. An acoustic shed would be established in the middle of the site for the purpose of managing out of hours tunnelling and spoil handling. Heavy vehicle movements to and from the site, and on the site outside the acoustic shed, would occur up to 24 hours per day and seven days per week. Spoil handling outside of the acoustic shed would be limited to standard daytime construction hours only. Heavy vehicle movements outside of standard construction hours associated with tunnel spoil removal would only occur via access and egress directly to and from Pennant Hills Road.

Spoil would be moved during the day where practical, and feasible and reasonable management strategies investigated to minimise the volume of heavy vehicle movements at night.

Car parking, site office and staff amenities would be located at the northern end of the site, with a workshop and general laydown located to the east of the acoustic shed.

Following tunnel construction, the permanent tunnel support facility would be constructed.

Heavy vehicle access and egress to and from the site would be left in and left out from Pennant Hills Road. Light vehicle access and egress would be to and from Wilson Road.

At the completion of construction, the areas surrounding the permanent operational facilities would be rehabilitated and landscaped.

Table 5-13 Wilson Road indicative construction program

Construction activity	Indicative construction timeframe																							
	2014				2015				2016				2017				2018				2019			
Site establishment								■	■	■														
Shaft excavation											■	■	■	■										
Tunnelling												■	■	■	■	■								
Tunnel lining														■	■	■	■							
Pavement																■	■	■						
Tunnel mechanical and electrical fit-out																■	■	■	■	■	■			
Tunnel support facility construction															■	■	■	■	■	■				
Site rehabilitation / landscaping																					■	■	■	

Trelawney Street compound (C7)

The Trelawney Street compound would be located between Trelawney Street and Loch Maree Avenue on the eastern side of Pennant Hills Road in Thornleigh. The site currently comprises residential properties and several businesses.

The proposed construction works at the site would include:

- Excavation of a shaft to main alignment tunnels.
- Support for tunnel excavation works, including power supply, ventilation, water supply, water treatment plant and workforce facilities.
- Removal of around 492,200 cubic metres of spoil.
- Construction of permanent operational facilities.

An indicative construction site layout for the Trelawney Street compound is shown in **Figure 5-40** and the proposed construction activities sequence is outlined in **Table 5-14**.

Four large road headers and one smaller road header would be launched from this site. Large road headers would excavate the tunnels in both a northerly and southerly direction while the smaller road header would be used for cross passage excavation. An acoustic shed would be established in the northern section of the site for the purpose of managing out of hours tunnelling and spoil handling. Heavy vehicle movements to and from the site, and on the site outside the acoustic shed, would occur up to 24 hours per day and seven days per week. Spoil handling outside of the acoustic shed would be limited to standard daytime construction hours only.

Heavy vehicle movements outside of standard construction hours associated with tunnel spoil removal would only occur via access and egress directly to and from Pennant Hills Road.

Spoil would be moved during the day where practical, and feasible and reasonable management strategies investigated to minimise the volume of heavy vehicle movements at night.

Car parking and office / staff amenities, general storage, laydown areas and a substation would be located at the southern end of the site.

Following tunnel construction, the permanent tunnel support facility would be constructed.

Heavy vehicle access to the site would be from Loch Maree Avenue with egress to Pennant Hills Road. Light vehicle access and egress would be to and from a separate point on Loch Maree Avenue.

At the completion of construction, the areas surrounding the permanent operational facilities would be rehabilitated and landscaped.

Table 5-14 Trelawney Street indicative construction program

Construction activity	Indicative construction timeframe																							
	2014				2015				2016				2017				2018				2019			
Site establishment																								
Shaft excavation																								
Tunnelling																								
Tunnel lining																								
Pavement																								
Tunnel mechanical and electrical fit-out																								
Tunnel support facility construction																								
Site rehabilitation / landscaping																								

Pioneer Avenue compound (C8)

An indicative construction site layout for the Pioneer Avenue compound is shown in **Figure 5-41** and the proposed construction activities sequence is outlined in **Table 5-15**.

Pioneer Avenue compound would be located directly adjacent to the Northern Railway Line on Pioneer Avenue in Thornleigh. The site was previously used as a malt works which is not currently operational. A number of structures exist on the site which would require removal for construction of the compound.

The site would generally consist of:

- Up to 600 light vehicle parking spaces.
- A bus transfer area for up to 12 buses.
- Employee change rooms and showers.
- A first aid station.

The compound would be primarily used as a car parking location for construction personnel. A shuttle bus would be used to transfer workers to and from construction sites throughout the construction footprint. This would limit the amount of workforce parking required within the construction compounds and in the surrounding streets.

The site would be established at the commencement of the construction period and would remain in use until construction works are complete. The employee car parking and shuttle bus would operate up to 24 hour per day and seven days per week.

Access to the site would primarily be from Lymoore Avenue with secondary access from Pioneer Avenue.

Table 5-15 Pioneer Avenue indicative construction program

Construction activity	Indicative construction timeframe																							
	2014				2015				2016				2017				2018				2019			
Site establishment					■																			
Construction support					■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Site rehabilitation / landscaping																						■	■	

Northern interchange compound (C9)

The northern interchange compound would be located adjacent to the M1 Pacific Motorway / Pennant Hills Road connector and north of Eastbourne Avenue. The area currently comprises vegetated vacant land owned by Roads and Maritime.

The proposed construction works at the site would include:

- Excavation of a shaft to main alignment tunnels.
- Support for tunnel excavation works, including power supply, ventilation, water supply, water treatment plant and workforce facilities.
- Removal of around 743,150 cubic metres of spoil.

An indicative construction site layout for the northern interchange is shown in **Figure 5-42** and the proposed construction activities sequence is outlined in **Table 5-16**.

Four road headers would be launched from this site and excavate the tunnels in both a northerly and southerly direction. An acoustic shed would be established in the northern section of the site for the purpose of managing out of hours tunnelling and spoil handling. Heavy vehicle movements to and from the site, and on the site outside the acoustic shed, would occur up to 24 hours per day and seven days per week. Spoil handling outside of the acoustic shed would be limited to standard daytime construction hours only.

Heavy vehicle movements outside of standard construction hours associated with tunnel spoil removal would only occur via access and egress directly to and from the M1 Pacific Motorway.

Spoil would be moved during the day where practical, and feasible and reasonable management strategies investigated to minimise the volume of heavy vehicle movements at night.

The southern end of the compound would comprise car parking, staff facilities and general laydown areas.

This compound would also be used to support the northern interchange surface construction works including earthworks and road widening for the on and off-ramp portals.

Heavy vehicle access and egress to and from the compound would be from the M1 Pacific Motorway / Pennant Hills Road connector. Light vehicle access and egress would be to and from Eastbourne Avenue via a new access road.

At the completion of construction, the site would be rehabilitated and landscaped.

Table 5-16 Northern interchange indicative construction program

Construction activity	Indicative construction timeframe																			
	2014				2015				2016				2017				2018			
Site establishment					■	■														
Shaft excavation					■	■	■													
Tunnelling							■	■	■	■	■	■	■	■	■					
Tunnel lining											■	■	■	■	■	■	■			
Pavement													■	■	■	■	■			
Tunnel mechanical and electrical fit-out											■	■	■	■	■	■	■	■	■	
Site rehabilitation / landscaping																		■	■	■

Bareena Avenue compound (C10)

The Bareena Avenue compound would be located on the corner of Bareena Avenue and Woonona Avenue North in Wahroonga. The site currently comprises residential properties.

The proposed construction works would include:

- Construction of the ventilation facility building.
- Fit out of tunnel ventilation, mechanical and electrical equipment.

Spoil from the cut-and-cover tunnel construction would also be removed through this site.

An indicative construction site layout for the Bareena Avenue compound is shown in **Figure 5-43** and the proposed construction activities sequence is outlined in **Table 5-17**.

Site offices and car parking would be located in the western portion of the site, with general storage and water collection areas provided in the eastern portion of the site.

Heavy vehicle and light vehicle access and egress to and from the compound would primarily be from the M1 Pacific Motorway however occasional access would be required from Woonona Avenue North, Wahroonga.

At the completion of construction, the areas surrounding the permanent operational facility would be rehabilitated and landscaped.

Table 5-17 Bareena Avenue indicative construction program

Construction activity	Indicative construction timeframe																			
	2014				2015				2016				2017				2018			
Site establishment								■	■											
Ventilation outlet construction									■	■	■	■	■	■	■	■	■			
Site rehabilitation / landscaping																■	■	■		

Junction Road compound (C11)

The Junction Road compound would be located on the eastern side of the M1 Pacific Motorway, north of Junction Road. The site currently comprises vegetated vacant land, part of which is located within the existing road reserve of the M1 Pacific Motorway.

An indicative construction site layout for the Junction Road compound is shown in **Figure 5-44** and the proposed construction activities sequence is outlined in **Table 5-18**.

The site is proposed to be used as a parking and site office facility only, with office facilities located at the southern end of the site and car parking facilities at the northern end.

Light vehicle access and egress would be to and from Coonanbarra Road and Carrington Road. With the exception of site establishment and delivery vehicles, heavy vehicle movements are not proposed at this site. The access road from Coonanbarra Road would require a temporary crossing of Cockle Creek.

At the completion of construction, the site would be rehabilitated and landscaped.

Table 5-18 Junction Road indicative construction program

Construction activity	Indicative construction timeframe																							
	2014				2015				2016				2017				2018				2019			
Site establishment																								
Construction support																								
Site rehabilitation / landscaping																								

Figure 5-34 Indicative Windsor Road construction compound

(Blank page)

Figure 5-35 Indicative Darling Mills Creek viaduct construction compound

(Blank page)

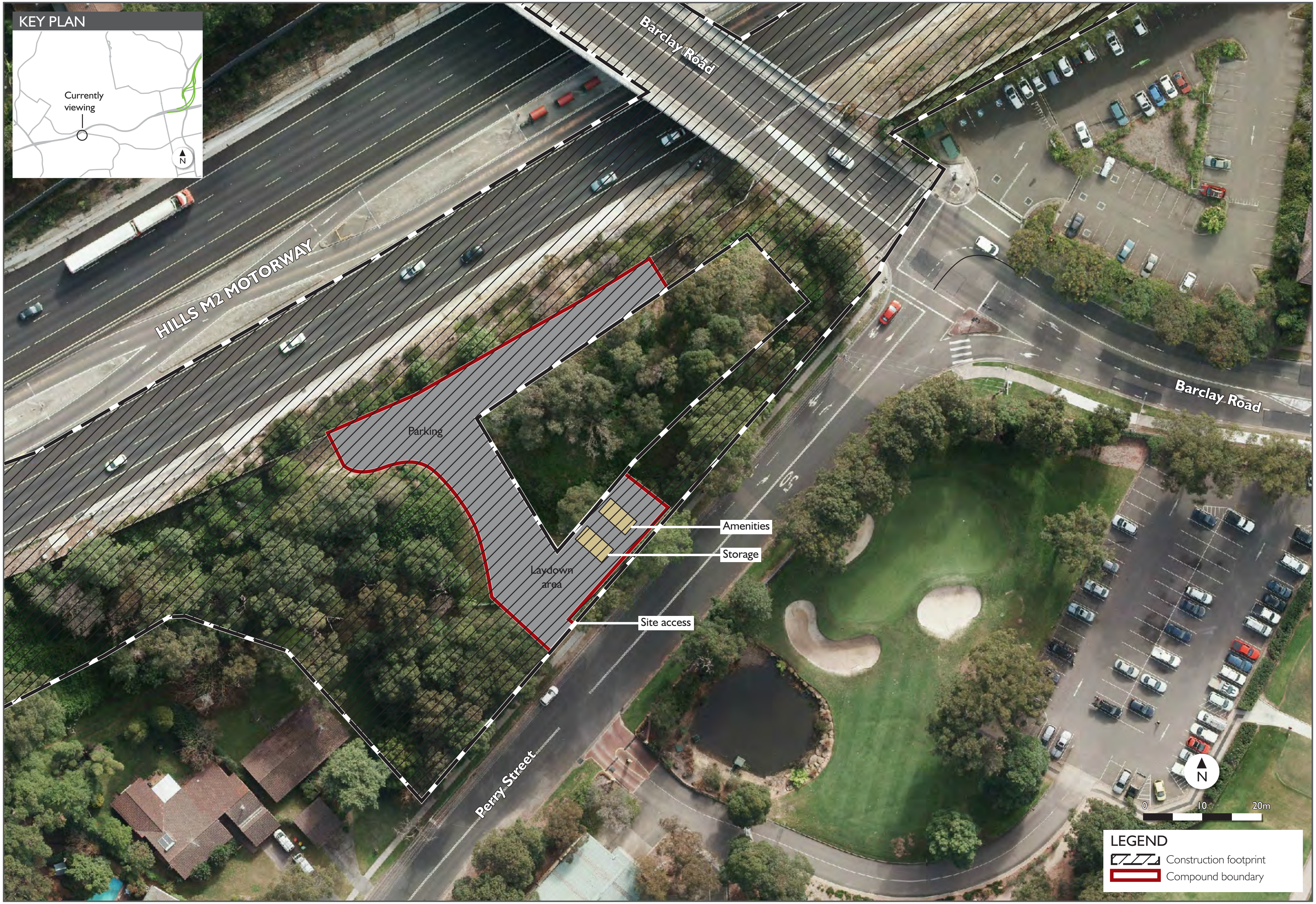


Figure 5-36 Indicative Barclay Road construction compound

(Blank page)

Figure 5-37 Indicative Yale Close construction compound

(Blank page)

Figure 5-38 Indicative southern interchange construction compound

(Blank page)

Figure 5-39 Indicative Wilson Road construction compound

(Blank page)

Figure 5-40 Indicative Trelawney Street construction compound

(Blank page)

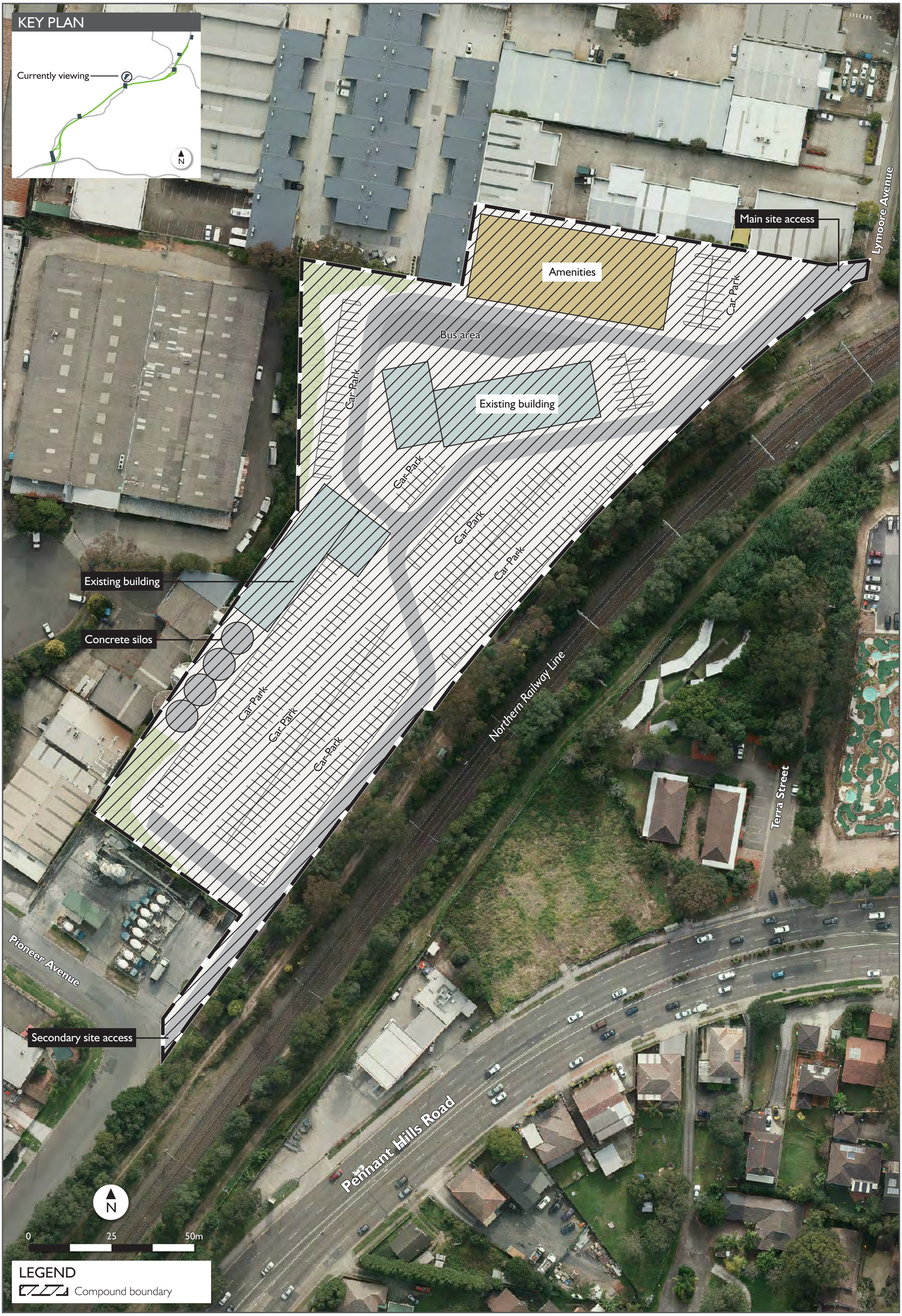


Figure 5-41 Indicative Pioneer Avenue construction compound

(Blank page)

Figure 5-42 Indicative northern interchange construction compound

(Blank page)

Figure 5-43 Indicative Bareena Avenue construction compound

(Blank page)

Figure 5-44 Indicative Junction Road construction compound

(Blank page)

5.3.13 Demolition

The project has been designed with the aim of minimising the need for land acquisition and property demolition as far as practical. However, the project would require the demolition of a number of properties located within the construction footprint with the majority of these being residential properties. Indicatively, the project would involve the demolition of:

- Forty-seven residential properties.
- Three commercial properties.
- Various industrial buildings and structures at the Pioneer Avenue compound (C8) including a storage shed, steel silos, a kiln structure and a residential house.

The Hills M2 Motorway integration works and the M1 Pacific Motorway tie-in would also require the demolition of some existing road infrastructure including bridge elements, road pavement and retaining walls.

Generally, demolition works would be undertaken early in the construction program to ensure site readiness and to allow main construction activities to commence.

5.3.14 Traffic management and access

The construction of the project would be subject to careful traffic management to ensure the ongoing functionality of surrounding roads, and the safety of members of the public, motorists and construction personnel.

Generally, temporary road pavements would be constructed early in the construction program to remove live traffic from the construction work zones. However, a number of phases of traffic management and traffic switches would be required around the two interchanges to facilitate construction of the on and off-ramps as well as the Hills M2 Motorway integration works and the M1 Pacific Motorway tie-in.

The project would also necessitate the temporary alteration of cyclist and pedestrian facilities, although alternative access arrangements would be implemented around construction sites, compounds and access points. As the project would occupy the breakdown lanes of both the Hills M2 Motorway and the M1 Pacific Motorway during the construction period, it would be necessary to exclude cyclists from these stretches of road for safety reasons. Appropriate detour routes would be established, utilising existing cycle routes and paths wherever possible.

The proposed access and egress points to and from the construction ancillary facilities are described in **Section 5.3.2.**

Daily worst case light vehicle and heavy vehicle numbers associated with spoil and waste removal, material deliveries and arrival and departure of construction workers are summarised in **Table 5-19**. Wherever possible, access and egress routes are proposed to be from major arterial roads.

Table 5-19 Construction traffic management and access

Site	Proposed access route	Daily heavy vehicle	Daily light vehicle
Windsor Road compound (C1)	Torr Street	20	85
Darling Mills compound (C2)	Hills M2 Motorway eastbound carriageway and Ventura Street.	50	20
Barclay Road compound (C3)	Perry Street	50	52
Yale Close compound (C4)	Hills M2 Motorway westbound carriageway.	50	20
Southern interchange (C5)	Eaton Road (left in, right out)	740	165
Wilson Road compound (C6)	Pennant Hills Road (left in, left out; heavy vehicles only) Wilson Road (light vehicles only)	600	100
Trelawney Street compound (C7)	Loch Maree Avenue (left in; heavy vehicles only) Pennant Hills Road (left out; heavy vehicles only) Loch Maree Avenue (separate light vehicle only access)	570	100
Pioneer Avenue compound (C8)	Lymoore Avenue Pioneer Avenue (secondary)	12	650
Northern interchange (C9)	M1 Pacific Motorway / Pennant Hills Road connector (left in, left out; heavy vehicles only) Eastbourne Avenue (light vehicles only)	720	100
Bareena Avenue compound (C10)	M1 Pacific Motorway (left in, left out) Woonona Avenue North	20	25
Junction Road compound (C11)	Coonanbarra Road	1	100

5.3.15 Construction workforce and construction work hours

Construction workforce

Around 1,250 jobs are expected to be directly created during the peak construction period of the project. This would include both the staff and labour workforce. Further jobs in the local area are likely to be indirectly supported by the project.

Construction work hours

The proposed construction hours for surface, tunnelling and traffic management at each of the construction sites are summarised in **Table 5-20**.

The majority of above ground construction works would be undertaken between the following hours:

- 7 am to 6 pm Monday to Friday.
- 8 am to 1 pm Saturdays.
- No works on Sundays or Public Holidays.

As tunnelling works operate continuously, below ground tunnelling and the associated surface support activities would be undertaken up to 24 hours per day and seven days per week. This would include heavy vehicle movements to and from the tunnelling support compounds, and on these sites outside the acoustic sheds, up to 24 hours per day and seven days per week.

Heavy vehicle movements outside of standard construction hours associated with tunnel support works (spoil removal, concrete delivery and other truck movements) would only occur via access and egress directly to and from Pennant Hills Road or the M1 Pacific Motorway and would only occur at the following compounds:

- Southern interchange compound (C5).
- Wilson Road compound (C6).
- Trelawney Street compound (C7).
- Northern interchange compound (C9).

Spoil would be moved during the day where practical, and feasible and reasonable management strategies investigated in consultation with the NSW Environment Protection Authority to minimise the volume of heavy vehicle movements at night.

Substantial works would need to be undertaken outside of these hours to reduce inconvenience to road users and ensure the safety of construction workers and the public. This would include activities such as:

- Widening and lengthening of existing bridges.
- Road tie-in works.
- Traffic management, set-up and traffic switches.
- Utility relocations (where the relocation is in proximity to traffic).
- Erection of traffic signs (where erection is in proximity to traffic).
- Pavement and temporary median works.
- Asphalt works and line-marking.
- Use of construction compounds to support out of hours works.

Table 5-20 Proposed construction hours

Activity	Construction hours	Comments or exceptions
Underground construction activities		
Tunnelling works	24 hours per day, seven days per week.	• Activities that support tunnelling works would occur 24 hours per day, seven days per week. • Rock hammering and blasting in the tunnel would be avoided between 10 pm and 7 am where it may impact nearby receivers.
Surface construction activities		
Construction sites	Daytime construction hours: • 7 am to 6 pm on weekdays. • 8 am to 1 pm on Saturdays. • No works on Sundays or public holidays.	Where noise management measures have been established, the following activities would be undertaken 24 hours per day, up to seven days per week: • Surface works supporting underground construction. • Construction traffic movements for tunnel support. • Excavation and spoil removal from construction shafts at the surface, conducted over two shifts per day. • Temporary possession of roads may need to be undertaken outside standard construction hours to avoid elevated safety impacts and inconvenience to commuters.
Construction traffic	24 hours per day, up to seven days per week.	• Construction traffic would be limited and managed during peak hours and special events. • Construction vehicle movements would be limited and managed during evening and night-time in residential areas or close to identified sensitive receivers. • Heavy vehicle movements outside of standard construction hours associated with tunnel support works (spoil removal, concrete delivery and other heavy vehicle movements) would only occur via access and egress directly to and from Pennant Hills Road or the M1 Pacific Motorway and would only occur at the following compounds: – Southern interchange compound (C5). – Wilson Road compound (C6). – Trelawney Street compound (C7). – Northern interchange compound (C9). Spoil would be moved during the day where practical, and feasible and reasonable management strategies investigated in consultation with the NSW Environment Protection Authority to minimise the volume of heavy vehicle movements at night.

Other works which would be undertaken outside of standard daytime construction hours without any further approval would include any of the following circumstances:

- Works which are determined to comply with the relevant Noise Management Level at the nearest sensitive receiver.
- The delivery of materials as required by the Police or other authorities for safety reasons.
- Where it is required to avoid the loss of lives, property and / or to prevent environmental harm in an emergency.
- Where agreement is reached with affected receivers.

Out of hours work may also be undertaken where explicitly approved through an environment protection licence.

5.3.16 Plant and equipment

The equipment listed in **Table 5-21** are likely to be used during the construction the project.

Table 5-21 Indicative construction plant and equipment

Plant / equipment	Hills M2 Motorway integration	Southern interchange compound (C5)	Wilson Road compound (C6)	Trelawney Street compound (C7)	Northern interchange compound (C9)	Bareena Avenue compound (C10)
Surface						
100 tonne / 10 tonne gantry crane			✓	✓	✓	
160 kilowatt fan		✓(4)	✓(4)	✓(4)	✓(4)	
20 tonne excavator		✓	✓	✓		✓
24 tonne excavator		✓(2)	✓	✓	✓	
30 tonne excavator	✓(6)	✓	✓	✓		✓
Backhoe	✓(6)	✓	✓	✓		
Bobcat		✓	✓	✓		
80 tonne piling rig	✓(3)	✓	✓	✓		✓
Dozer	✓(6)					✓
Dump truck						✓(4)
25 tonne mobile crane		✓	✓	✓		✓
50 tonne mobile crane	✓(6)	✓	✓	✓		✓
100 tonne mobile crane		✓	✓	✓		✓
Hiab truck		✓	✓	✓		✓
10 tonne smooth drum vibrating roller	✓(6)	✓	✓	✓		✓
Compactor						✓
Grader	✓(6)					
Concrete saw / cutter	✓(4)					
Rock saw	✓(4)					
Hydraulic hammer / rock breaker	✓(6)					
Jackhammer	✓(6)					
Rock crusher	✓(6)					

Plant / equipment	Hills M2 Motorway integration	Southern interchange compound (C5)	Wilson Road compound (C6)	Trelawney Street compound (C7)	Northern interchange compound (C9)	Bareena Avenue compound (C10)
Asphalt laying machine	✓(2)					
Truck	✓(10)					
Line marking machine	✓(2)					
Paving machine	✓(2)					
30 tonne gantry crane			✓	✓	✓	
60 kilowatt fan		✓				
Air compressor		✓(2)	✓(2)	✓(2)	✓(2)	
Bucket loader		✓(2)	✓	✓	✓	✓
100 tonne crawler crane		✓(2)	✓	✓	✓	
Grout plant / paddle mixer		✓(2)	✓	✓	✓	
Jumbo drill (shaft)		✓(2)	✓	✓	✓	
Road sweeper truck		✓	✓	✓	✓	✓
Skid steer loader		✓	✓	✓	✓	✓
Submersible pump		✓(8)	✓(6)	✓(6)	✓(6)	✓
Sump pump		✓(3)	✓(2)	✓(2)	✓(2)	✓(3)
Water cart	✓(2)	✓	✓	✓	✓	✓
Water treatment plant		✓	✓	✓	✓	
100 kilovolt ampere generator	✓(4)	✓	✓	✓		✓
Underground						
12 tonne mini excavator with hammer		✓	✓	✓	✓	
24 tonne excavator		✓	✓	✓	✓	
24 tonne excavator with diamond cutting tool		✓(2)	✓	✓	✓	
Booster pumps		✓	✓	✓	✓	
Bucket loader		✓(3)	✓(3)	✓(3)	✓(3)	
Colloidal grout mixer		✓	✓	✓	✓	
Concrete agitator		✓(4)	✓(4)	✓(4)	✓(4)	
Deduster (dry type) and fan		✓(4)	✓(5)	✓(5)	✓(5)	
25 tonne articulated dump truck		✓(7)	✓(6)	✓(6)	✓(6)	
Gate end box		✓(4)	✓(4)	✓(4)	✓(4)	
200 kilowatt roadheader (for cross passages)			✓	✓	✓	
300 kilowatt roadheader		✓(4)	✓(4)	✓(4)	✓(4)	
Rockbolting rig		✓(3)	✓(3)	✓(3)	✓(3)	
Shotcrete robot		✓(3)	✓(3)	✓(3)	✓(3)	
Skid steer loader			✓	✓	✓	
Water cart					✓	

5.3.17 Construction materials

Construction would require various materials and pre-cast elements. The major construction materials required would include:

- General fill and select fill for earthworks. This would be sourced from within the project cutting and from tunnel spoil where the material is of suitable quality.
- Pavement materials, including road base and sub-base.
- Materials for lining drainage channels.
- Aggregate used for concrete and asphalt.
- Cement and concrete.
- Steel for reinforcement.
- Wood for use in formwork and other temporary structures.
- Water.
- Pre-cast concrete including pipes, culvert segments, and roadside barriers.
- Mechanical and electrical equipment for tunnel fit out.

Construction material would generally be sourced from off-site suppliers. This would include the balance of fill material to address shortfalls in required volumes in the event that material sourced from on-site is unsuitable. Wherever possible, local sources of construction materials would be preferred in order to minimise haulage distances.

5.3.18 Spoil and waste disposal

Based on the concept design, the project would generate around 2.6 million cubic metres of spoil. The anticipated volume from each site is shown in **Table 5-22.**

Table 5-22 Anticipated spoil generation

Site	Spoil volume (cubic metres)
Southern interchange compound (C5)	613,900
Wilson Road compound (C6)	441,950
Trelawney Street compound (C7)	492,200
Northern interchange compound (C9)	743,150
Northern portals	281,200
Hills M2 Motorway integration works	39,800
Total	2,612,200

Other waste streams which would be generated during construction of the project include:

- Demolition waste from existing structures and properties.
- Contaminated soil which may be encountered during construction.
- General construction waste such as concrete, steel and timber formwork off-cuts.
- Vegetation waste from clearing and grubbing.
- Plant and vehicle maintenance waste such as oils and lubricants.
- General office waste such as paper, cardboard, plastics and food waste.
- Sewage waste.

Disposal sites

A number of potential sites have been identified with the necessary capacity to receive the spoil generated by the project. These include:

- The ADI site, St Marys with a capacity for between two and 2.5 million cubic metres.
- Gosford Quarry with a capacity of around 2.5 million cubic metres.
- Hornsby Quarry with a capacity of around 3.3 million cubic metres.
- The CSR Quarry with a capacity of around 1.16 million cubic metres.
- The Defence precinct Schofields (HMAS Nirimba) with a capacity of 500,000 cubic metres.
- The Great Southern Rock Quarry Sandy Point with an anticipated capacity of around five million cubic metres.

Other disposal / re-use sites may be used depending on need at the time spoil is generated. Further details regarding spoil generation and management are provided in **Section 7.1** (Traffic and transport) and **Section 8.3** (Resource management and waste minimisation).

5.3.19 Resource consumption

Indicative quantities of the major sources of materials required for construction are detailed in **Table 5-23**.

Table 5-23 Indicative resource requirements

Material	Estimated quantity required
Plain shotcrete	41,000 cubic metres
Steel fibre reinforced shotcrete – concrete	221,000 cubic metres
Steel fibre reinforced shotcrete – steel	8,200 tonne
Polypropylene reinforced shotcrete – polypropylene	136 tonne
No-Fines – concrete	64,000 cubic metres
Base paving – concrete	66,400 cubic metres
New jersey kerbs – concrete	26,000 cubic metres
Piles – concrete	59,000 cubic metres
Retaining walls – concrete	54,000 cubic metres
Bridges – concrete	1,300 cubic metres
Noise walls -	1,400 cubic metres
Rock bolts	5,000 tonne
Reinforcing steel	5,280 tonne
Asphalt	25,000 tonne
Crushed aggregate	21,500 tonne
Conduit – PVC	810,000 metres
Copper cables	1,880 tonne
Concrete drainage pipes	18,000 metres
Power	80 million kilowatt hours
Water	3,000 mega litres

Construction power

Power supply would be required during the construction works, at the majority of construction ancillary facilities. In particular, high voltage power would be required at the tunnel support sites. Prior to the connection of mains power supply to the tunnel support sites, road headers would be powered by diesel generators. The power supply for each site would be sourced from outside the project area. **Table 5-24** summarises the power supply for construction ancillary facilities including supply source, likely supply route and power demand. The construction power supply routes shown below are for information purposes only and do not form part of this assessment. Further assessment would be required in consultation with the relevant power supply authority.

Table 5-24 Construction power supply

Construction site	Supply source substation	Distance to worksite (kilometres)	Supply route	Connected load (mega volt ampere)
Southern interchange compound (C5)	Pennant Hills Zone Substation	5	Victoria Road into Loftus Road then Pennant Hills Road to the southern interchange site	7
Wilson Road compound (C6)	Pennant Hills Zone Substation	0.5	Victoria Road into Loftus Road then to Killaloe Avenue and along Wilson Road to the site	5
Trelawney Street compound (C7)	Pennant Hills Zone Substation	4	Victoria Road across Loftus Road to Boundary Road then into Belamy Street. Up Stevens Street to Yarrara Road which becomes the Esplanade to Duffy Road. Along Duffy Road to Pennant Hills Road then to Loch Maree Avenue and into the site.	5
Northern interchange compound (C9)	Hornsby Zone Substation	4.5	Bridge Road to Sherbrook Road, Edgeworth David Avenue to the M1 Pacific Motorway corridor. Along the motorway corridor to the construction site	5

Note: These routes are indicative only and subject to change during detailed design and consultation with relevant power authorities.

Construction water

Tunnelling works would require significant volumes of water for excavation and would generate wastewater requiring treatment and disposal. Further details are provided in **Section 7.9** (Surface water).

Construction water supply would also be required for the following construction activities:

- Interchange construction and road widening activities, including earthworks, concreting and dust suppression for surface works.
- Building construction activities.

Estimated volumes of water required for construction are provided in **Table 5-25**.

Table 5-25 Indicative construction water supply

Source		Southern interchange compound (C5)	Wilson Road compound (C6)	Trelawney Street compound (C7)	Northern interchange compound (C9)	Road works	Total
Total potable water supply (mega litres)	Sydney Water mains	635	485	450	600	80	2,250
Total non-potable water supply (mega litres)	Collected rainwater	35	10	10	15	-	70
	Treated groundwater	190	160	150	235	-	735
Total		860	655	610	850	80	3,055

6 Consultation

This chapter describes the communication and engagement activities carried out to date during the recent stages of the project's development and the preparation of the environmental impact statement. **Table 6-1** outlines the Director-General's Requirements as they relate to community consultation and where these have been addressed in the environmental impact statement. A summary of the consultation carried out during the options and alternatives development stage of the project (from 2002 to 2007) is also provided.

Also outlined in this chapter is the process for the public exhibition of the environmental impact statement as well as planned consultation activities during the construction and commissioning phases, should the project be approved.

Table 6-1 Director-General's Requirements - consultation

Director-General's Requirement	Where addressed
During the preparation of the EIS, consult with the relevant local, State or Australian Government authorities, service providers, community groups and affected landowners. In particular you must consult with:	Information regarding consultation carried out during the environmental impact statement is provided in this chapter.
• Local, State and Australian government authorities, including the: – Environment Protection Authority; – NSW Health; – Office of Environment and Heritage (including Heritage Division); – NSW Office of Water; – Department of Primary Industries; – The Hills Shire Council; – Hornsby Shire Council; and – Ku-ring-gai Municipal Council.	Consultation with government authorities is described in **Section 6.3** and **Section 6.4**. Issues raised by government agencies are identified in **Table 6-6** and issues raised by local councils are identified in **Table 6-7**.
• specialist interest groups, including Local Aboriginal Land Councils and Aboriginal stakeholders;	Consultation with Aboriginal stakeholders is described in **Section 6.3.2** and **Section 6.4.4**. Further details are provided in **Section 7.11** and the technical working paper: Aboriginal heritage (**Appendix M**).
• emergency services;	Consultation with emergency services is described in **Section 6.3**.
• utilities and service providers; and	Consultation with utility and service providers is described in **Section 6.3**.
• the public, including community groups and adjoining and affected landowners.	Consultation with the public, including community groups and adjoining and affected landowners is described in **Section 6.3**.

Director-General's Requirement	Where addressed
The EIS must describe the consultation process and the issues raised, and identify where the design of the infrastructure has been amended in response to these issues. Where amendments have not been made to address an issue a short explanation should be provided.	The consultation process, the issues raised, and where in the environmental impact statement these issues have been addressed is provided in **Section 6.3** and **Section 6.4**.
A Community Communication Framework for construction, identifying relevant stakeholders, procedures and distributing information and receiving/responding to feedback and procedures for resolving community complaints during construction. Key issues addressed in the draft framework should include (but not necessarily be limited to): • air quality monitoring and management; • traffic management (including property access, pedestrian access); • landscaping/urban design matters; • construction activities including out of hours work; and • noise and vibration mitigation and management.	A Community Communication Framework is provided in **Appendix D**.

6.1 Community and stakeholder engagement overview

Community and stakeholder engagement has been and will be carried out in accordance with the Director-General's Requirements, the Community Engagement Policy Statement 2012 (Roads and Maritime, 2012a), the Stakeholder Engagement Framework (Transurban, 2013) and supporting policies and standards.

Meaningful and engaging community consultation is an essential component of any project. Consultation activities have been developed and implemented to build on previous community consultation conducted from 2002 to 2007 as part of the *F3 to Sydney Orbital Link Study* (SKM, 2004) (the 2004 report) and the 2007 Pearlman Review of that study (refer to **Chapter 4**).

Communication and consultation activities have been, or would be, tailored for each phase of the project, including:

- Introductory public information sessions (October and November 2013).
- Request for tender and tender evaluation process.
- Preparation of the environmental impact statement.
- Public exhibition of the environmental impact statement and subsequent project approval.
- Construction and commissioning.
- Operation.

To date, community and stakeholder consultation for the project has included:

- Consultation into the alternatives and options development process as part of the 2004 report and the 2007 Pearlman Review.
- Market sounding as part of the unsolicited proposal process and to initiate the Request for Tender addressing industry stakeholders and potential tender contractors.

- Community events to introduce the NorthConnex project as part of the unsolicited proposal process, giving stakeholders an opportunity to meet the project team, provide feedback, ask questions and identify areas of concern.
- Consultation with government agencies including the Environment Protection Authority, Department of Primary Industries, NSW Health, NSW Office of Environment and Heritage, NSW Office of Water and the Department of Planning and Environment.
- Meetings with The Hills Shire Council, Hornsby Shire Council and Ku-ring-gai Council.
- Briefings with State and Federal Members of Parliament.
- Meetings with emergency services representatives.
- Meetings with services and utility providers.
- Presentations and meetings with key stakeholders such as local schools, the Road Freight Industry Council, the NRMA and business groups.
- Phone, email and written correspondence.
- Set up and regular updates of the project website.
- Community events to raise awareness of the project as part of the unsolicited proposal process with Government. Feedback forms were used to capture community feedback and concerns to inform the development of the tender design options.
- Door knocks, phone calls, one-on-one interviews and letters of acquisition notification addressed to owners of properties potentially required for full or partial surface acquisition for the project. Communication and interviews outlined potential property impacts, property owners' rights and the property acquisition process and timing.
- Interest group briefings targeting: traffic and transport; business and industry; and environment and community.
- Community events displaying the preferred tender design.
- Public access to an interactive website displaying details of the preferred tender design.
- Distribution of community updates and 'letters to the householder' regarding technical field investigations, project progress and milestones as well as community involvement opportunities.

6.2 Consultation objectives and strategy

6.2.1 Consultation objectives

Community and stakeholder consultation aims to provide opportunities for involvement at each project stage. To achieve this, the following project consultation objectives have been applied:

- Ensure an open, accountable and transparent community involvement process.
- Ensure the community and interested stakeholders are proactively provided sufficient information about the project and the likely impacts so they can provide informed input.
- Encourage community support and involvement in the project to facilitate better and more generally accepted outcomes through accessible communication methods.

- Engage with specialist interest groups and residents to discuss key project features including the interchanges, the motorway operations complex, ventilation facilities, tunnel support facilities and construction compounds.
- Ensure appropriate and direct communication with property owners in relation to access to and investigations on landholdings within the study area.
- Integrate community consultation feedback into the environmental impact assessment and specialist studies to deliver a comprehensive analysis supporting the environmental impact statement.
- Ensure community concerns regarding environmental and community impacts are properly addressed.
- Ensure ongoing, appropriate and direct communication with potentially directly affected property owners.
- Build ongoing relationships with the community and stakeholders to ensure optimum project outcomes and be responsive to individuals and the communities concerns.

6.2.2 Consultation strategy

Community consultation has been an integral component in the development of the project. The community consultation program proactively informs and involves stakeholders and community members at each project stage. This approach aims to increase public understanding of, participation in and support for the development of the project. The project has benefitted from the input of local knowledge, insight, experience, goals and priorities, which has helped to identify issues, potential mitigation strategies and opportunities to improve project outcomes. The timing of each consultation phase has been considered to optimise the distribution of information and availability of the project team to minimise the potential for misinformation.

6.3 Consultation process and activities to date

6.3.1 Stakeholders

Stakeholders were identified from consideration of the project's potential direct and indirect impacts and from records of previous correspondence with relevant government bodies, business groups and community groups. Stakeholders were grouped into the following categories:

- Government – comprising Australian government, State government and local government stakeholders.
- Key influencers and interest groups – including media, traffic and transport groups, schools and education institutions, community development and precinct groups, hospital and emergency services, Rotary and Lions Clubs, aged care facilities, environmental groups, businesses and sporting groups.
- Community – including affected landowners, Aboriginal communities, the project corridor communities, the general public and motorists and cyclists.

Table 6-6, **Table 6-7** and **Table 6-8** list agency, government and community issues identified and where these issues are addressed within this environmental impact statement.

Consultation tools and feedback data management

The communication and consultation tools established include:

- Toll free community information line (1800 997 057).
- Project email (enquiries@northconnex.com.au).
- Project website (www.northconnex.com.au).
- Interactive web-mapping tool (http://gisapps.aecomgis.com/northconnex/map_view.html).
- Project database to record correspondence relevant to the project, including contact details and issues raised during the life of the project.
- Registered stakeholder database to receive email updates.
- Community update newsletters and letters to the householder.
- Community information sessions and information displays.
- Targeted stakeholder group forums (traffic and transport, industry and business and environment and community).
- Interest group correspondence including letters and phone calls.
- Stakeholder briefings.
- Face-to-face meetings with individual property owners and residents of properties that may be affected by the project.
- Advertisements and proactive media articles in the local press.
- Letterbox drops.
- Media events at key milestones of the project.

The variety of two-way consultation and communication tools utilised has provided information to community members and enabled the project team to consult with and involve the community in the project.

Project telephone and email address

The project has established and administered a community information telephone line (1800 997 057) and an email address, enquiries@northconnex.com.au to provide the community and stakeholders with a central point for contact. The telephone number and email address have been published on printed project communication material and are provided on the project website. The telephone line is staffed during business hours (9 am to 5 pm) and during site investigations or work conducted outside of business hours. For the announcement of the preferred tender design the operating hours of the project telephone were extended to 7 pm for one week. Hours of operation of the telephone line would be reviewed for the detailed design and construction stages.

The project's community relations team coordinates responses to community and stakeholder enquiries via telephone and email. Statistics of phone calls and emails received are provided in **Table 6-2**.

Table 6-2 Telephone and email statistics

Activity	Total between project launch (June 2013) and 14 June 2014
Community information line calls received	554
Project emails received	731

Project website

The project website (www.northconnex.com.au) provides up to date information about the project. It includes a home page with the latest news, an overview of the project history, key project related materials and background documentation, and contact details.

Stakeholder database

All stakeholder content and activity for the project is managed using a confidential database. All enquiries, comments and issues received by telephone, email or letter are recorded in the database along with project team responses. Feedback received during community events, property owner interviews and stakeholder meetings are also recorded.

A community subscriber register is also maintained through this database. Over 1,654 subscribers have registered to date, since June 2013.

6.3.2 Aboriginal cultural heritage consultation

Aboriginal community consultation for the project has been carried out in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005b) and the Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI) (Roads and Maritime, 2011c). In line with these requirements, an advertisement was placed inviting the Aboriginal community and other relevant agencies and stakeholders (who hold cultural knowledge relevant to determining the significance of Aboriginal objects and / or places in and around the project) to register their involvement in the consultation process.

Aboriginal consultation carried out to date is summarised in **Table 6-3**.

Table 6-3 Aboriginal consultation

Survey date	Aboriginal representatives
24-25 September 2013	Metropolitan Local Aboriginal Land Council Guringai Tribal Link Aboriginal Corporation
2 October 2013	Metropolitan Local Aboriginal Land Council Guringai Tribal Link Aboriginal Corporation
19 December 2013	Metropolitan Local Aboriginal Land Council

Further details relating to Aboriginal heritage are provided in **Section 7.11** (Aboriginal heritage) and the technical working paper: Aboriginal heritage (**Appendix M**).

6.3.3 Consultation to date

The following section provides an overview of key consultation activities carried out to date as part of the project, commencing in 2002 with community consultation as part of the options and alternatives development, through to the public exhibition of the preferred tender design in March and April 2014.

An overview of the recent key consultation activities carried out for the project during the tender stage and during the preparation of the environmental impact statement is provided in **Table 6-5**. In addition to these events, a number of community updates have also been distributed along the project corridor and other informal community consultation has been carried out. These are also detailed in **Table 6-5**.

Consultation during the options and alternative development

Consultation has been an important part of project since 2002 with consultation commencing during the 2004 report. Extensive community consultation and engagement activities were undertaken as part of the 2004 report including:

- During 2002 and 2003, publication of a series of community newsletters, media releases and a project website to provide information on the identification and analysis of alternatives and corridor alignment options.
- The establishment of three Community Focus Groups that met during 2002 to provide comments and feedback on alternative and options.
- Public information days held at five locations during May 2002 to provide information to interested stakeholders and community members, and to solicit comment on alternative and options. It was estimated that some 2,000 people visited the displays.
- Route options displays held at four locations during August 2003 to provide information on identified route options, and to receive comments on those options from the community and stakeholders. It was estimated that more than 2,500 people attended these events.

Feedback received from the community and stakeholders was summarised and addressed in the 2004 report. The report summarises the main issues highlighted by stakeholders as:

- Ventilation outlets (predominately issues around number and location of outlets).
- General concerns about air quality.
- Noise.
- Further investigation of public transport options rather than road solutions.
- Health impacts.

Further opportunity was provided for interested parties to provide input into the assessment of corridor alignment options through the 2007 Pearlman Review. As part of the review, the public was invited to make submissions on the 2004 report. A total of 53 submissions were received in early 2007, and each submitter was invited to present its submission at one of three public meetings before the Hon Mahla Pearlman AO in June 2007. Issues raised in submissions and through the public meeting were considered in formulating the recommendations of the 2007 Pearlman Review. Issues raised during the 2007 Pearlman Review included:

- Inadequate consultation.
- Public transport, rail improvements and global warming.
- Amenity issues.
- Cost.

Feedback received during the 2004 report and the 2007 Pearlman Review has been considered as part of the recent design development and in the preparation of the consultation strategy for the project.

Consultation during the tender stage

In October and November 2013, four community engagement events were held to provide up to date information about the status of the project and the design and construct tender process.

This consultation was aimed at informing the community of the unsolicited proposal received by the NSW Government and that the purple corridor identified in the 2004 report was being used to direct the tender designs.

The events were used to gather submissions and comments on the community's key issues and concerns, which were summarised and provided to the three design and construct tenderers to be taken into account as part of their respective designs. In addition to these events, several briefing sessions were also held with councils, government agencies and utility providers to provide input into the tender designs. The dates and details of these meetings are included in **Table 6-5**.

Exhibition of the preferred tender design

Following announcement of the preferred project tender design in March 2014, a further series of four community information sessions were held to provide more detailed information about the project. At these sessions, project design information was provided and community members commented on key issues of interest and concern. Through feedback obtained during those sessions, and in subsequent feedback, key community issues have been identified. These issues have been addressed in this environmental impact statement and as part of the ongoing design development for the project.

During this period, stakeholders were also engaged through interest group meetings. Interest groups included an environmental and community interest group, a business and industry interest group and a traffic and transport interest group.

Changes have been made to the project design and construction methodologies in response to feedback received during this consultation period. Some specific examples are provided in **Table 6-4**. The project team is continuing to examine community feedback as part of ongoing design refinements.

Table 6-4 Project amendments in response to consultation

Issue	Description	Nature of amendment
Visual	The community raised concerns about the visual impacts of the Wilson Road tunnel support facility.	The height of the main emergency smoke extraction building has been lowered to reduce the overall bulk and visual impact of this infrastructure. The site has also been lowered from Pennant Hills Road level and stepped down across the site to further reduce the apparent height of the infrastructure and flatten the steep landscaped batters.
Visual	The community raised concerns about the visual impacts of the Trelawney Street tunnel support facility.	The height of the main smoke emergency extraction building has been lowered to reduce the overall bulk and visual impact of this infrastructure.
Visual	The community raised concerns about the visual impacts during the construction of the operational ancillary infrastructure.	A commitment has been made to investigate the early implementation of noise walls and landscape planting around ancillary facilities in order to provide visual screening and minimise noise impacts during construction.
Traffic / noise	The community raised concerns about the impact on local streets (such as noise and traffic) from the use of the Ventura Road access track to the Darling Mills Creek compound (C2).	The use of the Ventura Road access track at the Darling Mills Creek compound (C2) would be restricted to the delivery and removal of large excavation equipment, with the main access point being directly to and from the Hills M2 Motorway.

The dates and details of consultation on the preferred tender design are included in **Table 6-5**.

Agency consultation

Relevant government agencies including the Department of Planning and Environment, the Environment Protection Authority and Ministry of Health (NSW Health) were consulted during the tender development process as part of interagency regulatory groups meetings. Four meetings were held in 2013 from June to November.

Fire and Rescue NSW

Fire and Rescue NSW was consulted during the tender development stage to provide input into the tender designs. Four meetings were held from July 2013 to February 2014.

Table 6-5 Overview of consultation activities during the tender and environmental impact statement processes

Date	Details
Interagency regulatory meetings	
26 June 2013	Interagency regulatory meeting No.1 was held with the Environment Protection Authority, the Department of Planning and Infrastructure (now the Department of Planning and Environment) and NSW Health. The purpose of the meeting was to introduce the project discuss the planning approvals process and identify likely key environmental issues.
30 July 2013	Interagency regulatory meeting No.2 was held with the Environment Protection Authority, the Department of Planning and Infrastructure (now the Department of Planning and Environment) and NSW Health. The purposed of the meeting was to review to the progress of the project and strategy to date and discuss the approach to assessment of environmental impacts.
26 September 2013	Interagency regulatory meeting No. 3 was held with the Environment Protection Authority, the Department of Planning and Infrastructure (now the Department of Planning and Environment) and NSW Health. The purposed of the meeting was to review to the progress of the project and strategy to date, identify any concerns and further discuss the approach to the assessment of impacts.
21 November 2013	Interagency regulatory meeting No. 4 was held with the Environment Protection Authority and the Department of Planning and Infrastructure (now the Department of Planning and Environment). The purposed of the meeting was to review to the progress of the project and strategy to date, identify any concerns, provide updates on community information sessions and further discuss the approach to the assessment of impacts.
Fire life safety meetings	
18 July 2013	Fire life safety meeting No.1 was held with Fire and Rescue NSW to discuss the requirements for the fire strategy and the fire and life safety design.
3 October 2013	Fire life safety meeting No.2 was held with Fire and Rescue NSW to discuss the requirements for the fire strategy and the fire and life safety design.
30 October 2013	Fire life safety meeting No.3 was held with Fire and Rescue NSW to discuss the requirements for the fire strategy and the fire and life safety design.
20 February 2014	Fire life safety meeting No.4 was held with Fire and Rescue NSW to discuss the requirements for the fire strategy and the fire and life safety design.
Community updates	
September 2013	Community update No.1 was sent to around 14,000 property addresses along the project corridor. The community update introduced the project, provided a map of the project corridor, advised of next steps and provided details on how residents could register to receive future updates. The community update was also published on the project website.
December 2013	Community update No.2 was sent to around 14,000 property addresses along the project corridor. The community update advised the availability of the NorthConnex community involvement issues report, detailed early field investigations and advised next steps including tender assessment and environmental impact statement processes. The community update was also published on the project website with email notifications sent to over 200 registered stakeholders.

Date	Details
Week commencing 16 March 2014	Community update No.3 was sent to around 14,400 property addresses within the project area. The community update announced the preferred design, introduced the Hills M2 Motorway integration works, outlined the key features of the project and invited community members to attend community information sessions held in March – April 2014. Stakeholders were encouraged to provide feedback on the preferred design which would be addressed in the environmental impact statement. The community update was also published on the project website with email notification sent to over 789 registered stakeholders.
Planning focus meeting	
27 September 2013	A planning focus meeting was held at Hornsby Shire Council, from 10 am to 4 pm. Presentations at the meeting introduced the project, described the unsolicited proposal process, outlined the environmental assessment process and provided the expected project delivery program. The meeting was attended by representatives from the Department of Planning and Environment, NSW Health, Hornsby Shire Council, The Hills Shire Council and Ku-ring-gai Council.
Tender stage exhibition	
22 October 2013	A community engagement event was held at Turramurra Masonic Hall and Function Centre, from 6.30 pm to 8 pm, to introduce the NorthConnex project, give stakeholders an opportunity to meet the project team, provide feedback, ask questions and identify areas of concern. A total of 73 stakeholders registered in attendance. Feedback received was provided to the three tenderers for consideration during the development of their respective tender submissions.
23 October 2013	A community engagement event was held at Muirfield Golf Course, from 6.30 pm to 8 pm, to introduce the NorthConnex project, give stakeholders an opportunity to meet the project team, provide feedback, ask questions and identify areas of concern. A total of 101 stakeholders registered in attendance. Feedback received was provided to the three tenderers for consideration during the development of their respective tender submissions.
24 October 2013	A community engagement event was held at Hornsby War Memorial Hall, from 6.30 pm to 8 pm, to introduce the NorthConnex project, give stakeholders an opportunity to meet the project team, provide feedback, ask questions and identify areas of concern. A total of 135 stakeholders registered in attendance. Feedback received was provided to the three tenderers for consideration during the development of their respective tender submissions.
18 November 2013	A community engagement event was held at Cheltenham Recreation Club, from 7 pm to 8.30 pm, to introduce the NorthConnex project, give stakeholders an opportunity to meet the project team, provide feedback, ask questions and identify areas of concern. A total of 37 stakeholders registered in attendance.

Date	Details
Preferred tender design exhibition	
26 March 2014	A community information session was held at Pennant Hills Golf Club, from 7 pm to 9 pm. The event gave stakeholders an opportunity to view and discuss with members of the project team the preferred tender design and the Hills M2 Motorway integration works via an interactive model and display material detailing key project features. Attendees were encouraged to ask questions, provide feedback and identify areas of concern which would be addressed in the environmental impact statement. The event was advertised through a community update, the project website and notifications printed in local newspapers. Issues raised during the meetings were recorded and considered in the environmental impact statement.
27 March 2014	A community information session was held at Hornsby RSL, from 7 pm to 9 pm. The event gave stakeholders an opportunity to view and discuss with members of the project team the preferred tender design and the Hills M2 Motorway integration works via an interactive model and display material detailing key project features. Attendees were encouraged to ask questions, provide feedback and identify areas of concern which would be addressed in the environmental impact statement. The event was advertised through a community update, the project website and notifications printed in local newspapers. Issues raised during the meetings were recorded and considered in the environmental impact statement.
3 April 2014	A community information session was held at Pennant Hills Golf Club, from 7 pm to 8 pm. The event gave stakeholders an opportunity to view and discuss with members of the project team the preferred tender design and the Hills M2 Motorway integration works via an interactive model and display material detailing key project features. Attendees were encouraged to ask questions, provide feedback and identify areas of concern which would be addressed in the environmental impact statement. The event was advertised through a community update, the project website and notifications printed in local newspapers. Issues raised during the meetings were recorded and considered in the environmental impact statement.
5 April 2014	A community information session was held at Pennant Hills Community Centre, from 2 pm to 4 pm. The event gave stakeholders an opportunity to view and discuss with members of the project team the preferred tender design and the Hills M2 Motorway integration works via an interactive model and display material detailing key project features. Attendees were encouraged to ask questions, provide feedback and identify areas of concern which would be addressed in the environmental impact statement. The event was advertised through a community update, the project website and notifications printed in local newspapers. Issues raised during the meetings were recorded and considered in the environmental impact statement.
Utility providers meeting	
25 October 2013	A utility providers meeting was held with Endeavour Energy to discuss potential utility impacts, power supply, utility adjustments and project timing.
25 October 2013	A utility providers meeting was held with Telstra to discuss potential utility impacts, telecommunications, utility adjustments and project timing.
7 November 2013	A utility providers meeting was held with Ausgrid to discuss potential utility impacts, power supply, utility adjustments and project timing.

Date	Details
Interest group meetings	
28 March 2014	An environmental and community interest group meeting was held at Pennant Hills Golf Club. A total of 14 attendees representing environmental organisations and interest groups, and community groups discussed potential impacts from the preferred tender design and key features of the project. Additional information was provided to meeting participants as applicable.
2 April 2014	A business and industry interest group meeting was held at Pennant Hills Road. A total of 17 attendees from organisations representing business and industry groups discussed potential business impacts from the preferred tender design and key features of the project. Additional information was provided to meeting participants as applicable.
3 April 2014	A traffic and transport interest group meeting was held at Pennant Hills. A total of ten attendees from organisations representing traffic and transport groups discussed potential traffic and transport issues from the preferred tender design and key features of the project. Additional information was provided to meeting participants as applicable.
Briefing sessions	
16 October 2013	A briefing session was held with The Hills Shire Council General Manager and Councillors to describe the project and to answer questions. The presentation introduced the project, described the unsolicited proposal process, outlined the environmental impact statement process, outlined potential key issues and provided the expected project delivery program.
24 October 2013	A briefing session was held with State and Federal Members of Parliament to describe the project and to answer questions. The presentation introduced the project, described the unsolicited proposal process, outlined the environmental impact statement process, outlined potential key issues and provided the expected project delivery program.
21 November 2013	An update meeting was held with the Department of Planning and Infrastructure (now Department of Planning and Environment) to discuss planning approval processes and timing.
9 December 2013	A meeting was held with Normanhurst Boys High School and Abbotsleigh School for Girls to introduce the project, establish methods of contact for the schools, parents and students and to answer initial questions.
12 December 2013	A project briefing session was held with the Member for Parramatta to describe the project and to answer questions.
19 December 2013	A project briefing session was held with the Member for Epping and his staff to describe the project and to answer questions.
19 December 2013	A briefing session was held with Ku-ring-gai Council staff to describe the project and to answer questions. The presentation introduced the project, described the unsolicited proposal process, outlined the environmental impact statement process, outlined potential key issues and provided the expected project delivery program.
27 February 2014	A presentation was made to the Independent Advisory Committee on Tunnel Air Quality regarding the air quality modelling approach for the project.

Date	Details
20 March 2014	A briefing session was held with State and Federal Members of Parliament. The purpose of the briefing sessions was to present the preferred tender design and seek feedback.
21 March 2014	A presentation was made to the Roads Freight Industry Council with representatives from the Australian Trucking Association, the Livestock and Bulk Association, Transport Workers Union, Toll and Linfox.
17 April 2014	A presentation was made to the NRMA. The purpose of the meeting was to present the preferred tender design and seek feedback.
8 April 2014	A meeting was held with Ku-ring-gai Council. The purpose of the meeting was to present the preferred tender design and seek council feedback.
9 April 2014	A meeting was held with Hornsby Shire Council. The purpose of the meeting was to present the preferred tender design and seek council feedback.
20 May 2014	A meeting was held with The Hills Shire Council. The purpose of the meeting was to present the preferred tender design and seek council feedback.
5 May – 30 May 2014	Meetings were held with relevant schools, aged care, medical facilities and places of worship within the project area. The purpose of the meetings was to present the preferred tender design, and provide an opportunity to discuss potential construction and operational impacts specific to each facility.
Interviews and surveys	
December 2013	Interviews and surveys were conducted with potentially affected business owners.
Communications	
July 2013	Property owners were notified of geotechnical and ecological field studies, including telephone calls and letterbox drops to targeted residents notifying them of the start of environmental field work.
October 2013	A 'Letter to the householder' was sent to around 14,000 property addresses along the project corridor detailing community engagement events to be held in October 2013. Details of the events were also published on the project website and advertised in local newspapers.
October 2013	Letters were sent to around 200 interest groups inviting them to attend the community engagement events in October 2013 and to provide feedback on the project. Feedback received from interested parties was provided to the three tenderers for consideration during the development of their respective tender designs.
November to December 2013	Property owners were notified of air quality monitoring, noise and heritage field studies, including telephone calls and letterbox drops to targeted residents notifying them of the start of environmental field work.
December 2013	The NorthConnex community involvement issues report was published on the project website. The report provided a summary of the community feedback received to date including issues raised at community engagement events. Over 200 registered stakeholders were informed by email about the publication of the report.

Date	Details
Week commencing 16 March 2014	Postcards were sent to around 7,000 properties within the preferred project corridor (along the proposed tunnel alignment) encouraging residents to attend upcoming community information sessions and to visit the interactive web mapping site for more project information.
Week commencing 16 March 2014	A ‘Letter to the householder’ was sent accompanied by community update No. 3 distributed to over 3,000 along the corridor potentially affected by the Hills M2 Motorway integration work.
Week commencing 16 March 2014	Letters were sent to over 658 interest groups and local organisations, including schools, places of worship, aged care facilities and clubs. Follow up calls to 79 schools providing project information and eight briefings were held.
Week commencing 16 March 2014	Invitations were sent to around 202 interest groups to attend targeted interest group briefings. Three interest group briefings were held covering: traffic and transport; business and industry; and environment and community.
16 March 2014	The preferred tender design and tenderer was publicly announced by the Prime Minister and Premier for NSW.
16 March 2014	Door knocks and letters of acquisition notification were delivered to potentially directly impacted property owners along the preferred project corridor outlining property impacts, the property acquisition process and timing.
Week commencing 28 April 2014	Phone calls to 25 aged care and medical facilities in the project area and 55 places of worship, providing project information and briefing invitation

6.4 Summary of issues raised

Issues identified during the consultation process for the NorthConnex project by government agencies, local government, interest groups, local communities, and Aboriginal stakeholders have informed the environmental impact assessment process and the ongoing development of the project. A summary of these issues and the locations in the environmental impact statement where they have been addressed are provided below.

6.4.1 Issues raised by government agencies

A list of government agencies consulted over the course of the project and during the preparation of the environmental impact statement, and their key issues and requirements are detailed in **Table 6-6**. **Table 6-6** also identifies the section of this environmental impact statement that has addressed each issue.

6.4.2 Issues raised by local government

Issues raised by The Hills Shire Council, Hornsby Shire Council and Ku-ring-gai Council during the consultation process are detailed in **Table 6-7**. **Table 6-7** also identifies the section of this environmental impact statement that has addressed each issue.

6.4.3 Issues raised by local communities

Questions and issues arising from consultation activities have been recorded in the project's stakeholder database. Rigorous data management enables transparent and comprehensive consideration of feedback in conjunction with the technical inputs, specialist studies and value management design evaluation.

Issues raised by community members, stakeholder and interest groups and local businesses during the consultation process are detailed in **Table 6-8**. To consolidate the feedback received by the community, the table groups inputs by issue category. Some wording has been modified or abbreviated where appropriate to allow consolidation of issues raised by multiple contributors.

Table 6-8 also identifies the section of the environmental impact statement that has addressed each issue.

6.4.4 Issues raised by Aboriginal stakeholders

Representatives of the Metropolitan Local Aboriginal Land Council and the Guringai Tribal Link Aboriginal Corporation have been consulted during the preparation of the Aboriginal heritage assessment for the project. Issues raised by these stakeholders and how they have been addressed are provided in the technical working paper: Aboriginal heritage (**Appendix M**).

Table 6-6 Issues raised by government agencies

Issue category	Issue raised	Where addressed
Environment Protection Authority		
General	The requirements of the *Protection of the Environment Operations Act 1997* should be addressed.	The requirements of the *Protection of the Environment Operations Act 1997* are identified in **Chapter 2** and addressed in the relevant assessment sections, including in relation to air quality (**Section 7.3**), noise (**Section 7.2**), water quality (**Section 7.9**) and waste (**Section 8.3**).
Noise and vibration	Noise and vibration impacts need to be assessed, quantified and reported on.	Construction and operational noise and vibration impacts have been assessed in **Section 7.2**.
	Construction noise associated with the proposed development should be assessed using the Interim Construction Noise Guidelines (DECC, 2009b).	A construction noise impact assessment consistent with the Interim Construction Noise Guidelines is provided in **Section 7.2** and **Appendix F**.
	Vibration from construction and operation should be assessed using the guidelines contained in the Assessing Vibration: A technical guideline (DEC, 2006a).	A construction vibration impact assessment consistent with Assessing Vibration: a technical guideline is provided in **Section 7.2** and **Appendix F**.
	If blasting is required, blast impacts should comply with the guidelines contained in Australian and New Zealand Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZEC, 1990).	Underground blasting may be required during tunnelling activities. However, a detailed quantitative impact assessment of potential blasting impacts has not been conducted because the location of blasting (if it is required) would not be known until tunnelling works are being conducted. If blasting is necessary further assessment would be conducted consistent with the guidelines contained in Australian and New Zealand Council – Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration (ANZECC, 1990).
	Operational noise from all industrial activities (including private haul roads and private railway lines) should be assessed using the guidelines contained in the NSW Industrial Noise Policy (EPA, 2000b) and Industrial Noise Policy Application Notes.	An operational industrial noise assessment consistent with the NSW Industrial Noise Policy (EPA, 2000b) and the associated Industrial Noise Policy Application Notes (EPA, 2010) is provided in **Section 7.2** and **Appendix F**.

Issue category	Issue raised	Where addressed
	Noise on public roads from increased road traffic generated by land use developments should be assessed using the guidelines contained in the Environmental Criteria for Road Traffic Noise (EPA, 1999).	An assessment of the project's impacts on traffic generated road noise comparing noise levels with and without the project and consistent with Road Noise Policy (DECCW, 2011) is provided in **Section 7.2** and **Appendix F**. The Road Noise Policy supersedes the Environmental Criteria for Road Traffic Noise (EPA, 1999).
	Noise from new or upgraded public roads should be assessed using the Environmental Criteria for Road Traffic Noise (EPA, 1999).	An assessment of the project's impacts on traffic generated road noise comparing noise levels with and without the project and consistent with the Road Noise Policy (DECCW, 2011) is provided in **Section 7.2** and **Appendix F**.
Air quality	Air quality impacts need to be assessed, quantified and reported on in a detailed air quality impact assessment.	Air quality impacts associated with construction and operation of the project have been assessed in **Section 7.3** and **Appendix G**.
	Air dispersion modelling should be carried out where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment.	Air dispersion modelling has been conducted for operation of the project. Results of the modelling have been assessed and are summarised in **Section 7.3**. Detailed results are presented in **Appendix F**.
	Air dispersion modelling should be conducted in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW 2005.	The air dispersion modelling has been carried out in accordance with the Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2005a). A detailed description of the methodology for the air quality assessment, including a description of the modelling is provided in **Section 7.3** and **Appendix G**.
	The project should comply with the relevant regulatory framework, specifically the *Protection of the Environment Operations Act 1997* and the Protection of the *Environment Operations (Clean Air) Regulations 2010*.	The project has been designed to comply with the relevant requirements of the Protection of the Environment Operations Act 1997 and the Protection of the Environment Operations (Clean Air) Regulations 2010.
	Assessment of the project against the priorities and targets adopted under the NSW State Plan and its implementation plan *Action for Air*.	Air quality impacts associated with construction and operation of the project are assessed in **Section 7.3**. The priorities and targets under the NSW State Plan and Action for Air are outlined in **Chapter 3**.
Health	The risk (environmental harm, risk to human health and amenity) associated with potential discharges of fugitive and point source emissions for all stages of the project including operation need to be assessed.	A human health risk assessment has been carried out and is provided in **Section 7.4** and **Appendix H**. Risks to the environment and amenity from fugitive and point sources are assessed in relation to air quality in **Section 7.3** and water quality in **Section 7.9**.

Issue category	Issue raised	Where addressed
	All processes that could result in air emissions should be identified and described.	Processes which may result in air emissions are identified and described in **Section 7.3**.
	Consideration of 'worst case' emissions scenarios and impacts at proposed emission limits.	The human health risk assessment (**Section 7.4**) and the air quality impact assessment (**Section 7.3**) consider 'worst case' emissions scenarios. The technical working paper: air quality (**Appendix G**) includes consideration of an operational scenario to inform identification of potential emissions limits.
	Emission control techniques / practices to be employed on the project.	Mitigation measures to control air emissions are provided in **Section 7.3**.
Geology and soils	Impacts on soils including contaminated sites and general soil issues need to be assessed, quantified and reported on.	The impact of the construction and operation of the project on soils including contamination and general soil issues are assessed in **Section 7.8**.
	An assessment of the contaminated site should be carried out in accordance with the guidelines made or approved under section 105 of the *Contaminated Land Management Act 1997*.	Identification of potentially contaminated sites and appropriate mitigation measures are provided in **Section 7.8**. The assessment takes into account the Managing Land Contamination: Planning Guidelines SEPP 55 – Remediation of Land (DUAP & EPA, 1998) and other relevant guidelines published by the EPA in relation to contaminated land investigations.
	How will site contamination be remediated and/or managed so that the site is, or can be, made suitable for the proposed use?	Identification of potentially contaminated sites and appropriate mitigation measures are provided in **Section 7.8**. The potential for contamination and the need for remediation is also considered.
	All reports should be prepared in accordance with the Guidelines for Consultants Reporting on Contaminated Sites (EPA, 2000a).	Identification of potentially contaminated sites and appropriate mitigation measures are provided in **Section 7.8**. The assessment of potential contaminated land has been conducted with regard to the relevant guidance provided in Guidelines for Consultants Reporting on Contaminated Sites (EPA, 2000a).
	Will a site auditor, accredited under the *Contaminated Land Management Act 1997*, be engaged to issue a site audit statement to certify on the suitability of the current proposed uses?	Identification of potentially contaminated sites and appropriate mitigation measures are provided in **Section 7.8**. If required, an accredited site auditor will be engaged to issue a site audit statement. The need for such a site audit statement will be considered during the detailed design phase of the project.

Issue category	Issue raised	Where addressed
	An assessment of the potential impacts on soil and land resources should be carried out, guided by the Soil and Landscape Issues in Environmental Impact Assessment (DLWC 2000).	Assessment of potential soil impact is provided in **Section 7.8**, and has considered the relevant guidance in Soil and Landscape Issues in Environmental Impact Assessment (DLWC, 2000)
	The nature and extent of any significant impacts on soil and land resources should be identified, with particular attention given to: soil erosion and sediment transport; mass movement (landslides); and urban and regional salinity.	An assessment of the impact of construction and operation of the project on soils have been provided in **Section 7.8** with additional information on erosion and sediment transport provided in **Section 7.9**. The potential for mass movement hazards and salinity is considered in **Section 7.8**.
	Mitigation and management options to prevent, control, abate or minimise identified soil and land resource impacts should be provided. The effectiveness and reliability of the measures and any residual impacts after these measures are implemented should be assessed.	Mitigation and management measures to prevent or minimise soil and landscape resource impacts have been provided in **Section 7.8**. The mitigation and management measures are well-known and commonly applied to major infrastructure project construction activities, and on this basis, the effectiveness and reliability of the measures has not been subject to further detailed assessment.
Surface water and ground water	Water quality impacts need to be assessed, quantified and reported on.	An assessment of potential surface water quality impacts is provided in **Section 7.9**. An assessment of potential groundwater is provided in **Section 7.8**.
	Position of any intakes and discharges, volumes, water quality and frequency of all water discharges should be detailed.	Details of project drainage are provided in **Chapter 5**. Information on groundwater inflows, treatment, volumes and discharge requirements are provided in **Section 7.8**. Details on surface water treatment, volumes and discharge are provided in **Section 7.9**.
	Demonstrate all practical options to avoid discharge have been implemented and environmental impacts minimised where discharge is necessary.	Options regarding the management of groundwater inflows and the associated need to treat and discharge water to the environment are discussed in **Chapter 4**. Measures to manage and mitigate discharge have been provided in **Section 7.6**, **Section 7.8** and **Section 7.9**.

Issue category	Issue raised	Where addressed
	Where relevant, include a water balance for the project including water requirements (quantity, quality and source(s)) and proposed storm and wastewater disposal, including type, volumes, proposed treatment and management methods and re-use options.	An assessment of surface water impacts is provided in **Section 7.9**. Stormwater disposal, volumes, treatment, management and re-use options are provided in **Section 7.8** and **Section 7.9**.
	An assessment needs to be carried out for any water resource (existing surface and groundwater) likely to be affected by the project.	An assessment of groundwater impacts on is provided in **Section 7.8**. An assessment of project impacts on surface water is provided in **Section 7.9**.
	Water Quality Objectives for the receiving waters relevant to the project. These refer to the community's agreed environmental values and human uses endorsed by the NSW Government as goals for ambient waters. Where groundwater may be impacted an assessment should be carried out to identify appropriate groundwater environmental values.	An assessment of surface water impacts, including identification of the receiving environments and appropriate discharge water quality criteria is provided in **Section 7.9**. Potential impacts on groundwater are considered in **Section 7.8**.
	The indicators and associated trigger values or criteria for the identified environmental values should be stated. This information should be sourced from the ANZECC (2000) Guidelines for Fresh and Marine Water Quality.	An assessment of surface water impacts is provided in **Section 7.9**, which includes identification of appropriate discharge water quality criteria based on guidance in the Guidelines for Fresh and Marine Water Quality (ANZECC, 2000)
	Any locally specific water quality objectives, criteria or targets which have been endorsed by the NSW Government should be identified.	An assessment of surface water impacts, including identification of the receiving environments and endorsed water quality objectives, criteria and targets, as relevant, is provided in **Section 7.9**.
	Describe the nature and degree of impact any proposed discharges will have on the receiving environment.	A description and assessment of the impacts associated with the discharge of water to the environment are provided in **Section 7.6**, **Section 7.8** and **Section 7.9**.
	Impacts against the relevant ambient water quality outcomes should be assessed.	An assessment of surface water impacts, including identification of the receiving environments and relevant ambient water quality outcomes is provided in **Section 7.9**.

Issue category	Issue raised	Where addressed
	How will the project be designed and operated to protect the water quality objectives for receiving waters where they are currently being achieved and contribute towards achievement of the water quality objectives over time where they are not currently being achieved?	As identified in **Section 7.9**, water discharge during construction would be in accordance with an environment protection licence issued for the project. The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines (ANZECC & ARMCANZ, 2000). The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase taking into consideration the current water quality of the receiving watercourses.
	Where a discharge is proposed that includes a mixing zone, how will wastewater discharged to waterways ensure ANZECC (2000) water quality criteria for relevant chemical and non-chemical parameters are met at the edge of the initial mixing zone of the discharge and any impacts in the initial mixing zone are reversible?	As identified in **Section 7.9**, water discharge during construction would be in accordance with an environment protection licence issued for the project. The project has been designed to achieve a maximum water discharge quality equivalent to the 95 per cent protection level specified for freshwater eco-systems in accordance with ANZECC guidelines (ANZECC & ARMCANZ, 2000). The discharge water quality level would be determined in consultation with the NSW Environment Protection Authority during the detailed design phase taking into consideration the current water quality of the receiving watercourses.
	Impacts on groundwater and groundwater dependent ecosystems should be assessed.	An assessment of impacts from the construction and operation of the project on groundwater is provided in **Section 7.8** and groundwater dependent ecosystems in **Section 7.6**.
	How will stormwater be managed both during and after construction?	Surface water management during construction and operation is described and assessed in **Section 7.9**.
	How will predicted impacts be monitored and assessed over time?	A surface water quality monitoring program would be developed as identified in **Section 7.9**.
Resource management and waste minimisation	Waste impacts including hazardous material and radiation, waste EARs for waste facilities and general waste need to be assessed, quantified and reported on.	Waste impacts associated with the project are described and assessed in **Section 8.3**.

Issue category	Issue raised	Where addressed
	A detailed plan for in-situ classification of waste material, including the sampling locations and sampling regime that will be employed to classify the waste, particularly with regards to the identification of contamination hotspots should be prepared.	Construction and operational waste management including classification, sampling, proposed quantities and disposal is provided in **Section 8.3**. If relevant contamination is identified during the detailed design of the project, an appropriate plan for in-site sampling and characterisation of materials would be developed.
	Identify, characterise and classify all waste (including waste intended for re-use or recycling) that is proposed to be disposed of to an offsite location, including proposed quantities of the waste and the disposal locations of the waste	Construction and operational waste management include classification, sampling, proposed quantities and disposal is provided in **Section 8.3**.
	All waste should be classified in accordance with the Environment Protection Authority's Classification Guidelines.	Construction and operational waste management include classification, sampling, proposed quantities and disposal is provided in **Section 8.3**. Waste generated by the project would be classified in accordance with the Waste Classification Guidelines.
	All sampling and classification results should be retained for the life of the project in compliance with EPA's Waste Classification Guidelines.	Construction and operational waste management include classification, sampling, proposed quantities and disposal is provided in **Section 8.3**. Waste sampling and classification data would be managed in accordance with the Waste Classification Guidelines.
	How will waste be handled and managed onsite to minimise pollution including: stockpile location and management; and erosion, sediment and leachate control?	Handling and management of waste is outlined in **Section 8.3**. Erosion, sedimentation and surface water management measures are outlined in **Section 7.8** and **Section 7.9**.
	How will waste be handled and managed during transport to a lawful facility? For waste possessing hazardous characteristics, how will the waste be treated or immobilised to render it suitable for transport and disposal?	Handling and management of waste including waste transport is outlined in **Section 8.3**. Wastes involving hazardous characteristics are not anticipated to be handled during construction or operation of the project.
	Procedures and protocols to be implemented to ensure that any waste leaving the site is transported and disposed of lawfully and does not pose a risk to human health or the environment.	A resource and waste assessment including protocols and procedures to be implemented to ensure safe and lawful, transport and disposal of waste is provided in **Section 8.3**.

Issue category	Issue raised	Where addressed
	Statement demonstrating awareness of the Environment Protection Authority's requirements with respect to notification and tracking of waste.	Waste management including transport of waste from the site is assessed in **Section 8.3**. Roads and Maritime is aware of the Environment Protection Authority's requirements with respect to notification and tracking of waste, and would ensure that the construction contractor(s) is similarly aware of these requirements.
	Statement demonstrating awareness of the relevant legislative requirements for the disposal of waste, including any relevant Resource Recovery Exemptions, as gazetted by the Environment Protection Authority.	An assessment of resource requirement and waste management is provided in **Section 8.3**. Roads and Maritime is aware of the legislative requirements with respect to disposal of wastes, and would ensure that the construction contractor(s) is similarly aware of these requirements.
	Outline contingency plans for any event that affects operations at the site that may result in environmental harm including: excessive stockpiling of waste; and volume of leachate generated exceeds the storage capacity available on site.	Mitigation measures for waste management are provided in **Section 8.3**. The Spoil Management Plan to be developed and implemented for the project will include contingency measures in the unlikely event that spoil generation exceeds anticipated volumes and construction site capacities.
Greenhouse gas and climate change	Greenhouse gas emissions impacts need to be assessed, quantified and reported on.	A greenhouse gas assessment is provided in **Section 8.4**.
Cumulative impact	Cumulative impacts associated with existing emission sources as well as any current approved developments linked to the receiving environment.	Cumulative impacts are assessed within the respective impact assessment sections of the environmental impact statement.
Agriculture NSW - Department of Primary Industries		
Biodiversity	Management of weeds during and post construction in the area of construction works.	Weed management and mitigation measures during and following construction are provided in **Section 7.6**.
NSW Office of Water - Department of Primary Industries		
Surface water and groundwater	The project should comply with the relevant requirements of the *Water Management Act 2000* including the objects and water management principles of the act.	A construction and operational water impact assessment consistent with the relevant requirements of the *Water Management Act 2000* is provided in **Section 7.8** and **Section 7.9**. The assessment has taken into account the objects and water management principles of that Act.

Issue category	Issue raised	Where addressed
	A groundwater assessment should be prepared consistent with the requirements of the NSW Aquifer Interference Policy, including both licensing requirements and aquifer impact considerations, for the construction and operational phases.	A ground water assessment consistent with the requirements of the NSW Aquifer Interference Policy is provided in **Section 7.8**. The assessment considers licensing requirements and potential aquifer impacts.
	The project should be consistent with the rules within the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources and the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources.	Surface water and ground water assessments consistent with the relevant requirements of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources and the Water Sharing Plan for the Greater Metropolitan Region Unregulated River Water Sources are provided in **Section 7.8** and **Section 7.9**.
	Licensing requirements for the project should be in accordance with the provisions of the Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources under the *Water Management Act 2000*.	Licensing requirements are detailed in **Chapter 2**. An assessment of potential groundwater impacts is provided in **Section 7.8**, which takes into account the relevant requirements of application Water Sharing Plans and the *Water Management Act 2000*
	An assessment of the applicability of any exemptions to the project under the *Water Management (General) Regulation 2011*, in particular Clause 2 of Schedule 5 – Road Authorities should be prepared.	Licensing requirements are detailed in **Chapter 2**. An assessment of potential groundwater impacts is provided in **Section 7.8**. Roads and Maritime would take groundwater as a consequence of the construction and ongoing operation of the project, and would rely on the exemptions under clause 2, Schedule 5 of the *Water Management (General) Regulation 2011* to the extent that a water access licence may be required for this groundwater take.
	A detailed assessment of water requirements for the project should be prepared.	An assessment of water requirements for construction and operation of the project is provided in **Section 8.3** and **Section 7.9**.
	A detailed assessment of the potential impact of the project on water sources of the State should be prepared.	Potential surface water impacts are described and assessed in **Section 7.9**. Potential groundwater impacts are described and assessed in **Section 7.8**
	A predictive assessment of the impact of the project on surface water sources should be prepared.	An assessment of potential impacts to surface water has been provided in **Section 7.9**.
	A predicted assessment of the impact on groundwater dependent ecosystems should be prepared.	An assessment of the potential project impacts on groundwater dependent ecosystems is provided in **Section 7.6**.

Issue category	Issue raised	Where addressed
NSW Health		
Noise and vibration	An assessment of the noise and vibration impacts of the project during operation, consistent with the Road Noise Policy (EPA, 2011) should be prepared.	An assessment of the noise and vibration impacts of the project during operation, consistent with the Road Noise Policy (EPA, 2011) is provided in **Section 7.2** and **Appendix F**. Potential human health impacts associated with noise are considered in **Section 7.4** and **Appendix H**.
	An assessment of construction noise and vibration impacts, consistent with the Interim Construction Noise Guidelines (DECC, 2009b) and Assessing Vibration: a technical guideline (DEC, 2006a) should be prepared.	A construction noise and vibration assessment consistent with the Interim Construction Noise Guidelines (DECC, 2009b) and Assessing Vibration: a technical guideline (DEC, 2006a) is provided in **Section 7.2** and **Appendix F**. Potential human health impacts associated with noise are considered in **Section 7.4** and **Appendix H**.
Air quality	An assessment of the impact of operation of the tunnel on regional air quality should be prepared.	An assessment of operational impacts to air quality, including impacts from operation of the project tunnels on regional air quality, is provided in **Section 7.3** and **Appendix G**. Potential human health impacts associated with air quality are considered in **Section 7.4** and **Appendix H**.
	Potential emissions sources relating to construction including dust from unpaved service locations, dust from transport of spoil and emissions from non-road diesel engines should be described. Consideration should be given to all feasible mitigation measures.	A construction air quality assessment including potential emissions sources is provided in **Section 7.3**. Feasible and reasonable mitigation measures are also identified in **Section 7.3**.
Health	A comprehensive assessment of the human health risks associated with the project’s impact on local and regional air quality during construction and operation should be prepared.	A comprehensive human health risk assessment, taking into account relevant impacts on local and regional air quality is provided in **Section 7.4** and **Appendix H**.
	The health risk assessment should be conducted in accordance with the approach described in the NSW Health document Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards (2012).	The human health risk assessment has been carried out in accordance with relevant guidance document and in consultation with NSW Health.

Issue category	Issue raised	Where addressed
	Consideration should be given to a range of pollutants including $PM_{2.5}$, PM_{10}, TSP, CO, NO_2 and other nitrogen oxides, volatile organic compounds and ozone. Relevant short and long term exposure and impact of odours should be considered.	The human health risk assessment includes consideration of relevant pollutants and short and long term exposures. The air quality assessment (**Section 7.3** and **Appendix G**) and the human health risk assessment (**Section 7.4** and **Appendix H**) provide justification for the relevant pollutants considered as part of those assessments.
	Both incremental changes in exposure from existing background pollutant levels and the cumulative impacts of project specific and existing pollutant levels should be addressed at the location of receptors.	The human health risk assessment includes consideration of incremental changes in exposure from background pollutant levels and cumulative impacts of project specific and existing pollutant levels.
	Exposure to pollutants should be addressed at the location of the most affected receptors and also for other sensitive receptors such as childcare centres, schools, hospitals and aged care facilities.	The human health risk assessment considers the most affected receivers and other sensitive receivers.
	Consideration should be given to the size of the population exposed to increased concentrations of air pollutants.	The human health risk assessment considers the characteristics of the local population that may be affected by the project.
	The location, configuration and design of all emissions sources including ventilation stack(s) and tunnel portals. The pollutant levels from any stack and/or portal emissions should be modelled.	**Chapter 5** describes the project including the tunnel ventilation system. Modelling of potential air quality impacts is provided in **Section 7.3** and **Appendix G**.
	Consideration should be given to all feasible mitigation measures in addition to stack ventilation, such as filtration of emissions prior to discharge, and a rationale provided for inclusion or exclusion of these measures.	**Section 7.3** and **Appendix G** include consideration of reasonable and feasible mitigation and management measures in the context of residual air quality impacts. This includes analysis of the costs and benefits of potential tunnel filtration.
	An assessment of in tunnel air quality and the human health effects of potential exposure to pollutant scenarios for vehicle occupants (including infants, children and adults) and motorcyclists using the tunnel should be prepared.	An assessment of the potential human health effects of the in-tunnel air quality is provided in **Section 7.4** and **Appendix H**.
NSW Office of Environment and Heritage		
Biodiversity	Impacts on flora and fauna, including threatened species, populations and endangered ecological communities and their habitats should be addressed in accordance with OEH's Threatened Species Survey and Assessment Guidelines and any relevant draft or final recovery plans.	A biodiversity assessment including impacts on flora and fauna, including threatened species, populations and endangered ecological communities and their habitats, and consistent with the relevant requirements of OEH's Threatened Species Survey and Assessment Guidelines (OEH, 2013d) is provided in **Section 7.6**.

Issue category	Issue raised	Where addressed
	Steps taken to mitigate or offset any identified impacts to the environment should be detailed.	Measures to mitigate and manage biodiversity impacts are provided in **Section 7.6**. Preliminary offset calculations are also provided in **Section 7.6** and **Appendix J**.
	The NSW offset principles for major projects (state significant development and state significant infrastructure) should be used to assess and determine the adequacy of any offsets.	Preliminary offset calculations are provided in **Section 7.6** and based on the Biobanking Assessment Methodology. Further development of offsets through a Biodiversity Offset Strategy would be consistent with the NSW offset principles for major projects.
Surface water and groundwater	A preliminary hydrological and hydraulic assessment for the project catchment, including overland flow paths associated with major drainage, should be carried out. The assessment should determine flood extent for a range of flood sizes up to the probable maximum flood (PMF).	The surface water assessment is provided in **Section 7.9**. This has considered potential flooding impacts.
	If the preliminary hydrological and hydraulic assessment indicates that the project is on flood prone land (ie below the PMF level) a detailed assessment should be carried out for both existing and developed conditions.	The project is not located on flood prone land.
	The project should comply with the relevant policies and guidelines including NSW Government Flood Prone Land Policy as set out in the Floodplain Development Manual (2005), Section 117(2) Local Planning Direction 4.3 “Flood Prone Land” and Planning circular PS 07-003 “New guideline and changes to section 117 direction and EP&A Regulation on flood prone land”.	The surface water assessment is provided in **Section 7.9**. This has considered potential flooding impacts, consistent with relevant guidelines. The project is not located on flood prone land.
Aboriginal cultural heritage	Aboriginal cultural heritage should be addressed in accordance with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (2005).	The assessment of Aboriginal cultural heritage impacts provided in **Section 7.11** and **Appendix M** has been carried out consistent with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (2005).
	Impacts on Aboriginal cultural heritage should be avoided where possible. Where it is not possible, mitigation strategies must be explored in consultation with Aboriginal stakeholders.	There are no anticipated direct impacts on Aboriginal cultural heritage from the project. Measures have been proposed to prevent indirect impacts on Aboriginal cultural heritage sites in the vicinity of works.

Table 6-7 Issues raised by local government

Issue category	Issue raised	Where addressed
The Hills Shire Council		
Consultation process	Consultation should be carried out with other agencies within Transport for NSW, particularly in relation to the impact on public transport and the North West Rail Link project.	Information regarding consultation with various stakeholders including government agencies is provided in this chapter. The project has been designed to avoid direct interaction with NWRL. Potential impacts on public transport are considered in **Section 7.1**.
	Consultation should be carried out with the various emergency services or the Local and Regional Emergency Management Committees.	Information regarding consultation with various stakeholders including local and regional emergency management committees is provided in this chapter. This has included consultation with Fire and Rescue NSW.
	Comprehensive stakeholder engagement required with both Council and the local community	Details of consultation undertaken with the local community and Councils are provided in this chapter.
Noise	Management of truck movements along local roads needs to be carefully managed to mitigate noise impact to local residents	Measures to manage and mitigate noise impacts include those from heavy vehicle movements are provided in **Section 7.2**.
Air quality	How will air quality be measured during the planning and operational phases of the project to ensure that local communities are not adversely affected by tunnel emissions? Details of the location of any temporary or permanent air quality monitoring stations and how air quality data can be assessed should be provided.	Assessment of air quality impacts including baseline monitoring locations, methodology and results are provided in **Section 7.3**. During operation of the project, it is proposed that air quality monitoring would be conducted to verify the air quality performance of the project and demonstrate consistency with air quality modelling predictions presented in this environmental impact statement.
	Impacts on air quality, for local communities located near the tunnel portals, from construction activities.	Assessment of potential air quality impacts during construction and operational is provided in **Section 7.3** and **Appendix G**.
Landscape character and visual amenity	Obligation should be placed on the operator to ensure that any landscaping works at the tunnel interchanges are maintained to an acceptable standard. This would include areas outside any noise walls but within the project corridor.	Details of landscaping including operational mitigation measures are provided in **Section 7.5**. Management measures would be development and implemented during operation to ensure that landscaping within the responsibility of the motorway operator is adequately managed and maintained.
Design	Height of tunnel to avoid impact of overheight vehicles causing delays to motorists.	Design features of the project are described in **Chapter 5**. The tunnel would be the highest tunnel in Sydney at 5.3 metres in order to minimise the likelihood of an incident involving overheight vehicles.

Issue category	Issue raised	Where addressed
	Management of spoil is of concern especially given the number of projects in the local government area	The management of spoil is described in **Section 8.3**. Potential traffic and noise impacts from spoil removal are assessed in **Section 7.1** and **Section 7.2**. Consideration has also been given to cumulative impacts with other major infrastructure projects in the region in relevant assessment sections of this environmental impact statement.
Hornsby Shire Council		
Consultation process	A mechanism needs to be in place to manage awareness of the project on future and new land owners beyond the point of initial consultation.	The consultation strategy for the project including consultation during construction is provided in **Section 6.4** and the Community Communications Framework in **Appendix D**. Roads and Maritime has been active in the provision of information about the project since its inception and public announcement through several media, as summarised in **Section 6.3**.
	Details regarding complaints handling in regards to noise and vibration.	The consultation strategy includes a complaint handling procedure is provided in **Section 6.4**. Complaints handling mechanisms and procedures would be reviewed and updated as required prior to the commencement of construction and prior to project opening, to reflect the specific needs and issues for those project phases.
Noise and vibration	Noise from plant and equipment associated with the project should be considered in line with the NSW Industrial Noise Policy.	An operational industrial noise assessment consistent with the NSW Industrial Noise Policy (EPA, 2000b) is provided in Section 7.2 and Appendix F.
	Consideration should be given to impacts from architectural noise and emission treatments in addition to the construction of the primary infrastructure.	An assessment of potential noise impacts and feasible and reasonable mitigation measures is provided in **Section 7.2**.
	Noise and vibration mitigation measures during standard construction work hours.	Measures to manage and mitigate noise and vibration impacts are provided in **Section 7.2**. While much of the construction of the project can be carried out during standard construction hours, some construction activities including tunnelling and tunnelling support, and works within live motorways, must be scheduled out of standard construction hours and / or on a continuous basis for practical or safety reasons.

Issue category	Issue raised	Where addressed
	Selection and application of best work practices to minimise noise impacts.	Measures to manage and mitigate noise and vibration impacts are provided in **Section 7.2**. These measures reflect reasonable and feasible noise mitigation consistent with the requirements of noise assessment policies in NSW.
Biodiversity	Impacts on remnant Blue Gum High Forest, a Critical Endangered Ecological Community listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1995* that occurs within the Pennant Hills Road corridor.	Potential biodiversity impacts including impacts to endangered ecological communities are considered in **Section 7.6** and **Appendix J**. Blue Gum High Forest consistent with the definition of this community under the *Threatened Species Conservation Act 1995* would be impacted by the project. However, this community within does not meet the equivalent community definition under the *Environment Protection and Biodiversity Conservation Act 1999* within the project disturbance footprint.
	Impacts on remnant Turpentine Ironbark Forest, a Critical Endangered Ecological Community listed under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Threatened Species Conservation Act 1995* that occurs within the broader vicinity of the Pennant Hills Road corridor.	Potential biodiversity impacts including impacts to endangered ecological communities are considered in **Section 7.6** and **Appendix J**. Sydney Turpentine Ironbark Forest consistent with the definition of this community under the *Threatened Species Conservation Act 1995* would be impacted by the project. However, this community within does not meet the equivalent community definition under the *Environment Protection and Biodiversity Conservation Act 1999* within the project disturbance footprint.
	Impacts on non-Critical Endangered Ecological Community or Endangered Ecological Community vegetation contained within the Pennant Hills Road corridor and adjacent areas.	A biodiversity impact assessment is provided in **Section 7.6** and **Appendix J**. The assessment includes consideration of listed threatened species, communities, populations and their habitats.
	Impacts on threatened species that occur or potentially occur within or utilise the road corridor (including nesting, foraging, refuge and dispersal).	A biodiversity impact assessment is provided in **Section 7.6** and **Appendix J**.
	Changes to connectivity and edge effects on the linear remnant vegetation within the Pennant Hills Road corridor and adjacent patches of Blue Gum High Forest.	A biodiversity impact assessment is provided in **Section 7.6** and **Appendix J**. The assessment includes consideration of listed threatened species, communities, populations and their habitats.
	Changes to connectivity of stepping stone vegetation between the Cockle Creek, Lane Cove River and Berowra Creek catchments.	A biodiversity impact assessment is provided in **Section 7.6** and **Appendix J**. The assessment includes consideration of vegetation and habitat connectivity.

Issue category	Issue raised	Where addressed
	Impacts of the project on connectivity for the spread of floristic genetics including seed dispersal via wind, water and fauna and also the pollination of plants through insects and other fauna.	A biodiversity impact assessment is provided in **Section 7.6** and **Appendix J**. The assessment includes consideration of vegetation and habitat connectivity.
	Impacts of the project on connectivity for the movement of fauna species between linear remnant patches within the corridor and adjacent vegetation.	A biodiversity impact assessment, including the identification of wildlife corridors, is provided in **Section 7.6** and **Appendix J**. The assessment also includes consideration of vegetation and habitat connectivity.
	Consideration should be given to the *Draft Hornsby Shire Council Local Environment Plan 2012*, the *Draft Hornsby Shire Council Development Control Plan 2012*, particularly 1B.6 and 1C.1 and Councils Green Offsets Code 2013.	Preliminary calculations of biodiversity offsets are provided in **Section 7.6**. The offsets have been calculated consistent with the Biobanking Assessment Methodology, which has been adopted for use in NSW.
	Impacts upon groundwater and surface water and related impacts (water quality, flora and fauna) upon tributaries of Berowra Creek and Lane Cove River.	Groundwater impacts are assessed in **Section 7.8**. Surface water impacts including water quality are assessed in **Section 7.9**. Biodiversity impacts have been provided in **Section 7.6.3**. These assessments have considered potential impacts on Berowra Creek and the Lane Cover River, including their catchments, water quality and ecology, where relevant.
	Mitigation options and offsets including: weed management and the control of pathogens; alternative locations that minimise impacts on local flora and fauna; protected areas of vegetation and habitat; additional habitat created due to any lost habitat (offset); features to provide suitable fauna crossings; fauna exclusion area in high traffic areas; and fauna refuge areas.	Measures to mitigate and manage biodiversity impacts are been provided in **Section 7.6**. The project has been designed to avoid and minimise the need to clear vegetation, particularly vegetation and habitats of conservation significance, where reasonable and feasible. Preliminary calculations of biodiversity offsets are provided in **Section 7.6**.

Issue category	Issue raised	Where addressed
	Impacts to Kenley Park including: Remnant Blue Gum High Forest and connectivity of vegetation within the park to adjacent Blue Gum Forest; threatened species habitat, populations and communities; connectivity role of the park in relation to stepping stone vegetation between Lane Cove River and Berowra Creek catchments; Transport Infrastructure Development Corporation offset works; and stormwater drainage into tributary of Berowra Creek through Berowra Valley National Park.	A biodiversity impact assessment is provided in **Section 7.6** and **Appendix J**. This assessment considers listed threatened species, communities, populations and their habitats, vegetation and habitat connectivity, indirect impacts through surface and groundwater effects, and cumulative impacts and offsets associated with other major infrastructure projects in the region. Direct impacts to Kenley Park have been avoided through the project design.
Landscape character and visual amenity	The design and visual amenity of associated facilities should be considered both during and after construction, including the impact of temporary hoardings, equipment etc.	An assessment of construction and operational urban design, landscape character and visual amenity is provided in **Section 7.5**. The urban design of the project, including ancillary facilities, would be further developed during detailed design.
	Consideration of impacts should include impacts on views and vistas, including visual settings, amenity and streetscapes.	Assessment of construction and operational urban design, landscape character and visual amenity impacts is provided in **Section 7.5**. The urban design of the project, including ancillary facilities, would be further developed during detailed design.
Socio-economic	An assessment of socio-economic impacts should include the Pacific Highway from Berowra to Wahroonga.	An assessment of social and economic impacts is provided in **Section 7.7**. This includes relevant areas along and around the Pacific Highway.
Geology and soils	Consideration should be given to mitigation options for erosion and sediment control.	Measures to mitigate and manage erosion and sedimentation are provided in **Section 7.8**.
	Likely nature and classification of excavated material should be in accordance with the Department of Environment, Climate Change and Water NSW *Waste Classification Guidelines* and the Environment Protection Authority's *General Resource Recovery Exemptions*.	An assessment of waste, including spoil management is provided in **Section 8.3**. Waste materials would be characterised consistent with the requirements of the Waste Classification Guidelines.
	The potential use of recycled excavated material should be in accordance with the Environment Protection Authority's General Resource Recovery Exemptions pursuant to the *Protection of the Environment Operations (Waste) Regulations 2005*.	An assessment of waste, including spoil management and re-use options is provided in **Section 8.3**. Waste materials would be characterised consistent with the requirements of the Waste Classification Guidelines.

Issue category	Issue raised	Where addressed
Non-Aboriginal heritage	Consideration should be given to draft and listed heritage items and heritage conservation area.	An assessment of non-Aboriginal heritage is provided in **Section 7.10**. The assessment includes consideration of currently listed heritage items, heritage items currently subject to draft listings, and heritage conservation areas.
	Both tunnel portals will be located within existing and adjacent heritage conservation areas.	An assessment of non-Aboriginal heritage, including consideration of heritage conservation areas, is provided in **Section 7.10**. The assessment has taken into account potential impacts on heritage conservation areas.
Land use and property	An assessment of land use and property impacts should include the Pacific Highway from Berowra to Wahroonga.	An assessment of land use and property impacts is provided in **Section 8.1**. The assessment considers land potentially directly and indirectly impacted by the project.
Ku-ring-gai Council		
Biodiversity	For above ground infrastructure located in or adjacent to bushland the planning for bushfire requirements will need to be carefully considered in terms of impact on biodiversity.	Potential biodiversity impacts including consideration of development within bushfire prone land is provided in **Section 7.6**. An assessment of project hazards and risks, including in relation to bushfires, is provided in **Section 8.3**.
Surface water and groundwater	Regional specific guidelines developed by Hornsby Shire Council and Ku-ring-gai Council should be considered in line with the ANZECC 2000 guidelines in relation to water quality impacts. Drainage for project facilities and infrastructure as part of construction and operation	An assessment of surface water, water quality impacts is provided in **Section 7.9**. Where relevant and available, this has considered local guidelines and surface water quality data. Details of project drainage infrastructure are provided in **Chapter 5**, with the potential for localised flooding and drainage changes considered in **Section 7.9**.

Issue category	Issue raised	Where addressed
Traffic	Consideration of traffic impacts / benefits to Pacific Highway for both construction and operation.	An assessment of construction and operational traffic impacts / benefits is provided in **Section 7.1** and **Appendix E**. The assessment includes consideration of the impacts and benefits for the local and regional road network, including the Pacific Highway where relevant.
Noise	Extent of noise reduction measures at the northern portal to be addressed in the EIS.	Measures to manage and mitigate noise impacts are provided in **Section 7.2**. The assessment includes consideration of noise impacts around the northern portal as a result of construction traffic and activities, operational traffic, operational ancillary facilities, and potential portal breakout noise. Noise mitigation and management measures have been identified and proposed in response to modelling and assessment of these noise sources.

Table 6-8 Issues raised by the community

Issue category	Issue raised	Where addressed
Process		
Strategic justification and project need	Appropriateness of the unsolicited proposal process with NSW Government and Transurban.	The unsolicited proposals process in NSW, as outlined in Unsolicited Proposals: Guide for Submission and Assessment (NSW Government, 2014) (revised and updated since its original publication in 2012), is a consistent, transparent and streamlined approach for the receipt, assessment and determination of unsolicited proposals that may be developed and submitted by the private sector for works and/ or activities that would have historically been conducted by Government. Unsolicited proposals and the guidelines that govern their assessment and published on the NSW Government website (http://www.nsw.gov.au/your-government/unsolicited-proposals). The unsolicited proposal received by Government from Transurban and the Westlink M7 Motorway Sponsors in relation to the NorthConnex project has been conducted strictly in accordance with published guidelines that govern unsolicited proposals.
	Selection criteria and process for appointing the preferred tenderer and design.	An outline of the tender evaluation process is provided in **Chapter 4**. A key input into the assessment of tenders was an analysis of potential environmental, social and land use impacts associated with each tender design.
	Evidence that the preferred scheme was the 'best' option.	An overview of the options development process and the tender evaluation process is provided in **Chapter 4**.
	Government investment should focus on public transport initiatives and improvements as well as cycling infrastructure.	The NSW Government recognises the need to provide balanced planning, funding and implementation of transport infrastructure that responds to the needs of New South Wales, including Sydney. The NSW Long Term Transport Master Plan (Transport for NSW, December 2012a) responds to this need with a clear and transparent framework of transport infrastructure priorities, including investments in road, rail and other public transport infrastructure. The Master Plan includes arrangements for funding new and upgrade transport infrastructure, including public transport infrastructure, and a prioritised program for delivery of this infrastructure.
	Support for project as a solution to improve existing traffic congestion and noise impacts along Pennant Hills Road.	The support for the project is acknowledged.

Issue category	Issue raised	Where addressed
	Cost-benefit assessment of project impacts and project objectives.	The justification and conclusion of the project, having taken into account the identified environmental impacts and mitigation measures, is provided in **Chapter 11**. This includes consideration of the project against the objects of the *Environmental Planning and Assessment Act 1979*.
Project funding	Project funding, government contributions and commercial incentives for Transurban.	Project funding arrangements are described in **Chapter 4**. The Australian and State Governments have each committed up to $405 million to the project. The remainder of the cost of the project would be funded by Transurban and the Westlink M7 Shareholders and would be recouped from tolls on the project and changes to tolling for heavy vehicles on some Sydney motorways. The proposed toll on the project would be generally consistent with the tolling structure on the Hills M2 Motorway.
	Increase in tolling and taxes to benefit private sector investment (Transurban).	Project funding arrangements are described in **Chapter 4**. The Australian and State Governments have each committed up to $405 million to the project. The remainder of the cost of the project would be funded by Transurban and the Westlink M7 Shareholders and would be recouped from tolls on the project and changes to tolling for heavy vehicles on some Sydney motorways. The proposed toll on the project would be generally consistent with the tolling structure on the Hills M2 Motorway.
	Increase tolls for trucking industry.	Project funding arrangements, including tolling changes, are described in **Chapter 4**. The Australian and State Governments have each committed up to $405 million to the project. The remainder of the cost of the project would be funded by Transurban and the Westlink M7 Shareholders and would be recouped from tolls on the project and changes to tolling for heavy vehicles on some Sydney motorways. The proposed toll on the project would be generally consistent with the tolling structure on the Hills M2 Motorway.
	Concession Deed changes across the motorway network to fund the Project proposal.	Project funding arrangements are described in **Chapter 4**. The Australian and State Governments have each committed up to $405 million to the project. The remainder of the cost of the project would be funded by Transurban and the Westlink M7 Shareholders and would be recouped from tolls on the project and changes to tolling for heavy vehicles on some Sydney motorways. The proposed toll on the project would be generally consistent with the tolling structure on the Hills M2 Motorway.

Issue category	Issue raised	Where addressed
	Security of project finance and funding needs to ensure the viability of the project.	Project funding arrangements are described in **Chapter 4**. The Australian and State Governments have each committed up to $405 million to the project. The remainder of the cost of the project would be funded by Transurban and the Westlink M7 shareholders and would be recouped from tolls on the project and changes to tolling for heavy vehicles on some Sydney motorways. The proposed toll on the project would be generally consistent with the tolling structure on the Hills M2 Motorway.
	Consideration of distance based and time of use tolling.	Project funding arrangements are described in **Chapter 4**. The proposed toll on the project would be consistent with the tolling structure on the Hills M2 Motorway.
Project development and alternatives	Consideration of alternatives to the proposed tunnel to alleviate traffic congestion.	Project options and alternatives are provided in **Chapter 4**.
	Consideration of other corridors as part of the current project. A more long term option for an extra crossing over the Hawkesbury River, connection to the Westlink M7 and inclusion of a rail line should be included. The 'yellow route' from the 2004 study would resolve the Macquarie Park accessibility problems.	Project options and alternatives are provided in **Chapter 4**. Project alternatives and route alignment options have been assessed through several reports, including community consultation, since 2002. A road tunnel connection consistent with the project has been reviewed and confirmed as meeting the transport needs of Sydney in the immediate term.
	An option for upgrading the Pacific Highway (south / east from M1 Pacific Motorway interchange) should be included.	Upgrading of the Pacific Highway is outside the scope of this project but has been considered in previous studies by Roads and Maritime since 2002 (refer to **Chapter 4**).
	The 'purple route' was preferred as it followed the alignment of Pennant Hills Road and avoided going under homes.	The preferred tender design is within the purple corridor option identified by the 2004 report. Details of the options assessment is provided in **Chapter 4**.
	Project delivery program including construction start, staging and duration.	The project description including project staging is provided in **Chapter 5**. The program for delivery of the project has been developed to strike an appropriate balance between timely implementation of the project and minimisation of impacts on the surrounding environment and communities.

Issue category	Issue raised	Where addressed
	Selection and alternatives for the location of the northern ventilation facility, away from residential area and schools. Suggested alternative to locate the facility within the industrial area located to the North or to the south around Pearce's corner.	The locations of the two project ventilation facilities has taken into account operational efficiencies associated with location close to the main alignment tunnel portals, and balanced consideration of other relevant factors including engineering and construction practicality, local topography and landscape, availability and access to land and the need to acquire land, environmental and land use impacts, and potential community disruption during construction. Further details regarding site selection for the ventilation facilities is provided in **Chapter 4**.
	Selection and alternatives for the location of the southern ventilation facility, away from residential area. Suggested alternative to locate the facility within the Pennant Hills Golf Club, to the east of Pennant Hills Road.	The ventilation facilities for project have been shown through the air quality assessment (refer to **Section 7.3**), human health risk assessment (refer to **Section 7.4**) and the noise assessment (refer **Section 7.2**) to meet acceptable air quality, health and noise outcomes during operation. In most cases, impacts on receivers adjacent to and around the ventilation facilities are very low. On this basis, it has been concluded that both ventilation facilities could be operated in their proposed locations without significant impacts on the environment or local communities. Further details regarding site selection for the ventilation facilities is provided in **Chapter 4**.
	Selection and alternatives for the location of the Wilson Road tunnel support facility. Suggested alternative to locate the facility across Pennant Hills Road in Observatory Park.	For operational and safety reasons, the tunnel support facilities are required to be located at around third points along the main alignment tunnels and directly above the tunnels. The assessments undertaken and presented in this environmental impact statement demonstrate that the Wilson Road tunnel support facility could be constructed and operated without significant impacts on the environment or local communities. Further details regarding site selection for the tunnel support facilities is provided in **Chapter 4**.
	Selection and alternatives for the location of the Trelawney Street tunnel support facility. Suggested alternative to locate the facility in the industrial land area across Pennant Hills Road.	For operational and safety reasons, the tunnel support facilities were required to be located at around third points along the main alignment tunnels and directly above the tunnels. The assessments undertaken and presented in this environmental impact statement demonstrate that the Trelawney Street tunnel support facility could be constructed and operated without significant impacts on the environment or local communities. Further details regarding site selection for the tunnel support facilities is provided in **Chapter 4**.

Issue category	Issue raised	Where addressed
	Consideration of the Equilibria project proposal as a design alternative. The Equilibria proposal involved the northern portals of the NorthConnex tunnel being moved approximately one kilometre further north along the M1 Pacific Motorway and for the current footprint of the M1 Pacific Motorway to be used for residential development.	The alternative Equilibria proposal to government would need to be considered under the NSW Government's unsolicited proposals process. The equilibria proposal does not align with the unsolicited proposal currently being considered by the NSW Government in accordance with *The Guide of Submissions and Assessment of Unsolicited Proposals (2012).* A response has been provided to the Equilibria proponents citing safety, traffic management, financial and equity limitations including: • No suitable alternative for dangerous goods vehicles travelling along the M1 Pacific Motorway. Vehicles carrying dangerous goods would be forced off the motorway around Berowra and would need to travel through additional residential areas of Berowra, Asquith and Hornsby. Alternatively, safety standards would need to be relaxed to allow dangerous goods vehicles in the tunnel which would have potential implications for in-tunnel road safety. • Forcing vehicles who need to access the Pennant Hills road corridor from the M1 Pacific Motorway through a tolled tunnel. • Lack of consideration of traffic management issues of the tunnel extension were closed due to an incident (unlike NorthConnex with Pennant Hills Road remaining as an alternative). • Lack of robust financial and cost estimate information that allows for proposal appraisal. The additional length of tunnelling would also require another intermediate tunnel support facility (similar to the Wilson Road and Trelawney Street tunnel support facilities) in order to provide a safe in-tunnel environment in the event of an emergency. This would result in additional land acquisition, and associated social and environmental impacts.
Project scope	The location, number, scale and design features of the northern and southern interchanges.	A project description including interchange information is provided in **Section 5**. The northern and southern interchanges have been designed to provide efficient traffic connections, and to balance environmental and community issues to minimise impacts overall.
	Design options including elevated sections of road or ramps.	Design refinements carried out as part of the tender process are described in **Chapter 4**.
	Mid-tunnel access options for motorists (eg near Beecroft Road).	The reasons for not including an intermediate interchange in the scope of the project are discussed in **Chapter 4**.

Issue category	Issue raised	Where addressed
	Tunnel depth, alignment options following Pennant Hills Road or under properties.	Design refinements carried out as part of the tender process, including consideration of tunnel depth and the horizontal alignment are described in **Chapter 4**.
	Tunnel interface, including design and safety implications, with other infrastructure such as the North West Rail Link.	Design refinement details including the consideration of other infrastructure are provided in **Chapter 4**.
	Hills M2 Motorway integration work is on the same side of the motorway as the previous widening for the Hills M2 Motorway Upgrade project. The same residents will be impacted again.	The scope of the Hills M2 Motorway integration works is detailed in **Chapter 5**. Potential impacts from this project component are provided throughout the impact assessment sections in **Chapter 7** and **Chapter 8**.
	Southern interchange ramp design and location resulting in impacts on nearby residential areas.	The design of the southern interchange is described in **Chapter 5**. Potential impacts from this project component are provided throughout the impact assessment sections in **Chapter 7** and **Chapter 8**. The southern interchange and tunnel portals have been design and located to optimise traffic efficiency, minimise engineering complexity and cost, and minimise potential impacts on the environment, local communities and land use. The need for land acquisition has been minimise through design of this infrastructure.
	Northern interchange and tunnel portal entry and exit design and locations resulting in impacts on nearby residential areas.	The design of the northern interchange is described in **Chapter 5**. Potential impacts from this project component are provided throughout the impact assessment sections in **Chapter 7** and **Chapter 8**. The northern interchange and tunnel portals have been design and located to optimise traffic efficiency, minimise engineering complexity and cost, and minimise potential impacts on the environment, local communities and land use. The need for land acquisition has been minimise through design of this infrastructure.
	Design, including form and height, of the tunnel ventilation and support facilities in relation to existing residential context.	Project description including the design of the tunnel, ancillary facilities and ventilation system is provided in **Chapter 5**. Tunnel ventilation facilities have been design to provide efficient and effective dispersion of emissions, having regard to surrounding receivers, meteorology and topography. The need to minimise visual impacts, land take and disruption to the local community were also important factors taken into account in the design of the ventilation facilities. A similar design process has been applied to other ancillary facilities, which have been subject to a balance assessment of potential environmental, community and land use issues to minimise potential impacts overall.

Issue category	Issue raised	Where addressed
	Limitation of tunnel design to include only two lanes in each direction, when the tunnel is opened.	Design options including the number of lanes are provided in **Chapter 4**. The decision to open with project to two lanes of traffic in each direction has been based on traffic forecasting and detailed analysis of traffic demands. To future-proof the project, space has been allowed in the main alignment tunnels to mark a third lane in each direction, if growth in traffic demand and other operational considers warrant increased tunnel capacity.
	Noise reduction road surface material to be considered as part of project design.	Measures to mitigate and manage noise impacts are provided in **Section 7.2**. The design of the project includes low noise road pavement for surface works on motorways.
	Future extent of additional widening along the M1 Pacific Motorway to accommodate the use of the third lane in each direction.	Any future widening of the M1 Pacific Motorway, if undertaken, is outside the scope of this project. If required in the future, works on the M1 Pacific Motorway would be subject to separate assessment and approval in accordance with the *Environmental Planning and Assessment Act 1979*.
Environmental assessment	Environmental impact statement methodology for the project.	The impact assessment methodology for each environmental aspect is consistent with relevant guidelines. Details of the assessment methodologies are provided in **Chapter 7** and **Chapter 8**.
	Consideration of construction and operational impacts.	Assessment of environmental impacts from construction and operation of the project is provided in the respective sections of **Chapter 7** and **Chapter 8**.
	Consideration of alternatives.	A description of the options and alternatives process is provided in **Chapter 4**.
	Degree to which issues raised by the community are addressed in the environmental impact statement.	Details of community consultation are provided in this chapter. Issues raised have been considered in the environmental impact statement and in the design of the project.
	Degree to which the assessment process is conducted in an independent manner.	This environmental impact statement has been: • Prepared in accordance with relevant guidelines developed by regulatory agencies. • Certified by the authors as neither false nor misleading. • Reviewed by regulatory agencies including the Department of Planning and Environment, the EPA, NSW Health, NSW Office of Water, Office of Environment and Heritage, and Department of Primary Industries. The Department of Planning and Environment has undertaken an assessment of the project and recommended the Minister for Planning makes a determination with consideration given to community and regulatory agency inputs.

Issue category	Issue raised	Where addressed
	Extend consultation period as part of the environmental impact statement public exhibition period due to lack of consultation during the project development phase, the complexity and scale of the project and the significant potential impact of the project.	The public exhibition period for this environmental impact statement is determined by the Department of Planning and Environment, and in accordance with the provisions of the *Environmental Planning and Assessment Act 1979*. The minimum period for public exhibition would be 30 days. Any extensions to this period are at the discretion of the Department of Planning and Environment.
	Environmental impact statement, technical documents and air quality data should be presented in plain-English and accessible to the public.	The environmental impact statement is prepared to enable the document to be accessible and understood by the general public. A series of community information sessions have been programmed during the public exhibition of the environmental impact statement to provide further opportunities for interested community members to discuss information presented in the environmental impact statement.
Consultation process	Availability and accessibility of data collected from field investigations such as noise, air quality and traffic monitoring data to the public.	The data collected from field investigations has been presented in the relevant sections of this environmental impact statement.
	Timing and inadequacy of available project information and distribution.	Consultation undertaken during the preparation of the environmental impact statement is described in this chapter. Consultation has included provision of information to the community as it becomes available, and will continued through the public exhibition of the environmental impact statement, including community information sessions.
	Extent of distribution area for project related communication (such as Community Update newsletters and letters to the householder).	The distribution area for community information materials has covered the local community around all project components. In identifying the distribution area, all endeavours were made to ensure that potentially affected and interested community members were informed of project consultation activities.
	Details of the communication program to advise the community of the project scope, proposed design, tender evaluation, environmental assessment process, project development and opportunities for consultation.	Details of the consultation process throughout the project are provided in this chapter.
	Accessibility and location selection of community information session venues.	Community information sessions were scheduled across the project corridor. In identifying the community information venues, all endeavours were made to ensure that potentially affected and interested community members had reasonable access to information session venues.

Issue category	Issue raised	Where addressed
	Community event format – formal Question and Answer structure does not provide enough opportunity for individuals to raise questions and concerns across the project.	Community events were structured to provide a balance between those who preferred to ask questions in an open forum and those who prefer to ask questions on an individual basis. A mix of question-answer sessions, information displays and one-on-one discussions with members of the project team have been provided.
	Concern regarding the limited project details available for effective community consultation in the early project stages.	Project details were provided to the community at community information sessions at the earliest available opportunity.
	Lack of transparency and community involvement as part of the unsolicited proposal process.	The unsolicited proposals process in NSW, as outlined in Unsolicited Proposals: Guide for Submission and Assessment (NSW Government, 2014) (revised and updated since its original publication in 2012), is a consistent, transparent and streamlined approach for the receipt, assessment and determination of unsolicited proposals that may be developed and submitted by the private sector for works and/ or activities that would have historically been conducted by Government. Unsolicited proposals and the guidelines that govern their assessment and published on the NSW Government website (http://www.nsw.gov.au/your-government/unsolicited-proposals). The unsolicited proposal received by Government from Transurban and the Westlink M7 Motorway Shareholders in relation to the project has been conducted strictly in accordance with published guidelines that govern unsolicited proposals.
	Accessibility of background information and previous studies such as the Pearlman Report.	Background information including the 2004 report and the 2007 Pearlman Review are available on the Roads and Maritime Services website at: (www.rms.nsw.gov.au/roadprojects/projects/building_sydney_motorways) Background information relevant to the project has been provided through community information sessions as it has become available.
	Opportunity for community consultation on the preferred tender design to inform changes to the project proposal.	Community consultation throughout the detailed design and construction stages are described in this chapter and the Community Communication Framework in **Appendix D**. Consultation on the location and design of the project has been ongoing since 2002.
	Lack of consultation with residents regarding the location and the design of ancillary project surface infrastructure, including the location of the ventilation outlets and tunnel support facilities.	The selection process for the locations of the ancillary infrastructure is provided in **Chapter 4**. The project, including ancillary project infrastructure, has been designed with a balanced consideration of engineering practicalities, cost implications, road network performance and safety, environmental and community impacts, and land use and land acquisition requirements. The project design has been optimised to minimise impacts overall.

Issue category	Issue raised	Where addressed
	Limited and inaccurate visual images to represent the project proposal. Before and after images requested to provide a more clear understanding of proposed buildings and sites.	Before and after artists' impressions of the project are provided in **Section 7.5**.
	Concern project information may not be reaching non-English speaking background families and communities.	Community updates provide relevant information for people of non-English speaking background to gain information regarding the project, including details of translation services.
	Inadequate consultation and notification regarding Hills M2 Motorway integration work. Work will result in cumulative construction and long-term impacts on the same communities impacted by the recent Hills M2 Motorway Upgrade project.	Consultation with the local community regarding the Hills M2 Motorway integration works is described in this chapter. The relevant sections of the environmental impact statement have considered the cumulative impacts with the recently completed Hills M2 Motorway Upgrade project.
	Complaint management during construction, particularly in relation to night-time work impact on the sleep of local residents.	Consultation strategy including complaint management during construction is provided in this chapter and the Community Communication Framework in **Appendix D**. Information regarding proposed the hours of works are provided in **Chapter 5**.
Potential environmental impacts		
Construction methodology	Construction program, duration of activities and extent of impacts around construction compounds.	The project description including construction staging is provided in **Chapter 5**. The program for delivery of the project has been developed to strike an appropriate balance between timely implementation of the project and minimisation of impacts on the surrounding environment and communities.
	Construction hours for activities at construction compounds.	Project description including construction hours at ancillary facilities is provided in **Chapter 5**. While much of the construction of the project can be carried out during standard construction hours, some construction activities including tunnelling and tunnelling support, and works within live motorways, must be scheduled out of standard construction hours and / or on a continuous basis for practical or safety reasons.
Operational traffic	Potential project benefit to reduce current traffic levels on Pennant Hills Road and the local traffic network.	Assessment of traffic impacts including identification of potential benefits is provided in **Section 7.1** and **Appendix E**.

Issue category	Issue raised	Where addressed
	Improved reliability along Pennant Hills Road due to a reduction in traffic accidents.	Assessment of traffic impacts including identification of potential benefits is provided in **Section 7.1** and **Appendix E**.
	Impact to traffic flow on the Hills M2 Motorway, Pennant Hills Road, local area networks and the Sydney Orbital network.	Assessment of traffic impacts including identification of potential benefits is provided in **Section 7.1** and **Appendix E**.
	Traffic on Pennant Hills Road will not improve as a result of the project because the existing topography and surrounding bushland reserves make Pennant Hills Road the primary north-south roadway.	Assessment of traffic impacts including identification of potential benefits is provided in **Section 7.1** and **Appendix E**.
	Management of trucks on Pennant Hills Road and incentives to use the tunnel.	Details regarding heavy vehicle regulatory measures are provided in **Chapter 5**.
	Adjustments to Pennant Hills Road as part of the project proposal to reduce the number of surface lanes, changes to traffic light sequences, funnel vehicles into the tunnel and to include a dedicated bus lane and / or cycle lane.	A detailed description of all work associated with the project is provided in **Chapter 5**. While the project provides opportunities for future enhancements along Pennant Hills Road, these do not form part of the scope of this project and would need to be considered separately by the relevant government agencies.
	Changes to existing intersections and interchanges at the northern and southern end of the tunnel.	A detailed description of work associated with the project including surface works around interchanges is provided in **Chapter 5**.
	Ineffective operation of the interchanges and their integration into the local road network resulting in drivers using local roads as rat runs, especially during construction.	Assessment of traffic performance of the interchanges is provided in **Section 7.1** and **Appendix E**.
	Changes to the local road network and traffic conditions on local streets.	Changes to the local road network are outlined in **Chapter 5**.

Issue category	Issue raised	Where addressed
	Use of traffic lights at the tunnel entry and exit points.	Traffic lights are not proposed at tunnel entry and exit points. Traffic lights at tunnel entry and exit points would not be consistent with the intended operation of the project as a seamless, efficient motorway connection.
	Traffic modelling to remove 50 per cent of trucks off Pennant Hills Road is not enough to make an improvement given the increase in future traffic volumes. Pennant Hills Road will remain congested.	Assessment of operational traffic impacts, including future conditions along Pennant Hills Road, is provided in **Section 7.1**.
Construction traffic	Access to construction areas from residential roads and residents impacted along truck haulage routes.	Site access and egress and haulage routes are provided in **Section 7.1**. Wherever possible, site access points have been located with direct access to and from the arterial road network.
	Construction access for work on the Darling Mills Creek viaduct should not use Ventura Road for access.	Access arrangements for the Darling Mills Creek compound are described in **Chapter 5**. In response to this feedback received, use of Ventura Road access tack has been limited to the delivery and removal of large excavation equipment only. The main access point would be directly to and from the Hills M2 Motorway.
	Construction impact on bushwalking access under the Darling Mills Creek viaduct.	Impacts during construction to the walking track are described in **Section 7.7**.
	Traffic delays on the Hills M2 Motorway and local roads as a result of construction activities and truck movements.	An assessment of construction traffic impacts is provided in **Section 7.1**. Disruptions to traffic during construction would be managed to minimise the extent and duration of impacts to the surrounding road network.
	Impact on existing traffic volumes on Pennant Hills Road and the surrounding road network by introducing large numbers of construction vehicles onto these roads.	An assessment of construction traffic impacts is provided in **Section 7.1**. Construction traffic would be scheduled and managed to minimise potential impacts on the surrounding road network where reasonable and feasible.
	Traffic impact from increase in heavy vehicles during construction on location streets and intersections	An assessment of construction traffic impacts is provided in **Section 7.1**. Construction traffic would be scheduled and managed to minimise potential impacts on the surrounding road network where reasonable and feasible.
	Traffic impact along spoil haulage routes.	An assessment of construction traffic impacts is provided in **Section 7.1**.

Issue category	Issue raised	Where addressed
	Existing parking problems on local streets, particularly near to bus and train stops, will increase during construction.	An assessment of construction traffic impacts is provided in **Section 7.1**. It is proposed to utilise a central parking location for construction workers in order to limit potential parking impacts surrounding the compounds.
	Managing pedestrians around heavy construction vehicles especially during school hours.	An assessment of construction traffic impacts, including the identification of mitigation measures which consider the safety of the public, is provided in **Section 7.1**. Construction traffic would be scheduled and managed to minimise potential impacts on the surrounding road network where feasible and reasonable.
Public transport impact	Changes to public transport service and routes along Pennant Hill Roads, Hills M2 Motorway and local streets during construction and operation.	Potential impacts on public transport and local streets during construction and operation of the project are described in **Section 7.7**.
	Changes to public transport services and routes along the Hills M2 Motorway during construction and operation.	Potential impacts on public transport during construction and operation of the project are described in **Section 7.7**.
	Impact to existing bus stops including Barclay Road and Oakes Road during construction and / or operation.	Potential impacts on public transport during construction and operation, including potential for alterations to the Barclay Road and Oakes Road bus stops are described in **Section 7.7**.
	Provision of additional parking around train stations and bus stops should be considered.	Provision of additional car parking for public transport infrastructure is outside the scope of this project.
Cyclist considerations	Impact to cyclists on the Hills M2 Motorway during construction of required westbound integration work.	Potential impacts on cyclists during construction and alternative cycle routes are discussed in **Section 7.7.3**.
	Safety and design considerations for an alternative cycle route during construction.	Potential impacts on cyclists during construction and alternative cycle routes are discussed in **Section 7.7**.
	Opportunity to include a dedicated cycle lane on Pennant Hills Road.	The project offers the potential to consider enhancements along Pennant Hills Road in the future, however these do not form part of this project. The potential for future embellishments would be subject to separate consideration by relevant government agencies and local councils.
Operational traffic safety	Likelihood of an incident as a result of overheight vehicles within the tunnel.	The tunnel has been designed as the highest tunnel is Sydney to reduce the likelihood of an incident involving overheight vehicles. This, along with tunnel overheight detection systems are discussed in **Section 8.2**.

Issue category	Issue raised	Where addressed
	Risk to local communities of a tunnel collapse incident similar to what occurred during the construction of the Lane Cove Road tunnel.	Lessons learnt from the Lane Cove tunnel incident have been applied to the design and construction methods for this project. The risk of tunnel collapse is discussed in **Section 8.2**.
	Tunnel design features to minimise driver fatigue and potential for in-tunnel incidents.	Measures to minimise operational hazards and risks including the potential for in-tunnel incidents are provided in **Section 8.2**. In-tunnel way finding signage is proposed in order to provide interest to the journey through the tunnel and minimise the risk of driver fatigue.
Hazard and incident response	Management of dangerous goods vehicles in the tunnel.	Dangerous goods would not be allowed in the tunnel.
	Incident management in case of fire or blackout in the tunnel.	Tunnel emergency management infrastructure and procedures are described in **Chapter 5** and **Section 8.2**.
	Potential for motorists to be trapped in the tunnel during major bushfire events. The M1 Pacific Motorway and Pennant Hills Road have been blocked as a result of bushfires in the past.	The design of tunnel includes in-tunnel management measures in the event of incidents. These are described in **Section 8.2**.
	Development of emergency response management plan.	The emergency response and management features of the project are described in **Section 8.2**.
Noise and vibration	Existing and increasing noise levels from heavy vehicles on Pennant Hills Road.	Assessment of construction and operational noise impacts is provided in **Section 7.2** and **Appendix F**.
	Existing and increasing noise levels on Hills M2 Motorway from heavy vehicles and the use of compression breaking. Existing noise issues since the connection with the Westlink M7 remains unresolved and will increase as a result of widening work and additional heavy vehicles from the tunnel.	Assessment of construction and operational noise impacts is provided in **Section 7.2** and **Appendix F**.
	Existing and increasing noise levels along the M1 Pacific Motorway.	Assessment of construction and operational noise impacts is provided in **Section 7.2** and **Appendix F**.

Issue category	Issue raised	Where addressed
	Acceptability of noise impact assessment methodology, including adequacy of monitoring and modelling as well as the process for determining noise mitigation options and properties eligible to receive noise treatment.	The noise and vibration methodology, assessment of potential impacts, and management and mitigation measures are provided in **Section 7.2** and **Appendix F**.
	Noise wall movements along the NorthConnex tunnel, M1 Pacific Motorway and the Hills M2 Motorway.	Measures to manage and mitigate operational noise impacts, including an assessment of noise barriers, is provided in **Section 7.2**.
	Noise wall design, height, material and colour. Noise walls should blend into environmental surroundings, eg painted green, similar to some existing noise walls along the Hills M2 Motorway.	An assessment of visual and urban design impacts including noise walls is provided **Section 7.5**. Final details of the nature, location and design of noise walls would be established during detailed design of the project.
	Consideration of noise walls along the Darling Mills Creek viaduct on the Hills M2 Motorway.	Measures to manage and mitigate operational noise impacts, including an assessment of noise barriers, is provided in **Section 7.2**. Final details of the nature, location and design of noise walls would be established during detailed design of the project.
	Design and extent of new noise walls around the tunnel support facilities and ventilation facilities. Clarification on existing noise walls to be retained along the M1 Pacific Motorway.	Measures to manage and mitigate operational noise impacts, including an assessment of noise barriers, is provided in **Section 7.2**. Final details of the nature, location and design of noise walls would be established during detailed design of the project.
	Inadequate existing noise walls along existing roads including the Hills M2 Motorway and M1 Pacific Motorway. Many existing noise walls are made of old materials and are not high enough.	Measures to manage and mitigation operational noise impacts, including an assessment of noise barriers, is provided in **Section 7.2**. Final details of the nature, location and design of noise walls would be established during detailed design of the project.
	Noise impact at properties located near to ventilation outlets and the tunnel support facilities during construction and operation.	Assessment of construction and operational noise impacts is provided in **Section 7.2** and **Appendix F**.
	Noise impact at properties located near the northern and southern interchange.	Assessment of construction and operational noise impacts is provided in **Section 7.2** and **Appendix F**.

Issue category	Issue raised	Where addressed
	Noise impact on residential properties nearby construction compounds and along spoil disposal haulage routes.	Assessment of construction noise impacts, including construction traffic noise, is provided in **Section 7.2** and **Appendix F**.
	Noise impact as a result of night work as part of tunnelling and along the Hills M2 Motorway.	Assessment of construction noise impacts, including potential out of hours works, is provided in **Section 7.2** and **Appendix F**.
	Vibration impact as a result of tunnelling work and construction activities, particularly at night.	Assessment of construction vibration impacts is provided in **Section 7.2** and **Appendix F**.
	Vibration impact in homes located above the tunnel during operation, particularly where the tunnel ramps are shallow to the surface.	Assessment of construction vibration impacts is provided in **Section 7.2** and **Appendix F**.
	Operational vibration impact resulting in disruption and property damage.	Assessment of construction vibration impacts is provided in **Section 7.2**. The operation of the project tunnels is not anticipated to generate vibration impacts.
	Acceptable noise levels for construction and operation.	Assessment of construction and operational noise impacts is provided in **Section 7.2**. The noise criteria have been established in accordance with the relevant applicable noise assessment guidelines and policies endorsed by the Environment Protection Authority.
	Impact along the Hills M2 Motorway from night work and the relocation of existing operational noise walls.	Assessment of construction and operational noise impacts is provided in **Section 7.2**, including for construction activities to be conducted outside of standard construction hours.
	Construction noise impact at properties along Pennant Hills Road, the Hills M2 Motorway and around the two interchanges.	Assessment of construction noise impacts is provided in **Section 7.2** and **Appendix F**.
Air quality	Construction dust impact at properties near Pennant Hills Road, Hills M2 Motorway and construction compounds.	Assessment of construction air quality impacts is provided in **Section 7.3** and **Appendix G**.
	Potential improvements to local air quality that would result from less congestion and traffic on Pennant Hills Road.	Assessment of operational air quality impacts and benefits is provided in **Section 7.3** and **Appendix G**.

Issue category	Issue raised	Where addressed
	Qualitative and quantitative effects on regional and local air quality.	Assessment of construction and operational air quality impacts is provided in **Section 7.3** and **Appendix G**.
	Monitoring, management and mitigation of potential local air quality impact. Transparency and availability of air quality data and assessments to the public.	Assessment of construction and operational air quality impacts and measures to manage and mitigate the impact is provided in **Section 7.3**. Air quality data is provided in the technical working paper: air quality in **Appendix G**.
	Opportunity for tunnel design to minimise in tunnel air quality impact.	The tunnel has been designed to maintain appropriate air quality within the tunnel that is protective of the health and amenity of motorists. An assessment of the air quality within the tunnels is provided in **Section 7.4**.
	Number, location and design height of ventilation facilities along the project corridor.	A description of ventilation systems and facilities is provided in **Chapter 5** and **Section 7.3**.
	Opportunity to use filtration to treat air quality in the tunnel and from ventilation facilities such as on the M5 East, particularly in residential areas.	Discussion of potential filtration as part of the project ventilation system is provided in **Section 7.3**. Based on an assessment of the costs and benefits of tunnel filtration, and in light of the minimal air quality and human health impacts of the project, it has been concluded that tunnel filtration is not warranted.
	Management of in-tunnel air quality during operation and during incident response.	The project ventilation system has been designed to maintain appropriate air quality within the tunnel that is protective of the health and amenity of motorists. An assessment of the air quality within the tunnels is provided in **Section 7.4**.
	Location of existing background air quality monitoring stations.	The rationale for the locations of the background air quality monitoring stations is provided in **Section 7.3**.
	Duration of background monitoring to inform the air quality assessment.	An overview of background air quality monitoring is provided in **Section 7.3**.
	Location of permanent air quality monitoring locations as part of tunnel operations.	Operational air quality monitoring is described in in **Section 7.3**. Details of operational air quality monitoring would be developed during detailed design of the project, and to meet the specific requirements of conditions of approval, if relevant.
	Consideration should be given to monitoring air quality at residential properties nearby the ventilation outlets.	Operational air quality monitoring is described in in **Section 7.3**. Details of operational air quality monitoring would be developed during detailed design of the project, and to meet the specific requirements of conditions of approval, if relevant.
	Clarification on what pollutants are being monitored and measured.	The air quality impact assessment methodology is provided in **Section 7.3**, including pollutants that have been monitored.

Issue category	Issue raised	Where addressed
	Clarification on who is responsible for monitoring and the analysis of the results.	Monitoring has been undertaken by the project on behalf of Roads and Maritime. The analysis of air quality results has been undertaken as part of the environmental impact statement. Future monitoring requirements would be determined in consultation with the Environment Protection Authority and would be undertaken by the motorway operator.
	Existing air quality impact along the Hills M2 Motorway, M1 Pacific Motorway and Pennant Hills Road will not be addressed but rather impact will increase.	The assessment of construction and operational air quality impacts and benefits is provided in **Section 7.3**. Air quality modelling has been conducted for areas likely to be affected by air quality changes associated with the project.
	Consideration of weather conditions as part of the air quality assessment.	The air quality impact assessment includes consideration of meteorological conditions. The methodology is described in **Section 7.3**.
	Air pollution contributions from NorthConnex tunnel emissions in comparison to other pollution source contributions in Sydney.	Assessment of construction and operational air quality impacts and benefits is provided in **Section 7.3**. Predicted contributions of air pollutants from the project have been compared with background concentrations of those pollutants.
	Consideration for the EPA to license emissions discharge from the tunnel under the *Protection of the Environment Operations Act 1997*.	Schedule 1 of the *Protection of the Environment Operations Act 1997* provides activities for which an environment protection licence is required. In includes construction but not operation of the project.
	Assessment of impacts from nano-particles as part of the air quality assessment.	The air quality assessment has been undertaken in accordance with the Director-General's Requirements and the Approved Methods for the Modelling and Assessment of Air Pollutants (DEC, 2005a). The methodology is described in **Section 7.3**. The assessments particles as small as the $PM_{2.5}$ fraction.
	Scope of air quality assessment to include the tunnel at full capacity.	The air quality assessment includes a scenario for the theoretical maximum peak hour capacity. This is provided in **Section 7.3**.
	Potential assessment of impacts from tunnel portal emissions.	Assessment of operational air quality impacts and benefits is provided in **Section 7.3**. The project does not currently propose portal emissions from the main alignment tunnels, however this approach may be considered in the future and would be subject to appropriate assessment and approval at the relevant time.
	Air quality assessment to include the microclimate of the Spring Gully valley, prevailing winds and other metrological conditions.	The air quality impact assessment includes consideration of local and regional meteorological conditions. The methodology is described in **Section 7.3**.

Issue category	Issue raised	Where addressed
	Requirements and scope for continuous monitoring of air quality impacts and transparency in reporting.	Operational air quality monitoring is described in in **Section 7.3**. Details of operational air quality monitoring would be developed during detailed design of the project, and to meet the specific requirements of conditions of approval, if relevant.
	Two ventilation outlets are insufficient to manage in-tunnel air quality and will result in concentrating emissions at two points rather than distributing emissions across multiple points.	Assessment of operational air quality impacts within the tunnel and around the two ventilation outlets is provided in **Section 7.3**. The assessment demonstrates that two ventilation facilities are adequate to ensure that air pollution contributions from the project are within air quality and health risk criteria, and in most cases lower than existing background pollution.
Health	Air quality impact as a result of the project may cause health issues for residents living near ventilation and emergency smoke extraction facilities.	Assessment of health impacts is provided in **Section 7.4**. The health assessment demonstrates that the project would not pose an unacceptable health risk.
	Adverse impacts from air pollution, particularly on young children and elderly residents.	Assessment of health impacts is provided in **Section 7.4**. The assessment includes consideration of sensitive populations, including infants, children and the elderly.
	Air quality impact at schools and other sensitive receivers within the project corridor.	Assessment of health impacts is provided in **Section 7.4**. The assessment includes consideration of sensitive receivers.
	Health impacts on nearby residents experiencing increased stress caused by the project.	Assessment of health impacts is provided in **Section 7.4**.
	Impacts from new substations on local residents as a result of exposure to electro-magnetic fields.	Consideration of electric and magnetic fields from substations is provided in **Section 8.2**. Substations and electrical infrastructure would be designed to meet current guidance on electric and magnetic fields from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).
	Impacts on health as a result of long-term exposure versus short term impacts and irritation.	Assessment of health impacts is provided in **Section 7.4**. The assessment includes consideration of both acute (short term) and chronic (long term) health effects.
	Increase in the incidence of cancer and cardio-respiratory disease as a result of the project.	Assessment of health impacts is provided in **Section 7.4**. The assessment includes consideration of cancer and cardio-respiratory disease.
	Impact of ultra-fine particles on health.	Assessment of health impacts is provided in **Section 7.4**.

Issue category	Issue raised	Where addressed
	Response to findings from previous reports, noting impact to local air quality as a result of tunnel ventilation outlets and / or portals.	Assessment of health impacts is provided in **Section 7.4**. The assessment considers previous advice from the National Health & Medical Research Council in relation to air quality in and around road tunnels.
Landscape character and visual amenity	Noise wall treatment and colour should complement existing environmental surroundings along the M1 Pacific Motorway and the Hills M2 Motorway.	An assessment of visual and urban design including noise walls is provided **Section 7.5**. Noise wall treatment long the Mills M2 Motorway would be consistent with the urban design for the recently completed Hills M2 Motorway Upgrade project.
	Visual impact on nearby residents from the location of signage and lighting along the Hill M2 Motorway, tunnel portals, toll gantries and other support facilities.	Assessment of visual impact from the operation of the project is provided in **Section 7.5**.
	Visual impact from tunnel ramps and entry and exit portals, including view changes and impacted sight lines.	Assessment of visual impact from the operation of the project is provided in **Section 7.5**.
	Visual impact of ventilation facilities and outlets.	Assessment of visual impact from the operation of the project is provided in **Section 7.5**.
	Request for permanent noise walls and landscaping plantings around the operational ancillary facilities to be carried out early in the construction program.	In response to feedback received during the preferred tender design exhibition a mitigation measure was incorporated to consider the early implementation of permanent noise walls and landscaping around operational ancillary facilities during construction planning. This is described in **Section 7.5**.
	Visual impact from tunnel support facilities.	Assessment of visual impact from the operation of the project is provided in **Section 7.5**. In response to the feedback received during the preferred tender design exhibition, the two tunnel support facilities have been lowered in height to reduce their overall bulk and visual impact.
	Impacts from poor landscaping along existing noise walls and the removal of existing vegetation during construction.	An assessment of visual impact from construction and operation of the project is provided in **Section 7.5**. Further details of urban design and landscaping measures would be developed during detailed design.
	Overshadowing and privacy impacts from new buildings on residential properties.	An assessment of visual impact from the operation of the project, including consideration of overshadowing, is provided in **Section 7.5**.

Issue category	Issue raised	Where addressed
Biodiversity	Identification, management and monitoring of potential impacts on the remaining Blue Gum Forest ridge line. Impact may result from a change in ground conditions and geology.	An assessment of biodiversity impacts, including impacts to Blue Gum High Forest, from construction of the project is provided in **Section 7.6**.
	Assessment of impact on microbats and their habitat as a result of the project and nearby ventilation facilities.	Assessment of biodiversity impacts from construction and operation of the project, including potential impacts to microbats, is provided in **Section 7.6**.
	Loss of established trees and vegetation currently providing a buffer to existing roads.	Assessment of biodiversity impacts from construction and operation of the project is provided in **Section 7.6**. Visual impacts associated with the loss of screening vegetation are provided in **Section 7.5**.
	Replanting of native flora during and post construction.	Landscaping and rehabilitation measures are described in **Section 7.5** and **Section 7.6**. Further details of urban design and landscaping measures would be developed during detailed design. It is intended that landscaping would be implemented with native species.
	Seed collection before the removal of vegetation to develop native tube stock for replanting.	Rehabilitation measures to mitigate biodiversity impacts are provided in **Section 7.6**.
	Potential impacts on the Bidjigal Reserve Trust land management area.	Assessment of biodiversity impact from construction and operation of the project is provided in **Section 7.6**. The assessment takes into account potential indirect impacts on the Bidjigal Reserve.
Geology and soils	Concern regarding unstable geotechnical conditions along the corridor.	Assessment of regional geology is provided in **Section 7.8**. Consideration of potential hazards and risks associated with unstable ground conditions are provided in **Section 8.2**.
	Uncertainty regarding existing underground services resulting in tunnelling impacts.	Impacts to existing services are described in **Section 8.1**.
Surface water and ground water	Management of drainage and groundwater issues along the length of the tunnel.	Assessment of surface water impacts, including management measures, is provided in **Section 7.9**. Assessment of groundwater impacts, including management measures, is provided in **Section 7.8**.
	Impacts on existing protected riparian zones such as Spring Gully Creek.	Assessment of surface water impacts and measures to manage and mitigate these impacts is provided in **Section 7.9**.
	Concerns regarding existing drainage issues.	Assessment of surface water impacts and measures to manage and mitigate these impacts is provided in **Section 7.9**.

Issue category	Issue raised	Where addressed
Non-Aboriginal heritage	Impacts on the Hornsby Heritage Conservation Area.	Assessment of potential non-Aboriginal heritage impacts, including conservation areas, is provided in **Section 7.10**.
Resource management and waste minimisation	Management and storage of material from the tunnel and associated surface work.	Management, storage and disposal of spoil is described in **Section 8.3**.
	Peak oil phenomenon and its potential impact on project viability.	Peak oil is discussed in **Section 8.3**.
Cumulative impacts	Cumulative construction impacts and fatigue experienced by nearby residents from the project (including the Hills M2 Motorway integration work), the North West Rail Link, the Epping to Thornleigh third track and the Hills M2 Motorway Upgrade project.	Cumulative impacts with other major construction projects in the region are assessed within the relevant impact assessment sections in **Chapter 7** and **Chapter 8**. Potential construction fatigue associated with the Hills M2 Motorway integration works are discussed in **Section 7.2**.
Social and economic		
Social and economic	Impact on and loss of community facilities to accommodate construction sites.	Assessment of construction and operational impacts on community facilities is provided in **Section 7.7**.
	Aesthetic impact at properties near Pennant Hills Road and the Hills M2 Motorway as a result of construction activities.	An assessment of visual impacts from construction is provided **Section 7.5**.
	Impact on quality of life for residents living near ventilation outlets.	Consideration of social impacts is provided in **Section 7.7**. Impacts on the community are described throughout the relevant assessment chapters.
	Recent community impact from the Hills M2 Motorway Upgrade project.	Assessment of cumulative noise impacts and potential construction fatigue along the Hills M2 Motorway (from the cumulative impacts of the project and the recently completed Hills M2 Motorway Upgrade project) is provided in **Section 7.2**.
Business	Impact on local business as a result of acquisition or loss in passing trade on Pennant Hills Road.	Potential business impacts, including from direct acquisition and from a loss in passing trade is provided in **Section 7.7**.
	Impact on local businesses as a result of construction impact.	Potential business impacts during construction are described in **Section 7.7**.

Issue category	Issue raised	Where addressed
	Opportunities for local businesses.	Potential business impacts and opportunities during construction and operation are described in **Section 7.7**.
	Support for businesses affected by the project.	Mitigation and management measures relating to business impacts are provided in **Section 7.7**.
Land use and property	Early identification and notification of potentially impacted properties along the corridor. Rights and influence (do property owners have a say?) of potentially affected property owners.	Details regarding notification and consultation with affected stakeholders are provided in this **Section 6.1** and **Section 6.3.1** of this chapter. Additional details regarding property impacts are provided in **Section 8.1**.
	Property damage as a result of construction and operation and rectification of damage by the project.	Existing conditions surveys would be undertaken on properties within the preferred project corridor. This, and the potential for damage to properties from vibration, is described in **Section 7.2**.
	Property acquisition of Roads and Maritime owned properties near the southern interchange for the project.	Details regarding property acquisition are provided in **Section 8.1**. Roads and Maritime already own a number of properties required for the project.
	Impact on properties located near the southern and northern interchanges.	Assessment of impacts on land use and property is provided in **Section 8.1**.
	Certainty of the nature and the extent of properties affected by acquisition as part of the project.	Details regarding property acquisition are provided in **Section 8.1**.
	Property valuation process and timing – the project should purchase properties at pre-project values.	Property acquisition would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.
	Property owner compensation for loss of property value and quality of life impact as a result of the project.	This environmental impact statement demonstrates that the project would not have a significant impact on surrounding properties or receivers. There would therefore be no basis for devaluation of properties as a result of the potential impacts of the project.
	Property value guarantee and/or buy back scheme similar to what was offered as part of the M5 East project.	This environmental impact statement demonstrates that the project would not have a significant impact on surrounding properties or receivers. There would therefore be no basis for devaluation of properties as a result of the potential impacts of the project.
	Impact on property values above the tunnel or nearby ancillary surface infrastructure.	This environmental impact statement demonstrates that the project would not have a significant impact on surrounding properties or receivers. There would therefore be no basis for devaluation of properties as a result of the potential impacts of the project.

Issue category	Issue raised	Where addressed
	Consideration of voluntary property acquisition as part of the project.	Property acquisition would be undertaken for properties Property acquisition would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.
	Impact of sub-stratum land acquisition, constraining the future development of private property.	Property acquisition, including sub-stratum acquisition, would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.
	Compensation for sub-stratum land acquisition.	Property acquisition, including sub-stratum acquisition would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*.
	Unnecessary impact on private property instead of using public spaces such as Observatory Park and Brickpit Park.	The site selection process to determine the location of construction and operational ancillary facilities is provided in **Chapter 4**. Impacts to Observatory Park have been avoided due to the high ecological and heritage value of that site. Brickpit Park is an historical landfill, and has been avoided based on contamination and geotechnical stability issues.
	Long-term insurance from the project for damages that occur in the future, post construction, as a result of tunnel operation.	Existing condition surveys of properties within the preferred project corridor would be undertaken prior to construction in consultation with each property owner. Any damage attributable to the project would be rectified at no cost to the property owner.
	Request for additional geotechnical investigations nearby residences to avoid property impacts and confirm suitability of ground conditions for tunnelling.	Geotechnical investigations have been undertaken to inform the preferred tender design. It is likely that additional geotechnical investigation would be required to inform the detailed design for the project.
	Damage to homes from heavy vehicle movements on residential streets, particularly on older or heritage listed properties.	Vibration impacts from construction and operation, and management measures are provided in **Section 7.2**. Potential impacts to heritage listed properties are assessed in **Section 7.10**.

6.5 Consultation during the exhibition of the environmental impact statement

The environmental impact statement will be advertised and placed on public exhibition for a minimum of 30 days. The environmental impact statement will be available for viewing at the following locations:

- **Hills Shire Council**, 3 Columbia Court, Baulkham Hills.
- **Hornsby Shire Council**, 296 Pacific Highway, Hornsby.
- **Ku-ring-gai Council**, 818 Pacific Highway, Gordon.
- **Gosford City Council**, 49 Mann Street, Gosford.
- **Parramatta City Council**, 30 Darcy Street, Parramatta.
- **Turramurra Library**, 5 Ray Street, Turramurra.
- **Pennant Hills Library**, corner of Ramsey Road and Yarra Road, Pennant Hills.
- **Epping Library,** Chambers Court, Epping.
- **Hornsby Central Library**, 28-44 George Street, Hornsby.
- **Baulkham Hills Library**, Railway Street, Baulkham Hills.
- **NorthConnex Community Information Centre**, 354 – 356 Pennant Hills Road, Pennant Hills.
- **Roads and Maritime Services North Sydney office**, Level 9, 101 Miller Street, North Sydney.
- **Department of Planning and Environment Information Centre**, 23-33 Bridge Street, Sydney.
- **Nature Conservation Council of NSW,** 2/5 Wilson Street, Newtown.

Opening hours of these venues and additional locations where the environmental impact statement can be viewed are provided on the project website (www.northconnex.com.au).

Static displays advertising the environmental impact statement public exhibition will be set up at the following locations:

- Westfield Hornsby, 236 Pacific Highway, Hornsby.
- Pennant Hills Shopping Centre, 4-10 Hillcrest Road, Pennant Hills.
- Thornleigh Marketplace, 2-12 The Comenarra Parkway, Thornleigh.
- Carlingford Court, Pennant Hills Rd, Carlingford.
- Brickpit Park, Dartford Road, Thornleigh.

Staffed displays and stakeholder / community meetings will be held during the exhibition of the environmental impact statement to promote access to project information, environmental impact statement documentation and project representatives. These meetings and displays will provide opportunity for members of the community to ask questions of the project team and help to further inform the development of formal submissions regarding the proposal. During the public exhibition period, the community, government agencies and other interested parties are invited to make written submissions on the project to the Department Planning and Environment.

The community will be informed of the staffed displays through a community update, letters to interest groups who have registered with the project, email notification to registered stakeholders, information on the project website and advertisements in the local and metropolitan media.

During the exhibition of the environmental impact statement an interactive mapping tool will be available to assist community members and property owners in understanding the potential impacts of the project.

Following the exhibition of the environmental impact statement, the Director-General would provide copies of submissions received to Roads and Maritime or a report containing a summary of the issues raised. The Director-General would then require Roads and Maritime to prepare a submissions report to respond to the issues raised. Additionally a preferred infrastructure report may be prepared at this time if changes are proposed to the project.

The Director-General would prepare a Director-General’s environmental assessment report and provide it to the Minister for Planning. The Minister for Planning would then decide whether or not to approve the project and the related conditions of approval.

6.6 Future consultation

Following the exhibition period, Roads and Maritime would continue to identify and manage issues of interest or concern to the community during the assessment and approval process and, if the project is approved, during the construction, commissioning and the operational phases. The aims of ongoing communication and consultation are to provide the community with:

- Accurate and accessible information regarding the processes and activities associated with the project.
- Information in a timely manner.
- Appropriate avenues for providing comment or raising concerns, and to ensure they are aware of the avenues.
- A high level of responsiveness to their issues and concerns throughout development and delivery of the project.

6.6.1 Consultation during construction and commissioning stages

A community liaison involvement plan would be developed prior to construction and implemented during to construction. This would set out the methods to be employed and stakeholders targeted as part of consultation and communication. **Appendix D** provides a Community Communication Framework for construction, identifying relevant stakeholders, procedures and distributing information and receiving / responding to feedback and procedures for resolving community complaints during construction.

As a minimum, consultation during the detailed design and construction phases of the project would include:

- Ongoing consultation with the emergency services to comply with up-to-date emergency response procedures during construction and operation and to ensure the construction would not constrain emergency services responses in the area.
- Ongoing consultation with The Hill Shire Council, Hornsby Shire Council and Ku-ring-gai Council to manage and minimise any impact on existing infrastructure.
- Ongoing consultation with government agencies including the Department of Planning and Environment, Environment Protection Authority, Department of Primary Industries, NSW Health and NSW Office of Environment and Heritage.
- Provision of regular updates to the surrounding community throughout the remainder of the planning and construction phases.
- Development and maintenance of a comprehensive community complaints register and response system.
- Ongoing consultation with landowners who may be potentially impacted by the project and nearby landowners, residents, business owners and community facility operators. This would include notification, as appropriate, before the start of construction activities, including out of hours work, to minimise any access disruption. Notices relating to road work and road network access changes would be issued as email alerts, placed in local newspapers and delivered to letterboxes at least five days before the change.

6.6.2 Consultation during project operation

Community liaison would continue during the operation phase of the project. Community consultation protocols would be established within an Operational Environmental Management Plan. This would include protocols for:

- Ongoing management of community complaints during operations.
- Community notifications prior to major maintenance activities.
- Wider notifications of major maintenance activities that require full tunnel carriageway closures.

carbon neutral

australian made

recycled