

NorthConnex

Building for the future

The main cover image shows a large cable-stayed bridge with a metal mesh railing spanning over a multi-lane road. A white truck with a blue tarp-covered trailer is in the center of the frame, surrounded by several cars. A street sign for "RAILWAY ST" is visible on the right. The sky is blue with some clouds.

Volume 6

Environmental Impact Statement - Volume 6

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

July 2014

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.

Appendix K

Technical working paper:
Business

NorthConnex

Building for the future



Technical working paper: Business

Technical Working Paper: Business

NorthConnex

Client: Roads and Maritime Services

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24-May-2014

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Quality Information

Document Technical Working Paper: Business

Date 24-May-2014

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Revision History


Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	14-Apr-2014	Draft for Issue	Caitlin Bennett – Principal Environmental Planner	
2	14-May-2014	Final for issue	Caitlin Bennett – Principal Environmental Planner	
3	24-May-2014	Final for exhibition	Caitlin Bennett Principal Environmental Planner	

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Executive Summary

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney (the project).

The key benefits of the project would include:

- Providing the missing link in Sydney's motorway network and the National Land Transport Network between the Hills M2 Motorway and the M1 Pacific Motorway.
- Future travel time savings of up to 40 minutes compared to without the project.
- 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 traveling along Pennant Hills Road.
- Providing opportunities for future public transport improvements and the reinvigoration of the Pennant Hills Road corridor.

The purpose of this report is to undertake an assessment of the potential positive and negative impacts of the project on local businesses and the regional economy. The Director-General's environmental assessment requirements (DGRs) for the project include a requirement for a socio-economic impact assessment (including the business impact assessment) to address the following:

- Impacts on directly affected properties and land uses, including impacts related to access, land use, property acquisition and amenity related changes.
- Social and economic impacts to businesses along Pennant Hills Road and the Pacific Highway, and the community associated with traffic, access, property, public domain and amenity related changes.

The methodology for this assessment was developed with consideration to the DGRs and the Roads and Maritime Draft Socio-economic Assessment Practice Note (Roads and Maritime, 2012). The assessment includes a review of previous assessments, business profiling of the study area, a survey of indirectly impacted businesses, an assessment of potential positive and negative impacts and an assessment of management and mitigation measures.

Outputs of the strategic transport model for the year of opening (2019) with and without the project, and ten years after opening (2029) with and without the project, have been used to identify the study area for the business impact assessment. It was determined that the study area would include Pennant Hills Road, between the Hills M2 Motorway and the M1 Pacific Motorway, and the Pacific Highway between the M1 Pacific Motorway and Pacific Highway interchange at Wahroonga between Hornsby and Mona Vale Road in Pymble. The regional context of the project has been defined by Hornsby Local Government Area (LGA).

To determine the potential impact of changes in passing trade to businesses in the study area, a survey of businesses has been conducted. The selection of indirectly impacted businesses to be interviewed was based on those that could potentially draw a considerable proportion of their business activity from passing traffic. These businesses included service stations, cafes/restaurants and accommodation establishments. Based on this approach, 31 businesses were identified as potentially being impacted by changes in passing trade. Survey results were captured from 23 of these businesses.

The assessment of impacts has taken into account both construction and operational impacts. The project would be likely to create both positive and negative impacts on local businesses and the regional economy.

The project is likely to result in significant benefits in the form of output and employment to the economy due to construction expenditure. Local business would principally benefit from this expenditure through purchases made by construction businesses and associated workers to build and support the development of the project. Around 1,250 jobs are expected to be created during the peak construction period of the project.

Through economic multipliers it was determined that construction expenditure would contribute a total of \$3.9 billion dollars of output, \$0.7 billion dollars of household income, around 8,700 full-time equivalent (FTE) jobs and \$1.3 billion of value added to the New South Wales economy per year of construction. Operational expenditure was estimated to contribute a total of \$39 million in output, \$9 million in household income, 121 FTE jobs and \$16 million of value added per year of operation.

The majority of construction activity would occur underground, which would limit the extent of amenity impacts to businesses along the corridor. However, surface works would be required at the northern and southern interchanges, along the Hills M2 Motorway and at compound sites. Businesses adjacent to these locations may experience noise, vibration, air quality and visual amenity impacts. During construction, businesses such as outdoor restaurants, cafes and eateries would stand to be the most affected by noise and air quality impacts. The magnitude of the impact of amenity would be largely influenced by the construction hours, length of the construction period, the activity, the proximity to the project, and the nature of the business.

Construction activities would be staged and undertaken in a manner that minimises the disruption to traffic where reasonable and feasible. Construction traffic would also be managed to minimise movements during peak periods where possible. Nonetheless, due to existing capacity constraints along the network, the project would have an impact on the performance of the road network. This may impact businesses that are reliant on deliveries as they may experience longer transit times. Freight and commercial vehicles that use Pennant Hills Road, the Pacific Highway, the Hills M2 Motorway and the M1 Pacific Motorway may also experience longer transit times and decreased efficiencies over the construction period.

During the operation of the project there is the potential for changes to the volumes of traffic on Pennant Hills Road and the Pacific Highway. Potential reductions of traffic on Pennant Hills Road could reduce road congestion along the corridor for vehicles that would continue to use Pennant Hills Road, such as localised trips. Businesses are likely to benefit from the improved accessibility for customers due to reduced congestion. It would also remove a significant proportion of heavy vehicles that travel along Pennant Hills Road, which have considerable adverse impacts on local amenity. Reduced traffic would also likely result in lower travel times along the corridor, which may change the travel and shopping patterns of local residents and may lead to increased turnover for local businesses.

There would be limited amenity impacts on businesses due to the operation of the project. The surface components of the project are in predominately residential areas and outside established and future commercial, industrial and retail centres.

Five (5) businesses would be impacted by full acquisition, leading to potential decreases in employment and economic activity. Under the worst case scenario the acquisition of the properties containing the five businesses would result in a loss of 25 full-time equivalent jobs. Based on the outcomes of the business survey it has been estimated that under the worst case scenario there would be an annual reduction of around \$5.6 million and around 18 full-time equivalent jobs in the region due to impacts on passing trade. The reduction in output or employment as a result of the project represents a worst case scenario and does not account for any increase in turnover due to the changes in local traffic, business adaptation and opportunities, or the benefits to the freight industry due to travel time savings.

The project has the potential to provide benefits to the movement of freight due to the improvement in connections between the M1 Pacific Motorway and the Hills M2 Motorway. The reduced transit times would reduce operational costs associated with fuel and wages and improve safety by reducing the number of times trucks have to stop at traffic lights. Provision of an alternative route for freight transport between the M1 Pacific Motorway and the Sydney Orbital 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.

Cumulative impacts to the local economy and businesses are most likely to result from the construction and operation of the North West Rail Link and Epping to Thornleigh Third Track. Cumulative impacts are likely to intensify both construction and operation impacts of the project. The concurrent construction of these projects is likely to intensify the impacts with regard to employment opportunities for local residents and economic stimulus. The opportunity for local businesses to supply goods or services to the construction of these projects and their construction workforces has the potential to increase business turnover due to high demand from the multiple projects. There is the potential for construction vehicles using the local road network to increase and this may intensify or prolong the impacts on amenity and congestion during the construction period. During operation of the project it is not anticipated that the NWRL would reduce vehicle traffic on Pennant Hills Road or the Pacific Highway and therefore would not impact passing trade. Epping to Thornleigh Third Track may result in additional reduction in freight vehicles on Pennant Hills Road and the Pacific Highway. Any further reduction in freight vehicles would intensify the operational impacts as highlighted above.

The study recommends a number of mitigation measures that are intended to minimise any impacts that would be associated with the construction and operation of the project. These are detailed in **Chapter 6.0** of this report.

On balance, it is considered that the overall impact of the project on businesses would be positive for the region.

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1.0 Introduction

1.1 Overview

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney (the project) (refer to **Figure 1**). 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 project is an unsolicited proposal from Transurban and the Westlink M7 Shareholders to build, 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.

Construction of the project is anticipated to commence in early 2015 and is expected to take around four years to complete.

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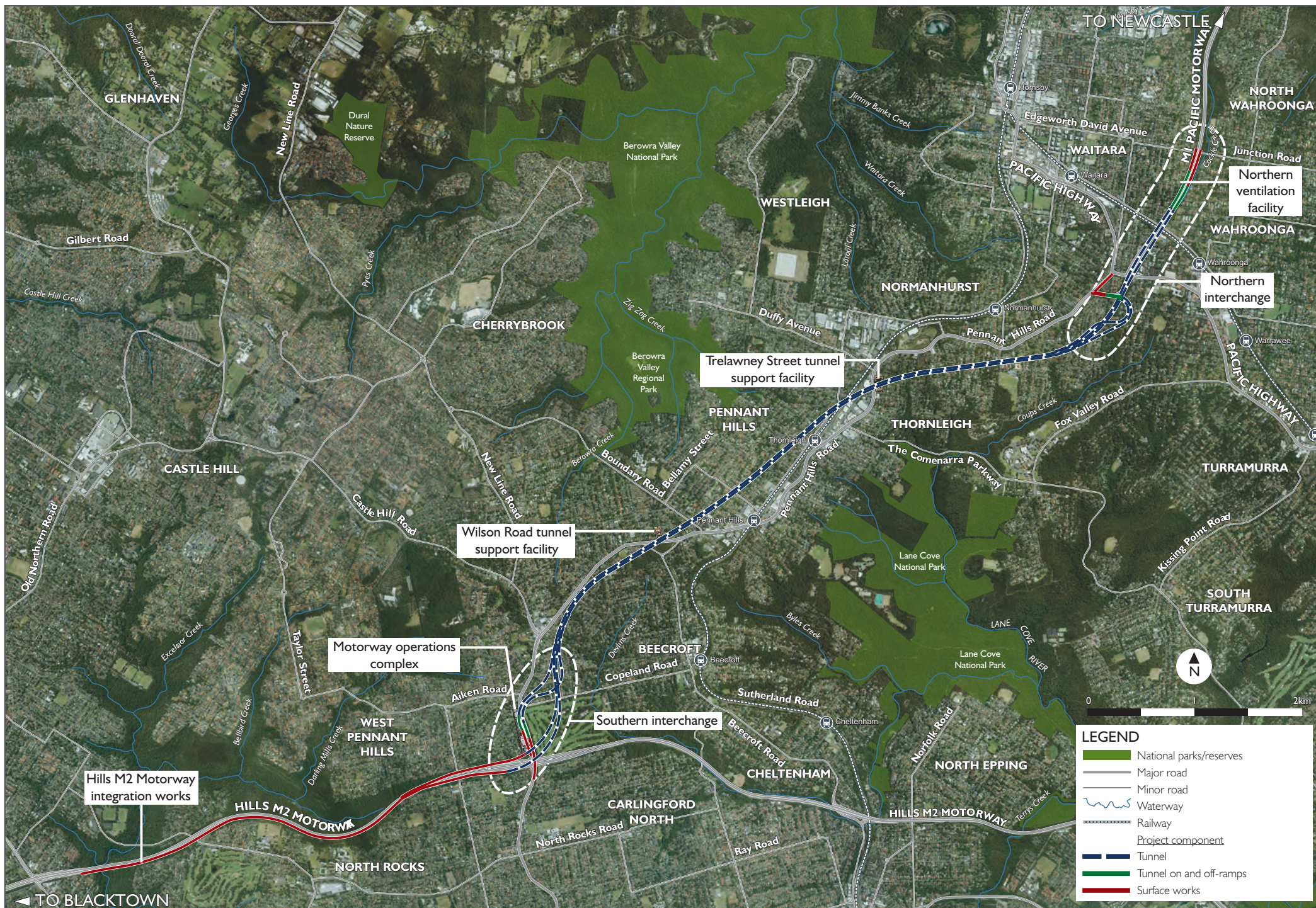


Figure 1 The project

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1.2 Purpose of this report

The Director-General's environmental assessment requirements (DGRs) for the project were issued on 29 October 2013 and re-issued on 11 April 2014 with amendments. The DGRs have informed the preparation of the environmental impact statement for the project. The DGRs include a requirement for a socio-economic impact assessment (including the business impact assessment) to address the following:

- Impacts on directly affected properties and land uses, including impacts related to access, land use, property acquisition and amenity related changes.
- Social and economic impacts to businesses along Pennant Hills Road and the Pacific Highway, and the community associated with traffic, access, property, public domain and amenity related changes.

This assessment specifically considers matters relevant to the potential positive and negative impacts of the project on local businesses and the state economy.

Table 1 outlines where the requirements of the DGR have been addressed within this report. The methodology for this assessment is provided in **Chapter 2.0** of this report.

Table 1 Director-General's requirements

DGR reference	Report section
Impacts on directly affected properties and land uses, including impacts related to access, land use, property acquisition and amenity related changes	Section 5.1 and Section 5.2
Social and economic impacts to businesses along Pennant Hills Road and the Pacific Highway, and the community associated with traffic, access, property, public domain and amenity related changes	Section 5.1 and Section 5.2

The assessment of matters relating to social impacts and land use impacts are considered in Section 7.7 and Section 8.1 of the environmental impact statement for the project.

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2.0 Methodology

The purpose of the business impact assessment is to:

- Determine the impact of the reduction in passing traffic on businesses within the defined study area. For the purposes of this assessment, these are referred to as 'indirectly impacted businesses'.
- Determine the impact of acquisition of businesses on employment and turnover in the region. These businesses are referred to as 'directly impacted businesses'.
- Determine the impact of changes to travel times on businesses reliant on regional and interstate freight movement during construction and operation of the project.
- Determine the impact of amenity, accessibility and parking on businesses during construction and operation of the project.

The methodology for this assessment was developed with consideration to the DGRs and the Roads and Maritime Draft Socio-economic Assessment Practice Note (Roads and Maritime, 2012), and was based on the following steps:

- Review of previous assessments undertaken for the project to provide context and background to the project.
- Definition of a study area for the business impact assessment, considering the components of the project and potential impact during construction and operation, predicted changes in traffic within the surrounding road network. This is discussed further in **Section 2.2**.
- A desk-top analysis of businesses within the study area that may be directly impacted due to acquisition or indirectly impacted by the project (for example, due to losses in passing trade), followed by a site visit to confirm these findings.
- Development of a baseline profile for current businesses within the defined study area using published data sources including the Australian Bureau of Statistics (2012 and 2013), NSW Bureau of Transport Statistics (2013) and Tourism Research Australia (2013).
- Analysis of key stakeholder issues, including a survey of business that were identified as having the potential to be indirectly impacted by the project. The approach to the business survey is provided in more detail in **Section 2.3**.
- Quantification of positive and/or negative impacts on the businesses as a result of the project, such as growth of existing businesses or investment in new enterprises, or the closure of existing businesses or downsizing of businesses due to acquisition or loss of passing trade. The measures used to assess business impacts were:
 - Employment: The projected net change in the number of people employed in local businesses. The change in employment is measured by total employment and full time equivalent (FTE) employment. The latter measure converts the number of full time, part time and casual employees into a unit equivalent to the number of full time employees.
 - Turnover: The projected net change in turnover (\$) generated by local businesses.
 - Other: Additional components of business operations that may be impacted by the project, which are unable to be quantified.

The method of analysis to quantify the potential impacts differed between the indirect and direct business impact assessments:

- Indirect businesses – use of data collected through the business survey conducted in December 2013 and January 2014 to determine the businesses' reliance on passing trade, current employment and turnover.
- Direct businesses – use of industry benchmarking to determine the potential losses in employment.
- Identification of measures to mitigate or manage the potential impacts on businesses.

2.1 Economic Multipliers

Economic multipliers are used to quantify economic impacts, or changes in economic activity resulting from a stimulus such as construction of the project. These multipliers can be calculated from input-output tables. The ABS prepares a national input-output table, the most recent being for 2009/10 (ABS, Australian National Accounts: Input-Output Tables 2009/10, 5209.0.55.001, 20 September 2013). The table describes inter-industry transactions among 114 industries, showing the fixed amounts of inputs that are required to produce a given output at the national level. The table is compiled in accordance with the Australian national accounting system, and international Government accounting standards.

State-level input-output tables can be derived by adjusting the national table to reflect each state's inter-industry transactions and final demand flows, based on information and data at the state level within the Australian national accounting system and on the latest Census data.

Four multipliers are usually used to measure economic impact: output (value of production or turnover), value added (which can be directly compared to gross domestic product and gross state product), household income and employment. Two types of multipliers can be calculated:

- Type 1 multipliers, which measure the direct and production-induced impacts of a stimulus or activity - the latter impacts refer to the subsequent rounds of purchases of inputs by businesses supplying the direct suppliers of the stimulus or activity (industrial flow-on effects).
- Type 2 multipliers, which capture the Type 1 effects and also measure the consumption-induced effects that flow from the expenditure of income that is earned from the production of additional output.

Input-output multipliers are based on a number of assumptions that provide a relative measure (to be compared with other industries) of the interdependence between one industry and the rest of the economy. This interdependence arises solely from the sales and purchase links between industries and is based on estimates of transactions occurring over a recent historical period. The limitations of input-output analysis therefore include:

- *Lack of supply-side constraints* – it is assumed that extra output can be produced in one area without taking resources away from other activities, thus potentially overstating economic impacts. The actual impact is likely to be dependent on the extent to which the economy is operating at or near capacity.
- *Fixed prices* – it is assumed that any change in the demand for productive factors would not induce any change in their cost.
- *Fixed ratios for intermediate inputs and production* – it is assumed that there is a fixed input structure in each industry and fixed ratios for production (as described by fixed technological coefficients).
- *No allowance for purchasers' marginal responses to change* – it is assumed that households consume goods and services in exact proportion to their initial budget shares and that this applies equally to industrial consumption of intermediate inputs and factors of production.
- *Absence of budget constraints* – it is assumed for consumption-induced effects (Type 2 multipliers) that household and government consumption is not subject to budget constraints.

It is preferable to apply Type 1 multipliers, because an input-output model is based on the above simplifying assumptions which have the effect of imposing few constraints to economic expansion. As a result, Type 2 multipliers could overstate potential impacts, particularly where assessing the expansion of an existing activity rather than the contribution of an existing activity.

2.2 Definition of the study area

To define the study area for this assessment, the outputs of the strategic transport model with and without the project for the year of opening (2019) and ten years after opening (2029) were analysed. A detailed description of the strategic transport model is presented in technical working paper: traffic and transport (AECOM, 2014).

This analysis considered changes in traffic on major thoroughfares in the surrounding road network including Castle Hill Road, Boundary Road, Beecroft Road, Pennant Hills Road, the Pacific Highway north to the Berowra interchange, and south to Mona Vale Road, Pymble. As no businesses are situated on the Hills M2 Motorway, this thoroughfare was not included in the assessment.

The results of this analysis indicated that the reduction in traffic flows would be the most significant on Pennant Hills Road. Medium level changes would occur on Beecroft Road and the Pacific Highway both north and south of Pennant Hills Road between Hornsby and Mona Vale Road. Smaller changes were identified to occur on Castle Hills Road and Boundary Road. Further details of this analysis are presented in the technical working paper: traffic and transport.

Geographical statistical areas that encompass these roadways and the wider catchment as it relates to current usage of Pennant Hills Road were therefore considered in the assessment (this is further discussed in **Section 3.1**).

The majority of the study area lies within the Hornsby Local Government Area (LGA). However, small portions of the study area are located outside this LGA, with:

- Areas to the west and north of Pennant Hills Road between Castle Hill Road and the Hills M2 Motorway located in the Hills LGA.
- Areas along the Pacific Highway between the M1 Pacific Motorway and Pacific Highway interchange at Wahroonga and Mona Vale Road located in the Ku-ring-gai LGA.

Businesses within these areas that could be indirectly impacted by the project are considered low when compared to the number of businesses present in the Hornsby LGA. The Hills and Ku-ring-gai LGAs span vast areas where the majority of the commercial, retail and industrial activities occur beyond the road corridor, including ancillary sites, and are beyond the reach of potential direct or indirect impacts of the project. As such, these LGAs have not been considered in this assessment as the data collated on these areas may not correctly represent the business activity that occurs in the study area. For example, The Hills LGA includes agricultural land to the north west of Sydney that does not effectively represent the nature of businesses that have the potential to be impacted by the project.

Unlike social impacts, which occur at a community level, positive and negative impacts to businesses, that manifest themselves in changes to turnover or employment, generally occur at the location of the business activity. This is due to the fact that businesses generally rely on the attractiveness and accessibility of their location to induce business activity. As such, businesses that reside far beyond the boundaries of the project are unlikely to be significantly impacted by the project, unless they rely on the project corridor for freight or delivery purposes. As a result, businesses that reside within The Hills and Ku-ring-gai LGAs have not been included in this assessment, except where they are impacted due to their freight or delivery capacity.

The study area is used as a major thoroughfare for freight and commercial activity linking Sydney and the Central Coast, Newcastle and Brisbane. Therefore, some impacts related to freight and commercial movement would occur beyond the scope of the study, at a state-wide or national level.

2.3 Business Survey

2.3.1 Selection of businesses interviewed

One of the key objectives of the business impact assessment is to assess the potential impact on business operations, turnover and employment as a result of a loss in passing trade. As a result, the selection of indirectly impacted businesses to be interviewed was based on those that could potentially draw a considerable proportion of their business activity from passing traffic. Selected businesses fell into three categories including:

- Service stations: Operations selling fuel to passing motorists and generally including a small retail operation selling convenience goods such as food, drinks, magazines, newspapers and toiletries. The category also includes establishments offering car wash facilities.
- Cafes/Restaurants: Food operations such as cafes, restaurants and takeaway outlets that attract passing trade. The core businesses in this category are national chains that have private car parks, target impulse sales and often have drive-through facilities.
- Accommodation establishments: Hotels, motels and serviced apartments offering short term accommodation. The establishments are located on the Pacific Highway or Pennant Hills Road providing visual access to passing traffic.

Businesses selected to undertake the survey can be categorised as being located in the following precincts:

- Pennant Hills Road: Along Pennant Hills Road between the Hills M2 Motorway and the M1 Pacific Motorway.
- Pacific Highway South: Along the Pacific Highway between the M1 Pacific Motorway and Pacific Highway interchange at Wahroonga and interchange of the Pacific Highway and Mona Vale Road at Pymble.
- Pacific Highway North: Along the Pacific Highway between the M1 Pacific Motorway interchange at Wahroonga and Hornsby.
- Boundary Road: Along Boundary Road between Pennant Hills Road and New Line Road.
- Beecroft Road: Along Beecroft Road between Pennant Hills Road and Cheltenham Road.
- Castle Hill Road: Along Castle Hill Road between Pennant Hills Road and Old Northern Road.

No service stations, cafes/restaurants or accommodation establishments that are normally considered reliant on passing trade were identified on Boundary Road, Beecroft Road or Castle Hill Road.

Based on this approach, 31 businesses were identified as potentially being impacted by changes in passing trade. Survey results were captured from 23 of these businesses. The results of the survey are collated in **Chapter 4.0**.

2.3.2 Interview topics

The purpose of the indirect business survey is to understand business practices within the study area and determine the potential impacts associated with changes in through traffic within the study area as a result of the project. The key interview topics included:

- Business characteristics: The key characteristics of businesses including main activities, number of persons employed in operating the business, business floor space, parking arrangements and business hours. These questions provide an overview of the existing business environment and a baseline to assess the potential business impacts of the project.
- Dependence on through traffic: The dependence of business operations on through traffic travelling to or from the M1 Pacific Motorway or Hills M2 Motorway. This definition of through traffic enabled the survey to capture the passing trade attributable to motorists likely to be diverted due to the project. These questions provide an indication of the existing reliance on passing traffic on businesses and inform the analysis of potential losses that could occur as a result of the project.
- Potential impacts of project: Identification of potential impacts and changes to the business as a result of the project being constructed, such as impacts on local traffic trade, accessibility of the business or amenity.

A copy of the survey instrument is included in **Appendix A**.

3.0 Existing context

3.1 Workforce characteristics

Data for local workforce characteristics have been collated from the 2011 Census of Housing and Population, Place of Work (ABS, 2012), unless otherwise stated. Workforce indicator tables are provided at **Appendix B**.

The study area has been profiled by examining the data for statistical areas defined as Statistical Area 2 (SA2) by the Australian Bureau of Statistics (ABS). The following areas were included:

- West-Pennant Hills SA2 (The Hills Local Government Area (LGA));
- Pennant Hills – Cheltenham SA2 (Hornsby LGA);
- Normanhurst-Thornleigh-Westleigh SA2 (Hornsby LGA);
- Hornsby-Waitara SA2 (Hornsby LGA);
- Wahroonga – Warrawee SA2 (Ku-ring-gai LGA);
- Turramurra SA2 (Ku-ring-gai LGA); and
- Pymble SA2 (Ku-ring-gai LGA).

The geographical areas of comparison are Hornsby LGA and New South Wales. The Hills and Ku-ring-gai LGAs have not been used for comparison as the above SA2s reflect only a small proportion of the vast areas that these LGAs span.

Hornsby LGA spans a considerable area that includes urbanised and non-urbanised areas, commercial, industrial, retail and agricultural lands. The diversity in businesses and employment in the Hornsby LGA may not correctly profile the types of businesses that have the potential to be impacted by the project. In order to correctly identify the types of business that may be impacted by the project, the above SA2s have been used to inform the existing context. As with the justification for the study area in **Section 2.2**, impacts to businesses that manifest themselves in changes to turnover or employment, generally occur at the location of the business activity. The above statistical areas were chosen due to their proximity to the project and their ability to best represent the business profile and geographical location of potentially impacted businesses.

The following indicators provide the key characteristics of people that are employed in businesses within the study area and how they compare against the workforces of Hornsby LGA and New South Wales:

- Businesses in the study area employed around 41,000 people in 2011. The highest employing industries in the study area were health care/social assistance (20 per cent), education/training (13 per cent), professional/scientific/technical services (13 per cent) and retail trade (12 per cent). The study area had a higher proportion of employment in all of these industries than the New South Wales averages.
- Employment in the study area was predominately (57 per cent) on a full-time basis. Part-time employees represented 38 per cent of all employees in the study area. This is higher than the NSW average of 30 per cent part-time employment. Pennant Hills – Cheltenham, Wahroonga - Warrawee and Turramurra had a higher proportion of part-time employment (42, 46 and 51 per cent respectively) than the study area average, Hornsby LGA (39 per cent) and the NSW average (30 per cent) in 2011.
- The total weekly personal income for employees in the study area closely reflected the Hornsby LGA distribution of income. The majority of employees earned a total weekly personal income of less than \$1000 per week (60 per cent). The proportion of employed persons earning less than \$1000 per week was higher in the study area than the NSW average of 55 per cent. Around eight per cent of employees earned under \$200 per week and an additional 13 per cent earned over \$2000 per week.
- Employees in the study area mostly resided in suburbs surrounding their location of employment. In Pennant Hills-Cheltenham, Hornsby-Waitara, Normanhurst-Thornleigh-Westleigh and Wahroonga-Warrawee the workforce was most likely to reside in the Hornsby LGA in 2011. The workforce of West Pennant Hills was most likely to reside in The Hills LGA and the workforce of Turramurra was most likely to reside in Ku-ring-gai LGA in 2011.

- The most common transport mode used by employees in the study area travel to work by car, with 43 per cent of employees driving to work and eight per cent of employees travelling as a car passenger. 16 per cent of people that worked in the study area travel by train.

3.2 Economic/business environment

The Hornsby LGA has a relatively diversified economy and is not heavily reliant on one industry. In 2011-12, the Hornsby LGA had an estimated \$6 billion gross regional product (AECOM GRP Model, 2014). The largest contributing industries to the economy were manufacturing, health care/social assistance, professional/scientific/technical services and education/training all contributing around eight to nine per cent of total industry contribution to the economy (gross sector value added) (AECOM GRP Model, 2014).

There were 14,200 businesses in the study area in 2012 (ABS, 2013). The largest numbers of businesses were in the industries of professional/scientific/technical services, construction and rental/hiring/real estate services. Most of the businesses in the study area were small businesses with 66 per cent of businesses having turnover of less than \$200,000 and 97 per cent of businesses employing less than 20 employees¹ (ABS, 2013).

Upwards of 100 businesses were identified as located on Pennant Hills Road between the interchange of Pennant Hills Road and the M1 Pacific Motorway in the north and the interchange of Pennant Hills Road and the Hills M2 Motorway in the south. These businesses fell within the following industries:

- Retailers, including supermarkets and pharmacies.
- Cafés, restaurants, pubs and bars.
- Accommodation services.
- Service stations and mechanics.
- Car dealerships.
- Other service providers such as funeral homes, gyms, travel agents, real estate agents, physiotherapists, dry cleaners, dentists, beauty and hair salons.

Businesses along Pennant Hills Road are generally clustered around the main transport hubs. Pennant Hills and Thornleigh Stations attracted the majority of business activity along Pennant Hills Road. Clusters of businesses were situated at the following locations:

- Thompson's Corner: A cluster of retail services (including a Coles supermarket), real estate agents, restaurants and cafés, and a service station.
- Pennant Hills Station: A cluster of complementary health service providers, kitchen and homeware retailers, mechanics and car dealers, restaurants and cafés, and the Pennant Hills Hotel.
- Thornleigh Station (Wells Street through to Duffy Avenue, Thornleigh): The cluster of business around Thornleigh Station includes two shopping centres: Thornleigh Marketplace and Central Park Centre. Businesses in this cluster are generally convenience and discretionary retail services.
- Hornsby: A major regional business hub including commercial, retail and industrial businesses. Business activity in Hornsby occurs in a variety of forms including a Westfield Shopping Centre, high street retail, bulk goods, car dealerships and mechanic services along the Pacific Highway and an industrial park.
- Carlingford, Normanhurst, Beecroft, Westleigh, Wahroonga, Warrawee, Turramurra and Pymble: Various clusters of town centres that provide personal services, convenience retail and food services.

Businesses catering for passing trade in the study area include service stations, cafés/restaurants and accommodation establishments. These businesses are generally located along main thoroughfares to provide visual access to passing traffic and capture trade from freight, commercial and tourism activities. These types of businesses are mainly located along Pennant Hills Road and the Pacific Highway in the study area to capture the main bulk of passing trade. **Figure 2** provides an overview of the location of the above business within the context of the project.

¹ The ABS defines a small business as having less than 20 employees.

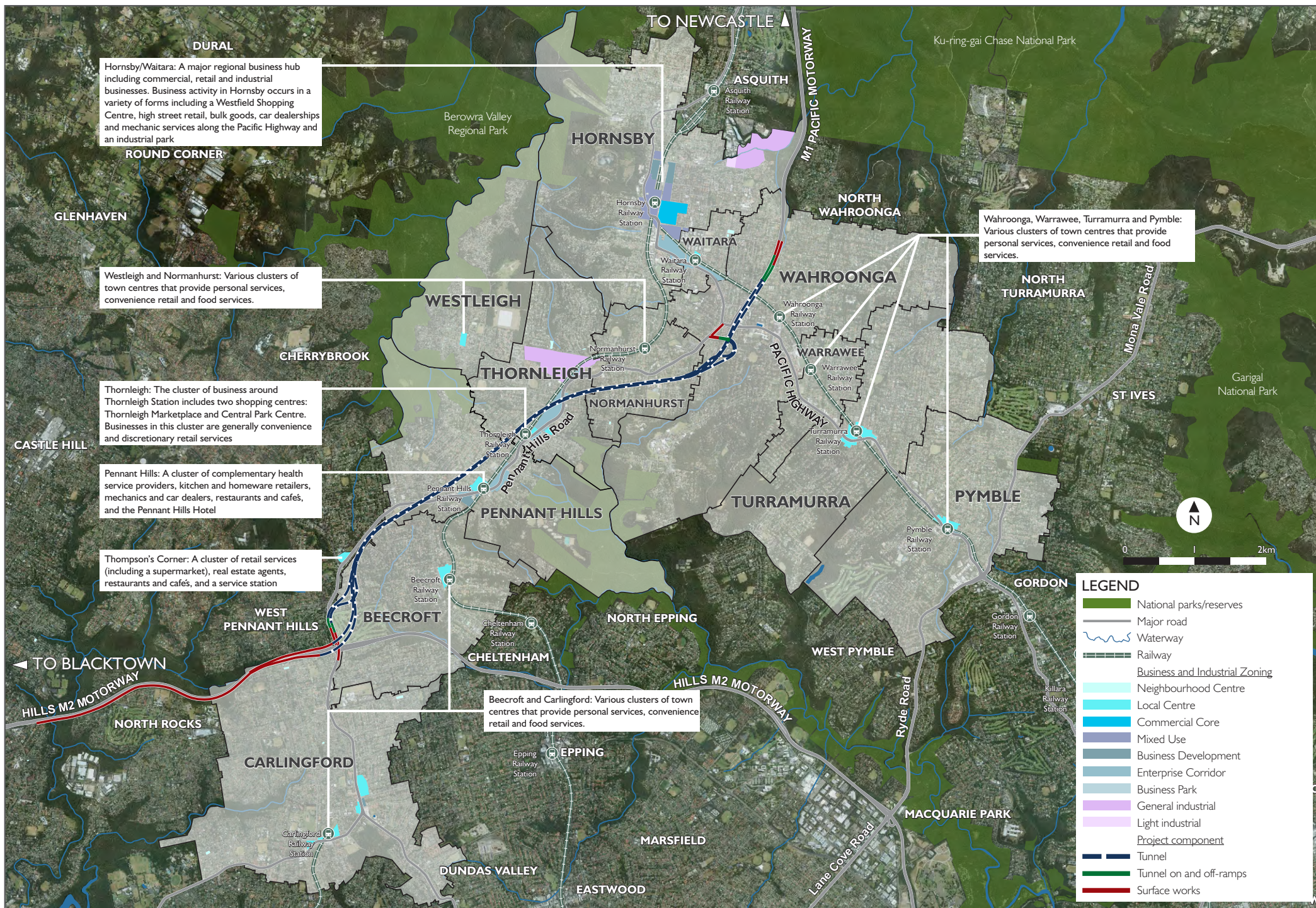


Figure 2 Business areas within proximity to the project

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3.3 Tourism

The total number of day trip visitors to the study area between September 2011 and September 2013 was around 946,000 (TRA, 2013). Hornsby-Waitara was the most popular destination within the study area with around two-thirds of visitors accounted for in these suburbs. The purpose of around half of these day trips was to visit friends or relatives. Visitors with the purpose of holiday or leisure accounted for 20 per cent of all day trips and visitors with a business purpose accounted for 15 per cent.

Day trips to the study area accounted for around 1.6 per cent of all day trips within Sydney (TRA, 2013). The study area is generally not a tourist destination and its significance in the industry is in its provision of services to tourists passing through the study area on their way to or from the M1 Pacific Motorway. These services are provided by businesses including cafes, restaurants and fast food establishments, service stations and accommodation. There are currently:

- Five accommodation venues that cater for holiday and leisure as well as businesses trips along Pennant Hills Road and the Pacific Highway near the M1 Pacific Motorway interchange;
- Sixteen service stations along Pennant Hills Road and the Pacific Highway near the M1 Pacific Motorway interchange; and
- Eight cafés and fast food restaurants.

The NSW North Coast, Central Coast and Hunter Regions are all very popular tourist destinations for domestic and international tourists. These areas attracted around 37 million day trips between September 2011 and September 2013 (TRA, 2013). In addition to day trips, around 20 million overnight trips were conducted by domestic tourists over the same period (TRA, 2013).

As the major arterial route for the NSW North Coast, Central Coast and Hunter Region, the M1 Pacific Motorway provides access for tourists to these destinations. Additionally, the Hills M2 Motorway provides tourists from the north of Sydney access to the Sydney Orbital Network and tourist destinations in Sydney and the NSW South Coast.

3.4 Travel patterns

3.4.1 Passenger vehicles and public transport

Pennant Hills Road is a major arterial route that provides access between the Hills M2 Motorway in the south to the M1 Pacific Motorway in the north, travelling through suburbs including West Pennant Hills, Beecroft, Pennant Hills, Thornleigh, Normanhurst and Wahroonga.

The M1 Pacific Motorway is the major route for road traffic between Sydney and the NSW North Coast, including Newcastle, Gosford and the Hunter Region, for both passenger and freight road transport.

Pennant Hills Road and the Pacific Highway are currently used as feeder roads to enter and exit the M1 Pacific Motorway from or to the wider Sydney road network. Access to and from the wider Sydney road network most commonly uses the Hills M2 Motorway, Westlink M7 Motorway and M5 South-West Motorway.

Private vehicles are the predominant mode of transport in the study area, which is reflected in high levels of household vehicle ownership in the Hornsby LGA (1.7 vehicles per household) in comparison to the Sydney Greater Metropolitan Region (1.6 vehicles per household). The 2011/12 Household Travel Survey (NSW Bureau of Transport Statistics, 2013) shows that 71 per cent of total trips on a typical weekday made in the Hornsby LGA are car-based, compared to an average of 68 per cent in the Sydney Greater Metropolitan Area.

Rail passengers represent nine per cent of average weekday travel mode share in the project area (NSW Bureau of Transport Statistics, 2013). Since the completion of the Epping to Chatswood rail link in 2009, services on the Northern Line operate from Hornsby and Epping and onward to Macquarie Park, North Sydney and the Sydney central business district via Chatswood and North Sydney. Public transport patronage is likely to change upon the completion of the North West Rail Link, which would provide train services into the north west. Along with the addition of train services, bus routes are likely to change to feed passengers into the stations, providing fast and efficient transport to Macquarie Park, Chatswood and the Sydney central business district.

Bus passengers represent four per cent of average weekday travel mode share in the project area (NSW Bureau of Transport Statistics, 2013). Pennant Hills Road is an important corridor with a number of bus services operating in the project area. Bus stops are located at regular intervals in both directions, with these services operating in the project area. Bus stops are located at regular intervals in both directions, with these services providing connections between a number of centres, including Pennant Hills, Beecroft, Castle Hill, Parramatta and the Sydney central business district via the Hills M2 Motorway. The Hills M2 Motorway provides quick access to the Sydney central business district, although service levels and reliability of bus operations are dependent on traffic conditions on Pennant Hills Road, the motorway itself and surrounding local road network.

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 and Castle Hill Road intersection and the Pennant Hills Road interchange with the Hills M2 Motorway, there are no dedicated cyclist facilities along this section of Pennant Hills Road.

3.4.2 Freight and commercial travel patterns

Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway forms part of the National Road Network. The National Road Network is based on national and inter-regional transport corridors including connections through urban areas, links to ports and airports, rail, road and intermodal connections that together are of critical importance to national and regional economic growth, development and connectivity. The M1 Pacific Motorway is the main strategic highway linking Sydney, the Central Coast, Newcastle and Brisbane. Pennant Hills Road and the Pacific Highway play a major part in connecting the M1 Pacific Motorway to Sydney and to wider freight and commercial vehicle destinations.

As the links between the M1 Pacific Motorway and the Hills M2 Motorway, Westlink M7 Motorway and M5 South-West Motorway, Pennant Hills Road and the Pacific Highway carry a high volume of freight and commercial vehicles on a daily basis.

Pennant Hills Road carries large volumes of traffic with two-way annual average daily traffic (AADT) in 2011 of about 80,000 vehicles per day (Infrastructure NSW, 2011). Traffic surveys completed for the project in December 2013 found a high proportion of heavy vehicles that use both the M1 and M2 Motorways to transport goods around Sydney, with the M1 near Pennant Hills Road recording around 21 per cent heavy vehicles and Hills M2 Motorway west of Pennant Hills Road recording around 14 per cent heavy vehicles across the weekday (referred to as average weekday daily traffic (AWDT)) (refer to technical working paper: traffic and transport (AECOM, 2014). Linking these two motorways, Pennant Hills Road is also subject to high volumes of heavy vehicles, with around 14 per cent of the AWDT recorded north of the Hills M2 Motorway interchange. Pacific Highway recorded lower percentages of heavy vehicles, with around three to six per cent of the AWDT comprising of heavy vehicles.

The 2007 Sydney Urban Corridor Strategy developed by the NSW and Australian Governments found that congestion on Pennant Hills Road directly affects performance of the National Highways network. The F3-M2 connector: Supporting research undertaken by PWC in 2012 also highlights the 'bottleneck' caused by Pennant Hills Road that restricts the movement to, from and through Sydney.

The completion of the Westlink M7 Motorway has resulted in significant industrial development in Western Sydney due to improved transport connectivity and available and affordable land. Investment has included major warehouse and distribution operations at Eastern Creek and Moorebank that has facilitated the transport of goods throughout Sydney and Australia. The majority of long distance traffic on the M1 Pacific Motorway north of Sydney has an origin or destination within Sydney. Industrial investment in Western Sydney has increased the importance of the corridor to the transport of freight at both a regional and interstate level.

Service stations along the Pacific Highway and Pennant Hills Road are likely to have located there to capture the freight and commercial vehicle movement between Sydney and the Central Coast, Newcastle and Brisbane. Freight and commercial trade is likely to represent a higher proportion of trade for these businesses than those located elsewhere in the study area.

3.5 Summary

The study area is used as a major thoroughfare for freight, commercial and tourist activity linking Sydney and the Central Coast, Newcastle and Brisbane. On a local level, the road network serves the needs of the local residents and the local workforce.

The road network within the study area is generally congested due to the high dependency of the local workforce on transportation by car and the movements associated with tourist, freight and commercial vehicles through the study area. The local economy has grown to cater for both these markets with a mixture of discretionary retail and services for the local residents, as well as a high number of service stations and fast food restaurants catering for passing trade.

Businesses that have been identified as potentially relying on passing trade include service stations, cafés and fast food restaurants and accommodation providers. Service stations along the Pacific Highway and Pennant Hills Road which are likely to cater for freight and commercial activity, are potentially reliant on a higher proportion of passing trade than other roads in the local network.

The economy of the region is generally reliant on services that cater to local residents such as health and education services and does not appear to be significantly dependent on industries that rely on passing trade. However, 12 per cent of the local workforce is employed in retail services highlighting the importance of this industry to the local economy.

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4.0 Consultation and key stakeholder issues

Consultation with potentially impacted businesses and business stakeholder groups has been undertaken as part of the business impact assessment.

Consultation with potentially impacted business owners occurred in conjunction with the business survey. These businesses were asked to provide comments on the potential impacts (both positive and negative) that they believed might affect their businesses. The results received highlighted some of the concerns of businesses owners and managers with regard to their business. The results also highlighted some of the potential positive effects business owners believed may arise due to the project.

In addition to consultation with the potentially impacted businesses, AECOM concurrently consulted with business stakeholder groups. Representative business and industry key stakeholders were invited to participate as part of the project's Business and Industry stakeholder group. The purpose of consulting with this group as part of the business impacts assessment is to capture feedback on perceived impacts of the project, both positive and negative, on local businesses and freight movements. A business and industry stakeholder briefing session on the project was held on 2 April 2014, which was attended by:

- NSW Business Chamber.
- Hornsby Business Alliance (formerly Hornsby and District Chamber of Commerce)
- Sydney Hills Business Chamber
- Parramatta City Chamber of Commerce.
- Epping Chamber of Commerce
- Ku-ring-gai Chamber of Commerce.
- Ryde Business Forum.
- Hornsby Business Alliance.
- Westfield.
- Woolworths.
- McDonalds.
- Bunnings.

The aim of consultation with business and industry key stakeholders was to capture industry views on:

- The potential impact of changes in travel times for businesses reliant on regional and interstate freight movement.
- The potential impact of the project on passing trade to local businesses.
- The potential impact of the project on local trade (increase or decrease in local trade due to changes in traffic and parking).
- The potential impact of changes in amenity to businesses.

The feedback that emerged during consultation with businesses and industry stakeholders, and the location where this has been addressed in this report, are summarised in **Table 2**.

Table 2 Feedback provided by stakeholders

Issue	Detail	Report section
Construction		
Business and economic issues	<p>Potential increases in turnover due to increased patronage from construction workers.</p> <p>Potential changes in employment (positive and negative) due to changes in turnover.</p> <p>Potential acquisition of businesses directly impacted by the project footprint.</p> <p>Opportunities for local businesses in terms of supply of goods and services during construction of the project.</p>	Section 5.1.1 and 5.1.4
Amenity	Potential amenity implications to businesses during the construction of the project and the potential impact to trade.	Section 5.1.2
Traffic and access arrangements	<p>Impacts to accessibility during construction.</p> <p>The ability to make and receive deliveries during the construction of the project.</p> <p>Potential decrease in parking due to construction vehicles.</p> <p>Cumulative traffic impacts of other major projects in the area.</p>	Section 5.1.3
Operation		
Traffic and access arrangements	<p>The ability to make and receive deliveries during the operational stage of the project.</p> <p>Impact of the reduction in heavy vehicles on the road.</p>	Section 5.2.1 and 5.2.3
Business and economic issues	<p>Potential loss of trade due to reduction in passing traffic.</p> <p>Impact to advertising and attracting passing traffic.</p> <p>Impact on employment due to reduction in passing trade.</p> <p>Impacts to local businesses due to acquisition.</p> <p>Opportunities to local or new businesses along the corridor as result of the project in terms of improved access and amenity.</p>	Section 5.2.5, Section 5.2.3, Section 0 and Section 5.2.5.

The Business and Industry stakeholder group would continue to be consulted at key project stages, providing high level insights that would be strategic and holistic in nature. Engagement with this group also has the potential to raise project awareness, sanction project support and advocates and seek broader inputs by leveraging their existing business contacts.

5.0 Assessment of impact

During the construction and operation of the project, there is the potential for positive and negative impacts on local businesses and the regional economy. An assessment of the potential impacts has been undertaken to determine the type, direction and magnitude of the potential impacts.

The potential impact to businesses due to the project varies depending on the location and type of business. These factors also influence the magnitude of the impact.

Further details of impacts are presented in the following sections, with potential impacts during construction and operation discussed separately.

5.1 Construction

The following potential impacts during project construction have been identified:

- Increase in output, industry value added, household income and employment from direct and indirect impacts due to construction expenditure and employment.
- Amenity impacts, resulting in a reduction in trade due to construction activities in proximity to individual businesses, or commercial / retail centres.
- Changes in accessibility due to traffic congestion due to construction traffic, or reductions in car parking availability due to construction.
- Acquisition of industrial-zoned land for the Pioneer Avenue compound, which is currently vacant.
- Cumulative impacts due to concurrent construction activities associated with other major infrastructure projects in the region, specifically North West Rail Link and Epping to Thornleigh Third Track.

This reflects the consultation undertaken with local businesses, as discussed in **Chapter 4.0** and listed in **Table 2**.

5.1.1 Increased business turnover and employment

The construction expenditure of the project would be of significant benefit to the economy. This expenditure would inject economic stimulus benefits into the local, regional and state economies. Local business would principally benefit from this expenditure through purchases made by construction businesses and associated workers to build and support the development of the project. The analysis assumes that four per cent of labour, plant and equipment, materials or other inputs would be sourced from interstate and six per cent of equipment, materials and other inputs would be sourced from overseas.

Around 1,250 jobs are expected to be created during the peak construction period of the project (classified as 'initial' employment in this assessment). There may be employment opportunities for local residents as part of the construction workforce. As a result, the overall wealth and/or disposable income of the community are expected to grow. Wages also have the potential to increase due to the increase in demand for construction workers.

Table 3 presents the direct, indirect and total impacts of construction expenditure on the New South Wales economy per year of construction.

Direct impacts (including employment) are the initial and 'first-round' effects of construction expenditure where 'first round' effects refer to the impacts on businesses supplying directly to the construction of the project. Business that may directly benefit from construction of the project may include local construction contractors and those businesses who service or supply goods to the construction industry such as food and beverage retailers, accommodation providers, and other retail outlets that would cater to the day-to-day needs of the construction workforce. The increase in turnover may subsequently lead to increased employment opportunities and incomes for those businesses (and employees) providing goods and services.

The expenditure would also have flow-on effects to other businesses in the area. Indirect effects refer to flow-on effects to the wider state economy.

The assessment of direct, indirect and total impacts of construction expenditure has been conducted using the economic multiplier methodology presented in **Section 2.1**.

Table 3 shows that for New South Wales:

- Construction expenditure, in terms of output, contributes an estimated \$2.9 billion directly, with flow-on (indirect) effects of \$1 billion, giving an estimated total impact of \$3.9 billion.
- Household income generated by the construction of the project is estimated to be \$0.5 billion, with flow-on effects of \$0.2 billion, giving an estimated total household income contribution of \$0.7 billion.
- Direct employment (initial and 'first round') supported by the construction of the project is estimated to average 5,060 FTE positions per year for four years. Flow-on employment is estimated to average 3,649 FTE positions per year for four years, giving a total of around 8,700 annual FTE positions over the four year construction period.
- Value added attributable to the construction of the project is estimated to be around \$0.9 billion directly, with flow-on effects of around \$0.4 billion, giving an estimated total value added contribution of \$1.3 billion. This is the estimated contribution to Gross State Product (GSP).

Table 3 Direct, Indirect and total impacts of construction expenditure on the New South Wales economy per year of construction

Impact	Increase in industry output	Increase in household income	Increase in employment	Increase in value added
	\$ million (2014 prices)	\$ million (2014 prices)	Full time equivalent positions ^(a)	\$ million (2014 prices)
Direct	2,853	519	5,060	873
Indirect	1,061	240	3,649	430
Total^(a)	3,914	759	8,709	1,302

Source: AECOM (2014)

Notes:

(a) Average number of FTE positions supported for four years.

5.1.2 Amenity impacts

Amenity has an impact on a customer's decision on where to shop. The impact of amenity on a business could potentially result in loss of trade as customers shop elsewhere to avoid adverse conditions. A place that has 'amenity' is regarded as pleasant and attractive, as well as convenient and comfortable.²

Amenity impacts include any factors that affect the ability of customers, employees or business owners to enjoy their workplace and daily activities such as noise, vibration, detrimental changes to views or changes to air quality.

Amenity impacts during the construction of the project have been discussed in detail in Section 7.2 (Noise and vibration), Section 7.3 (Air quality), Section 7.5 (Urban design, landscape character and visual amenity) and Section 7.7 (Social and economic) of the environmental impact statement.

With reference to those assessments, the potential impact to businesses during construction within the study area as a result of changes in amenity would occur as a result of:

- Increases in noise and vibration, including increases in road traffic noise and periods when night time works would be required.
- Potential changes in local air quality due to increased dust emissions associated with surface disturbance and/or the handling, transport and disposal of spoil.
- Changes in visual amenity due to construction compounds or activities close to businesses.

² Handy, S. Amenity and Severance 2002.

The majority of construction activity would occur underground, which would limit the extent of amenity impacts to businesses along the corridor. However, surface works would be required at the northern and southern interchanges, along the Hills M2 Motorway and at compound sites. The transport of spoil and other construction materials would also increase road traffic noise along key routes or in proximity to construction sites and compounds.

Construction activities or construction compounds that would be close to businesses within study area include:

- Muirfield Golf Course, which is located near the Hills M2 Motorway integration works.
- The southern interchange and the Hills M2 Motorway integration works. Activities at the southern interchange would be undertaken directly opposite to the Pennant Hills Golf Course and close to a strip of retail shops near Carmen Drive at Carlingford.
- Wilson Road compound, which is located in an area that is predominately residential. However, some businesses occur in proximity, namely a veterinary clinic and a funeral home located around 200 metres and 300 metres away respectively.
- Trelawney Street compound, which is located opposite a number of businesses along Pennant Hills Road, Phyllis Avenue and Central Avenue. This includes hotel accommodation, retail, food outlets and service stations. Heavy vehicles associated with this compound would utilise Phyllis Avenue roundabout to undertake u-turn movements.
- Pioneer Avenue compound at Thornleigh, which is located adjacent to a number of businesses and passive and active recreational areas.
- The northern interchange. Construction activities would be undertaken around 200 metres from a hotel on Ingham Road, Wahroonga, and a serviced apartment business along Pacific Highway in Wahroonga.

During construction, businesses such as outdoor restaurants, cafes and eateries would stand to be the most affected by noise and air quality impacts. It should be noted that those businesses, located on Pennant Hills Road and the Pacific Highway, would already experience reduced amenity from traffic along those roads.

The magnitude of the impact of amenity would be largely influenced by the construction hours, length of the construction period, the construction activity, proximity to the project and the nature of the business.

The construction noise assessment (refer to technical working paper: noise and vibration (AECOM, 2014)) identifies that there is the potential for exceedances of the recommended Noise Management Levels during certain activities that would be conducted in standard construction hours and out-of-hours activities. Feasible and reasonable mitigation measures would be implemented to reduce noise emissions as low as possible. However, the potential for residual impacts remains and consultation strategies would be required for affected businesses that are sensitive to changes in noise amenity.

As detailed in technical working paper: air quality (AECOM, 2014), the potential for dust to be emitted from above-ground construction works would be managed through standard mitigation measures identified within that technical report.

5.1.3 Changes to accessibility

As the project would be largely constructed underground in tunnel, potential disruptions to property accesses or the performance of the road network would be attributed to:

- Works on existing surface roads that require modification to accommodate the project or to connect to the project.
- Connections to the motorways.
- Establishment and use of ancillary construction compounds.
- Increased congestion along the network due to construction traffic.
- Reduced traffic lanes or travel speeds due to construction zones.

Construction activities would be staged and undertaken in a manner that minimises the disruption to traffic where reasonable and feasible. Construction traffic would also be managed to minimise movements during peak periods where possible. Nonetheless, due to existing capacity constraints along the network, the construction phase of the project would have an impact on the performance of the road network (refer to technical working paper: traffic and transport (AECOM, 2014) found in Appendix E of the environmental impact statement). This may impact businesses that are reliant on deliveries as they may experience longer transit times. Freight and commercial vehicles that use Pennant Hills Road, the Pacific Highway, the Hills M2 Motorway and the M1 Pacific Motorway may also experience longer transit times and decreased efficiencies over the construction period.

Businesses that rely on deliveries from and to their premises may experience some increases in transit times due to increased traffic on the road network from construction vehicles. Delivery times may be increased, which may increase delivery costs, particularly fuel and labour costs. An increase in the cost base may increase prices and could potentially decrease demand for these services.

The maintenance of access to businesses is vital to the viability of businesses. Excluding works along the two motorways, road works that would impact surface roads are largely concentrated at the northern and southern interchanges. There are no businesses located along these roads.

Temporary works are proposed at various stages of construction, such as temporary diversions for road, cycle and pedestrian traffic near work areas, and alternative arrangements would be provided where property accesses may be temporarily disrupted. In the event that accesses to businesses are unavoidable, consultation would be undertaken with the property owner and/or tenant to develop an appropriate alternative access arrangement. This may involve provision of a temporary access point or signage.

It is anticipated that the Trelawney Street compound would attract significant additional heavy vehicle trips to the road network, particularly the Pennant Hills Road intersections with Loch Maree Avenue and Trelawney Street and the northbound construction movements on Phyllis Avenue. Pioneer Avenue compound movements are expected to peak during shift change and would add significant additional light vehicle demand to the local road network. While the additional traffic may cause congestion at these two locations, access to businesses is not anticipated to be significantly impacted.

It is not proposed to remove off- or on-street car parking near businesses along the project corridor. To minimise construction vehicles or construction workers using on- or off- street parking, construction vehicles and workers accessing the construction compound sites would be provided with an employee parking transfer facility at Pioneer Avenue compound or within the construction facilities. Public transport options are also available along the construction corridor, and construction workers would also be encouraged to use these options to travel to and from the project, or to car pool.

Despite these initiatives, there remains the potential for construction workers to park along local streets that are used by customers of local businesses. However, this would likely be limited to those areas near compound sites, such as Trelawney Street compound. Mitigation and management measures are recommended to mitigate this potential impact.

5.1.4 Acquisition

Where the project requires acquisition of a land that a business occupies, it has the potential to impact on the economic productivity and the viability of that business. Where possible, the location of businesses along the corridor has been considered during the design of the project so that impacts to businesses would be minimised. There are five properties that contain private businesses that would be fully acquired, and one property that would be partially acquired at Pioneer Avenue compound that contains an unoccupied malt works facility as a result of the project.

All private land acquired for construction and/or operation would occur prior to the commencement of construction. While the acquisition would occur prior to the commencement of construction, the acquisition of five properties containing private businesses would be permanently required for the project. As such, the assessment of the short to long term economic impacts of that acquisition has been discussed in **Section 0** of this report.

The site at Pioneer Avenue would be temporarily required for construction and would function as a centralised parking facility for construction workers. The site currently accommodates an unoccupied malt works facility and an unoccupied site managers residence. To cater for the compound, the majority of the existing buildings within the site would be demolished. When the required use of the Pioneer Avenue compound concludes, it is intended that the site would be rehabilitated if necessary to enable a future use that is consistent with the land use zoning of the site under *Hornsby Local Environmental Plan 2013*.

5.1.5 Cumulative impacts

Cumulative impacts to the local economy and businesses are most likely to result from the construction of the North West Rail Link (NWRL) in the Hornsby, the Hills and Blacktown local government areas. The NWRL is estimated to support more than 16,200 jobs (NSW Government, 2011) during construction and inject \$25 billion (directly and indirectly) into the NSW economy (NSW Government 2011).

Epping to Thornleigh Third Track (ETTT) is the construction of six kilometres of new rail track between Epping and Thornleigh and is likely to be a significant employer of construction workers from 2014 until completion of construction.

Cumulative impacts are likely to intensify the impacts identified above, particularly with regard to employment and economic stimulus. The demand for labour for major projects such as this project, the NWRL, ETTT and other similar projects in the area would increase employment opportunities for local residents. There is potential for wages to increase due to high demand for construction workers.

The opportunity for local businesses to supply goods or services to the construction of these projects and their construction workforces has the potential to increase business turnover due to high demand from the multiple projects.

There is the potential for construction vehicles for ETTT and NWRL to contribute further to congestion on the road network, however, the majority of construction vehicles associated with the project would be using Pennant Hills Road with minimal use of local roads. The major civil works for ETTT, such as earthworks, spoil removal and structures, are programmed for completion by the end of 2014. Therefore, the potential for overlap with the peak period of this project during late 2015 and early 2016 would be related to station works for the ETTT project, the installation of track, signalling, overhead wires and communications. To minimise impacts on the surrounding road network, ETTT Vehicle Movement Plans General Procedure indicates that where feasible, construction material is to be delivered via rail and attempt to use the rail corridor to move materials and machinery and will plan delivery and haulage outside of school zones and peak hour periods. It is therefore considered that while there may be some cumulative impacts between the two projects, it is likely to be short-term (2015 – 2016) and not significant.

Three NWRL construction sites would be in the general vicinity of the project at Cherrybrook, Cheltenham and Epping. The NWRL Construction Traffic Management Plan also notes that the bulk of the construction-related trucks will be scheduled to arrive and depart from each site outside of the AM peak period (7 am – 9 am) and PM peak period (3 pm – 6 pm), with any truck movement after 6 pm subject to approval. This may intensify or prolong the impacts on amenity and congestion during the construction period. As discussed in the technical working paper: traffic and transport (AECOM, 2014), that due to the anticipated timeframe for the construction of NWRL, any cumulative impacts between the NWRL and this project would be minimal and not significant.

5.1.6 Summary of construction related impacts

During the construction of the project, there is the potential for a boost in the economy due to construction expenditure in the region. Local business would principally benefit from this expenditure through purchases made by construction businesses and associated workers to build and support the development of the project.

Employment opportunities would grow in the region through the potential increase in business patronage and through the increase in demand for construction workers. The increase in demand for labour may increase wages in the region, particularly for construction workers who would be in high demand.

Through economic multipliers it was determined that construction expenditure would contribute a total of \$3.9 billion dollars of output, \$0.7 billion dollars of household income, around 8,700 full-time equivalent jobs and \$1.3 billion of value added to the New South Wales economy per year of construction.

There is the potential for businesses to experience impacts to amenity due to the project in the form of increases in noise and vibration, potential increases in dust and changes in visual amenity. The majority of construction activity would occur underground, which would limit the extent of amenity impacts to businesses along the corridor. Businesses such as outdoor restaurants, cafes and eateries would stand to be the most affected by noise and air quality impacts.

It is anticipated that the construction phase of the project has the potential to impact on the performance of the road network. As a result, businesses that are reliant on deliveries may experience longer transit times. Freight and commercial vehicles that use Pennant Hills Road, the Pacific Highway, the Hills M2 Motorway and the M1 Pacific Motorway may also experience longer transit times and decreased efficiencies over the construction period.

One property would be acquired for the Pioneer Avenue compound. This property is currently vacant, and its use for the project would not preclude the future use of the site that is consistent with its land use zoning. The acquisition of this property would occur prior to the commencement of construction.

5.2 Operation

The following potential impacts during the operation of the project have been identified.

- Increased output, household income, value added and employment from the operation of the project.
- Improvements in amenity and accessibility for businesses due to reduced congestion and traffic volumes along Pennant Hills Road.
- Reductions in amenity and accessibility for businesses in proximity to above ground elements of the project.
- Losses associated with the acquisition of business (employment, turnover).
- Loss in trade and employment due to changes in volumes of passing traffic.
- Changes in visibility.
- Improvements to freight transport efficiencies.
- Cumulative impacts associated with other major infrastructure projects in the region, specifically North West Rail Link and Epping to Thornleigh Third Track.

This reflects the consultation undertaken with local businesses, as discussed in **Chapter 4.0** and listed in **Table 2**.

5.2.1 Increased business turnover and employment

The assessment of direct, indirect and total impacts of operational expenditure has been conducted using the economic multiplier methodology presented in **Section 2.1**.

Table 4 presents the direct, indirect and total impacts of operational expenditure on the New South Wales economy per year of operation:

- Operation of the project, in terms of output, is estimated to contribute around \$32 million directly, with flow-on (indirect) effects of around \$17 million, giving an estimated total impact of around \$39 million.
- Household income generated by operation of the project is estimated to be around \$7 million, with flow-on effects of around \$2 million, giving an estimated total household income contribution of around \$9 million.
- Direct employment supported by the operation of the project is estimated to average 93 FTE positions per year of operation. Flow-on employment is estimated to average 28 FTE positions per year of operation, giving a total of 121 annual FTE positions.
- Valued added attributable to the operation of the project is estimated to be \$13 million directly, with flow-on effects of \$3 million, giving an estimated total value added contribution of \$16 million. This is the estimated contribution to Gross State Product (GSP).

Table 4 Direct, indirect and total impact of operation expenditure on the New South Wales economy per year of operation

Impact	Increase in industry output	Increase in household income	Increase in employment	Increase in value added
	\$ million (2014 prices)	\$ million (2014 prices)	Full time equivalent positions	\$ million (2014 prices)
Direct	32	7	93	13
Indirect	17	2	28	3
Total	39	9	121	16

Source: AECOM

Note: The numbers presented in Table 4 have been rounded.

5.2.2 Improved amenity and accessibility

The project would remove a significant proportion of heavy vehicles that travel along Pennant Hills Road as well as a proportion of light vehicle through movements, which have considerable adverse impacts on local amenity. The performance of Pennant Hills Road would improve at certain locations as a result of the project, however, background growth caused as a result of local trips would mean that some key intersections would experience congestion irrespective of the project. Reduced traffic would also likely result in lower travel times along the corridor. A northbound journey on Pennant Hills Road is expected to take around 13 minutes less during the PM peak in 2019 and 21 minutes less in 2029 when compared to travel times for a similar journey in the absence of the project. This may change the travel and shopping patterns of local residents.

5.2.3 Reduced amenity and accessibility

Decreases in amenity or accessibility have the potential to impact on the viability of a business, depending on the type of business and the ability of that business to respond to any changes.

Amenity impacts could include decreased visual amenity due to the presence of new infrastructure, increased noise levels which would impact the ambience of the business (such as cafes) or decreased air quality.

Reduced accessibility would occur if access arrangements for individual businesses or retail centres change as a direct result of the project. There are no proposed changes to access arrangements for individual businesses or retail centres. Therefore this has not been considered further.

There would be limited potential for amenity impacts on businesses due to the operation of the project. The surface components of the project are in predominately residential areas and outside established and future commercial, industrial and retail centres, with the following exceptions:

- At the Trelawney Street tunnel support facility, located to the east of an established commercial centre at Thornleigh.
- At the Pennant Hills Golf Course, this is located to the east of the southern interchange. At this location, on- and off-ramps portals, as well as the motorway control centre, the southern ventilation facility and other supporting ancillary infrastructure would be located.
- At a small retail strip at Carmen Drive, Carlingford. This retail strip is located to the south of the Hills M2 Motorway near the Oakes Road underpass.

Noise and vibration and air quality impacts were assessed as part of Section 7.2 (Noise and vibration) and Section 7.3 (Air quality) of the environmental impact statement. The air quality assessment determined that the expected pollutant concentrations resulting from the project are low and within the relevant criteria. No noise exceedances are predicted at operational ancillary facilities, and feasible and reasonable noise mitigation measures (such as low noise pavement and noise barriers) have been identified for road traffic noise which would provide benefit for non-residential receivers.

5.2.4 Acquisition

As discussed in **Section 5.1.4**, five properties that contain businesses would be fully acquired for the project prior to the commencement of construction. This has the potential to impact on the economic productivity and the viability of those businesses. The acquisition of the property would occur under the Roads and Maritime Land Acquisition Information Guide (Roads and Maritime, 2012) and under the terms of *Land Acquisition (Just Terms Compensation) Act 1991*.

The five (5) businesses that would be directly impacted due to property acquisition comprise:

- One landscaping business, which is located within the operational footprint of the southern interchange.
- Four businesses located within the footprint of the Trelawney Street tunnel support facility, comprising two retail and two service-based businesses.

While the acquisition of land would occur prior to the commencement of construction, the impact of acquisition would have both short term impacts (during construction of the project) and medium to long term impacts (during operation of the project) on the economy through the loss of employment and turnover.

These businesses may choose to relocate to another site within the region and continue trading. However, for the purposes of this assessment, the worst-case scenario has been considered which assumes a permanent loss of contribution of those businesses to the economy. As such, the results of this assessment may overstate the loss of turnover, employment and economic activity in the region.

Based on relevant industry averages of employment and turnover, and applying the methodology described in **Chapter 2.0**, it has been estimated that there would be a reduction of around 25 full-time equivalent jobs in the region annually (refer to **Table 5**). The reduction in employment of 25 full-time-equivalent positions is equivalent to less than 0.1 per cent of total jobs in the Hornsby LGA. As the directly impacted businesses may differ from the averages due to size and location, the results presented in **Table 5** should be used as an indicator only.

Table 5 Potential impact of acquisition

Number of businesses	Annual potential loss of employment (FTE positions)
5	25

Note: A PV factor of seven per cent over 30 years has been applied to obtain a permanent loss of business activity. 30 years is assumed to be the life of a business.

5.2.5 Reduction in passing trade

While the reduction in traffic volumes along Pennant Hills Road would improve amenity of the local centres, reduced traffic volumes can negatively impact those businesses reliant on passing trade. The tunnel would mean that businesses that were previously visible to passing trade would no longer be seen to vehicles passing through the tunnel and vehicles may no longer patronage these businesses. Studies of bypass impacts in NSW³ have shown that the most affected businesses are those directly serving the needs of the motorist such as motor services, particularly service stations, food and beverage outlets and, to a lesser extent, accommodation establishments.

The strategic traffic model (refer to technical working paper: traffic and transport (AECOM, 2014)) provided estimates in the projected changes in traffic volumes in 2019 and 2029 with and without the project across the broader road network. For the purposes of this assessment, the changes in traffic volumes as predicted in the strategic model for key major roads were reviewed.

³ Assessments reviewed include: NSW RTS and University of Sydney (2009), *Evaluation of the Economic Impacts of Bypass Roads on Country Towns: Final Report* and NSW RTA and University of NSW (2011), *Economic Evaluation of Town Bypasses: Review of Literature*.

The potential change in value of passing trade has been estimated based on changes in volumes of traffic and the results of the business survey (refer to **Chapter 4.0**). This provides an estimate in the direct loss of employment and turnover after the opening of the project and represents a worst case scenario in so far as it does not take account of an increase in turnover due to changes in local traffic and business adaptation. The linkages with other businesses supplying goods and services to those businesses directly impacted were not quantified. These would be indirect or second round impacts on employment and turnover resulting from the diversion of through traffic and are likely to be minor.

A total of 31 businesses were identified as potentially being impacted by a reduction in passing trade, which include hotels, cafes, and service stations. Survey responses were received from 23 out of 31 businesses. For the businesses that did not provide response to the survey, the average number of employees and the estimated reliance of passing trade was calculated as the average of the responses in the corresponding category of establishment.

Output (or business turnover) was estimated using employment to output ratios published by the ABS (1991-92) and inflated to 2013 prices. Therefore, the assessment has assumed that the businesses assessed were representative of the 'average' business in Australia in their classified type of business. This does not take into account efficiencies or deficiencies within the businesses that could reflect higher or lower turnover estimates.

Based on the outcomes of the business survey, and applying the methodology described in **Chapter 2.0**, it has been estimated that there would be an annual reduction of around \$5.6 million in output and around 18 full-time equivalent jobs due to loss in passing trade (refer to **Table 5**). This equates to a loss of 7.8 per cent of total output and 6.4 per cent of full-time equivalent employment of the businesses surveyed.

This is a worst case scenario analysis of the impact of the reduction of passing trade based on industry averages and the results presented in **Table 6** should be used as an indicator only. It should also be considered in the context of the travel time improvements and the associated benefits to the freight industry as discussed in **Section 0**, and the employment opportunities generated by the project, as discussed in **Section 5.2.1**.

Table 6 Potential impact of passing trade

Type of business	Number of businesses	Annual potential loss of output (\$)	Annual potential loss of employment (FTE positions)
Hotels	5	42,000	0
Cafés and fast food restaurants	9	913,000	6
Service stations including those with car wash facilities	17	4,626,000	12
Total	31	5,580,000	18

Source: ABS Consumer Price Index, All groups, Sydney, ABS Retailing in NSW 1991-92, Catalogue Number 8623.1, ABS Australian National Accounts: Input-Output Tables 2009-10, Catalogue Number 5209.0

5.2.6 Changes in visibility

Several businesses including KFC, McDonalds and Ibis hotels currently advertise along Pennant Hills Road and/or the M1 Pacific Motorway to attract passing trade to their operations. With the potential reduction in traffic along Pennant Hills Road and the Pacific Highway, the visibility of these businesses to through traffic would be reduced. Visibility is important to businesses that rely on passing trade. Customers for these types of businesses are generally impulse or convenience purchasers. The likely change in through traffic may necessitate potential changes to advertising operations to continue to draw customers to some businesses.

5.2.7 Freight and efficiency impacts

Long distance freight traffic on the M1 Pacific Motorway is forecast to increase significantly over the next 20 years as the population of South Eastern Australia continues to grow. The F3-M2 connector: Supporting research highlights the increased congestion on Pennant Hills Road as a result of the significant population growth projected for North West Sydney. This would further reduce the efficiency of freight movement over time, and would place increased stress on road infrastructure along Pennant Hills Road and the Pacific Highway.

As travel speeds along major road corridors decrease, road freight productivity and commuter efficiency is being impacted, presenting an economic cost to the State. There are 21 sets of traffic signals between the Pennant Hills interchange at Hills M2 Motorway and the M1 Pacific Motorway interchange at Wahroonga that would be bypassed as a result of the project. When compared with travel time on Pennant Hills Road, the project would offer travel time savings of around six to 15 minutes in 2019 and nine to 25 minutes in 2029 (see technical working paper: traffic and transport (AECOM, 2014)). When compared to travel time on Pennant Hills Road without the project, the project would offer travel time savings of around 10 to 25 minutes in 2019, and 12 to 40 minutes in 2029. This travel time saving would not only be of benefit to commuters and other private vehicles, but also commercial and freight vehicles transporting goods on the regional and state road network. Transport for NSW valued the travel time for freight movement at \$57.84 per vehicle per hour in 2013, demonstrating a significant benefit of reduced travel times for freight movement (TfNSW, 2013a). The NSW Freight and Ports Strategy estimated that a one per cent increase in freight efficiency saves the national economy \$1.5 billion (TfNSW, 2013b).

The reduced transit times would reduce operational costs associated with fuel and wages and improve safety by reducing the number of times trucks have to stop for traffic lights. It would also improve the efficiency of freight movements given the improvements in connections between the M1 Pacific Motorway with the Hills M2 Motorway, and beyond. 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. In order to boost productivity, grow the economy and create new jobs, improvements to the NSW urban road network needs to occur.

5.2.8 Cumulative impacts

Cumulative impacts to the local economy and businesses are most likely to result from the concurrent operation of the North West Rail Link (NWRL) in Hornsby, the Hills and Blacktown LGAs and the Epping to Thornleigh Third Track (ETTT). Cumulative impacts are likely to intensify the impacts identified above through any changes in traffic on Pennant Hills Road and the surrounding road network from transport mode shifts from private vehicles or freight to rail. This would intensify the impacts on amenity, accessibility and changes in passing trade highlighted above.

It is not anticipated that the NWRL would reduce vehicle traffic on Pennant Hills Road or the Pacific Highway and therefore would not impact passing trade.

The ETTT project is one of four projects that form the Northern Sydney Freight Corridor Program, an initiative to improve the capacity and reliability for freight trains on the main North Line between Sydney and Newcastle. As detailed in the technical working paper: traffic and transport (AECOM, 2014), it is likely that any future capacity increase as a result of the ETTT project would be taken up by the projected freight growth by 2031, and is unlikely to impact on the heavy vehicle movements on Pennant Hills Road.

As such, ETTT project may result in additional reduction in freight vehicles on Pennant Hills Road and the Pacific Highway as it would absorb some of the predicted increase in freight transport volumes. Any further reduction in road freight may intensify the impacts on amenity, accessibility and changes in passing trade highlighted in **Section 5.2.2.**

5.2.9 Summary of operational impacts

The project has the potential to change the volumes of traffic on Pennant Hills Road and the Pacific Highway. For Pennant Hills Road, this would reduce congestion at key locations along Pennant Hills Road. However, background traffic growth associated with local movements would mean that some intersections would be congested irrespective of the project. It would also remove a significant proportion of heavy vehicles that travel along Pennant Hills Road, which currently have considerable adverse impacts on local amenity. Reduced traffic would also likely result in lower travel times along the corridor, which may change the travel and shopping patterns of local residents and benefit local businesses.

Reduced traffic would improve access and connectivity for businesses and make it easier for businesses to make and receive deliveries, including local takeaway and home delivery establishments. This has the potential to reduce businesses costs, particularly fuel and labour costs. A decreased travel time for deliveries has the potential to increase demand for these businesses as their operations become more efficient.

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.

Operational expenditure was estimated to contribute a total of \$39 million in output, around \$9 million in household income, 121 FTE jobs and \$16 million of value added per year of operation.

Under the worst case scenario five (5) businesses would be acquired resulting in a loss of 25 FTE jobs. In addition, it has been estimated that there would be an annual reduction of around \$5.6 million in output and around 18 full-time equivalent jobs due to loss in passing trade

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6.0 Mitigation and Management Measures

6.1 Construction

The recommended measures to mitigate or manage impacts generated during the construction of the project are summarised in **Table 7**.

Table 7 Construction mitigation measures

Impact	Detail
Amenity	
Noise and vibration	Mitigation measures specific to construction noise and vibration can be found in section 7.2 of the environmental impact statement for this project.
Air quality	Mitigation measures specific to construction air quality can be found in Section 7.3 of the environmental impact statement for this project.
Traffic and access arrangements	
Accessibility	<p>Implement a community involvement plan to provide timely, regular and transparent information about changes to access and traffic conditions, details of future work programs and general construction progress throughout the construction phase of the project. Information to be provided in a variety of ways including letter box drops, media releases, internet site, signage and a hotline.</p> <p>Provision of appropriate signage to ensure motorists' understanding of access to local businesses adjacent to construction works.</p> <p>Mitigation measures specific to Traffic and Transport can be found in Section 7.1 of the environmental impact statement for this project.</p>
Parking	<p>Workers are to be directed to use parking at the Pioneer Avenue compound, public transport or parking facilities within construction compound sites to minimise the impact on public parking availability for customers and staff along the corridor.</p> <p>Monitor the need for time parking restrictions near the Trelawney Street compound.</p>
Business and economic issues	
Acquisition	Carry out the acquisition of property in accordance with the Roads and Maritime Land Acquisition Information Guide (Roads and Maritime, 2012) and under the terms of <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .
Other business impacts	<p>Maintain of a toll free number and website to enable business owners and/or operators to receive prompt responses to their concerns, access information and view assistance measures in place during construction related work.</p> <p>Maintain a business impact risk register to identify and manage the specific impacts associated with construction related works for individual businesses.</p> <p>Maintain and continue the business stakeholder forum during detailed design and throughout construction to ensure business concerns are addressed. Further information about consultation can be found in Chapter 6 of the environmental impact statement for this project.</p>

6.2 Operation

The recommended measures to mitigate or manage impacts generated during the operation of the project are summarised in **Table 8**.

Table 8 Operational mitigation measures

Impact	Detail
Amenity	
Noise and vibration	Mitigation measures specific to operational noise and vibration can be found in Section 7.2 of the environmental impact statement for this project.
Visual amenity	Mitigation measures specific to operational visual amenity impacts Section 7.5 of the environmental impact statement for this project.
Business and economic issues	
Acquisition	Carry out the acquisition of property in accordance with the Roads and Maritime's Land Acquisition Information Guide (Roads and Maritime, 2012) and under the terms of <i>Land Acquisition (Just Terms Compensation) Act 1991</i> .
Passing trade	Advertising and signage opportunities along the M1 Pacific Motorway and Hills M2 Motorway would be considered to inform motorists of businesses and services that can be accessed at the next exit.
Traffic and access arrangements	
Accessibility	<p>The traffic and access arrangements associated with the operation of the tunnel are expected to be primarily positive due to reduced traffic, particularly heavy vehicles. As such, there is unlikely to be any significant required mitigation measures.</p> <p>Any required changes to traffic and access arrangements would be supported by the provision of appropriate signage to ensure motorists understand the changes.</p> <p>Mitigation measures specific to traffic and transport can be found in Section 7.1 of the environmental impact statement.</p>

7.0 Conclusion

This report has identified and assessed the potential impacts to businesses associated with the construction and operation of the project. This assessment has been conducted with regard to the existing business environment, a survey of indirectly impacted businesses, an assessment of potential positive and negative impacts and an assessment of management and mitigation measures.

The project has aimed to minimise potential negative impacts through the project design.

During the construction of the project, there is the potential for a boost in the economy due to construction expenditure in the region. Local business would principally benefit from this expenditure through purchases made by construction businesses and associated workers to build and support the development of the project.

Around 1,250 jobs are expected to be created during the peak construction period of the project. Employment opportunities would grow in the region through the potential increase in business patronage and through the increase in demand for construction workers. The increase in demand for labour may increase wages in the region, particularly for construction workers who would be in high demand.

Amenity impacts during construction are anticipated to be limited as the majority of construction activity would occur underground. Amenity impacts are likely to be limited during construction to the northern and southern interchanges, along the Hills M2 Motorway and at compound sites. Noise and vibration impacts may occur from construction vehicles and from tunnelling where the tunnel passes under businesses.

As the project would be largely constructed underground in tunnel, potential disruptions to property accesses or the performance of the road network would be limited to surface works during construction of the northern and southern interchanges, the establishment and use of ancillary construction compounds and due to increased congestion and/or reduced travel speeds and reduced traffic lanes.

It is anticipated that five (5) businesses would require acquisition due to the construction and operation of the project. These properties would be acquired under the Road and Maritime's Land Acquisition Information Guide (Roads and Maritime, 2012) and under the terms of *Land Acquisition (Just Terms Compensation) Act 1991*. An additional property would be acquired for temporary use during the construction period. The use of this land would not preclude its use for industrial purposes following the completion of construction.

It has been identified that businesses trading as service stations, takeaway restaurants and accommodation providers along Pennant Hills Road and the Pacific Highway between Hornsby and the interchange of the Pacific Highway and Mona Vale Road at Pymble have the potential to be impacted by a reduction of passing trade. Under the worst case scenario this annual reduction would be in the magnitude of around \$5.8 million and around 18 full-time equivalent jobs, or four per cent loss in output and employment in businesses reliant on passing trade.

The project is expected to significantly benefit freight transport in New South Wales. The project provides a solution to the increased congestion and decreased travel times along Pennant Hills Road, which forms part of the National Road Network. Road freight productivity and commuter efficiency is expected to increase, potentially boosting productivity, economic growth and creating new jobs. The reduced transit times would also reduce operational costs associated with fuel and wages and improve safety by reducing the number of times trucks have to stop for traffic lights. Improving connections between markets promotes the efficient movement of goods through the supply chain and ultimately has the potential to enhance productivity.

Where necessary, a number of mitigation measures have been proposed to minimise any impacts that would be associated with the construction and operation of the project.

Overall the positive impacts on businesses and the economic benefit of the project is expected to outweigh any negative impacts that cannot be satisfactorily mitigated.

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Appendix A

Business Questionnaire



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M1-M2 Business Survey Interview Proforma

As part of the M1-M2 (formerly the F3-M2) proposal, this survey is being carried out on behalf of Transurban. The purpose of the survey is to understand business practices within the project area and determine the potential impacts (both positive and negative) resulting from changes in through traffic to Pennant Hills Road and the Pacific Highway. For further details on the M1-M2 project, please see the community update provided with this survey or visit the project website at www.rms.nsw.gov.au/m1tom2.

Business Name: _____

Interviewee's Name: _____

Address: _____

Status (please circle): Owner / Manager / Employee Other _____

Contact address: _____

(if different from above) _____

Contact phone number: _____

Interview date and time: _____

Location (please circle): At premises / Telephone

Other (please state): _____

Interviewer(s): _____

1) Please describe the main activities of your business:

2) How many persons are employed (including family members) in operating this business?

Full Time

Part Time

Casual

3) What is the area of retail floor space in your business premises (square metres)?

4) Please indicate the type of current parking arrangements and number of spaces available to your customers:

On-street parking

Private car park

Public (shared) car park

5) Please indicate the current operational businesses hours of the business:

6) Would you please rate how dependent your business operations are on the through traffic (ie. Traffic passing to and from the M1 Pacific Motorway, or Hills M2 Motorway)?

Very Dependent

Not Very Dependent

5

4

3

2

1

(Please circle appropriate rating)

7) Can you please estimate approximately what percentage of your current annual turnover is derived from passing through traffic (ie. Traffic passing to and from the M1 Pacific Motorway, or Hills M2 Motorway)? _____%

8) Do you have any additional comments in relation to the potential changes to your business as a result of the project (ie. Impact on local traffic trade, accessibility of business, amenity)?

☐ I would like to register for community updates on the Project

Appendix B

Business Indicator Tables

Appendix B Business Indicator Tables

Table B-1 Labour force status (Place of work)

Labour force status	West Pennant Hills (SA2)	Pennant Hills – Cheltenham (SA2)	Hornsby- Waitara (SA2)	Normanhurst-Thornleigh-Westleigh (SA2)	Wahroonga – Warrawee (SA2)	Turrumurra (SA2)	Pymble (SA2)	Study area	Hornsby LGA	New South Wales
Worked Full-time	71%	54%	57%	59%	50%	44%	66%	57%	56%	65%
Worked Part-time	24%	42%	38%	36%	46%	51%	30%	38%	39%	30%
Away from work	4%	4%	4%	4%	4%	4%	3%	4%	4%	4%
Hours worked not stated	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Total	2,908	4,849	14,514	4,942	5,211	3,406	5,309	41,139	41,501	3,033,526

Source: ABS (2012), 2011 Census of Housing and Population, Place of Work

Table B-2 Industry of employment (Place of work)

Industry	West Pennant Hills (SA2)	Pennant Hills - Cheltenham (SA2)	Hornsby- Waitara (SA2)	Normanhurst -Thornleigh- Westleigh (SA2)	Wahroonga - Warrawee (SA2)	Turrumurra (SA2)	Pymble (SA2)	Study area	Hornsby LGA	New South Wales
Agriculture/Forestry/Fishing	3%	0%	0%	0%	0%	0%	0%	0%	1%	2%
Mining	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
Manufacturing	1%	2%	8%	12%	2%	2%	6%	6%	8%	9%
Electricity/Gas/Water/Waste Services	0%	0%	1%	0%	0%	0%	1%	0%	1%	1%
Construction	5%	4%	3%	8%	3%	6%	6%	4%	6%	7%
Wholesale Trade	2%	2%	5%	5%	1%	3%	12%	5%	5%	5%
Retail Trade	3%	18%	17%	11%	4%	13%	5%	12%	14%	11%
Accommodation/Food Services	2%	5%	6%	13%	4%	5%	3%	6%	7%	7%
Transport/Postal/Warehousing	1%	1%	3%	3%	0%	1%	4%	2%	3%	5%
Information Media/Telecommunications	1%	2%	1%	1%	2%	2%	1%	1%	1%	2%
Financial/Insurance Services	2%	3%	2%	1%	2%	3%	3%	2%	3%	5%
Rental/Hiring/Real Estate Services	2%	2%	1%	2%	2%	3%	3%	2%	2%	2%
Professional/Scientific/Technical Services	63%	9%	6%	12%	7%	12%	18%	13%	8%	8%
Administrative/Support Services	3%	2%	2%	3%	2%	3%	3%	2%	2%	3%
Public Administration and Safety	2%	2%	5%	2%	0%	1%	4%	3%	3%	6%
Education/Training	2%	20%	10%	12%	21%	13%	15%	13%	13%	8%

Industry	West Pennant Hills (SA2)	Pennant Hills - Cheltenham (SA2)	Hornsby- Waitara (SA2)	Normanhurst -Thornleigh- Westleigh (SA2)	Wahroonga - Warrawee (SA2)	Turrumurra (SA2)	Pymble (SA2)	Study area	Hornsby LGA	New South Wales
Health Care/Social Assistance	6%	17%	22%	10%	45%	27%	8%	20%	16%	12%
Arts/Recreation	0%	2%	1%	1%	1%	1%	1%	1%	1%	2%
Other Services	2%	6%	5%	4%	3%	4%	3%	4%	5%	4%
Inadequately described/Not stated	1%	1%	1%	1%	1%	1%	2%	1%	1%	1%
Total Employed Persons	2,908	4,849	14,515	4,944	5,207	3,406	5,308	41,137	41,501	3,033,526

Source: ABS (2012), 2011 Census of Housing and Population, Place of Work

Table B-3 Total personal income (Weekly) (Place of work)

Total weekly personal income	West Pennant Hills (SA2)	Pennant Hills – Cheltenham (SA2)	Hornsby- Waitara (SA2)	Normanhurst- Thornleigh- Westleigh (SA2)	Wahroonga – Warrawee (SA2)	Turrumurra (SA2)	Pymble (SA2)	Study area	Hornsby LGA	New South Wales
Negative/ Nil income	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
\$1-\$199	2%	9%	8%	9%	6%	9%	5%	7%	9%	5%
\$200-\$299	2%	5%	5%	5%	5%	6%	3%	5%	5%	4%
\$300-\$399	2%	6%	6%	6%	5%	8%	4%	6%	6%	6%
\$400-\$599	5%	12%	13%	12%	12%	14%	7%	11%	13%	12%
\$600-\$799	6%	12%	15%	13%	13%	15%	9%	13%	14%	15%
\$800-\$999	8%	10%	13%	11%	12%	10%	11%	11%	12%	13%
\$1,000-\$1,249	11%	11%	12%	12%	11%	10%	12%	12%	12%	12%
\$1,250-\$1,499	11%	8%	8%	8%	9%	6%	10%	8%	8%	9%
\$1,500 - \$1,999	22%	13%	10%	12%	13%	10%	15%	12%	11%	11%
\$2,000 or more	30%	12%	8%	11%	12%	9%	22%	13%	9%	11%
Personal income not stated	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
Total	2,249	4,847	14,515	4,943	5,208	3,407	5,308	40477	41,501	3,033,526

Source: ABS (2012), 2011 Census of Housing and Population, Place of Work

Table B-4 Residential location of workers (Top 5 in study area)

Residential location of workers (LGA)	Hornsby – Waitara (SA2)	Normanhurst - Thornleigh – Westleigh (SA2)	Pennant Hills – Cheltenham (SA2)	Pymble (SA2)	Turramurra (SA2)	Wahroonga – Warrawee (SA2)	West Pennant Hills (SA2)	Study area
Hornsby	10%	13%	13%	7%	12%	12%	11%	11%
Ku-ring-gai	5%	4%	3%	7%	13%	8%	3%	6%
The Hills	7%	8%	11%	5%	7%	8%	12%	8%
Gosford	9%	7%	7%	7%	8%	9%	4%	7%
Parramatta	5%	5%	8%	4%	5%	5%	7%	6%
Blacktown	5%	7%	7%	4%	5%	3%	6%	5%
Wyong	7%	4%	4%	5%	4%	6%	3%	5%
Ryde	4%	4%	4%	4%	4%	4%	5%	4%
Other	48%	48%	43%	56%	43%	47%	50%	48%

Source: BTS (2012), 2011 Journey to Work Data

Table B-5 Journey to work mode (Place of work)

Mode	West Pennant Hills (SA2)	Pennant Hills – Cheltenham (SA2)	Hornsby – Waitara (SA2)	Normanhurst - Thornleigh – Westleigh (SA2)	Wahroonga – Warrawee (SA2)	Turramurra (SA2)	Pymble (SA2)	Study Area
Train	8%	15%	21%	14%	14%	17%	19%	16%
Bus	3%	3%	2%	2%	3%	1%	2%	2%
Vehicle Driver	48%	42%	34%	50%	42%	47%	44%	43%
Vehicle Passenger	6%	10%	10%	8%	8%	8%	8%	8%
Walked Only	1%	1%	2%	1%	4%	1%	1%	2%
Other	8%	7%	12%	10%	6%	8%	11%	9%
Worked at home or did not go to work	26%	22%	19%	16%	24%	18%	14%	20%

Source: BTS (2012), 2011 Journey to Work Data

Table B-6 Businesses by employment sizes

Employing businesses	West Pennant Hills (SA2)	Pennant Hills – Cheltenham (SA2)	Hornsby – Waitara (SA2)	Normanhurst - Thornleigh – Westleigh (SA2)	Wahroonga – Warrawee (SA2)	Turramurra (SA2)	Pymble (SA2)	Study area
Non Employing	912	1,231	1,690	929	1,269	1,155	1,271	8,457
1-4 employees	438	601	863	503	583	603	601	4,192
5-19 employees	83	176	362	159	130	129	151	1,190
20-199 employees	32	44	106	41	31	29	52	335
More than 200 employees	3	0	0	6	3	0	12	24
Total	1,468	2,052	3,021	1,638	2,016	1,916	2,087	14,198

Source: ABS (2013), Counts of Australian Businesses, including entries and exits, June 2012

Table B-7 Businesses by industry, 2012

Industry	West Pennant Hills (SA2)	Pennant Hills – Cheltenham (SA2)	Hornsby – Waitara (SA2)	Normanhurst - Thornleigh – Westleigh (SA2)	Wahroonga – Warrawee (SA2)	Turramurra (SA2)	Pymble (SA2)	Study area
Agriculture/Forestry/Fishing	23	46	22	24	60	51	53	279
Mining	0	3	9	0	0	6	3	21
Manufacturing	31	60	135	58	27	42	45	398
Electricity/Gas/Water/Waste Services	0	0	3	0	3	3	3	12
Construction	175	189	297	234	143	153	162	1,353
Wholesale Trade	88	72	187	85	73	53	78	636
Retail Trade	84	112	221	90	95	104	92	798
Accommodation/Food Services	41	81	108	28	37	40	43	378
Transport/Postal/Warehousing	45	62	127	45	18	32	34	363
Information Media/Telecommunications	19	27	38	30	31	34	29	208
Financial/Insurance Services	164	207	242	147	327	246	282	1,615
Rental/Hiring/Real Estate Services	207	242	298	157	249	223	292	1,668
Professional/Scientific/Technical Services	300	470	586	415	474	532	528	3,305
Administrative/Support Services	44	81	145	78	78	64	67	557
Public Administration and Safety	3	0	8	6	3	3	10	33
Education/Training	29	33	58	31	44	40	40	275
Health Care/Social Assistance	118	224	241	64	242	165	187	1,241
Arts/Recreation	8	26	31	15	23	35	41	179
Other Services	44	50	160	66	34	43	38	435
Inadequately described/Not stated	45	67	105	65	55	47	60	444
Total	1,468	2,052	3,021	1,638	2,016	1,916	2,087	14,198

Source: ABS (2013), Counts of Australian Businesses, including entries and exits, June 2012

Table B-8 Businesses by turnover, 2012

Business turnover	West Pennant Hills (SA2)	Pennant Hills – Cheltenham (SA2)	Hornsby – Waitara (SA2)	Normanhurst - Thornleigh – Westleigh (SA2)	Wahroonga – Warrawee (SA2)	Turramurra (SA2)	Pymble (SA2)	Study area
Zero to \$50,000	539	690	884	507	687	661	669	4,637
\$50,000 to less than \$100,000	211	346	520	303	338	322	352	2,392
\$100,000 to less than \$200,000	266	358	512	297	321	339	318	2,411
\$200,000 to less than \$500,000	262	383	514	271	389	340	404	2,563
\$500,000 to less than \$2,000,000	158	217	429	181	236	195	242	1,658
More than \$2,000,000	32	58	162	79	45	59	102	537
Total	1,468	2,052	3,021	1,638	2,016	1,916	2,087	14,198

Source: ABS (2013), Counts of Australian Businesses, including entries and exits, June 2012

Table B-9 Industry value add and gross regional product, Hornsby LGA, 2012

Industry	Hornsby	Sydney SD	NSW
Agriculture, forestry and fishing	\$17.6	\$432.5	\$6,764.0
Mining	\$16.7	\$2,265.7	\$14,436.0
Manufacturing	\$523.0	\$24,360.9	\$35,154.0
Electricity, gas, water and waste services	\$99.3	\$6,782.2	\$11,834.0
Construction	\$350.2	\$15,051.5	\$22,403.0
Wholesale trade	\$320.8	\$17,030.8	\$20,321.0
Retail trade	\$387.1	\$12,674.6	\$18,729.0
Accommodation and food services	\$187.6	\$8,376.1	\$13,052.0
Transport, postal and warehousing	\$238.6	\$16,285.0	\$21,420.0
Information media and telecommunications	\$116.3	\$16,749.5	\$18,314.0
Financial and insurance services	\$424.2	\$57,956.4	\$64,316.0
Rental, hiring and real estate services	\$151.3	\$8,567.5	\$11,236.0
Professional, scientific and technical services	\$489.5	\$28,787.4	\$33,649.0
Administrative and support services	\$162.0	\$10,311.1	\$13,182.0
Public administration and safety	\$140.2	\$13,361.1	\$20,118.0
Education and training	\$483.9	\$13,149.0	\$20,170.0
Health care and social assistance	\$552.4	\$17,611.7	\$27,232.0
Arts and recreation services	\$56.3	\$3,334.5	\$4,266.0
Other services	\$152.6	\$5,658.2	\$8,292.0
Ownership of dwellings	\$654.7	\$27,319.1	\$36,675.0
Gross Sector Value Add	\$5,524.3	\$306,064.9	\$421,563.0
<i>Taxes Less Subsidies</i>	\$441.8	\$24,475.7	\$33,712.0
Gross Regional Product	\$5,966.0	\$330,540.6	\$455,275.0

Source: AECOM (2013), AECOM In-house GRP Model



Appendix L

Technical working paper:
Non-Aboriginal heritage

NorthConnex

Building for the future



Technical working paper: Non-Aboriginal heritage

Technical Working Paper: Non-Aboriginal Heritage Assessment

NorthConnex

Client: Roads and Maritime Services

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Quality Information

Document Technical Working Paper: Non-Aboriginal Heritage Assessment

Ref 60300684

Date 15-May-2014

Prepared by Dr Darran Jordan

Reviewed by Luke Kirkwood

Revision History


Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	16-Apr-2014	Final for Issue	Scott Jeffries Associate Director - Environment	Signed
2	15-May-2014	Final	Scott Jeffries Associate Director - Environment	

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Glossary of terms and abbreviations

Term	Meaning
Bullnosed	A rounded edge or corner.
Construction footprint	The extent of surface disturbance required for construction of the project.
EIS	Environmental impact statement.
Federation	Australian Federation architecture, dating predominantly between 1890 and 1915.
Heritage Branch	NSW Heritage Branch within the NSW Office of Environment and Heritage.
Hills M2 Motorway integration works	The works to join the project to the Hills M2 Motorway extending from the southern interchange to Windsor Road.
LEP	Local Environmental Plan.
Main alignment tunnels	The two underground tunnels forming the principal carriageways of the project.
Northern interchange	The connections of the project with the M1 Pacific Motorway (formerly known as the F3 Freeway), Pennant Hills Road and the Pacific Highway. For the purpose of this report, the term also captures the M1 Pacific Motorway tie-in works, and the construction compounds that would support the construction of the northern interchange.
OEH	NSW Office of Environment and Heritage.
Off-ramp	A section of road which allows vehicles to exit the motorway or project.
On-ramp	A section of road which allows vehicles to enter the motorway or project.
Portal	Where a tunnel emerges to the surface, being the entrance or exit of the main alignment tunnels, off-ramps or on-ramps.
(The) project	NorthConnex
Preferred project corridor	A zone on the surface equal to a distance of 50 metres from the outer edge of the underground tunnels.
Roads and Maritime	Roads and Maritime Services.
SEPP	State Environmental Planning Policy.
Site establishment works	Preliminary works carried out prior to the commencement of construction, including: <ul style="list-style-type: none"> - installation of environmental controls; - demolition of existing structures; - vegetation clearing; and - establishment of temporary construction facilities.

Term	Meaning
Southern interchange	The connections of the project with the Hills M2 Motorway and Pennant Hills Road. For the purpose of this report, the term also captures the construction compounds that would support the construction of the southern interchange.
Study area	<p>As defined in Section 1.3 of this report the study area for this assessment consists of:</p> <ul style="list-style-type: none">- The preferred tender design, as summarised in Section 1.1 of this report, and as detailed further in Chapter 5 of the environmental impact statement for the project.- The preferred project corridor.- The construction footprint of the project and properties within 50 metres from the construction footprint.
Tie-in works	The works to join the project to existing roads, such as the M1 Pacific Motorway.
Ventilation facilities	Facilities for the mechanical removal of air from the main alignment tunnels, or mechanical introduction of air into the tunnels.

Executive Summary

Roads and Maritime Services (Roads and Maritime) is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney (the project).

This report is an assessment of possible heritage impacts (both direct and indirect) on listed heritage items within proximity of the proposed works. This assessment has been undertaken in response to the Director-General's environmental assessment requirements. The study area for this assessment has been informed by the operational and construction footprint of the project, the preferred project corridor, ancillary facilities associated with construction and operation, and the location and construction methodology of underground infrastructure (such as the main alignment tunnels).

Within the study area, 62 heritage items would be directly or indirectly impacted by the project. In some instances, an item would be directly and indirectly impacted by the project. Of the 62 heritage items:

- One item would be fully and directly impacted with the removal of two Canary Island Palms (Hornsby LEP reference: I762) located within a property that would be partially acquired. Feasible and reasonable options would be investigated during detailed design to relocate the two Canary Island Palms, however, the impacts to this item are likely to be significant
- Two items would be partially and directly impacted with
 - The demolition of structures associated with the Thornleigh Maltworks site (Hornsby LEP reference: A66). Feasible and reasonable options have been investigated during design of the project to date with the aim of retaining the original industrial structure associated with this site, however, the impacts to the overall site complex are likely to be significant.
 - Impacts to the curtilage of heritage listed street trees at Woonona Avenue, Wahroonga (Hornsby LEP reference: I769). Feasible and reasonable options would be investigated to avoid or minimise the impact. If it is necessary to remove the trees, this would have some impact to the heritage value of the item. This impact could be mitigated through sympathetic plantings of similar species through revegetation efforts.
- Two heritage conservation areas would be partially and directly impacted, being the North Wahroonga heritage conservation area (Hornsby LEP reference: C2), and the Beecroft-Cheltenham heritage conservation area (Hornsby LEP reference: C8). Landscaping of the project within these areas would minimise the potential impacts. The overall heritage value of the heritage conservation areas would not be significantly impacted by the project.
- Eleven items would be potentially directly impacted due to construction vibration from surface works. These impacts are anticipated to have a negligible to minor risk of affecting the value of the heritage items (*Ku-ring-gai Planning Scheme Ordinance 1971* reference: I897, I898, I900, I901 and I902¹, *Draft Ku-ring-gai Local Environmental Plan 2013* reference: I855, and Hornsby LEP reference: I767, I750, I770, I771, and I791). The degree of impact to these items is anticipated to be minor to negligible. The overall heritage value of the heritage items would not be significantly impacted by the project.
- Forty-four items would be potentially directly impacted due to vibration, settlement and groundwater drawdown as a result of tunnelling works. These items are primarily located within the preferred project corridor and include items consisting of houses of local significance. Impacts to these items are anticipated to be minor to negligible. Two of these items would also be potentially directly impacted by construction vibration due to surface works. The overall heritage value of the heritage items would not be significantly impacted by the project.

Of the 62 heritage items, 21 items may also be indirectly impacted by the project, due to temporary and / or permanent visual impacts. Of the 21 items, 19 items would also be directly impacted as outlined above. Impacts to the heritage items as a result of visual effects are anticipated to be minor to negligible. The overall heritage value of the heritage items would not be significantly impacted by the project.

¹ For the purpose of this report, heritage item identification numbers for listed items in Ku-ring-gai local government area have been referred to using the identification numbers assigned to the items under *Draft Ku-ring-gai Local Environmental Plan 2013* because the *Ku-ring-gai Planning Scheme Ordinance 1971* does not include equivalent identification numbers.

There is also the potential for direct impacts due to potential eligibility for at-property acoustic treatment. Three of the 62 items have also been identified as being potentially eligible for acoustic treatment. This would be confirmed during detailed design, in consultation with landowners, and with consideration of potential impacts to heritage values.

The cumulative impact of the project to heritage values would be minimal owing to the majority of the heritage items only being potentially impacted by the project. These potential impacts are to be managed to reduce the risk of actual impacts to the identified items.

The potential impacts on heritage items due to ground movement and construction vibration would be confirmed during detailed design. If required, mitigation and management measures to minimise impacts would be investigated, and monitoring would be carried out at properties identified as being above recommended criteria. Property dilapidation surveys would also be carried out for all heritage items located within the preferred project corridor or properties within recommended safe working setbacks (in the case of potential vibration impacts).

Detailed mitigation and management measures would be developed for each heritage item directly impacted by the project once final disturbance areas have been identified through detailed design. These mitigation and management measures would be included in the construction environmental management plan(s) for the project.

1.0 Introduction

1.1 Project description

Roads and Maritime Services (Roads and Maritime), is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the Hills M2 Motorway at West Pennant Hills in northern Sydney (the project) (refer to **Figure 1**). The project would be located within the Hornsby, Ku-ring-gai and Hills local government areas.

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.

Construction of the project is anticipated to commence in early 2015 and is expected to take around four years to complete.

On 18 October 2013, the project was declared by the Minister for Planning and Infrastructure to be State significant infrastructure and Critical state significant infrastructure.

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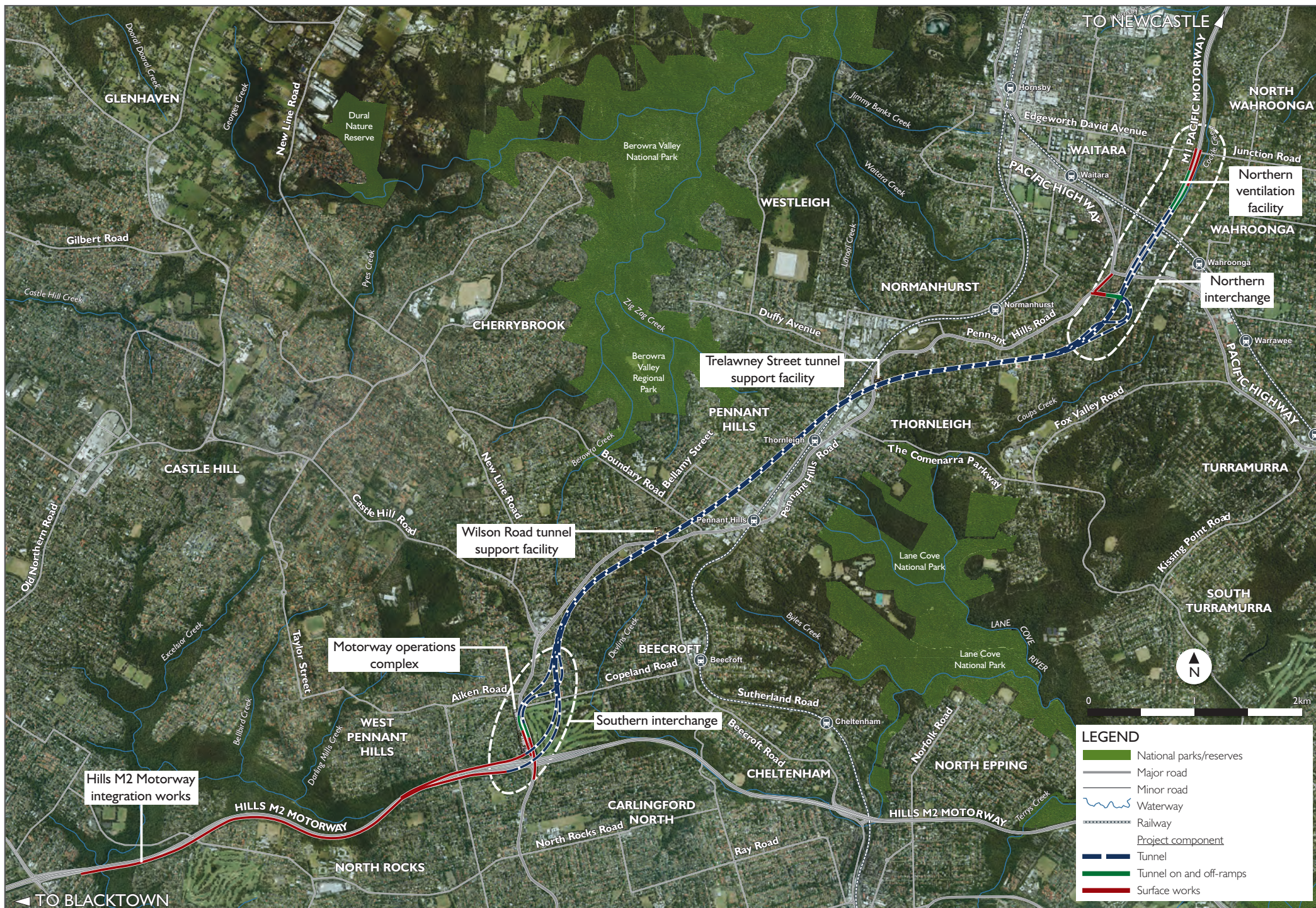


Figure 1 The project

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1.2 Purpose of this report

The Director-General's environmental assessment requirements (DGRs) for the project were issued on 29 October 2013 and re-issued with amendments on 11 April 2014, which has informed the preparation of the environmental impact statement. The DGRs include the following requirement specific to potential impacts on historic cultural heritage:

An assessment of direct and/or indirect impacts to state and local heritage. Where impacts to State or locally significant historic heritage is identified, the assessment shall:

- *Outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the guidelines in the NSW Heritage Manual (Heritage Office and Department of Urban Affairs and Planning 1996).*
- *A statement of heritage impact for all heritage items/areas to be impacted (including significance assessment); and*
- *Consider the impacts from vibration, demolition, altered historic arrangements and access and architectural noise treatment.*

This technical report presents the assessment of the potential impacts on historic heritage as a result of the project, as part of the environmental impact statement for the project.

1.3 Study area

The study area for this assessment has been informed by:

- The preferred tender design, as summarised in **Section 1.1** of this report, and as detailed further in Chapter 5 of the environmental impact statement for the project.
- The preferred project corridor, which represents a zone on the surface equal to a distance of 50 metres from the outer edge of excavations for the main alignment tunnels (underground).
- The construction footprint of the project at the surface and properties within 50 metres from the construction footprint. The construction footprint represents the area that would be physically impacted by construction works, including construction ancillary facilities.
- The construction methodology.

1.4 Limitations

This assessment targeted individual listed heritage items as indicated through maps and location data provided in relevant heritage databases and registers. Potential impacts on heritage items have been identified through an initial, conservative evaluation of potential construction and operational impacts.

Access to properties and internal assessments of each listed heritage items was not possible at the time of the assessment. Where possible, heritage items were inspected from the nearest publicly-accessible location(s). Visual inspections were limited in some cases where elements such as gates, fences and vegetation obscured the item.

Mitigation and management measures recommended within this report include the completion of a ground settlement assessment during detailed design to confirm the predicted impacts on heritage structures and to identify additional feasible and reasonable mitigation measures. Existing condition surveys would also be completed prior to the commencement of construction for heritage items within the preferred project corridor or that have been identified during detailed design to be within recommended safe working distances to surface works. At that time, internal condition assessments would also be undertaken. These are discussed further in **Chapter 9.0**

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2.0 Historical context

This chapter provides a brief overview of the area to contextualise the assessment of potential heritage impacts associated with the project. It is not intended to be a detailed history of the north western Sydney region.

2.1 Aboriginal history

Archaeological research at Parramatta (around five kilometres south of the study area) suggests that Aboriginal occupation of this part of Sydney commenced at least 35,000 years Before Present (B.P.) (Attenbrow, 2010). Like other areas across the continent, the Aboriginal economy of this region was probably based on the exploitation of a range of terrestrial and riverine food resources, and the use of local stone, wood and other plant materials for the manufacture of tools and other items (Attenbrow, 2010).

From 18,000 B.P. rising sea levels significantly reduced land area in the Sydney region, and likely prompted a general westward movement of peoples, along with changes in group organisation and economic strategies. It is at this time that the study area first appears to have been occupied, with a living site in the Bidjigal Reserve (SF2) dated to at least 11,800 B.P. (Attenbrow, 2010). Evidence from this and similar sites suggests the use of local volcanic tuff for stone tools and, from 5,000 B.P., the development of new tool technologies, including backed artefacts used primarily for working bone and wood (Attenbrow, 2010).

Stone tool kits continued to expand over the subsequent millennia, suggesting a growing emphasis on wood and bone working, while the use of new, imported raw materials point to the establishment of long distance trade networks. By 1,500 B.P. there is evidence of growing territoriality and regional differences, with coastal dwellers favouring tools of bone and shell, while groups in and around the study area continued to exploit their abundant stone resources for tool manufacture (Attenbrow, 2010).

When the first colonists arrived in the Sydney region in 1788, they found a land occupied by some 5,000 Aboriginal people and they met with increasing resistance as they pushed inland. Pemulwuy, an important leader in the Aboriginal resistance movement, orchestrated a series of raids in and around the study area in the late 18th century, and is reputed to have based himself in what is now the Bidjigal Reserve that abuts the southern extent of the study area. While there were fatalities on both sides of this frontier conflict, Aboriginal deaths far outnumbered those of settlers. This, added to the impact of introduced diseases and the environmental changes associated with land clearing, saw Aboriginal life change drastically by the 1820s (Attenbrow, 2010).

2.2 Settlement

Colonial settlement of the study area was driven principally by convict timber-getters seeking out the blue gums, iron barks, cedar and mahogany available in the Western Sydney forests (Kass, 1993). Seeking to support this industry, Governor Macquarie established a government sawmill on the northern edges of the Field of Mars Common (present day Pennant Hills) in 1816. The bullock road established to link this sawmill with Ermington Wharf to the south became the Pennant Hills Road that lies within the study area (Kass, 1993).

Agriculturalists and other primary producers followed in the wake of the timber getters, establishing small holdings on the cleared land. The area was soon discovered to be excellent for the production of stone and citrus fruit, and became Sydney's main orcharding district. Small villages were subsequently established at Pennant Hills, Hornsby and Wahroonga to support the farmers and their workers (Kass, 1993).

2.3 Early 20th Century

The trajectory for the study area's 20th century history was set when Homebush to Waratah railway line was established in 1886. This railway line linked the study area to the centre of Sydney, and what had once been an isolated rural area suddenly became an easy commute from the city. The elevated, picturesque nature of the study area added to its attractions, and it was soon a popular residential retreat. Orchards were quickly replaced by the grand houses of the colonial elite, as well as more modest housing estates for workers, including the Bundarra Estate which straddles the study area (Kass, 1993) (Davies, 2010).

The progress of the railway and the associated population increase was accompanied by industrial development, and a number of industries were established in the study area in the early 20th century. This included the building of sawmills, brickworks and maltworks, as well as the establishment of quarries to service the railway and, from the 1920s, the road builders (Kass, 1993). Travelling overland by horse or bullock wagon was a slow and laborious process in colonial NSW and, as a consequence, river and rail transport was used by preference and road networks were limited. This changed with the introduction of the motorcar in the early 20th century and, by the 1920s, there was growing demand for an improved road system. One of the main priorities was a road linking Sydney with its northern regions, and the first stage of this road was constructed between Pennant Hills Road in Hornsby and Peat's Ferry. Opened in the late 1920s, the road was originally called the Great North Road, but was soon renamed the Pacific Highway (Kass, 1993). Both Pennant Hills Road and the Pacific Highway were repeatedly upgraded in the ensuing years to cater for the ever increasing traffic load (Kass, 1993).

2.4 Post World War II

Building and development in and around the study area had slowed during the depression and the ensuing war years but, in 1945, work resumed apace. Remaining rural land and larger residential estates were further subdivided to provide more housing, with both private enterprise and Housing Commission of NSW developing new estates (Kass, 1993). With the increasing population came a growing number of service and commercial enterprises, including one of the first major shopping malls in suburban Sydney, constructed at Hornsby by the Westfield Group in 1961.

Increasing pressure on the road system between Sydney and Newcastle saw the establishment of a new freeway through the second half of the 20th century. Beginning with an upgrade of a section of the Pacific Highway, the 'F3 Freeway' gradually expanded to link the road systems of Sydney and Newcastle, with the section through the study area in Wahroonga opening in 1989. Now renamed the 'M1 Pacific Motorway', the road has been continually upgraded and widened.

2.5 Present Day

The study area covers a populous residential and commercial area in north western Sydney, and supports the main road infrastructure linking Sydney to the Central Coast, Newcastle and Hunter region.

3.0 Statutory controls

A number of planning and legislative documents govern how heritage is managed in NSW and Australia. The following section provides an overview of the requirements under each as they apply to the project.

3.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth) took effect on 16 July 2000.

Under Part 9 of the EPBC Act, any action that is likely to have a significant impact on a matter of National Environmental Significance (known as a controlled action under the Act), may only progress with approval of the Commonwealth Minister for the Environment. An action is defined as a project, development, undertaking, activity (or series of activities), or alteration. An action will also require approval if:

- it is undertaken on Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land; or
- it is undertaken by the Commonwealth and will have or is likely to have a significant impact.

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and non-Aboriginal historic cultural heritage items. Under the EPBC Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE). While the RNE has been suspended and is no longer a statutory list, it remains available as an archive.

The heritage registers mandated by the EPBC Act have been consulted and there are no heritage items listed on these registers within the study area.

3.2 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) provide the framework for environmental planning in NSW. They include provisions to ensure that developments and activities that have the potential to impact on the environment are subject to detailed assessment and provide opportunity for public involvement. In NSW, environmental impacts are interpreted as including impacts on cultural heritage.

Roads and Maritime is seeking approval for the project under Part 5.1 of the EP&A Act. The project has been declared to be State significant infrastructure and critical State significant infrastructure.

The following Local Environmental Plans (LEPs), Planning Scheme Ordinances and draft LEPs apply to the preferred project corridor:

- *Hornsby Local Environment Plan 2013* (Hornsby LEP).
- *The Hills Local Environmental Plan 2012* (The Hills LEP).
- *Ku-ring-gai Planning Scheme Ordinance 1971*, as amended (Ku-ring-gai Planning Ordinance).
- *Draft Ku-ring-gai Local Environmental Plan 2013* (Draft Ku-ring-gai LEP)

These instruments set out objectives for conservation and protection of historic heritage within each local government area. Each instrument also provides a list of heritage items in each local government area.

3.3 Heritage Act 1977

The *Heritage Act 1977* was enacted to conserve the environmental heritage of NSW. Under section 32 of the *Heritage Act 1977*, places, buildings, works, relics, moveable objects or precincts of heritage significance are protected by means of either Interim Heritage Orders (IHO) or by listing on the State Heritage Register (SHR). Items that are assessed as having State heritage significance can be listed on the SHR by the Minister for the Environment on the recommendation of the Heritage Council.

Archaeological relics (any relics that are buried) are protected by the provisions of section 139 of the *Heritage Act 1977*. Under this section it is illegal to disturb or excavate any land knowing or suspecting that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed. In such cases, an excavation permit under section 140 of the *Heritage Act 1977* is required. No formal listing is required for archaeological relics; they are automatically protected if they are of local significance or higher.

Approvals under section 139 of the *Heritage Act 1977* are not required for a State Significant Infrastructure project approved under Part 5.1 of the EP&A Act by virtue of section 115ZG of the EP&A Act. However, the impact on heritage items as a result of the project has been addressed through this assessment report.

Proposals to alter, damage, move or destroy places, buildings, works, relics, moveable objects or precincts protected by an IHO or listed on the SHR require an approval under section 60 of the *Heritage Act 1977*. Demolition of whole buildings will not normally be approved except under certain conditions (section 63). Some of the sites listed on the SHR or on LEPs may either be 'relics' or have relics associated with them. In such cases, a section 60 approval is also required for any disturbance to relics associated with a listed item.

Under section 170 of the *Heritage Act 1977*, NSW government agencies are required to maintain a register of heritage assets. The register places obligations on the agencies, but not on non-government proponents, beyond their responsibility to assess the impact on surrounding heritage items.

4.0 Methodology

This assessment has followed the NSW Heritage Office publications *Assessing Historical Significance*, *Assessing Significance for Historical Archaeological Sites and Relics* (NSW Heritage Branch, 2009) and *Statements of Heritage Impact* (NSW Heritage Office, 2002). Further guidance and requirements for this assessment have been detailed in the DGRs.

The assessment of non-Aboriginal heritage has included the following tasks to address relevant aspects of the NSW Heritage Branch guidelines:

- A search of relevant historic heritage registers has been conducted, including:
 - World Heritage List (World Heritage Committee, UNESCO).
 - National Heritage List (Australian Heritage Council).
 - Commonwealth Heritage List (Australian Heritage Council).
 - NSW State Heritage Register (NSW Heritage Branch, OEH).
 - NSW State Heritage Inventory (NSW Heritage Branch, OEH).
 - NSW section 170 Heritage and Conservation Registers compiled by Roads and Maritime, Sydney Water, Sydney Trains and Transport for NSW.
 - Hornsby LEP, The Hills LEP, Ku-ring-gai Planning Scheme Ordinance, and the Draft Ku-ring-gai LEP.
 - National Trust Listings.
 - Register of the National Estate (Australian Heritage Council) (non-statutory).
- A review of historical parish maps and plans to determine any potential for archaeological heritage items.
- Mapped historic heritage listings have been assessed to ascertain properties within the study area with possible direct and indirect impacts during construction and operation of the project:
 - for construction, it is anticipated that direct impacts may include surface works and/ or land acquisition, and indirect impacts may include vibration or settlement generated by construction activity at the surface or underground.
 - for operation, it is anticipated that direct impacts may include acoustic treatments at affected properties and indirect impacts may include the visual presence of adjoining permanent features of the project, for example, interchanges, ventilation infrastructure and/or noise walls.
- Available heritage listing information has been compiled of the potentially impacted listings, including past inspection photographs. This data has been compiled to provide a point of comparison.
- Field surveys of the identified properties have been carried out, recording the current condition each site, with each listed heritage item photographed and compared to past description/photos.
- During the surveys, areas of potential heritage value have been investigated to look for historic heritage outside the recorded listing locations that may be impacted by the proposed works.
- Existing background information has been updated with field survey results.
- Statements of Heritage Impact (SOHIs) have been produced for the identified heritage sites considering potential direct and indirect impacts during construction and operation.
- Results of the non-Aboriginal heritage investigations and assessment have been documented in this report, including identification of mitigation and management measures to address potential direct and indirect impact on heritage items.

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5.0 Heritage inventory results

Relevant heritage databases, registers and lists were searched on 2 December 2013 to identify non-Aboriginal heritage items within the study area. The results of these searches are summarised in **Table 1** and shown in **Figure 2**.

Appendix A provides maps illustrating the curtilage of the heritage items relative to the key features of the project.

Table 1 Non-Aboriginal heritage items identified in heritage databases, registers and lists

Register	Jurisdiction	Items within the study area
World Heritage List	Commonwealth	No listed items
National Heritage List	Commonwealth	No listed items
Commonwealth Heritage List	Commonwealth	No listed items
Register of the National Estate (non-statutory)	Commonwealth	No listed items
NSW State Heritage Register	State	No listed items
NSW State Heritage Inventory	State	No listed items
Section 170 Registers (Roads and Maritime, Transport for NSW, Sydney Water, Sydney Trains)	State	One item – Windsor Road and Old Windsor Road (Roads and Maritime)
The Hills LEP	Local	One listed item – Windsor Road from Baulkham Hills to Box Hill.
Hornsby LEP	Local	Fifty-three heritage listed items, including four archaeological items and three heritage conservation areas.
Ku-ring-gai Planning Ordinance	Local	Ten heritage listed items, including two heritage conservation areas.
Draft Ku-ring-gai LEP	Local	Five additional items are included in the draft Ku-ring-gai LEP that are not already listed on the Ku-ring-gai Planning Ordinance.
National Trust of Australia (non-statutory)	Voluntary	One item – Blackwood Memorial Sanctuary.

Two sites have been listed under more than one register, list or database being:

- The Windsor Road and Old Windsor Road site is listed under the section 170 register maintained by Roads and Maritime and The Hills LEP.
- The Blackwood Memorial Sanctuary is listed under the Hornsby LEP 2013 and the non-statutory National Trust of Australia register.

For the purpose of this report, these have been carried forward with the listings under the Local Environmental Plans only to avoid duplication.

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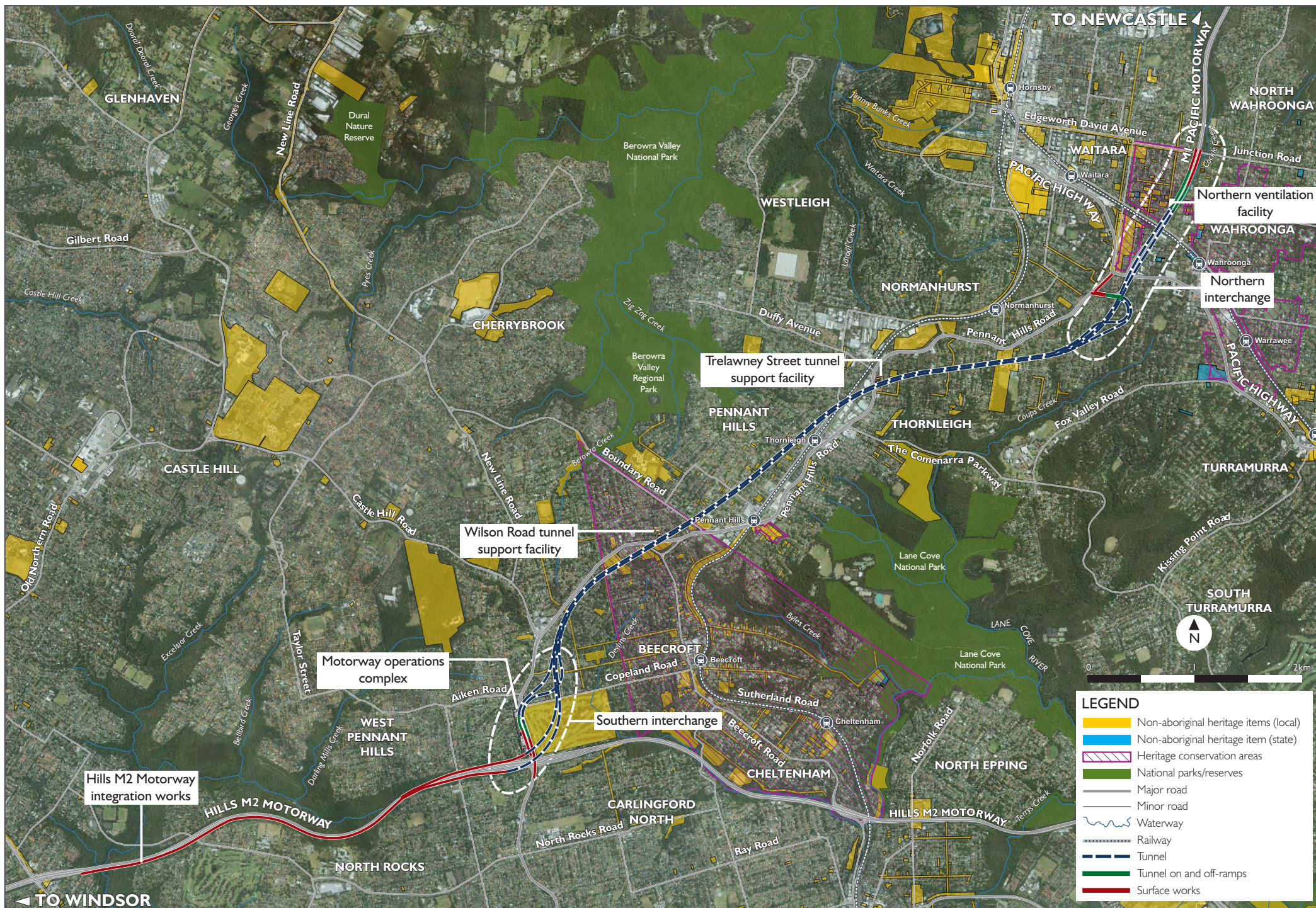


Figure 2 Heritage inventory results within the study area and surrounds

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6.0 Site inspection

6.1 Inspection results

A targeted inspection of listed heritage items was carried out by heritage specialists Dr Darran Jordan and Rochelle Coxon on 11, 13 and 19 December 2013. During the field inspections, listed heritage properties identified as having the potential to be impacted (either directly or indirectly) were inspected for current condition to inform an assessment of potential impacts to heritage values. A follow up survey was conducted for the Thornleigh Maltworks (Hornsby LEP item #A66) on 27 March 2014 by heritage specialists Luke Kirkwood and Karyn Virgin.

At the time, properties could not be accessed and assessments were undertaken from the property boundary or other publicly-accessible locations. Interior features or condition of the interior, if relevant to the listing, were based on the details provided within the specific database listing.

The following descriptions of heritage items are the result of a combination of research and the visual inspections for all properties identified as listed heritage items located within the bounds of, or in proximity to, areas of project works. These listed heritage items were assessed for current condition in comparison to photographs from past inspections (where available) and the descriptions contained in the heritage listing details. Statements of significance included here are quoted verbatim (where available), having been sourced from the published listings for these properties. Quoted items are referenced accordingly.

6.2 Hornsby Local Environmental Plan 2013

Item A61 – Blackwood Memorial Sanctuary including North Road Culvert

Address: Beecroft Road, Pennant Hills

Lot and DP: Lot 6 DP 828179

Significance: Local

Additional Heritage Listings: National Trust

LEP Statement of Significance:

“An important and highly visible site, conserving a rare stand of the high Bluegum Forest with intact understorey. Site exhibits the successful bushland regeneration methods of the National Trust. Of regional significance (but endorsed significance only Local). Donated to the National Trust by the Blackwood family, this site has been managed since about the 1970's by the Trust, using a method of bush regeneration developed from the pioneering work of Joan Bradley.

Site in small sloping valley conserving remnant of the high Bluegum/ Blackbutt forest that once dominated this area of the Shire. Also conserves embankment of the New North Road, opened in 1829. The vegetation is dominated by ancient tall Blue Gums and Blackbutts to 35m high. Other species include Turpentines, Smooth Bark Angophoras and Grey Ironbark, with a lower strata of native shrubs, vines and grasses. The area presumably functions as a sanctuary for small native creatures. Some exotic Lemon Scented Gums still exist in the reserve, and were probably planted c1950/60 period” (Hornsby Shire Council, 2014).

Archaeological site (North Road Culvert) circa 1829 - Part of the road system linking Sydney with the Hunter Valley, this section (New Line Road 1829) cut distance by 15 miles. Culvert - Important survival of crucial phase in the European settlement of NSW and Hornsby Shire.

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 1 Ludovic Blackwood Memorial Sanctuary / North Road Culvert c.1992 (Hornsby Shire Council, 2014)

Plate 2 Ludovic Blackwood Memorial Sanctuary / North Road Culvert c.2013

Item A66 – Remains of Maltworks**Address:** 1 Pioneer Avenue, Thornleigh**Lot and DP:** Lot 12 DP 235680**Significance:** Local**LEP Statement of Significance:**

“Unusual industry which continues to use an older building layout and style though the present buildings date to the late 1960s. Important industry for the region and employer in the locality.”

AECOM 2014 Inspection: The listed item was found to have been subject to substantial change to the site particular since the late 1960s. Original structures include the germination house and the Manager's House.



Plate 3 **Main Malting Complex circa 1917-1930.**

This photo shows the main germination building in the mid ground, with the kilns for drying behind. View from storage shed looking east along rail siding.



Plate 4 **Photo showing the original kilns and the germination building covered in ivy**

Item I68 – Street Trees**Address:** Cardinal Avenue, West Pennant Hills**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

This large group of native trees are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) community.....The BGHF community is typically defined by a mixed age structure and diverse floristic composition. This remnant group is dominated by mature Sydney Blue Gums (*Eucalyptus saligna*), Blackbutts (*Eucalyptus pilularis*) and Turpentine (*Syncarpia glomulifera*).

Although fragmented and reduced to only scattered remnant canopy trees, the group is considered to be significant in terms of its natural, representative, rarity, ecological/ biodiversity, genetic, visual and aesthetic values. The dramatic size and scale of these mature trees create a distinctive sense of place and bushland aesthetic quality to this suburban streetscape. These native trees are part of a larger, albeit highly fragmented and modified BGHF remnant community, which is confined to the surrounding shale-capped ridges and slopes (see listings for Hannah Street, Chapman Avenue, Hull Road and Lyndon Way).

The Cardinal Avenue group contains some exceptional old growth specimen trees in the public verges and large private gardens. Two massive old growth Sydney Blue Gums (*Eucalyptus saligna*), located on the verges adjacent to No.11 and No.26 Cardinal Avenue, are amongst the largest known specimens in the Hornsby Shire. These trees measure approximately 30 metres high / 25 metres canopy diameter/ 2000mm DBH and 25 metres high/ 30 metres canopy diameter/ 1700mm DBH respectively. Remnant native trees of this age structure, size and scale are now rare. They provide essential habitat for a range of tree-dependent fauna and are of individual significance" (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 5 Cardinal Avenue Street Trees c.2007 (Hornsby Shire Council, 2014)

Plate 6 Cardinal Avenue Street Trees c.2013

Item I98 – Street Trees**Address:** Hannah Street, Beecroft**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“Hannah Street is comprised of two fragmented groups (i.e. Western group between Pennant Hills Road and Hull Road and an eastern group between York Street and Beecroft Road). Both groups contain remnant native components of the Blue Gum High Forest (BGHF) community. The eastern group (i.e. Between York Street and Beecroft Road) was not listed in the HSLEP 1994. Both groups are of significance in terms of their natural, representative, rarity, ecological/biodiversity, genetic, visual and aesthetic values.....

The BGHF community is typically defined by a mixed age structure and diverse floristic composition. The western group, adjoining Fearnley Park and the Devlin’s Creek corridor (adjacent to Burns Road North), provides an important linkage with remnant BGHF in Cardinal Avenue, Chapman Avenue and Hull Road (refer to listings). Fearnley Park, a core BGHF protected area (1.94Ha) and the upper Devlin’s Creek corridor are under a current bush regeneration/restoration strategy.

The western group also retains a small but very diverse native understorey and ground stratum within a road cutting. Road-side examples of BGHF with understorey components, particularly along ridge-tops, are now rare in the Hornsby Shire. The eastern group is highly fragmented and largely confined to a number of old growth specimens including White Mahogany (*Eucalyptus acmenoides*), Sydney Blue Gum (*E. saligna*) and Blackbutt (*E. pilularis*). Old growth specimens of *E. acmenoides* are now rare in the Sydney metropolitan area” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 7 Hannah Street c.2007 (Hornsby Shire Council, 2014)



Plate 8 Hannah Street c.2013

Item I111 – Street Trees**Address:** Hull Road, Beecroft**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

This group of native trees, of mixed age and floristic structure, are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) communityThe BGHF community has a highly restricted geographic distribution and is further threatened by urban development. Although highly fragmented and reduced to only scattered remnant canopy trees (particularly in the section north of Pennant Hills Road), the group is considered to be significant in terms of its natural, representative, rarity, ecological/biodiversity, genetic, visual and aesthetic values.

The dramatic size and scale of these mature trees create a distinctive sense of place and bushland aesthetic quality to this suburban streetscape. Notably, most of this remnant group occurs within adjoining large private gardens surrounding the Devlin's Creek corridor (north of Chapman Avenue). This group provides a high level of connectivity with Fearnley Park, a core BGHF protected area (1.94Ha) and other remnant BGHF groups in Hannah Street, Chapman Avenue and Cardinal Avenue (see listings). Furthermore, a number of old growth specimen trees, occurring within the Devlin's Creek Corridor, are of individual significance" (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 9 Hull Road c.2007 (Hornsby Shire Council, 2014)

Plate 10 Hull Road c.2013

Item I138 – Pennant Hills Golf Club – Grounds**Address:** 589 Pennant Hills Road, Beecroft**Lot and DP:** Lot 10 DP 801176**Significance:** Local**LEP Statement of Significance:**

“Golf course conserving significant Blackbutt and Bluegums. Remnant forest above Devlins Creek in a naturalistic landscape and intact landscape elements and cultural planting from c1960#s. Of regional significance. Not specified Golf course sited on undulating topography above Devlins Creek which runs through site. Conserving large stands of mature indigenous Eucalypts particularly Blackbutts Bluegums and Stringybarks (to 30 metres) between fairways. Also indigenous trees around boundary and on nature strips including Blackbutt Smoothbark Angophora Stringybarks and Turpentines to 25m high.

“Clubhouse and entry area developed c1950/60. Entry stonework of yellow sandstone in rough-face and capped style intact from this period including Pencil and Golden Cyresses in car park zone with characteristic low plants such as Fish Fern Strelitzias and Annuals as border plants and extending to edge of course. More recently a line of Brush Box Trees to 14m on north boundary exists from c1960. Additional ornamental tree planting has been added to fairways since c1960’s.

Course is generally well maintained but parking could be controlled along eastern nature strip to protect indigenous trees. Weed in bushland zones not assessed but probably require regeneration by qualified workers. Landscape on course could be simplified and enhanced if more emphasis was placed on indigenous Eucalypt forest and its regeneration and replanting rather than on additional introduction of exotic species. However the exotic planting around the parking area has significance as an important period landscape” (Hornsby Shire Council, 2014; NSW Office of Environment & Heritage, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 11 Pennant Hills Golf Club c.1993 (Hornsby Shire Council, 2014)

Plate 12 Pennant Hills Golf Club c.2013

Item I475 – Street Trees**Address:** Edgeworth David Avenue, Hornsby**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“Ground A: this small group of native trees location between Newcastle Expressway and Myra Street are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) community. This community has a highly restricted geographic distribution and is typically associated with soils derived from Wianamatta Shale (Tozer 2003). Blue Gum High Forest has been highly fragmented and modified by urban development, particularly small-scale clearing and alterations associated with residential subdivision, roads and service easement upgrades.

This group has significance in terms of its natural, representative, rarity, ecological/biodiversity, genetic, visual and aesthetic values. Old growth specimens in the group are of individual significance. Together the trees create a memorable sense of place in this suburban streetscape and are evocative of the original bushland character. This BGHF group is contiguous with the Woonona Avenue northern group (see listing) and has a broader association with other remnant tree groups in the local area further reinforcing the significance of this cluster (refer to similar listings for Bundarra Avenue and Fern Avenue, Wahroonga).

Group B: The formal single species avenue/ row plantation of Brush Box (*Lophostemon confertus*) located between the Pacific Highway and Myra Street is believed to date from the mid to late Post War period (c. 1950s-1960s). This plantation has local group significance in terms of its historic, cultural visual/ aesthetic and representative values. This species has been used extensively in street tree planting schemes throughout Sydney since the early twentieth century. Brush Box has been used in local planting programs associated with new subdivisions, the rail corridor and railway stations since the Post War period (refer to listings)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 13 Edgeworth David Avenue c.2007 (Hornsby Shire Council, 2014)

Plate 14 Edgeworth David Avenue c.2013

Item I590 – Street trees**Address:** Campbell Avenue, Normanhurst**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

"This large but highly fragmented group of native trees are components (canopy trees) of the Blue Gum High Forest (BGHF) community. Blue Gum High Forest (BGHF) has a highly restricted geographic distribution and is typically associated with soils derived from Wianamatta Shale (Tozer 2003). This community has been highly fragmented and modified by urban development, particularly small-scale clearing and alterations associated with residential subdivision, roads and service easement upgrades.

This group, dominated by Sydney Blue Gums (*Eucalyptus saligna*), is considered to be significant in terms of its natural, representative, rarity, ecological/biodiversity, genetic, visual and aesthetic values. The dramatic size and scale of these trees defines a special sense of place and bushland aesthetic to this suburban streetscape. Some old growth specimen trees are of individual significance. Furthermore, these trees are part of a larger, albeit highly fragmented BGHF community, now scattered throughout local road verges and private gardens (refer to Calga Avenue and other local listings)" (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 15 Campbell Avenue c.2007 (Hornsby Shire Council, 2014)



Plate 16 Campbell Avenue c.2013

Item I596 – Garden**Address:** 1-7 Frith Avenue, Wahroonga**Lot and DP:** Lot 3 DP 1077836**Significance:** Local**LEP Statement of Significance:**

“Significance has been reduced by the loss of the house and much of its original planting but a number of significant trees survive on the site. Notable among these are mature specimens of *Cryptomeria japonica* (Japanese Cedar), *Araucaria heterophylla* (Norfolk Island Pine), *Araucaria cunninghamii* (Hoop Pine), *Brachychiton acerifolius* (Illawarra Flame Tree), *Magnolia grandiflora* (Bull Bay), *Lagerstroemia indica* (Crepe Myrtle), *Macadamia tetraphylla* (Australian Nut), *Camellia japonica* cultivars. These remnants interpret the previous use of the place and contribute to the aesthetic values of the site” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection:

As noted in the listing for the site, the 1920s house has been replaced by retirement units and the garden area impacted as a result. It is noted that the Hornsby Shire Council Heritage Register states that Hornsby Shire Council endorsed the removal of the heritage item from the Hornsby LEP 2013 on 20 November 2013.

The visible vegetation at the time of the 2013 AECOM inspection appeared to correspond to its past recording and photographs, but its position behind a walled area meant that only a limited inspection of the garden's extant extent was possible. The item remains in comparable condition with its local heritage significance unchanged.

Hornsby Shire Council endorsed the removal of the heritage item from the Hornsby LEP 2013 on 20 November 2013 and endorsed the use of tree preservation orders to provide an alternative protection mechanism for selected trees. According to Hornsby Shire Council's website, Council is anticipating the amendment to the LEP will be made in early 2014.



Plate 17 1-7 Frith Avenue Wahroonga Campbell Avenue
c.2013 (Hornsby Shire Council, 2014)

Plate 18 1-7 Frith Avenue, Wahroonga c. 2013

Item I603 – House**Address:** 4 Mount Pleasant Avenue, Normanhurst **Lot and DP:** Lot D DP 366271**Significance:** Local**LEP Statement of Significance:**

“Grand example of a late Federation style house. Set in generous landscaped grounds. Excellent condition and virtually unaltered. Distinctive half-timbered gable. Excellent quality leadlight windows” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. During the current inspection, it was noted that the fence had fallen over on the left hand side of the property and that the elements of the garden had been modified.



Plate 19 4 Mount Pleasant Avenue c.1992 (Hornsby Shire Council, 2014)



Plate 20 4 Mount Pleasant Avenue c.2013

Item I618 – St Agatha’s Primary School – Grounds (Excluding Buildings)**Address:** 18-26 Boundary Road, Pennant Hills**Lot and DP:** Lot 1 DP 1040701**Significance:** Local**LEP Statement of Significance:**

“School grounds conserving indigenous trees and cultural planting from c. 1940s” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: Limited access was available to the school grounds, with inspection undertaken from outside the school gates. As far as visibly possible to assess, the listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 21 St Agatha’s Primary School c.1993 (Hornsby Shire Council, 2014)



Plate 22 St Agatha’s Primary School from the front gate c.2013

Item I607, A60 – Loretto [sic] Convent Group – Ground, Gates and Cemetery**Address:** 91-93 Pennant Hills Road and 16–22 Mount Pleasant Avenue, Normanhurst**Lot and DP:** Lot 1 DP 734965; Lot 15 DP 6612, Lot 16 DP 6612**Significance:** Local**LEP Statement of Significance:**

“Group of early Federation period brick school buildings, including grounds and early unified character created by consistent use of gothic style in face brick and sandstone. Buildings generally in good condition. Retain most of their original character despite some unsympathetic modern additions. Social and historical significance as a local centre of education.”

“Entrance to a major educational establishment, symbolising the importance of Hornsby Shire as an educational centre. The imposing style is typical of a time during which the battle for private education as waged with particular firmness by the Catholic church. The inscription on the gate identifies the order.”

“Well maintained ground of college and former convent displaying characteristic elements from late Victorian/Federation period. This includes sandstone and cast iron gateway and fence period layout with notable period trees and conserving a band of indigenous forest a burial ground while forming a visual element in the surrounding landscape and a highly visible landmark on Pennant Hills Road.”

“Example of an enclosed religious order which buries its dead within the grounds of the institution. Reflects the importance of one religious denomination within the Shire and the ethnic (Celtic) origins of many members of the order” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The inspection was undertaken from outside the school gates. As far as visibly possible to assess, the listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 23 Loretto [sic] Convent group c.1992 (Hornsby Shire Council, 2014)



Plate 24 Loretto [sic] Convent group c.2013

Item I619 – “Cheddington” and Stables (Formerly “Niara”)**Address:** 27 Boundary Road, Pennant Hills**Lot and DP:** Lot 5, DP 16057; Lot 4, DP 622198**Significance:** Local**LEP Statement of Significance:**

“Example of a large early Queen Anne Federation style house. Cheddington is of social historic significance for its association with Chief Commissioner of Railways, Charles Oliver. It is a significant suburban estate with prominent position on the corner of a major road junction”.

“A rare existing example of a vernacular stable. Good piece of functional architecture. The grouping and siting of the buildings is indicative of late Victorian site planning and subdivision related to a major road junction. Local significance” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: Currently the location for the Pennant Hills branch of White Lady Funerals who have operated at this location since mid-1999. The main structure (the Queen Anne Federation style house) has been substantially renovated and modified. It now includes a chapel with seating capacity for 30 people, a coffin show room, catering area, reception and arrangement room. A garden area has been landscaped adjacent to the main building, with a fountain, garden benches and a gazebo in a lawn area with trees around the periphery and a brick wall separating the garden area from view of Pennant Hills road. Other additions include a covered entryway/ driveway to the house typical of other White Lady Funeral homes.

The second structure is the vernacular stables, accessed from Boundary Road (where the primary entrance to White Lady Funerals is now located). The stables have a hipped corrugated iron roof with rafters, brick walls, timber joinery and timber plank stable doors. While the Federation style house has been significantly modified, the stables themselves are a highly intact structure with only minor modifications noted including addition of a skylight and maintenance.



Plate 25 Queen Anne Federation Style House – 27 Boundary Road c.2013

Plate 26 Vernacular Stables - 27 Boundary Road c.2013

Item I626 – House**Address:** 7 Fulbourne Avenue Pennant Hills**Lot and DP:** Lot 14 DP 10203**Significance:** Local**LEP Statement of Significance:**

“Good example of fully restored weatherboard cottage from Inter-War period. Much original detail. Circa Date: 1935. Style: Inter-War California Bungalow. Small weatherboard cottage. Simple gabled form with symmetrical facade. Projecting central porch with shingled gable. Leadlight casement windows and original glass doors. Terracotta tiled roof. Good symmetrical picket fence. Sympathetic colour scheme. Well planted garden. Modifications: Recently extensively restored (1992)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 27 7 Fulbourne Avenue c.1992 (Hornsby Shire Council, 2014)

Plate 28 7 Fulbourne Avenue c.2013

Item I630 – House**Address:** 17 Greycliffe Avenue, Pennant Hills**Lot and DP:** Lot 87 DP 11134**Significance:** Local**LEP Statement of Significance:**

“Good example of an Inter-War period house. In excellent condition and virtually unaltered. Fine quality original detail, including liver brickwork and casement windows. The work of innovative architect George Sydney Jones. Local significance. Circa Date: 1920.

“Inter-War period house. Hipped terracotta tile roof with boxed eaves. Cast iron chimney pot. Symmetrical design with projecting central porch opening. Liver brick walls with top course brick on end. Casement windows in groups of three sashes with diamond pattern leadlight flat hoods and shingles skirts. Original fence. Modifications: Fence partly rendered” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The main difference was in the vegetation growth of shaped hedging in the front garden area. The item remains in comparable condition with its local heritage significance unchanged. A new fence appears to have been added to the item.



Plate 29 17 Greycliffe Avenue c.1992 (Hornsby Shire Council, 2014)



Plate 30 17 Greycliffe Avenue c.2013

Item I652 – “Camira”**Address:** 418 Pennant Hills Road, Pennant Hills**Lot and DP:** Lot 102 DP 263746**Significance:** Local**LEP Statement of Significance:**

“Good example of a large, Federation period, two storey bungalow. Notable for large areas of shingling. Good condition. Built for Charles N.J. Oliver, Chief Railway Commissioner until 1907” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged. The main difference was in the vegetation growth of shaped hedging in the front garden area providing a screen against Pennant Hills Road.



Plate 31 418 Pennant Hills Road c.1992 (Hornsby Shire Council, 2014)

Plate 32 418 Pennant Hills Road c.2013

Item I653 – Mount St. Benedict's Convent and Grounds**Address:** 449D Pennant Hills Road, Pennant Hills **Lot and DP:** Lot 2 DP 1042630**Significance:** Local**LEP Statement of Significance:**

"The original building is an outstanding example of a Federation Free style building, designed by George Sydney Jones. It retains most of its original exterior and interior features. The later group of large Inter-War period buildings is notable for its polychrome brickwork. It has high integrity due to consistent use of materials and closely matching styles. Sympathetically altered in the Post-War period. Social and historical significance as a centre of education in the area" (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The inspection was undertaken from outside the school gates. As far as possible to visually assess, the listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 33 **Mt St. Benedict's Convent c.1992 (Hornsby Shire Council, 2014)**



Plate 34 **Mount St. Benedict's Convent c.2013**

Item I654, A62 – Observatory Park – Observatory Site and Park**Address:** 449X Pennant Hills Road, Pennant Hills**Lot and DP:** Lot 7 DP 828179**Significance:** Local**LEP Statement of Significance:**

“Outstanding small example of remnant high Blue Gum and Blackbutt. Native forest conserved on shale derived soils, originally logged in the colonial period. Significant in surrounding landscape, and seen from as far as the city. Located in prominent road junction” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. A memorial and plaque have been established on the northern part of the park to commemorate the location of the original Pennant Hills Observatory. The item remains in comparable condition with its local heritage significance unchanged.



Plate 35 **Observatory Park c.1992 (Hornsby Shire Council, 2014)**



Plate 36 **Observatory Park showing the Observatory memorial and plaque c.2013**

Item I660 – Fence**Address:** 34 Ramsay Road, Pennant Hills**Lot and DP:** Lot 78 DP 11134**Significance:** Local**LEP Statement of Significance:**

“Excellent example of an Inter-War period brick fence. Good condition and virtually unaltered. Local significance. House of some architectural interest. Circa Date: 1925. Style: Inter-War. Original brick boundary fence to both streets. Approximately six courses high. Crenellated parapet of alternate headers and soldiers. Square piers to corner and gate with soldier course capping. Steel gates. Good Inter-War period Bungalow. Complements No. 37 opposite. Double-fronted with two battened gables facing street. Terracotta tile roof” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged. The exterior of the house has been painted since the last inspection, with brown highlights added to the eaves and windows.



Plate 37 34 Ramsay Road c.1992 (Hornsby Shire Council, 2014)

Plate 38 34 Ramsay Road showing the fence and house c.2013

Item I661 – Fence**Address:** 35 Ramsay Road, Pennant Hills**Lot and DP:** Lot 1 DP 317985**Significance:** Local**LEP Statement of Significance:**

“Excellent example of an Inter-War period brick and chain wire fence. Good condition and virtually unaltered. Local significance. House of some architectural interest good support building for No 37. Circa Date: 1930. Style: Inter-War. Original brick and wire mesh fence. Brick walling approximately four courses high with soldier course capping. Wire mesh with steel pipe framing painted. Square brick piers with corbelled capping and top course rendered and painted. Simple brick house circa 1930” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. Vegetation growth is currently obscuring the front fence, which is present behind shrubs and hedging. It was unclear if gate currently associated with fence is a recent addition. The item ultimately remains in comparable condition with its local heritage significance unchanged.



Plate 39 35 Ramsay Road c.1992 (Hornsby Shire Council, 2014)

Plate 40 35 Ramsay Road c.2013

Item I662 – House and Fence**Address:** 37 Ramsay Street, Pennant Hills**Lot and DP:** Lot A DP 364826**Significance:** Local**LEP Statement of Significance:**

“Excellent example of an Inter-War Bungalow. Good condition and virtually unaltered. Exterior features much original fine detail throughout. Original fence of note. Local significance. Single Storey Residence Circa Date: 1920. Very good Inter-War Bungalow circa 1930. Tuck-pointed face brick with terracotta tiled roof. Designed for corner site with hipped verandah on both frontages. Half-timbered gables with shingled apexes. Solid verandah piers with stub posts infill and brackets. Simple timber balustrade. Exposed rafter eaves. Excellent leadlight windows mostly double-hung. Original brick and timber fence to match verandah. Good garden” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The exterior of the building has been painted since the previous inspection, with blue paint utilised in highlights on the eaves, railings and windows. The garden visible in 1992 has also since been replaced with lawn in addition to upgrades of the footpath. The overall item remains in comparable condition with its local heritage significance unchanged.

**Plate 41** 37 Ramsay Street c.1992 (Hornsby Shire Council, 2014)**Plate 42** 37 Ramsay Road c.2013

Item I666 – “Bushloe”**Address:** 25-27 Stevens Street, Pennant Hills**Lot and DP:** Lot A DP 401750**Significance:** Local**LEP Statement of Significance:**

“Good representative example of an early 20th Century Federation bungalow style house, altered in parts. House however remains as evidence of historical development in the area.

“Towards the turn of the Twentieth Century, industry (such as maltworks, poultry and various growers) began to proliferate in the Thornleigh and Pennant Hills area, taking advantage of the railway line construction (completed 1886 and linking St Leonards to Hornsby) to freight goods to Sydney. The subsequent suburbanisation of the area saw large land portions being subdivided and sold. In 1910 Lot 25 of the 'Nyors Estate', comprising of one acre, was purchased by William Clarke. It was on this site that Bushloe was built. Stone recovered from the excavation of the block was used in foundations and the Stevens Street fence. Subdivisions of one house block each were made in 1923 and 1945.

“Single storey Federation brick bungalow style house. Prominent tiled roof with addition of eave lining evident. Deep verandah with possible alterations to timber posts and handrail detailing. Face brickwork remains exposed on Stevens Street facade. Despite some modification the house retains the essence of its Federation styling” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 43 25-27 Stevens Street c.2003 (Hornsby Shire Council, 2014)	Plate 44 25-27 Stevens Street c.2013
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Item I680 – House**Address:** 20 Warne Street, Pennant Hills**Lot and DP:** Lot 16 DP 5158**Significance:** Local**LEP Statement of Significance:**

“Good example of an Inter-War period house. Unusual masonry verandah. Good condition. Local significance. Circa Date: 1925. Style: Inter War. Federation Bungalow design. Hipped slate roof. Exposed rafters. Single large gable at front, half timbered and roughcast. Unusual hipped roof verandah with roughcast arches. Good roughcast chimneys. Sandstone basecourse. Sympathetic well planted garden. Modifications: Modern brick fence. Weatherboard extension at rear” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 45	20 Warne Street c.1992 (Hornsby Shire Council, 2014)	Plate 46	20 Warne Street c.2013
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Item I681 – House**Address:** 24 Warne Street, Pennant Hills**Lot and DP:** Lot 2 DP 501154**Significance:** Local**LEP Statement of Significance:**

“Good example of an early Federation period cottage in traditional Georgian form. Best of a row of three. Good condition. Little integrity lost through generally sympathetic modifications. Local significance. Circa Date: 1910. Style: Federation Georgian.

“Weatherboard cottage with slate roof. Traditional form with hipped roof and symmetrical facade. Original double-hung windows of special note with moulded architraves. Good brick chimney. Modifications: Verandah is sympathetic replacement. Unsympathetic security door. Sympathetic picket fence” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The exterior of the house had been repainted since the last inspection, with the window edges changed from brown to green and the front porch surface changed from green to brown. The garden has also been modified. The item remains in comparable condition with its local heritage significance unchanged.



Plate 47 24 Warne Street c.1992 (Hornsby Shire Council, 2014)



Plate 48 24 Warne Street c.2013

Item I682 – House**Address:** 9 Weemala Road, Pennant Hills**Lot and DP:** Lot 60 DP 11134**Significance:** Local**LEP Statement of Significance:**

“Good example of an Inter-War period house. Fine quality original materials in good condition, including extensive use of shingling. Local significance. Circa Date: 1935. Inter-War brick house, probably 1930's. Liver coloured brick walls. Decorative use of unusual rock-faced brick. Gabled terracotta tiled roof with hipped all round verandah. Solid brick piers with scalloped brick balustrading. Unusual informal shingling to gable. Excellent leadlight casement windows” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The roof has been reshingled. The item remains in comparable condition with its local heritage significance unchanged.



Plate 49	9 Weemala Road c.1992 (Hornsby Shire Council, 2014)	Plate 50	9 Weemala Road c.2013
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Item I683 – “Hillcourt”**Address:** 9 Werona Street, Pennant Hills**Lot and DP:** Lot 1 DP 524506**Significance:** Local**LEP Statement of Significance:**

“Good representative example of early 20th Century Federation bungalow style, suitably sited on a large block. House remains as evidence of historical development in the area. Examples of this age and level of intactness in the Pennant Hills area appear to be uncommon.

“Towards the turn of the twentieth Century, Orchardists in the Pennant Hills, Thornleigh and surrounding areas took advantage of the recently constructed railway line (completed 1886 and linking St Leonards to Hornsby) to freight fruit to Sydney. The subsequent proliferation of this and other industries would prompt the start of suburbanisation of the area, with large land portions being subdivided and sold. 1901 saw subdivision of the area known as 'Mellidays Land' into residential and orchard sites mostly between 1 and 2 acres. Lots 35 & 36, an area of 2 acres, were purchased in 1903 by Eliza Sherman, wife of Christopher Sherman of Goolma, farmer. It would appear soon after the house 'Hillcourt' was constructed on lot 35.

“Early 20th Century Federation brick bungalow with a pitched roof, broken over the encircling verandah, sections of which have been enclosed at various times to create an ensuite, dressing room and study. Brickwork has been painted and original tiles replaced with profile roof cladding. Chimney stacks appear to be original. Modifications: Rear addition” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 51	9 Werona Street c.2003 (Hornsby Shire Council, 2014)	Plate 52	9 Werona Road c.2013
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Item I684 – “Karoola”**Address:** 14 Werona Street, Pennant Hills**Lot and DP:** Lot 1 DP 533036**Significance:** Local**LEP Statement of Significance:**

“Good intact representative example of an early 20th Century timber framed Federation bungalow style house in extensive gardens. House remains as evidence of historical development in the area. Towards the turn of the Twentieth Century, Orchardists in the Pennant Hills, Thornleigh and surrounding areas took advantage of the recently constructed railway line (completed 1886 and linking St Leonards to Hornsby) to freight fruit to Sydney.

“The subsequent proliferation of this and other industries would prompt the start of suburbanisation of the area, with large land portions being subdivided and sold. In 1904, Lot 4 of the 'Nyora Estate' was purchased by Dorcas P Pollard. It was on this site that Karoola was built, research revealing the site originally contained a fur tree lined creek and tennis court, among other features. Early timber framed 20th Century Federation bungalow style house with hipped corrugated steel profile roof, deep timber posted verandah and weatherboard cladding. Set back deeply on generously proportioned block with extensive ornate garden features. Largely intact, however evidence of alteration (particularly to verandah timbers) exists” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 53	14 Werona Street c.2003 (Hornsby Shire Council, 2014)	Plate 54	14 Werona Road c.2013
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Item I689 – House**Address:** 4 Yarrara Road, Pennant Hills**Lot and DP:** Lot 3 Section 15 DP 2097**Significance:** Local**LEP Statement of Significance:**

“Good example of an early Federation period weatherboard cottage in traditional Georgian style. Good condition. Integrity little affected by generally sympathetic alterations. Original fence and gate. Local significance. Circa Date: 1900. Style: Federation Georgian. Old weatherboard house. Traditional Georgian form. Corrugated iron hip roof with close eaves. Separate skillion roof verandah supported on four square timber posts. Double-hung windows. Half-glazed door with toplight. Good fence and gate. Modifications: Weatherboards to side elevation replaced. Skillion roof addition to rear” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 55 4 Yarrara Road c.1992 (Hornsby Shire Council, 2014)

Plate 56 4 Yarrara Road c.2013

Item I690 – House**Address:** 6 Yarrara Road, Pennant Hills**Lot and DP:** Lot 4 Section 15 DP 2097**Significance:** Local**LEP Statement of Significance:**

“Excellent timber example of an Inter-War Bungalow. Has much in common with the original Californian model, with suggested Japanese influence. Unusual double-gabled design. Good condition. Fine quality original timber detail, including windows and gables. Local significance. Circa Date: 1930. Style: Inter-War California Bungalow.

“Inter-War period weatherboard house with iron roof. Symmetrical design with low pitched all gabled roof. Long wide gable over verandah. Casement windows at front. Good timberwork to front gable. Window hoods at sides. Modifications: Roof recently replaced. Otherwise appears original. Fence replaced” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 57 6 Yarrara Road c.1992 (Hornsby Shire Council, 2014)

Plate 58 6 Yarrara Road c.2013

Item I691 – The Maze**Address:** 18-20 Yarrara Road, Pennant Hills**Lot and DP:** Lot 1 DP 10203**Significance:** Local**LEP Statement of Significance:**

“Good example of an early Federation brick house with traditional wrap-around verandah. Integrity partly compromised by painting of brickwork. Local significance. Home and surgery of Dr Cuthbert and Richard Geeves (1927-60).

“Traditional Georgian style brick house with hipped terracotta tiled roof. Symmetrical facade. Long bullnosed verandah returns to sides. Turned timber posts with scalloped valence panels. Double-hung windows. Original style door with sidelights and toplight. Brick chimneys with terracotta pots. Low picket fence, probably original. Well planted garden area. Modifications: Bricks now painted. Double-hung windows shuttered at front” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The exterior of the building has been repainted since the last inspection. The item remains in comparable condition with its local heritage significance unchanged.



Plate 59 18 Yarrara Road c.1992 (Hornsby Shire Council, 2014)

Plate 60 18 Yarrara Road c.2013

Item I710 – Street Trees**Address:** Loch Maree Avenue, Thornleigh**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

"This small group of native trees, dominated by old growth specimens, are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) community..... The BGHF community has a highly restricted geographical distribution and is typically associated with local shale-derived soils of the ridge tops. In the past, the community was largely cleared for agriculture and is now threatened by urban development. Less than 5% of the original distribution of BGHF community still exists... Although highly fragmented and reduced to only scattered remnant canopy trees, the group is considered to be significant in terms of its natural, representative, rarity, ecological/ biodiversity, genetic, visual and aesthetic values.

"The dramatic size and scale of these trees, particularly old growth specimens, creates a memorable sense of place and bushland aesthetic to this suburban streetscape. A number of large specimen trees are conserved in rear gardens (eastern side) near the creek-line. Furthermore, these trees are part of a much larger, albeit highly fragmented (BGHF) community (refer to Calga Avenue and Campbell Avenue and other local listings). Notably, Trelawney Street (linking to Loch-Maree Avenue) conserves a small but impressive group of remnant Blue Gum High Forest, including old growth specimens, which is currently not heritage listed. All items of natural occurrence [ie. not cultivated]. Resident of No.27 Loch-Maree Avenue has requested removal of old growth specimen (*E. saligna*) in verge following recent branch fall (Council corro. date unknown/ pers. comm. 18/07/2007). These native trees (BGHF community) have been retained/ protected within the western public verge and adjoining private gardens, particularly within and adjacent to Nos.25, 27 and 31 Loch-Maree Avenue. Native tree species include the following:- Common Name(s): Botanical Name(s): Rough-barked Apple (*Angophora floribunda*); Blackbutt (*Eucalyptus pilularis*); Sydney Blue Gum (*Eucalyptus saligna*)" (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 61 Loch Maree Avenue Street Trees c.2007 (Hornsby Shire Council, 2014)



Plate 62 Loch Maree Avenue Street Trees c.2013

Item I714 – “Loch Maree House” and Garden**Address:** 237 Pennant Hills Road, Thornleigh**Lot and DP:** Lot 1 DP 245272**Significance:** Local**LEP Statement of Significance:**

“Outstanding Federation house. Finely crafted detail in a variety of materials. Excellent condition. One of the best quality houses in the area. Outbuilding at the rear also of interest. Local significance. Reconstructed federation garden including original tall Canary Island Pine and Camphorlaurels from c1950's notable period element on major road. Of local significance. Loch Maree' was built for Herbert Garratt licensee of the Cambridge Hotel Castlereagh Street Sydney as well as the Pennant Hills Hotel. Construction commenced in 1898 and Mr Garrett had moved in by 1 April 1899. The original garden had a formal layout with a gravelled driveway flower beds tennis court. There was also an orchard piggery and a swimming pool with a separate dressing room building. In 1910 it was sold to Robert Tulloch the owner of a heavy engineering works in Pyrmont. He expanded the size of the farm to 60 acres. The Tulloch family lived in 'Loch Maree' until 1954.

“Outstanding Federation house. Red face brick walls. Complex terracotta tiled roof. Castellated tower and original style shingled dormer. Roughcast gable to front with porthole window. Large arched window below with stained glass and leadlight. Verandah returns to one side. Lattice valence. but roof remains visible above. Fine ridge capping and Norman Shaw style chimney near towers. Outbuilding at the rear. Second dormer is probably of a later date. Unsympathetic high front fence. Reconstructed garden to fine federation house including probably original tall Canary Island Pine from c1920 and line of Camphorlaurels to 13m on south side from c1950's. Fine reconstructed curved brown gravel drive (brick edge). Border planting of Strap Lillies, Roses and Cannas and corner Jacaranda 8m high. Stylish reconstructed H.W. fence in sympathy with period. Modifications: Second dormer is probably of a later date. Unsympathetic high front fence” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 63 237 Pennant Hills Road c.1992 (Hornsby Shire Council, 2014)



Plate 64 237 Pennant Hills Road c.2013

Item I716 – House**Address:** 3 Pritchard Street, Thornleigh**Lot and DP:** Lot 5 Section 14 DP 2097**Significance:** Local**LEP Statement of Significance:**

“Good example of a late Federation style Bungalow. Interesting design variation with symmetrical facade and central porch. Fine quality original detail. Inter-War period weatherboard house. Symmetrical design with central projecting gabled porch. Hipped terracotta tile roof with exposed rafters. Pair of brick chimneys. Good leadlight casement windows. Porch gable is faced with battened asbestos cement has spindle valence timber posts supported on brick piers.

“Physical Description: Originally a single-storey circa 1920s weatherboard cottage with a terracotta tiled roof. Now greatly extended and modified with the addition of an upper level, side wing and corrugated steel roofing. Chimney extended vertically.

“Historical Notes: The property at 3 Pritchard Street, Thornleigh was built c1922 for William Ritchie Morris, engineer, on Lot 5, Section 14 of the Third Subdivision of the Thornleigh Township (DP 2097). It lies on land that was originally part of a grant of 640 acres to George Henry Thorn in 1840 the whole of which was sold to James Bellamy in 1856. Bellamy divided his farm in 1873 among his four married daughters and his son James jnr. In 1888 around 94 acres of this land was subdivided by the Haymarket Permanent Land Building and Investment Company as the Third Subdivision of the Thornleigh Township (DP 2097). Lots 4 and 5, Section 14 of this subdivision were purchased in 1891 by Frederick Shettle but a mortgagee sale in 1905 saw the land revert back to the Haymarket Permanent Land Building and Investment Company. In 1918 the lots were sold to Mary Pettit and in 1921 Lot 5, containing 32 ½ perches, was sold to William Ritchie Morris. Morris owned the land until 1949 and was responsible for the construction of the subject house. The house was sold to Patience and John Peter and their daughter, Patience Joan Peter, in 1949 and the family owned the property until 1980. It was purchased by John and Angela Haysom in 1980. The house remains on its original allotment. The house has had a second-storey added in similar style, with open car port and side wing extension” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.

It is noted that Hornsby Shire Council endorsed the removal of the heritage item from the Hornsby LEP 2013 on 20 November 2013 following the exhibition of a planning proposal in 2013. This was on the basis that it has been extended and modified, and its significance has been reviewed as a result. According to Hornsby Shire Council's website, Council is anticipating the amendment to the LEP will be made in early 2014.



Plate 65 3 Pritchard Street c.2012 (Hornsby Shire Council, 2014)



Plate 66 3 Pritchard Street c.2013

Item I723 – House**Address:** 80 The Esplanade, Thornleigh**Lot and DP:** Lot 12 DP 1008101**Significance:** Local**LEP Statement of Significance:**

“Good example of an Inter-War period weatherboard house. Unusual verandah column brackets. Much good quality original detail. Local significance. Circa Date: 1925. Style: Inter-War Traditional.

“1920's style weatherboard house. Corrugated iron roof bellcast over verandah. Central gablet over verandah entry. Unusual curved verandah post brackets. Original door with sidelights and toplight. French doors. Good moulded architraves to openings. Well planted in front with hedge. Modifications: New roofing. Side enclosure to verandah in asbestos cement. Verandah posts partly replaced” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The exterior of the house has been repainted since the previous inspection. The item remains in comparable condition with its local heritage significance unchanged.



Plate 67 80 The Esplanade c.1992 (Hornsby Shire Council, 2014)



Plate 68 80 The Esplanade c.2013

Item I724 – Gardens**Lot and DP:** Lot K, DP 389092, Lots A and B, DP 373698, Lots 1 and 2, DP 1034977**Address:** 17, 19, 21, 23 and 23A Trelawney Street Thornleigh**Significance:** Local**LEP Statement of Significance:**

“Remnants of original indigenous Sydney Blue Gum High Forest ecological community which is listed as endangered under the Threatened Species Conservation (TSC) Act 1995. Although only isolated trees and possibly regrowth after early logging in the area, these specimens have local historical, aesthetic and scientific/research significance and are representative of the original dominant tree species in the area.

“Remnant of original plant community of area or regrowth thereof. Remnant indigenous eucalypts, mainly *Eucalyptus saligna* (Sydney Blue Gum), surviving on nature strip and in several gardens on the north side of Trelawney Street, providing evidence of original Sydney Blue Gum High Forest ecological community. Two very large blue gums on nature strip outside No.17 and one outside No.19, both of which are single-storey fibro houses with tile-clad hipped roofs. There is another tall blue gum in the rear garden of No.17 and another in the rear garden of No.19 is forked approximately 8 metres above ground level. A recent battle-axe subdivision at rear of No.21 has produced No.21A Trelawney Street, with a shared right-of-way between No. 19 and 21 (No. 21 and 21A had 'sold' signs at front at time of inspection).

“There is a very large blue gum beside the new drive and another, not quite as large, in the front garden, with a forked blue gum at the far end of the new driveway. No.21 is a refurbished weatherboard clad single-storey house with tiled roof and garage under a concrete deck. No.23A is a recent (c1990s) 1½ storey house with two blue gums in the front garden and another in the rear garden. No.23, on the curve in the road, has six younger blue gums along its north-eastern boundary. Exotic ornamental trees and shrubs in gardens add to local amenity but are not considered of heritage significance. Modifications: No. 19 Trelawney - Tree Application 2003, No. 23 Trelawney - Construction Certificate for carport 2001, DA for two lot of Torrens Title 1998, Section 96(2) DA for modification to boundary 2001, Section 96(2) modification to approved subdivision to amend location of common boundary 2000, DA for carport 2001, two tree applications 2011. No. 23A Trelawney - DA and Construction Certificate for dwelling 2001” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.

It is noted that Hornsby Shire Council endorsed the removal of the heritage item from the Hornsby LEP 2013 on 20 November 2013, and endorsed the use of tree preservation orders to provide an alternative protection mechanism for selected trees. According to Hornsby Shire Council's website, Council is anticipating the amendment to the LEP will be made in 2014.



Plate 69 17-23A Trelawney Street c.1992 (Hornsby Shire Council, 2014)

Plate 70 17-23A Trelawney Street c.2013

Item I725 – House**Address:** 17 Wells Street, Thornleigh**Lot and DP:** Lot 14 Section 15 DP 2097**Significance:** Local**LEP Statement of Significance:**

“Example of a Federation period Arts and Crafts weatherboard cottage with standard asymmetrical plan. Only in fair condition and has unsympathetic new work. Unusual hood design and fine quality original detail. Local significance. Circa Date: c1915. Style: Federation Arts and Crafts.

“Federation period painted weatherboard cottage. Terracotta tiled hip roof with front and side shingled gable and belcast verandah. Exposed rafters. Decorative timber brackets to paired verandah posts supported on masonry piers. Roughcast render to piers and basecourse. Timber casement windows with toplights. Cement steps.

Modifications: Front and side verandah enclosed with narrower weatherboards and aluminium sliding doors. Weatherboard extension to rear, with fibro lean-to supported on rear. Unsympathetic 3-4 level which brick block of flats next door. Integrity/Intactness: Much integrity has been lost due to substantial unsympathetic alterations” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 71 17 Wells Street c.1997 (Hornsby Shire Council, 2014)



Plate 72 17 Wells Street c.2013

Item I731 – Garden**Address:** 45 Bundarra Avenue, Wahroonga**Lot and DP:** Lot 9 DP 667410**Significance:** Local**LEP Statement of Significance:**

“Garden conserving cultural trees from c1950 period forming Bundarra Ave precinct of high local landscape significance. Of local significance” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The growth of trees has increased since the last inspection, which has led to the lower branches of the cypress being stressed by close crowding from the surrounding vegetation. Otherwise the item remains in comparable condition with its local heritage significance unchanged.



Plate 73	45 Bundarra Avenue c.1993 (Hornsby Shire Council, 2014)	Plate 74	45 Bundarra Avenue c.2013
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Item I743 – Street trees**Address:** Edwards Road, Wahroonga**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“This group of native trees are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) community. Clearing for agriculture and more recently, urban development, has significantly reduced the size of this community..... Although highly fragmented and reduced to only scattered remnant canopy trees, the group in Edwards Road is considered to have significance in terms of its natural, representative, rarity, ecological/ biodiversity, genetic, visual and aesthetic values. This group is dominated by mature Sydney Blue Gums (*Eucalyptus saligna*), Blackbutts (*Eucalyptus pilularis*) and Smooth-barked Apple (*Angophora costata*).

The dramatic size and scale of these mature trees create a distinctive sense of place and bushland aesthetic to this suburban streetscape. Some old growth specimen trees are of individual significance (eg. *Eucalyptus pilularis* in No.2 Edwards Road, *E. saligna* in No.13 Edwards Road and *Angophora costata* on verge adjacent to No.19 Edwards Road). Furthermore, these trees are part of a larger, albeit highly fragmented community (BGHF) on local shale-capped ridges (see listings for Fraser Road and Russell Avenue)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 75	Edwards Road c.2007 (Hornsby Shire Council, 2014)	Plate 76	Edwards Road c.2013
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Item I750 – Street trees**Address:** Ingram Road, Wahroonga**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“The formal avenue plantation along Ingram Road is a fine example of late Post War period (c.1960s) public planting. The avenue is significant in terms of its historic/cultural associations, visual/aesthetic and representative values. The use of a single native species, Brush Box (*Lophostemon confertus*), continues an important local thematic approach typical of this period (e.g. Myra Street plantation linking to Ingram Road, Edgeworth David Avenue, Wahroonga and Jersey Street, Hornsby). The original design intent of a single species avenue has been retained. Furthermore, overall integrity, balance and continuity of this avenue has been maintained with minimal pruning of canopies. This species has been used extensively in street tree plantations throughout Sydney since the early twentieth century and Hornsby Shire retains significant plantations associated with the Post War period” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 77 Ingram Street Trees c.2007 (Hornsby Shire Council, 2014)

Plate 78 Ingram Street Trees c.2013

Item I755 – House**Address:** 6 John Hughes Place, Wahroonga**Lot and DP:** Lot 26 DP 703961**Significance:** Local**LEP Statement of Significance:**

“Good example of Post War Spanish Mission Style house. Features typical of the style include rendered walls with exaggerated texture and verandah logia. Good condition and little altered” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. Vegetation growth (ivy) that was previously growing on the structure has been removed and the front garden has increased with new plantings. The item remains in comparable condition with its local heritage significance unchanged.



Plate 79 6 John Hughes Place c.1992 (Hornsby Shire Council, 2014)	Plate 80 6 John Hughes Place c.2013
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Item I762 – Garden**Address:** 1 Pacific Highway, Wahroonga**Lot and DP:** Part Lot A DP 9921**Significance:** Local**LEP Statement of Significance:**

“Domestic garden with period palm trees, forming a prominent landscape element on busy main road corner. Of local significance. Circa Date: 1930 Two mature Canary Island Palms (to 3m) in front garden of circa 1960's house. 1930s period brick and steel pipe fence, with privet hedge. (Possible that the Palms were part of a larger garden, which was subdivided from the adjacent 1930s residence)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. Both palms are still present and appear to be in good condition. The item remains in comparable condition with its local heritage significance unchanged.



Plate 81 1 Pacific Highway c.1992 (Hornsby Shire Council, 2014)

Plate 82 1 Pacific Highway c.2013

Item I767 – St Pauls Church – Pearces Corner**Address:** 1711 Pacific Highway Wahroonga**Lot and DP:** Lot B DP323414**Significance:** Local**LEP Statement of Significance:**

“Neat stone church. One of very few nineteenth century churches to survive in the Shire, reasonably unaltered. A good example of Victorian Gothic styling. Prominently sited at Pearces Corner and closely associated with its long history. Constructed in 1881. Foundation stone laid by Bishop Barker in 1879. Replaced by an earlier wooden building from c1865. First church services were conducted from Aaron Pearce's cottage nearby. An embryonic settlement grew up at Pearces Corner where the old sawyers' track from Lane Cove branched to Pennant Hills and Peats Ferry. Prior to the railway was known as Hornsby. Name later changed to Wahroonga.

Stone fence to the street boundary was constructed in early Post-war period. The foundation stone for the hall is dated 10 July 1960. The flat roofed addition on the northern side of the church was unveiled on 20 August, 1967. Bas relief design and executed by Donald R. Begbie (the rector) was completed at the same time. Old stone church in the ecclesiastical Gothic style. Coursed, rock faced sandstone. Gabled porch to one side. Distinguished by fine bellvedere. Lancet windows and Gothic arched doors. Stone buttresses. Good lych-gate.

Stone fence. Brick hall on same site, dating from Post-war period. Now with concrete tiled roof. Flat roofed addition on northern side is reasonably unobtrusive on views from the road. Bronze bas relief beside northern addition. Otherwise little altered” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: At the 2013 AECOM inspection the site was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.

**Plate 83** St Pauls Church c.1992 (Hornsby Shire Council, 2014)**Plate 84** St Pauls Church c.2013

Item I768 – Street trees**Address:** Russell Avenue, Wahroonga**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“This group of native trees are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) community. Clearing for agriculture and more recently, urban development has significantly reduced the size of this community.....The impressive stand of trees in Russell Avenue is dominated by Sydney Blue Gums (*Eucalyptus saligna*) of varying age structure. A large number of old growth specimen trees are each of individual significance. The dramatic size and scale of the trees creates a memorable sense of place and bushland character to this suburban streetscape. The group has significance in terms of its natural, representative rarity, ecological/biodiversity, genetic, visual and aesthetic values. Furthermore, these trees are part of a larger, albeit highly fragmented community (BGHF) (see listings for Edwards Road, Fraser Road, Malsbury Road and other listings)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 85 Russell Avenue c.2007 (Hornsby Shire Council, 2014)

Plate 86 Russell Avenue c.2013

Item I769 – Street Trees**Address:** Woonona Avenue, Wahroonga**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“These native trees are remnant components (canopy trees) of the Blue Gum High Forest (BGHF) community.....This community is typically associated with soils derived from Wianamatta Shale. At the far northern end of Woonona Avenue this community grades to Peppermint-Angophora Forest associated with Hawkesbury Sandstone. Although highly fragmented and reduced to remnant groups of canopy species (north and south of Edgeworth David Avenue), these trees are considered to have significance in terms of natural, representative, rarity, ecological/ biodiversity, genetic, visual and aesthetic values. The groups display a typical mixed species composition dominated by Blackbutt (*Eucalyptus pilularis*), Sydney Peppermint (*E. piperita*) and Smooth-barked Apple (*Angophora costata*).

Old growth specimens are of individual significance. Together the trees define a memorable sense of place to this suburban streetscape and are evocative of the original bushland character. Notably, the southern group (south of Edgeworth David Avenue) merges with the Fern Avenue, Ingalara Avenue and Churchill Avenue groups. These groups conserve an impressive number of heritage trees including many old growth specimens. Ingalara Avenue and Churchill Avenue groups are not currently heritage listed. It is important to recognise the combined significance of this cluster of trees in the Wahroonga local area (see listings for Alexandria Parade, Edgeworth David Avenue, Bundarra Avenue and Fern Avenue). All items of natural occurrence (ie. not cultivated). These remnant native trees have been retained within the road reserve, particularly along the wide western verges and extend to adjoining private gardens on both sides of the road. The mixed native species include:- Common Name(s): Botanical Name(s): Smooth-barked Apple (*Angophora costata*); Rough-barked Apple (*Angophora floribunda*); Red Bloodwood (*Corymbia gummifera*); Blackbutt (*Eucalyptus pilularis*); Sydney Peppermint (*Eucalyptus piperita*); Sydney Blue Gum (*Eucalyptus saligna*); Red Mahogany (*Eucalyptus resinifera* subsp. *resinifera*); Turpentine (*Syncarpia glomulifera*)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 87 Woonona Avenue Street Trees c.2007 (Hornsby Shire Council, 2014)



Plate 88 Woonona Avenue Street Trees c.2013

Item I770 – “Cherrygarth” and Garden**Address:** 42 Woonona Avenue, Wahroonga**Lot and DP:** Lot 11 DP 563185**Significance:** Local**LEP Statement of Significance:**

“Outstanding Federation mansion. Let down by painted brick but little altered otherwise. One of the better examples in the Shire and one of only a handful retaining their original landscaped grounds. Local significance. c.1897-98. Federation mansion set in generous landscaped grounds. Two storeys. Constructed of brick with slate roof. Complex plan and roof form. Double verandah on either side of gabled front projection. Turned timber posts with iron lace decoration. Full length double hung windows to upper verandah. Corbelled brick chimneys and terracotta ridge capping. Interiors feature Wunderlich ceilings, marble fireplaces and cedar joinery. Face brick now painted. Otherwise minor alterations only. Unsympathetic modern tubular metal fence” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item has been repainted since the last inspection. The item remains in comparable condition with its local heritage significance unchanged.



Plate 89 42 Woonona Avenue c.1993 (Hornsby Shire Council, 2014)

Plate 90 42 Woonona Avenue c.2013

Item I771 – “Neringala” and Garden**Address:** 46 Woonona Avenue, Wahroonga**Lot and DP:** Lot 1 DP 563185**Significance:** Local**LEP Statement of Significance:**

“Period trees remaining in grounds of Federation residence. Of local significance. Notable Federation mansion. Spoiled by some unsympathetic alterations and additions but seems easily capable of reconstruction. Local significance. Garden c.1910 - 1920; House constructed in 1895. Trees underscoring character of two storeyed Federation period brick house. Include two fine Deodars (to 22m), Ponderosa Pine (to 19m), Cypress (to 12m) and Camphor Laurel (to 16m). Planting of Photinia and Camellias recent but sympathetic. Unsympathetic modern reproduction metal fence. Two storey Federation Queen Anne mansion built c.1895. Dichromatic face brick with terracotta tiled roof. Complex asymmetrical design. Large octagonal projection to front. Balcony to one side, supported by solid, decorative, timber bracket. Front steps back again to double verandah. Turned timber posts with lacework balustrading. Long upper balcony runs along north side. Recessed porch to front below. Casement windows to projection feature multiple upper panes and skylights. Other windows double hung. Well planted grounds, including front garden area. Major alterations, mostly reversible. These include some very unsympathetic balcony and verandah enclosures. Lacework trim and balustrading does not appear original. Carport at side. Unsympathetic modern fencing” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. A front fence has been added to the front of this property including brick and metal bars in its structure. The item remains in comparable condition with its local heritage significance unchanged.



Plate 91 46 Woonona Avenue c.1992 (Hornsby Shire Council, 2014)



Plate 92 46 Woonona Avenue c.2013

Item I772 – Street Trees and Bushland**Address:** Alexandria Parade, Waitara**Lot and DP:** Road Reserve**Significance:** Local**LEP Statement of Significance:**

“Group A: The road reserve adjacent to the railway easement conserves a significant linear group of Blue Gum High Forest (BGHF). This community has a highly restricted geographic distribution and is typically associated with soils derived from Wianamatta Shale (Tozer 2003). Blue Gum High Forest has been highly fragmented and modified by urban development, particularly small-scale clearing and alterations associated with residential subdivision, roads and service easement upgrades.

This group has significance in terms of its natural, representative, rarity, ecological/biodiversity, genetic, visual and aesthetic values. The group displays a typical mixed species composition dominated by Blackbutt (*Eucalyptus pilularis*), Sydney Blue Gum (*E. saligna*) and Smooth-barked Apple (*Angophora costata*). The dramatic scale of these trees define a memorable sense of place and provide an important visual buffer to the railway corridor. Notably, this group retains a native understorey, albeit highly modified by past clearing and weed invasion. Furthermore, the group is part of a significant cluster of fragmented remnant native trees (BGHF) in local streets (refer to listings for Woonona Avenue, Fern Avenue, Bundarra Avenue and Edgeworth David Avenue).

Group B: A formal row plantation of Brush Box (*Lophostemon confertus*), located in the western portion of Alexandria Parade, is believed to date from c. 1950s period. The plantation has local group significance in terms of its historic, cultural, visual/ aesthetic and representative values. Brush Box has been used extensively in street tree planting schemes throughout Sydney since the early twentieth century. Locally, this plantation is part of a broader thematic planting program associated with upgrades and embellishment of railway stations and the rail corridor during the Post War period (refer to listings for Jersey Street, Hornsby and Denman Parade, Normanhurst)” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 93 Alexandria Parade c.2007 (Hornsby Shire Council, 2014)

Plate 94 Alexandria Parade c.2013

Item I791 – House**Address:** 587 Pennant Hills Road, West Pennant Hills **Lot and DP:** Lot 5 DP 801996**Significance:** Local**LEP Statement of Significance:**

“The original cottage is one of the oldest structures in the Shire, possibly the oldest. Despite subsequent alteration most of the original fabric is retained. Much is also revealed internally. Rare example of an early surviving primitive cottage. Regional significance. The original two rooms are believed to be pre-1830. Known locally as 'Marsden's Shepherd's Cottage'. Built on the southeastern corner of the 40 hectare 1799 grant to Samuel Marsden. Marsden sold the property 'Mt Wilberforce' in 1818. It is not known if the cottage was built during his ownership or sometime after. Rendered brick house. Built in several stages around the two original rooms of sandstock brick. Original section has a hipped iron roof and skillion verandah, pitching to the rear. Now supported by solid masonry columns. Original fireplace and chimney at northern end. More recent extensions in the form of intersecting wings. These form an attractive entry courtyard with verandahs along two sides. Several modifications over the years, most of which are now part of the history of the building. The original two rooms are believed to be pre-1830. Known locally as 'Marsden's Shepherd's Cottage'. Built on the southeastern corner of the 40 hectare 1799 grant to Samuel Marsden. Marsden sold the property 'Mt Wilberforce' in 1818. It is not known if the cottage was built during his ownership or sometime after” (Hornsby Shire Council, 2014).

AECOM 2013 Inspection: At the time of inspection view-lines to the item were blocked by a high wall, fence and closed gate. Where visible, the listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 95	587 Pennant Hills Road c.1993 (Hornsby Shire Council, 2014)	Plate 96	587 Pennant Hills Road c.2013
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6.3 Ku-ring-gai Planning Scheme Ordinance 1971

For the purpose of this report, heritage item identification numbers for listed items in Ku-ring-gai local government area have been referred to using the identification numbers assigned to the items under *Draft Ku-ring-gai Local Environmental Plan 2013* because the *Ku-ring-gai Planning Scheme Ordinance 1971* does not include equivalent identification numbers.

Item I897, I898, I900, I901, I902 – Coonanbarra Road Timber Cottages Group

Address: 120, 122, 126, 128 and 130 Coonanbarra Road, Wahroonga

Lot and DP: Lot A DP 321310, Lot 1 DP 966050, Lot 1 DP 365320 and Lot 8 DP 263707

Significance: Local

LEP Statement of Significance:

The listed statement of significance, historic background and description for this site states these are residential buildings (private) that are examples of timber cottages (NSW Office of Environment & Heritage, 2014).

AECOM 2013 Inspection: The listed item was found to mostly correspond to its past description for numbers 120, 122, 126 and 128 Coonanbarra Drive. The item local heritage significance is unchanged for numbers 120, 122, 126 and 128, which are well maintained and in good condition.

Although the register listing includes 130 Coonanbarra Drive, that property does not contain a timber cottage but instead is a two storey house of relatively recent construction. It is noted that Ku-ring-gai Municipal Council resolved to recommend its removal from Schedule 5 of the Draft Ku-ring-gai LEP to the Department of Planning and Infrastructure (Minutes of Ordinary Meeting of Council 26 November 2013). Once made, this the Draft Ku-ring-gai LEP will supersede the current Ku-ring-gai Planning Scheme Ordinance.



Plate 97 126 Coonanbarra Drive c.2013

Plate 98 128 Coonanbarra Drive c.2013

Item I953 – “Bolton Grange”, Dwelling House**Address:** 21 Lucinda Avenue, Wahroonga**Lot and DP:** Lot 92 DP 534261**Significance:** Local**LEP Statement of Significance:**

“Reasons for listing; cultural, architectural, municipal significance. Historical period: 1921-1940. Substantially intact” (NSW Office of Environment & Heritage, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 99 21-23 Lucinda Avenue (Bolton Grange) c.1987
(NSW Office of Environment & Heritage, 2014)

Plate 100 21-23 Lucinda Avenue (Bolton Grange) c.2013

Item I955 – “Matakana” Dwelling House**Address:** 28 Lucinda Avenue, Wahroonga **Lot and DP:** Lot 1 DP 500695**Significance:** Local**LEP Statement of Significance:**

No statement of significance is contained within the Ku-ring-gai Planning Ordinance. The reasons for listing this item are due to its cultural, architectural and municipal significance.

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 101 28 Lucinda Avenue c.2013

Item I956 – “Cullingral” Dwelling House**Address:** 33 Lucinda Avenue, Wahroonga**Lot and DP:** Lot 1 DP 549844**Significance:** Local**LEP Statement of Significance:**

No statement of significance is contained within the Ku-ring-gai Planning Ordinance. The reasons for listing this item are due to its cultural, architectural and municipal significance.

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 102 33 Lucinda Avenue c.2013

Item I1012 – “Poole House”, Dwelling House**Address:** 24 Woonona Avenue, Wahroonga**Lot and DP:** Lot 14 DP 2870 & Lot 1 DP 1004733**Significance:** Local**LEP Statement of Significance:**

“Reasons for listing; architectural, municipal significance. Historical period: 1901-1920. The oldest building on the Junior Campus. Altered or extended unsympathetically” (NSW Office of Environment & Heritage, 2014).

AECOM 2013 Inspection: The listed item was found to correspond to its past recording description and photographs. The item remains in comparable condition with its local heritage significance unchanged.



Plate 103 26 Woonona Avenue c.1987 (NSW Office of Environment & Heritage, 2014)

Plate 104 26 Woonona Avenue c.2013

6.4 Draft Ku-ring-gai Local Environmental Plan 2013

This section considers heritage items identified under the *Draft Ku-ring-gai Local Environmental Plan 2013* which are not otherwise already listed under the *Ku-ring-gai Planning Scheme Ordinance 1971*.

Item I855 – Dwelling House

Address: 4 Burns Road, Wahroonga

Lot and DP: Lot 2 DP 548275

Significance: Local

LEP Statement of Significance:

No statement of significance has been prepared for this item. The reasons for listing this item in the *Draft Ku-ring-gai Local Environmental Plan 2013* is due to its cultural, architectural and municipal significance.

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 105 4 Burns Road c.2010



Plate 106 4 Burns Road c.2013

Item I954 – Dwelling House**Address:** 24 Lucinda Avenue, Wahroonga**Lot and DP:** Lot A DP 367553**Significance:** Local**LEP Statement of Significance:**

No statement of significance is contained within the Ku-ring-gai Planning Ordinance. The reasons for listing this item are due to its cultural, architectural and municipal significance.

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 107 24 Lucinda Avenue c.2013

Item I957 – “Mansfield” Dwelling House**Address:** 41 Lucinda Avenue, Wahroonga**Lot and DP:** Lot 1 DP 16374**Significance:** Local**LEP Statement of Significance:**

No statement of significance is contained within the Ku-ring-gai Planning Ordinance. The reasons for listing this item are due to its cultural, architectural and municipal significance.

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 108 41 Lucinda Avenue c.2013

Item I959 – “Hindfell” Dwelling House**Address:** 11A Lucinda Avenue, Wahroonga**Lot and DP:** Lot 4 DP 624660**Significance:** Local**LEP Statement of Significance:**

No statement of significance is contained within the Ku-ring-gai Planning Ordinance. The reasons for listing this item are due to its cultural, architectural and municipal significance.

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 109 11A Lucinda Avenue c.2013

Item I960 – Dwelling House**Address:** 37A Lucinda Avenue, Wahroonga**Lot and DP:** Lot 22 DP 561089**Significance:** Local**LEP Statement of Significance:**

“Excellent timber example of an Inter-War Bungalow. Has much in common with the original Californian model, with suggested Japanese influence. Unusual double-gabled design. Good condition. Fine quality original timber detail, including windows and gables” (NSW Office of Environment & Heritage, 2014).

AECOM 2013 Inspection: The listed item was found to be in good condition with its local heritage significance unchanged.



Plate 110 37A Lucinda Avenue c.2013

6.5 The Hills Local Environmental Plan 2012

Item I28 – Windsor Road from Baulkham Hills and Box Hill**Address:** Windsor Road from Baulkham Hills to Box Hill**Lot and DP:** Road reserve**Significance:** Local**Additional Heritage Listings:** Section 170 Heritage and Conservation Register (Roads and Maritime)**Statement of Significance:**

“The Windsor and Old Windsor Roads, as first laid out in 1794 and re-aligned in 1812-1813, are of State and national significance. They incorporate the second road to be laid out in the colony and played an important role in the settlement of the Hawkesbury region and the development of the colony of NSW. The Windsor and Old Windsor Roads retain characteristics evocative of the historic, rural character of the Cumberland plain, both within the current road reserve and in redundant sections outside the reserve. Together they are vital in understanding the cultural landscapes of the region. Remaining historic road fabric, both inside and outside the current road reserve, demonstrates the methods of road construction and maintenance over two centuries.” (NSW Office of Environment & Heritage, 2014).

The Windsor Road and Old Windsor Road Conservation Management Plan (Clive Lucas Stapleton, 2005) provides details of the grades of significance, significant features and heritage precincts relating to the listed roads. While the Conservation Management Plan identifies the earliest alignments as being of state historical significance, its statutory listing was restricted to sections that had been bypassed or have retained elements of their original roadside setting. These are as follows:

- McGraths Hill Archaeological Site and Cemetery;
- Old Hawkesbury Road WR6: Vineyard Alignment;
- First Ponds Creek Alignment;
- Box Hill Vergescape;
- Rouse Hill Road Cutting;
- Caddies Creek Alignment;
- Strangers Creek Alignment;
- Excelsior Way Alignment ;
- Stanhope Farm Alignment; and
- Meurant's Lane Alignment.

None of the listed items are close to the Hills M2 Motorway or Windsor Road interchange.

AECOM 2013 Inspection: This section of Windsor Road within the study area has been impacted by the construction and subsequent upgrade of the Hills M2 Motorway. More recently, as part of the Hills M2 Motorway Upgrade project, this section of road has been impacted by the construction of the additional westbound on-ramps and eastbound off-ramps at the Windsor Road interchange. The previous construction activities have required substantial works to the road at this location, and the alignment appears to have been altered at the time of constructing the interchange as sections on either side of the interchange are reasonably sinuous whereas the interchange has been design to meet contemporary road design requirements.

6.6 Heritage Conservation Areas

Item C2 – Beecroft-Cheltenham Heritage Conservation Area (Hornsby)

Heritage Listing: Hornsby LEP

Significance: Local

Statement of Significance:

The heritage conservation area covers the suburbs of Beecroft and Cheltenham in the Hornsby local government area. The heritage conservation area is part of a larger landscape of existing roads, houses and vegetation, and has been divided into five precincts under the Hornsby Development Control Plan 2013. The relevant precinct for this assessment is the Northern Triangle precinct.

“The Beecroft-Cheltenham Heritage Conservation Area is significant as an example of a government subdivision that was used to fund the development of a railway line. The area developed from 1893 as a township due to its proximity to Beecroft Station.

The Heritage Conservation Area demonstrates a multi-layered history of suburban subdivision, re-subdivision and development from the interim boom period of the Victorian crown land subdivision of 1887 to the 1960's, and less noticeably into the present day.

The area contains a fine collection of buildings from the Victorian, Federation, Arts and Crafts, Inter-War, and Post-War eras. There have been comparatively few demolitions to interrupt the “development diary” resulting in generally intact early residential fabric and streetscapes.

The Beecroft Village Precinct contains an important public reserve and community buildings including the Beecroft School of Arts and the Beecroft War Memorial that represent the aspiration of a growing suburb. The continuing focus in the Beecroft village for day to day activities and community interaction, together with the community buildings, clubs and activities show an enduring sense of community cohesiveness” (Hornsby Shire Council, 2013).

The Hornsby Development Control Plan 2013 also describes the character statement for the Northern Triangle precinct, which is as follows:

“The triangle on the northern side of Pennant Hills Road is an area of more recent development. This area remained semi-rural until the Inter-war period, with orchards still present in the early 1960s. The undulating landscape has an irregular subdivision pattern with varying lot sizes. Large Federation houses are located along Pennant Hills Road and Boundary Road, and at the southern end towards Chapman Avenue. The remnant forest canopy is important to the area's character” (Hornsby Shire Council, 2013).

AECOM 2013 Inspection: The listed conservation area was found to be in good condition with its local heritage significance unchanged.

Item C7 – Wahroonga Heritage Conservation Area (Hornsby)**Heritage Listing:** Hornsby LEP**Significance:** Local**Statement of Significance:**

The heritage conservation area covers from John Hughes Place to Ingram Road and Isis Street, Wahroonga. The area is part of a larger landscape of existing roads, houses and vegetation. This heritage conservation area contains listed items I751, I752, I753, I754, I756 and I767 within its bounds (Hornsby Shire Council, 2014).

“The Wahroonga Heritage Conservation Area is an example of early 19th century subdivision with a consistent built form of modest single and two storey houses. The area is closely associated with the construction of the North Shore railway line and Pearces corner settlement” (Hornsby Shire Council, 2013).

AECOM 2013 Inspection: The listed conservation area was found to be in good condition with its local heritage significance unchanged.

Item C8 – Wahroonga North Heritage Conservation Area (Hornsby)**Heritage Listing:** Hornsby LEP**Significance:** Local**Statement of Significance:**

The heritage conservation area covers from Highlands Avenue to Woonona Avenue and Alexandria Parade, Wahroonga. The area is part of a larger landscape of existing roads, houses and vegetation. This heritage conservation area contains items I7/01, I727, I728, I730, I732, I734, I738, I739, I741, I744, I745, I746, I747, I748, I749, I760, I769, I770 and I771 within its bounds (Hornsby Shire Council, 2014).

The Wahroonga North Heritage Conservation Area is closely associated with the opening of the North Shore Railway line in the 1890's, and includes land in the early estates of the locality, Bundarra Estate (1892) and its subsequent Federation development. It also includes the pre War and Inter War subdivisions of the Bundarra (Ingalara) Estate (1913), Wahroonga Heights Estate (1926) and the two divisions of the Highlands Estate (1933 and 1938) that led to the Inter War development of the area.

The Heritage Conservation Area is strongly associated with significant local persons including the Hordern Family and particularly the family matriarch, Caroline Hordern and the Hordern Family Estate which centred on their mansion, “Highlands House. The Heritage Conservation Area is aesthetically distinctive, with a strong collection of Federation residential buildings. This includes “Highlands House” (1892), “Neringla” (1895) and “Cherrygarth” (1897). The overlay of Inter War houses is unified and made complementary by the landscaped setting.

The Heritage Conservation Area is important as a reference site for Hornsby, particularly in relation to the early development of the area. The area has potential to reveal its pre-Victorian development and use through research. The Heritage Conservation Area demonstrates the post 1892 residential development of the area, exhibiting built and landscape qualities that are becoming rare within Hornsby and which are endangered by continuing unsympathetic development. (Sue Haertsch Planning 2010)

AECOM 2013 Inspection: The listed conservation area was found to be in good condition with its local heritage significance unchanged.

Item C1 – Wahroonga Heritage Conservation Area (Ku-ring-gai)

Heritage Listing: Ku-ring-gai Planning Scheme Ordinance

Significance: Local

Statement of Significance:

This area covers from John Hughes Place to Ingram Road and Isis Street, Wahroonga. The area is part of a larger landscape of existing roads, houses and vegetation.

The listed statement of significance for this site states:

“Wahroonga Heritage Conservation Area is of heritage significance for its distinctive residential streetscapes which evidence the transformation of early subdivisions of the 1890s into the later rectilinear grid lot street and lot pattern of later subdivisions including the Wahroonga Heights Estate. The area contains a significant collection of grand residences from the Federation and Inter-war periods, built following the opening of the North Shore railway line in 1890, many of these the residences of prominent families of this period, and often designed by prominent architects, for example the 1894 Ewan House (formerly Innisfail) designed by architect Howard Joseland. The western end of Burns Road and western side of Coonanbarra Road are representative streetscapes of intact more modest Federation period houses.

The through-block pathways and formal avenues of street trees within the area (in Burns Road, Water Street and Coonanbarra Road) along with the formal landscaping of Wahroonga Park, and its distinctive John Sulman-design shops in Coonanbarra Road facing the Park, are a tribute to the work of the Wahroonga Progress Association in the early 20th century (which included Sulman as a member), and have resulted in a high-quality and distinctive residential landscape” (Davies, 2010).

AECOM 2013 Inspection: The listed conservation area was found to be in good condition with its local heritage significance unchanged.

6.7 Non-listed heritage items

During the surveys, areas of potential heritage value were investigated to look for items with heritage value that are not listed and may be impacted by the project. In general, it was found that unlisted items of potential were captured through locally listed heritage conservation areas. No items of heritage value that are not currently listed were considered as being at risk from direct impact from surface works associated with the project. Likewise, there would be potential negligible impacts to structures along the preferred project corridor as a result of tunnel construction. Nonetheless, existing condition surveys for properties within this corridor would be completed prior to construction. This is discussed further in **Section 8.2**.

6.8 Archaeological heritage

In addition to listed archaeological sites identified within existing heritage registers (refer to **Chapter 5.0**), a review of historical parish maps and plans was undertaken for the study area to gain an understanding and appreciation of the potential archaeological heritage present within the identified impact areas. Apart from those areas previously identified as part of local government heritage studies, no new potential archaeological resources were identified. While there may be potential for intact archaeological deposits to be present, the localised footprint of surface works likely to cause impacts, coupled with the extent of current modern impacts associated with the existing road network makes impacts to this archaeology unlikely. This has not been considered further in this assessment. However, mitigation measures have been identified in the event of unexpected cultural heritage finds (refer to **Chapter 9.0**).

7.0 Significance Assessment

7.1 Significance Assessment Criteria

In order to understand how development would impact on a heritage item, it is essential to understand why an item is significant. An assessment of significance is undertaken to explain why a particular site is important and to enable the appropriate site management and curtilage to be determined. Cultural significance is defined in the Australia ICOMOS Charter for the conservation of places of cultural significance (the Burra Charter) as meaning "aesthetic, historic, scientific or social value for past, present or future generations" (Article 1.1). Cultural significance may be derived from a place's fabric, association with a person or event, or for its research potential. The significance of a place is not fixed for all time, and what is of significance to us now may change as similar items are located, more historical research is undertaken and community tastes change.

The process of linking this assessment with a site's historical context has been developed through the NSW Heritage Management System and is outlined in the guideline Assessing Heritage Significance (NSW Heritage Office, 2001), part of the NSW Heritage Manual (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996). The Assessing Heritage Significance guidelines establish seven evaluation criteria (which reflect four categories of significance and whether a place is rare or representative) under which a place can be evaluated in the context of State or local historical themes. Similarly, a heritage item can be significant at a local level (i.e. to the people living in the vicinity of the item), at a State level (i.e. to all people living within NSW) or be significant to the country as a whole and be of National or Commonwealth significance.

Following amendments to the *Heritage Act 1977* in 2009, to be of State significance an item must meet two or more of the criteria outlined in **Table 2**. Items can be deemed to be of local significance if they meet one or more criteria. An item is excluded under this criterion if it is a poor example or has lost the range of characteristics of a type. The Heritage Council requires the summation of the significance assessment into a succinct paragraph, known as a Statement of Significance. The Statement of Significance is the foundation for future management and impact assessment.

A review of the significance assessment for of each listed heritage item is provided in **Table 3**. The review has been undertaken in light of the outcomes of the field inspections conducted to inform this report, in order to confirm whether the original significance assessment remains current and accurate.

Table 2 NSW Heritage significance criteria

Criterion	Requirements
Criterion (a) - An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area).	<ul style="list-style-type: none"> - items which demonstrate strong associations to past customs, cultural practices, philosophies or systems of government, regardless of the intactness of the item or any structure on the place; - items associated with significant historical events, regardless of the intactness of the item or any structure on the place; - significant cultural landscapes and other items demonstrating overlays of the continual pattern of human use and occupation; and/or - items where the physical fabric (above or below ground) demonstrates any of the points described above.
Criterion (b) – an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history (or the cultural or natural history of the local area).	<ul style="list-style-type: none"> - items which demonstrate strong associations to a particular event, historical theme, people or philosophies, regardless of the intactness of the item or any of its structures; - items associated with significant historical events, regardless of the intactness of the item or any structure on the place; and/or - items where the physical fabric (above or below ground) demonstrates any of the points described above.

Criterion	Requirements
Criterion (c) – an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area).	<ul style="list-style-type: none"> - items which demonstrate creative or technical excellence, innovation or achievement; - items which have been the inspiration for creative or technical achievement; - items which demonstrate distinctive aesthetic attributes in form or composition; - items which demonstrate a highly original and influential style, such as an important early (seminal) work of a major architect; and/or - items which demonstrate the culmination of a particular architectural style (known as climactic).
Criterion (d) – an item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons.	<ul style="list-style-type: none"> - items which are esteemed by the community for their cultural values; - items which if damaged or destroyed would cause the community a sense of loss; and/or - items which contribute to a community's sense of identity. - Items are excluded if: - they are valued only for their amenity (service convenience); and/or - the community seeks their retention only in preference to a proposed alternative.
Criterion (e) – an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area).	<ul style="list-style-type: none"> - has the potential to yield new or further substantial scientific and/or archaeological information - is an important benchmark or reference site or type - provides evidence of past human cultures that is unavailable elsewhere
Criterion (f) – an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area).	<ul style="list-style-type: none"> - provides evidence of a defunct custom, way of life or process - demonstrates a process, custom or other human activity that is in danger of being lost - shows unusually accurate evidence of a significant human activity - is the only example of its type - demonstrates designs or techniques of exceptional interest - shows rare evidence of a significant human activity important to a community
Criterion (g) – An item is important in demonstrating the principal characteristics of a class of NSW's: <ul style="list-style-type: none"> - cultural or natural places; or - cultural or natural environments. 	<ul style="list-style-type: none"> - is a fine example of its type - has the principal characteristics of an important class or group of items - has attributes typical of a particular way of life, philosophy, custom, significant process, design, technique or activity - is a significant variation to a class of items - is part of a group which collectively illustrates a representative type - is outstanding because of its setting, condition or size - is outstanding because of its integrity or the esteem in which it is held

Table 3 Summary significance assessment of listed heritage items

LEP / Ordinance	LEP No.	Item	Original significance assessment							AECOM assessment
			a	b	c	d	e	f	g	
Hornsby LEP	A60	Loretto [sic] Convent group—grounds, gates and cemetery		•	•					Significance confirmed.
Hornsby LEP	A61	Blackwood Memorial Sanctuary, including North Road culvert			•			•	•	Significance confirmed.
Hornsby LEP	A62	Observatory Park — Observatory site and park			•			•	•	Significance confirmed.
Hornsby LEP	A66	Remains of Maltworks			•					The heritage item actually meets criteria B, F and G due to its association with the Chilvers family and its representativeness and rarity.
Hornsby LEP	C2	Beecroft - Cheltenham Conservation Heritage Area	•	•	•			•	•	Significance confirmed.
Hornsby LEP	C7	Wahroonga Heritage Conservation Area	•	•	•			•	•	Significance confirmed.
Hornsby LEP	C8	Wahroonga North Heritage Conservation Area	•	•	•			•	•	Significance confirmed.
Hornsby LEP	I68	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I98	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I111	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I138	Pennant Hills Golf Club—grounds			•			•	•	Significance confirmed.
Hornsby LEP	I475	Street trees			•			•	•	Significance confirmed.

LEP / Ordinance	LEP No.	Item	Original significance assessment							AECOM assessment
			a	b	c	d	e	f	g	
Hornsby LEP	I590	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I596	Garden			•					Significance confirmed.
Hornsby LEP	I603	House			•					Significance confirmed.
Hornsby LEP	I607	Loretto [sic] Convent group—grounds, gates and cemetery		•	•					Significance confirmed.
Hornsby LEP	I618	St. Agatha's Primary School—grounds (excluding buildings)			•			•	•	Significance confirmed.
Hornsby LEP	I619	"Cheddington" and stables (formerly "Niara")				•				The main building 'Cheddington' has been significantly renovated and extended. The stables have had only minor modification.
Hornsby LEP	I626	House			•					Significance confirmed.
Hornsby LEP	I630	House			•					Significance confirmed.
Hornsby LEP	I652	"Camira"			•					Significance confirmed.
Hornsby LEP	I653	Mount St. Benedict's Convent and grounds		•	•					Significance confirmed.
Hornsby LEP	I654	Observatory Park — Observatory site and park			•			•	•	Significance confirmed.
Hornsby LEP	I660	Fence			•					Repainted.
Hornsby LEP	I661	Fence			•					Vegetation growth has obscured the fence.

LEP / Ordinance	LEP No.	Item	Original significance assessment							AECOM assessment
			a	b	c	d	e	f	g	
Hornsby LEP	I662	House and fence			•					Significance confirmed.
Hornsby LEP	I666	"Bushloe"			•					Significance confirmed.
Hornsby LEP	I680	House			•					Significance confirmed.
Hornsby LEP	I681	House			•					Significance confirmed.
Hornsby LEP	I682	House			•					Significance confirmed.
Hornsby LEP	I683	"Hillcourt"			•					Significance confirmed.
Hornsby LEP	I684	"Karoola"			•					Significance confirmed.
Hornsby LEP	I689	House			•					Significance confirmed.
Hornsby LEP	I690	House			•					Significance confirmed.
Hornsby LEP	I691	The Maze			•					Significance confirmed.
Hornsby LEP	I710	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I714	"Loch Maree House" and garden			•					Significance confirmed.
Hornsby LEP	I716	House			•					Significance confirmed.
Hornsby LEP	I723	House			•					Significance confirmed.
Hornsby LEP	I724	Gardens			•			•		Significance confirmed.

LEP / Ordinance	LEP No.	Item	Original significance assessment							AECOM assessment
			a	b	c	d	e	f	g	
Hornsby LEP	I725	House			•					Significance confirmed.
Hornsby LEP	I731	Garden			•					Significance confirmed.
Hornsby LEP	I743	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I750	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I755	House			•					Significance confirmed.
Hornsby LEP	I762	Garden			•					Significance confirmed.
Hornsby LEP	I767	St Pauls Church - Pearces Corner			•					Significance confirmed.
Hornsby LEP	I768	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I769	Street trees			•			•	•	Significance confirmed.
Hornsby LEP	I770	"Cherrygarth" and garden			•					Significance confirmed.
Hornsby LEP	I771	"Neringala" and garden			•					Significance confirmed.
Hornsby LEP	I772	Street trees and bushland			•			•	•	Significance confirmed.
Hornsby LEP	I791	House			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	C1	Wahroonga Heritage Conservation Area	•	•	•			•	•	Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	I897	Timber Cottages Group			•					Significance confirmed.

LEP / Ordinance	LEP No.	Item	Original significance assessment							AECOM assessment
			a	b	c	d	e	f	g	
Ku-ring-gai Planning Scheme Ordinance	1898	Timber Cottages Group			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	1900	Timber Cottages Group			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	1901	Timber Cottages Group			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	1902	Timber Cottages Group			•					The structure currently at the listed address is a two storey brick house. The timber structure previously registered here has likely been demolished and council has recommended its removal from the heritage schedule of the LEP.
Ku-ring-gai Planning Scheme Ordinance	1953	"Bolton Grange" Dwelling House			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	1955	"Matakana" Dwelling House			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	1956	"Cullingral" Dwelling House			•					Significance confirmed.
Ku-ring-gai Planning Scheme Ordinance	11012	"Poole House" Dwelling House			•					Significance confirmed.
Draft Ku-ring-gai LEP	1855	Dwelling House			•					Significance confirmed.
Draft Ku-ring-gai LEP	1954	Dwelling House			•					Significance confirmed.
Draft Ku-ring-gai LEP	1957	"Mansfield" Dwelling House			•					Significance confirmed.

LEP / Ordinance	LEP No.	Item	Original significance assessment							AECOM assessment
			a	b	c	d	e	f	g	
Draft Ku-ring-gai LEP	I959	"Hindfell" Dwelling House			•					Significance confirmed.
Draft Ku-ring-gai LEP	I960	Dwelling House			•					Significance confirmed.
The Hills LEP	I28	Windsor Road from Baulkham Hills and Box Hill	•	•	•	•	•			The sections of road that represent this listing are not within the study area. Nonetheless, it is noted that those sections of the road within the study area have been recently modified following the construction of additional ramps at the Windsor Road interchange as part of the Hills M2 Motorway Upgrade project.

8.0 Issues and potential impacts

The following section draws upon information provided in **Chapter 5.0** and **Chapter 6.0** to address the issues and potential impacts on identified heritage items during the construction and operation of the project. These impacts would need to be reviewed during detailed design.

8.1 Potential impact areas

For the purpose of the historic heritage impact assessment, the potential areas of impact have been divided into the following components:

- **Windsor Road compound**, which would be used for construction only (C1).
- **The southern interchange**, including on-ramps- and off- ramps, the southern ventilation facility, the motorway control centre and southern interchange construction compound (C5).
- **The main alignment tunnels**.
- **Wilson Road site**, which would be the Wilson Road compound (C6) during construction and the Wilson Road tunnel support facility during operation.
- **Trelawney Street site**, which would be the Trelawney Street compound during construction (C7), and the Trelawney Street tunnel support facility during operation.
- **Pioneer Ave compound** which would be used for construction only (C8).
- **The northern interchange**, including on-ramps and off-ramps, surface road works, the northern ventilation facility, the M1 Pacific Motorway tie-in works and the three construction compounds (northern interchange compound (C9), Bareena Avenue compound (C10) and Junction Road compound (C11)).

With the exception of the Windsor Road compound (C1), no listed heritage items are located in proximity to the Hills M2 Motorway integration works (including the Darling Mills Creek compound (C2), the Barclay Road compound (C3) and the Yale Close compound (C4)). These areas have therefore not been considered further in this report.

Potential impact areas are shown in **Figure 3** to **Figure 7**, with more detailed descriptions of activities that would be undertaken at each of the sites listed above provided in Chapter 5 of the environmental impact statement for the project.

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Figure 3 Impact Area - Hills M2 Motorway integration works

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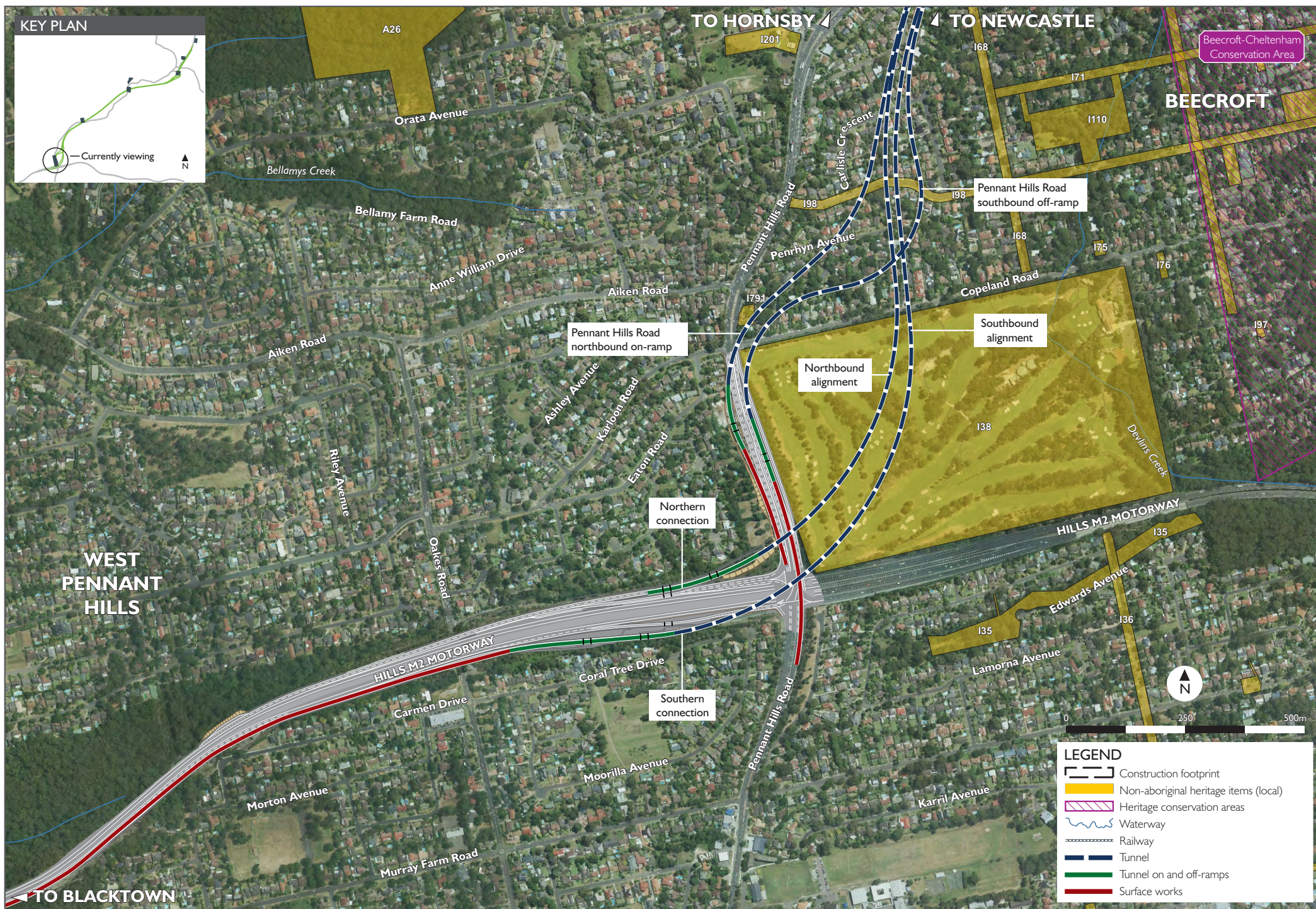


Figure 4 Impact area - southern interchange

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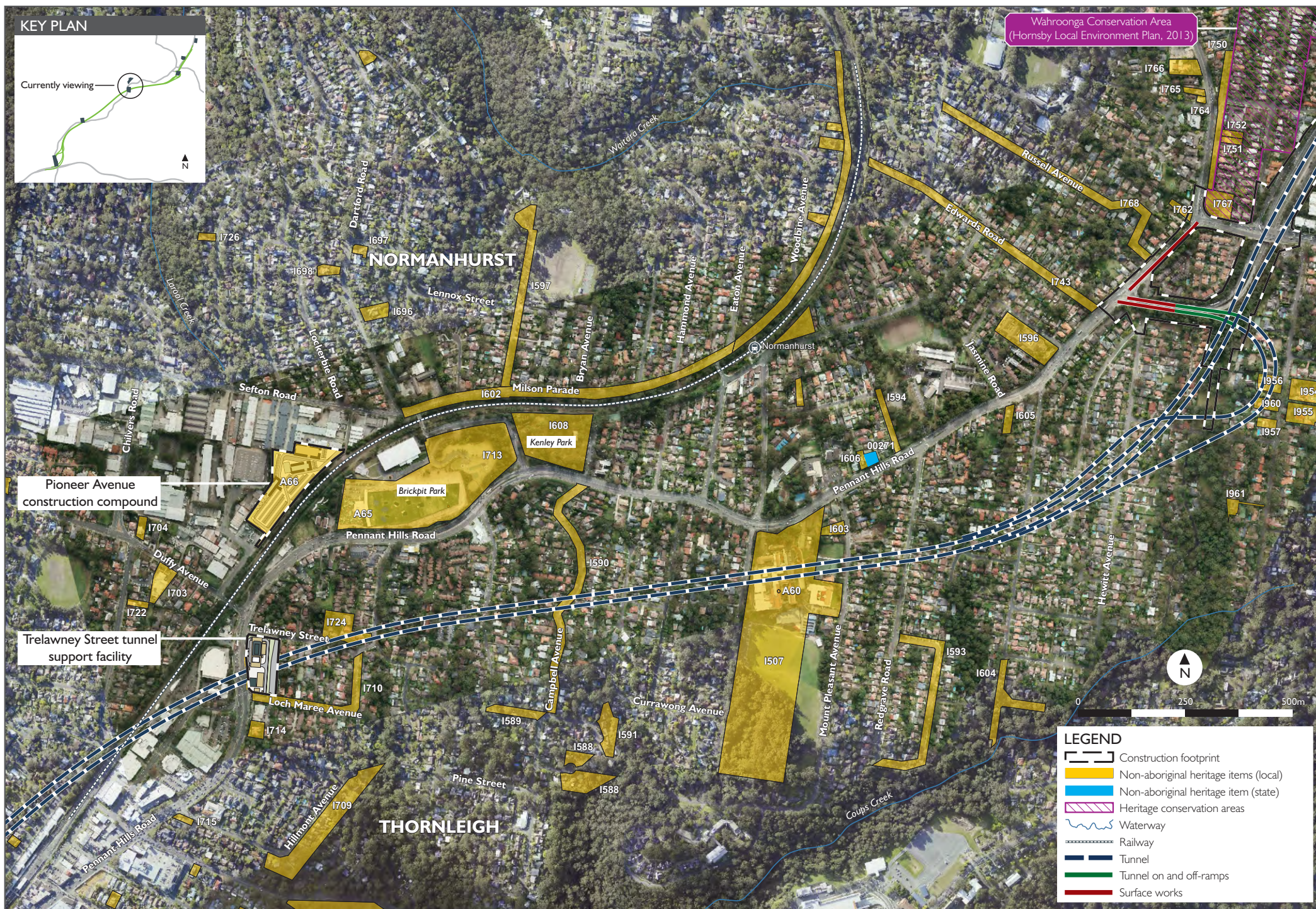


Figure 6 Impact area - Trelawney Street and Pioneer Avenue construction compound and tunnels

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8.2 Potential impact types

Impacts on non-Aboriginal heritage items have been categorised as follows:

- **Direct** – where the project would be located within the curtilage of the heritage item and / or involve the demolition or modification of the heritage item.
- **Potentially direct** – where the project may impact on the heritage item subject to the condition of the item, more detailed investigation, construction methodologies and / or the implementation of mitigation and management measures.
- **Indirect** – where the project would change the visual context and surroundings of a heritage item.

Table 4 Potential impact types

Impact	Description
Direct	
Heritage vegetation removal	Road widening and construction activities resulting in the requirement to remove heritage listed vegetation.
Acquisition	Impacts resulting from the full or partial acquisition (and associated demolition) of properties that contain heritage items.
Change in heritage conservation area values	Construction of a new element within a heritage conservation area.
Demolition	Demolition of structures for construction compound.
Potentially direct	
Acoustic treatment	Properties, some of which may be listed heritage items, may qualify for at-property acoustic treatment. This may impact on the fabric or the significance of the heritage item.
Vibration, settlement and groundwater drawdown from tunnelling works	The area of potential impact for the main alignment tunnels, on-ramp and off-ramp tunnels includes a zone on the surface equal to a distance of 50 metres from the outer edge of the underground tunnels. The potential impacts on non-Aboriginal heritage items would be a potential indirect impact by virtue of: <ul style="list-style-type: none"> - construction vibration as the road headers pass underneath properties; - the settlement of land if tunnelling activities are conducted underneath or close to heritage features; or - impacts on tree roots, in the case of street trees, depending on the depth of the tunnelling activity.
Vibration from surface works	Depending on the setback of buildings from the construction footprint, there is the potential for vibration impacts associated with surface road works, building construction and / or the cut-and-cover sections of the main alignment tunnels, and on and off-ramps.
Dust	Construction activities may result in the generation of dust where works are at the surface or during the handling of spoil. Spoil handling would be in part undertaken inside acoustic sheds at compounds. Air quality impacts during construction would be managed by implementing standard and best practice mitigation measures. As such, this potential impact has not been considered further.

Impact	Description
Indirect	
Visual	<p>There may be temporary and permanent visual impacts as result of the project. These may include:</p> <ul style="list-style-type: none"> - construction of new road infrastructure or ancillary facilities; - alterations to surface roads; - new noise walls or modifications to existing noise walls, including changes to the height of noise walls; - removal of vegetation; or - establishment and use of construction compounds.

8.2.1 Vibration

Technical working paper: noise and vibration (AECOM, 2014) provides an assessment of potential construction vibration impacts as a result of works at surface and below ground (tunnelling).

The extent of potential vibration impacts to structures would be dependent on the type of equipment, the activity being undertaken and the separation distances. Earthworks, tunnelling and bridge works are expected to be the major vibration causing activities, given the activity and the type of equipment being used.

In summary, the noise and vibration assessment for the project concludes that:

- for tunnelling activities, the predicted vibration levels at heritage items are estimated to be around 2 mm/s or less, which is below the recommended maximum level of vibration that would be applicable to heritage structures set within the German Standard DIN 4150 - Part 3 - Structural Vibration in Buildings – Effects on Structures (refer to **Table 5**). These levels are designed to minimise the risk of cosmetic surface cracks and are set well below the levels that have the potential to cause damage to the main structure. Examples of threshold or cosmetic cracking include minor non-structural effects such as superficial cracking in cement render or plaster.
- for surface works, such as at the northern interchange and southern interchange, cosmetic damage to buildings would be unlikely where the building is distanced from the project by five metres to 25 metres (depending on the vibration-generating equipment being used and the location of that equipment within each construction area). Safe working distances for vibration intensive plant equipment are outlined in the technical working paper: noise and vibration (AECOM, 2014), along with recommended mitigation measures where works within these setbacks cannot be avoided.

Table 5 Structural damage vibration limits relevant to heritage structures

Type of structure	Vibration Velocity (mm/s)			
	At Foundation at a Frequency of			Vibration at the Horizontal Plane of the Highest Floor
	Less than 10Hz	10Hz to 50 Hz	50Hz to 100Hz	All frequencies
Structures that because of their particular sensitivity to vibration, do not correspond to commercial, industrial, or residential building types and have intrinsic value (e.g. buildings that are under a preservation order)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

8.2.2 Ground settlement

The ground settlement as a result of the project, and its potential impacts on heritage structures would be dependent on the geotechnical conditions, the depth of the tunnelling activity, the number of storeys of the building, and the position, condition and masonry of the structure itself.

Section 7.8 of the environmental impact statement for the project provides an assessment of the potential impacts of ground settlement on structures. Specific to heritage items, it is noted that:

- for the majority of items, no or very little settlement (five millimetres or less) has been estimated along the preferred project corridor. The magnitude of potential movement would be minor, and therefore the risk of damage to structures would be negligible.
- for a limited number of properties located near the southern and northern interchanges, settlement of around 10 millimetres has been estimated, with an angular distortion of up to around 0.03 per cent. Based on Burland et al (1996) and the angular distortion predicted at those properties, the degree of damage to the structure as result would be negligible. Examples of visible potential impacts would be cosmetic and could include hairline cracks less than around 0.1 millimetres.

However, it is noted that these results are preliminary and do not take into account the specifics of the property itself. Further assessments and property condition reports would be undertaken during detailed design to determine the level of potential impact on structures and to identify what mitigation and management measures would be required to minimise potential ground settlement impacts.

8.2.3 Acoustic treatment

Technical working paper: noise and vibration (AECOM, 2014) identifies properties that may be eligible for at-property acoustic treatment, due to the potential for exceedances of applicable noise criteria at these locations. Depending on the level of noise exceedance, at-property treatment may include for example, sealing of wall vents or upgrading of window and door seals.

Three of the properties identified for at-property acoustic treatment are or contain listed heritage items, namely:

- "Hindfell" Dwelling House (Draft Ku-ring-gai LEP reference: I959).
- St Pauls Church - Pearces Corner (Hornsby LEP reference: I767).
- "Cherrygarth" and garden (Hornsby LEP reference: I770).

The need for acoustic treatment at each property would be confirmed during detailed design, in consultation with the relevant landowners, and with consideration of potential impacts to heritage values.

Should at-property acoustic treatment be required for the above listed heritage items, this may result in impacts to the fabric of these items. Treatment would be sympathetic to the heritage values of each item and would be undertaken in accordance with the Burra Charter, which stipulates that changes which reduce cultural significance should be reversible.

8.3 Assessment of potential impacts

For the purposes of comparative assessment, the criteria in **Table 6** have been established for ranking the degree of impact from the construction and operation of the project.

Table 6 Non-Aboriginal heritage impact criteria

Impact assessment	Criteria
Negligible	- Impacts to the heritage item in question would be negligible and would not affect the overall heritage significance of the item.
Minor impact	- Minor impacts may occur to the listed item, typically with respect to its reported curtilage as opposed to the listed item itself. - These impacts would be minimal in nature and would not affect the overall heritage significance of the item.
Significant impact	- Impacts to the heritage item are unavoidable with the current project design. - The heritage value of the item would be impacted.

8.4 Identified impacts to listed heritage items

Identified impacts to heritage items, both direct and indirect, are detailed in

Table 7.

In summary, 62 heritage items would be directly or indirectly impacted by the project. In some instances, an item would be directly and indirectly impacted by the project. Of the 62 heritage items:

- One item would be fully and directly impacted with the removal of two Canary Island Palms (Hornsby LEP reference: I762) located within a property that would be partially acquired. Feasible and reasonable options would be investigated during detailed design to relocate the two Canary Island Palms, however, the impacts to this item are likely to be significant
- Two items would be partially and directly impacted with
 - The demolition of structures associated with the Thornleigh Maltworks site (Hornsby LEP reference: A66). Feasible and reasonable options have been investigated during design of the project to date with the aim of retaining the original industrial structure associated with this site, however, the impacts to the overall site complex are likely to be significant.
 - Impacts to the curtilage of heritage listed street trees at Woonona Avenue, Wahroonga (Hornsby LEP reference: I769). Feasible and reasonable options would be investigated to avoid or minimise the impact. If it is necessary to remove the trees, this would have some impact to the heritage value of the item. This impact could be mitigated through sympathetic plantings of similar species through revegetation efforts.
- Two heritage conservation areas would be partially and directly impacted, being the North Wahroonga heritage conservation area (Hornsby LEP reference: C2), and the Beecroft-Cheltenham heritage conservation area (Hornsby LEP reference: C8). Landscaping of the project within these areas would minimise the potential impacts. The overall heritage value of the heritage conservation areas would not be significantly impacted by the project.
- Eleven items would be potentially directly impacted due to construction vibration from surface works. These impacts are anticipated to have a negligible to minor risk of affecting the value of the heritage items (*Ku-ring-gai Planning Scheme Ordinance 1971* reference: I897, I898, I900, I901 and I902², *Draft Ku-ring-gai Local Environmental Plan 2013* reference: I855, and Hornsby LEP reference: I767, I750, I770, I771, and I791). The degree of impact to these items is anticipated to be minor to negligible. The overall heritage value of the heritage items would not be significantly impacted by the project.
- Forty-four items would be potentially directly impacted due to vibration, settlement and groundwater drawdown as a result of tunnelling works. These items are primarily located within the preferred project corridor. Impacts to these items are anticipated to be minor to negligible. Two of these items would also be potentially directly impacted by construction vibration due to surface works. The overall heritage value of the heritage items would not be significantly impacted by the project.

Of the 62 heritage items, 21 items may also be indirectly impacted by the project, due to temporary and / or permanent visual impacts. Of the 21 items, 19 items would also be directly impacted as outlined above. Impacts to the heritage items as a result of visual effects are anticipated to be minor to negligible. The overall heritage value of the heritage items would not be significantly impacted by the project.

As noted in **Section 8.2.2**, at-property acoustic treatment may also be required for three items listed above, which would be confirmed during detailed design.

² For the purpose of this report, heritage item identification numbers for listed items in Ku-ring-gai local government area have been referred to using the identification numbers assigned to the items under *Draft Ku-ring-gai Local Environmental Plan 2013* because the *Ku-ring-gai Planning Scheme Ordinance 1971* does not include equivalent identification numbers.

It is noted that some heritage items identified through the registry search results have multiple listings as the item has been identified for its built and archaeological significance. For the purposes of this report, the following items have been counted as one item in this section and subsequent sections of the report:

- Loretto (sic) Convent group – grounds, gates and cemetery (listed under the Hornsby LEP as I607 and A60).
- Blackwood Memorial Sanctuary (listed under the Hornsby LEP (Hornsby LEP reference: A61) and under the National Trust register).
- Observatory Park (listed under the Hornsby LEP as I654 and A62).

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Table 7 Potential impact summary

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
Windsor Road compound (C1)	The Hills LEP	I28	Windsor Road from Baulkham Hills to Box Hill	No impact	<p>The Windsor Road compound (C1) would be located within a previously disturbed site that was used as a construction compound during the M2 Upgrade.</p> <p>The sections of road that have heritage value do not extend into the study area. This section of road was also recently widened to cater for additional motorway ramps at the Windsor Road interchange.</p>	No impact.
<p>Wilson Road compound (C6)</p> <p>Wilson Road tunnel support facility</p> <p>Main alignment tunnels</p>	Hornsby LEP	C2	Beecroft - Cheltenham Conservation Heritage Area	Change in heritage conservation area values	<p>Impacts on heritage values within the conservation area would be localised to specific areas already associated with major transport network infrastructure.</p> <p>Potential visual impacts due to the presence of the Wilson Road compound (C6) and Wilson Road tunnel support facility. Landscaping of the tunnel support facility, once established, would reduce the potential visual impacts within the conservation area.</p>	Minor impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
<p>Trelawney Street compound (C7)</p> <p>Trelawney Street tunnel support facility</p> <p>Main alignment tunnels</p>	Hornsby LEP	I710	Street trees	Vibration and settlement (tunnelling)	<p>A part of Loch Maree Avenue would be located within the preferred project corridor.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. A program of monitoring would also be undertaken to identify early potential risks to the heritage item. <p>The main alignment tunnels would be around 25 metres below ground level at this point and would be unlikely to impact on tree roots.</p> <p>Access to the Trelawney Street compound (C7) would be via Loch Maree Avenue. Impacts to street trees would be avoided during construction.</p>	Potential negligible impact.
Pioneer Avenue compound (C8)	Hornsby LEP	A66	Remains of Maltworks	Demolition of structures	Direct impact will occur through the demolition of some structures within the curtilage of this item. One of the original structures on the site would be retained.	Direct impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
Main alignment tunnels	Hornsby LEP	A61	Blackwood Memorial Sanctuary, including North Road culvert	Vibration and settlement (tunnelling)	<p>Blackwood Memorial Sanctuary would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. <p>The tunnel would be around 85 metres below ground at this point and would be unlikely to impact on tree roots.</p>	Potential negligible impact.
		I68	Street trees	Vibration and settlement (tunnelling)	<p>A part of Cardinal Avenue would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. <p>The main alignment tunnels would be around 85 metres below ground at this point and would be unlikely to impact on tree roots.</p>	Potential negligible impact.
		I98	Street trees	Vibration and settlement (tunnelling)	<p>A part of Hannah Street would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. <p>The main alignment tunnels would be around 55 metres below ground at this point and would be unlikely to impact on tree roots.</p>	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I111	Street trees	Vibration and settlement (tunnelling)	<p>A part of Hull Road would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. <p>The main alignment tunnels would be around 85 metres below ground at this point and would be unlikely to impact on tree roots.</p>	Potential negligible impact.
		I590	Street trees	Vibration and settlement (tunnelling)	<p>A part of Campbell Avenue would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. <p>No impact to tree roots is anticipated given the depth of the main alignment tunnels at this location (around 20 to 30 metres).</p>	Potential negligible impact.
		I603	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I607 / A60	Loretto [sic] Convent group—grounds, gates and cemetery	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I618	St. Agatha's Primary School—grounds (excluding buildings)	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I619	"Cheddington" and stables (formerly "Niara")	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I626	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I630	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I652	"Camira"	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I653	Mount St. Benedict's Convent and grounds	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I654 / A62	Observatory Park — Observatory site and park	Vibration and settlement (tunnelling)	<p>A part of Observatory Park would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. <p>The main alignment tunnels would be around 85 metres below ground at this point would unlikely have an impact on tree roots.</p>	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I660	Fence	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I661	Fence	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I662	House and fence	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I666	"Bushloe"	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I680	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I681	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I682	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I683	"Hillcourt"	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I684	"Karoola"	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I689	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I690	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I691	The Maze	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I714	"Loch Maree House" and garden	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I716	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I723	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I724	Gardens	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I725	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.
		I731	Garden	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I755	House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact - vibration.
Northern interchange	Hornsby LEP	C7	Wahroonga Heritage Conservation Area	Visual	There would be no above ground works within the heritage conservation area. The preferred project corridor passes under the eastern edge of the conservation area, and widening works at the intersection of Pennant Hills Road and Pacific Highway would be undertaken adjacent to this conservation area.	Negligible impact.
		C8	Wahroonga North Heritage Conservation Area	Change in heritage conservation area values	<p>Impacts to heritage values within the conservation area would be localised to specific areas already associated with major transport network infrastructure.</p> <p>The M1 Pacific Motorway would be widened to cater for the northern portal and associated ancillary facilities. This would extend to the eastern edge of the heritage conservation area and would include the acquisition of a property on the corner of Bareena Avenue and Woronora Avenue, Wahroonga. Visual impacts due to changes to noise walls and the northern ventilation facility which would be visible above the noise walls may affect certain properties.</p> <p>Landscaping would provide screening of the project from the heritage conservation area, once established.</p> <p>Temporary visual impacts may also occur while the Bareena Road compound (C10) is operational during construction.</p>	Minor impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I475	Street trees	No impact	Construction activities would be undertaken in proximity to, but not directly affecting this heritage item. There would be no construction activities undertaken along Edgeworth David Avenue west of the M1 Pacific Motorway.	No impact.
		I596	Garden	No impact	Construction activities would be undertaken in proximity to, but not directly affecting this heritage item. The construction activities would be undertaken within the Pennant Hills Road reserve and would not require the removal of street trees.	No impact
		I743	Street trees	No impact	Construction activities would be undertaken in proximity to, but not directly affecting this heritage item. There would be no construction activities undertaken directly adjacent to the heritage item, with works limited to the road reserve.	No impact.
		I750	Street trees	Vibration (surface works) Visual	<p>This site would be located adjacent to the construction footprint and has the potential to be directly and/ or indirectly impacted. Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. A program of monitoring would be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation however this would be reduced in part by distance and the screening effect of surrounding residential developments. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>It is unlikely that vibration during construction works would diminish the heritage value of this item.</p> <p>As the item is on the corner of two major roads, any visual change to surrounding landscape of the road caused by the widening of the Pacific Highway as part of the project is unlikely to be significant given the existing landscape.</p>	<p>Potential negligible impact – vibration.</p> <p>Negligible impact – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I762	Garden	Acquisition Heritage vegetation removal	Partial land acquisition would be required at the front of the property to cater for the widening of Pennant Hills Road northbound carriageway at Pearces Corner to create a permanent additional right-turn lane onto the Pacific Highway. The two heritage listed trees (Canary Island Palms) would be removed during construction of the project, resulting in a direct loss of heritage value for this item.	Significant impact – heritage vegetation removal.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		1767	St Pauls Church - Pearces Corner	Vibration (surface works)	This site would be located in adjacent to the construction footprint and has a potential for direct and indirect impacts.	Potential negligible impact – vibration.
				Visual	Potential impacts may include:	
				At-property acoustic treatment	<ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation however this would be reduced in part by distance and the screening effect of surrounding residential developments. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. - Potential direct impacts due to eligibility for at-property acoustic treatment. As the typical hours of use of this property differ to residential dwellings, a different set of treatment criteria apply. As such, this property has been flagged for further investigation, including an internal investigation. The need for acoustic treatment at this property would be confirmed during detailed design, in consultation with the landowner, and with consideration of potential impacts to heritage values. <p>It is unlikely that vibration during construction works would diminish the heritage value of this item.</p> <p>As the item is on the corner of two major roads, any visual change to surrounding landscape of the road caused by the widening of the Pacific Highway as part of the project is unlikely to be significant given the existing landscape.</p>	<p>Negligible impact – visual.</p> <p>Potential impact depending on required treatment – At-property acoustic treatment.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		1768	Street trees	No impact	Construction activities would be undertaken in proximity to, but not directly affecting this heritage item. The construction activities would be undertaken within the Pennant Hills Road reserve and would not require the removal of street trees..	No impact.
		1769	Street trees	Heritage vegetation removal	<p>Potential tree clearance would be required at southern end of heritage item to cater for site access to the Bareena Road compound (C10) and the northern ventilation facility.</p> <p>Measures to avoid direct impacts to the specific listed vegetation "Blue Gum High Forest" would be investigated during the detailed design phase.</p> <p>If avoidance is not feasible or reasonable, some impact to the overall heritage value of this item would occur.</p>	Minor impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I770	"Cherrygarth" and garden	Vibration and settlement (tunnelling) Vibration (surface works) Visual At-property acoustic treatment	<p>This item would be located opposite the northern ventilation facility. Noise walls and landscaping would provide some visual screening, once established. However, the taller components of the northern ventilation facility are located further north and may be visible above the noise walls.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which would be negligible. - Vibration impacts during tunnelling and surface construction, however: <ul style="list-style-type: none"> • Vibration levels from tunnelling are anticipated to be below potential damage levels relevant to heritage structures. • Surface works would adhere to safe working distances. - An existing condition survey and a program of monitoring would be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. - Potential direct impacts due to eligibility for at-property acoustic treatment. The need for acoustic treatment at this property would be confirmed during detailed design, in consultation with the landowner, and with consideration of potential impacts to heritage values. 	<p>Potential minor impact – vibration and settlement</p> <p>Minor impact – visual</p> <p>Potential impact depending on required treatment – At-property acoustic treatment.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I771	"Neringala" and garden	Vibration (surface works) Visual	<p>This heritage item would be located directly opposite the northern ventilation facility. Noise walls and landscaping would provide some visual screening, once established. However, the taller components of the northern ventilation facility may be visible above the noise walls.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact –vibration</p> <p>Minor impact – visual.</p>
		I772	Street trees and bushland	Vibration and settlement (tunnelling)	<p>The eastern end of Alexandria Parade within the Hornsby local government area would be located within the preferred project corridor. However, impacts would be unlikely given that the main alignment tunnels would be located within the M1 Pacific Motorway corridor at this location.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
	Ku-ring-gai Planning Ordinance	C1	Wahroonga Heritage Conservation Area	Visual	<p>The heritage conservation area is located to the east of the M1 Pacific Motorway. Properties that are directly adjacent to but not within the conservation area would be subject to full or partial acquisition due to the widening of the motorway at this location to accommodate the integration of the southbound portal. This would locate road infrastructure closer to the western edge of the heritage conservation area that is currently the case.</p> <p>Visual impacts would be associated with construction (short-term) and operation. For operation, the impacts would be associated with changes to noise walls and loss of screening vegetation. Landscaping would provide screening of the project from the conservation area, once established.</p>	Negligible impact.
		I897	Timber Cottages Group	Vibration (surface works) Visual	<p>This heritage item would be located near the northern portal of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	Potential minor impact – vibration. Minor impact – visual.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I898	Timber Cottages Group	Vibration (surface works) Visual	<p>This item would be located near the northern portal of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration.</p> <p>Minor impact – visual.</p>
		I900	Timber Cottages Group	Vibration (surface works) Visual	<p>This heritage item would be located near the northern portal of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration.</p> <p>Minor impact – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I901	Timber Cottages Group	Vibration (surface works) Visual	<p>This heritage item would be located near the northern portal of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration.</p> <p>Minor impact – visual.</p>
		I902	Timber Cottages Group	Vibration (surface works) Visual	<p>Despite being listed on the current Ku-ring-gai Planning Scheme Ordinance, the current state of the property is not consistent with the listed heritage item description. Ku-ring-gai Municipal Council has resolved to recommend its removal from Schedule 5 of the Draft Ku-ring-gai LEP to the Department of Planning and Infrastructure.</p>	Negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I953	"Bolton Grange" Dwelling House	Vibration and settlement (tunnelling) Visual	<p>This item would be located above the on-ramp and off-ramp portals on the M1 Pacific Motorway / Pennant Hills Road connector and would lie directly above the on-ramp and off-ramp tunnels. The northern interchange compound (C9) would also be located directly adjacent to the property boundary.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which may result in cosmetic damage only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts from vegetation clearance and the introduction of new infrastructure. Re-vegetation of the area would occur following construction which would limit potential long-term visual impacts. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration and settlement.</p> <p>Minor impact – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I955	"Matakana" Dwelling House	Vibration and settlement (tunnelling) Visual	<p>The property would be located within the preferred project corridor.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Permanent visual impacts associated with surface works at the northern interchange are unlikely given the distance to these areas (over 250 metres) and presence of surrounding residential properties and vegetation. Temporary visual impacts would also unlikely be significant for the same reasons. 	<p>Potential negligible impact – vibration and settlement.</p> <p>Negligible impact – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I956	"Cullingral" Dwelling House	Vibration and settlement (tunnelling) Visual	<p>This item would be located above the on-ramp and off-ramp portals on the M1 Pacific Motorway connector and would lie directly above the ramps to the main alignment tunnels. The northern interchange compound (C9) would also be located near item.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which may result in cosmetic damage only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts however adjacent properties are likely to screen views to the project from this property. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration and settlement.</p> <p>Minor impact – visual.</p>
		I1012	"Poole House" Dwelling House	Vibration and settlement (tunnelling)	<p>The property would be located within the preferred project corridor. Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. 	Potential negligible impact.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
	Draft Ku-ring-gai LEP	I855	Dwelling House	Vibration (surface works)	Part of the property would be located within 50 metres of cut-and-cover sections of the northern portal.	Potential minor impact – vibration.
				Visual	<p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. Vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation primarily due to the widening of the existing M1 Pacific Motorway corridor at this location and changes to noise walls. However, this impact would be minimised due to the screening effect from surrounding residential developments. 	Minor impact – visual.

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I954	Dwelling House	Vibration and settlement (tunnelling) Visual	<p>The property would be located within the preferred project corridor.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Permanent visual impacts associated with surface works at the northern interchange are unlikely given the distance to these areas (over 250 metres) and presence of surrounding residential properties and vegetation. Existing properties would also likely obscure temporary visual impacts associated the northern interchange compound (C9). 	<p>Potential negligible – vibration and settlement.</p> <p>Negligible – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I957	"Mansfield" Dwelling House	Vibration and settlement (tunnelling) Visual	<p>This heritage item would be located near the on and off-ramp portals on the M1 Pacific Motorway / Pennant Hills Road connector and would lie directly above the on and off-ramp tunnels. The northern interchange compound (C9) would also be located near item.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement impacts during and after construction, however this would be five millimetres or less, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. However this would be reduced in part due the screening effect of surrounding residential developments. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration and settlement.</p> <p>Minor impact – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		1959	"Hindfell" Dwelling House	Vibration and settlement (tunnelling)	The property would be located within the preferred project corridor.	Potential negligible impact – vibration and settlement.
				Visual	Potential impacts may include:	
				At-property Acoustic treatment	<ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - No significant permanent change to visual context given the presence of the existing motorway. Potential for temporary visual impacts while construction works are undertaken within the existing motorway corridor. - Potential direct impacts due to eligibility for at-property acoustic treatment. The need for acoustic treatment at this property would be confirmed during detailed design, in consultation with the landowner, and with consideration of potential impacts to heritage values. 	<p>Negligible impact – visual.</p> <p>Potential impact depending on required treatment – At-property acoustic treatment.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I960	Dwelling House	Vibration and settlement (tunnelling) Visual	<p>This heritage item would be located above the on and off-ramp portals on the M1 Pacific Motorway / Pennant Hills Road connector and would lie directly above the on and off-ramp tunnels. The northern interchange compound (C9) would also be located near item.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which may result in cosmetic damage only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during and after construction, however this would be reduced in part by distance and the screening effect of surrounding residential developments. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. 	<p>Potential minor impact – vibration and settlement.</p> <p>Minor impact – visual.</p>

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
Southern interchange	Hornsby LEP	I791	House	Vibration and settlement (tunnelling)	This heritage item would be located near the southern interchange and would lie directly above the northbound on-ramp tunnel from Pennant Hills Road.	Potential minor impact – vibration and settlement.
				Vibration (surface works)	Potential impacts may include:	Minor impact – visual.
				Visual	<ul style="list-style-type: none"> - Settlement during or after construction, however this would be five millimetres or less, which is considered to be negligible. - Vibration impacts during tunnelling and surface construction, however: <ul style="list-style-type: none"> • Vibration levels from tunnelling are anticipated to be below potential damage levels relevant to heritage structures. • Surface works would adhere to safe working distances - An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impact during construction and operation. This would be reduced in part, due to the large brick wall surrounding the property. 	

Impact area	LEP / Ordinance	LEP no.	Item	Impact type	Comment	Degree of impact
		I138	Pennant Hills Golf Club—grounds	Vibration and settlement (tunnelling) Visual	<p>The main alignment tunnels would pass directly underneath the golf course. Potential impacts to heritage values would be largely avoided as the project would not be located near the golf club house or club entry.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement within the western fairways during and after construction, however this would be 10 millimetres or less, which may result in cosmetic changes only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. - Visual impact during construction and operation. However existing vegetation along the perimeter of the golf course would not be impacted and would effectively screen construction activities and operational buildings from the golf course. 	<p>Potential minor impact – vibration and settlement.</p> <p>Minor impact – visual.</p>

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9.0 Mitigation and management

Mitigation and management measures have been recommended for where there is the potential for loss of heritage value. The recommended measures are presented in **Table 8** and would be developed further on a case by case basis during detailed design with consideration to the final areas of disturbance. The final suite of mitigation and management measures would be documented within a construction environmental management plan(s) for the project.

Table 8 Recommended mitigation and management measures

Potential impact	Mitigation and management measures
General construction impacts	<p>In the event of an unexpected cultural heritage find, the Standard Management Procedure – Unexpected Archaeological Finds (Roads and Maritime, 2012) would be followed. This would include notification to the NSW Heritage Division.</p> <p>Construction personnel would be made aware of non-Aboriginal heritage sites as part site inductions.</p>
Demolition of listed items	<p>Demolition of late 20th century items associated with the Thornleigh Maltworks (A66) would be undertaken. The original germination structure would be maintained.</p> <p>Prior to demolition:</p> <ul style="list-style-type: none"> - A structural assessment of the germination structure would be conducted to ascertain the possible impact of the demolition of adjacent structures to identify suitable mitigation methods to ensure the germination structure remains intact. Additional measures would be identified and implemented, if required, to treat the newly exposed surfaces of the germination structure to protect it from the elements as a result of the demolition of adjacent structures. - Archival recording of the industrial site would be undertaken to record the connection of the original structures to the modern upgraded structures. - A program of archaeological test excavation would also be undertaken to assess the archaeological potential of identifying evidence of the early malting industry in this area, the relationship of the industrial site to the urban site and evidence of the occupation of the Manager's House by the Chilvers family.
Removal of heritage listed vegetation	<p>Feasible and reasonable options for the relocation of the two mature Canary Island Palms (I762) would be investigated during detailed design.</p> <p>If the trees cannot be relocated:</p> <ul style="list-style-type: none"> - Archival samples would be collected in accordance with NSW Royal Botanic Gardens collection procedures. - Options would be investigated to collect seed samples for later propagation. - Oral histories (if relevant) would be obtained. <p>Feasible and reasonable options to avoid direct impacts to identified heritage listed vegetation along Woonona Ave, Wahroonga (I769) would be investigated during detailed design.</p> <p>If impacts cannot be avoided:</p> <ul style="list-style-type: none"> - The street frontage would be revegetated in consultation with the landowner (Hornsby Shire Council). - Plantings that are representative species of the Blue Gum High Forest ecological community would be considered.

Potential impact	Mitigation and management measures
Construction vibration and / or ground settlement	<p>Where non-Aboriginal heritage items have been identified as having the potential to be impacted by construction vibration or ground settlement, the following would be implemented:</p> <ul style="list-style-type: none"> - A ground settlement assessment would be undertaken during detailed design to confirm predicted impacts on heritage structures. - Completion of existing condition surveys prior to the commencement of construction for heritage items within the project corridor or that have been identified during detailed design to be within recommended safe working distances to surface works. A post-construction condition survey would also be undertaken of these items to identify if impacts have occurred. <p>Additional feasible and reasonable mitigation and management measures to be implemented would be identified based on the above assessments. This would include the use of vibration monitoring where recommended maximum levels are predicted to be exceeded. The placement of vibration monitors would consider the heritage fabric of the item.</p>
Impacts to North Wahroonga heritage conservation area and Beecroft-Cheltenham heritage conservation area	Landscaping of ancillary infrastructure sites would be undertaken with consideration of the heritage values of the Wahroonga North heritage conservation area and Beecroft Cheltenham heritage conservation area.
Impacts to heritage values due to changes in views (construction)	The heritage values of items I771, I953, I956 and I957 (including views and vistas from the items) would be considered during the detailed design of built elements of the project and the development of the landscaping plan.
Impacts to heritage values due to changes in views (operation)	The heritage values of items I771, I953, I956 and I957 (including views and vistas from the items) would be considered during the detailed design of built elements of the project and the development of the landscaping plan.

10.0 Statement of heritage impact

Statements of heritage impact (refer to **Table 9**) have been prepared for the following:

- Directly impacted items.
- Potentially directly impacted items with an impact rating of minor or significant.
- Indirectly impacted items with an impact rating of minor or significant.

For the three items that may be eligible for at-property acoustic treatment, the need and type of treatment would be confirmed during detailed design. Consideration of the potential impacts on the heritage values of the property as a result of acoustic treatment, if required, would be considered during detailed design. Any such treatment would be sympathetic to the heritage values and would need to be undertaken in accordance with the Burra Charter.

Table 9 Statement of Heritage Impacts

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Hornsby LEP	C2	Beecroft-Cheltenham heritage conservation area	Wilson Road compound (C6) Wilson Road tunnel support facility Main alignment tunnels	Change in heritage conservation area values	Impacts to heritage values within the conservation area would be localised to specific areas already associated with major transport network infrastructure. The overall heritage value of the conservation heritage area would not be significantly impacted by the project and associated works.
Hornsby LEP	C8	Wahroonga North heritage conservation area	Northern interchange	Change in heritage conservation area values	Impacts to heritage values within the conservation area would be localised to specific areas already associated with major transport network infrastructure. The overall heritage value of the conservation heritage area would not be significantly impacted by the project and associated works.

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Hornsby LEP	I138	Pennant Hills Golf Course – grounds	Southern interchange	Vibration and settlement (tunnelling) Visual	<p>Pennant Hills Golf Course would be located across from the southern interchange area. The main alignment tunnels would pass directly underneath the golf course. Potential impacts to heritage values would be largely avoided as the project would not be located near the golf club house or club entry.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement within the western fairways during and after construction, however this would be 10 millimetres or less, which may result in cosmetic changes only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. - Visual impact during construction and operation, however existing vegetation along the perimeter of the golf course would not be impacted and would effectively screen construction activities and operational buildings from the golf course. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>
Hornsby LEP	A66	Remains of Maltworks	Thornleigh Maltworks compound (C8)	Demolition of Structures	<p>Overall, there would be a moderate impact to the heritage significance of the item. Direct impact would occur through the demolition of some structures within the curtilage of this item which would change the context of the original use of the site. Although, except for the Manager's House, the remaining structures to be demolished have no intrinsic heritage value apart from their connection to the site as a whole. This would change the context of the original use of the site. The retention of one of the original structures (the germination building) on site would have a minor positive outcome.</p>
Hornsby LEP	I762	Garden	Northern interchange	Acquisition Heritage vegetation removal	<p>The two heritage listed trees would be removed during construction of the project, resulting in a direct loss of heritage value for this item.</p> <p>Options to avoid direct impacts or identify appropriate areas for potential relocation would be investigated during the detailed design phase. In the event that a feasible and reasonable option to relocate the trees cannot be identified, there would be a direct loss of the heritage item. In this event seed collection and archival samples would be undertaken.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Hornsby LEP	1769	Street trees	Northern interchange	Heritage vegetation removal	<p>The trees identified in this streetscape are reflective of the original floral biota of this area. The identified impacts to this area as a result of the project would be restricted to the southern portion (around 100 square metres or one per cent of the total area) of the listed curtilage for this streetscape.</p> <p>Measures to avoid direct impacts to the specific listed vegetation would be investigated during the detailed design phase in order to minimise potential impacts to the item's heritage value. If avoidance is not feasible or reasonable, some impact to the overall heritage value of this item would occur. However this would be mitigated through sympathetic plantings of similar species as part of landscaping / revegetation of the site following completion of construction.</p>
Hornsby LEP	1770	"Cherrygarth" and garden	Northern interchange and northern ventilation facility	Vibration and settlement (tunnelling) Vibration (surface works) Visual	<p>This heritage item would be located opposite the northern ventilation facility.</p> <p>Noise walls and landscaping would provide some visual screening between the project and the heritage item, once established. However, the taller components of the northern ventilation facility would be located further north and may be visible above the noise walls.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be less than five millimetres, which would be negligible. - Vibration impacts during tunnelling and surface construction, however: <ul style="list-style-type: none"> • Vibration levels from tunnelling are anticipated to be below potential damage levels relevant to heritage structures. • Surface works would adhere to safe working distances. - An existing condition survey and a program of monitoring would be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Hornsby LEP	1771	"Neringala" and garden. Dwelling house	Northern interchange and northern ventilation facility	Vibration (surface works) Visual	<p>This heritage item would be located directly opposite the northern ventilation facility.</p> <p>Noise walls and landscaping would provide some visual screening between the project and the heritage item, once established. However, the taller components of the northern ventilation facility would be located further north and may be visible above the noise walls.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Hornsby LEP	1791	House	Southern interchange	Vibration and settlement (tunnelling) Vibration (surface works) Visual	<p>This heritage item would be located near the southern interchange and would be located directly above the northbound on-ramp tunnel from Pennant Hills Road.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during or after construction, however this would be five millimetres or less, which would be negligible. - Vibration impacts during tunnelling and surface construction, however: <ul style="list-style-type: none"> • Vibration levels from tunnelling are anticipated to be below potential damage levels relevant to heritage structures. • Surface works would adhere to safe working distances - An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impact during construction and operation. This would be reduced, in part, due to the large brick wall surrounding the property. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>
Ku-ring-gai Planning Ordinance	1897	Timber Cottages Group	Northern interchange	Vibration (surface works) Visual	<p>This heritage item would be located near the northern portals of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Ku-ring-gai Planning Ordinance	1898	Timber Cottages Group	Northern interchange	Vibration (surface works) Visual	<p>This heritage item would be located near the northern portals of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>
Ku-ring-gai Planning Ordinance	1900	Timber Cottages Group	Northern interchange	Vibration (surface works) Visual	<p>This heritage item would be located near the northern portals of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Ku-ring-gai Planning Ordinance LEP	I901	Timber Cottages Group	Northern interchange	Vibration (surface works) Visual	<p>This item would be located near the northern portals of the project with surface works required immediately adjacent to the item on the M1 Pacific Motorway.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>
Ku-ring-gai Planning Ordinance	I902	Timber Cottages Group	Northern interchange	Vibration (surface works) Visual	<p>Despite being listed on the current Ku-ring-gai Planning Scheme Ordinance, the current state of the property is not consistent with the listed heritage item description. Ku-ring-gai Municipal Council has resolved to recommend its removal from Schedule 5 of the Draft Ku-ring-gai LEP to the Department of Planning and Infrastructure.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Ku-ring-gai Planning Ordinance	1953	"Bolton Grange" Dwelling House	Northern interchange	<p>Vibration and settlement (tunnelling)</p> <p>Visual</p>	<p>This item would be located above the on-ramp and off-ramp portals on the M1 Pacific Motorway / Pennant Hills Road connector and would lie directly above the on-ramp and off-ramp tunnels. The northern interchange compound would also be located directly adjacent to the property boundary.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which may result in cosmetic damage only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts from vegetation clearance and the introduction of new infrastructure. Re-vegetation of the area would occur following construction which would limit potential long-term visual impacts. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Ku-ring-gai Planning Ordinance	1956	"Cullingral" Dwelling House	Northern interchange	Vibration and settlement (tunnelling) Visual	<p>This heritage item would be located above the on-ramp and off ramp portals on the M1 Pacific Motorway connector and would lie directly above the ramps to the main alignment tunnels. The northern interchange compound (C9) would also be located near the item.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which may result in cosmetic damage only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts however adjacent properties are likely to screen views to the project from this property. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>
Draft Ku-ring-gai LEP	1855	Dwelling House	Northern interchange	Vibration (surface works) Visual	<p>Part of the property would be located within 50 metres of cut-and-cover sections of the northern portal.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Vibration impacts during surface construction, however surface works would adhere to safe working distances. Vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation primarily due to the widening of the existing M1 Pacific Motorway corridor at this location and changes to noise walls. However, this impact would be minimised due to the screening effect from surrounding residential developments. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Draft Ku-ring-gai LEP	1957	"Mansfield" Dwelling House	Northern interchange	<p>Vibration and settlement (tunnelling)</p> <p>Visual</p>	<p>This heritage item would be located near the on and off-ramp portals on the M1 Pacific Motorway / Pennant Hills Road connector and would lie directly above the on-ramp and off-ramp tunnels. The northern interchange compound would also be located near the item.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement impacts during and after construction, however this would be five millimetres or less, which is considered to be negligible. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during construction and operation. However this would be reduced in part due the screening effect of surrounding residential developments. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

LEP / Ordinance	LEP no.	Item	Impact area	Impact type	Statement of heritage impact
Draft Ku-ring-gai LEP	1960	Dwelling House	Northern interchange	<p>Vibration and settlement (tunnelling)</p> <p>Visual</p>	<p>This heritage item would be located above the on-ramp and off-ramp portals on the M1 Pacific Motorway / Pennant Hills Road connector and would lie directly above the on-ramp and off-ramp tunnels. The northern interchange compound would also be located near item.</p> <p>Potential impacts may include:</p> <ul style="list-style-type: none"> - Settlement during and after construction, however this would be 10 millimetres or less, which may result in cosmetic damage only. - Vibration impacts during tunnelling. However, vibration levels are anticipated to be below potential damage levels relevant to heritage structures. An existing condition survey and a program of monitoring would also be undertaken to identify early potential risks to the heritage item. - Visual impacts during and after construction, however this would be reduced in part by distance and the screening effect of surrounding residential developments. Existing vistas and view lines from the property would be considered during detailed design, including rehabilitation strategies that are sympathetic to the heritage item. <p>The overall heritage value of the listed item would not be affected by the project and associated works.</p>

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11.0 Key findings and recommendations

Within the study area, 62 heritage items would be directly or indirectly impacted by the project. In some instances, an item would be directly and indirectly impacted by the project. Of the 62 heritage items:

- One item would be fully and directly impacted with the removal of two Canary Island Palms (Hornsby LEP reference: I762) located within a property that would be partially acquired. Feasible and reasonable options would be investigated during detailed design to relocate the two Canary Island Palms, however, the impacts to this item are likely to be significant.
- Two items would be partially and directly impacted with
 - The demolition of structures associated with the Thornleigh Maltworks site (Hornsby LEP reference: A66). Feasible and reasonable options have been investigated during design of the project to date with the aim of retaining the original industrial structure associated with this site, however, the impacts to the overall site complex are likely to be significant.
 - Impacts to the curtilage of heritage listed street trees at Woonona Avenue, Wahroonga (Hornsby LEP reference: I769). Feasible and reasonable options would be investigated to avoid or minimise the impact. If it is necessary to remove the trees, this would have some impact to the heritage value of the item. This impact could be mitigated through sympathetic plantings of similar species through revegetation efforts.
- Two heritage conservation areas would be partially and directly impacted, being the North Wahroonga heritage conservation area (Hornsby LEP reference: C2), and the Beecroft-Cheltenham heritage conservation area (Hornsby LEP reference: C8). Landscaping of the project within these areas would minimise the potential impacts. The overall heritage value of the heritage conservation areas would not be significantly impacted by the project.
- Eleven items would be potentially directly impacted due to construction vibration from surface works. These impacts are anticipated to have a negligible to minor risk of affecting the value of the heritage items (*Ku-ring-gai Planning Scheme Ordinance 1971* reference: I897, I898, I900, I901 and I902, *Draft Ku-ring-gai Local Environmental Plan 2013* reference: I855, and Hornsby LEP reference: I767, I750, I770, I771, and I791). The degree of impact to these items is anticipated to be minor to negligible. The overall heritage value of the heritage items would not be significantly impacted by the project.
- Forty-four items would be potentially directly impacted due to vibration, settlement and groundwater drawdown as a result of tunnelling works. These items are primarily located within the preferred project corridor. Impacts to these items are anticipated to be minor to negligible. Two of these items would also be potentially directly impacted by construction vibration due to surface works. The overall heritage value of the heritage items would not be significantly impacted by the project.

Of the 62 heritage items, 21 items may also be indirectly impacted by the project, due to temporary and / or permanent visual impacts. Of the 21 items, 19 items would also be directly impacted as outlined above. Impacts to the heritage items as a result of visual effects are anticipated to be minor to negligible. The overall heritage value of the heritage items would not be significantly impacted by the project.

There is also the potential for directly impacts due to potential eligibility for at-property acoustic treatment. This would be confirmed during detailed design, in consultation with landowners, and with consideration of potential impacts to heritage values.

The potential impacts to heritage items due to ground movement and construction vibration would be confirmed during detailed design. If required, mitigation and management measures to minimise impacts would be investigated, and monitoring undertaken at properties identified as being above recommended criteria. Property dilapidation surveys would also be undertaken for all items located within the preferred project corridor or properties within recommended safe working setbacks.

Mitigation measures are recommended to be developed for the loss of heritage value. It is recommended that these be clearly defined on an item by item basis once the final areas of level of disturbance have been defined during detailed design. The measures would be detailed with the construction management plan.

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12.0 References

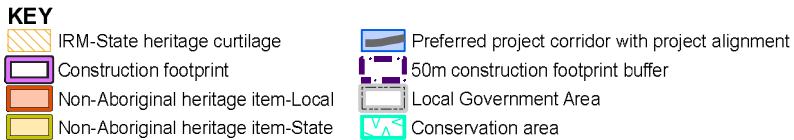
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Appendix A

Maps

Appendix A Maps



C1 – Wāhroonga North conservation area (Ku-Ring-Gai)
 C2 – Beecroft/Cheltenham conservation area (Hornsby)
 C7 – Wāhroonga conservation area (Hornsby)
 C8 – Wāhroonga North conservation area (Hornsby)





KEY

- IRM-State heritage curtilage
- Construction footprint
- Non-Aboriginal heritage item-Local
- Non-Aboriginal heritage item-State
- Preferred project corridor with project alignment
- 50m construction footprint buffer
- Local Government Area
- Conservation area

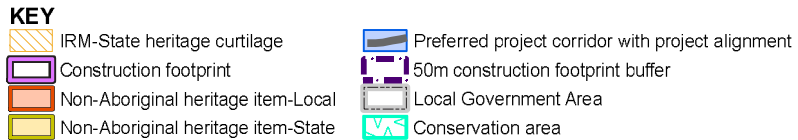
- C1 – Wahroonga North conservation area (Ku-Ring-Gai)
- C2 – Beecroft/Cheltenham conservation area (Hornsby)
- C7 – Wahroonga conservation area (Hornsby)
- C8 – Wahroonga North conservation area (Hornsby)



**M1-M2
Non-Aboriginal Heritage Items
Map Series**

Source: AECOM, LPMA (2011)

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m



C1 – Wāhroonga North conservation area (Ku-Ring-Gai)
 C2 – Beecroft/Cheltenham conservation area (Hornsby)
 C7 – Wāhroonga conservation area (Hornsby)
 C8 – Wāhroonga North conservation area (Hornsby)





KEY

- IRM-State heritage curtilage
- Construction footprint
- Non-Aboriginal heritage item-Local
- Non-Aboriginal heritage item-State
- Preferred project corridor with project alignment
- 50m construction footprint buffer
- Local Government Area
- Conservation area

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- C2 – Beecroft/Cheltenham conservation area (Hornsby)
- C7 – Wahroonga conservation area (Hornsby)
- C8 – Wahroonga North conservation area (Hornsby)



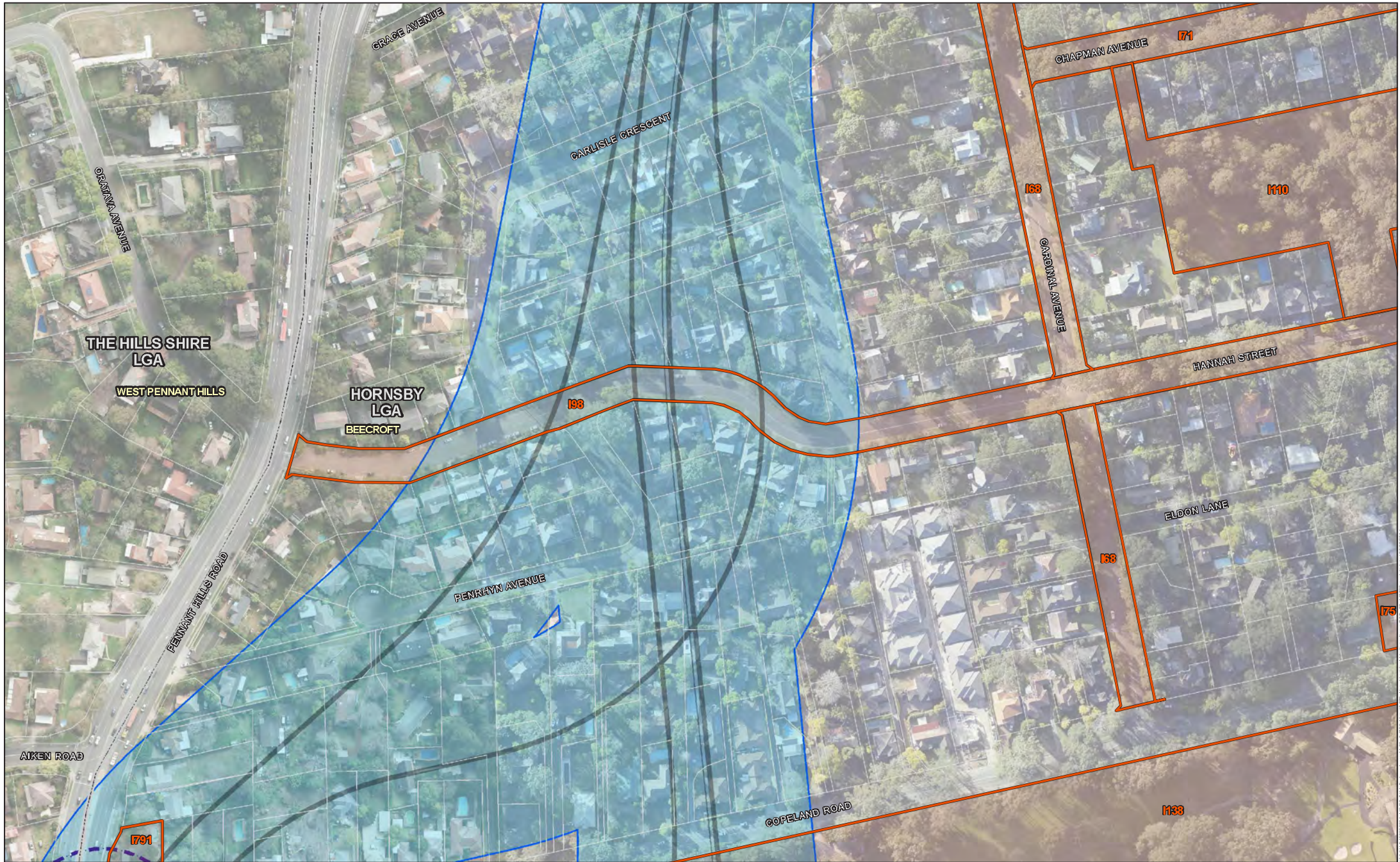
M1-M2 Non-Aboriginal Heritage Items Map Series

Source: AECOM, LPMA (2011)

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- KEY**
- IRM-State heritage curtilage
 - Construction footprint
 - Non-Aboriginal heritage item-Local
 - Non-Aboriginal heritage item-State
 - Preferred project corridor with project alignment
 - 50m construction footprint buffer
 - Local Government Area
 - Conservation area

C1 – Wahroonga North conservation area (Ku-Ring-Gai)
 C2 – Beecroft/Cheltenham conservation area (Hornsby)
 C7 – Wahroonga conservation area (Hornsby)
 C8 – Wahroonga North conservation area (Hornsby)



**M1-M2
Non-Aboriginal Heritage Items
Map Series**

Source: AECOM, LPMA (2011)

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m



- KEY**
- IRM-State heritage curtilage
 - Construction footprint
 - Non-Aboriginal heritage item-Local
 - Non-Aboriginal heritage item-State
 - Preferred project corridor with project alignment
 - 50m construction footprint buffer
 - Local Government Area
 - Conservation area

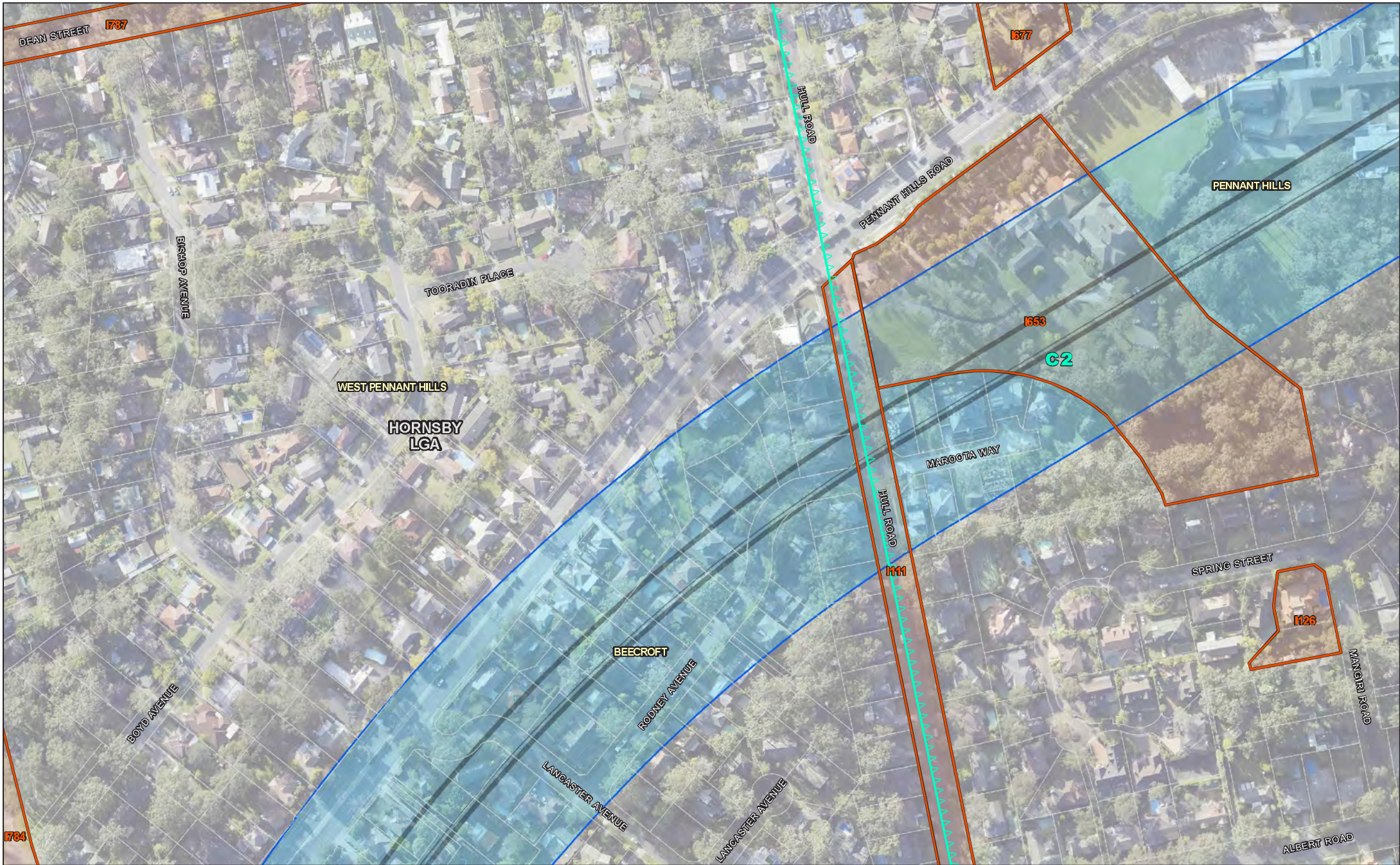
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- C8 – Wahroonga North conservation area (Hornsby)



**M1-M2
Non-Aboriginal Heritage Items
Map Series**

Source: AECOM, LPMA (2011)

0 25 50 100
m



- KEY**
- IRM-State heritage curtilage
 - Construction footprint
 - Non-Aboriginal heritage item-Local
 - Non-Aboriginal heritage item-State
 - Preferred project corridor with project alignment
 - 50m construction footprint buffer
 - Local Government Area
 - Conservation area

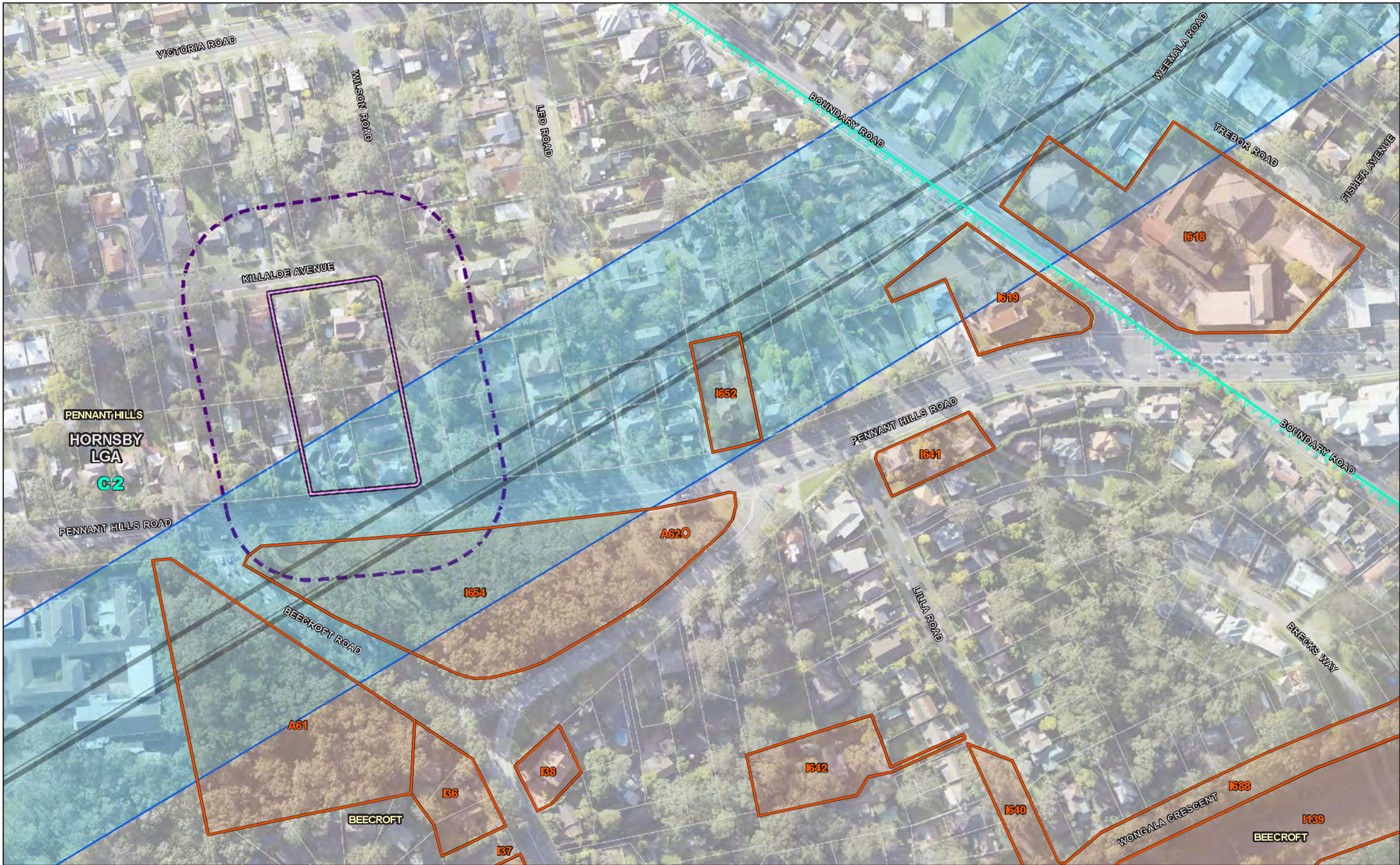
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**M1-M2
Non-Aboriginal Heritage Items
Map Series**

Source: AECOM, LPMA (2011)

0 25 50 100 m



- KEY**
- IRM-State heritage curtilage
 - Construction footprint
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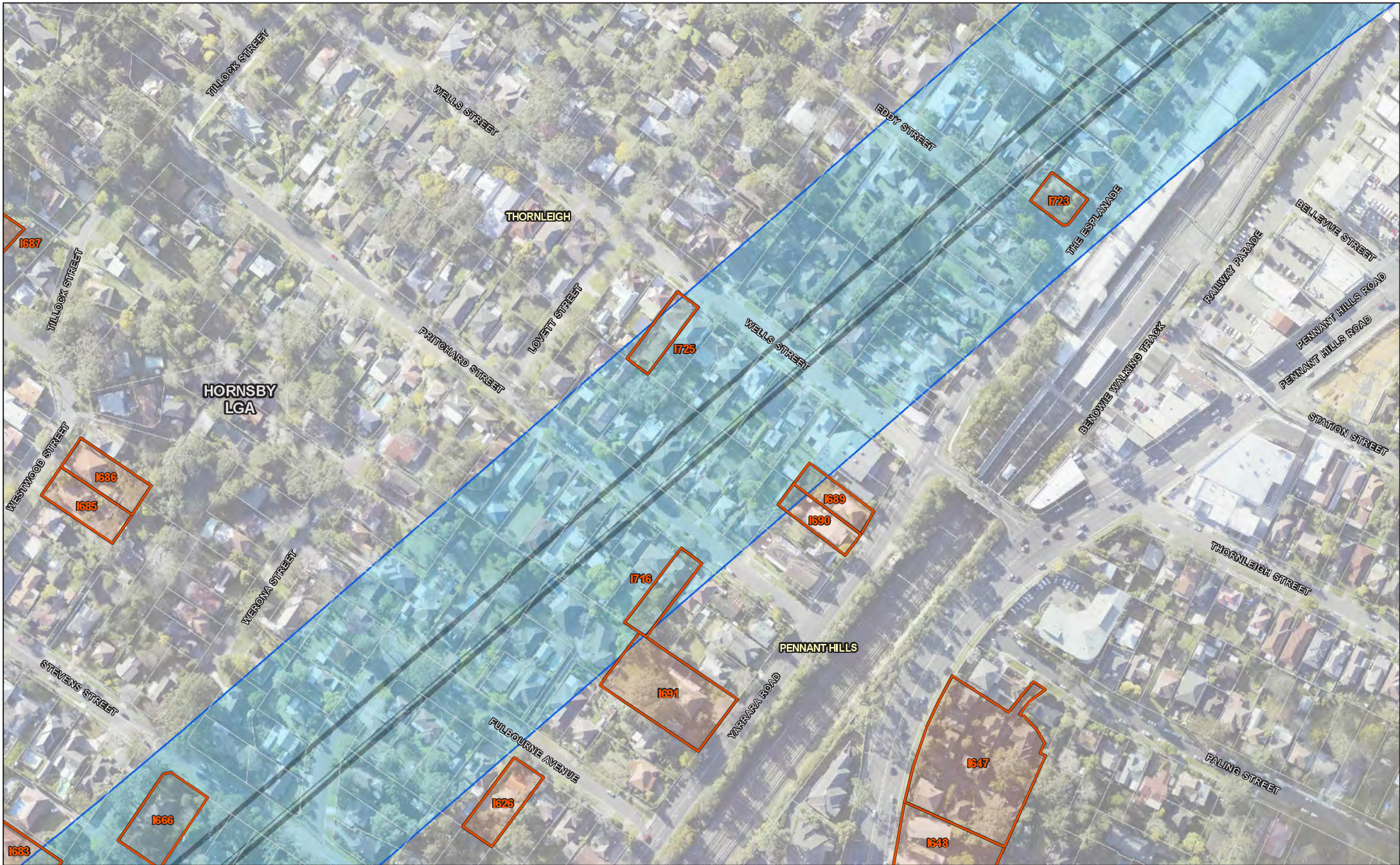
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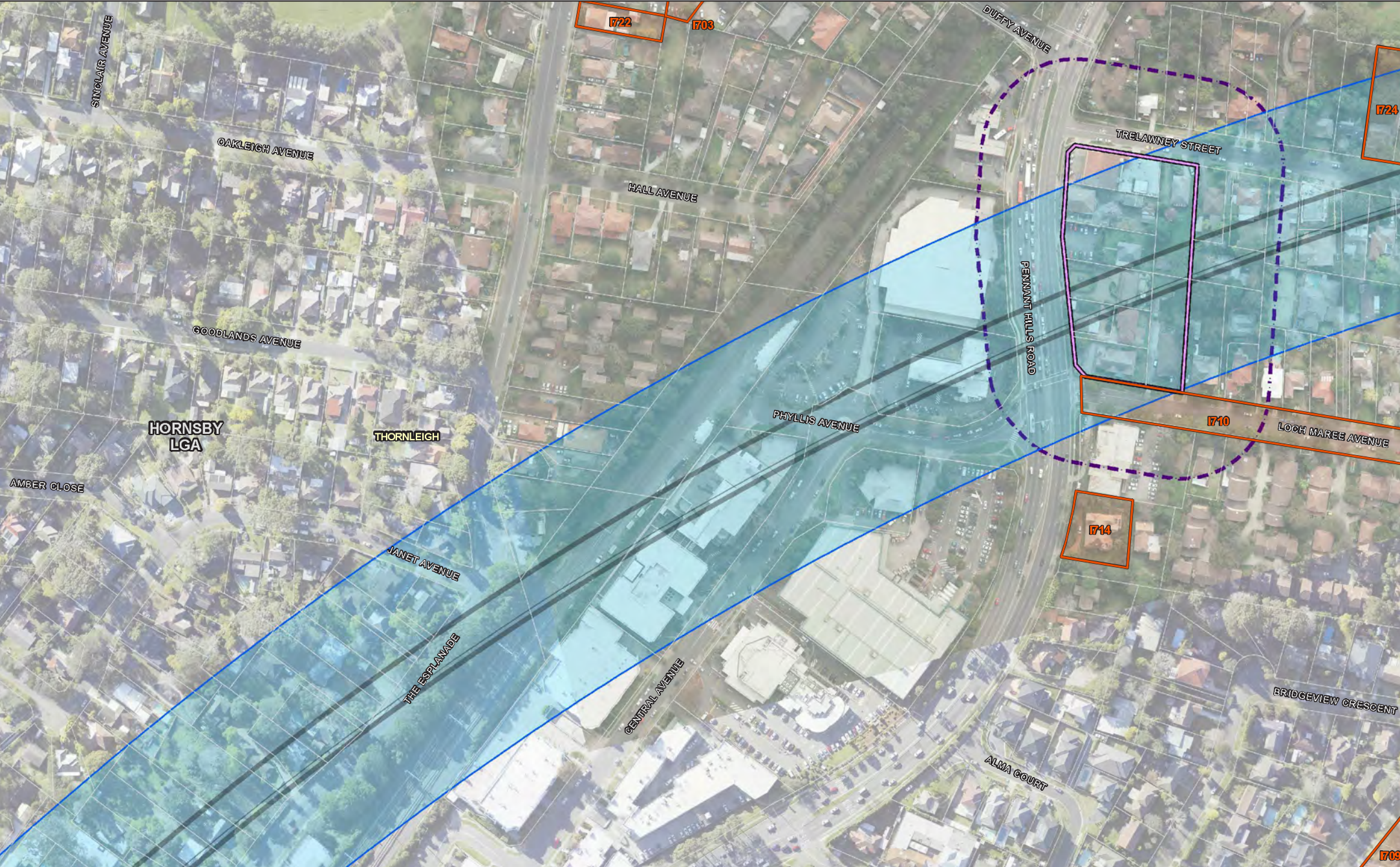
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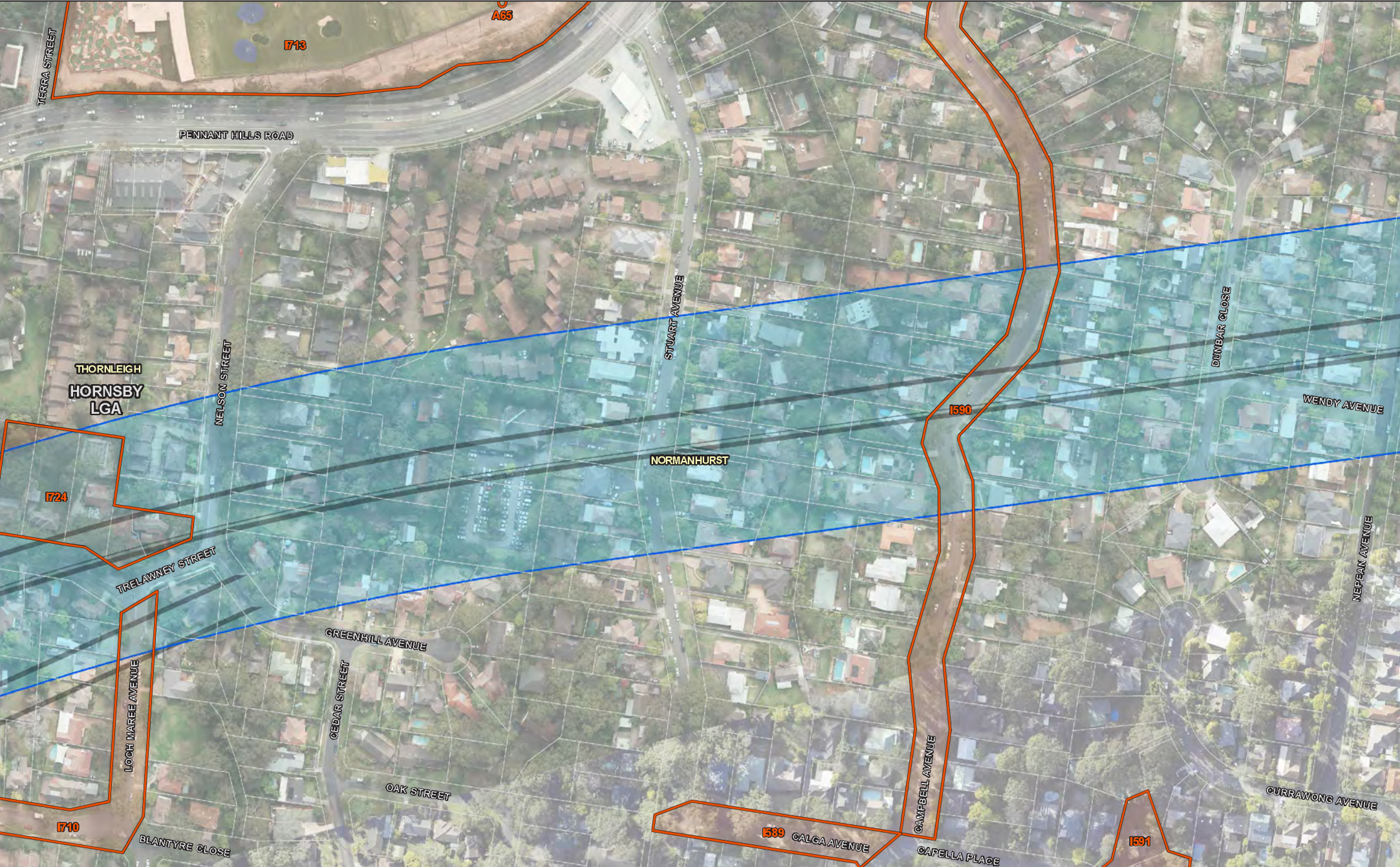
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0 25 50 100
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- Non-Aboriginal heritage item-State

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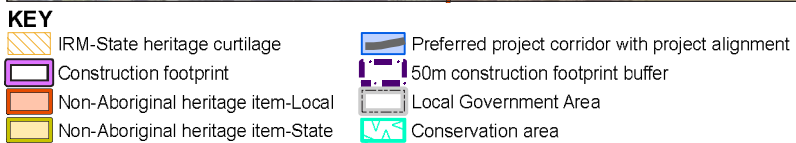
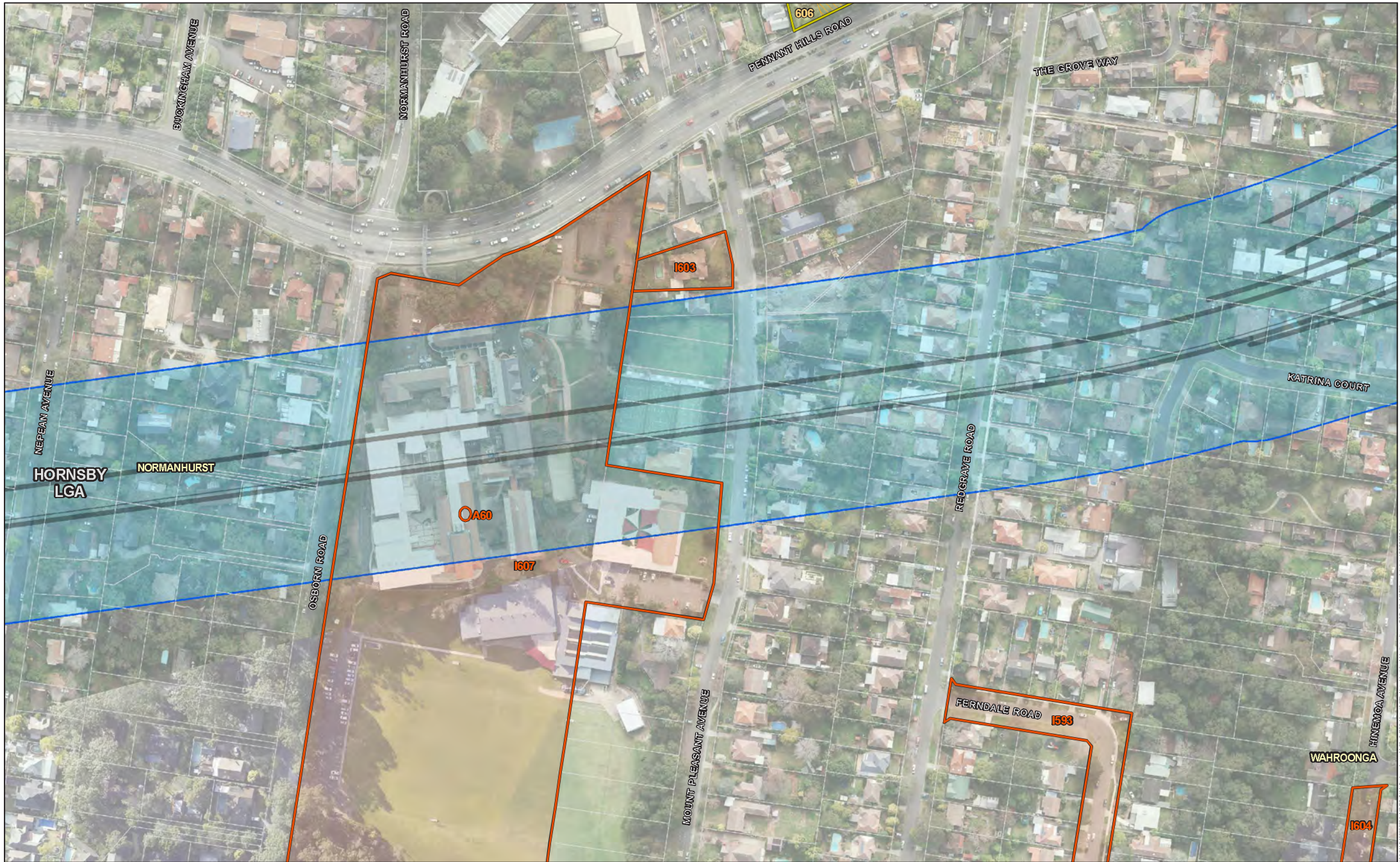
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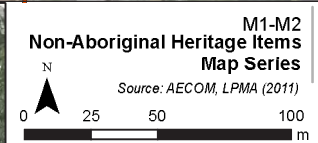
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Non-Aboriginal Heritage Items
Map Series**

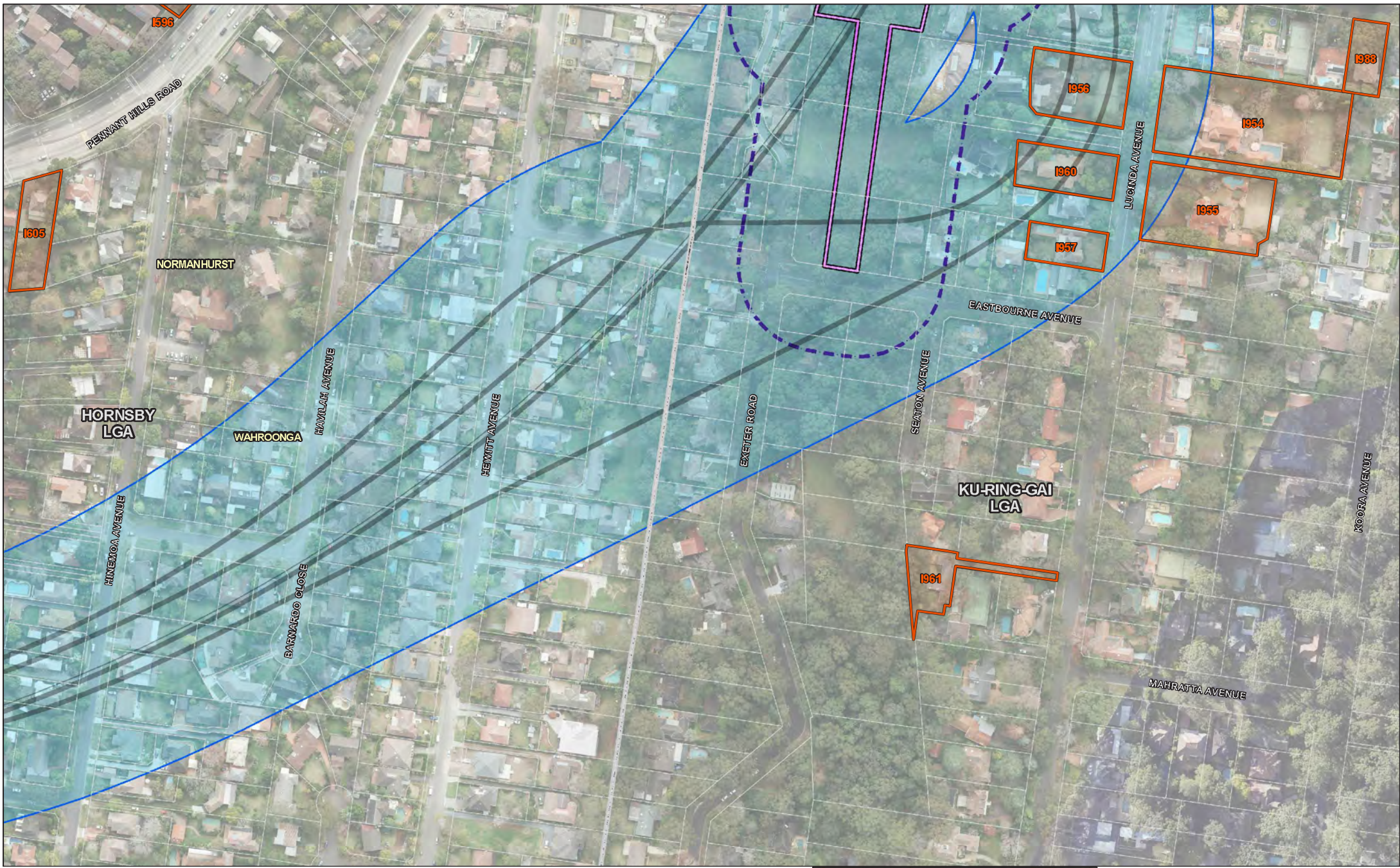
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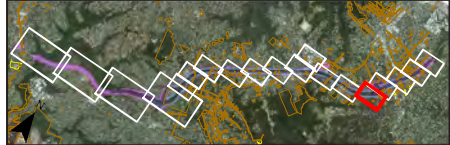




KEY

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Construction footprint	50m construction footprint buffer
Non-Aboriginal heritage item-Local	Local Government Area
Non-Aboriginal heritage item-State	Conservation area

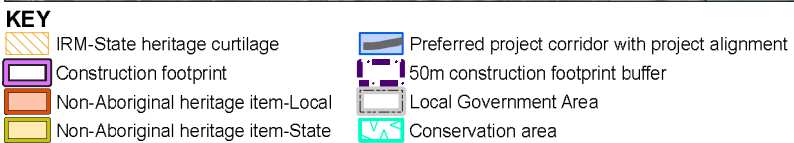
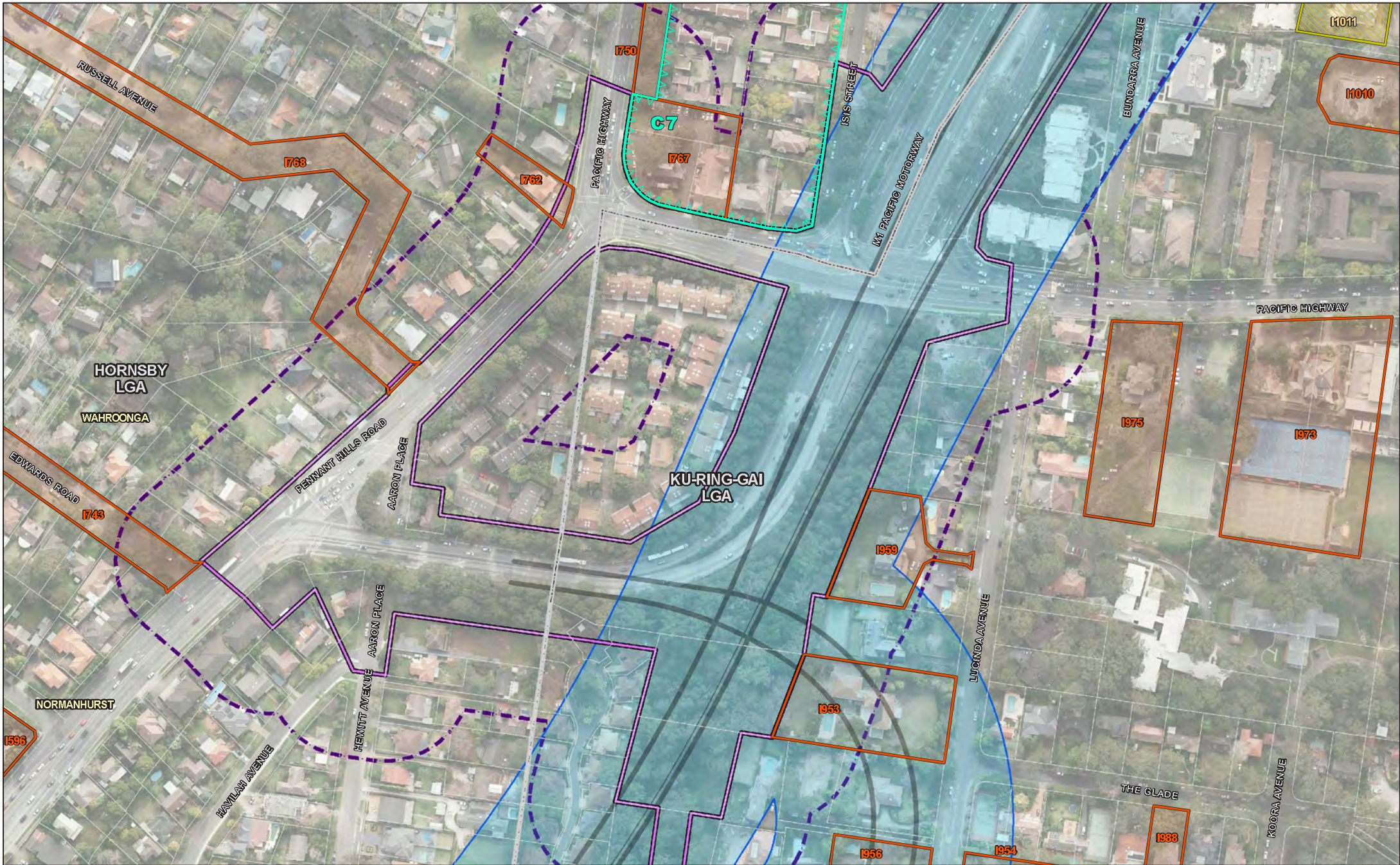
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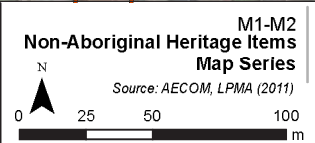
M1-M2
Non-Aboriginal Heritage Items
 Map Series

Source: AECOM, LPMA (2011)

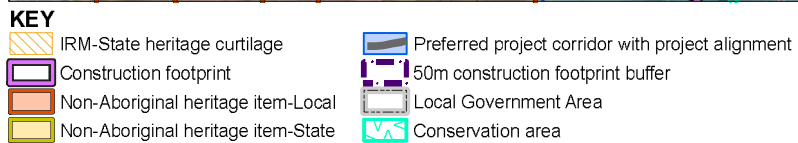
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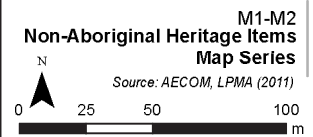
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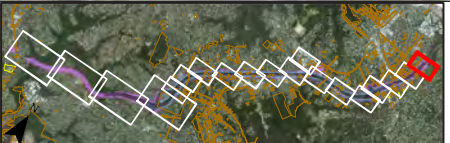


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**M1-M2
Non-Aboriginal Heritage Items
Map Series**

Source: AECOM, LPMA (2011)

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Appendix B

Former Maltworks, Thornleigh report

16 April 2014

Transurban Group
Level 9 / 1 Chifley Square
SYDNEY NSW 2000

Heritage impact assessment of Thornleigh Maltworks, 1 Pioneer Avenue, Thornleigh, NSW - NorthConnex

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) was commissioned to conduct a heritage impact assessment of the locally listed Thornleigh Maltworks (*Hornsby Local Environmental Plan 2013 - #A66*), located at 1 Pioneer Avenue, Thornleigh, NSW in the Hornsby local government area (Lot 12 DP235680). The site would be developed for the purpose of providing the site amenities, bus transfer area and car parking spaces (referred to as the Pioneer Avenue compound) for the NorthConnex project (the project). This would require the demolition of a locally listed heritage item.

This assessment involved:

- a search of the relevant heritage databases including:
 - NSW State Heritage Inventory;
 - *Hornsby Local Environment Plan 2013* (Hornsby LEP 2013);
- desktop review of available documentary sources/ heritage reports on the identified structure using existing information (both online and at the Hornsby Shire Library); and
- a one day site inspection of the Thornleigh Maltworks.

The contents of this letter report have been compiled in accordance with the NSW Heritage Division's guidelines *Assessing Heritage Significance* (NSW Heritage Office 2001).

2.0 Proposed Activity

As part of the construction of the project, the requirement for staff amenities and parking compound that can accommodate the large project workforce for this project has been identified. The Pioneer Avenue compound has been selected owing to its position relative to project construction areas and major private and public transport hubs.

The proposed compound would generally consist of:

- parking spaces for light vehicles;
- a bus transfer area for up to 12 buses;
- employee change rooms and showers; and
- 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. This would limit the number of workforce parking spaces required within the individual construction compounds and the potential for impacts on public parking spaces 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.

3.0 Relevant Legislation

3.1 Heritage Act 1977

The *Heritage Act 1977* was enacted to conserve the environmental heritage of NSW. Under section 32, places, buildings, works, relics, moveable objects or precincts of heritage significance are protected by means of either Interim Heritage Orders (IHO) or by listing on the State Heritage Register (SHR). Items that are assessed as having State heritage significance can be listed on the SHR by the Minister on the recommendation of the Heritage Council.

Archaeological relics (any relics that are buried) are protected by the provisions of section 139 of the *Heritage Act 1977*. Under this section it is illegal to disturb or excavate any land knowing or suspecting that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed. Note that no formal listing is required for archaeological relics; they are automatically protected if they are of local significance or higher.

3.2 Hornsby Local Environmental Plan 2013

Clause 5.10 of the Hornsby LEP 2013 controls development in relation to heritage items within the Hornsby Shire area. Development consent is required for the following:

- demolishing or moving a heritage item;
- altering a heritage item;
- disturbing or excavating an archaeological deposit;
- erecting a building on land where a heritage item exists; and
- subdividing land where a heritage item exists.

All development that may impact on heritage listed items must consider the effect of the proposed development on the heritage significance of the item concerned. Development consent is not required as the project is permissible without consent by virtue of *State Environmental Planning Policy (Infrastructure) 2007*.

Schedule 5 of the Hornsby LEP 2013 provides a list of identified heritage items, conservation areas and streetscapes. One listed heritage item and focus of this study, the Thornleigh Maltworks (Hornsby LEP 2013 #A66, 'Remains of maltworks'), was identified in this schedule.

4.0 Historical Context

4.1 The Thornleigh Maltworks

The Thornleigh Maltworks were officially opened on 29 August 1913 by the 19th Premier of New South Wales, the Honourable William Holman. During the ceremony, Premier Holman announced that he had accepted the invitation to attend the 'interesting and novel' occasion with pleasure, and that he considered the Maltworks to be a valuable industrial enterprise for the state of New South Wales (Anon 1913c). Among the large crowd of locals who attended the ceremony were representatives of the Tooheys Limited brewing company and the Department of Agriculture, as well as the renowned Sydney brewer A.W. Tooth of Tooth and Company Limited.

The opening of the Thornleigh Maltworks represented a significant step forward in the industrialisation of the local area, as well as in the progression of the Australian malting industry. Prior to the opening of the Thornleigh Maltworks, only one malting house was in operation in New South Wales. This malting house was located in Mittagong, approximately 130 kilometres outside of Sydney, and despite being estimated to have doubled in capacity since its installation, was not able to produce the volume of malt required by the major Sydney breweries that it serviced. Consequently, New South Wales continued to purchase malt from other states at an estimated annual cost of around £130,000 (Anon 1911a).

In September of 1911, the impetus to open a second malt house in New South Wales culminated in a proposal to construct a malting house on the Main Northern Line, between Sydney and Hornsby. In October of that same year, the New South Wales Malting Company (NSW Malting Co.) purchased 12 acres of orchard from a Mr. Cheetham in Thornleigh (Anon 1911b) and by November 1912 the construction of the Maltworks and an associated railway siding was well underway (Anon 1912) with the works being completed by July of 1913 (Anon 1913b). At that time, the NSW Malting Co. was identified as the only public malting company operating in New South Wales (Anon 1913a). The total costs of construction were estimated at around £15,000, and the new Maltworks were expected to produce between 90,000 and 100,000 bushels of malt per season, the equivalent of around one fifth of the amount of malt still being purchased from other states (Anon 1913c).

The Maltworks operated smoothly under the guidance of William George Chilvers, a highly experienced and renowned maltster who had gained experience malting both in England and Australia prior to accepting the position at Thornleigh. Following his death in 1937, Chilvers was succeeded by his son Hugh Cecil. The Chilvers family lived in a three bedroom house that was constructed in 1913 within 50 metres of the Maltworks. Throughout its years of operation, between 12 and 20 men were employed at the Maltworks at any one time (pers. comm., H. Chilvers to T. Kennedy).

Over time, the Maltworks established itself as an important feature of the local community and agriculture industry; in 1915 agricultural students from Granville and Sydney Technical Colleges visited in the orchards attached to the Maltworks for a lesson in pruning apple trees (Anon 1915), and from the 1910s to the 1940s both William and Hugh Chilvers acted as the lead judges of barely crops at the annual Sydney Royal Easter Show (numerous).

In 1966, the NSW Malting Co. sold the Thornleigh Maltworks to Barrett Bros. and Burston and Co. Pty. Ltd., an English malting company established in the 1860s. Following this change of hands, the Maltworks were subject to extensive remodelling and modernisation at a cost of around £2,356,000 (Anon 1968). Production recommenced under the new owners by the end of 1967 (Barrett Bros. and Burstone Co. Pty. Ltd. 1972, 11), and continued up until the late 2000s when the site was closed.

4.2 A Family Enterprise

The Chilvers family have significant connections with the early Australian malting industry, as well as with the Hornsby Shire local area. William George Chilvers was born in Hunslet, Leeds, on 19 September 1872 to George Chilvers, also a maltster, and his wife Rose Ellen Mole. Prior to migrating to Australia, Chilvers worked for the English malting firm of William Jones and Sons Ltd, where he was responsible for overseeing the operation of over 30 large maltings (Anon 1904b). When Jones and Sons Ltd. purchased maltings in Toowoomba, Queensland, they invited Chilvers to relocate to Australia and oversee operations (Anon 1904b). At the time, Chilvers was considered to be a leader in his field; and had been described as 'practically the best maltster obtainable in England to-day' (Anon 1904a).

Chilvers worked at the Toowoomba Maltings until he relocated to Sydney in 1912 to oversee the construction and manage the operation of the Thornleigh Maltworks. He brought with him his wife, Alice Maud Shellard, and their seven children; Birdie Violet, Iris Constance, Audrey Lillian, Hugh Cecil, Millicent Grace, Arthur Herbert and

Douglas Algenon (Anon 2014b). The family lived in a three bedroom home located within 50 metres of, and constructed at the same time as, the original Maltworks buildings.

William Chilvers passed away on 1 September 1937, at which time his son Hugh Cecil Chilvers took over management of the Maltworks. Hugh had been his fathers' understudy for many years previously, and represented the fifth generation of Chilvers to take up the role of maltster (pers. comm., H. Chilvers to T. Kennedy). Following the sale of the Maltworks to Barrett Bros. and Burston and Co. Pty. Ltd in 1966, Hugh retired as manager but stayed on for a further 10 years as Plant Manager under the new owners.

Both William and Hugh were notable local personalities within the Hornsby Shire area; from the 1910s through to the 1930s both father and son were invited to act as expert judges of barley crops at the annual Sydney Royal Easter Show, and the Chilvers family regularly appeared in local newspapers (Anon 1916). Hugh was particularly well known throughout New South Wales as a result of his skills as a cricketer; between 1929 and 1937 he played 32 first-class matches for New South Wales, 25 of which were Sheffield Shield matches alongside fellow cricketer Donald Bradman. Hugh's performances on the cricket pitch have earned him the description of 'the best spin bowler never to play for Australia' (Anon 2014a).

5.0 Desktop Review

5.1 NSW Heritage Inventory

A search of the NSW Heritage Inventory for the Study Area and its surrounds identified that one locally listed heritage item, the 'remains of maltworks' (Hornsby LEP 2013 #A66), is located within the Study Area. The item is described as:

The old Maltings occupied the same site and two of the existing buildings (railway shed and small office) may belong to that period, as they are very similar to those shown on a '1960s painting by J. Segall, now in the manager's office [sic] Material Exterior : brick and concrete Material Interior : not inspected

NSW State Heritage Inventory

The statement of significance subsequently states that the item is an:

Unusual industry which continues to use an older building layout and style though the present buildings date to the late 1960s. Important industry for the region and employer in the locality.

NSW State Heritage Inventory

The remains of the Thornleigh Maltworks are not listed on the State Heritage Register. The closest State Heritage listed item to the Study Area is the Gilligaloola' residence (SHR #271), which is located around 1.3 kilometres to the east. Aerial photography has also concluded that the listing description is incorrect and that the two existing buildings from the early history of the site are the germination building and the Manager's House. (see Section 5.3).

5.2 Previous Heritage Reports

5.2.1 Higginbotham 1993

Higginbotham Consultant Archaeological Services were commissioned in 1993 by Perumal Murphy Wu Pty Ltd (on behalf of Hornsby Shire Council and the Department of Planning) to prepare a report on the historical archaeology of the Hornsby Shire (Kass 1993; Higginbotham 1993). This report formed part of the wider Hornsby Heritage Study conducted to inform the listing of local heritage for the first Hornsby Shire Local Environmental Plan in 1994.

The report identified 95 historical archaeological sites within the Hornsby Shire area. Within the historical theme of 'Industrialisation', Higginbotham identified the Thornleigh Maltings (Report Listing No. 077) as an important local historic site (Higginbotham 1993: 14). The report asserted that the Maltworks were still in use, but had been entirely remodelled but did not identify any specific recommendations for the conservation, protection or archival recording of the site.

5.2.2 SKM 2004

SKM were commissioned by the Australian Government in early 2002 to undertake the F3 to Sydney Orbital Link Study, which included a non-Indigenous heritage assessment component. The report stated that the remains of the Thornleigh Maltworks had been identified by Hornsby Council as an item of regional heritage significance, and that it was therefore possible for the site to be considered for State heritage listing ((Sinclair Knight Merz Pty Ltd 2004, 15–18)).

5.3 Aerial Photography and Archival Documentation

A review of aerial photography and archival documents of the Study Area from 1930 to the present day shows how the layout and structural components of the Thornleigh Maltworks site have changed over time (refer to **Figure 1** to **Figure 3**). Two distinct phases of construction have been identified; the original construction works, which were commissioned by the NSW Malting Co. and occurred between 1911 and 1913 (refer to **Figure 1**), and the remodelling and modernisation works, which were commissioned by Barrett Bros. and Burston and Co. Pty. Ltd and took place between 1966 and 1968 (refer to **Figure 3**).

5.3.1 Initial Construction and Production – 1917 to 1930s

The initial construction and development of the Maltworks took place in the rural landscape of Thornleigh prior to its industrialisation with the principal structures of the Maltworks being surrounded by orchards to the north and south. The excavation pit associated with the Thornleigh Brickworks can be seen to the southeast opposite the Northern Rail Line.

From an assessment of the 1930s aerial photograph, it is likely that the arrangement of structures is similar to the original layout of the Maltworks and includes the main malting complex and the Manager's House; the initial railway siding; and a small grain storage shed located to the south of the main complex. The main malting complex consisted of a germination building (still extant) and at least two pyramidal roofed kilns for drying the germinated cereal grain. The Manager's House was constructed as a family home by William Chilvers for the purpose of being able to oversee the construction of the maltworks and to supervise the malting process while accommodating his young family.

Based on a comparison of aerial and early photography, it can be determined that the germination building within the Main malting complex and the Manager's House are the only original structures from this early part of the Maltworks history. It is also likely that the current rail siding follows the original siding route, although it is unclear if the trackwork is original or was upgraded when the siding was extended further into the compound.

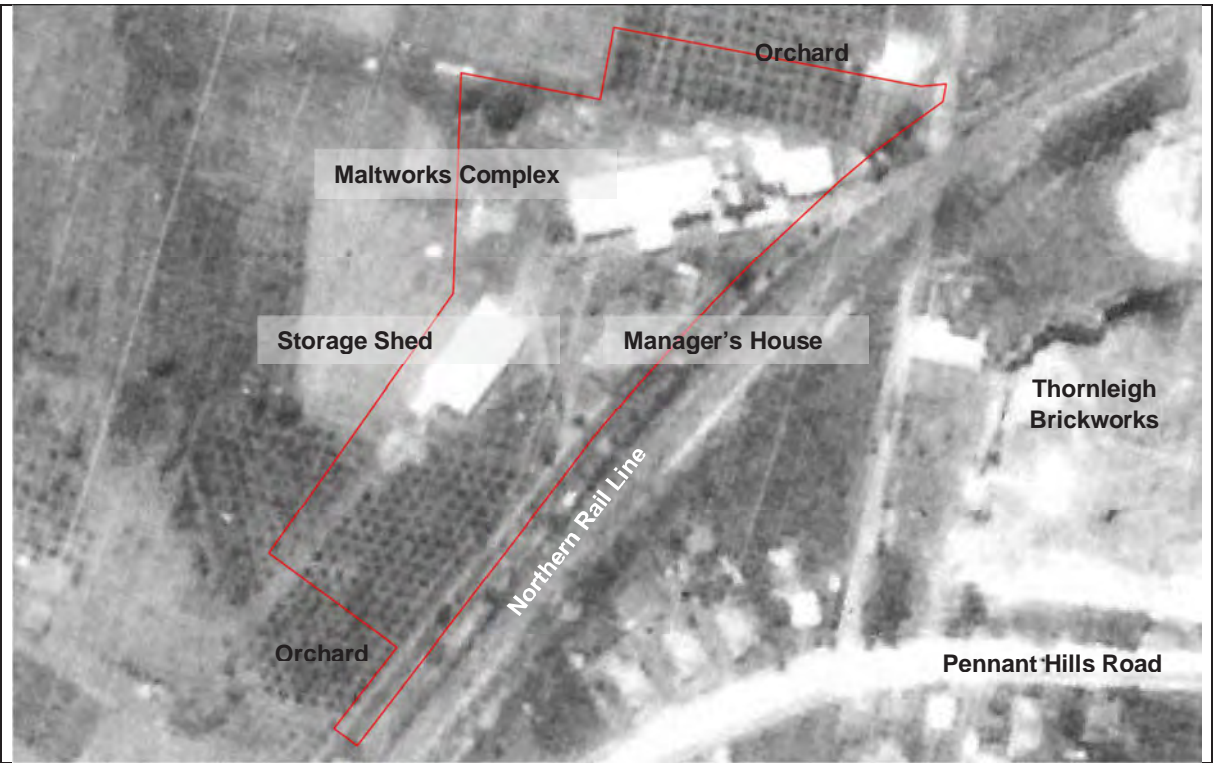


Figure 1 Aerial Photography 1930
(Source: Department of Land and Property Information, NSW Government)

<p>Plate 1 Main Malting Complex circa 1917-1930. Photo shows the main germination building in the midground, with the kilns for drying behind. View from storage shed looking east along rail siding.</p>	<p>Plate 2 Manager's House and Storage Shed circa 1917-1930. View from Main Malting Complex looking south west towards Northern Line. A steam train can be seen travelling north.</p>

	
<p>Plate 3 Undated painting of the Maltworks showing the main germination building in the foreground and red kilns behind that. The chimneys of the Thornleigh Brickworks can be seen in the background.</p>	<p>Plate 4 Undated photo of the Manager's house.</p>

5.3.2 Expansion, Stabilisation and Urban Creep – 1940s to 1965

The years from World War II to the mid 1960s was a period denoted by expanded storage capacity followed by extensive stability for the maltworks. An extension to the grain storehouses was undertaken between 1930 and the 1943 as evidenced from aerial photography. In addition to this one can see a decline in the number and size of orchards in the area combined with an increase in urban development. This trend increases through to the 1960s where we see the removal of the orchards at a time when industrialisation of the area begins in earnest. During this time, the maltworks remained relatively unchanged, save for minor landscape modifications, and path improvement.

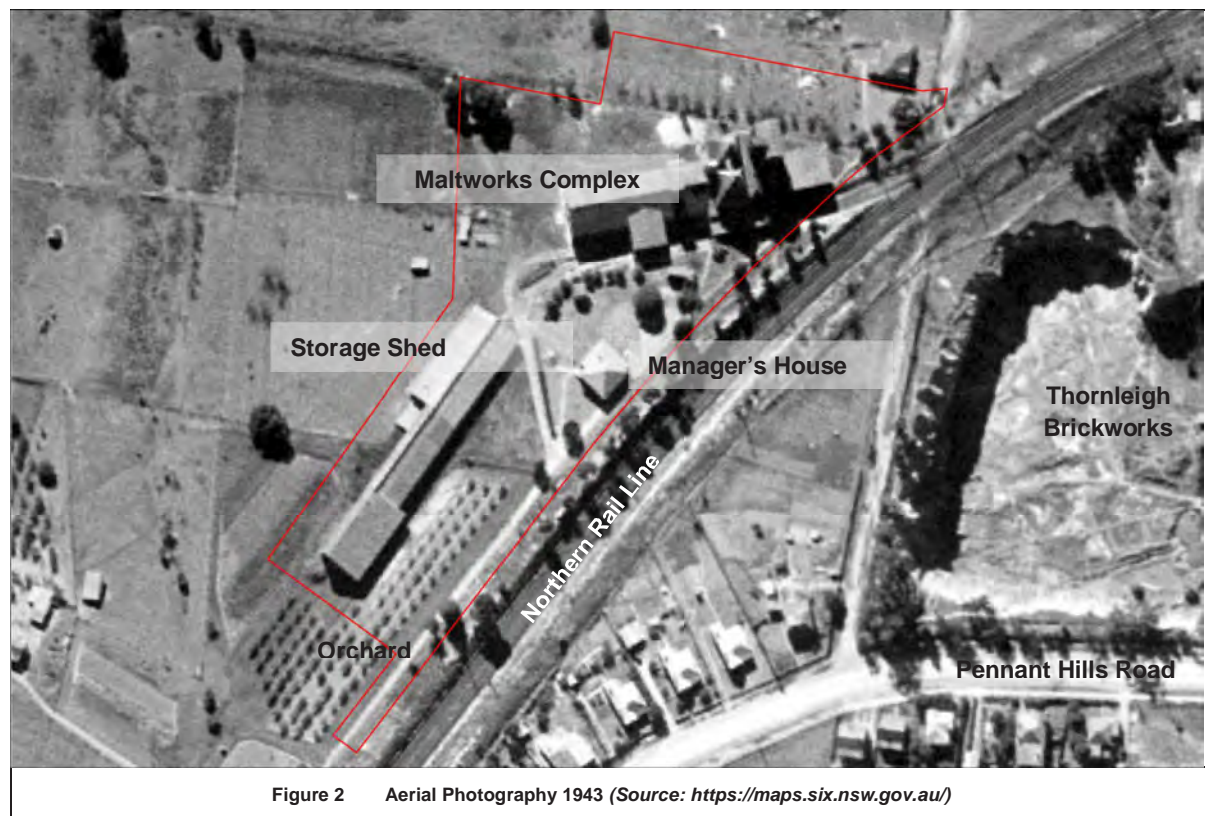




Plate 5 Steam train exiting the Gonarro Siding that serviced the Maltworks circa mid-20th century



Plate 6 Photo showing the original kilns and the germination building covered in ivy

5.3.3 Modernisation - 1966 to 2000s

With the closure of the maltworks in Mittagong in the 1970s, the Thornleigh maltworks found itself becoming one of the principal suppliers of malt to NSW. This combined with a destructive fire in the transit bins in 1970 marked a period of significant redevelopment of the site. The timber kilns and transit bins were replaced during this time and a new steephouse for washing of grains was constructed to the west of the germination building. Administration, laboratory testing facilities and workshops were added to the south of the malting complex. The germination building was also upgraded to accommodate new machinery to assist with the germination process. In addition to the new upgrades for the main malting complex, the southern half of the maltworks saw significant works being undertaken including the construction of new grain treatment/storage sheds and silos. Finally in the north of the site, the other major infrastructure was a water treatment plant that was built to treat the excess water generated by the plant during the cleaning process. These major developments within the site were set against a backdrop of extensive industrialisation of the Thornleigh area that also saw the construction of Pioneer Avenue to service the new industries of the area.



Figure 3 Aerial Photography 1978 (Source: Department of Land and Property Information, NSW Government)



Plate 7 Fire damage to the transit bins in 1970



Plate 8 Silos and grain receiving area circa, 1965-1970

6.0 Site Inspection

A one day field inspection of the Thornleigh Maltworks was undertaken on Thursday 27 March 2014 by AECOM heritage specialists Luke Kirkwood and Karyn Virgin. The site inspection comprised a site walkover to assess:

- the current status and layout of the Thornleigh Maltworks;
- the level of both historic structural impact and ground disturbance to the site; and
- the potential for historical archaeological deposits to be present.

The overall site structures were found to be still 'intact' with respect to the late 20th century arrangement of items within the Study Area. Certain elements such as machinery and moveable items have been sold or removed since the closure of the site. While the site is generally maintained, some areas of the site show significant vegetative growth notably the ivy covered walls of the germination building and grassed areas surrounding the main malting complex.

The original structures identified on site from aerials (the germination building and Manager's House) were assessed for heritage integrity. The germination building has seen some modification in the late 20th century to accommodate modern refrigeration techniques for the malting process. This included the installation of piping, electrics and machines inside the main structures and the removal of wooden louvered windows and enclosure of windows with bricks. Likewise the Manager's House is ultimately unchanged from its original design.

The field inspection also assessed the immediate surrounding area of the main malting complex and the Manager's House for archaeological remains. It was observed in this area that the ground surface integrity was high with no evidence to indicate that substantial groundwork had taken place in those places. Ground surface visibility ranged from near 100 per cent to low in part due to the presence of grasses and ground litter from trees. All areas of ground surface visibility were inspected. No evidence of archaeological features was identified.

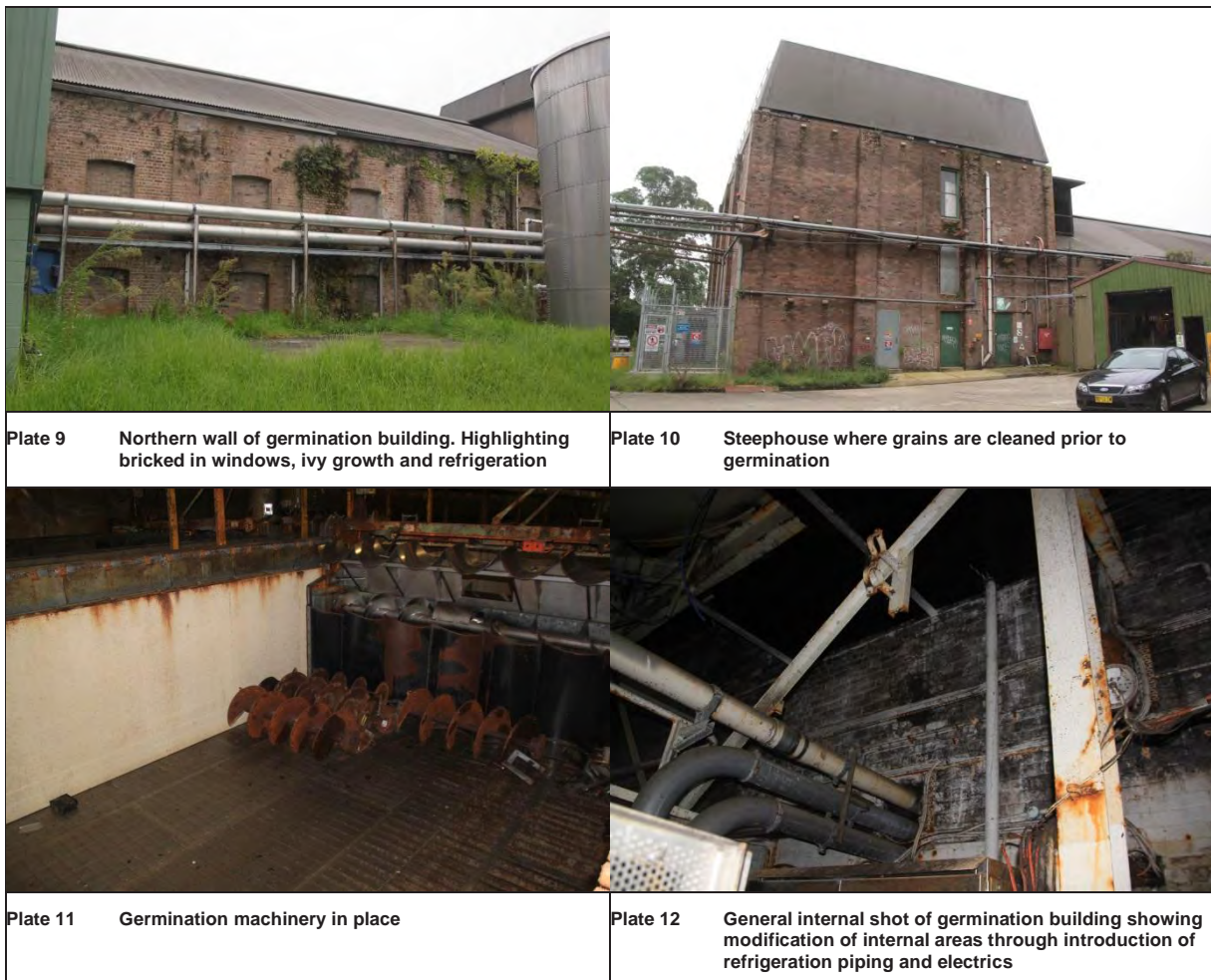




Plate 13 Main silos and rail siding in south western portion of the site

Plate 14 Kilns and storage areas at eastern end of the site



Plate 15 Water Treatment Plant in the north of the site

Plate 16 Manager's House. This item has seen major modification since its original construction with the enclosure of the north west veranda, removal of verandah features such as columns and brickwork, and modification of the garden and removal of the original stairs.

7.0 Significance Assessment

This section provides an assessment of the heritage significance of the Thornleigh Maltworks under the NSW State Heritage Register criteria.

Table 1 Application of the NSW State Heritage Division's Assessment Criteria

NSW State Heritage Criterion	Assessment
Criterion A – Historic Value <i>an item is important in the course, or pattern, of NSW's cultural or natural history</i>	The Thornleigh Maltworks does not fulfil this criterion. While certainly representative of a key component of the brewing network in NSW, the Thornleigh Maltworks was one of many maltings present in NSW at one time or another. The site also post-dates the more important and extensive Mittagong Maltworks ruins. Thus the site is not considered important in the course/pattern of NSW cultural or natural history.
Criterion B – Associated with a NSW identity <i>an item has strong or special association with the life or works of a person, or group of persons, of importance in NSW's cultural or natural history</i>	<p>The Thornleigh Maltworks are associated strongly with both the Chilvers family and the Barrett Burston Malting Company.</p> <p>William Chilvers, who oversaw the construction and management of the Thornleigh maltworks, was considered one of the foremost English maltsters of his day. This reputation saw him invited to migrate specifically to Australia from England to assist in setting up and overseeing the setting up of maltworks in Queensland and NSW. His son, Hugh Chilvers, took over as manager following his father's death in 1937 ending a successful career as a leg-spin bowler for NSW. Commentators have remarked that Hugh Chilvers was the greatest leg-spin bowler never to play for Australia taking 151 wickets in first grade cricket.</p> <p>Hugh Chilvers sold the company to Barrett Bros. and Burston and Co. Pty. Ltd in the mid 1960s. The Barrett Burston companies were one of the first to establish commercial malting in Australia in the 1860s. They have since grown to be second largest malt producers in Australia producing 30 per cent of the country's malt production capacity.</p>
Criterion C – Technical Achievement <i>an item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW</i>	The Thornleigh Maltworks employed traditional malting techniques (pre-refrigeration temperature control using ivy and timbered louvers, floating floors, coal fired kilns etc) developed in England in the late 19 th and early 20 th centuries. This technology was commonly used by most if not all maltworks in the state. Following refurbishment to the site in the mid 1960s, new modern techniques were adopted. While demonstrating key technical aspects of the malting process, the site is not unique in demonstrating these nor are these processes considered a creative or technical achievement.
Criterion D – Social Value <i>an item has strong or special association with a particular community or cultural group in NSW for social, cultural or spiritual reasons</i>	There are no known strong associations with this structure for social, cultural or spiritual reasons amongst the greater NSW population. No wider community consultation was conducted as part of this assessment.
Criterion E – Contributory Value <i>an item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history</i>	The Thornleigh Maltworks does not meet this criterion as the structures do not have the potential to yield information that will contribute to an understanding of NSW's cultural or natural history.

NSW State Heritage Criterion	Assessment
Criterion F – Rarity <i>an item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history</i>	Intact and original maltworks from the late 19 th and early 20 th centuries are increasingly rare in NSW. While the Thornleigh Maltworks have been extensively redeveloped over the last 100 years, the principal germination building remains substantially intact with internal modifications to accommodate the mechanisation of the malting process. Unlike the Mittagong Maltworks which have fallen into ruin, this structure remains structurally intact and accessible, clearly showing evidence of its original function. The site is also rare in having an associated Manager's House onsite that has been consistently lived in for close to 100 years representing an industrial-urban cultural connection that is rarely seen continued in late 20 th century industries.
Criterion G - Representativeness <i>an item is important in demonstrating the principal characteristics of a class of NSW's</i> - cultural or natural places; or - cultural or natural environments	The Thornleigh Maltworks represents, until recently, a working industrial site that has constantly evolved and been redeveloped to adapt to market requirements and improved efficiency in the malting process. The site and its structure are for the most part intact. That said, the most representative structure on site for the Maltworks that demonstrates the principal characteristics of the maltworks in NSW is the original germination building.

The Thornleigh Maltworks are of local significance to the development of the Thornleigh region in particular the local industrial estates which grew up around the site. While the overall site remains of local significance, the germination building meets criterion B, F and G for NSW State Heritage significance, however significant structural modifications to the structure in the late 20th century and extensive site modification have reduced these values. Further detailed structural assessments are required to determine how much of the internal elements of the structure are intact following refurbishment for mechanisation in the mid-1960s and an appreciation be undertaken of how this affects the structure's significance rating.

8.0 Impact Assessment

Direct impacts have been identified to the Thornleigh Maltworks:

- The demolition of several late 20th century structures associated with the malting process.
- The removal of a house linked to the early development of the site.

It is noted that the local listing of the site is for its archaeological value, although limited details are provided on the justification for this listing. Desktop review has identified that at least two structures, the germination building and the Manager's House have been present on the site, with minor modification, since the initial construction of the maltworks.

8.1 Statement of Heritage Impact Questions - Demolition of a Building or structure/s

Have all options for retention and adaptive re-use been explored?

The project requires a suitably sized staff compound to accommodate both the major workforce and shift change of this project. In doing so, the project has evaluated a number of sites, all of which do not meet the specific project requirements of providing a safe parking and staff compound area for the project.

The majority of the site is representative of a late 20th century industrial complex and only bear resemblance to the original layout of the Thornleigh Maltworks through the malting process steps. The demolition of parts of the site, while reflecting a loss in terms of a modern unique 20th century industrial site to the Thornleigh area, also represents an opportunity to focus conservation efforts on the original industrial building for the site, the germination building. While the loss of the Manager's House is unavoidable, the potential impacts on any archaeological relics would also be managed through the preparation of an Archaeological Test Excavation Research Design and Methodology to investigate the potential for archaeological remains linked to the early usage of the site, the connection between the industrial and urban settings and the link to the original occupants of the house, the Chilvers family.

Can all of the significant elements of the heritage item be kept and any new development be located elsewhere on the site?

The significant elements of the heritage item (namely the original germination building) would be kept as part of the redevelopment of the site. The internal structure would be maintained and protected for the lifetime of the project.

Is demolition essential at this time or can it be postponed in case future circumstances make its retention and conservation more feasible?

Demolition of the surrounding structures cannot be postponed as the compound is a critical component of the project in providing a safe working environment for a large component of the workforce for the project.

Has the advice of a heritage consultant been sought? Have the consultant's recommendations been implemented? If not, why not?

AECOM has worked closely with the NorthConnex team in identifying an approach that recognises the heritage significance of the germination building as being the most important heritage item within the Maltworks complex. The AECOM assessment also recognises the archaeological value of the site highlighted in the original LEP listing.

Due to the heritage value of the site, a number of designs have been put forward that investigated options for retention and adaptive re-use of various structures within the Maltworks complex, while still fulfilling the requirements of providing a safe working environment for future project staff. This was done in conjunction with the project's heritage advisors which resulted in a design that retained the main germination building. The advice of the consultant was also to undertake an archaeological investigation to determine the potential for archaeological deposits to be present as identified in the Hornsby Shire Council LEP.

8.2 Statement of Heritage Impact

From the assessment against the Heritage Branch guidelines (NSW Heritage Office 2002) a number of potential impacts have been assessed. These are graded to determine their impact against the significance of the site (see Table 2).

Table 2 Summary of the nature of the direct impacts

Impact Type	Impact
Major negative impacts (substantially affects fabric or values of state significance)	None. The item is not of state significance.
Moderate negative impacts (irreversible loss of fabric or values of local significance; minor impacts on State significance)	The project involves the demolition of the majority of structures onsite including the Manager's House. The demolition of these structures constitutes an irreversible loss of the fabric of this item of local significance. However it is noted that the main original structure of the Thornleigh Maltworks site, the germination building, would be retained allowing for future conservation of this unique building.
Minor negative impacts (reversible loss of local significance fabric or where mitigation retrieves some value of significance; loss of fabric not of significance but which supports or buffers local significance values)	None.
Negligible or no impacts (does not affect heritage values either negatively or positively)	None.
Minor positive impacts (enhances access to, understanding or conservation of fabric or values of local significance)	The retention of the germination building represents a heritage outcome that seeks to retain the original industrial component of this site. While the site itself will be substantially changed, this will allow for focus of the site to be on the germination building establishing conservation controls for the management of the item for future generations.
Major positive impacts (enhances access to, understanding or conservation of fabric or values of state significance)	None.

Overall, the impact to the heritage significance of the Thornleigh Maltworks is deemed to be moderate negative effect. The demolition of structures will forever change the context of the original industrial site in addition to the loss of the Manager's House which is thought to be contemporary to the original layout of the Thornleigh Maltworks. However, it is noted, that apart from the Manager's House, the remaining structures to be demolished date to the late 20th century and have no intrinsic heritage value apart from their connection to the site as a whole. The retention of the germination building is also considered to be a minor positive outcome, which has the potential to be a major positive outcome with appropriate conservation management controls for the future management of the site.

9.0 Key Findings and Summary of Recommendations

9.1 Key Findings

- The Thornleigh Maltworks are of local significance both as an early example of the maltings industry in NSW in addition to being a component of the local history of the area, specifically that relating to the creation of an industrial zone in this area; and
- The germination building and Manager's House reflect part of the original layout of the Maltworks and show a continued almost 100 year industrial/urban relationship linked to Chilvers family and later site managers.
- The Manager's House despite being an original structure has undergone modification since its initial construction.

9.2 Recommendations

Should it be deemed necessary to demolish the structures, the following recommendations are made:

- The germination building is to be conserved as it reflects one of two original structures of the Maltworks;
- A structural assessment of the germination structure would be conducted to ascertain the possible impact of the demolition of adjacent structures to identify suitable mitigation methods to ensure the germination structure remains intact. Additional measures would be identified and implemented, if required, to treat the newly exposed surfaces of the germination structure to protect it from the elements as a result of the demolition of adjacent structures.
- A demolition mitigation strategy would be developed. This strategy would include as a minimum:
 - In all instances, archival recording of the item would be undertaken following a risk assessment relating to entry into the relevant structure;
 - Protocols for archival recording of the site to be undertaken prior to demolition to record the structures and linking each structure to the maltings process;
 - The archival recording would include digital architectural drawings of the external and internal features of each item undertaken by a building surveyor, in addition to documenting any individual elements for all structures within the site;
 - Complete photographic record be made for all extant buildings, including their interiors;
 - An archaeological test excavation program would be undertaken to identify if historic archaeology is present on site. A test excavation methodology would be developed to assess the archaeological potential of identifying evidence of the early malting industry, the relationship of the original industrial site (the germination building) with the urban site (Manager's House), and evidence of the occupation of the Manager's House by the Chilvers family and subsequent site managers with their relationship to their staff. The test excavation methodology would be informed by the *NSW Heritage Manual* and would be undertaken by a suitable qualified historic archaeologist;
 - An archival report would be prepared and would include the findings of the test excavation. This report would also include, as an appendix, a collection of all known reports regarding the site; and
 - A copy of the archival report would be provided to the Sydney Branch of the National Archives of Australia or any other relevant repository.
- A conservation management plan would be developed for the germination building and associated structures not identified for demolition. The conservation management plan would be drafted by a qualified heritage practitioner and would be conducted in consultation with a structural engineer and architect with experience in historic 20th century structures;
- Copies of the archival report documentation would be provided to the following stakeholders: Hornsby Shire Council and the NSW Heritage Division of the Office of Environment and Heritage.

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Appendix M

Technical working paper:
Aboriginal heritage

NorthConnex

Building for the future



Technical working paper: Aboriginal heritage

Technical Working Paper: Aboriginal Cultural Heritage

NorthConnex

Client: Roads and Maritime Services

ABN: 76 236 371 088

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25-May-2014

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25-May-2014

Quality Information

Document Technical Working Paper: Aboriginal Cultural Heritage

Ref p:\60300684_m2-f3_ta\6. aecom – ta\4. tech work area\4.1 environment\06.
specialists\02. final reports\aboriginal heritage\rev 3 (exhibition)\20140524
aboriginal heritage technical working paper - rev 3_rms.docx

Date 25-May-2014

Prepared by Dr Darran Jordan

Reviewed by Luke Kirkwood

Revision History


Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
1	14-Apr-2014	Final for issue - Unrestricted	Scott Jeffries Associate Director - Environment	Original signed
2	15-May-2014	Final for exhibition	Scott Jeffries Associate Director - Environment	Original signed
3	25-May-2014	Final for exhibition	Scott Jeffries Associate Director - Environment	

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Glossary of terms and abbreviations

Term	Meaning
AHIMS	Aboriginal Heritage Information Management System.
Archaeological potential	The likelihood of undetected surface and/or subsurface archaeological materials existing at a location.
Aboriginal archaeological site	The present spatial extent of visible Aboriginal archaeological material(s) at a given location.
Artefact	Any object which has been physically modified by humans.
BP	Before Present.
Exposure	An area where the ground surface is visible, usually as the result of thinner vegetation cover, erosive forces or human-caused disturbance. In archaeological surveys, the percentage of ground surface that is visible is recorded. These percentages of exposure are then used to calculate effective coverage.
Ground Surface Visibility (GSV)	A term used to describe the area of the ground's surface that is visible during archaeological field surveys.
In situ	In the natural or original position. Applied to a rock, soil, or fossil when occurring in the situation in which it was originally formed or deposited.
OEHS	NSW Office of Environment and Heritage.
PACHCI	The Roads and Maritime Services Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI).
Potential Archaeological Deposit	PAD is the hypothesised presence of archaeological deposit where there is uncertainty due to a lack of visibly eroding artefacts, lack of test excavation either locally or in analogous landforms in the region.
Roads and Maritime	Roads and Maritime Services.
Stone artefact	Any piece of rock modified by human behaviour.

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Executive summary

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 in northern Sydney (NorthConnex). NorthConnex (the project) would comprise road tunnel(s) generally following the alignment of Pennant Hills Road. At the northern and southern end of the project, interchanges would connect the tunnels to the M1 Pacific Motorway, the Hills M2 Motorway, Pennant Hills Road and the Pacific Highway.

On 18 October 2013, the project was declared by the Minister for Planning and Infrastructure to be State significant infrastructure and critical State significant infrastructure. As such, Roads and Maritime is seeking approval for the project under Part 5.1 of the *Environmental Planning and Assessment Act 1979*. On 29 October 2013, the Director-General's environmental assessment requirements for the project were issued on 29 October 2013, and re-issued with amendments on 11 April 2014. The DGRs included a requirement to undertake an assessment of potential impacts of the project on Aboriginal cultural heritage.

The project follows the general alignment of Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway. It crosses through the suburbs Northmead, Baulkham Hills, North Rocks, Carlingford, West Pennant Hills, Pennant Hills, Beecroft, Normanhurst, and Wahroonga. This area consists of highly modified slopes, with existing road, business and residential areas having heavily disturbed the natural landscape. It has been subject to a variety of past disturbances, including vegetation clearance, road construction, infrastructure development, creek/drainage line modification and the development of multiple business and residential properties. However, large tracts of vegetation remain in the region, at Bidjigal Reserve located next to the Hills M2 Motorway and Ku-ring-gai National Park to the north of the project.

To inform this assessment, targeted field inspections of areas within or in proximity to the project were undertaken on 24-25 September 2013, 2 October 2013 and 19 December 2013 with representatives of the Metropolitan Local Aboriginal Land Council and Guringai Tribal Link Aboriginal Corporation. Areas for inspection were based on areas of potential archaeological sensitivity and the potential areas of disturbance by the project. Areas of potential archaeological sensitivity were informed by existing Aboriginal Heritage Information Management System (AHIMS) sites, proximity to water sources and levels of past disturbance. Sites located in proximity to the study area were also ground-truthed during the inspections.

No specific Aboriginal archaeological heritage values were identified during these inspections outside existing AHIMS site areas, within the exception of two management zone areas, being:

- An area of archaeological sensitivity, containing three valid registered AHIMS sites and the potential for further sites, located in the southern portion of the study area adjacent to the Hills M2 Motorway integration works. This area is referred to in this report as ASA1 (Archaeological Sensitivity Area 1) management zone. The area is adjacent to Blue Gum Creek and contains numerous outcrops and rock overhangs.
- An area containing two rockshelter sites and overhangs near Darling Mills Creek and located north of the Hills M2 Motorway, adjacent to the Hills M2 Motorway integration works. There is also potential for further Aboriginal archaeological sites to be located in this area. This area is referred to in this report as ASA2 (Archaeological Sensitivity Area 2) management zone.

The construction footprint for the project would not extend into either ASA1 or ASA2 management zones.

Based on the results of the targeted inspections of the study area, it was concluded that a detailed cultural heritage impact assessment is not required for this project. Nonetheless, mitigation and management measures are recommended:

- The detailed design of the project should be developed to avoid direct impacts on the ASA1 and ASA2 management zones and previously identified archaeological sites.
- The identified rockshelter sites and overhangs located in proximity to the Hills M2 Motorway integration works should be clearly delineated prior to construction works to avoid inadvertent impacts during construction.
- During construction, vibration monitoring would be conducted for vibration intensive works within 50 metres of rockshelter sites and associated overhangs associated with ASA2 management zone to ensure that the rockshelter sites and overhangs are not adversely affected. The need for vibration monitoring would be informed by a preliminary screening of activities at this location to identify what activities have the potential

for vibration at the areas of sensitivity. The preliminary screening and works requiring monitoring would be contained within the construction environmental management plan.

- If impacts on Aboriginal heritage sites or areas of archaeological sensitivity cannot be avoided, then it is recommended that the assessment progress to Stage 3 of the Roads and Maritime PACHCI process for formal consultation (Roads and Maritime, 2011).
- The AHIMS database should be updated through submission of site cards and ASIR card/s prior to works commencing. This should provide the data gathered during the field inspections carried out to inform this assessment so that the latest coordinate and condition data is accurate within the AHIMS register.
- In the event that additional areas outside of those inspected as part of this assessment are identified as having potential for Aboriginal heritage and the potential for disturbance as a result of the project, then the need for additional Stage 2 assessments should be reviewed.
- If an Aboriginal object(s) or human remains are discovered during construction and the discovery should be managed in accordance with the Roads and Maritime standard management procedure Unexpected Archaeological Finds (July, 2012).

1.0 Introduction

1.1 The project

Roads and Maritime Services (Roads and Maritime), is seeking approval under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to construct and operate a tolled motorway linking the M1 Pacific Motorway at Wahroonga to the M2 Hills Motorway at the Pennant Hills Road interchange at West Pennant Hills in northern Sydney (the project) (refer to **Figure 1**).

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.

Construction of the project is anticipated to commence in early 2015 and is expected to take around four years to complete.

On 18 October 2013, the project was declared by the Minister for Planning and Infrastructure to be State significant infrastructure and critical State significant infrastructure.

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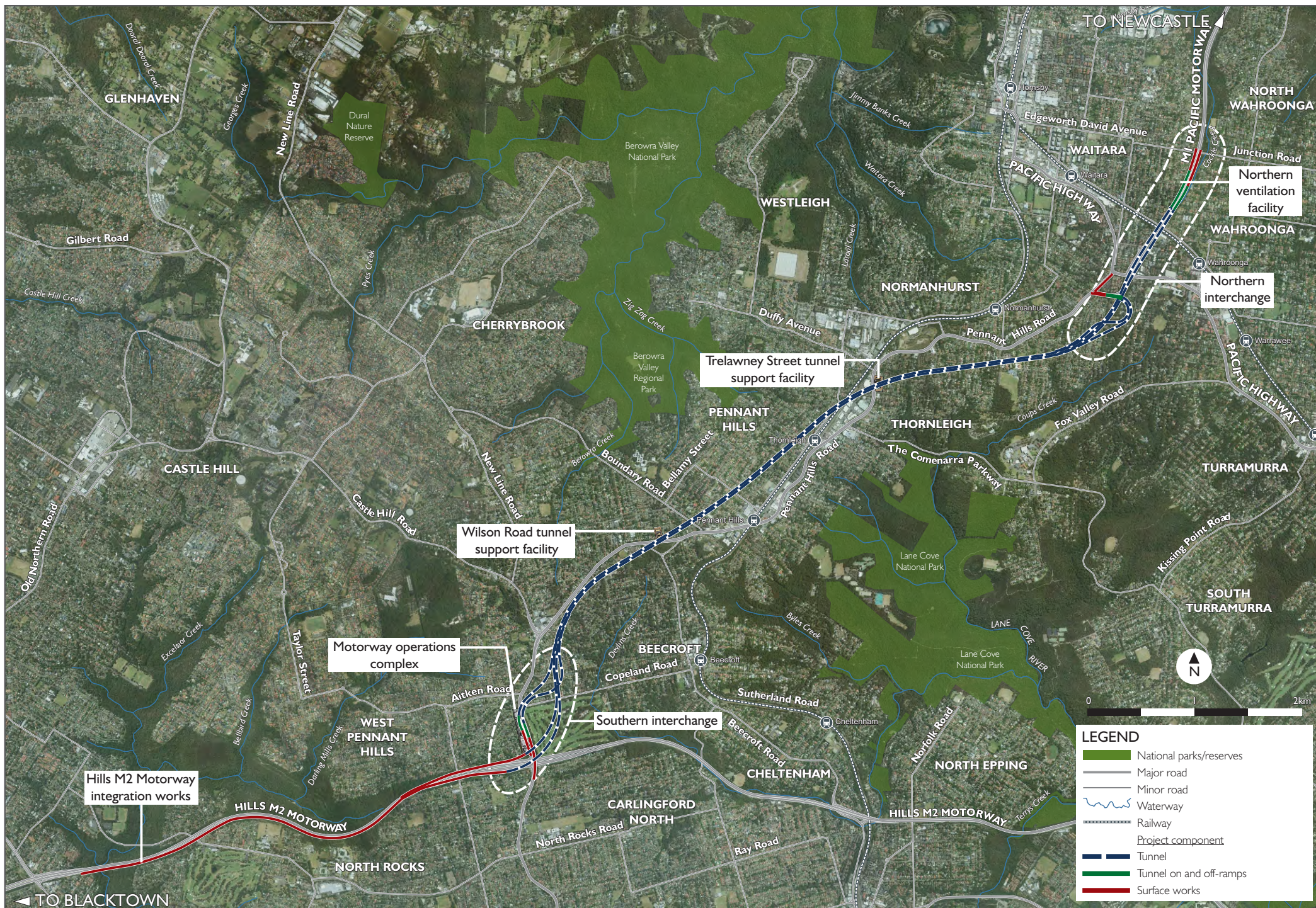


Figure 1 The project

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1.2 Project location

The project would consist of underground tunnels generally following the alignment of Pennant Hills Road between the M1 Pacific Motorway and the Hills M2 Motorway. It would span the suburbs of Wahroonga, Normanhurst, Thornleigh, Pennant Hills, Beecroft, West Pennant Hills, Carlingford, North Rocks, and Baulkham Hills.

The majority of the area in which the project is located consists largely of highly modified slopes, with existing roads, businesses and residential areas having heavily disturbed the natural landscape. The area has been subject to a variety of past disturbances, including vegetation clearance, road construction, infrastructure development, creek/drainage line modification and the development of multiple businesses and residential properties. However, large tracts of vegetation remain at Bidjigal Reserve located next to the Hills M2 Motorway and Ku-ring-gai National Park to the north of the project.

1.3 Purpose of this report

The Director-General's environmental assessment requirements (DGRs) for the project were issued on 29 October 2013, and were re-issued with amendments on 11 April 2014. The DGRs have informed the preparation of the environmental impact statement for the project. The DGRs include the following requirements specific to potential impacts on Aboriginal cultural heritage:

- An assessment of the potential Aboriginal cultural heritage impacts of the project, including an assessment of objects, places of significance, natural and landscape values of the corridor and surrounding area, taking into account the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, July 2005).
- Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures).

This technical working paper presents the assessment on the potential impacts on Aboriginal cultural heritage as a result of the project. This assessment has been undertaken in accordance with the DGRs and the Roads and Maritime procedure for Aboriginal cultural heritage consultation and investigation, abbreviated as the PACHCI process (Roads and Maritime, 2011) (refer to **Figure 2**).

The PACHCI process is a staged approach to assessment and consultation, compiled specifically for Aboriginal archaeological assessments on Roads and Maritime projects. Stages 1 and 2 of the PACHCI process align with the OEH Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, 2010). Stage 3 of the PACHCI represents the preparation of a detailed cultural heritage impact assessment and consultation with Aboriginal stakeholders as part of that assessment. Stage 3 aligns with the OEH guideline Aboriginal Cultural Heritage Consultation requirements for proponents (the 2010 consultation guideline) (DECCW, 2010).

As discussed later in this report, the assessments undertaken in accordance with the PACHCI process concluded that the assessment did not need to advance to the preparation of a detailed cultural heritage impact assessment (a Stage 3 assessment).

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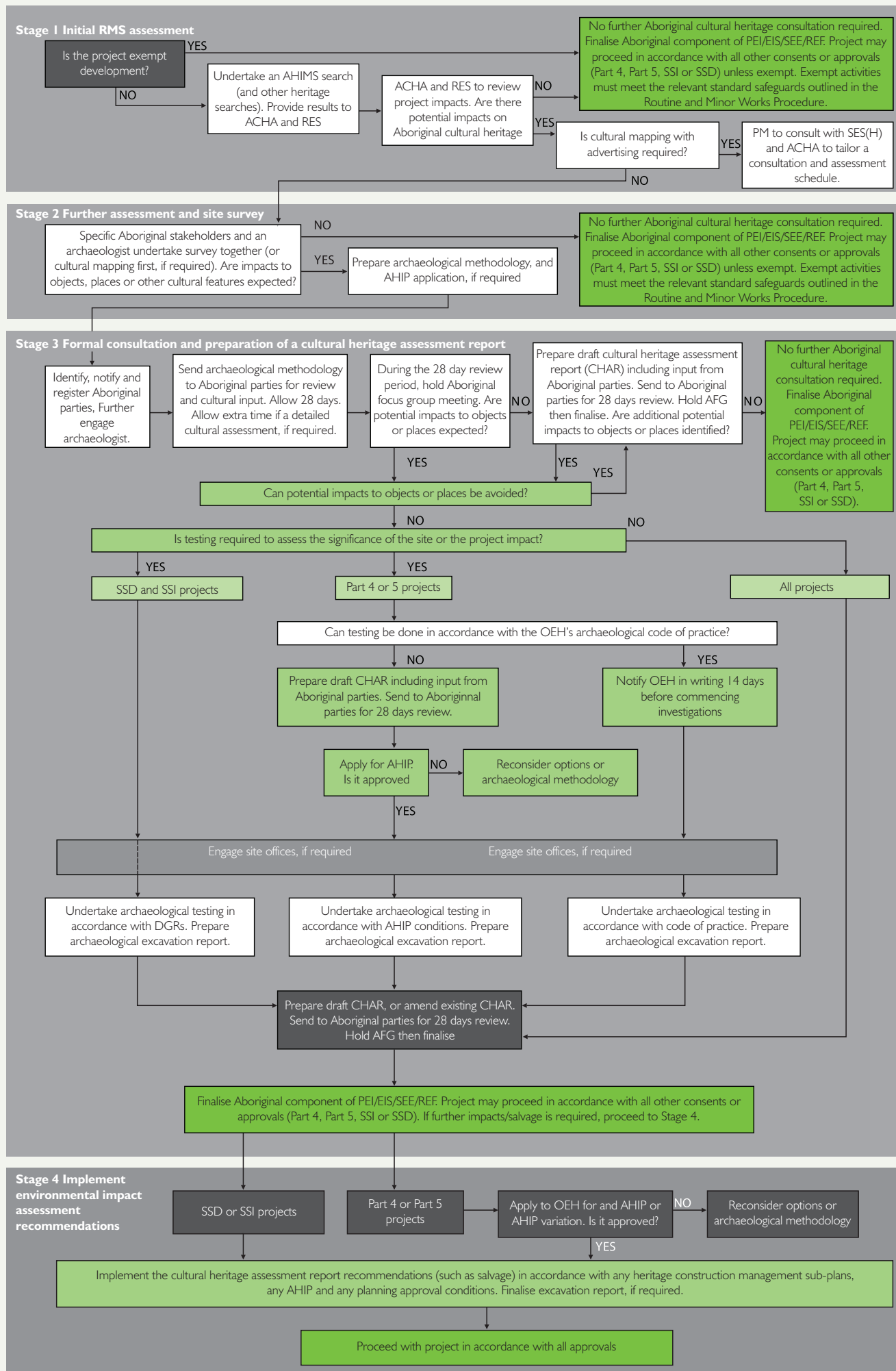


Figure 2 The PACHCI process (Roads and Maritime Services, 2011)

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1.4 Study area

The study area for this assessment has been informed by:

- Areas of potential archaeological sensitivity based on water sources, past disturbances and existing sites listed in Aboriginal Heritage Information Management System (AHIMS) register, administered by the Office of Environment and Heritage (OEH).
- The preferred tender design, as summarised in **Section 1.1** of this report, and as detailed further in Chapter 5 of the environmental impact statement for the project.
- The preferred project corridor, which represents a zone on the surface equal to a distance of 50 metres from the outer edge of the underground tunnels.
- The construction footprint of the project with a 200 metre buffer. The construction footprint represents the area that would be physically impacted by construction works, including all construction ancillary facilities.

The operational footprint of the project is no larger than the construction footprint (and in some cases, it is smaller). For the purpose of this report, the construction footprint assessed reflects the worst case disturbance footprint for direct impacts at the surface.

The preferred tender design and construction footprint of the project as assessed within this technical working paper represent the preferred tender design. Sufficient flexibility has been provided in the preferred tender design to allow for refinement during detailed design, or to minimise environmental impacts, or in response to submissions received during the exhibition of the environmental impact statement. The final design may therefore vary from the project as described and assessed within this technical working paper.

1.5 Structure of this report

This report has the following structure:

Chapter 1 introduces the project.

Chapter 2 details the legislative considerations relevant to the project and Aboriginal heritage.

Chapter 3 details the methodology for the assessment.

Chapter 4 provides a summary and analysis of background information.

Chapter 5 details the results of the archaeological assessment.

Chapter 6 summarises the constraints of the project and study area.

Chapter 7 provides recommendations for the project.

Chapter 8 provides a conclusion for the assessment.

Chapter 9 provides the references used to assist in the preparation of this report.

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2.0 Legislative considerations

Several planning and legislative documents govern how heritage is managed in NSW. The following section provides an overview of the requirements under each as they apply to the project.

2.1 Commonwealth legislation

2.1.1 Aboriginal and Torres Strait Islander Heritage Protection Act 1984

The *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (the ATSIHP Act) provides for the preservation and protection of places, areas and objects of particular significance to Indigenous Australians. The stated purpose of the ATSIHP Act is the 'preservation and protection from injury or desecration of areas and objects in Australia and in Australian waters, being areas and objects that are of particular significance to Aboriginals in accordance with Aboriginal tradition' (section 4).

Under the ATSIHP Act, 'Aboriginal tradition' is defined as "the body of traditions, observances, customs and beliefs of Aboriginals generally or of a particular community or group of Aboriginals, and includes any such traditions, observances, customs or beliefs relating to particular persons, areas, objects or relationships" (section 3). A 'significant Aboriginal area' is an area of land or water in Australia that is of 'particular significance to Aboriginals in accordance with Aboriginal tradition' (section 3). A 'significant Aboriginal object', on the other hand, refers to an object (including Aboriginal remains) of like significance.

For the purposes of the ATSIHP Act, an area or object is considered to be injured or desecrated if:

In the case of an area:

- It is used or treated in a manner inconsistent with Aboriginal tradition.
- The use or significance of the area in accordance with Aboriginal tradition is adversely affected.
- Passage through, or over, or entry upon, the area by any person occurs in a manner inconsistent with Aboriginal tradition.

In the case of an object:

- It is used or treated in a manner inconsistent with Aboriginal tradition.

The ATSIHP Act can prevail over State and Territory laws in situations where a state or territory has approved an activity, but the Commonwealth Minister prevents the activity from occurring by making a declaration to protect an area or object. However, the Minister can only make a decision after receiving a legally valid application under the ATSIHP Act and, in the case of long term protection, after considering a report on the matter. Before making a declaration to protect an area or object in a state or territory, the Commonwealth Minister must consult the appropriate Minister of that State or Territory (section 13).

2.1.2 Environment Protection and Biodiversity Conservation Act 1999

Under Part 9 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), any action that is likely to have a significant impact on a matter of National Environmental Significance may only be carried out with the approval of the Commonwealth Minister for the Environment.

An action is defined as a project, development, undertaking, activity, series of activities, or alteration.

An action will also require approval if:

- It is undertaken on Commonwealth land and will have or is likely to have a significant impact.
- It is undertaken outside Commonwealth land and will have or is likely to have a significant impact on the environment on Commonwealth land.
- It is undertaken by the Commonwealth and will have or is likely to have a significant impact.

The EPBC Act defines 'environment' as both natural and cultural environments and therefore includes Aboriginal and historic heritage items. Under the EPBC Act, protected heritage items are listed on the National Heritage List (items of significance to the nation) or the Commonwealth Heritage List (items belonging to the Commonwealth or its agencies). These two lists replaced the Register of the National Estate (RNE). The RNE has been suspended and is no longer a statutory list.

2.1.3 Native Title Act 1993

Native title is the recognition in Australian law that some Indigenous Australians continue to hold rights to their land and waters, which come from their traditional laws and customs. The *Native Title Act 1993* provides for the recognition and protection of native title rights and interests. The native title rights and interests held by particular Indigenous Australians depend on both their traditional laws and customs and what interests are held by others in the area concerned.

Section 8 of the *Native Title Act 1993* states that the Act is not intended to affect the operation of any law of a State or Territory that is capable of operating concurrently with the Act.

A search of the register maintained by the National Native Title Tribunal indicates that there is one native title claim that has been registered with respect to land within the area of the project (reference NC2013/002). The application has been made by the Awabakal and Guringai People. The project would not directly affect Crown land that is the subject of the native title claim.

In accordance with the PACHCI, a representative from the Guringai Tribal Link Aboriginal Corporation participated in the site inspection and was consulted as part of this assessment (refer to **Section 3.1** and **Section 5.3**).

2.2 State legislation

2.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation) provide the framework for environmental planning in NSW and include provisions to ensure that proposals that have the potential to impact on the environment are subject to an appropriate level of assessment. The EP&A Act and EP&A Regulation also provide opportunity for public involvement in the environmental impact assessment process. In NSW, environmental impacts are interpreted as including impacts on cultural heritage.

Roads and Maritime is seeking approval for the project under Part 5.1 of the EP&A Act. The project has been declared to be State significant infrastructure and critical State significant infrastructure.

Development consent is not required for the project pursuant to the provisions of the *State Environmental Planning Policy (Infrastructure) 2007*.

The following Local Environmental Plans (LEPs) or Planning Scheme Ordinances apply to the study area:

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

These instruments require consent to be granted when:

- Demolishing or moving a heritage item, Aboriginal object, building, work, relic or tree within a heritage conservation area.
- Altering a heritage item that is a building by making structural changes to its interior or by making changes to anything inside the item that is specified in the applicable Schedule of the LEP or Ordinance.
- Disturbing or excavating an archaeological site while knowing, or having reasonable cause to suspect, that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed.
- Disturbing or excavating an Aboriginal place of heritage significance.
- Erecting a building on, or subdividing, land on which a heritage item is located or that is within a heritage conservation area.

However, as noted the project is permissible without development consent. Therefore consent is not required by the local councils under Part 4 of the EP&A Act.

2.2.2 Director General's Environmental Assessment Requirements

As discussed in **Section 1.3**, the Director-General's environmental assessment requirements (DGRs) for the project were issued on 29 October 2013 and re-issued with amendments on 11 April 2014. Regarding Aboriginal cultural heritage, the DGRs require that the environmental impact statement includes:

- An assessment of the potential Aboriginal cultural heritage impacts of the project, including an assessment of objects, places of significance, natural and landscape values of the corridor and surrounding area, taking into account the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, July 2005).
- Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures).

Consultation has been undertaken for this assessment in order to obtain information on the potential cultural impacts of the project. The inspection methodology has been aligned with the PACHCI process and corresponds to the due diligence process of the Code of Practice. Representatives from the Guringai Tribal Link Aboriginal Corporation (GTLAC) and Metropolitan Local Aboriginal Land Council (MLALC) were engaged by Roads and Maritime to take part in the targeted inspections and to provide input into the assessment on the potential Aboriginal cultural heritage impacts of the project.

2.2.3 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act 1974* (NPW Act), administered by the Office of Environment and Heritage (OEH), is the primary legislation for the protection of Aboriginal cultural heritage in NSW. The NPW Act gives the Director-General of OEH responsibility for the proper care, preservation and protection of 'Aboriginal objects' and 'Aboriginal places', defined under the Act as follows:

- Article I. An *Aboriginal object* is any deposit, object or material evidence (that is not a handicraft made for sale) relating to Aboriginal habitation in NSW, before or during the occupation of that area by persons of non-Aboriginal extraction (and includes Aboriginal remains).
- Article II. An *Aboriginal place* is a place declared so by the Minister administering the NPW Act because the place is or was of special significance to Aboriginal culture. It may or may not contain Aboriginal objects.

Part 6 of the NPW Act provides specific protection for Aboriginal objects and places by making it an offence to harm them. Under Part 5 of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) must be obtained if impacts to Aboriginal objects and/or places are anticipated. AHIPs are issued under section 90 of the NPW Act. Consultation with Aboriginal communities is required under OEH policy when an application for an AHIP is considered and is an integral part of the permit process. AHIPs may be issued in relation to a specified Aboriginal object, Aboriginal place, land, activity or person or specified types or classes of Aboriginal objects, Aboriginal places, land, activities or persons. An AHIP is not required if the development is approved under Part 5.1 of the EP&A Act. However, a commensurate level of assessment as would otherwise be required for an AHIP is nonetheless typically required for assessment under Part 5.1 of the EP&A Act.

Section 89A of the NPW Act requires notification of the location of identified Aboriginal objects within a reasonable time, with penalties for non-notification, including daily penalties. Section 89A is binding in all instances. It should be noted that the NPW Act includes a strict liability offence whereby a person may be prosecuted for harming an Aboriginal object even when the person was not aware that the object was an Aboriginal object and when the Aboriginal object may have been harmed unknowingly.

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3.0 Methodology

The methodology for this assessment has been developed as per the requirements of the PACHCI guideline. The analysis of Aboriginal heritage constraints for this project included:

- A desktop review of the project and surrounding area in order to identify previously recorded sites of Aboriginal heritage significance and areas with the potential for archaeological sensitivity.
- Stage 2 consultation in accordance with the Roads and Maritime PACHCI process with the Metropolitan Local Aboriginal Land Council (MLALC) and the Guringai Tribal Link Aboriginal Corporation (GTLAC), as facilitated by Clive Freeman, Aboriginal Cultural Heritage Officer for Roads and Maritime.
- Development and use of predictive mapping. The predictive mapping has been based on the information gathered through the desktop review and the consultation feedback, and assisted in defining the study area for the project. This was then used to focus the site inspection to areas of potential archaeological and cultural sensitivity.
- Field inspections held on 24-25 September 2013, 2 October 2013 and 19 December 2013 to ground-truth items of Aboriginal cultural heritage identified during the desktop review, and to identify surface expressions of Aboriginal archaeological and cultural heritage values (including cultural landscape values) within the targeted areas of potential archaeological sensitivity. Areas were inspected with attention to their capacity to contain Aboriginal archaeological deposits. All outcrops were inspected for grooves and engravings; all mature trees were inspected for signs of modification.

The field inspections were completed across four days, with the following participants:

- September and October 2013 – AECOM archaeologists, Dr Darran Jordan, Dr Andrew McLaren and Rochelle Coxon, a Metropolitan Local Aboriginal Land Council (MLALC) representative Allen Madden and a Guringai Tribal Link Aboriginal Corporation (GTLAC) representative Tracey Howie.
- December 2014 - AECOM archaeologists, Dr Darran Jordan and Rochelle Coxon, and a Metropolitan Local Aboriginal Land Council (MLALC) representative Allen Madden.

Each site inspection involved:

- A combined vehicle and pedestrian inspection of the study area of 14 transects.
- Ground-truthing of previously registered AHIMS Aboriginal sites located within the bounds of or in proximity to the study area, according to the search result coordinates and site cards provided by OEH.
- Taking notes throughout the site inspection, detailing landform, ground surface visibility and areas of exposure. Data was recorded on a hand-held GPS and photographs were taken.

The representatives from the MLALC and GTLAC were invited to submit a report on their findings of the site inspection(s) for incorporation into the formal Roads and Maritime reporting on the site inspection results (referred to as a Stage 2 PACHCI report).

Consultation with the MLALC and GTLAC is discussed further in **Section 3.1** and **Section 5.3**.

- Identification and mapping of previously recorded sites and areas of Aboriginal archaeological potential based on the field inspection to determine the potential impact on these sites and areas and if further assessment in accordance with the PACHCI is required.
- Development of a draft archaeological testing methodology, should a Stage 3 PACHCI assessment be required.

As discussed in **Chapter 5.0** and **Chapter 6.0** of this report, it was concluded that there would be no impacts as a result of the project on Aboriginal archaeological sites, areas of archaeological sensitivity or areas that have cultural value. As such, the assessment did not advance to further field investigations or consultation with the Aboriginal community.

3.1 Aboriginal representative consultation

Aboriginal representatives are in the best position to provide information on the Aboriginal social/cultural heritage values of a given area, including the cultural landscape values. It is not appropriate for non-Aboriginal people to assess or comment on cultural values. Representatives from the Metropolitan Local Aboriginal Land Council (MLALC) and Guringai Tribal Link Aboriginal Corporation (GTLAC) participated in the site inspections held in late 2013.

Consultation was undertaken in accordance with Stage 2 of the PACHCI, which aligned with the OEH Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, 2010). Details of field attendance are summarised in **Table 1**.

Table 1 Aboriginal Representative Attendance for 2013 Field Inspections

Date	24 September 2013	25 September 2013	2 October 2013	19 December 2013
MLALC Attendee	NA	Allen Madden	Allen Madden	Allen Madden
GTALC Attendee	Tracey Howie	Tracey Howie	Tracey Howie	NA

Both representatives provided verbal feedback during the field inspections, which was considered in this assessment. The representatives were invited to provide a report or comments detailing their findings of the inspections for consideration in the assessment of the potential impacts of the project. Further detail on the results of this consultation is discussed in **Section 5.3**.

As detailed later in this report, it is concluded that no impacts to Aboriginal objects, places or cultural features would occur as a result of the project. As such, no further consultation or investigation was required. This is consistent with the OEH Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales (DECCW, 2010).

4.0 Summary and analysis of background information

Environmental factors such as topography, hydrology, geology, soils, flora and fauna would have been key influences on past Aboriginal occupation and land use, as well as archaeological site patterning and distribution, site survival over time, and the likelihood of detecting any extant archaeological sites. Any attempt to predict or interpret the character and distribution of Aboriginal sites in a given landscape must consider these environmental factors, along with historic and current land use practices, to enable predictions to be made concerning the likely presence or absence of sites in a given area and, where appropriate, their archaeological integrity.

4.1 Landform and topography

The geology of the project and surrounding area includes the Mittagong Formation which separates the Wianamatta Group and underlying Hawkesbury Sandstone Formation (NSW Department of Mineral Resources, 1983). The topography of the study area includes multiple landform types, including slopes, crests, ridges, rugged to rolling steep hills, rock outcrops, hillcrests, valleys, creeks and creek banks (Chapman & Murphy, 1989). The natural landforms throughout the study area have been highly disturbed by development, with natural formations heavily modified.

As well as extensive residential development in each of the suburbs within the study area, there has also been a long period of development and use of the road network linking them. The principal thoroughfares through the study area are the M1 Pacific Motorway and Pennant Hills Road, which have both supported and facilitated development and landscape modification within the study area. Pennant Hills Road links the suburbs within northern Sydney, and principally, Carlingford, West Pennant Hills, Pennant Hills, Thornleigh, Westleigh, Beecroft, Normanhurst and Wahroonga.

Pennant Hills Road began as a bullock track for timber transportation before being developed under Governor Macquarie's administration between 1810 and 1821 as a public road (NSW Government State Records Authority of New South Wales, 2013; The Hills Shire Council, 2013). Either side of the road along its extent are now situated connecting roads, businesses and residential areas as well as associated urban infrastructure. While the majority of the study area has been heavily disturbed through development, some natural landforms are still present in the wider region in parks and reserves, including:

- Bidjigal Reserve verges on a section of bush within the southern portion of the project.
- Pennant Hills Park is located to the south of the central portion of the project.
- Lane Cove National Park is located to the east of the project.
- Ku-ring-gai Chase National Park is located to the north of the northern-most extent of the project.
- Smaller park areas, reserves and associated creek lines are present within the bounds of the project.

4.2 Hydrology

The project is predominantly located within the Hawkesbury-Nepean catchment, with its southern portions located within the Upper Parramatta River Catchment. Both the Hawkesbury-Nepean Catchment and the Upper Parramatta River Catchment have been modified due to development across the wider region and the waterways in multiple areas are currently enclosed by stone banks and concrete along their extent, rather than the natural creek banks. Water flow is generally higher in the Hawkesbury Sandstone areas, while the Wianamatta Shale country creeks have very little water flow during dry weather periods (Upper Parramatta River Catchment Trust, 2002).

The area is rich with natural water sources which would have provided both drinking water and resource foods for Aboriginal peoples. The primary areas of hydrology within the study area include Blue Gum Creek, Devlins Creek, Berowra Creek, Tedburn Creek, Scout Creek, Cockle Creek and Darling Mills Creek (located in proximity to areas inspected for this assessment). In addition to these creeks, a number of drainage lines and unnamed tributaries also occur, some verging on the Lane Cove Valley area, located between Pennant Hills and West Pymble.

4.3 Soils

The southern and western portions of the project are underlain by Wianamatta Shales of the Cumberland Plain, while the north east portions are underlain by Hawkesbury Sandstone. The majority of the project is underlain by the Glenorie erosional landscape, which is characterised by podzolic soils subject to high levels of erosion. Crests contained red podzolic soils of moderate depth, upper slopes contained red and brown podzolic soils of moderate depth, lower slopes contained yellow podzolic soils with deep deposits, while yellow podzolic soils and gleyed podzolic soils occurred along drainage lines (Chapman & Murphy, 1989).

The area also contains smaller portions of Blacktown Residual Landscape and Hawkesbury Colluvial Landscape. The Hawkesbury Landscape is characterised by shallow discontinuous lithosols and siliceous sands, yellow earths and some yellow and red podzolic soils. The Blacktown landscape contains shallow to moderately deep red and brown podzolic soils as well as deep deposits of yellow podzolic soils and soloths on lower slopes and in areas of poor drainage. High levels of soil erosion occur across the majority of the study area, with the Hawkesbury landscape also subject to rock fall and highly permeable soils (Chapman & Murphy, 1989).

4.4 Flora and fauna

The area has been predominantly cleared for road, residential, commercial and industrial development all having significantly altered the biodiversity values of these areas. Plant species include Long Leaf Wattle (*Acacia longissima*), Black Wattle (*Acacia mearnsii*), Spike Acacia (*Acacia oxycedrus*), Burrawang (*Macrozamia communis*), Common Maidenhair (*Adiantum aethiopicum*) and Common Ground Fern (*Calochlaena dubia*) (Australian Government, 2013).

Searches of the NSW Wildlife Atlas and EPBC Protected Matters databases were undertaken for the purposes of the biodiversity assessment for the environmental impact statement (Technical working paper: biodiversity (Eco Logical Australia Pty Ltd, 2014). These searches identified a total of five threatened flora species, 20 threatened fauna species and one endangered population that could potentially occur within the biodiversity study area (being areas that would be disturbed by the project). No threatened fish species have been recorded within the catchments of the study area. Flora and fauna in the area includes species that would have been utilised as traditional Aboriginal food and medicine resources.

4.5 Ethnographic context

The project is located within the traditional country area of the Guringai Aboriginal people. The Guringai are also referred to as Kuringgai, Kurikgai and Kuring-gai. The name Kurikgai was coined by linguist and ethnographer Reverend Dr John Fraser in his introduction to Reverend Lancelot Edward Threlkeld's posthumously published study of language, tradition and custom. Therein Fraser stated: "*we have now come to know that this dialect was essentially the same as that spoken by the sub-tribes occupying the land where Sydney now stands, and that they all formed parts of one great tribe, the Kurikgai*" (Threlkeld, 1892:ii). In detailing the distinction further within the book, Threlkeld wrote using the name Kuringgai, stating: "*The next great tribe is the Kuringgai on the sea coast. Their 'taurai' (hunting ground or territory) is known to extend north to the Macleay River, and I found that southwards it reached the Hawkesbury. Then, by examining the remains of the language of the natives about Sydney and southwards, and by other tests, I assured myself that the country thereabout was occupied by sub-tribes of the Kuringgai*" (Threlkeld, 1892:ix).

The traditional territory of the Guringai stretched from Sydney to Newcastle and inland to the Great Dividing Range (Attenbrow, 2002:33). The area contained such clan groups as the Awaba, Borregegal, Cadigal, Cammeragal/Camaraigal, Garigal, Gayimai and Walkeloa (Gibberagong Environmental Education Centre, 1983:9; J Kohen, 1993). This area was closely bordered by the Darug/Dharug area to the east, the Awabakal and Darkinung areas to the north and north-east and the Turuwal to the south (Horton, 1996). There has been debate regarding the location of the boundary between the Guringai area and the Darug area, with it being defined in the vicinity of Parramatta based on linguistic evidence (Ross, 1988). This is challenged by a counter-argument that the Darug territory extended to the coastline between Port Jackson and Botany Bay, based on the ethnographic observations of explorers and settlers (J Kohen, 1985, 1988; James Kohen & Lampert, 1987). Although language and dialect differed between varying groups, there was enough similarity and commonality through shared words that communication could and did occur (Attenbrow, 2002:33).

The Guringai area was rich in natural resources, containing both coastal and inland areas. Both riverine and coastal areas were utilised for fish and shellfish (oysters, mussels and cockles), as evidenced by the presence of shell middens and fish traps (Ku-ring-gai Council, 2013). Yams, bulbs and seeds were utilised for food, along with the burrawang (macrozamia) nut, fern roots, lillypillies and berries. As well as bush foods, many plants were utilised for their medicinal qualities. Fauna species including possums and birds were hunted, with marine animals such as turtles, dugongs and seals also likely to have been a part of the diet (Gibberagong Environmental Education Centre, 1983:12).

The Guringai utilised hunting tools such as boomerangs, spears and clubs. Fishing spears were made from plant stems with prongs added, made from grass tree flower stems, fish bones or shells and affixed by bees wax and gum (Gibberagong Environmental Education Centre, 1983:14). Fibrous grasses and oyster shell were also utilised to make hooks and fishing lines (Gibberagong Environmental Education Centre, 1983:15). A record of the Guringai living space is also present throughout the traditional country in the form of rock art and engravings. Known motifs include fish, dugong, and human figures. The arrival of European settlers radically transformed the life of the Guringai, as access to land and traditional food resources were blocked by growing settlements and pastoral developments (Gibberagong Environmental Education Centre, 1983:17). In the late 1780s a smallpox epidemic swept through the Guringai people, (Tench, 1793) causing a decline in population numbers in the area.

4.6 Archaeological context

4.6.1 NSW Aboriginal Heritage Information Management System (AHIMS)

The Aboriginal Heritage Information Management System (AHIMS) database, administered by the Office of Environment and Heritage (OEH), contains records of Aboriginal objects reported to the Director-General of the Department of Premier and Cabinet in accordance with section 89A of the *National Parks and Wildlife (NPW) Act 1974*. It also contains information about Aboriginal places which have been declared by the Minister to have special significance with respect to Aboriginal culture. Previously recorded Aboriginal objects and declared Aboriginal places are referred to by AHIMS as 'Aboriginal sites' (NSW Office of Environment & Heritage, 2013).

A search was undertaken of the AHIMS database on 17 July 2013 and 5 December 2013 (AHIMS search #106367 and AHIMS search #118838 respectively) for an area of around nine kilometres by eight kilometres area around preferred project corridor, and an area of around 7.8 kilometres by 10 kilometres along the Hills M2 Motorway integration works (refer to **Figure 3** and **Appendix B**). This search identified 189 registered Aboriginal archaeological sites, noting that the search results included two entries that were not sites. These two items have been excluded from the summary provided in **Table 2**. **Figure 5** shows the sites within proximity to the project.

Past experience with the AHIMS database has identified multiple errors and omissions. Site coordinates are often incorrect in AHIMS search results due to datum changes and estimates based on legacy grid coordinates. Further reference to the original site card recordings combined with ground-truthing to determine site extent (both surface and potential subsurface) would be required to definitively state the distance of recorded sites to the project.

Of the 187 sites identified through the search of the AHIMS database, and accounting for coordinate error, site card duplication and past site destruction, 15 sites have been identified as being within proximity to areas that may be impacted by the project.

Table 2 AHIMS search results

Site type	Number of sites	Percentage of sites
Artefact Scatter	69	37%
Rockshelter	30	16%
Rockshelter with Art	24	13%
Potential Archaeological Deposit (PAD)	20	11%
Grinding Grooves	19	10%
Engraving	13	7%
Isolated Artefact	6	3%
Modified Tree	2	1%
Midden	1	0.5%
Burial	1	0.5%
Quarry	1	0.5%
Water Hole	1	0.5%
TOTAL	187	100%

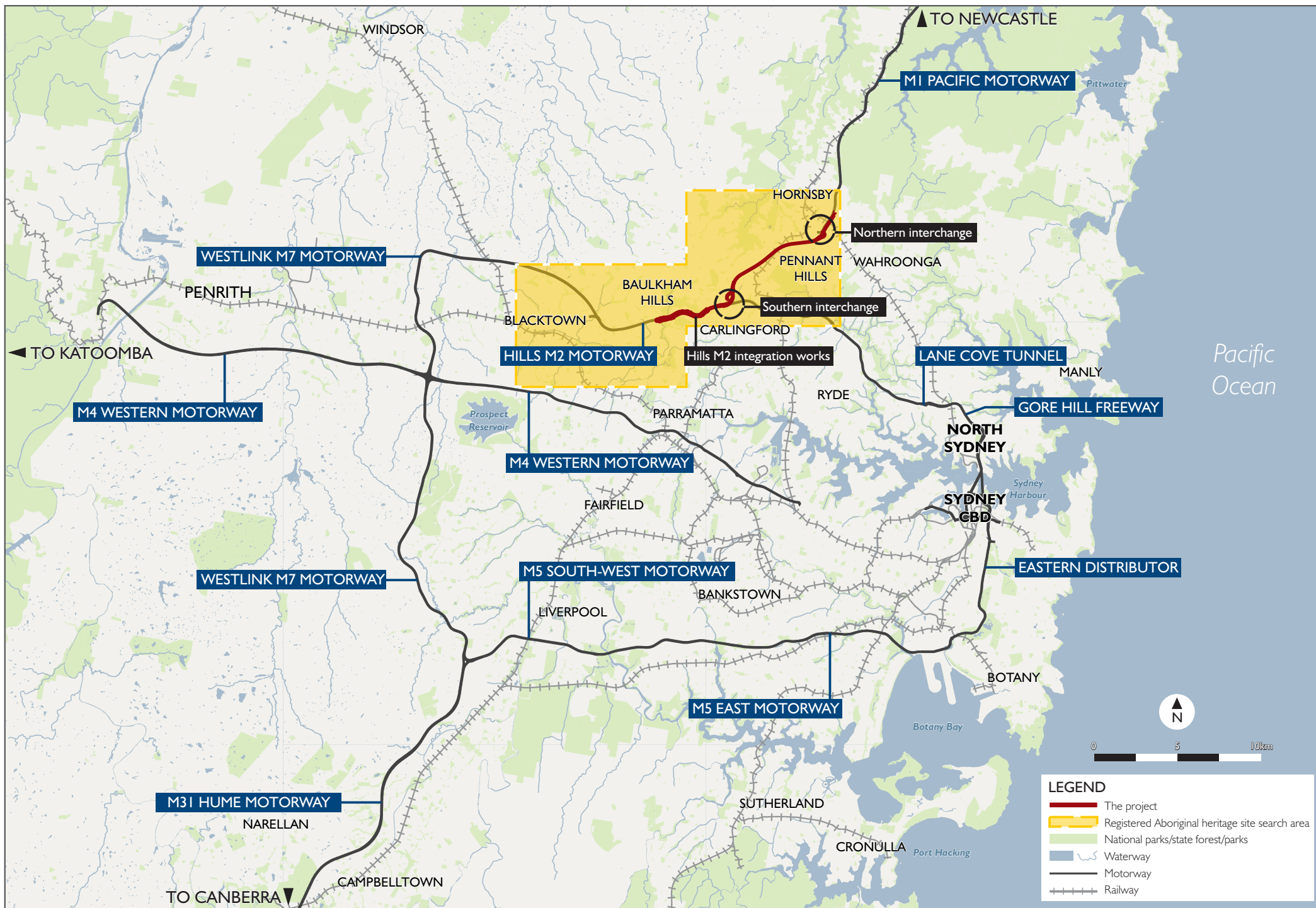


Figure 3 Registered Aboriginal heritage site search area

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4.6.2 Previous archaeological surveys and excavations

Past archaeological assessments involving survey, test excavation and salvage have been conducted in the region around the project, relating to past residential development, subdivision and road construction. Those past surveys and assessments that are most relevant to the study area are summarised in **Table 3**.

Table 3 Previous archaeological investigations within 16 km of the study area

Author	Year	Key findings	Location in relation to the project
L. Haglund	1989	Haglund undertook a preliminary survey for Aboriginal sites along Pennant Hills Road to Lane Cove River. Previously recorded site AHIMS #45-6-977 was re-identified and six new sites were found, including two rockshelters with middens, two rockshelters with potential occupation deposits and two engraving sites. A total of 19 areas were identified for further investigation.	Within study area.
L. Haglund	1991	Haglund undertook an assessment of Aboriginal heritage from Pennant Hills Road at Beecroft to Pittwater Road at Ryde. Four archaeological sites were identified and previously recorded site AHIMS #45-6-977 relocated. Seven rockshelters with potential archaeological deposits (PAD) and three rockshelters with habitation potential were also identified.	Within study area.
T. Corkill	1991	Corkill undertook a survey of the CSIRO site at Delhi Road, North Ryde. The survey relocated AHIMS #45-6-1854. In addition, a rockshelter with PAD was found and recorded and several sandstone exposures were identified as possible venues for rock engravings.	Approximately 12 kilometres south-east of the study area.
T. Corkill	1992	Corkill undertook a Darling Mills Creek Stormwater Management Strategy Preliminary Survey for Aboriginal archaeological sites. The fieldwork resulted in the identification of two new archaeological sites in addition to the relocation of two previously known sites in the Darling Mills Creek area. Twelve new and six previously known PAD sites were found. A total of 25 potential habitation rockshelters were also noted.	Approximately two kilometres south-west of the study area.
T. Corkill	1993	Corkill excavated five rockshelters in the Darling Mills Creek Valley area, including two rockshelters with deposit (AHIMS #45-6-2548 and #45-6-2542) and three rockshelters with PAD. The excavations confirmed two of the PADs as sites. The test excavations yielded 40 artefacts. Corkill concluded that the sites had been disturbed to various levels by flooding, roof-fall and public visitation. The sites were assessed as having low significance.	Approximately two kilometres south-west of the study area.
T. Corkill	1994	Corkill undertook a survey for archaeological sites at Toongabbie Creek. The survey found one Aboriginal site, AHIMS #45-5-0970, consisting of eight stone artefacts on the creek bank.	Approximately four kilometres south-west of the study area.
T. Corkill	1995a	Corkill assessed a series of rock piles alleged to be Aboriginal burials in the path of the Hills M2 Motorway at Devlins Creek. The investigation concluded that they were European in origin, most likely relics of WWII army training that had occurred in that area.	Within study area.

Author	Year	Key findings	Location in relation to the project
L. Haglund	1989	Haglund undertook a preliminary survey for Aboriginal sites along Pennant Hills Road to Lane Cove River. Previously recorded site AHIMS #45-6-977 was re-identified and six new sites were found, including two rockshelters with middens, two rockshelters with potential occupation deposits and two engraving sites. A total of 19 areas were identified for further investigation.	Within study area.
T. Corkill	1995b	Corkill conducted an Aboriginal heritage assessment of the western end of the Hills M2 Motorway Motorway corridor between Toongabbie Creek and Windsor Road. The survey identified two artefact scatters to the east of Old Windsor Road. The sites were in disturbed contexts with low significance, and Corkill recommended Consents to Destroy be issued for the two sites.	Within study area.
T. Corkill	1995c	Corkill conducted test excavations at a possible Aboriginal rockshelter site that had been identified as a PAD. The excavations confirmed the site as an Aboriginal rockshelter with a total of 137 Aboriginal stone artefacts recovered. Artefacts were quartz (91), silcrete (40), chert (five) and basalt (one). The site was highly disturbed. Corkill concluded that the rockshelter was of “minimal” scientific significance. Corkill recommended a Consent to Destroy be issued.	Within study area.
D. Crew	1995	Crew (1995) undertook an archaeological survey at Delhi Road, Lane Cove. The survey resulted in the identification of one potential habitation shelter at the eastern end of the survey area.	Approximately 12 kilometres south-east of the study area.
L. Haglund	1995	Haglund undertook the excavation of a rockshelter site. This resulted in the recovery of approximately 602 artefacts from two 50 x 50 cm test pits. The base of the excavation was dated to c.1,400 BP. The majority of the artefacts were quartz and silcrete.	Within study area.
M. Guider	1995a	Guider undertook an Aboriginal survey. Three rockshelters were found adjacent to the Hills M2 Motorway and all were classified as having PAD. No sites were found to be disturbed by the Hills M2 Motorway.	Within study area.
M. Guider	1995b	Guider undertook an Aboriginal survey and located ten rockshelters adjacent to Darling Mills Creek. One rockshelter site contained 11 artefacts and a white hand stencil. The remaining nine sites were classified as having PAD. The survey also identified several trees as potentially modified.	Within study area.
T. Corkill	1996a	Corkill monitored sites AHIMS #45-6-2543 and 45-6-2544 to assess the effects of periodic flooding resulting from the construction of a flood retarding basin in the Darling Mills Valley. The first two sites were low in the valley and were likely to experience periodic flooding; the third rockshelter was higher and out of the flood zone. The report recommended analysis of data after five years.	Approximately two kilometres south-west of the study area.
T. Corkill	1996b	Corkill undertook salvage at a rockshelter site at Darling Mills State Forest Carlingford. A total of 895 Aboriginal stone artefacts were salvaged from AHIMS #45-6-2472. The dominant raw material of recovered artefacts was quartz (471) followed by silcrete (344), Chert (41), quartzite (22), basalt (nine), mudstone (six), and lastly fine grained siliceous (two).	Within study area.

Author	Year	Key findings	Location in relation to the project
L. Haglund	1989	Haglund undertook a preliminary survey for Aboriginal sites along Pennant Hills Road to Lane Cove River. Previously recorded site AHIMS #45-6-977 was re-identified and six new sites were found, including two rockshelters with middens, two rockshelters with potential occupation deposits and two engraving sites. A total of 19 areas were identified for further investigation.	Within study area.
T. Corkill	1997a	Corkill conducted an assessment of hand stencils at two sites adjacent to the Hills M2 Motorway corridor.	Within study area.
T. Corkill	1997b	Corkill undertook test excavation in an area of PAD. Fourteen small silcrete, chert and indurated mudstone artefacts were recovered. Along with the Aboriginal artefacts, 19th and 20th century European material was also present.	Approximately 12 kilometres south-east of the study area.
T. Corkill	2000	Corkill conducted an analysis of an artefact assemblage excavated by Attenbrow at rockshelter site AHIMS #45-6-2097. Radio carbon dating of two pits was 2,500 and 10,000 years BP. A total of 2,079 artefacts were found, consisting of mostly quartz material with lower percentages of silcrete and volcanic material.	Within study area.
V. Attenbrow	2002	Attenbrow undertook an archaeological excavation of AHIMS #45-6-2097. Several thousand stone artefacts were recovered with faunal remains. The raw materials of the artefacts recovered included silcrete, chert, indurated mudstone, quartz, quartzite and basalt. Artefact types included flakes, flaked pieces, cores and bipolar pieces. The lower floor levels of the deposit were dated to 6,700 BP and possibly over 10,000 BP.	Within study area.
P. Irish	2004	Irish undertook an Aboriginal Archaeological monitoring program. It was determined that there were no archaeological constraints to the sub-surface works.	Approximately 16 kilometres south-east of the study area.
T. Corkill	2008	Corkill provided a monitoring report for rockshelter sites along the Hills M2 Motorway. The rockshelters included the sites: AHIMS #45-6-2160, #45-6-2097, #45-6-2161, #45-6-2162, #45-6-2543 and #45-6-2544. No detrimental effects were identified.	Within study area.
AECOM	2010	AECOM identified 15 registered AHIMS sites in proximity to the Hills M2 Motorway. All sites were inspected and erroneous coordinates identified in AHIMS.	Within study area.

4.7 Aboriginal site prediction model

This section provides a summary description of site types that possibly exist within or in proximity to the project and provides a predictive statement on the likelihood of finding such sites. This has been used to inform the identification of the site inspection areas. Further information is provided in **Appendix C**.

4.7.1 Rockshelters

Rockshelters are natural features such as rock overhangs that have been utilised for Aboriginal habitation. Rockshelters can contain surface artefacts and deposits associated with occupation periods. They can also have associated artwork, such as on a panel of the rockshelter wall. Based on the number of known sites corresponding to this site type located in the surrounding region, it is assessed as possible that rockshelters could occur within or in proximity to areas that would be impacted by the project.

4.7.2 Art sites/engravings

Art sites are locations where artwork has been produced by past Aboriginal people, including designs engraved into sandstone outcrops and motifs painted in ochre or pecked onto rock walls beneath overhangs or within rockshelters. Art surfaces can also be abraded and pitted. Based on the number of this site type located in the surrounding region, it is assessed as possible that art sites and/or engravings could occur within or in proximity to areas that would be impacted by the project.

4.7.3 Grinding grooves

Grinding grooves are produced on rock surfaces, the result of sharpening and forming tools by repeated grinding against a suitable surface. Stone tools manufacture for ground edge axes and spears can result in groove impressions left in sandstone outcrops, often in association with a water resource area. Grooves may also develop as rounded depressions from the grinding of seeds and grains. It is possible that grinding grooves could occur within or in proximity to areas that would be impacted by the project, most likely in association with a water source.

4.7.4 Stone artefact scatters

Stone artefact scatters consist of more than one stone artefact. Activities associated with this site type include stone tool production, hunting and gathering or domestic sites associated with campsites. Stone artefacts may be flakes of stone, cores (flakes are removed from the stone cores) or tools. Some scatters may also contain other material such as charcoal, bone, shell and ochre. It is assessed as possible that artefact scatters may be identified within or in proximity to areas that would be impacted by the project, most likely in association with a rockshelter.

4.7.5 Isolated artefacts

Isolated artefacts refer to a single artefact. These artefacts may have been dropped or discarded by its owner once it was of no use. This site type can also be indicative of further sub-surface archaeological deposits. These site types can be found anywhere within the landscape, however, they are more likely to occur within contexts with the same favourable characteristics as for stone artefact scatter sites. It is expected that there is a high potential for the identification of isolated artefacts within or in proximity to areas that would be impacted by the project.

4.7.6 Modified trees

Wood and bark of trees have been used in the past by Aboriginal peoples for a variety of purposes, such as carrying implements, shield or canoes. The removal of this raw material from a tree produces a 'scar'. The identification of a scar associated with Aboriginal custom as opposed to natural scarring can be difficult. The scar should be of a certain size and shape to be identifiable with its product; the tree should also be mature in age, from a time that Aboriginal people were still active in the area. Aboriginal people also modified trees through carving or binding branches together to form ring growths, used as markers in the landscape.

The area subject to this assessment has been systematically cleared of much of the native vegetation. It is predicted as unlikely that a culturally modified tree will be identified in areas of vegetation clearance, but likely that they may be located in areas where mature vegetation remains extant.

5.0 Results

5.1 Field Inspection

A total of 14 transects were inspected on 24-25 September 2013, 2 October 2013 and 19 December 2013 to ground-truth items of Aboriginal cultural heritage (refer to **Table 4**). No new Aboriginal archaeological sites were identified during the inspection. No artefacts were present at any of the inspected rock overhangs, many of which had their deposits eroded or washed away. As part of ground-truthing AHIMS sites, all inspected overhangs were compared to existing site cards and matched to previously registered sites where possible. Many site cards did not contain photographs or maps and had incorrect coordinate data, making matches difficult in some cases.

An overview of the transects is shown on **Figure 5**, with individual transects shown on **Figure 6** to **Figure 14**. A description and results for each transect are provided from **Section 5.1.1** to **Section 5.1.13**.

Table 5 details the results of the visual inspection for each transect.

Table 4 Transect details for the site inspections completed in September, October and December 2013

Number	Location	Length	Date	Participants
1	King Road and Burdett Street, Hornsby	815 m	2 October 2013	Darran Jordan Allen Madden Tracey Howie
2	Coonanbarra Road and M1 Pacific Motorway, North Wahroonga	786 m	24 September 2013	Andrew McLaren Darran Jordan Tracey Howie
3	Coonanbarra Road, North Wahroonga	264 m	24 September 2013	Andrew McLaren Darran Jordan Tracey Howie
4	Coonanbarra Road, Wahroonga	300 m	19 December 2013	Darran Jordan Rochelle Coxon Allen Madden
5	Kingsley Close, Wahroonga	980 m	2 October 2013	Darran Jordan Allen Madden Tracey Howie
6	Mount Pleasant Avenue to Lucinda Avenue, Normanhurst	1800 m	19 December 2013	Darran Jordan Rochelle Coxon Allen Madden
7	Blantyre Close, Thornleigh	145 m	24 September 2013	Andrew McLaren Darran Jordan Tracey Howie
8	Observatory Park, Beecroft	500 m	24 September 2013	Andrew McLaren Darran Jordan Tracey Howie
9	Orchard Road, Beecroft	256 m	24 September 2013	Andrew McLaren Darran Jordan Tracey Howie
10	Northern side of Hills M2 Motorway, West Pennant Hills	2000 m	25 September 2013	Darran Jordan Allen Madden

Number	Location	Length	Date	Participants
11	Haines Avenue to Yale Close, North Rocks	744 m	24 September 2013	Andrew McLaren Darran Jordan Tracey Howie
12	Perry Street to the Hills M2 Motorway, Baulkham Hills	880 m	19 December 2013	Darran Jordan Rochelle Coxon Allen Madden
13	Randall Crescent to Ventura Road, Baulkham Hills	440 m	19 December 2013	Darran Jordan Rochelle Coxon Allen Madden
14	Ventura Road to Renown Road, Baulkham Hills	1400 m	19 December 2013	Darran Jordan Rochelle Coxon Allen Madden

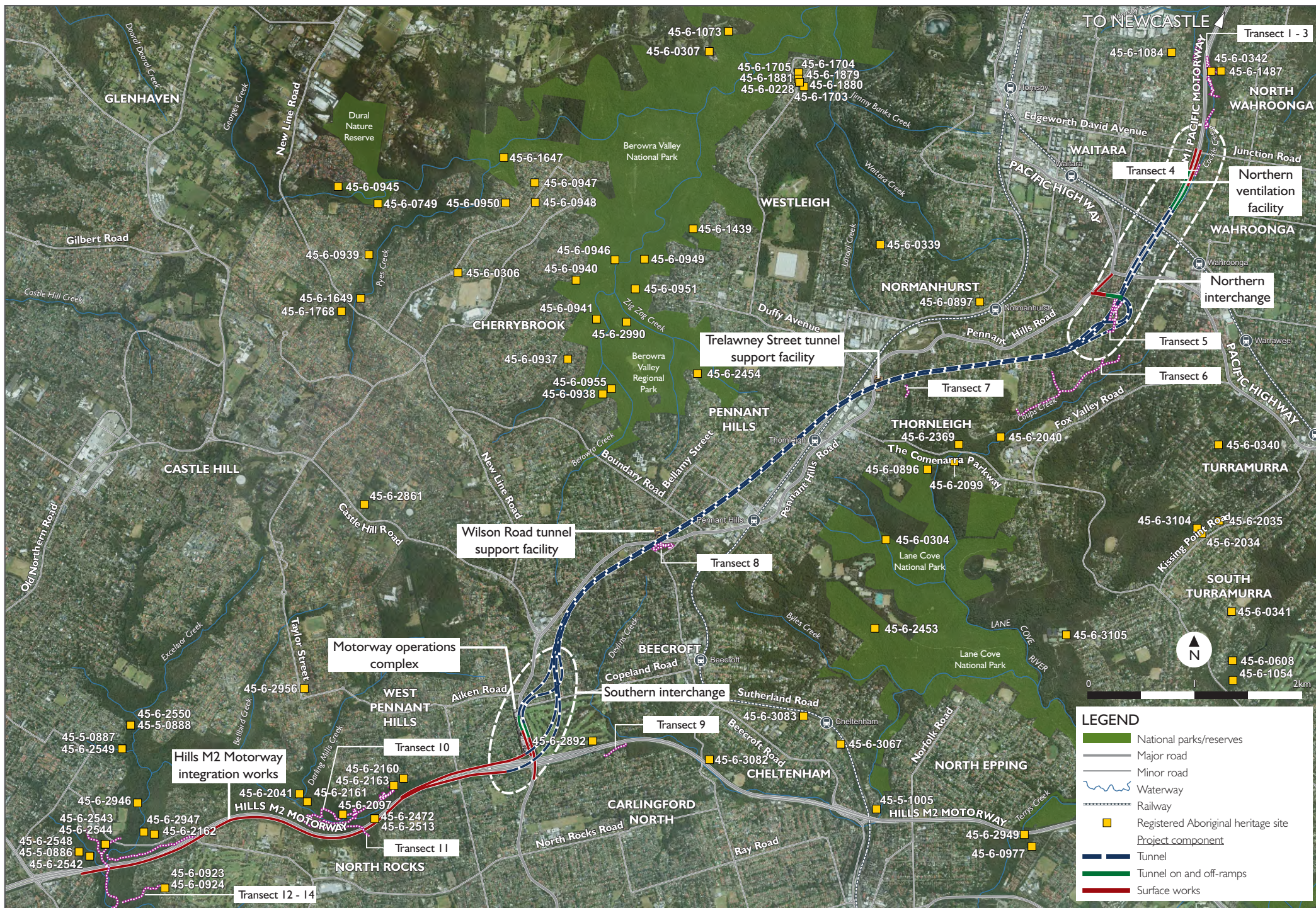


Figure 5 Overview of survey transects

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5.1.1 Transect 1 – King Road & Burdett Street, Hornsby

Transect 1 started at the intersection of King Road and Burdett Street, Hornsby, heading north on an alignment parallel to the M1 Pacific Motorway (refer to **Figure 6**).

The majority of the transect consisted of a paved road surface, created as a service road to access the motorway. This was adjoined directly on its western side by residential houses and backyard areas. A small portion of bush area was present along this transect. It had been subject to past vegetation clearance and consisted of regrowth. Some small outcrops were noted in the bush area and along Cockle Creek.

Cockle Creek crossed into the study area in this area, but the portion of creek line present here had been highly modified due to its proximity to the motorway. A culvert was present where the creek flowed under the M1 Pacific Motorway, joining to the culvert on the other side, previously identified in Transect 2. Ground surface visibility was zero to ten per cent on this transect due to vegetation growth, leaf litter and tree needles. The area was assessed as highly disturbed (refer to **Plate 1** to **Plate 4**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.



Plate 1 Transect 1, paved access road



Plate 2 Transect 1, outcrops and bush area



Plate 3 Transect 1, pipe across creek



Plate 4 Transect 1, culvert

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Figure 6 Survey transects 1, 2 and 3

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5.1.2 Transects 2 and 3 – Coonanbarra Road, North Wahroonga

Transects 2 and 3 were in between and parallel to Coonanbarra Road, North Wahroonga and the M1 Pacific Motorway, following the extent of Cockle Creek (refer to **Figure 6**). Transect 2 covered between the northern end of the study area and the northern side of Carrington Park, North Wahroonga. Transect 3 covered between the southern end of Carrington Park and the residential houses backing onto Cockle Creek.

Two previously registered AHIMS sites were identified in background research as having been identified within the Transect 2 area, AHIMS #45-6-1487 and AHIMS #45-6-0342. Reference to the site cards showed that AHIMS #45-6-1487 was destroyed under permit 450001 (January 1986). AHIMS #45-6-0342 was described on the site card as “prior to 1910 the group of engravings were cut out”. A 1988 review by Tessa Corkill could not identify the site. No remnants of the two sites were located during the inspection. Sandstone outcrops and natural overhangs were identified in the area, but with no signs of cultural modification or use.

Ground surface visibility during the inspection ranged between zero per cent and 10 per cent due to high levels of vegetation and leaf litter. Moss also obscured the surface of some sandstone outcrops, which were checked for signs of modification (grinding grooves/engravings). A small waterfall was noted along the extent of the creek, with running water present at the time of inspection.

Vegetation throughout the area was predominantly regrowth, denoting vegetation clearance as a past impact. Weeds such as lantana and bamboo were noted in the area. Cockle Creek and its associated drainage lines were highly modified in this area, with concrete channels, a concrete culvert under the M1 Pacific Motorway and channel cuttings into natural rock all evidenced. Other development impacts within the area included the construction of the motorway, rubbish dumping, graffiti, construction and use of a bike track, construction and use of walking paths and roads, pipelines, construction of a stormwater pollution trap, residential properties and associated infrastructure (refer to **Plate 5** to **Plate 14**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.

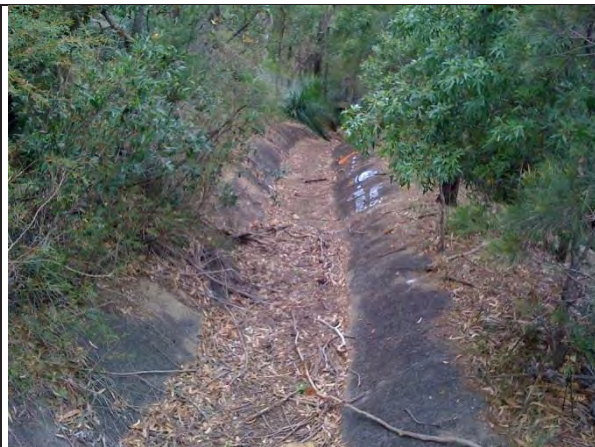


Plate 5 Transect 2, concrete channel



Plate 6 Transect 2, confluence of two concrete channels



Plate 7 **Transect 2, motorway culvert**



Plate 8 **Transect 2, channel cutting**



Plate 9 **Transect 2, pipeline**



Plate 10 **Transect 2, waterfall**



Plate 11 **Transect 2, bike track and rubbish**



Plate 12 **Transect 2, Storm water pollution trap**



5.1.3 Transect 4 – Coonanbarra Road, Wahroonga

Transect 4 was located at Coonanbarra Road, Wahroonga, NSW (refer to **Figure 7**).

There were no AHIMS sites along this transect.

Ground surface visibility during the inspection averaged 15 per cent due to grass cover. Vegetation throughout the area was predominantly grass with some regrowth, denoting vegetation clearance as a past impact.

Cockle Creek (also known as Spring Gully Creek) was highly modified in this area, with concrete channelling as well as brick walls shaping water flow directly behind suburban housing (refer to **Plate 15** and **Plate 16**).

Other development impacts within the area included roads and associated infrastructure (refer to **Figure 7**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area of proposed impact. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.



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Figure 7 Survey transect 4

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5.1.4 Transect 5 – Kingsley Close, Wahroonga

Transect 5 was in a north-south alignment adjacent to Kingsley Close in Wahroonga. The transect area was accessed via Eastbourne Avenue and comprised a cleared park area adjacent to residential backyards (refer to **Figure 8**).

In the centre of this was a densely overgrown area of vegetation. Some mature trees were present, but the majority of the area was covered by regrowth with dense patches of lantana and bamboo. The area had been disturbed by past vegetation clearance and the construction of residential properties and associated infrastructure. Ground surface visibility was zero to 10 per cent on this transect due to vegetation growth and leaf litter. There was no water resource within or in proximity to this area (refer to **Plate 17** and **Plate 18**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.



Plate 17 Transect 5, adjoining residential backyards



Plate 18 Transect 5, adjoining M1 Pacific Motorway

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Figure 8 Survey transects 5

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5.1.5 Transect 6 – Mount Pleasant Avenue to Lucinda Avenue, Normanhurst

Transect 6 was located at Mount Pleasant Avenue to Lucinda Avenue, Normanhurst, NSW (refer to **Figure 9**).

There were no AHIMS sites along this transect.

Ground surface visibility during the inspection averaged 15 per cent due to high levels of vegetation and leaf litter. Moss also obscured the surface of some small sandstone outcrops, which were checked for signs of modification (grinding grooves/engravings). Vegetation throughout the area was a mix of regrowth and mature vegetation.

Coups Creek was contained within a vegetation corridor with associated parks and walkways, but its associated drainage lines were highly modified.

Other development impacts within the area included roads, drains, park areas, bush tracks, housing and associated infrastructure (refer to **Plate 19** to **Plate 22**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.



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Figure 9 Survey transect 6

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5.1.6 Transect 7 – Blantyre Close, Thornleigh

Transect 7 extended from the end of Blantyre Close, Thornleigh along an unnamed tributary (refer to **Figure 10**). The tributary was found to be highly modified with cement sections, brick walls, utility holes, pipes and stormwater drains along its extent. Residential houses backed directly onto either side of the channel. Rubbish had been dumped throughout the area, including machinery parts and a bicycle. Loose bricks dislodged from a wall were also identified along the channel (refer to **Plate 23** and **Plate 24**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.



Plate 23 Transect 7, cemented channel



Plate 24 Transect 7, brick wall

5.1.7 Transect 8 – Observatory Park, Beecroft

Transect 8 was through Observatory Park, a heritage listed parkland area, situated in a triangular portion of land between Pennant Hills Road and Beecroft Road, Beecroft (see **Figure 11**).

It is listed as an area of local historic significance under the *Hornsby Local Environmental Plan 2013*. The park area was associated with a historic observatory located on the opposite side of Beecroft Road which dates back to the 1930s. The outer perimeter of the park is cleared lawn with paths and picnic areas, while the central portion has retained natural bush growth. Although the area has been subject to vegetation clearance in the past, its central portion retains mature trees including blue gums, blackbutt, wattle and grey ironbark. Aboriginal resource plants *Dianella* sp., *Lomandra* sp. and Kangaroo Grass (*Themeda triandra*) were also identified in the area.

Ground surface visibility was zero per cent to 10 per cent during inspection due to vegetation growth and leaf litter.

The park is not situated in a sensitive landform or close to a water source and as such was assessed as having low archaeological potential (refer to **Plate 25** and **Plate 26**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.

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Figure 10 Survey transect 7

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Figure 11 Survey transect 8

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5.1.8 Transect 9 – Orchard Road, Beecroft

Transect 9 was accessed from Orchard Road, Beecroft, running parallel to an unnamed tributary of Devlins Creek between residential houses to the Hills M2 Motorway (see **Figure 12**).

Past disturbances included vegetation clearance, residential housing, walking track and storm water drains. The end of the transect intersected with a cleared area beneath a raised portion of the Hills M2 Motorway.

Ground surface visibility averaged 90 per cent due to the walking track and cleared areas around the Hills M2 Motorway. The tributary banks were heavily vegetated however, predominantly with regrowth with bamboo noted in some areas. The tributary has been modified along its extent due to residential development and roadways, including the Hills M2 Motorway (refer to **Plate 27** and **Plate 28**).

According to the available coordinates, valid AHIMS site #45-6-2892 is located to the north of this transect within the bounds of the Pennant Hills Golf Course. As there was no site card available from AHIMS and a 2010 AECOM survey was unable to relocate the site based on the coordinates alone (AECOM Australia Pty Ltd, 2010), the coordinate location was not re-inspected during these works.

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.



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Figure 12 Survey transect 9

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5.1.9 Transect 10 – Bidjigal Reserve, northern side of Hills M2 Motorway, West Pennant Hills

Transect 10 was on a generally east to west alignment, parallel to the Hills M2 Motorway on its northern side in the West Pennant Hills area within the Bidjigal Reserve (see **Figure 13**).

This transect ran parallel to Blue Gum Creek and was situated within a bush area, located in proximity to other adjoining park and reserve areas such as Richard Webb Reserve, Excelsior Park, Munro Reserve, Baulkham Hills Park and the Eric Mobbs Recreational Reserve.

In the area immediately adjacent to the Hills M2 Motorway there had been substantial impacts resulting from its construction. Beyond the road corridor area there was still largely undisturbed bush with mature vegetation as well as regrowth.

The main disturbance impacts were limited clearance in some areas, such as along walking tracks, graffiti, littering, stormwater drains and modification works along Blue Gum Creek in proximity to the Hills M2 Motorway. Along Blue Gum Creek a culvert and areas of artificial bank construction comprising small stones bound in place by metal nets were noted. Weed species including lantana were present in the area and the steep slopes in some areas were subject to wash and erosion (refer to **Plate 29** to **Plate 38**).

Along the extent of the transect, numerous sandstone outcrops and overhangs were present, including previously identified AHIMS rockshelter sites. No surface artefacts were identified, but this could have been due to the low ground surface visibility, which averaged zero per cent to 10 per cent due to vegetation growth and leaf litter. Intact deposits were noted within and in proximity to rockshelters, having the potential for subsurface deposits.

The coordinates for previously recorded AHIMS site #45-6-2472/#45-6-2513 suggest that the site would be located within the current road corridor of the Hills M2 Motorway. The site was unable to be relocated during the site inspection and was therefore assessed as having been possibly destroyed. The site card records that an Application for a Grant to Destroy permit was to be made by former Roads and Traffic Authority, presumably as a result of the construction of the Hills M2 Motorway. No records associated with the site card indicating that the application was submitted were identified.

Rockshelters were identified at locations in proximity to the AHIMS coordinates for sites #45-6-2097, #45-6-2160, #45-6-2061 and #45-6-2163 allowing for errors in grid coordinate approximation on the original recordings. No photos were provided in the past site card recordings, making positive re-identification difficult for these sites. Images for sites #45-6-2097, #45-6-2160 and #45-6-2163 rockshelter areas identified during this inspection are included from **Plate 29** to **Plate 38**.

In summary, the survey identified the area as having archaeological potential and Aboriginal consultation identified the sites within this area as having cultural value. This area has been identified as an area of archaeological sensitivity, and a management zone has been recommended (refer to **Section 5.3**).

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Figure 13 Survey Transects 10 and 11

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Plate 29 Transect 10, outcrops at location of AHIMS #45-6-2097



Plate 30 Transect 10, graffiti on overhang at location of AHIMS #45-6-2097



Plate 31 Transect 10, graffiti on overhang at location of AHIMS #45-6-2163

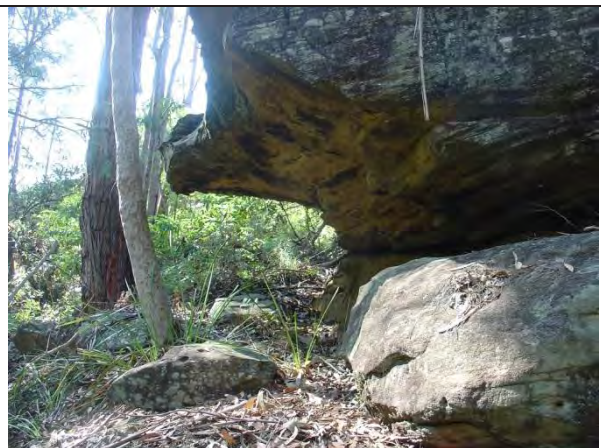


Plate 32 Transect 10, overhang at location of AHIMS #45-6-2163



Plate 33 Transect 10, rockshelter with potential deposit, view west at location of AHIMS #45-6-2160



Plate 34 Transect 10, rockshelter with potential deposit, view east at location of AHIMS #45-6-2160

	
Plate 35 Transect 10, Blue Gum Creek	Plate 36 Transect 10, Allen Madden at culvert on Blue Gum Creek next to Hills M2 Motorway
	
Plate 37 Transect 10, disturbed corridor immediately adjacent to Hills M2 Motorway	Plate 38 Transect 10, view south toward Hills M2 Motorway

5.1.10 Transect 11 – Haines Avenue to Yale Close, North Rocks

Transect 11 was located at Haines Avenue to near Yale Close, North Rocks (see **Figure 13**). The main extent of the transect was in an east to west trajectory, parallel to the Hills M2 Motorway on its southern side.

Due to areas of clearance and walking paths the overall ground surface visibility averaged 40 per cent. Vegetation throughout the area was composed of regrowth and there had been high levels of disturbance throughout the area, including concrete lining of drainage lines, culvert, storm water drains and construction impacts associated with the Hills M2 Motorway. Graffiti and littering were also noted in the area (refer to **Plate 39** to **Plate 42**).

Apart from the concrete filled drainage lines, there were no water resources within this transect area, but an unnamed tributary of Blue Gum Creek was present to the west of the end point of the transect, immediately adjacent to Yale Close. Two previously recorded AHIMS sites had coordinates situating the sites within this area, being #45-6-2097 and #45-6-2161. Ground-truthing placed the sites to the north of the Hills M2 Motorway, as identified in Transect 10.

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.

	
Plate 39 Transect 11, Andrew McLaren and Tracey Howie at culvert	Plate 40 Transect 11, drain utility hole
	
Plate 41 Transect 11, modified slope	Plate 42 Transect 11, adjacent to Hills M2 Motorway, view east

5.1.11 **Transect 12 – Perry Street to Hills M2 Motorway, Baulkham Hills**

Transect 12 was located at Perry Street to Hills M2 Motorway, Baulkham Hills, NSW.

There were no AHIMS sites along this transect.

Ground surface visibility during the inspection averaged 25 per cent due to vegetation and leaf litter. Vegetation throughout the area included grass areas, areas of regrowth, and limited mature vegetation.

Darling Mills Creek and its associated drainage lines were highly modified in this area.

Other development impacts within the area included tracks, the Hills M2 Motorway, modified drainage lines (concrete lined), sediment ponds, housing and associated infrastructure (refer to **Figure 14** and **Plate 43** to **Plate 46**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area to be disturbed as part of the project. Aboriginal consultation did not identify any cultural sensitivity within the area of potential impact.

	
Plate 43 Transect 12, access track between houses and Hills M2 Motorway	Plate 44 Transect 12, adjacent to Hills M2 Motorway
	
Plate 45 Transect 12, concrete drainage line	Plate 46 Transect 12, beneath Hills M2 Motorway adjacent to modified channel of Darling Mills Creek



Figure 14 Survey transects 12, 13 and 14

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5.1.12 Transect 13 – Randall Crescent to Ventura Road, Baulkham Hills

Transect 13 was located at Randall Crescent to Ventura Road, Baulkham Hills, NSW.

AHIMS sites within 200 metres of this transect were #45-6-0923 and #45-6-0924. Site #45-6-0923 was located within Transect 14. Site #45-6-0924 was not relocated.

Ground surface visibility during the inspection averaged 25 per cent due to vegetation and leaf litter throughout the bush reserve area. Vegetation included both mature vegetation and regrowth, with tracks linking suburban street areas to the bush area.

Darling Mills Creek was highly modified in this area. Other development impacts included tracks and stormwater drains (refer to **Figure 14**, **Plate 47** and **Plate 48**).

No Aboriginal archaeological sites or areas of archaeological sensitivity were identified within the area of proposed impact. Aboriginal consultation did not identify any specific cultural sensitivity within the area of potential impact.



Plate 47 Transect 13, bush reserve with tracks

Plate 48 Transect 13, bush reserve with tracks

5.1.13 Transect 14 – Ventura Road to Renown Road, Baulkham Hills

Transect 14 was located at Ventura Road to Renown Road, Baulkham Hills, NSW (refer to **Figure 14**).

AHIMS sites within 400 metres of this transect included #45-6-0923, #45-6-2548/ #45-5-0886, #45-6-2542, #45-6-2543 and #45-6-2544.

Ground surface visibility during the inspection averaged 20 per cent due to vegetation, leaf litter and concrete. Moss also obscured the surface of some sandstone outcrops, which were checked for signs of modification (grinding grooves/engravings). Vegetation throughout the area included both regrowth and mature vegetation.

Darling Mills Creek and its associated drainage line were both highly modified in this area, with modified channel and stormwater drains.

Other development impacts within the area included the Hills M2 Motorway, drains, modified creeklines (concrete lined), sewer vents, roads, tracks, housing and associated infrastructure (refer to **Plate 49** and **Plate 50**).

Overhangs were identified and four previously recorded AHIMS rockshelter sites were relocated. Areas of rock overhang either side of Darling Mills Creek and its associated tributary were found to contain these sites. These areas were noted as having archaeological sensitivity as well as Aboriginal cultural sensitivity, although these areas had been subject to impacts from graffiti, littering and modern campfires. Collectively, two of these sites have been identified as a management zone containing archaeological sensitivity. The identified sites are listed in **Table 7** and area shown in proximity to the project on **Figure 16**.



Plate 49 **Transect 14, stormwater drains**

Plate 50 **Transect 14, M2 motorway overhead with support pylons, maintenance access track and modified channel for Darling Mills Creek**

Table 5 Visual inspection results

Transect	Landform elements	Natural creek or drainage line observed within boundaries of disturbance footprint?	Average ground surface visibility (GSV)	Average ground integrity	Key disturbance factors	Surface artefacts observed	Archaeological sensitivity of area of proposed disturbance	Impact risk for area of proposed ground disturbance
1	Midslope and creek bank	Cockle Creek	Very Poor	Low	Vegetation clearance, service road construction/use, residential houses and associated infrastructure, culvert, pipes.	No	Low	Low
2	Midslope, lower slope, creek bank, creek channel	Cockle Creek	Very poor	Low	Native vegetation removal, walking track, bike track, rubbish dumping, graffiti, creek channel modification, concrete drainage channels, culvert, motorway construction; pipeline, stormwater pollution trap.	No	Low	Low
3	Lower slope, creek bank, creek channel	Cockle Creek	Very poor	Low	Native vegetation removal, creek channel modification, freeway construction, residential houses/infrastructure.	No	Low	Low
4	Creek bank	Cockle Creek	Poor	Low	Roads, modified creekline (concrete and brick lined), housing and associate infrastructure.	No	Low	Low
5	Midslope	No	Very Poor	Low	Vegetation clearance, residential houses and associated infrastructure, motorway construction/use.	No	Low	Low
6	Lower slope & creek bank	Coups Creek	Poor	Low	Roads, drains, park area, bush track, housing and associate infrastructure.	No	Low	Low

Transect	Landform elements	Natural creek or drainage line observed within boundaries of disturbance footprint?	Average ground surface visibility (GSV)	Average ground integrity	Key disturbance factors	Surface artefacts observed	Archaeological sensitivity of area of proposed disturbance	Impact risk for area of proposed ground disturbance
7	Modified tributary channel	Unnamed tributary	Very poor	Low	Cement lining, brick walls, utility holes, pipes, storm water drains, residential houses, rubbish.	No	Low	Low
8	Gentle slope	No	Very poor	Moderate	Vegetation clearance, park landscaping.	No	Low	Low
9	Modified creek bank	Tributary of Devlins Creek	Very good	Low	Residential housing, vegetation clearance, walking track, storm water drains, Hills M2 Motorway construction/use.	No	Low	Low
10	Slopes	Blue Gum Creek	Very Poor	Moderate	Vegetation clearance, tracks, culvert, creek line modification, erosion, wash.	No	High	High
11	Slope	Unnamed tributary of Blue Gum Creek	Fair	Low	Vegetation clearance, tracks, culvert, concrete lining of drainage lines, storm water drains, littering, graffiti, Hills M2 Motorway construction/use.	No	Low	Low

Transect	Landform elements	Natural creek or drainage line observed within boundaries of disturbance footprint?	Average ground surface visibility (GSV)	Average ground integrity	Key disturbance factors	Surface artefacts observed	Archaeological sensitivity of area of proposed disturbance	Impact risk for area of proposed ground disturbance
12	Upper slope, midslope, creek bank	Darling Mills Creek and tributary	Poor	Low	Tracks, motorway, modified drainage lines (concrete lined), sediment pond, housing and associate infrastructure.	No	Low	Low
13	Midslope, lower slope and creek bank	Darling Mills Creek	Poor	Low	Track, stormwater drains and modified creekline.	No	Low	Low
14	Midslope, lower slope and creek bank	Darling Mills Creek and tributary	Poor	Low	Motorway, drains, modified creekline (concrete lined), sewer vents, roads, tracks, housing and associate infrastructure.	No, but rockshelters present.	Moderate	Low

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5.2 Ground-truthing AHIMS registered sites

Prior to the field inspections, site cards were obtained for the previously identified AHIMS register search results. Information from the site cards was then utilised in inspecting the site location areas during field inspections. The significance of the items was not provided on the site cards.

Some sites were identified as having been destroyed during previous development works. Others were found to be registered at an erroneous coordinate, (e.g. #45-6-0897 was registered to a coordinate near Brickpit Park on Pennant Hills Road, but was described on the site card as being situated on Lane Cove River).

Details on the AHIMS sites that were subject to the field inspection have been provided in **Table 6** and the results are discussed in **Section 5.1**.

In summary:

- Site #45-6-0339 was unable to be located during the targeted inspection. However it is noted that the site card states that the site was “now obliterated by waterboard piping and works” suggesting that although it is listed as valid in the AHIMS register, it has in fact been destroyed.
- Site #45-6-0342 was unable to be located during the targeted inspection. It is noted that the site card for #45-6-0342 describes the engravings as having being “cut out” prior to 1910 and that a 1988 review by Tessa Corkill could not identify the site location.
- The site card for #45-6-1487 showed that the site was destroyed under permit 450001 (January 1986). No remnants of the site were located during the site inspection.
- Sites #45-6-2472/#45-6-2513 were possibly destroyed during previous development works. The site card records that an Application for a Grant to Destroy permit was to be made to the former Roads and Traffic Authority (now Roads and Maritime), presumably as a result of the construction of the Hills M2 Motorway. No records associated with the site card indicating that this application was submitted were identified.
- Site #45-6-2892 was unable to be located during the targeted inspection. Site #45-6-2892 does not have a site card on file in the AHIMS register and the AHIMS coordinate places the site on the Pennant Hills Golf Course. It was unable to be relocated during past surveys of the area undertaken previously by AECOM during the development of the Hills M2 Motorway Upgrade project (AECOM, 2010).
- Sites #45-6-0923, #45-6-2097, #45-6-2160, #45-6-2161, #45-6-2163, #45-6-2542, # 45-6-2543, #45-6-2544 and #45-6-2548 /#45-5-0886 were located and remain valid.
- Site #45-6-0924 could not be relocated during the site inspection.





Details of the AHIMS sites are summarised below in **Table 6** and **Table 7**.

Table 6 AHIMS Registered Sites within project corridor

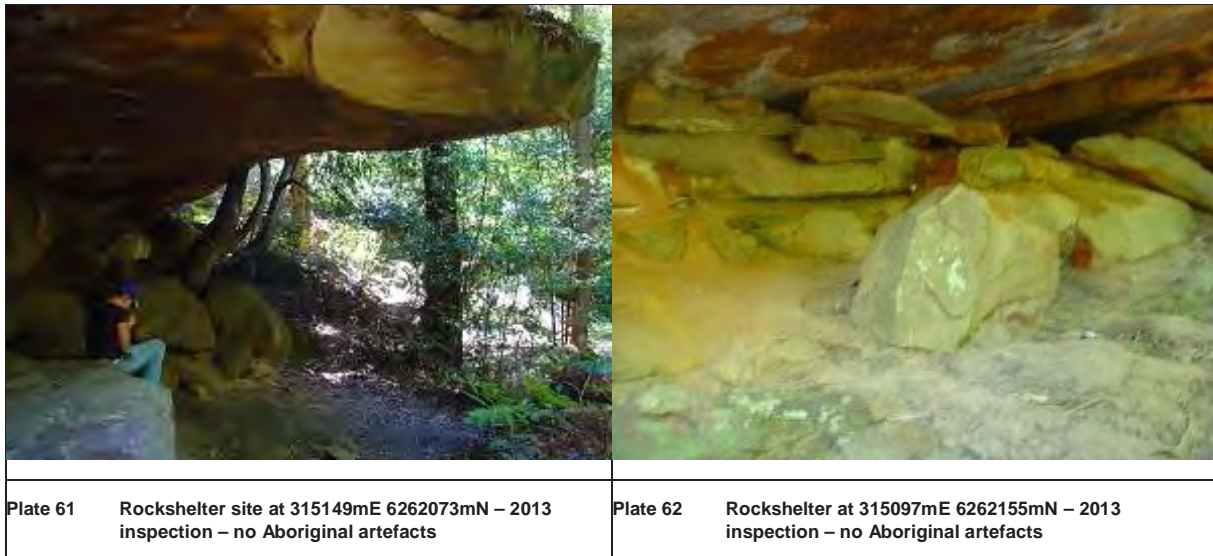
AHIMS #	Site name	Site type	Valid / destroyed
45-6-0339	Normanhurst	Grinding grooves	Destroyed
45-6-0342	Asquith	Engraving	Could not be relocated during the site inspection.
45-6-0923	DARLING MILLS CREEK 1	Rockshelter	Valid
45-6-0924	Darling Mills Creek; Parramatta	Rockshelter with art	Could not be relocated during the site inspection.
45-6-1487	Golf Links Track; HB-13;	Grinding grooves	Destroyed
45-6-2097	Darling Mills S.F. 2	Rockshelter	Valid
45-6-2160	CF1 a b; Cumberland S.F.	Art site/ Rockshelter	Valid
45-6-2161	CF3;Cumberland S. F.	Rockshelter	Valid
45-6-2163	CF5;Cumberland S.F.	Rockshelter	Valid
45-6-2472 / 45-6-2513	CF6/ CFC (Baulkham Hills) SEE 45-6-2472	Art site/ Rockshelter	Could not be relocated during the site inspection.
45-6-2542	DMC 6	Rockshelter	Valid
45-6-2543	DMC 7	Rockshelter	Valid
45-6-2544	DMC 8	Rockshelter	Valid
45-6-2892	PHGC 1 (Hills Golf Course)	Rockshelter	Could not be relocated during the site inspection.
45-6-2548 / 45-5-0886	DMC 1	Rockshelter	Valid

Table 7 Sites in proximity to Hills M2 Motorway integration works

AHIMS #	Site name	Site type	Notes
45-6-0923	DARLING MILLS CREEK 1	Rockshelter	Originally recorded in 1963, an inspection that searched for it in 1989 found likely matches in the locality but could not positively identify the rockshelter due to a lack of information on the site card. The same issues exist for this 2013 inspection, with this location the most likely match. A modern campfire was identified within this rockshelter.
45-6-2548/45-5-0886	DMC 1	Rockshelter	This site has been duplicated in the AHIMS register, with two sites cards referring to it. At the time of inspection a small overhang with rock base containing graffiti (A.Y.KM. 30.7.66) was noted to be directly adjacent to the larger rockshelter identified on the site cards. This site is in proximity to the existing Hills M2 Motorway, walking track and modified channel for Darling Mills Creek. It was noted to contain graffiti.
45-6-2543	DMC 7	Rockshelter	In addition to the initial site recording in 1993, this site was also reinspected in 2009 by AECOM. This rockshelter was located adjacent to #45-6-2544.
45-6-2544	DMC 8	Rockshelter	In addition to the initial site recording in 1993, this site was also reinspected in 2009 by AECOM. This rockshelter was located adjacent to #45-6-2543.
45-6-2542	DMC 6	Rockshelter	This site was in regular modern use, with evidence of past campfires, wood gathered and a depression excavated for a future campfire, tongs, broken glass and graffiti all present.
NA	NA	Rock overhang	No corresponding site card could be found for this rock overhang. Graffiti was noted as present.
NA	NA	Rock overhang	No corresponding site card could be found for this rock overhang. Graffiti was noted as present. This rock overhang is located immediately adjacent to a walking track alongside a tributary creek.

	
<p>Plate 51 AHIMS #45-6-0923 (no picture on site card for comparison)</p>	<p>Plate 52 AHIMS #45-6-2548/45-5-0886 - additional small overhang area adjacent to main section with graffiti</p>
	
<p>Plate 53 AHIMS #45-6-2548 – 1992 picture from site card</p>	<p>Plate 54 AHIMS #45-6-2548 – 2013 inspection</p>

	
<p>Plate 55 AHIMS #45-6-2543 – 2009 picture from site card</p>	<p>Plate 56 AHIMS #45-6-2543 – 2013 inspection</p>
	
<p>Plate 57 AHIMS #45-6-2544 – 2009 picture from site card</p>	<p>Plate 58 AHIMS #45-6-2544 – 2013 inspection</p>
	
<p>Plate 59 AHIMS #45-6-2542 with two campfire areas, firewood and graffiti – 2013 inspection (no picture on site card for comparison)</p>	<p>Plate 60 AHIMS #45-6-2542 graffiti detail – 2013 inspection</p>



5.3 Outcomes of aboriginal representative consultation

As detailed in **Section 3.1**, representatives from the Metropolitan Local Aboriginal Land Council (MLALC) and Guringai Tribal Link Aboriginal Corporation (GTLAC) participated in the site inspections held in late 2013.

Both representatives provided verbal feedback during the field inspections, which was considered in this assessment. The representatives were invited to provide a report or comments detailing their findings of the inspections for consideration in the assessment of the potential impacts of the project.

A report was received from the GTLAC representative for the site inspections undertaken in September and October 2013 (refer to **Appendix A**). In summary, the GTLAC representative advised that:

- “The study area for the proposed works, has been and still is, home to the Guringai speaking Mob (Wanangine), for generations and seasonally occupied in various locations by the Darug peoples.”
- “No Aboriginal sites were identified within the study area at the time of this survey. Previously recorded Aboriginal sites could not be identified at the time of this survey and it appears that these sites were subject to a Consent to destroy Permit (issued by DEC, now known as OEH) during the construction of the existing F3 and associated roadways.”
- “To our knowledge, some engraving sites were excavated and relocated to Ku-ring-gai Chase National Park and one was relocated to The Wildflower Gardens at St. Ives.”

As the GTALC representative was unable to attend the December 2013 inspection, a copy of the report for that inspection was provided to that representative for comment. The representative advised that no further comment would be provided.

Verbal advice received during the field inspections from the MLALC representative were considered in this assessment, being that there are no Aboriginal sites or areas of specific cultural values detected during the inspections in the areas proposed for disturbance. The MLALC representative was also provided with data from the inspection conducted on 24 September 2013 and a copy of the report relating to the inspection held on 19 December 2013. In providing comment on that report, the representative agreed with the recommendations relating to restrictions to management zones for areas of sensitivity (as discussed in **Section 5.4** and **Chapter 7.0**).

No specific cultural values (including cultural landscape values) were identified by the representatives as having the potential to be impacted by the proposed works.

5.4 Management Zones

Two management zones were identified during this assessment. The purpose of these management zones was to assist in the avoidance of areas containing Aboriginal heritage values during the proposed works. These management zones were identified based upon known and potential Aboriginal archaeological heritage values, objects and places. Triggers for consideration of a management zone included currently valid AHIMS sites, landforms with the potential for further sites to occur and input from participating Aboriginal representatives on cultural values (including cultural landscape values). Field inspections of these areas were utilised to assess the level of past disturbance and ground-truth AHIMS sites. The extent of these management zones were defined considering the combination of all of these elements. The curtilage was defined with reference to areas of high disturbance (such as the existing Hills M2 Motorway alignment) located outside its bounds.

These management zones are referred to as areas of archaeological sensitivity, being ASA1 and ASA2. The management zones were identified specifically in relation to this assessment, which had a defined study area. Archaeological sensitivity may also occur in the continuing landforms beyond the bounds of the identified management zones, but have not been assessed as they fall outside the parameters of this study and the defined study area. The identification of management zones ASA1 and ASA2 was specifically undertaken to manage the avoidance of impacts for the proposed works on both known and potential Aboriginal heritage.

Area of archaeological sensitivity – ASA1

The ASA1 management zone, which contains three previously registered AHIMS sites (#45-6-2097, #45-6-2160 and #45-6-2163), was identified in the southern portion of the study area west of the southern interchange (refer to **Figure 15**). The area was identified on transect 11 and is located on the northern side of the Hills M2 Motorway in West Pennant Hills. The area is adjacent to Blue Gum Creek and contains numerous outcrops and rock overhangs. In addition to the three registered AHIMS sites there is a potential for further Aboriginal archaeological sites to be located in this area. This area is outside of the construction footprint for the project.

Area of archaeological sensitivity – ASA2

Five previously registered AHIMS sites (#45-6-0923, #45-6-2548/45-5-0886, #45-6-2543, #45-6-2544 and #45-6-2542) and two rock overhangs were identified within 400 metres of the Hills M2 Motorway integrations works, to the north of the Hills M2 Motorway, adjacent to Darling Mills Creek (refer to **Figure 16**). The ASA2 management zone was identified on transect 14 as being that portion of the outcrop and rock overhang area within 200 metres of the proposed works. ASA2 management zone contains AHIMS sites #45-6-2543 and #45-6-2544 as well as further overhangs.

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Figure 15 Archaeological sensitivity area 1

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Figure 16 Area of archaeological sensitivity 2 within proximity to the project

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6.0 Summary of constraints

Two management zones were identified during these works. One of these areas (ASA1) was identified within Bidjigal Reserve on the northern side of Hills M2 Motorway, West Pennant Hills (refer to **Figure 15**). This area contains three registered AHIMS sites and has the potential for further sites to be located within the area. Aboriginal consultation identified this area as containing areas of cultural significance. This area is located outside of the construction footprint for the project.

The second management zone area contained two rockshelter sites and rock overhangs near Darling Mills Creek, located north of the Hills M2 Motorway. It was identified as a result of the assessment of the study area. There is also potential for further Aboriginal archaeological sites to be located in this area. This area is referred to in this report as ASA2 management zone, and was located on transect 14 (refer to **Figure 16**). The identified sites and area of potential fall outside of the construction footprint for the project.

For management zones ASA1 and ASA2, the construction footprint for the project would not extend into these areas.

The other transect areas inspected during this assessment have been assessed as disturbed with a low likelihood for containing Aboriginal archaeological sites and having no specific cultural values. Direct impacts to sites #45-6-0923, #45-6-2097, #45-6-2160, #45-6-2161, #45-6-2163, #45-6-2542, #45-6-2543, #45-6-2544 and #45-6-2548 / #45-5-0886 would be avoided.

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7.0 Summary of Findings & Recommendations

The analysis of Aboriginal cultural heritage for the project identified the following:

- Direct impacts to sites #45-6-0923, #45-6-2097, #45-6-2160, #45-6-2161, #45-6-2163, #45-6-2542, #45-6-2543, #45-6-2544 and #45-6-2548 / #45-5-0886 would be avoided.
- No specific Aboriginal archaeological heritage values were identified during these inspections outside existing AHIMS site areas, with the exception of two management zone areas, being:
 - An area of archaeological sensitivity, containing three valid registered AHIMS sites and the potential for further sites, located in the southern portion of the study area. This area is referred to in this report as ASA1 (Archaeological Sensitivity Area 1) management zone. The area is adjacent to Blue Gum Creek and contains numerous outcrops and rock overhangs.
 - An area containing two rockshelter sites and rock overhangs near Darling Mills Creek and located north of the Hills M2 Motorway, which were identified as being within 200 metres of the construction footprint. There is also potential for further Aboriginal archaeological sites to be located in this area. This area is referred to in this report as ASA2 (Archaeological Sensitivity Area 2) management zone.
 - The construction footprint for the project would not extend into either ASA1 or ASA2 management zones.
- Development works have previously been conducted in proximity to ASA2 management zone as part of the M2 Upgrade project. Activities conducted in this locality included establishment and operation of a construction compound site, bridge widening works and piling. The M2 Upgrade project was successfully completed without adversely affecting nearby rock outcrops and rock shelters.
- Project works proposed in proximity to ASA2 management zone relate to the Hills M2 Motorway, the majority of which would affect the southern side of the motorway. Where the integration works affect the northern side of the motorway, they would not extend beyond the area previously disturbed by the M2 Upgrade project. On this basis, and noting the absence of adverse impacts by the M2 Upgrade project, it is anticipated that the Hills M2 Motorway integration works would similarly not result in adverse impacts to this area of archaeological sensitivity.
- The targeted inspections have not identified any impacts on Aboriginal cultural values as a result of the project, and as such, the assessment has not advanced to a detailed cultural heritage impact assessment. Management recommendations have been compiled to protect sites identified in the surrounding area. This assessment, undertaken in accordance with OEH guidelines, does not identify any need for further assessment or consultation.
- Nonetheless, recommendations to safeguard these values have been developed and detailed in **Section 7.1**.
- Based on the results of this assessment, the AHIMS database should be updated through submission of site cards and ASIR card/s. This should provide the data gathered during this inspection so that the latest coordinate and condition data is accurate within the AHIMS register.

7.1 Management recommendations

Based on the results of the targeted inspections it is recommended that:

- The detailed design of the project should be developed to avoid direct impacts on the ASA1 and ASA2 management zones and previously identified archaeological sites.
- The identified rockshelter sites and overhangs located within 200 metres of the Hills M2 Motorway integration works should be clearly delineated prior to construction works to avoid inadvertent impacts during construction.

- During construction, vibration monitoring would be conducted for vibration intensive works within 50 metres of rockshelter sites and overhangs associated with ASA2 management zone to ensure that the rockshelter sites and overhangs are not adversely affected. The need for vibration monitoring would be informed by a preliminary screening of activities at this location to identify what activities have the potential for vibration at the areas of sensitivity. The preliminary screening and works requiring monitoring would be contained within the construction environmental management plan.
- If impacts on any Aboriginal heritage sites or areas of archaeological sensitivity cannot be avoided, then it is recommended that the assessment process progress to Stage 3 of the Roads and Maritime PACHCI process for formal consultation (Roads and Maritime, 2011).
- The AHIMS database should be updated through submission of site cards and ASIR card/s prior to works commencing. This should provide the data gathered during the field inspections carried out to inform this assessment so that the latest coordinate and condition data is accurate within the AHIMS register.
- In the event that additional areas outside of those inspected as part of this assessment are identified as having potential for Aboriginal heritage and the potential for disturbance as a result of the project, then the need for additional Stage 2 assessments should be reviewed.
- If an Aboriginal object(s) or human remains are discovered during construction, the discovery should be managed in accordance with the Roads and Maritime standard management procedure Unexpected Archaeological Finds (July, 2012).

**ABORIGINAL CULTURAL HERITAGE
IMPACT ASSESSMENT REPORT.
PROPOSED TOLLED MOTORWAY
LINKING the F3 to the HILLS M2
MOTORWAY
NORTH ROCKS to HORNSBY, NSW.**

*Prepared by Tracey Howie-Guringai Tribal Link Aboriginal Corporation
for
Roads and Maritime Services (RMS) NSW.*

October, 2013.

ABORIGINAL CULTURAL HERITAGE

IMPACT ASSESSMENT REPORT

**PROPOSED TOLLED MOTORWAY LINKING the F3 to the HILLS M2
MOTORWAY, NORTH ROCKS to HORNSBY, NSW**

Prepared by Guringai Tribal Link Aboriginal Corporation.

for Roads and Maritime Services (RMS) NSW.

INTRODUCTION:

Guringai Tribal Link Aboriginal Corporation (GTLAC) was contacted by Clive Freeman, Aboriginal Cultural Heritage Officer for RMS, in regards to an Aboriginal Cultural Heritage Impact Assessment for the proposed F3 to Hills M2 Motorway link road.

The proposal consists of a tolled Motorway linking the F3 (M1 Pacific Motorway) to the Hills M2 Motorway running between North Rocks and Hornsby and extending through Baulkham Hills, North Rocks, Carlingford, West Pennant Hills, Pennant Hills, Beecroft, Thornleigh, Normanhurst and Wahroongah, NSW.

This survey was to revisit previously recorded Aboriginal sites and assess undeveloped areas within the proposed construction corridor (study area) for any additional Aboriginal sites, as defined in Attachment 1.

STUDY AREA:

The study area extends from the F3 (M1 Pacific Motorway) to the Hills M2 Motorway, passing through Baulkham Hills, North Rocks, Carlingford, West Pennant Hills, Pennant Hills, Beecroft, Thornleigh, Normanhurst and Wahroongah, NSW.

METHODOLOGY:

The survey was conducted on foot with a focus on ground surface exposures, large mature trees and previously recorded Aboriginal sites.

Representatives on site;

24/09/13;

GTLAC - Tracey Howie and Archaeologists, Darran Jordan and Chris Ellis - AECOM P/L.

02/10/13;

GTLAC - Tracey Howie, AECOM - Darran Jordan and Metropolitan LALC - Allan Madden.

8.0 Conclusion

The desktop assessment and targeted field inspections, as detailed in this report, have not identified any impacts that would result from the construction and operation of the project on Aboriginal archaeological sites, areas of archaeological sensitivity or areas that have Aboriginal cultural value. Management and mitigation measures have been recommended to protect sites identified in the surrounding area. It is therefore concluded that no further assessment or consultation in accordance with PACHCI or Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, July 2005) is required for the project.

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Appendix A

GTLAC report

HISTORICAL INFORMATION:

The study area for the proposed works, has been and still is, home to the Guringai speaking Mob (Wanangine), for generations and seasonally occupied in various locations by the Darug peoples. Pre and post European settlement.

Well known and documented members of the Guringai mob were: Boongaree, Matora, Mosquito, Jewfish, Cora(Gooseberry), Flathead, Long Dick, Sophy, Kitty and Charlotte Ashby.(nec.Webb).

Thier presence in this area was initially recorded pre 1790. References to these Guringai speaking people are located on Government Blanket list and Court Bench records taken in the Northern Beaches areas and Colonial Secretary minutes, which are held at Hornsby Library and early recordings from surveyors John Fraser,Chappell, Felton & Sarah Matthews, journals written by Rev.L.E.Threlkeld, Rev. Glennie, Matthew Flinders, Augustus Earl, R.H Mathews, and current AIATSIS maps.

The traditional areas occupied by the Guringai speaking comprises of; All of Port Jackson catchment, including the tributaries of Middle Harbour and Lane Cove River, the Broken Bay catchment, including tributaries of Brisbane Water, Cowan Creek and Pitt Water,the water shed along Peats Ridge, following along the range through to Kulnura, as well as the Lakes of the Central Coast to lower Lake Macquarie.

Guringai - People of the Coast.

Darug - People of the Plains (as described by J.Fraser 1865)

Guringai and Darug People occupied and utilised the surrounding lands and waters of the wider Hornsby Local Government Areas and beyond, for centuries prior and post to European settlement.

With a predominately seafood diet, we fished and gathered from these waters and their banks and hunted for animals, collected berries, fruits and seeds, had ceremonies, celebrations and mourned within these areas.

Care was taken to not deplete our resources and respect was given to the Land.

FINDINGS:

No Aboriginal sites were identified within the study area at the time of this survey.

Previously recorded Aboriginal sites could not be identified at the time of this survey and it appears that these sites were subject to a Consent to destroy Permit (issued by DEC, now known as OEH) during the construction of the existing F3 and associated roadways.

To our knowledge, some engraving sites were excavated and relocated to Kuringai Chase National Park and one was relocated to The Wildflower Gardens at St. Ives.

RECOMMENDATIONS:

Should any Aboriginal sites/objects be located during the processes of any proposed works, work must cease in that area and the Office of Environment and Heritage (OEH, formally, Department of Environment Climate Change and Water, DECCW) & GTLAC are to be notified immediately.

Should any skeletal remains be unearth during any works or associated activities, all work must cease immediately within that vicinity and the NSW Police, OEH, NSW Coroner's Office and GTLAC are to be contacted.

Section 90(1) of the National Parks and Wildlife Act, 1974 states that it is an offence to destroy, deface or damage, or cause or permit destruction or defacement of or damage to, an Aboriginal object or Aboriginal place without first obtaining the consent of the Director General of the Office of Environment and Heritage.

Statutory Considerations.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984. (Commonwealth)

The Aboriginal and Torres Strait Islander Heritage and Protection Act 1984 (Cwlth) was enacted at a Federal level to preserve and protect areas (particularly sacred sites) and objects of particular significance to Aboriginal Australians from damage or desecration. Steps necessary for the protection of a threatened place are outlined in a gazetted Ministerial Declaration (Sections 9 and 10).

This can include the prevention of development.

As well as providing protection to areas, it can also protect objects by Declaration, in particular Aboriginal skeletal remains (Section 12). Although this is a Federal Act, it can be invoked on a State level if the State is unwilling or unable to provide protection for such sites or objects.

National Parks and Wildlife Act. 1974. (NSW)

The National Parks and Wildlife Act 1974 (NPW Act) provides blanket protection for Aboriginal objects (material evidence of Indigenous occupation) and Aboriginal Places (areas of Cultural significance to the Aboriginal community) across NSW. An Aboriginal object is defined as;

any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.

An Aboriginal place is any place declared to be an Aboriginal place by the Minister for the Office of Environment and Heritage (OEH), under Section 84 of the Act.

It is an offence to disturb Aboriginal objects or places without a permit authorised by the Director-General of the OEH. In addition, anyone who discovers an Aboriginal object is obliged to report the discovery to OEH

Attachment 1:

BRIEF DESCRIPTION OF ABORIGINAL SITES and OBJECTS:

(Please note that not all Aboriginal site types are listed here).

Artefacts: (as defined in NPW Act. 1974)

Stone artefacts are culturally modified stone materials that occur when a stone material is struck by another stone to manufacture stone tools and implements. Other types of artefacts are quartz, modified shells and glass or ceramic, post European settlement.

Shell midden:

Shell middens are large deposits of shell materials that have accumulated over centuries of celebrations, ceremonies and/or feasts performed on the foreshore areas. Middens usually also contain artefacts and small animal and/or bird bones.

Scarred or culturally modified trees:

Scarred and culturally modified trees are usually large trees in which the thick outer layer of the tree has been removed with a traditional tool. Large removals were used for making canoes. Other removals were used for coolamons (trays with concave edges used as buckets or large plates), shields and shelter.

Stone Hatchet/Axe:

Stone hatchets and axes are made from binding a hard rock that has been sharpened on a sandstone platform/outcrop, to the end of a piece of wood and secured with tree resin and/or string made from rubbing strands of long, tough grasses together until they are tightly fused.

Grinding Grooves:

Grinding grooves are indented scars on sandstone platforms/outcrops, as a result of sharpening spears and axes in the same indentation over centuries. They are usually located near a constant water source.

Engraving sites:

Engraving sites are located on sandstone platforms/outcrops and boulders and are depictions of animals, human figures both natural and mythological, site indication markers, travel route markers and traditional tools. All engraving sites have a special meaning and form sections of much larger site complexes/story lines.

Ochre/Pigment Art:

Ochre art is usually located within a sandstone shelter/overhang and consists of drawings or hand stencils. Hand stencils are made by chewing a small amount of ochre mixed with egg white or water and sprayed by mouth over the hand when placed against the wall of the shelter/overhang. Another type of pigment art is charcoal drawings.

Spear:

Spears were usually made from the long narrow stem of a matured Xanthoria grass tree and were either sharpened on a sandstone at one end or had a stone spear head fixed to one end by binding it with tree resins.

Womera:

Womeras were used to propel a spear by placing the blunt end of the spear onto a sharpened stick or animal tooth that has been fixed to one end of a narrow piece of wood, about 30cm in length. Womeras made the spears travel much faster and were more accurate than just throwing them with a bare hand.

DESCRIPTION OF ABORIGINAL SITES and OBJECTS Continued:

Aboriginal Place:

An area of land or waters identified as being of Cultural significance and importance to the Aboriginal Community and,
any place declared to be an Aboriginal place by the Minister for the Office of Environment and Heritage (OEHL), under Section 84 of the Act.

Water Holes:

Water holes are deep bowl like indentations in sandstone platforms/outcrops associated with fresh flowing water or permanent water sources such as natural springs.

Burial sites:

Burial sites contain human remains of Aboriginal persons pre European settlement and not within the confines of a graveyard/cemetery.

Sandstone Shelters:

Stone shelters were used as protection from extreme weather conditions and for shelter whilst travelling through the ridge top areas. They usually contain a sandy floor and can contain artefact materials.

Fish Traps:

Fish traps were made from boulders that are small enough to be carried and placed in a semi-circular formation within the low tide area of the foreshore. Upon a low tide the fish trapped within the rock formation were collected for consumption.

Knapping Site:

An area continually occupied over centuries/generations for the purposes of stone tool making and containing several, usually hundreds of offcuts and discarded fragments from the tools.

Appendix B

AHIMS register search results

AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 60300684

Client Service ID : 106367

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-2369	Bone shelter;	AGD	56	323180	6265680	Closed site	Valid	Artefact : -	Shelter with Deposit	2047
	<u>Contact</u>							<u>Permits</u>		
45-6-1084	Asquith;	AGD	56	325159	6269328	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>							<u>Permits</u>		
45-6-1439	Elouera Bushland Reserve	AGD	56	320710	6267687	Open site	Not a Site	Art (Pigment or Engraved) : -	Not an Aboriginal Site	
	<u>Contact</u>							<u>Permits</u>		
45-6-2513	CFC (Baulkham Hills) SEE 45-6-2472	AGD	56	317750	6262200	Closed site	Valid	Art (Pigment or Engraved) : -, Artefact : -	Shelter with Art,Shelter with Deposit	
	<u>Contact</u>							<u>Permits</u>		
45-6-0608	Lane Cove River;Turramurra Public School	AGD	56	325726	6263669	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>							<u>Permits</u>		
45-5-1005	IFCH1	AGD	56	322415	6262289	Open site	Not a Site	Artefact : -	Isolated Find	
	<u>Contact</u>							<u>Permits</u>		
45-6-2453	HR6	AGD	56	322400	6263970	Closed site	Valid	Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Deposit	3484
	<u>Contact</u>							<u>Permits</u>		
45-6-2454	HR7	AGD	56	320750	6266340	Closed site	Valid	Artefact : -	Shelter with Deposit	3484
	<u>Contact</u>							<u>Permits</u>		
45-6-2472	CF6	AGD	56	317750	6262200	Closed site	Valid	Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Deposit	
	<u>Contact</u>							<u>Permits</u>		
45-6-1487	Golf Links Track;HB-13;	AGD	56	325619	6269154	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	940
	<u>Contact</u>							<u>Permits</u>		
45-6-2097	Darling Mills S. F. 2	AGD	56	317453	6262240	Closed site	Valid	Artefact : -	Shelter with Deposit	1776,1809,191 1,2113,2293
	<u>Contact</u>							<u>Permits</u>		
45-6-2099	Dynamited;	AGD	56	323140	6265520	Closed site	Valid	Artefact : -	Shelter with Deposit	287
	<u>Contact</u>							<u>Permits</u>		
45-6-1157	Brown;Cut Inside Cave; RYDE 003	GDA	56	325234	6262680	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	

Report generated by AHIMS Web Service on 17/07/2013 for Darran Jordan for the following area at Datum :GDA, Zone : 56, Eastings : 316729 - 325947, Northings : 6261657 - 6269794 with a Buffer of 0 meters. Additional Info : Background research. Number of Aboriginal sites and Aboriginal objects found is 69

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 60300684

Client Service ID : 106367

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-1158	Brown Two Ceiling Domes Cave RYDE 004	AGD	56	325274	6262670	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-2163	CF5;Cumberland S.F.;	AGD	56	317926	6262507	Closed site	Valid	Artefact : -	Shelter with Deposit	1776,1779,2114
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0339	Normanhurst;	AGD	56	322450	6267538	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0340	Turramurra;Pennant Hills;	AGD	56	325595	6265678	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0341	Pymble;Turramurra;	AGD	56	325717	6264126	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0342	Asquith;	AGD	56	325528	6269152	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	940
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-2034	English house;	AGD	56	325440	6264850	Closed site	Valid	Artefact : -	Shelter with Deposit	1333
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-2035	Becks place;	AGD	56	325600	6264970	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	1333
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-2041	Darling Mills S.F. 1	AGD	56	317050	6262430	Closed site	Valid	Artefact : -	Shelter with Deposit	1776,1809,1911,2113,2114
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0749	Cherrybrook 5;	AGD	56	317780	6267920	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	1271
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-1768	Cherrybrook	AGD	56	317440	6266920	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	360
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0937	Rogans Hill	AGD	56	319544	6266475	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-0938	Rogans Hill;	AGD	56	319870	6266150	Open site	Valid	Art (Pigment or Engraved) : -, Grinding Groove : -	Axe Grinding Groove,Rock Engraving	

Report generated by AHIMS Web Service on 17/07/2013 for Darran Jordan for the following area at Datum :GDA, Zone : 56, Eastings : 316729 - 325947, Northings : 6261657 - 6269794 with a Buffer of 0 meters. Additional Info : Background research. Number of Aboriginal sites and Aboriginal objects found is 69

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 60300684

Client Service ID : 106367

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0939	Rogans Hill;	AGD	56	317696	6267446	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0940	Rogans Hill;(duplicate copy of 45-3-0940)	AGD	56	319621	6267209	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0941	Rogans Hill;	AGD	56	319811	6266846	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0945	Rogans Hill;Glenhaven;	AGD	56	317410	6268080	Open site	Valid	Grinding Groove : -, Water Hole : -	Axe Grinding Groove,Water Hole/Well	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0946	Rogans Hill;	AGD	56	319983	6267399	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0947	Hornsby;	AGD	56	319238	6268116	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0948	Rogans Hill;Hornsby;	AGD	56	319242	6267933	Closed site	Valid	Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0949	Normanhurst;	AGD	56	320258	6267404	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0950	Rogans Hill;Pyes Ck 3;	AGD	56	318967	6267928	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	764
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0951	Rogans Hill	AGD	56	320172	6267128	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-0955	Rogans Hill;	AGD	56	319950	6266200	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-1647	Cherrybrook;Pyes Creek 2;	AGD	56	318950	6268350	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	764,1214
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							

Report generated by AHIMS Web Service on 17/07/2013 for Darran Jordan for the following area at Datum :GDA, Zone : 56, Eastings : 316729 - 325947, Northings : 6261657 - 6269794 with a Buffer of 0 meters. Additional Info : Background research. Number of Aboriginal sites and Aboriginal objects found is 69

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 60300684

Client Service ID : 106367

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-1649	Pyes Creek 1(Cherry brook)	AGD	56	317620	6267040	Closed site	Valid	Artefact : -	Shelter with Deposit	764,1039
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald							
45-6-0304	Pennant Hills;	AGD	56	322503	6264795	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-6-0306	West Pennant Hills;Rogan's Hill;	AGD	56	318523	6267279	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-6-0307	Hornsby;	AGD	56	320860	6269336	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-6-0896	Window Cave;Pennant Hills;	AGD	56	322890	6265450	Closed site	Valid	Artefact : -	Shelter with Deposit	1809
	<u>Contact</u>	<u>Recorders</u>	Val Attenbrow,T Barlow,K Cutmore							
45-6-0897	Normanhurst;	AGD	56	323375	6267007	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-6-1879	Blackfellows Head Spur 2;	AGD	56	321700	6269050	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	R Clegg							
45-6-1880	Blackfellows Head Spur 3;	AGD	56	321700	6269050	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	R Clegg							
45-6-1881	Blackfellows Head Spur 4;	AGD	56	321700	6269050	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	R Clegg							
45-6-1054	Lane Cove;Man Goanna Cave;	AGD	56	325729	6263486	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-6-1073	Hornsby;Black Kangaroo Cave;	AGD	56	321040	6269523	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	580
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-6-1703	Blackfellows Head Spur 4;	AGD	56	321740	6269010	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald							
45-6-1704	Blackfellows Head Spur 3;	AGD	56	321690	6269140	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald							

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 60300684

Client Service ID : 106367

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-1705	Black Fellows Head Spur 2;	AGD	56	321690	6269080	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	
	<u>Contact</u>	<u>Recorders</u>	Margrit Koettig,Doctor.Jo McDonald							
								<u>Permits</u>		
45-6-0228	Blackfellow's Head Spur 1;West Leigh;	AGD	56	321700	6269050	Open site	Valid	Art (Pigment or Engraved) : -	Rock Engraving	209
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald,M Donald							
								<u>Permits</u>		
45-6-0977	Epping;Lane Cove River; Little bloodwood stump cave RYDE 001	GDA	56	323964	6262130	Closed site	Valid	Artefact : -	Shelter with Deposit	2047
	<u>Contact</u>	<u>Recorders</u>	Val Attenbrow,Aboriginal Heritage Office,Mr.Rick Bullers							
								<u>Permits</u>		
45-6-0978	Lane Cove River;	AGD	56	324729	6263192	Open site	Valid	Grinding Groove : -, Water Hole : -	Axe Grinding Groove,Water Hole/Well	
	<u>Contact</u>	<u>Recorders</u>	Mr.R Taplin							
								<u>Permits</u>		
45-6-2861	FR01	AGD	56	317654	6265123	Open site	Valid	Artefact : 5		
	<u>Contact</u> T Russell	<u>Recorders</u>	Jo McDonald Cultural Heritage Management							
								<u>Permits</u>		
45-6-2892	PHGC 1 (Hills Golf Course)	GDA	56	319880	6263112	Closed site	Valid	Artefact : -		3652
	<u>Contact</u>	<u>Recorders</u>	Mary Dallas Consulting Archaeologists							
								<u>Permits</u>		
45-6-2040	Coups creek;	AGD	56	323570	6265750	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	Val Attenbrow							
								<u>Permits</u>		
45-6-2949	M2A1	GDA	56	323895	6262241	Open site	Valid	Grinding Groove : 1		
	<u>Contact</u>	<u>Recorders</u>	Mr.Rick Bullers							
								<u>Permits</u>		
45-6-2160	CF1 a b;Cumberland S.F.;	AGD	56	318018	6262574	Closed site	Valid	Art (Pigment or Engraved) : -, Artefact : -	Shelter with Art,Shelter with Deposit	1776,2114
	<u>Contact</u>	<u>Recorders</u>	Mr.Rick Bullers,Ms.Tessa Corkill							
								<u>Permits</u>		
45-6-2161	CF3;Cumberland S. F.;	AGD	56	317123	6262357	Closed site	Valid	Artefact : -	Shelter with Deposit	1776,1779,2113,2114
	<u>Contact</u>	<u>Recorders</u>	Mr.Rick Bullers,Ms.Tessa Corkill							
								<u>Permits</u>		
45-6-2956	Colbarra Place PAD	GDA	56	317200	6263600	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	<u>Contact</u>	<u>Recorders</u>	Streat Archaeological Services							
								<u>Permits</u>	3305	
45-6-2990	Zig Zag Creek 01	GDA	56	320196	6267009	Closed site	Valid	Artefact : 2, Hearth : 1		102473
	<u>Contact</u>	<u>Recorders</u>	Mr.Michael Jackson							
								<u>Permits</u>		
45-6-3104	Rothwell Shelter KUR033	GDA	56	325500	6265090	Open site	Valid	Potential Archaeological Deposit (PAD) : -		

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : 60300684

Client Service ID : 106367

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-3067	Crescent 1	GDA	56	322187	6263082	Open site	Valid	Artefact : 1		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-3082	NWRL PAD1	GDA	56	320967	6262938	Open site	Valid	Potential Archaeological Deposit (PAD) : 1		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-3105	Canoon Rd Grooves 1 KUR143	GDA	56	324284	6264100	Open site	Valid	Grinding Groove : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-3042	Eden Ave Groove 1 KUR 052	GDA	56	325374	6262955	Open site	Valid	Grinding Groove : 1		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							
45-6-3083	Crescent 3	GDA	56	321842	6263343	Open site	Valid	Artefact : -		
	<u>Contact</u>	<u>Recorders</u>	<u>Permits</u>							

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-2443	Belvis 4	AGD	56	310500	6264960	Open site	Valid	Artefact : -	Open Camp Site	4153,98740
	<u>Contact</u>	<u>Recorders</u>	Michael Guider							
45-5-2017	Belvis 7 (Bella Vista)	AGD	56	310040	6263800	Open site	Valid	Artefact : -	Open Camp Site	4153,98740
	<u>Contact</u>	<u>Recorders</u>	Michael Guider							
45-5-2018	Belvis 3 (Bella Vista)	AGD	56	310480	6264920	Open site	Valid	Artefact : -	Open Camp Site	4153,98740
	<u>Contact</u>	<u>Recorders</u>	Michael Guider,Ms.Laila Haglund							
45-5-2019	Belvis 2 (Bella Vista)	AGD	56	310520	6264660	Open site	Valid	Artefact : -	Open Camp Site	4153,98740
	<u>Contact</u>	<u>Recorders</u>	Michael Guider,Ms.Laila Haglund							
45-5-2020	Belvis 1 (Bella Vista)	AGD	56	310300	6264780	Open site	Valid	Artefact : -	Open Camp Site	4153
	<u>Contact</u>	<u>Recorders</u>	Michael Guider							
45-5-1064	Toongabbie Creek 2 TC 2	AGD	56	311390	6262500	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	Michael Guider							
45-6-2542	Darling Mills_Creek 6;DMC 6;	AGD	56	315100	6261850	Closed site	Valid	Artefact : -	Shelter with Deposit	2670
	<u>Contact</u>	<u>Recorders</u>	Ms.Tessa Corkill							
45-6-2543	Darling Mills_Creek 7;DMC 7;	AGD	56	315240	6261961	Closed site	Valid	Artefact : -	Shelter with Deposit	2670
	<u>Contact</u>	<u>Recorders</u>	Mr.Rick Bullers,Ms.Tessa Corkill							
45-6-2548	DMC1;DMC 1;	AGD	56	315000	6261890	Closed site	Valid	Artefact : -	Shelter with Deposit	2670
	<u>Contact</u>	<u>Recorders</u>	Ms.Tessa Corkill							
45-5-0887	See 45-6-2549;	AGD	56	315400	6262850	Closed site	Valid	Artefact : -	Shelter with Deposit	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-5-0888	See 45-6-2550;	AGD	56	315480	6263070	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	
	<u>Contact</u>	<u>Recorders</u>	ASRSYS							
45-5-2408	Bella Vista 2;	AGD	56	310500	6264600	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>	Helen Brayshaw,Ms.Laila Haglund							
45-5-2409	Bella Vista 3;	AGD	56	310560	6264260	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>	Helen Brayshaw,Ms.Laila Haglund							
45-5-2295	Toongabbie 1;	AGD	56	312890	6259630	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	102742
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald							
45-5-2296	Toongabbie 2;	AGD	56	313300	6259360	Closed site	Valid	Artefact : -	Shelter with Deposit	102742
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald							

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-2297	Toongabbie 3;	AGD	56	313100	6259450	Open site	Valid	Shell : -, Artefact : -	Midden	102742
	<u>Contact</u>	<u>Recorders</u>	Doctor.Jo McDonald					<u>Permits</u>	502	
45-6-1886	William Place Shelters;	AGD	56	315600	6260100	Closed site	Valid	Artefact : -	Shelter with Deposit	1566,102196
	<u>Contact</u>	<u>Recorders</u>	R Mackay					<u>Permits</u>		
45-6-1887	Grinding Groove. Perry Street Groove.;Reserve;	AGD	56	316100	6261200	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	1566,1776
	<u>Contact</u>	<u>Recorders</u>	R Mackay					<u>Permits</u>		
45-5-0970	Toongabbie Ck 1	AGD	56	311110	6261770	Open site	Valid	Artefact : -	Open Camp Site	2832,3832,102742
	<u>Contact</u>	<u>Recorders</u>	John Edgar					<u>Permits</u>	610,682	
45-5-0973	Powers Lane 4;PL-4;	AGD	56	309850	6264400	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>	Denis Byrne,Tony Kondek					<u>Permits</u>	616	
45-6-2549	DMC2;DMC 2;	AGD	56	315400	6262850	Closed site	Valid	Artefact : -	Shelter with Deposit	2670
	<u>Contact</u>	<u>Recorders</u>	Ms.Tessa Corkill					<u>Permits</u>		
45-6-2550	DMC3;DMC 3;	AGD	56	315480	6263070	Closed site	Valid	Art (Pigment or Engraved) : -	Shelter with Art	2670
	<u>Contact</u>	<u>Recorders</u>	Ms.Tessa Corkill					<u>Permits</u>		
45-6-2553	Lake Parra R1;LP R1;	AGD	56	315640	6258780	Open site	Valid	Artefact : -	Open Camp Site	102196
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-6-2560	Lake Parra R2;LP R2;	AGD	56	315500	6258780	Open site	Valid	Artefact : -	Open Camp Site	102196
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>	2928	
45-5-1084	Matthew Pearce 1;	AGD	56	311620	6262600	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-5-1085	Matthew Pearce 2;	AGD	56	311250	6262500	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-5-1086	Vardys Road;	AGD	56	309140	6262740	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-5-1087	Vardys Road PS;	AGD	56	309340	6262700	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-5-1088	Foundry Road;	AGD	56	310500	6261620	Open site	Valid	Artefact : -	Open Camp Site	98740,102742
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-5-1089	Crestwood 1;	AGD	56	312120	6264180	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>	Michael Guider					<u>Permits</u>		
45-5-1090	Grantham Reserve;	AGD	56	308060	6259240	Open site	Valid	Artefact : -	Open Camp Site	

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1091	Chopin Street;	AGD	56	310280	6261700	Open site	Valid	Artefact : -	Open Camp Site	98740,102742
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-0348	Grantham Creek 1 Grantham Poultry Research Station	AGD	56	308320	6259710	Open site	Valid	Artefact : -	Open Camp Site	260,1018
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-0935	Powers Lane 1;	AGD	56	309610	6264050	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>	523	
45-5-0936	Powers Lane 2;	AGD	56	309640	6263790	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-0937	Powers Lane 3;	AGD	56	309440	6263780	Open site	Valid	Artefact : -	Open Camp Site	98740
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>	1398	
45-6-2579	Crestwood 2;	AGD	56	311720	6263680	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1092	Tory Burns Reserve;	AGD	56	312880	6262780	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1093	Mitchell High School;	AGD	56	306880	6259640	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1098	Blacktown Creek;	AGD	56	307040	6259680	Open site	Valid	Artefact : -, Stone Quarry : -	Open Camp Site,Quarry	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1104	Belvis 5	AGD	56	311220	6264660	Open site	Valid	Artefact : -	Open Camp Site	4153
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1105	Belvis 6	AGD	56	311180	6264240	Open site	Valid	Artefact : -	Open Camp Site	4153
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1108	Louise Ave;	AGD	56	312520	6262750	Open site	Valid	Artefact : -	Open Camp Site	
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1109	Delaney Drive	AGD	56	312520	6264720	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	102196
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-5-1110	Redbank;Northmead;	AGD	56	314020	6258060	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	102196
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		
45-6-2162	CF4 a b;Cumberland S.F.;	AGD	56	315701	6262054	Closed site	Valid	Artefact : -, Art (Pigment or Engraved) : -	Shelter with Art,Shelter with Deposit	1776,1779,211 3,2114
	<u>Contact</u>	<u>Recorders</u>						<u>Permits</u>		

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-0962	OWR 7;Rouse Hill; Contact	AGD	56	309550	6264950	Open site	Valid	Artefact : - Permits	Open Camp Site 433	98740
45-5-0963	OWR 8;Rouse Hill; Contact	AGD	56	309700	6264510	Open site	Valid	Artefact : - Permits	Open Camp Site 432,1383	98740
45-5-0842	Toongabbie Creek 3 Old Toongabbie Contact	AGD	56	313550	6259290	Open site	Valid	Artefact : - Permits	Open Camp Site	102742
45-5-0843	Finalysons Creek;Wentworthville; Contact	AGD	56	313040	6257910	Open site	Valid	Grinding Groove : - Permits	Axe Grinding Groove	102196
45-5-0871	Toongabbie CK 14;Baulkham Hills; Contact	AGD	56	311390	6262490	Open site	Valid	Grinding Groove : - Permits	Axe Grinding Groove	
45-5-0886	See 45-6-2548; Contact	AGD	56	315000	6261890	Closed site	Valid	Artefact : - Permits	Shelter with Deposit	
45-6-2036	Lake Parramatta 2 Contact	AGD	56	315710	6258920	Closed site	Valid	Art (Pigment or Engraved) : - Permits	Shelter with Art	102196
45-6-1781	Lake Parramatta Reserve Shelter; Contact	AGD	56	315650	6259250	Closed site	Valid	Art (Pigment or Engraved) : - Permits	Shelter with Art	102196
45-6-0923	Darling Mills Creek;Parramatta; Contact	AGD	56	315190	6261310	Closed site	Valid	Artefact : - Permits	Shelter with Deposit	1776
45-6-0924	Darling Mills Creek;Parramatta Contact	AGD	56	315799	6261555	Closed site	Valid	Art (Pigment or Engraved) : - Permits	Shelter with Art	1776
45-5-0824	Moxhams Road Cave; Contact	AGD	56	313926	6260011	Closed site	Valid	Artefact : 8 Permits	Shelter with Deposit	102742
45-5-0835	Toongabbie Cave;Old Toongabbie; Contact	AGD	56	313210	6259450	Closed site	Valid	Artefact : - Permits	Shelter with Deposit	102742
45-5-0839	Greystanes Creek 1;Toongabbie; Contact	AGD	56	308810	6258350	Open site	Valid	Artefact : - Permits	Open Camp Site	
45-5-0840	Greystanes Creek 2;Toongabbie; Contact	AGD	56	308750	6258130	Open site	Valid	Artefact : - Permits	Open Camp Site	

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Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-0841	Toongabbie Creek 4 Winston Hills	AGD	56	312890	6259660	Open site	Valid	Grinding Groove : -	Axe Grinding Groove	102742
	<u>Contact</u>								<u>Permits</u>	
45-5-0791	Toongabbie creek	AGD	56	311410	6260170	Open site	Valid	Artefact : -	Open Camp Site	102742
	<u>Contact</u>								<u>Permits</u>	
45-5-0792	John Curtin Reserve, Northmead;	AGD	56	314069	6260281	Closed site	Valid	Artefact : -	Shelter with Deposit	1809,2047
	<u>Contact</u>								<u>Permits</u>	
45-5-0492	Bella Vista 1	AGD	56	310030	6264790	Open site	Valid	Artefact : -	Open Camp Site	945,1018,2499, 98740
	<u>Contact</u>								<u>Permits</u>	
45-5-2712	PAD-05-19	AGD	56	309250	6263790	Open site	Valid	Artefact : -		98740
	<u>Contact</u>								<u>Permits</u>	
45-5-2713	PAD-05-18	AGD	56	308800	6264190	Open site	Valid	Artefact : -		98740
	<u>Contact</u>								<u>Permits</u>	
45-5-2774	Bella Vista 5	AGD	56	309945	6265025	Open site	Valid	Artefact : -		98740
	<u>Contact</u>								<u>Permits</u>	
45-5-2903	356 OWR	AGD	56	311200	6260350	Open site	Valid	Artefact : -		99516,102742
	<u>Contact</u>								<u>Permits</u>	
45-5-3288	BVFP3	GDA	56	310540	6264494	Open site	Valid	Artefact : 1		
	<u>Contact</u> Searle								<u>Permits</u>	
45-5-3289	BVFP1	GDA	56	310424	6264996	Open site	Valid	Artefact : 2		
	<u>Contact</u> Searle								<u>Permits</u>	
45-5-3290	BVFP2	GDA	56	310313	6264839	Open site	Valid	Artefact : 2		
	<u>Contact</u> Searle								<u>Permits</u>	
45-5-3291	BVFP4	GDA	56	310293	6264613	Open site	Valid	Artefact : 1		
	<u>Contact</u> Searle								<u>Permits</u>	
45-5-2970	Moxhams Road Bridge	AGD	56	313817	6259968	Closed site	Valid	Potential Archaeological Deposit (PAD) : 5		102742
	<u>Contact</u>								<u>Permits</u>	
45-5-2971	The Fernbanks	AGD	56	313771	6259863	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		102742
	<u>Contact</u>								<u>Permits</u>	
45-5-3081	OWR 8	AGD	56	309710	6264490	Open site	Valid	Artefact : 1		
	<u>Contact</u> T Russell								<u>Permits</u>	

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-6-2805	Lake Parramatta Playground 1	AGD	56	315572	6259151	Open site	Valid	Artefact : -		102196
	Contact Searle	Recorders	Jim Wheeler					Permits	2525	
45-5-3192	PL-OS-1	AGD	56	309040	6263940	Open site	Valid	Artefact : 3		
	Contact T Russell	Recorders	Mrs.Robynne Mills					Permits		
45-5-3193	ML-OS-2	AGD	56	309170	6264000	Open site	Valid	Artefact : 8		
	Contact T Russell	Recorders	Mrs.Robynne Mills					Permits		
45-5-3194	ML-OS-1	AGD	56	309610	6264440	Open site	Valid	Artefact : 4		
	Contact T Russell	Recorders	Mrs.Robynne Mills					Permits		
45-5-3195	ML-OS-3	AGD	56	309460	6264320	Open site	Valid	Artefact : 3		
	Contact T Russell	Recorders	Mrs.Robynne Mills					Permits		
45-5-3196	PL-OS-2	AGD	56	309220	6264090	Open site	Valid	Artefact : 8		
	Contact T Russell	Recorders	Mrs.Robynne Mills					Permits		
45-5-3323	Western Sydney PAD4	GDA	56	310500	6260350	Open site	Valid	Potential Archaeological Deposit (PAD) : -		100554,10274 2
	Contact Searle	Recorders	Navin Officer Heritage Consultants Pty Ltd					Permits		
45-5-3336	Quarry Branch 1	GDA	56	314464	6260821	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact Searle	Recorders	Jo McDonald Cultural Heritage Management					Permits		
45-5-3337	Quarry Branch 2	GDA	56	314448	6260803	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact Searle	Recorders	Jo McDonald Cultural Heritage Management					Permits		
45-5-3338	Quarry Branch 3	AGD	56	314349	6260745	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact Searle	Recorders	Jo McDonald Cultural Heritage Management					Permits		
45-5-3339	Quarry Branch 4	GDA	56	314305	6260783	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact Searle	Recorders	Jo McDonald Cultural Heritage Management					Permits		
45-5-3340	Quarry Branch 5	GDA	56	314185	6260714	Open site	Valid	Potential Archaeological Deposit (PAD) : -		
	Contact Searle	Recorders	Jo McDonald Cultural Heritage Management					Permits		

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-3341	Quarry Branch 6	GDA	56	314002	6260763	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		102742
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3342	Quarry Branch	GDA	56	314082	6260683	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		102742
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3343	Quarry Branch 8	GDA	56	314162	6260659	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3344	Quarry Branch 9	GDA	56	314181	6260406	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3345	Quarry Branch 10	GDA	56	314101	6260345	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		102742
	<u>Contact</u> Searle	<u>Recorders</u>	J & M Cook Engineering Services <u>Permits</u>							
45-5-3346	Quarry Branch 11	GDA	56	314173	6260191	Open site	Valid	Water Hole : 1		
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3347	Quarry Branch 12	GDA	56	314188	6260156	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3348	Quarry Branch 13	GDA	56	313978	6260064	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		102742
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3349	Quarry Branch 14	GDA	56	313744	6259675	Open site	Valid	Artefact : 1, Potential Archaeological Deposit (PAD) : -		102742
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							
45-5-3350	Quarry Branch 15	GDA	56	314214	6260521	Closed site	Valid	Potential Archaeological Deposit (PAD) : -		
	<u>Contact</u> Searle	<u>Recorders</u>	Jo McDonald Cultural Heritage Management <u>Permits</u>							

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AHIMS Web Services (AWS)

Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-3351	GC01 and TC02	AGD	56	312241	6263096	Open site	Valid	Artefact : 3, Potential Archaeological Deposit (PAD) : -		
	Contact T Russell	Recorders	Jo McDonald Cultural Heritage Management Permits							
45-5-3352	TC03	AGD	56	311704	6262423	Closed site	Valid	Potential Archaeological Deposit (PAD) : -, Non-Human Bone and Organic Material : -, Shell : -		
	Contact T Russell	Recorders	J & M Cook Engineering Services Permits							
45-5-3353	TC04 and CR01	AGD	56	311912	6264308	Open site	Valid	Artefact : 2		
	Contact T Russell	Recorders	Jo McDonald Cultural Heritage Management Permits							
45-5-3552	TC (Toongabbie Creek)	GDA	56	311289	6260227	Open site	Valid	Modified Tree (Carved or Scarred) : -		99516,102742
	Contact	Recorders	Michael Therin Permits							
45-5-3686	Blacktown Ck 3	GDA	56	306900	6260200	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-5-3687	Blacktown Ck 4	GDA	56	306750	6258650	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-5-3688	Blactown Ck 5	GDA	56	306690	6258100	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-5-3693	Model Farms Reserve	GDA	56	314200	6260400	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-5-3694	Yarrabee Cave	GDA	56	314120	6260620	Closed site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-6-2931	Lake Parra R3	GDA	56	315820	6258820	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-5-3695	Lake Parra R4	GDA	56	313700	6259050	Open site	Valid	Artefact : -		102742
	Contact	Recorders	Michael Guider Permits							
45-6-2932	Lake Parra R5	GDA	56	315700	6259050	Closed site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-6-2933	Belmore Park	GDA	56	315310	6258130	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider Permits							
45-5-3696	Valerie Avenue	GDA	56	311150	6262100	Open site	Valid	Artefact : -		102742
	Contact	Recorders	Michael Guider Permits							

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Extensive search - Site list report

Your Ref Number : F3-M2

Client Service ID : 118838

SiteID	SiteName	Datum	Zone	Easting	Northing	Context	Site Status	SiteFeatures	SiteTypes	Reports
45-5-3703	Kings Langley 1	GDA	56	309840	6263990	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider					Permits		
45-5-3704	Kings Langely 2	GDA	56	309840	6263960	Open site	Valid	Burial : -		
	Contact	Recorders	Michael Guider					Permits		
45-5-3705	Kings Langley 3	GDA	56	310100	6263350	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider					Permits		
45-5-3706	Kings Langley 4	GDA	56	309850	6264000	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider					Permits		
45-5-3707	Kings Langley 5	GDA	56	309350	6263650	Open site	Valid	Artefact : -		
	Contact	Recorders	Michael Guider					Permits		
45-6-2946	Bidjigal Scarred Tree DCAC	GDA	56	315650	6262536	Open site	Valid	Modified Tree (Carved or Scarred) : 1		
	Contact	Recorders	ARC - Andrew Roberts Consulting					Permits		
45-6-2947	Bidjigal Shelter DCAC	GDA	56	315707	6262265	Open site	Valid	Artefact : 1		
	Contact	Recorders	ARC - Andrew Roberts Consulting					Permits		
45-6-2544	Darling Mills_Creek 8;DMC 8;	AGD	56	315245	6261962	Closed site	Valid	Artefact : -	Shelter with Deposit	2670
	Contact	Recorders	Mr.Rick Bullers,Ms.Tessa Corkill					Permits		
45-5-4106	Oakes Road PAD	GDA	56	312442	6260234	Open site	Valid	Artefact : 31, Potential Archaeological Deposit (PAD) : -		
	Contact	Recorders	Mr.Paul Irish,Ms.Tamika Goward					Permits	3486,3523	

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Appendix C

Archaeological scientific ratings

Appendix C Archaeological scientific ratings

Table 8 Ground surface visibility (GSV rating scheme)

GSV rating	% GSV
Very poor	0-10%
Poor	11-30%
Fair	31-50%
Good	51-70%
Very good	71-90%
Excellent	91-100%

Table 9 Ground integrity (GI) rating scheme

GI rating	Definition
Low	Area has been subject to significant disturbance through natural and/or anthropogenic processes (e.g., heavy earthworks).
Moderate	Area has been subject to moderate disturbance (e.g., native vegetation clearance) but retains a reasonable degree of integrity.
High	Area remains in a natural or near-natural state.

Table 10 Archaeological sensitivity rating scheme

Rating	Definition
Nil	Land with no potential for subsurface archaeological deposit(s) due to past ground disturbance(s).
Low	Subsurface archaeological deposit(s) may be present. Relative to areas of high sensitivity, lower artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.
High	Subsurface archaeological deposit(s) likely to be present. Relative to areas of low sensitivity, higher artefact counts, densities and assemblage richness values expected. Integrity of deposit(s) will be dependent on the nature of localised land disturbances.

Table 11 Impact risk rating scheme

Impact risk	Definition
Low	The proposed activity is unlikely to disturb, destroy, damage or deface an Aboriginal object or objects.
Moderate	The proposed activity has reasonable potential to disturb, destroy, damage or deface an Aboriginal object or objects.
High	The proposed activity will - or is highly likely to - disturb, destroy, damage or deface an Aboriginal object or objects.



Appendix N

Greenhouse gas methodology and calculations

NorthConnex

Building for the future



Greenhouse gas methodology and calculations

Appendix N: Detailed GHG assessment results

N.1 Construction GHG calculation methodology

The following steps have been taken in estimating the GHG emissions associated with the construction of the project (as per the TAGG Workbook 2013):

- The GHG emissions relevant to the stages of project construction, operation and maintenance have been identified.
- The GHG inventory boundary has been determined, which defined the emissions sources to be considered in the assessment and those to be excluded (**Tables N-1 and N-2**).
- The emissions sources have been quantified (refer to **Table N-7**).
- For the different emissions sources, emissions factors have been established and the emissions calculated. This section provides the methodology used for calculating GHG emissions from fuel use, electricity use, vegetation removal and material use during construction of the project.
- Opportunities for mitigation have been identified, as detailed in **Section 8.4** of the environmental impact statement.

Guiding principles

The assessment has been conducted according to the following GHG accounting and reporting principles:

- **Relevance** – select and use GHG sources, sinks, data and methodologies appropriate for the project / organisation and intended use of GHG inventory results.
- **Completeness** – include all relevant GHG emissions and information which support methodology and criteria used.
- **Consistency** – use consistent data, calculation / modelling methods, criteria and assumptions to enable valid comparisons.
- **Transparency** – include clear, sufficient and appropriate information to enable others to understand the basis for results and make decisions regarding use of GHG inventory results with reasonable confidence.
- **Accuracy** – reduce bias and uncertainties, as much as practical.

In addition to the accounting and reporting principles presented above, the issue of materiality has also been assessed in the GHG assessment. This is a core accounting and auditing principle which ensures that sources, assumptions, values and procedures included in the GHG assessment are material to the project. As materiality is valued within the context of the project being assessed, this can vary significantly between projects.

GHG assessment boundary

Table N-1 and **Table N-2** summarise the emissions sources and activities considered within the project GHG assessment boundary during construction and operation, according to scope.

Table N-1 Construction GHG emission sources

Emission source category	Emission source	Emission scope		
		Scope 1	Scope 2	Scope 3
Fuel use	Mobile construction equipment	✓		✓
	Site vehicles	✓		✓
	Delivery of plant, equipment and construction materials			✓
	Spoil removal			✓
Electricity consumption	Electricity used to power construction plant and site offices		✓	✓
Vegetation removal	Clearance of vegetation as a result of the project	✓		
Materials	Construction materials			✓

Table N-2 Operation and maintenance GHG emission sources

Emission source category	Emission source	Emission scope		
		Scope 1	Scope 2	Scope3
Operation				
Electricity consumption	Electricity used to power tunnel lighting and ventilation, project offices such as the MCC and other electrical systems		✓	✓
Fuel use	Operational road use by light and heavy vehicles	✓		✓
Maintenance				
Fuel use	Mobile equipment	✓		✓
	Material delivery			✓

Some emission sources may be categorised into two scopes (ie Scope 1 and Scope 3 or Scope 2 and Scope 3), to account for GHG emissions generated by sources owned or controlled by the project (Scope 1) and associated indirect upstream GHG emissions, generated outside of the project boundary, due to third party supply chains in direct relation to the project. For example, use of fuel by project operated construction equipment would generate Scope 1 GHG emissions from the combustion of fuel onsite and Scope 3 GHG emissions associated with the extraction, production and transport of the purchased fuel.

The materiality checklist provided in Appendix A of the TAGG Workbook has been used to identify potential sources of emissions to be included or excluded from the assessment. Based on this guidance, the following list of emissions sources and sinks have been excluded from the GHG assessment boundary:

- Disposal of waste from demolition and inert materials such as imported fill, sand and fly ash are considered insignificant to the assessment and are excluded from the GHG assessment boundary.
- Fuel used by construction workers travelling to and from the site in privately owned vehicles or by public transport.
- Emissions associated with the international freight of road headers and operational components such as ventilation fans. At this stage of the project it is not known where this equipment would be sourced from.
- Emissions sinks associated with planted vegetation, such as landscaping carried out as part of the project or vegetation planting as part of biodiversity offset plans.

Vegetation clearance has been included in the GHG assessment boundary in line with the materiality checklist, as more than 0.5 hectares of vegetation would be removed as part of the project.

Specific methodologies for the calculation of emissions from each emissions source (eg fuel use, electricity consumption, vegetation clearance and material use) are provided in the following sections.

Fuel

The method used to calculate the Scope 1 GHG emissions from the combustion of liquid fuels, for transport energy purposes is given by the formula below, as given by the National Greenhouse Accounts (NGA) Factors 2013:

$$GHG \text{ emissions (t CO}_2\text{-e)} = ((Q \times ECF) / 1000) \times (EF_{CO_2} + EF_{CH_4} + EF_{N_2O})$$

Where:

- Q is the quantity of fuel (in kL).
- ECF is the relevant energy content factor (in GJ/kL).
- EF_{CO₂} is the relevant Carbon dioxide (CO₂) emission factor (in kg CO₂-e/GJ).
- EF_{CH₄} is the relevant Methane (CH₄) emission factor (in kg CO₂-e/GJ).
- EF_{N₂O} is the relevant Nitrous oxide (N₂O) emission factor (in kg CO₂-e/GJ).

The method used for calculating the Scope 3 GHG emissions from the combustion of liquid fuels, for transport energy purposes is given by the formula below, as given by the NGA Factors 2013:

$$GHG \text{ emissions (t CO}_2\text{-e)} = (Q \times ECF \times EF_{\text{Scope 3}}) / 1000$$

Where:

- Q is the quantity of fuel (in kL).
- ECF is the relevant energy content factor (in GJ/kL).
- EF_{Scope 3} is the relevant emission factor (in kg CO₂-e/GJ).

The Scope 1 and Scope 3 emission factors for diesel (post 2004 vehicles) are given in **Table N-3**.

Table N-3: Scope 1 and Scope 3 emission factors for the use of fuels (post 2004 vehicles) (NGA Factors 2013 Tables 4 and 40)

Fuel	Energy content factor (GJ per kL)	Scope 1 emission factor (kg CO ₂ -e/GJ)			Scope 3 emission factor (kg CO ₂ -e/GJ)	Emissions per unit quantity (t CO ₂ -e per kL)		
		CO ₂	CH ₄	N ₂ O		Scope 1	Scope 2	Scope 3
Diesel	38.6	69.2	0.01	0.6	5.3	2.6947	0	0.2046

Electricity

The method used to calculate the Scope 2 and Scope 3 GHG emissions from the consumption of purchased electricity is given by the formula below, as given by the NGA Factors 2013:

$$GHG \text{ emissions (t CO}_2\text{-e)} = Q \times (EF_{\text{for scope}} / 1000)$$

Where:

- Q is the quantity of purchased electricity (in kWh).
- EF_{for Scope} is the Scope 2 or Scope 3 emissions factor for NSW (in kg CO₂-e/kWh).

The emission factors for the consumption of purchased electricity are given in **Table N-4**.

Table N-4: Scope 2 and Scope 3 emission factors for the use of purchased electricity (Source: NGA Factors 2013 Table 41)

Fuel	Emissions per unit quantity		Units
	Scope 2	Scope 3	
Electricity	0.00087	0.00019	t CO ₂ -e per kWh

Vegetation removal

The TAGG Workbook (2013) provides a methodology for estimating the loss of carbon sequestration potential from the removal of vegetation that would be required as part of land clearing activities during construction of the project. The methodology provided in Appendix E of the TAGG Workbook was developed by GHD (2012) and is in line with the methodology used by the Department of the Environment to estimate Australia's national GHG emissions for reporting under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

The methodology is based on a conservative approach, in line with relevant GHG guiding and reporting principles, and the following assumptions:

- All carbon pools are removed as part of the clearance of vegetation (eg debris and soil).
- All carbon removed is converted to CO₂ and released to the atmosphere.
- Sequestration as a result of revegetation works carried out as part of the project has not been included in the assessment.

The methodology estimates the GHG emissions associated with the loss of carbon sequestration that exists in vegetation at the time of clearing and the potential carbon that could have been sequestered in future if the vegetation was not cleared. The GHG emissions associated with the loss of CO₂ sequestration potential through the removal of vegetation have been calculated using the following steps:

- The potential maximum biomass class ('Maxbio' class) has been determined for the project location using vegetation maps provided in Appendix E of the TAGG Workbook.
- The class of vegetation (Table 1 of the TAGG Workbook Appendix E) and the area in hectares for each vegetation type to be cleared as part of the project has been identified (refer to the technical working paper: biodiversity in **Appendix J**).
- The vegetation clearance emissions factors have been identified for each vegetation class for the selected 'Maxbio' class from Table 2 of the TAGG Workbook Appendix E.
- The GHG emissions associated with the loss of CO₂ sequestration potential has been estimated by multiplying the area of vegetation to be cleared (in hectares) by the corresponding emissions factor (t CO₂ per hectare) for each vegetation type.
- The total estimate of GHG emissions associated with the loss of CO₂ sequestration potential for the project has been obtained by adding the results for each vegetation type.

Vegetation clearance emissions factors for the project are identified in **Table N-5**.

Table N-5 Vegetation clearance emissions factors (TAGG Workbook Appendix E, 2013)

Project area	Maxbio class	Vegetation type	Vegetation class	Emissions factor (t CO2-e per hectare)
Windsor Road compound	Class 4 (150 – 250 tonnes of dry matter per hectare)	Open Forest	C	521
Hills M2 Motorway integration works		Eucalypt Tall Open Forest	B	401
		Open Forest	C	521
		Rainforest	A	384
		Grassland	I	110
		Eucalypt Tall Open Forest	B	401
Southern interchange		Open Forest	C	521
		Rainforest	A	384
		Grassland	I	110
		Eucalypt Tall Open Forest	B	401
Wilson Road compound		Open Forest	C	521
		Grassland	I	110
		Grassland	I	110
Trelawney Street compound		Grassland	I	110
Pioneer Avenue compound		Open Forest	C	521
		Grassland	I	110
		Eucalypt Tall Open Forest	B	401
Northern interchange		Open Forest	C	521
		Rainforest	A	384
	Grassland	I	110	

Note: the 'Maxbio' class is derived from the Australian Greenhouse Office and estimates the maximum tonnes of dry vegetation matter per hectare for a specific location. Conservative assumptions were used to classify non-native vegetation types.

Materials

Indirect Scope 3 GHG emissions from the use of materials have been calculated according to the formula below:

$$GHG \text{ emissions (t CO}_2\text{-e)} = Q \text{ (t)} \times EF \text{ (tCO}_2\text{-e/t)}$$

Where: Q is the quantity of material (in tonnes).

EF is the relevant Emission Factor (in t CO₂-e per tonne of material).

Material emission factors have primarily been sourced from the TAGG Workbook and are given in **Table N-6**.

Table N-6 Material Emission Factors (TAGG Workbook, 2013)

Material	Emission factor (t CO ₂ -e/t)	Assumptions
Concrete (40MPa)	0.155	TAGG Workbook Appendix D; Concrete 40MPa (1:1.5:3)
Concrete (30MPa)	0.127	TAGG Workbook Appendix D; Concrete 30MPa (1:2:4)
Concrete (20MPa)	0.096	TAGG Workbook Appendix D; Concrete 20MPa (1:3:6)
Cement (Portland Cement)	0.82	TAGG Workbook Appendix D
Steel reinforcement	1.05	TAGG Workbook Appendix D; Structural steel
Aggregate	0.007	TAGG Workbook Appendix D
Asphalt	0.058	TAGG Workbook Appendix D; Hot Mix Asphalt (400MJ/t)

Material	Emission factor (t CO ₂ -e/t)	Assumptions
Copper	5.15	TAGG Workbook Appendix D
Plastic - PVC	2.41	TAGG Workbook Appendix D
Plastic - Polypropylene	2.55	Australian Unit Processes LCI Database (IPCC 2007 GWP 100a V1.02)
Fly Ash	0.161	TAGG Workbook Appendix D
Sand	0.003	TAGG Workbook Appendix D
Imported fill	0.002	VIC Roads: Imported Structural Fill
Mains water	0.001	SimaPro: Water, drinking, Sydney/AU U

N.2 Construction GHG emissions activity data

This section details the quantification of the GHG emission source data used for estimating the GHG emissions associated with construction of the project, including the sources of information used and assumptions made.

Table N-7 to Table N-8 detail the GHG emission source data used in the GHG assessment, including assumptions and information sources.

Table N-7 GHG emission source data used in the GHG assessment

Emissions source category	Emissions source	Quantity	Units (for assessment)	Source	Assumptions
Fuel use - diesel consumption	Mobile construction plant and equipment (diesel)	35,492	kilolitres	Preferred tender design	Assumed to include fuel consumption for mobile plant and equipment for all construction works carried out as part of the project.
	Transport of materials, construction equipment and spoil to / from site (diesel)	38,544	kilolitres	Calculated from heavy vehicle numbers provided in the preferred tender design	Materials and items that would be transported by heavy vehicles include concrete, steel products, pre-cast concrete elements, excavation consumables, and various items of plant and equipment.
Fuel use - petrol consumption (gasoline)	Transport of project vehicles - light vehicles (gasoline)	6,456	kilolitres	Calculated from light vehicle numbers provided in the preferred tender design	Light vehicle movements associated with the use of project vehicles and construction employee movements to and from site.
Vegetation clearance	Removal of vegetation	59	hectares	Technical working paper: biodiversity (Appendix J)	Emissions calculated using the TAGG Workbook Appendix E (2013).
Electricity purchased from the grid	Electricity consumption to power road headers and other associated plant and equipment onsite	80,209,087	kilowatt hours	Preferred tender design	Assumed to include electricity consumption of road headers, lighting and ventilation during construction, site offices and other onsite electrical equipment.
Construction materials	Concrete - plain shotcrete (cast insitu)	94,300	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 40MPa.

Emissions source category	Emissions source	Quantity	Units (for assessment)	Source	Assumptions
	Concrete - reinforced shotcrete (cast insitu)	508,300	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 40MPa.
	Concrete - no-fines (cast insitu)	147,200	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 20MPa.
	Concrete - piles (cast insitu)	138,722	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 30MPa.
	Concrete - New Jersey Kerbs (precast)	60,607	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 30MPa.
	Concrete - retaining walls (precast)	124,587	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 30MPa.
	Concrete – Hebel noise walls (precast)	1,779	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 30MPa. A portion of the existing noise walls along the Hills M2 Motorway are assumed to be reused.
	Concrete - base paving (precast)	147,200	tonnes	Preferred tender design	2.3t/m ³ (TAGG Appendix C), 30MPa.
	Concrete - drainage pipes 450 diameter RRJ (precast)	3,312	tonnes	Preferred tender design	0.184 tonnes per metre length (as per assumptions made for the Hills M2 Motorway Upgrade project). 30MPa assumed.
	Cement (Portland Cement)	550	tonnes	Preferred tender design	
	Steel - steel fibre reinforcement for shotcrete	7,800	tonnes	Preferred tender design	Assume structural steel.
	Steel - rock bolts	5,000	tonnes	Preferred tender design	Assume structural steel.
	Steel - rebar	5,584	tonnes	Preferred tender design	Assume structural steel.
	Asphalt	25,000	tonnes	Preferred tender design	Hot mix asphalt.
	Aggregate	27,251	tonnes	Preferred tender design	Road base.
	Copper wire cable	1,875	tonnes	Preferred tender design	Sum of copper inputs for multi-core copper with PVC shield and road header temporary power copper core cables.

Emissions source category	Emissions source	Quantity	Units (for assessment)	Source	Assumptions
	Plastic - PVC	543	tonnes	Preferred tender design	Assume 0.00067 tonnes per metre length (as per assumptions made for the Hills M2 Motorway Upgrade project).
	Plastic - Polypropylene	136	tonnes	Preferred tender design	Shotcrete reinforcement.
	Mains water	3,105,000	tonnes	Preferred tender design	1 kilolitre per tonne (kL / t).

Note: Estimated quantities have been rounded to the nearest whole number.

Table N-8 GHG emissions factors

Emissions source	Emissions source	Quantity	Unit	Emissions per unit quantity			
				Scope 1	Scope 2	Scope 3	Units
Fuel - diesel combustion	Mobile construction plant and equipment	35,492	kilolitres	2.695		0.205	t CO ₂ -e per kL
	Transport of materials and spoil to / from site	38,544	kilolitres	2.695		0.205	t CO ₂ -e per kL
Fuel use - petrol (gasoline) combustion	Transport of project vehicles - light vehicles (petrol)	6,456	kilolitres	2.289		0.181	t CO ₂ -e per kL
Vegetation clearance	Removal of vegetation	59	hectares	**			tCO ₂ -e per ha
Electricity purchased from the grid	Electricity consumption for the operation of site facilities, road headers, and associated plant for each construction site	80,209,087	kilowatt hours		0.00087	0.00019	tCO ₂ -e per kWh
Construction materials	Concrete (40MPa)	602,600	tonnes			0.155	tCO ₂ -e per t
	Concrete (30MPa)	476,207	tonnes			0.127	tCO ₂ -e per t
	Concrete (20MPa)	147,200	tonnes			0.096	tCO ₂ -e per t
	Cement (Portland Cement)	550	tonnes			0.82	tCO ₂ -e per t
	Steel reinforcement	18,384	tonnes			1.05	tCO ₂ -e per t
	Aggregate	27,251	tonnes			0.007	tCO ₂ -e per t
	Asphalt	25,000	tonnes			0.058	tCO ₂ -e per t
	Copper	1,875	tonnes			5.15	tCO ₂ -e per t
	Plastic - PVC	543	tonnes			2.41	tCO ₂ -e per t
	Plastic - Polypropylene	136	tonnes			2.55	tCO ₂ -e per t
	Mains water	3,105,000	tonnes			0.001	tCO ₂ -e per t

for vegetation clearance emissions factors refer to **Table N-5

N.3 Detailed construction GHG assessment results

Table N-9 gives the GHG assessment results for the GHG emissions estimated to occur during construction of the project, reported according to Scope 1, Scope 2, Scope 3 and total emissions.

GHG emissions are reported in this assessment as tonnes of carbon dioxide equivalent (tCO₂-e).

Table N-9: Detailed construction GHG emissions results

Emission category	source	Emission source	Quantity	Unit	GHG emissions (t CO ₂ -e)				
					Scope 1	Scope 2	Scope 3	Total	Per cent total
Fuel use - diesel combustion		Mobile construction plant and equipment	35,492	kilolitres	95,638		7,261	102,899	19.22
		Transport of materials and spoil to / from site	38,544	kilolitres	103,863		7,885	111,748	20.87
Fuel use - petrol (gasoline) combustion		Transport of project vehicles - light vehicles	6,456	kilolitres	14,777		1,170	15,947	2.98
Vegetation clearance		Removal of vegetation	59	hectares	16,048			16,048	3.00
Electricity purchased from the grid		Electricity consumption for the operation of site facilities, road headers, and associated plant for each construction site	80,209,087	kilowatt hours		69,782	15,240	85,022	15.88
Construction materials		Concrete (40MPa)	602,600	tonnes			93,403	93,403	17.44
		Concrete (30MPa)	476,207	tonnes			60,478	60,478	11.30
		Concrete (20MPa)	147,200	tonnes			14,131	14,131	2.64
		Cement (Portland Cement)	550	tonnes			451	451	0.08
		Steel reinforcement	18,384	tonnes			19,304	19,304	3.60
		Aggregate	27,251	tonnes			191	191	0.04
		Asphalt	25,000	tonnes			1,450	1,450	0.27
		Copper	1,875	tonnes			9,656	9,656	1.80
		Plastic - PVC	543	tonnes			1,308	1,308	0.24
		Plastic - Polypropylene	136	tonnes			347	347	0.06
		Mains water	3,105,000	tonnes			3,105	3,105	0.58

Emission category	source	Emission source	Quantity	Unit	GHG emissions (t CO ₂ -e)				
					Scope 1	Scope 2	Scope 3	Total	Per cent total
Total					230,326	69,782	235,380	535,488	100.0
Total per cent					43.0	13.0	44.0	100.0	

N.4 Operation and maintenance GHG emissions

Methodology

This section estimates the GHG emissions that would occur due to the operation and maintenance of the project, throughout its anticipated design life of 100 years.

Emissions associated with the operation of road infrastructure have been estimated based on the annual consumption of electricity, purchased from the grid. Annual use of electricity for powering tunnel lighting and ventilation, communications systems, control systems, computer and safety systems, electronic signage and other associated electrical systems is based on annual electricity consumption estimates of the preferred tender design.

Default quantity factors, provided in the TAGG Workbook have been used to quantify activity data associated with the maintenance of the tunnel and road pavements. Emission estimates for the use of fuel and materials for the maintenance of the road pavement are based on the replacement of five per cent of the concrete pavement every 50 years, with only the top concrete layer requiring replacement (in accordance with 'typical' maintenance activities given in the TAGG Workbook).

Specific methodologies for the calculation of emissions from each emissions source (eg fuel use, electricity consumption, and material use) are provided in Section N.1 of this Appendix.

GHG emissions activity data

Operation

Table N-10: GHG emission source data used in the GHG assessment

Emissions source category	Emissions source	Quantity	Units	Source	Assumptions
Electricity consumption	Electricity to power tunnel lighting and ventilation, communications systems, control systems, computer and safety facilities and electronic signage	21,139,207	kWh per year	Preferred tender design	Electricity consumption is assumed to include power for tunnel lighting and ventilation, communications systems, control systems, computer and safety facilities and electronic signage. The assumed electricity consumption does not include power for the MVAC system or the emergency axial fans, which would only operate in the event of an emergency.

Table N-11: GHG emissions factors

Emissions source	Emissions source	Quantity	Unit	Emissions per unit quantity			Units
				Scope 1	Scope 2	Scope 3	
Electricity consumption	Electricity to power tunnel lighting and ventilation, communications systems, control systems,	21,139,207	kWh per year		0.00087	0.00019	tCO ₂ -e per kWh

Emissions source	Emissions source	Quantity	Unit	Emissions per unit quantity			
				Scope 1	Scope 2	Scope 3	Units
	computer and safety facilities and electronic signage						

Maintenance

Table N-12: GHG emission source data used in the GHG assessment

Emissions source category	Emissions source	Quantity	Units	Source	Assumptions
Fuel use - diesel consumption	Mobile maintenance plant and equipment, project vehicles	2082.22	kilolitres	TAGG Workbook	Assuming Hills M2 Motorway integration works are constructed with plain concrete pavement in line with the existing pavement, and the NorthConnex tunnel is constructed with reinforced concrete pavement.
Maintenance materials	Steel	735	tonnes	TAGG Workbook	
	Aggregate	2562.28	tonnes	TAGG Workbook	
	Cement - Portland Cement	488.67	tonnes	TAGG Workbook	

Table N-13: GHG emissions factors

Emissions source	Emissions source	Quantity	Unit	Emissions per unit quantity			
				Scope 1	Scope 2	Scope 3	Units
Fuel - diesel combustion	Mobile construction plant and equipment	2082.22	kilolitres	2.695		0.205	t CO ₂ -e per kL
Construction materials	Cement (Portland Cement)	735	tonnes			0.82	tCO ₂ -e per t
	Steel reinforcement	2562.28	tonnes			1.05	tCO ₂ -e per t
	Aggregate	488.67	tonnes			0.007	tCO ₂ -e per t

Detailed operation and maintenance results

Operation

Table N-14: Detailed annual operational GHG emissions results

Emission source category	Emission source	Quantity	Unit	GHG emissions (t CO ₂ -e)			
				Scope 1	Scope 2	Scope 3	Total
Electricity consumption	Electricity to power tunnel lighting and ventilation, communications systems,	21,139,207	kWh per year		18,391	4,016	22,408

Emission source category	Emission source	Quantity	Unit	GHG emissions (t CO ₂ -e)			
				Scope 1	Scope 2	Scope 3	Total
	control systems, computer and safety facilities and electronic signage						

Maintenance

Table N-15: Detailed maintenance GHG emissions results

Emission source category	Emission source	Quantity	Unit	GHG emissions (t CO ₂ -e)				Per cent Total
				Scope 1	Scope 2	Scope 3	Total	
Fuel - diesel combustion	Mobile construction plant and equipment	2082.22	kilolitres	5,611		426	6,037	83.53
Construction materials	Cement (Portland Cement)	735	tonnes			772	772	10.68
	Steel reinforcement	2562.28	tonnes			18	18	0.25
	Aggregate	488.67	tonnes			400	400	5.54
Total				5,611	0	1,616	7,227	100.0
Total per cent				77.6	0.0	22.4	100.0	

N.5 Operational road use GHG emissions

As improvements to traffic flow and congestion are achieved through increased speeds, reduced travel distances and reduced frequency of stopping, fuel efficiency is improved and subsequently GHG emissions associated with road use are reduced. As such, it is anticipated that the project would result in GHG emissions savings when compared to the base case scenario without the project.

Methodology

To assess the indirect Scope 3 GHG emissions associated with fuel combustion of vehicle traffic utilising the project, and to evaluate any potential GHG emissions savings as a result of the project, road use has been considered for two scenarios:

- The base case 'without project' scenario, assessing the future operational performance of Pennant Hills Road in its current condition
- The 'with project' scenario, including the future operational performance of Pennant Hills Road as well as the operational performance of the NorthConnex tunnel.

Traffic volumes were modelled for the years 2019 (the project opening year) and 2029 (the project opening plus ten years) as part of the assessment provided in the *technical working paper: traffic and transport* (**Appendix E**). These future years were chosen as they provide an indication of road network performance immediately after the project opening (2019), and also once traffic patterns have become accustomed to any changes brought about by the project (2029).

The analysis is based on the Vehicle Kilometres Travelled (VKT) and the average speed of vehicles for 2019 and 2029, for the operational traffic impact footprint. The GHG assessment for operational road use involved calculation of the following inputs:

- Length and average speed by road type.
- Vehicle kilometres travelled.
- Rate of fuel consumption.
- Total fuel quantity.
- Fuel quantity by fuel type.
- Calculation of GHG emissions.

Calculation of operational road use GHG emissions

Average speed by road type

For both scenarios, for the years 2019 and 2029, the average speed by road type has been sourced from the *technical working paper: traffic and transport* (**Appendix E**), for the operational traffic impact footprint. **Table N-16** gives the projected average speeds for the different road sections within the traffic impact footprint, including respective road section lengths.

Table N-16 Average speeds and section length estimates

Route	Section start	Section end	Length (km)	Average daily speed (km/h)			
				Without project		With project	
				2019	2029	2019	2029
Pennant Hills Road	North Rocks Road	Hills M2 Motorway	0.82	70	70	70	70
	Hills M2 Motorway	Copeland Road	0.53	30	28	35	34
	Copeland Road	Aiken Road	0.13	9	7	11	10
	Aiken Road	Castle Hill Road	0.57	59	59	60	59
	Castle Hill Road	Beecroft Road west	1.37	60	60	60	60
	Beecroft Road west	Beecroft Road east	0.31	31	31	33	32
	Beecroft Road east	Boundary Road	0.23	17	15	19	18
	Boundary Road	Yarrara Road	0.44	9	7	17	14
	Yarrara Road	The Crescent	0.12	69	68	69	69
	The Crescent	George Street	0.19	69	68	69	69
	George Street	Bellevue Street	0.97	69	68	69	69
	Bellevue Street	Comenarra Parkway	0.11	25	23	29	27
	Comenarra Parkway	Phyllis Avenue	0.43	31	27	36	34
	Phyllis Avenue	Duffy Avenue	0.2	31	27	36	34
	Duffy Avenue	Dartford Road	0.77	41	40	43	42
	Dartford Road	M1 Pacific Motorway	1.59	69	69	70	69
	M1 Pacific Motorway	Pacific Highway	0.26	60	60	33	32
NorthConnex tunnel	Southern interchange	Northern interchange	8.75	NA	NA	80	80

Vehicle kilometres travelled

For both scenarios, for the years 2019 and 2029, the Average Annual Daily Traffic (AADT) for light and heavy vehicles, has been sourced from the technical working paper: traffic and transport (**Appendix E**), for the operational traffic impact footprint, as given in **Table N-17** below. Vehicle kilometres travelled (VKT) for the project, presented in **Table N-18**, have been calculated based on the length and volume of traffic for each section of the road, 365 days per year.

Table N-17 AADT Estimates

Route	Section start	Section end	Without project				With project			
			2019	2029	2019	2029	2019	2029	2019	2029
			Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)
Pennant Hills Road	North Rocks Road	Hills M2 Motorway	54,529	5,300	63,933	7,204	55,288	6,430	66,416	7,295
	Hills M2 Motorway	Copeland Road	73,577	11,717	81,176	14,339	58,187	4,989	64,069	6,314
	Copeland Road	Aiken Road	74,846	11,504	82,899	13,924	67,376	5,288	74,295	7,047
	Aiken Road	Castle Hill Road	82,073	11,499	90,233	14,035	74,481	5,086	82,144	6,816
	Castle Hill Road	Beecroft Road west	62,565	9,633	67,189	10,347	59,597	3,924	62,615	5,421
	Beecroft Road west	Beecroft Road east	77,192	9,552	85,199	11,854	72,724	3,842	79,595	5,548
	Beecroft Road east	Boundary Road	86,242	10,045	95,002	12,695	81,347	4,198	89,465	5,750
	Boundary Road	Yarrara Road	83,100	11,468	90,622	13,321	79,388	4,884	84,520	6,014
	Yarrara Road	The Crescent	71,048	11,161	78,838	13,067	64,947	3,802	71,185	5,512
	The Crescent	George Street	68,071	10,657	75,411	12,593	62,265	3,299	68,057	5,038
	George Street	Bellevue Street	69,722	11,818	77,885	14,215	62,826	4,224	70,057	5,783
	Bellevue Street	Comenarra Parkway	66,606	11,743	74,920	14,143	59,587	4,149	66,985	5,708
	Comenarra Parkway	Phyllis Avenue	59,103	11,393	65,682	13,442	52,768	4,008	58,645	5,377
	Phyllis Avenue	Duffy Avenue	54,810	10,005	64,103	12,257	51,184	3,518	57,047	4,759
	Duffy Avenue	Dartford Road	57,377	9,467	63,257	11,523	50,153	3,528	55,380	4,746
	Dartford Road	M1 Pacific Motorway	62,852	9,680	70,738	11,515	57,466	4,415	64,692	5,525
	M1 Pacific Motorway	Pacific Highway	27,886	2,603	31,901	3,116	32,863	4,399	39,702	5,410
NorthConnex tunnel	Southern interchange	Northern interchange	NA	NA	NA	NA	21,510	8,444	29,824	9,822

Table N-18 VKT Estimates

Route	Section start	Section end	Without project				With project			
			2019		2029		2019		2029	
			Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)
Pennant Hills Road	North Rocks Road	Hills M2 Motorway	16,320,389	1,586,347	19,135,249	2,156,270	16,547,821	1,924,372	19,878,291	2,183,404
	Hills M2 Motorway	Copeland Road	14,233,486	2,266,698	15,703,542	2,773,831	11,256,179	965,058	12,394,238	1,221,474
	Copeland Road	Aiken Road	3,551,431	545,884	3,933,561	660,703	3,196,969	250,919	3,525,295	334,392
	Aiken Road	Castle Hill Road	17,075,212	2,392,442	18,772,945	2,919,974	15,495,783	1,058,131	17,090,023	1,418,166
	Castle Hill Road	Beecroft Road west	31,285,435	4,817,150	33,597,635	5,174,042	29,801,538	1,962,257	31,310,517	2,710,929
	Beecroft Road west	Beecroft Road east	8,734,271	1,080,831	9,640,275	1,341,329	8,228,665	434,690	9,006,223	627,785
	Beecroft Road east	Boundary Road	7,240,022	843,319	7,975,391	1,065,707	6,829,072	352,392	7,510,614	482,746
	Boundary Road	Yarrara Road	13,345,860	1,841,761	14,553,893	2,139,353	12,749,713	784,370	13,573,912	965,848
	Yarrara Road	The Crescent	3,111,910	488,841	3,453,092	572,323	2,844,683	166,534	3,117,888	241,420
	The Crescent	George Street	4,720,734	739,088	5,229,746	873,304	4,318,061	228,768	4,719,746	349,374
	George Street	Bellevue Street	24,685,118	4,184,174	27,575,083	5,032,778	22,243,519	1,495,588	24,803,625	2,047,349
	Bellevue Street	Comenarra Parkway	2,674,249	471,473	3,008,042	567,845	2,392,429	166,600	2,689,435	229,170
	Comenarra Parkway	Phyllis Avenue	9,276,214	1,788,117	10,308,768	2,109,708	8,281,946	629,061	9,204,275	843,953
	Phyllis Avenue	Duffy Avenue	4,001,136	730,398	4,679,489	894,732	3,736,404	256,825	4,164,398	347,430
	Duffy Avenue	Dartford Road	16,125,784	2,660,607	17,778,281	3,238,456	14,095,390	991,543	15,564,445	1,333,930
	Dartford Road	M1 Pacific Motorway	36,476,064	5,618,056	41,052,973	6,683,007	33,350,392	2,561,961	37,543,829	3,206,327

Route	Section start	Section end	Without project				With project			
			2019		2029		2019		2029	
			Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)	Light vehicles (two-way)	Heavy vehicles (two-way)
	M1 Pacific Motorway	Pacific Highway	2,646,428	247,071	3,027,381	295,715	3,118,659	417,494	3,767,686	513,370
NorthConnex tunnel	Southern interchange	Northern interchange	NA	NA	NA	NA	68,698,712	26,966,524	95,251,262	31,368,342

Rate of fuel consumption

The rate of fuel consumption has been calculated for each vehicle type within the traffic impact footprint, using the basic fuel-speed formula given below (Equation 1 in Austroads Guide to Project Evaluation Part 4: Project Evaluation Data part 6):

$$\text{Fuel Consumption (L/100km)} = A + (B/V) + (C \times V) + (D \times V^2)$$

Where: A, B, C and D are the Fuel consumption parameter values given in **Table N-19**.
V is the all day average link speed in km/h

Table N-19 Fuel consumption parameter values on freeways - litres/100 km (Austroads Guide to Project Evaluation Part 4: Project Evaluation Data Table 6.3)

Vehicle type	A	B	C	D
Cars	-18.433	1306.02	0.15477	0.0003203
Light commercial vehicle (LCV)	-27.456	2060.5	0.1911	0.000851
Rigid trucks	-65.056	4156.75	0.49681	0.0006798
Articulated vehicles	-80	6342.8	0.48496	0.0020895
Buses	-80	5131.63	0.60539	0.0015775

As the GHG emissions from road use have been assessed for two vehicle categories (light vehicles and heavy vehicles), weighted average fuel consumption parameters have been applied for each vehicle category, according to the likely proportional makeup of vehicle types within each category, based on the most recent Australian Bureau of Statistics NSW Registration vehicle type data for the year ending 30 June 2012 (given in **Table N-20**). The likely proportional makeup of cars and light commercial vehicles (LCV's) within the category of 'light vehicles' and the likely proportional makeup of rigid trucks, articulated vehicles and buses within the category 'heavy vehicles' are given in **Table N-21**. The weighted average fuel consumption parameters applied for calculation of the fuel consumption rate of light and heavy vehicles are given in **Table N-22**.

Table N-20 Australian Bureau of Statistics NSW Registration vehicle type data for calculating weighted average fuel consumption parameters for light and heavy vehicles (ABS 9208.0 Survey of Motor Vehicle Use for the 12 months ending 30 June 2012)

Category	2012 NSW registrations	Per cent of total vehicles	Heavy / light	Sub-classification according to fuel consumption parameters	Proportion heavy / light
Articulated trucks	18,727	0.39	H	Articulated vehicles	0.11
Buses	20,609	0.43	H	Buses	0.13
Heavy rigid trucks	122,862	2.54	H	Rigid trucks	0.74
Non-freight carrying trucks	3,427	0.07	H	Rigid trucks	0.02
Total	165,625	3.42	-	-	1.00
Light commercial vehicles	684,106	14.14	L	LCV	0.15
Motor cycles	181,930	3.76	L	Cars	0.04
Passenger vehicles	3,807,490	78.68	L	Cars	0.81
Total	4,673,526	96.58	-	-	1.00

Table N-21 Estimated proportional makeup of light and heavy vehicles according to vehicle type

Category	Cars	LCV	Rigid Trucks	Articulated vehicles	Buses
Light vehicles	0.85	0.15	0	0	0
Heavy vehicles	0	0	0.76	0.11	0.13

Table N-22 Fuel consumption parameter values on freeways for light and heavy vehicles - litres/100 km (adapted from Austroads Guide to Project Evaluation Part 4: Project Evaluation Data Table 6.3)

Category	A	B	C	D
Light vehicles	-19.78645000	1419.19200000	0.16021950	0.00039991
Heavy vehicles	-68.64256000	4523.94990000	0.50962190	0.00095157

Rates of fuel consumption calculated according to the parameters in **Table N-19** are applicable for the year 2008 (year of publication of Austroads Guide to Project Evaluation). Annual rates of fuel efficiency improvement have been applied to calculate rates of fuel consumption, for light and heavy vehicles, in the years 2019 and 2029, according to road transport fuel intensity projections by vehicle type, given by SKM (2011) in *Australian Transport Emissions Projections to 2050* (**Table N-23**), as follows:

- Rates of fuel consumption for the year 2019 have been calculated by applying the annual percentage change in fuel intensity for 2008-2020, given in **Table N-23**, to the rate of fuel consumption in the year 2008.
- Rates of fuel consumption in the year 2029 have been calculated by applying the annual percentage change in fuel intensity for 2020-2030, given in **Table N-23**, to the rate of fuel consumption in the year 2020.

Table N-23 Estimated Fuel Intensity Projections by Road Type (SKM (2011) Australian Transport Emissions Projections to 2050)

Vehicle type	Annual % fuel intensity change (2008-2020) ¹	Annual % fuel intensity change (2020-2030)	Heavy / light	Annual % fuel intensity change (2008-2020) (based on vehicle proportions)	Annual % fuel intensity change (2020-2030) (based on vehicle proportions)
Passenger	-1.1	-1.4	Light	-0.91	-1.37
Motorcycles	1	-0.8			
LCV	0.2	-1.2			
Buses	0.4	0.3	Heavy	-0.40	-0.53
Rigid	-0.5	-0.6			
Articulated	-0.7	-1.1			

Total fuel quantity combusted

For each scenario, for 2019 and 2029, VKT has been factored by the rate of fuel consumption, for each road type to determine the total quantity of fuel consumed in each scenario.

Fuel quantity combusted by fuel type

The analysis has considered three fuels, petrol, diesel and LPG. The total quantity of fuel combusted in each scenario, for 2019 and 2029, has been apportioned according to fuel type, based on Australian Bureau of Statistics Survey of Motor Vehicle Use for the 12 months to 30 June 2012. Estimates of the proportional makeup of light and heavy vehicles, by fuel type, are given in **Table N-24** below.

Table N-24 Fuel Type Proportions for Light and Heavy Vehicles (calculated from data in ABS Survey of Motor Vehicle Use 9208.0 for the 12 Months ending 30 June 2012)

Vehicle category	Fuel type	Estimated proportion
Light vehicles	Petrol	0.75
	Diesel	0.19
	LPG / CNG / dual fuel / hybrid (assume LPG)	0.06
Heavy vehicles	Petrol	0.01
	Diesel	0.97
	LPG / CNG / dual fuel / hybrid (assume LPG)	0.02

The estimated total quantities of each fuel type used in each scenario, for 2019 and 2029, are given in **Table N-25** below.

Table N-25 Fuel quantity estimates by fuel type

Route	Section start	Section end	Fuel consumption without project (kL)						Fuel consumption with project (kL)					
			2019			2029			2019			2029		
			Petrol	Diesel	LPG	Petrol	Diesel	LPG	Petrol	Diesel	LPG	Petrol	Diesel	LPG
Pennant Hills Road	North Rocks Road	Hills M2 Motorway	1,665	978	144	1,927	1,240	169	1,689	1,102	149	2,001	1,269	175
	Hills M2 Motorway	Copeland Road	3,415	2,970	315	4,119	3,899	386	2,238	1,301	194	2,516	1,597	220
	Copeland Road	Aiken Road	3,693	3,237	341	4,999	4,706	468	2,580	1,474	223	3,149	2,020	276
	Aiken Road	Castle Hill Road	1,919	1,436	172	2,087	1,685	190	1,731	857	147	1,887	1,037	162
	Castle Hill Road	Beecroft Road west	3,507	2,793	318	3,716	2,977	338	3,325	1,617	281	3,449	1,938	297
	Beecroft Road west	Beecroft Road east	2,004	1,466	179	2,229	1,774	202	1,793	820	151	1,969	1,034	168
	Beecroft Road east	Boundary Road	3,723	2,681	332	4,705	3,740	427	2,908	1,336	245	3,410	1,749	290
	Boundary Road	Yarrara Road	13,970	11,362	1,273	19,120	16,371	1,758	6,197	3,098	526	8,677	4,712	744
	Yarrara Road	The Crescent	320	254	29	352	292	32	291	132	24	315	164	27
	The Crescent	George Street	486	385	44	533	444	49	441	192	37	476	243	41
	George Street	Bellevue Street	2,542	2,126	233	2,812	2,494	260	2,273	1,102	192	2,504	1,352	215
	Bellevue Street	Comenarra Parkway	808	763	76	996	999	95	621	326	53	726	428	63
	Comenarra Parkway	Phyllis Avenue	2,222	2,217	211	2,852	3,017	274	1,594	866	137	1,873	1,139	163
	Phyllis Avenue	Duffy Avenue	958	918	90	1,294	1,301	123	719	371	61	847	488	73
	Duffy Avenue	Dartford Road	2,662	2,320	246	2,944	2,775	276	2,186	1,128	186	2,427	1,400	210
	Dartford Road	M1 Pacific Motorway	3,737	2,923	338	4,151	3,391	379	3,404	1,762	290	3,783	2,079	325

Route	Section start	Section end	Fuel consumption without project (kL)						Fuel consumption with project (kL)					
			2019			2029			2019			2029		
			Petrol	Diesel	LPG	Petrol	Diesel	LPG	Petrol	Diesel	LPG	Petrol	Diesel	LPG
	M1 Pacific Motorway	Pacific Highway	295	172	26	333	200	29	673	517	61	825	646	75
NorthConnex tunnel	Southern interchange	Northern interchange	NA	NA	NA	NA	NA	NA	6,899	10,782	731	9,415	12,838	961

Results

The GHG emission calculation

The Scope 3 GHG emissions associated with the use of petrol, diesel and LPG, in both scenarios, for 2019 and 2029 have been calculated according to the formula below, as given by the NGA Factors 2013:

$$GHG \text{ emissions (t CO}_2\text{-e)} = (Q \times EF_{full \text{ fuel cycle}}) / 1000$$

Where: Q is the quantity of fuel (in kL).
 $EF_{full \text{ fuel cycle}}$ is the relevant emission factor (in kg CO₂-e/kL).

The emission factor applied represents the full fuel cycle, which is the sum of Scope 1 and Scope 3 emissions. The emission factors for petrol, diesel and LPG are given in **Table N-26**.

Table N-26: Scope 1, Scope 3 and full fuel cycle emission factors for general transport (Source: NGA Factors 2013 Tables 4 and 40)

Fuel	Energy content factor (GJ per kL)	Scope 1 emission factor (kg CO ₂ -e/GJ)			Scope 3 emission factor (kg CO ₂ -e/GJ)	Emissions per unit quantity (t CO ₂ -e per kL)			Full fuel cycle (t CO ₂ -e per kL)
		CO ₂	CH ₄	N ₂ O		Scope 1	Scope 2	Scope 3	
Petrol (gasoline)	34.2	66.7	0.6	2.3	5.3	2.38032	0	0.18126	2.56158
Diesel oil	38.6	69.2	0.2	0.5	5.3	2.69814	0	0.20458	2.90272
Liquid petroleum gas (LPG)	26.2	59.6	0.6	0.6	5	1.59296	0	0.131	1.72396

The estimated GHG emissions from the use of fuel in each scenario, for 2019 and 2029 are given in **Table N-27** below.

Table N-27: GHG emission estimates

Route	Section start	Section end	Without project - GHG emissions		With project - GHG emissions		Difference between scenarios (with project - without project)	
			2019	2029	2019	2029	2019	2029
Pennant Hills Road	North Rocks Road	Hills M2 Motorway	7,352	8,827	7,782	9,111	431	284
	Hills M2 Motorway	Copeland Road	17,913	22,536	9,843	11,459	-8,070	-11,077
	Copeland Road	Aiken Road	19,443	27,273	11,270	14,403	-8,173	-12,870
	Aiken Road	Castle Hill Road	9,381	10,564	7,175	8,121	-2,205	-2,443
	Castle Hill Road	Beecroft Road west	17,638	18,741	13,695	14,971	-3,944	-3,769
	Beecroft Road west	Beecroft Road east	9,696	11,209	7,231	8,335	-2,465	-2,874
	Beecroft Road east	Boundary Road	17,891	23,646	11,750	14,311	-6,142	-9,335
	Boundary Road	Yarrara Road	70,960	99,531	25,774	37,185	-45,186	-62,346
	Yarrara Road	The Crescent	1,609	1,804	1,171	1,330	-438	-474
	The Crescent	George Street	2,438	2,739	1,752	1,996	-686	-743
	George Street	Bellevue Street	13,084	14,891	9,355	10,711	-3,729	-4,180
	Bellevue Street	Comenarra Parkway	4,413	5,614	2,630	3,212	-1,783	-2,402
	Comenarra Parkway	Phyllis Avenue	12,490	16,535	6,835	8,385	-5,655	-8,150
	Phyllis Avenue	Duffy Avenue	5,275	7,302	3,024	3,713	-2,250	-3,589
	Duffy Avenue	Dartford Road	13,976	16,073	9,194	10,642	-4,782	-5,431
	Dartford Road	M1 Pacific Motorway	18,639	21,129	14,337	16,286	-4,302	-4,843
	M1 Pacific Motorway	Pacific Highway	1,301	1,485	3,331	4,115	2,030	2,630
NorthConnex tunnel	Southern interchange	Northern interchange	0	0	50,230	63,039	50,230	63,039
Totals			243,497	309,900	196,379	241,327	-47,119	-68,574

Note: negative values indicate a savings in GHG emissions for the project compared to the 'without project' scenario.

