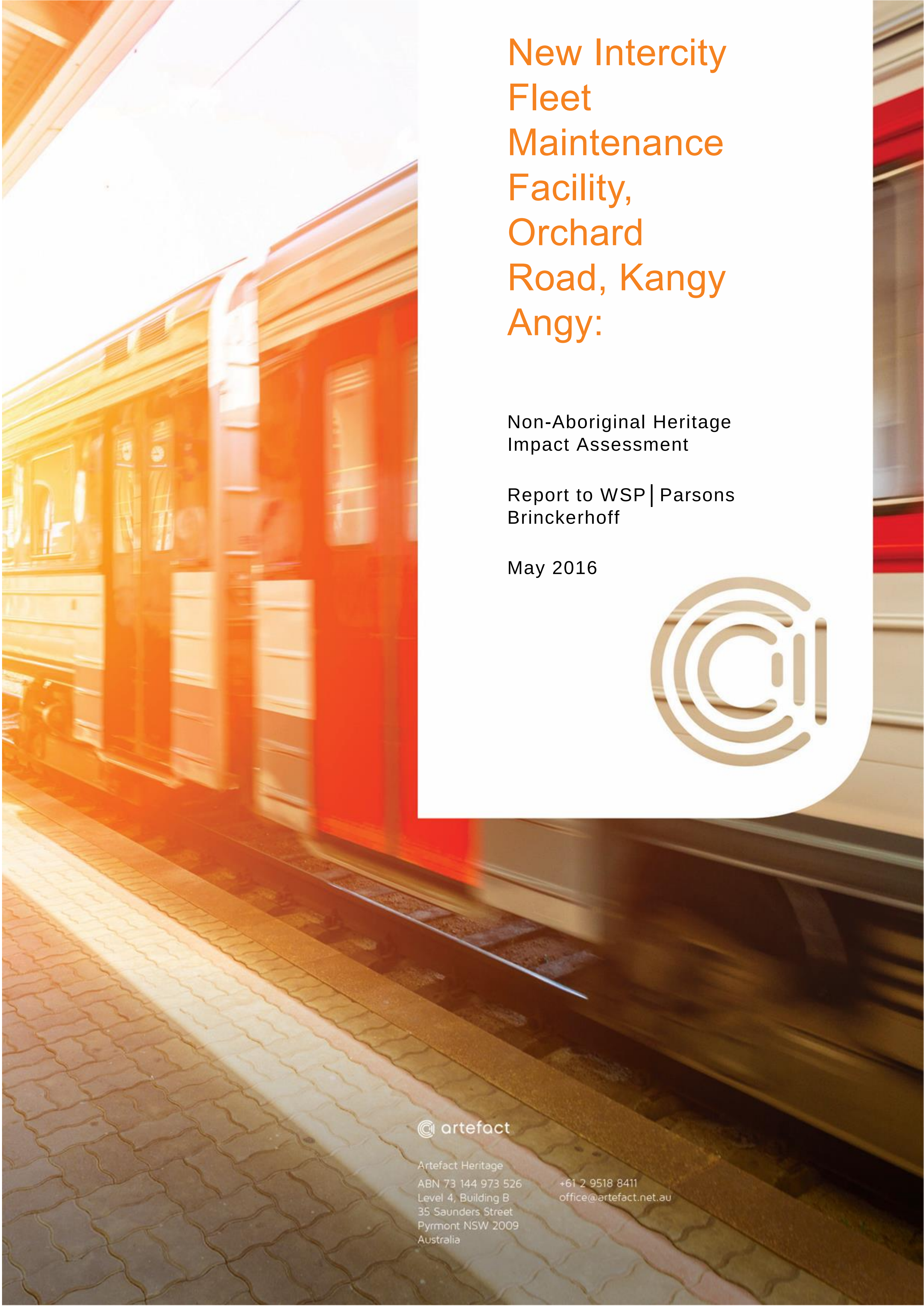
Appendix D

NON-ABORIGINAL HERITAGE IMPACT ASSESSMENT



New Intercity Fleet Maintenance Facility, Orchard Road, Kangy Angy:

Non-Aboriginal Heritage Impact Assessment

Report to WSP | Parsons Brinckerhoff

May 2016

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EXECUTIVE SUMMARY

Transport for New South Wales (TfNSW) proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. Artefact has been commissioned by WSP | Parsons Brinckerhoff (WSP/PB) on behalf of TfNSW to prepare the Non-Aboriginal Heritage Impact Assessment (HIA) for the Project. The purpose of the Non-Aboriginal HIA is to support the Review of Environmental Factors (REF) for the Project.

Overview of findings

There are no listed heritage items within or in close proximity to the study area. No areas of historical archaeological potential have been identified within the study area. Two unlisted heritage items have been identified within the study area:

- Main Northern Railway and Turpentine Road / Chittaway Creek underpass. The railway line was constructed in the late 1880s, and is significant in the history of the development of the state, and the local area specifically. As the line has been subject to regular maintenance and upgrade works, little original fabric remains. However, the Turpentine Road / Chittaway Creek underpass may retain original elements dating to the 1880s.
- Old Chittaway Road. The study area includes the location of a former alignment of Old Chittaway Road, which was in existence prior to 1889, and a section of the current alignment of Old Chittaway Road, which was realigned in c1889 and paved in the late twentieth century. The significance of these items relates to their alignment only. No archaeological remains relating to the former alignment are expected to be present within the study area. Fabric relating to the re-alignment is likely to date to the late twentieth century onwards.

Impact to these two items as a result of the proposed development will consist of:

- Construction of an additional rail bridge adjacent to the Turpentine Road / Chittaway Creek underpass.
- Realignment of the c1890 section of Old Chittaway Road.

Recommendations

As the two identified items are not listed, and do not comprise archaeological relics, there are no statutory requirements regarding their management. Management recommendations have been based on the assessed significance of the items, and the nature of the proposed impact.

The following recommendations are made:

- If the proposed development is changed to affect areas not included in the present report, further assessment of potential non-Indigenous heritage impact should be undertaken.

- Prior to commencement of works, a photographic archival record should be completed of the Turpentine Road / Chittaway Creek underpass. Copies of the record should be lodged with Sydney Trains, Wyong City Council, the local historical society and the Heritage Division, if those agencies are happy to accept the copy.
- Unexpected archaeological relics remain protected by the *Heritage Act 1977*. If a potential relic is found in the course of the work, work should cease in the vicinity, and the heritage Division of the Office of Environment and Heritage should be contacted for advice.

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1.0 INTRODUCTION

1.1 Background

Artefact has been commissioned by WSP│Parsons Brinckerhoff (WSP/PB) on behalf of Transport for NSW (TfNSW) to prepare the Non-Aboriginal Heritage Impact Assessment (HIA) for the proposed New Intercity Fleet Maintenance Facility Project (hereafter, referred to as 'the Project'). The purpose of the Non-Aboriginal HIA is to support the review of environmental factors (REF) for the Project.

This HIA is one of a number of technical reports supporting the REF for the Project.

1.2 Study area

The site is located in the suburb of Kangy Angy, within the Wyong Shire local government area on the New South Wales Central Coast. The site is generally bordered by the Main North Rail Line rail corridor to the south, and Orchard Road to the north west. Residential receivers on rural properties generally surround the site to the north, south and west, with industrial precincts to the south east and north-east (on the opposite side of the rail corridor to the site). The M1 Pacific Motorway is located approximately 0.85km to the north west, and Tuggerah Lake is approximately 3.5 km to the east of the site. Chittaway Creek crosses the project at the southern end and Ourimbah Creek is to the north of the site.

The study area is shown in Figure 1. It consists of part or all of ten lots known as 11 and 12 Ourimbah Road and 53 and 55 Orchard Road, Kangy Angy (32/1033784, 121/874784, 34-41/2877). It also includes Orchard Road, Schubolt Lane, and the adjacent railway corridor. The study area is located within the Wyong Local Government Area (LGA), and is within the boundary of the Darkinjung Local Aboriginal Land Council (LALC). It is in the Parish of Tuggerah, County of Northumberland.

1.3 Proposal

TfNSW proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. The facility would undertake light and heavy train maintenance activities for the New Intercity Fleet, including but not limited to

- Regular maintenance/servicing
- Repair/replacement of train components
- Interior and exterior cleaning.

It is expected that the proposed development will be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. On behalf of TfNSW, WSP│Parsons Brinckerhoff is preparing the required Review of Environmental Factors (REF). WSP│Parsons Brinckerhoff has engaged Artefact Heritage to prepare the present non Aboriginal Historical assessment to address the potential historic heritage impact of the proposed development.

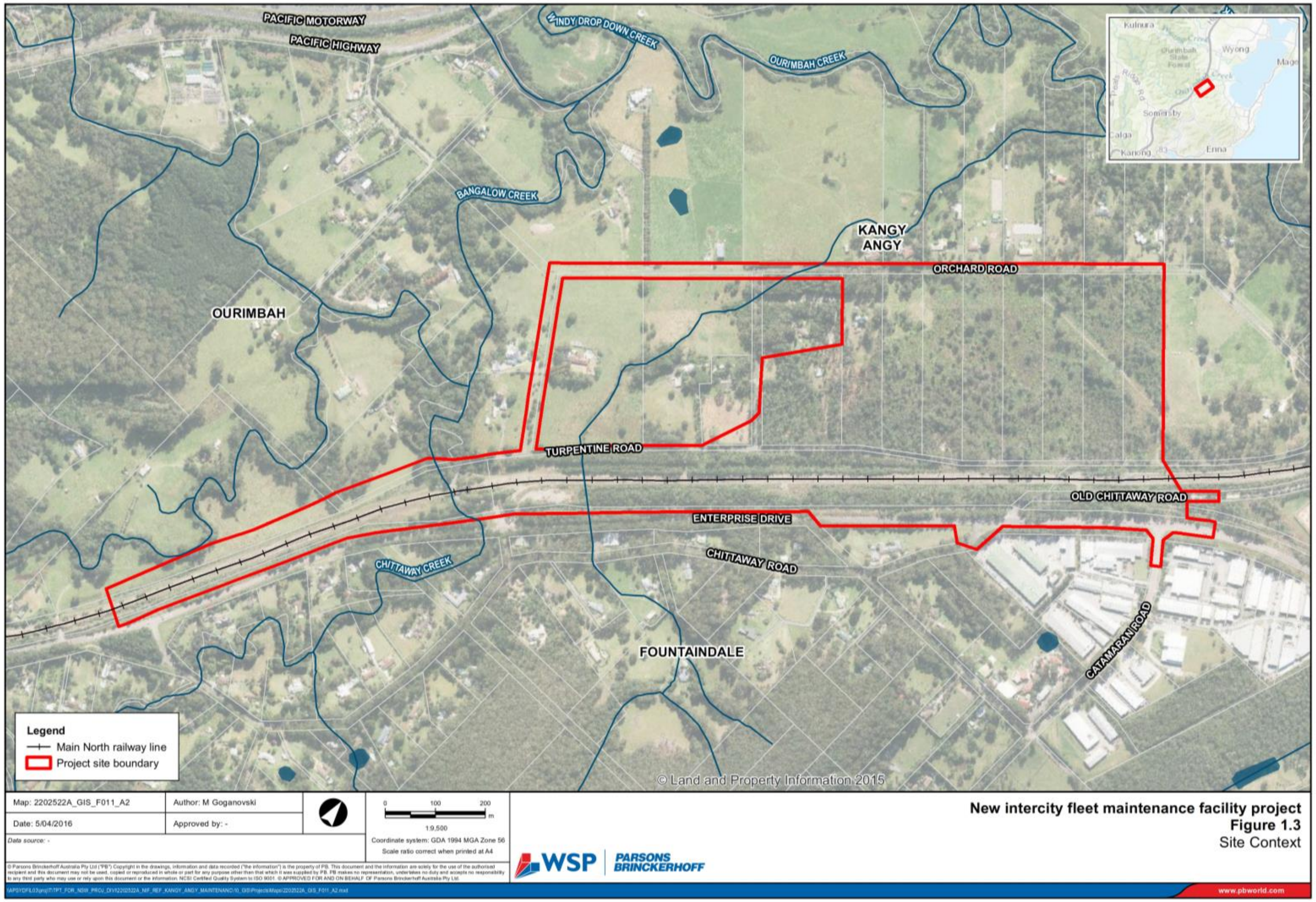
1.4 Authorship and acknowledgements

Alyce Haast and Fenella Atkinson prepared this report. Josh Symons (Principal) provided management input and reviewed the report. The survey was undertaken by Atkinson, Haast, Lee

Davison (Darkinjung Local Aboriginal Land Council) and Tracey Howie (Guringai Tribal Link Aboriginal Corporation). The assistance of the following people is gratefully acknowledged:

- Jarryd Barton and Alex McDonald, WSP│Parsons Brinkerhoff.
- Robert Parkinson, Land and Property Information.

Figure 1: Study area (Image courtesy of WSP│Parsons Brinkerhoff).



2.0 STATUTORY BACKGROUND

2.1 Heritage listings

A summary of the relevant Acts and the potential legislative implications for the proposed development follow.

2.1.1 Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legislative framework for the protection and management of matters of national environmental significance, that is, flora, fauna, ecological communities and heritage places of national and international importance. Heritage items are protected through their inscription on the World Heritage List, Commonwealth Heritage List or the National Heritage List.

The EPBC Act stipulates that a person who has proposed an action that will, or is likely to, have a significant impact on a World, National or Commonwealth Heritage site must refer the action to the Minister for the Environment (hereafter Minister). The Minister will then determine if the action requires approval under the EPBC Act. If approval is required, an environmental assessment would need to be prepared. The Minister would approve or decline the action based on this assessment.

A significant impact is defined as 'an impact which is important, notable, or of consequence, having regarded to its context or intensity'. The significance of the action is based on the sensitivity, value and quality of the environment that is to be impacted, and the duration, magnitude and geographic extent of the impact. If the action is to be undertaken in accordance with an accredited management plan, approval is not needed and the matter not need be referred to the Minister.

No items within or adjacent to the study area are included on the World, National or Commonwealth Heritage Lists.

2.1.2 Heritage Act 1977 (NSW)

The NSW *Heritage Act 1977* (Heritage Act) provides protection for items of 'environmental heritage' in NSW. 'Environmental heritage' includes places, buildings, works, relics, movable objects or precincts considered significant based on historical, scientific, cultural, social, archaeological, architectural, natural or aesthetic values. Items considered to be significant to the State are listed on the State Heritage Register (SHR) and cannot be demolished, altered, moved or damaged, or their significance altered without approval from the Heritage Council of NSW.

State Heritage Register

The SHR was established under Section 22 of the Heritage Act and is a list of places and objects of particular importance to the people of NSW, including archaeological sites. The SHR is administered by the Heritage Division of the Office of Environment and Heritage (OEH) and includes a diverse range of over 1500 items, in both private and public ownership. To be listed, an item must be deemed to be of heritage significance for the whole of NSW.

The SHR does not include any items within or in close proximity to the study area.

Section 170 registers

Under the Heritage Act all Government agencies are required to identify, conserve and manage heritage items in their ownership or control. Section 170 requires all government agencies to maintain a Heritage and Conservation Register that lists all heritage assets and an assessment of the significance of each asset. They must also ensure that all items inscribed on its list are maintained with due diligence in accordance with State Owned Heritage Management Principles approved by the Government on advice of the NSW Heritage Council. These principles serve to protect and conserve the heritage significance of items and are based on NSW heritage legislation and guidelines.

In some cases, the s170 Register listings are reproduced in the State Heritage Inventory. Both the Roads and Maritime Services and the Sydney Trains s170 Registers are also available online. These two Registerss170 Register, and the s170 Registers reproduced in the State Heritage Inventory do not include any items within or in close proximity to the study area.

Relics

The *Heritage Act* also provides protection for 'relics', which includes archaeological material or deposits. Section 4 (1) of the Heritage Act (as amended in 2009) defines a relic as:

> *...any deposit, artefact, object or material evidence that:*
>
> *a) relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
>
> *b) is of State or local heritage significance*

Sections 139 to 145 of the Heritage Act prevent the excavation or disturbance of land known or likely to contain relics, unless under an excavation permit. Section 139 (1) states:

> *A person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, damaged or destroyed unless the disturbance is carried out in accordance with an excavation permit.*

Excavation permits are issued by the Heritage Council of NSW, or its Delegate, under Section 140 of the *Heritage Act* for relics not listed on the SHR, or under Section 60 for relics included within an SHR curtilage. An application for an excavation permit must be supported by an Archaeological Assessment and Research Design prepared in accordance with the NSW Heritage Division archaeological guidelines. Minor works that will have a minimal impact on archaeological relics may be granted an exception under Section 139 (4) or an exemption under Section 57 (2) of the Heritage Act.

The potential for the presence of historical archaeological relics within the study area is discussed in Section Five.

The *Environmental Planning and Assessment Act 1979* (EP&A Act) establishes the framework for cultural heritage values to be formally assessed in the land use planning and development consent process. The EP&A Act requires that environmental impacts are considered prior to land development; this includes impacts on cultural heritage items and places as well as archaeological sites and deposits. The EP&A Act also requires that Local Governments prepare planning instruments (such as Local Environmental Plans [LEPs] and Development Control Plans [DCPs]) in accordance with the Act to provide guidance on the level of environmental assessment required.

Wyong Local Environmental Plan 2013

The study area is located within the Wyong Local Government Area (LGA). Heritage items and archaeological sites in this area are managed under the *Wyong Local Environmental Plan (LEP) 2013*. The LEP aims to conserve the fabric, setting and views, and integrity of heritage items and to protect archaeological resources.

Schedule 5 (Environmental Heritage) does not list any items within or adjacent to the study area.

2.2 Summary of heritage listings

As outlined above, the following statutory heritage lists were searched:

- State Heritage Register
- Wyong LEP 2013
- World Heritage List
- National Heritage List
- Commonwealth Heritage List
- Section 170 Heritage and Conservation Registers

The following non-statutory heritage lists were also searched:

- Register of the National Estate
- National Trust Register

No listed items were identified within or in close proximity to the study area.

3.0 DOCUMENTARY HISTORY OF THE STUDY AREA

3.1 Exploration and early land grants

During the first half of the 19th century, the wealth of timber resources in the Wyong region and its close proximity to Sydney attracted timber-getters, but permanent non-Indigenous settlement was slow to establish, due to the rugged topography of the area. Settlement began in the 1820s largely in response to the relaxation of laws prohibiting settlement beyond the immediate environs of the County of Cumberland, or north of the Hawkesbury River (David Scobie Architects 2010: 22).

During the 1820s and 1830s the land within the present Wyong area was divided between several land holders. Many of these grants however were not developed or even seen by their owners (David Scobie Architects 2010: 22). The study area was located within Portion 90 of the Parish of Tuggerah (Figure 2) located on Thomas McQuoids (or Macquoid) grant. McQuoid had arrived in Sydney in 1829 to take up the post of Sheriff of the Supreme Court of NSW. It is likely McQuoid never inhabited the Ourimbah estate as by 1835 he had purchased Waniassa, an estate near present-day Canberra, and established his residence in Darlinghurst (Tuggeranong Homestead, 2016).

By the 1830s much of the area remained largely unexplored, despite a handful of settlers moving to the area. The 1828 census indicates there were 15 households in the Gosford and Wyong districts; eight around Gosford and others at Erina and Narara Creeks, Wyong, The Entrance, Budgewoi and Tuggerah Lakes. Around this time groups engaging in illegal logging of valuable cedar were operating in the valleys to the west of Tuggerah Lake, in the vicinity of Wyong and Jilliby Creeks (Scott 1999: 13). Felton Mathew was sent in 1830 to chart the land within the Wyong district including features such as Ourimbah Creek. His journal described incredibly difficult terrain (Mathews 1830).

McQuoid died in 1841, and parish maps indicate that the property passed to John Edye Manning. Manning was Registrar of the Supreme Court, and owned a substantial amount of land in the Central Coast area (‘History of Wyong Shire’: 12). Manning was declared bankrupt in the 1840s depression; although his properties remained in the ownership of his family, development was sparse (‘History of Wyong Shire’: 21).

The earliest recorded use of the property was in the 1850s; at this time J.L Travers leased the property and established a saw mill (David Scobie Architects 2010: 27). The mill by 1855 was said to be "in full operation and capable of cutting 20,000 feet of timber per week" (Figure 3), and had became an important centre for the timber industry in Wyong. While the exact location of the saw mill is not known, no evidence of development within or close to the study area has been found for this period. Travers’ sold the lease in 1855 to William Jolly who continued the development of the mill, with the area becoming the centre of a developing settlement (David Scobie Architects 2010: 55).

3.2 Railway

In the early 1880s, a corridor running through the study area was acquired for the construction of the Main Northern Railway Line. The Main Northern Line was constructed in two stages. The line between Strathfield and Hawkesbury River, known as The Short North, was opened in April 1887. The northern section of the line ran from the northern bank of the Hawkesbury River, near Wondabyne, through to Newcastle, and was opened in January 1888.

The station at Ourimbah was opened in 1887, and the station at Tuggerah in 1890. With the arrival of the Railway in the late 1880s, the isolation of the area was eased, opening up the region to tourists who visited on day trips and for holidays, and giving local farmers quick and reliable access to markets (Pry and Fenton, 1998:21). The railway acted as a stimulus to development, and by the 1890s, citrus farming and dairying were growing industries in the region (Pittendrigh Shinkfield & Bruce, 2007:13).

Construction of the railway required significant earthworks, involving both cut and fill. Within the study area, construction drawings indicate that a timber bridge, 26 foot (7.9m) in width, was planned to carry the line across Chittaway Creek (Figure 4). It is unclear whether the timber construction eventuated or whether this plan was replaced by the sturdier brick piers presently in place.

Construction of the railway line also appears to have required realignment of the eastern part of Old Chittaway Road running through the study area (Figure 5). The original alignment passed through the eastern corner of the study area, to the north of the railway line. It was realigned to run along the southern side of the line.

3.3 Fountaindale Estate subdivision

In 1884 the Crown Land Act signalled a shift in government policy towards the sale of small portions of Crown land. This was enacted to encourage a larger demographic of the population to purchase land away from Sydney and live off the land. Land speculators quickly followed the trend subdividing many large estates in the Wyong region from the 1880s (Strom 1983:21). This was encouraged by the construction of the Main Northern Line.

The northern part of Portion 90, including the study area adjacent to the railway line, was subdivided as the Fountaindale Estate in 1889 (Figure 6). The subdivision plan outlined 68 farming blocks and town allotments, and promised a railway station and town centre, neither of which eventuated. Sales brochures for the subdivision boasted that "the soil being of the best quality the growing of fruit and vegetables will doubtless in the future constitute the leading industry of the region ..." (David Scobie Architects 2010: 22). The subdivision sold well in the 1890s and early 1900s despite the economic depression of the 1890s.

To the east of Ourimbah Road, the study area includes the whole of eight, and part of two more of the lots created during the subdivision (Figure 6 and Figure 7). To the west of Ourimbah Road is the area set aside as part of the town centre (which did not eventuate). The plan shows Old Chittaway Road as the main road running from Chittaway to Tuggerah.

However, the 1954 aerial photograph indicates that, with the exception of the railway line, development of the study area was limited through to the mid-twentieth century (Figure 8). The photograph shows the railway line through the study area, with a cleared area and an area of erosion on the northern side. Old Chittaway Road is also shown, as an unsurfaced road, and there are some other tracks passing through. But the remainder of the study area remained covered with vegetation. Orchard Road is not shown in this image.

The property known as 55 Orchard Road was subsequently cleared of vegetation, and may have been used for cattle grazing (Coffey Jan 2016: 2). The two properties to the west, 53 Orchard Road and 11 Ourimbah Road, have not been entirely cleared, but a house has been built on each, with associated outbuildings.

Figure 2: Thomas McQuoid's estate, with the circle indicating the approximate location of the study area (LPI Crown Plan 22.719).

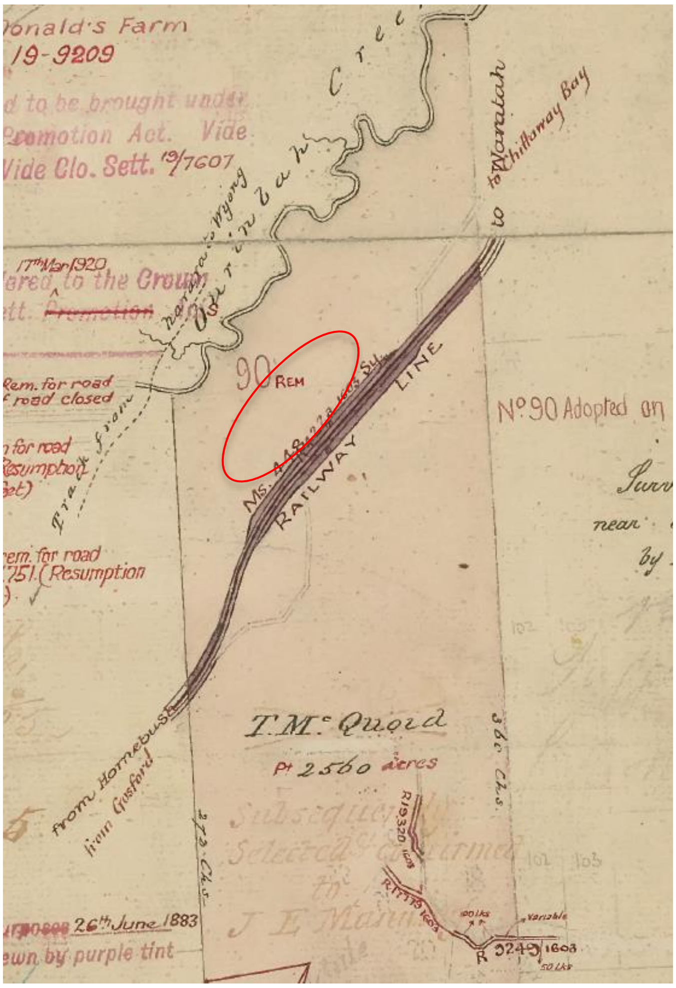
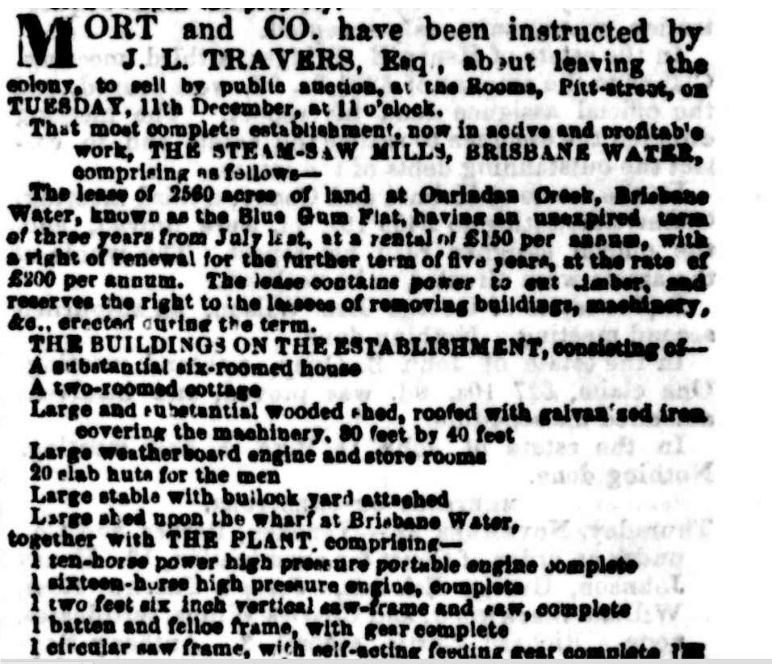


Figure 3: Sydney Morning Herald advertisement 22/11/1855 advertising J. L Travers Mill at Ourimbah.


MORT and CO. have been instructed by J. L. TRAVERS, Esq., about leaving the colony, to sell by public auction, at the Rooms, Pitt-street, on TUESDAY, 11th December, at 11 o'clock.

That most complete establishment, now in active and profitable work, THE STEAM-SAW MILLS, BRISBANE WATER, comprising as follows—

The lease of 2560 acres of land at Ouriadan Creek, Brisbane Water, known as the Blue Gum Flat, having an unexpired term of three years from July last, at a rental of £150 per annum, with a right of renewal for the further term of five years, at the rate of £200 per annum. The lease contains power to cut timber, and reserves the right to the lessees of removing buildings, machinery, &c., erected during the term.

THE BUILDINGS ON THE ESTABLISHMENT, consisting of—
A substantial six-roomed house
A two-roomed cottage
Large and substantial wooded shed, roofed with galvanised iron, covering the machinery, 80 feet by 40 feet
Large weatherboard engine and store rooms
20 slab huts for the men
Large stable with bullock yard attached
Large shed upon the wharf at Brisbane Water,
together with THE PLANT, comprising—
1 ten-horse power high pressure portable engine complete
1 sixteen-horse high pressure engine, complete
1 two feet six inch vertical saw-frame and saw, complete
1 batten and felloe frame, with gear complete
1 circular saw frame, with self-acting feeding gear complete

Figure 4: Plan of Great Northern Railway (LPI, Crown Plan Ms 448 Sy R).

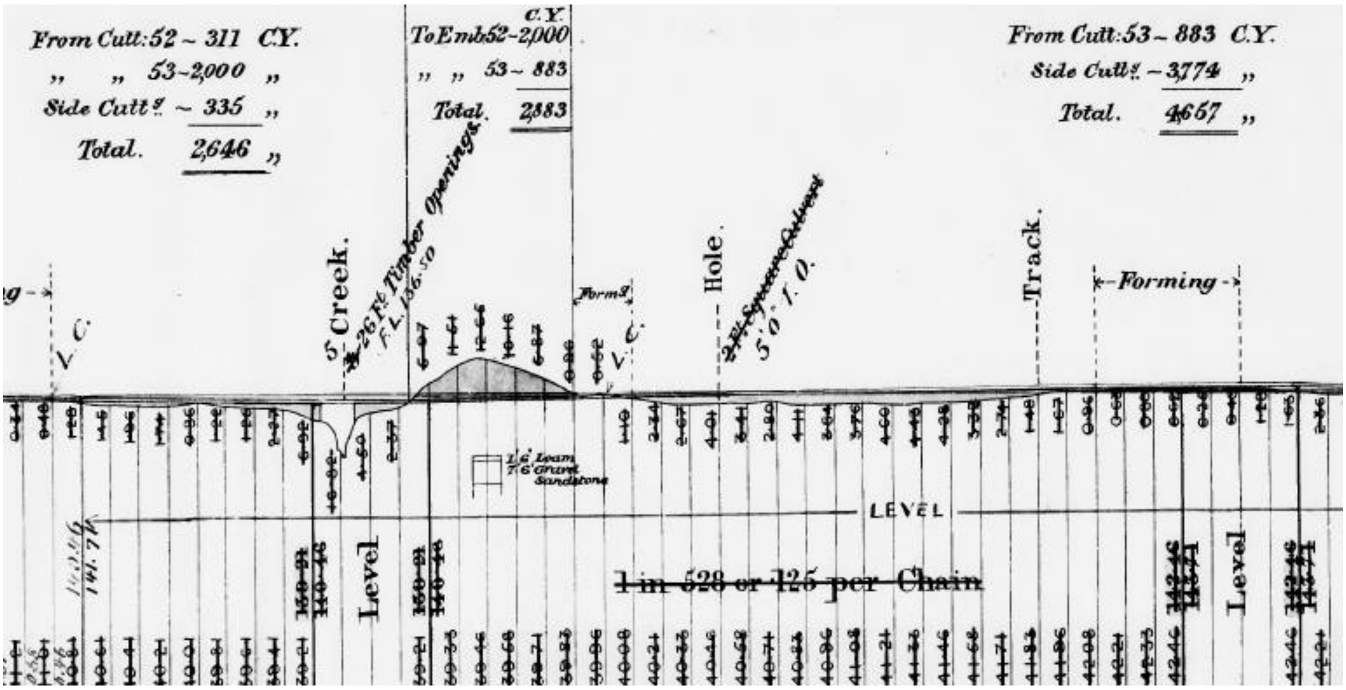


Figure 5: Detail of an 1889 plan showing the realignment of Old Chittaway Road, with the earlier alignment shaded blue, and the later shaded pink (LPI Crown Plan).

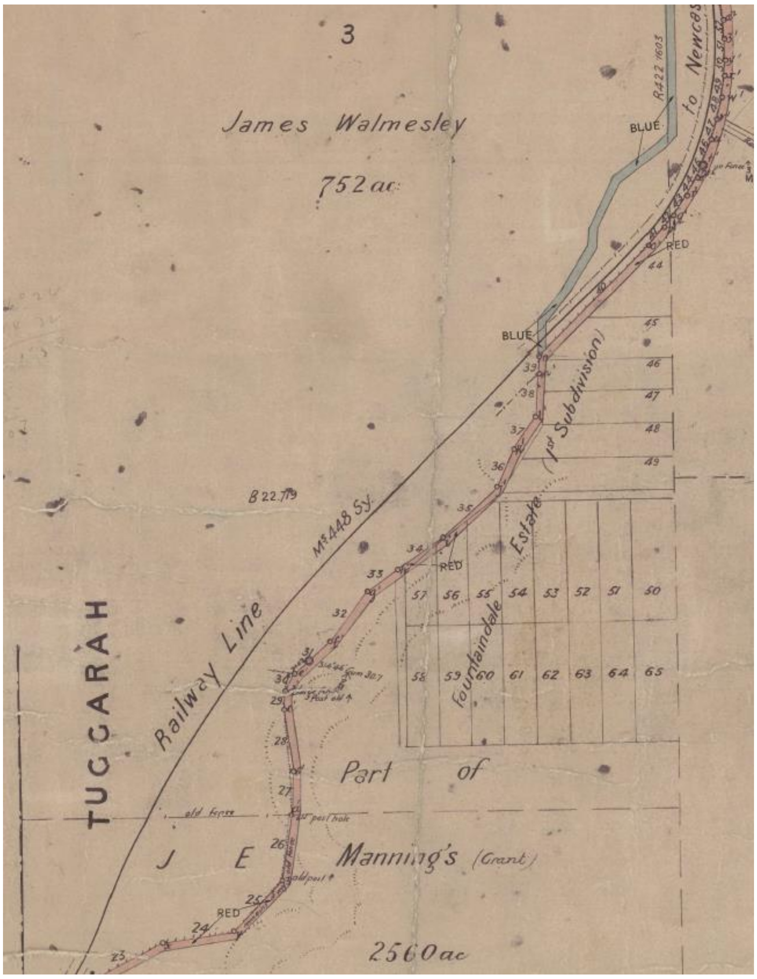


Figure 6: c1890 advertisement for the Fountaindale Estate subdivision (Mills & Piles, National Library of Australia).

Figure 7: Detail of the plan of the first subdivision of the Fountaindale Estate, with the study area outlined in red (LPI Deposited Plan 2877).

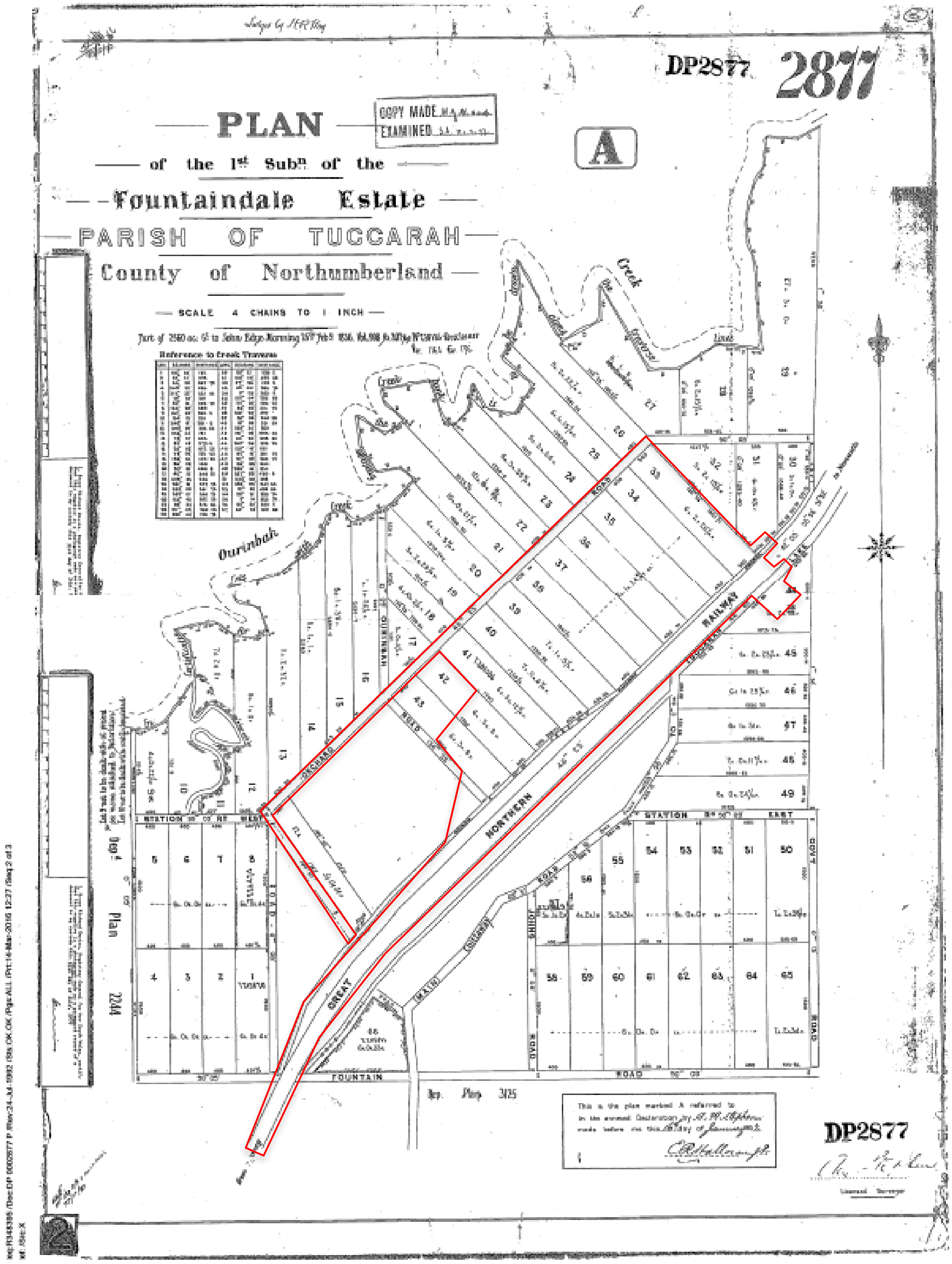


Figure 8: 1954 aerial photograph, with the study area outlined in red (LPI Aerial Imagery).

4.0 SITE INSPECTION

An inspection of the study area was conducted on the 19 February 2016. The main aims of the site inspection were to gain an overall impression of the intactness of the study area and identify whether unidentified Historical archaeological relics and heritage items occur or are likely to occur within the study area.

The study area consists of a small semi-rural subdivision containing ten residential properties as well as surrounding road and rail corridors. The study area can be separated into three distinct areas for the purpose of this description: the rail corridor and Turpentine Road / Chittaway Creek underpass, the road corridors, and the residential properties.

4.1 Rail corridor

The rail corridor was inaccessible and subsequently survey was limited to visual inspection from adjacent residential properties. The underlying track embankment varies in height above the surrounding ground level with a larger mound created along the western portion of the railway (Plate 1). The rail line runs on ballast, and is set on concrete sleepers.

The underpass is located at the intersection of the rail line and Turpentine Road. The original underpass was constructed of brickwork with two central piers and two outer abutments which abut the soil profile (Plate 2-3). The brickwork consists of English cross bond coursing. The western abutment is constructed of brickwork while the eastern abutment has been constructed of concrete likely the result of previous widening of the underpass. Both abutments are surrounded by wing walls to support the surrounding soil profile. The brick piers also have been reinforced by concrete caps possibly in order to raise the height of the underpass. Chittaway Creek runs through the central piers.

4.2 Road corridors

The roads within the study area include Orchard Road, Ourimbah Road, Turpentine Road. Old Chittaway Road and Schubolt Lane. The majority of these roads are unmarked dual lane public roads. The road corridors consist of bitumen pavement which largely conforms to the original slope and landscape of the study area with only a small amount of cutting for construction evident (Plate 4). The majority of the roads are cambered to allow drainage along the edges of the roads. Drainage infrastructure was limited to ditches along the side of the road with no kerbs or guttering noted during survey. Schubolt Lane however consists of a thin single lane flat road cut into the slope. The roads appear to conform to the layout of the original subdivision with the exception of the western extension of the Orchard Road road reserve which is grassed (Plate 5). It is likely a road was never built within this part of the road reserve. Similarly, the eastern extension of the Turpentine Road corridor consists of an unsealed track. Several areas of the road are lined by pines (Plate 6). No evidence of the former alignment of Old Chittaway Road was noted, however this area was heavily overgrown.

4.3 Properties

Properties could be split into two main types, those owned by the council (55 Orchard Road, Lots 34-40 DP 2871) which do not contain residential infrastructure and those properties owned by private residents (53 Orchard Road Lot 41/DP2877, 11 Ourimbah Road Lot 32 DP 1033784 and 12 Ourimbah Road Lot 121/DP87478) which have been cleared and include structural elements.

While the majority of the properties within the study area have no evidence of structural elements, two properties include housing developments. 53 Orchard Road consists of cleared land with multiple wooden fences and sheds on the property. The residence appeared to be of late twentieth century construction (Plate 7). A second home is located at 11 Ourimbah Road which also appears to have been constructed in the second half of the twentieth century.

Survey of 11 Ourimbah Road was restricted to the southern eastern corner of the property which consisted of cleared paddock, with the boundary of the property lined by trees. Tall grass in the majority of the paddock limited visibility.

The Council-owned properties, 55 Orchard Road, are dominated by thick grasses and shrubs. Consequently, survey of this area was restricted by extremely low visibility (Plate 8). A transmission line runs across this property, and an access track has been cleared along this alignment. Small tracks have also been created for access for geotechnical testing. Surveyable land within this area was limited to these tracks and the dirt track that runs adjacent to the northern side of the rail line, forming a western extension of Turpentine Road. Remnants of a loading ramp are located alongside this track (Plate 9-11).

Plate 1: Rail corridor.

Plate 1 View of Turpentine Road / Chittaway Creek underpass.

Plate 3: View of original brick piers with concrete capping.

Plate 4: Turpentine Road.

Plate 5: Grassed road corridor, western extension of Orchard Road.

Plate 6: Pine plantings, Turpentine road.

Plate 7: Property at 53 Orchard Road.

Plate 8: Visibility within council owned properties.

Plate 9: Remains of loading ramp.

Plate 10: Remains of loading ramp.

Plate 11: 4wd track adjacent to loading ramp.

5.0 HISTORICAL HERITAGE ITEMS AND ARCHAEOLOGICAL POTENTIAL

The following section contains an overview of the historical heritage values of the study area. It includes a summary of the identified heritage items, historical archaeological potential of the study area, and an initial assessment of significance.

5.1 Historical archaeological potential

The study area is part of a property that was granted by c.1830. However, the only development known to have taken place in the study area in the period before the construction of the railway line in the 1880s was the creation of Old Chittaway Road, the original alignment of which ran through the eastern corner of the study area. This is likely to have been an unsurfaced road, and archaeological evidence is therefore unlikely to remain.

The present fabric of the railway line indicates that the rail, sleepers and underlying ballast have been replaced since construction. It is also possible that the existing bridge carrying the line over Turpentine Road / Chittaway Creek replaced an earlier timber structure. However, it is unlikely that archaeological evidence of the possible timber bridge remains, as it would have been removed during earthworks for the present structure.

By the mid-twentieth century, Turpentine Road had been laid out to the west of Ourimbah Road. As with Old Chittaway Road this was an unsurfaced road, and archaeological remains of the early period of its use are therefore unlikely to remain. Development of the study area since the 1950s has included construction of two houses and residential buildings, and vegetation clearance for use of part of the study area as pasture. While some remains may be present from this period any relics associated with this period have low potential to reach the level of local significance.

5.2 Potential heritage items

There are no listed heritage items within or in proximity to the study area. However, the investigation undertaken for the present report resulted in the identification of several items which may be of some heritage significance (Figure 9). These are discussed below.

- Main Northern Railway and Turpentine Road / Chittaway Creek underpass

The study area includes a section of the Main Northern Railway Line. The construction of the Main Northern Line in the late 1880s was of great importance in the development of the state. In the local region, it played a significant role in opening the area to settlement and allowing local produce to reach the market. The line within the study area appears to follow the original railway alignment, although most of the fabric has been replaced over the course of time. The Turpentine Road / Chittaway Creek underpass may retain elements constructed in the late 1880s, although these have since been modified.

- Old Chittaway Road

Old Chittaway Road was in existence by the late 1880s, when it was realigned to accommodate the construction of the railway line. It appears to have been one of the main roads through the location region. The study area includes part of the original alignment, although evidence of this is unlikely to survive. That part of the current alignment included in the study area was laid out in the late 1880s and remained unsurfaced through to at least the mid-twentieth century. Similarly, fabric from the earlier part of its use is unlikely to remain.

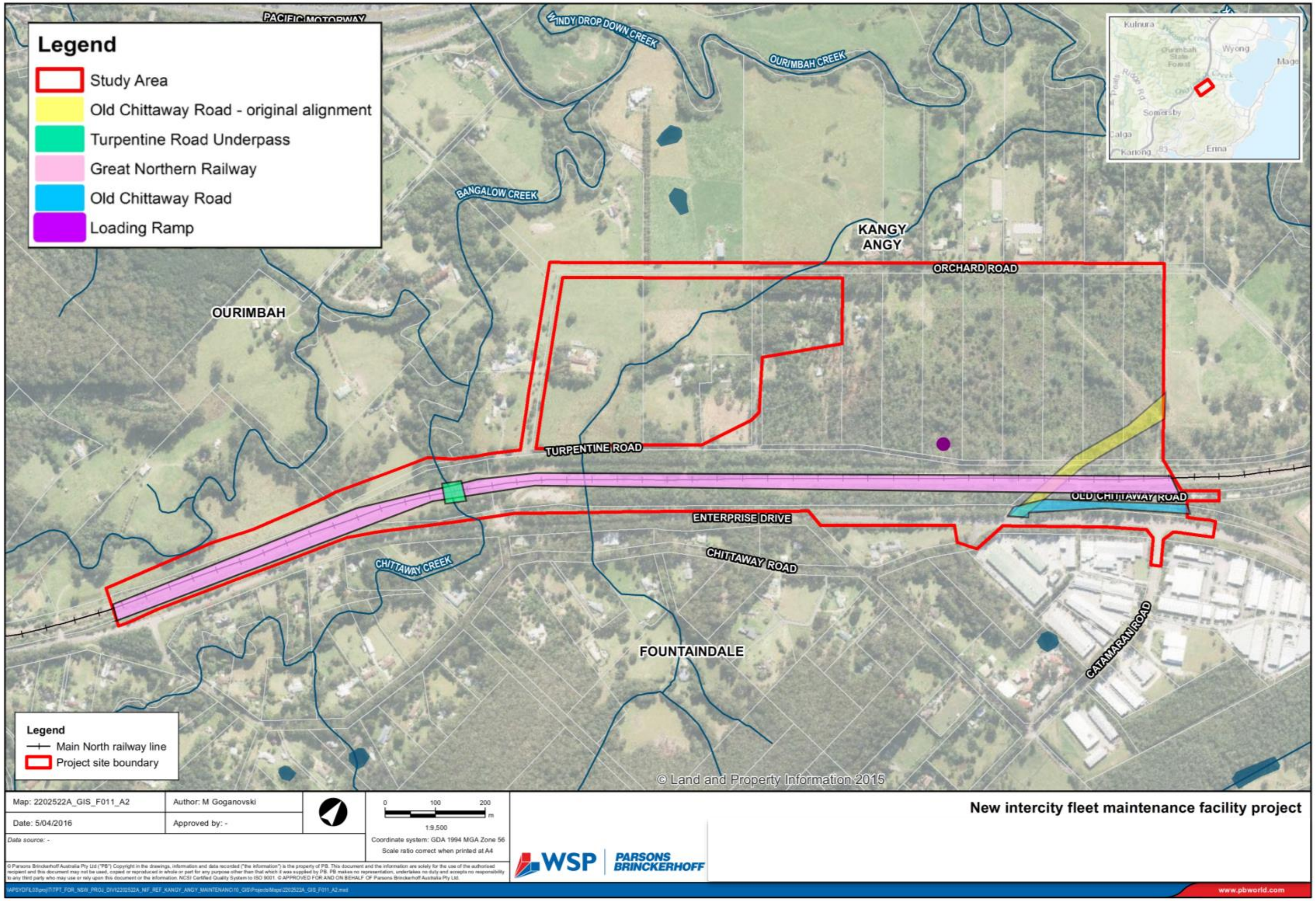
- Loading ramp

Remains of a stockyard and loading ramp were identified between the railway line and the eastern extension of Turpentine Road. These remains are likely to relate to pastoral use of the area in the late twentieth century. They are therefore considered unlikely to be of heritage value.

- Street side plantings

Survey highlighted several areas of linear pine plantings along boundary lines within the study area, along Turpentine Road and Enterprise Drive. The documentary evidence suggests that these plantings date to the late twentieth century. Although they now form a distinctive landscape element, they are considered unlikely to be of heritage value.

Figure 9: Potential heritage items identified within the study area (base map: WSP│Parsons Brinckerhoff).



5.3 Significance assessment

Of the four potential heritage items within the study area, two are considered not to be of heritage value. The significance of the remaining two is assessed in this section:

- Main Northern Railway and Turpentine Road / Chittaway Creek underpass.
- Old Chittaway Road.

Heritage significance is assessed in accordance with the criteria outlined in the significance assessment guidelines provided by the Heritage Division of the Office of Environment and Heritage (Heritage Office 2001). The criteria specified by the Heritage Division encompass the four values identified in the *Burra Charter*; historical significance, aesthetic significance, scientific significance and social significance (Australia ICOMOS 2013); and also consider representativeness and rarity values (Table 1). The heritage assessment guidelines also include two thresholds (state or local) for assessing the relative level of significance of heritage items.

Table 1: NSW heritage significance assessment criteria.

Criterion	Explanation
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).
B	An item has a 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).
C	An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or in the local area).
D	An item has a strong or special association with a particular community or cultural group in NSW (or local area) for social, cultural or spiritual reasons.
E	An item has the potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or cultural or natural history of the local area).
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).
G	An item is important in demonstrating the principal characteristics of a class of NSW's cultural or natural places; or cultural or natural environments (or a class of the local area's cultural or natural places; or cultural or natural environments).

5.3.1 Main Northern Line

The Main Northern Line, as it passes through the study area, is of state heritage significance in accordance with Criterion A. The Main Northern Line is of importance in the history of the state as it increased the speed and ease of communication, travel and transport between Sydney and the north. It was also important in the history of the local area specifically, allowing increased settlement of an area that was previously relatively inaccessible. Within the study area, this value is represented in the alignment of the railway, which follows the original alignment. However, original fabric is limited to elements of the Turpentine Road / Chittaway Creek underpass.

5.3.2 Old Chittaway Road

Old Chittaway Road is of local heritage significance in accordance with Criterion A. It relates to the sparse pre-railway development of the area and was one of the main routes through the district for the early settlers. Within the study area, this is represented by the location of part of the original alignment, which is unlikely to retain archaeological remains, and part of the c1889 realignment, the fabric of which is not considered to be of heritage significance.

6.0 POTENTIAL HISTORICAL HERITAGE IMPACT

6.1 Proposed development

TfNSW proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. The facility would be intended to undertake light and heavy train maintenance activities for the New Intercity Fleet, including but not limited to

- Regular maintenance/servicing
- Repair/replacement of train components
- Interior and exterior cleaning.

The proposed facility would include about six kilometres of electrified railway (in total), would be seven tracks wide at its widest point, covering an area of approximately 48 hectares, and would be bounded by a perimeter fence (Figure 10). The proposed facility would include the following key elements:

Maintenance facility

- Maintenance building
- Auxiliary workshops
- Electronic clean room
- Material storage, including flammable liquid storage
- Wheel lathe
- Train wash
- Site access roads

Ancillary facilities:

- Security
- Administration
- Facilities for presentation and train maintenance staff
- Operational control
- Training rooms
- Train simulator
- Power supply (traction power, bulk power, signalling power supply and backup generators)
- Detention basins
- Car parks
- Access roads.

6.2 Potential historical heritage impact

The assessment of impact has been undertaken in accordance with the Heritage Division guidelines (Heritage Office & DUAP 2002), and the level of impact is assessed as outlined in Table 3.

Table 2: Assessed scale of heritage impact.

Level of impact	Description
Major	The proposed works would directly impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and/or associated aesthetic elements. This would permanently impact the integrity/intactness of the item and the heritage significance of the item would be lost.
Moderate	The proposed works would impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and/or associated aesthetic elements. Although the integrity/intactness of the item would be impacted, some defining elements of the item would be retained. Therefore, there is potential for the heritage significance of the item to be retained.
Minor	The proposed works would impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and/or associated aesthetic elements. However, these impacts are not considered to detract from the heritage significance of the item.
Nil	The proposed works would not impact defining elements inherent to the item's heritage significance such as built fabric, archaeological remains, defining landscape characteristics and associated aesthetic elements. The works are not considered to detract from the heritage significance of the item.

Two unlisted heritage items have been identified within the study area. The potential heritage impact is outlined below and summarised in Table 3.

- Main Northern Railway and Turpentine Road / Chittaway Creek underpass.

The Proposal will not result in alterations to the current railway alignment. It will involve construction of a branch line, leaving the northern side of the line and running parallel to the line until it reaches the maintenance facility. Although this will involve impact to the existing fabric of the line, the fabric to be affected is unlikely to relate to the original construction of the line.

The Proposal will involve construction of an additional rail bridge, passing over Turpentine Road and Chittaway Creek, adjacent to the existing underpass. It is understood that the proposed works do not involve impact to the fabric of the underpass, but will affect the setting of the item, as the view from the north will be obscured.

- Old Chittaway Road.

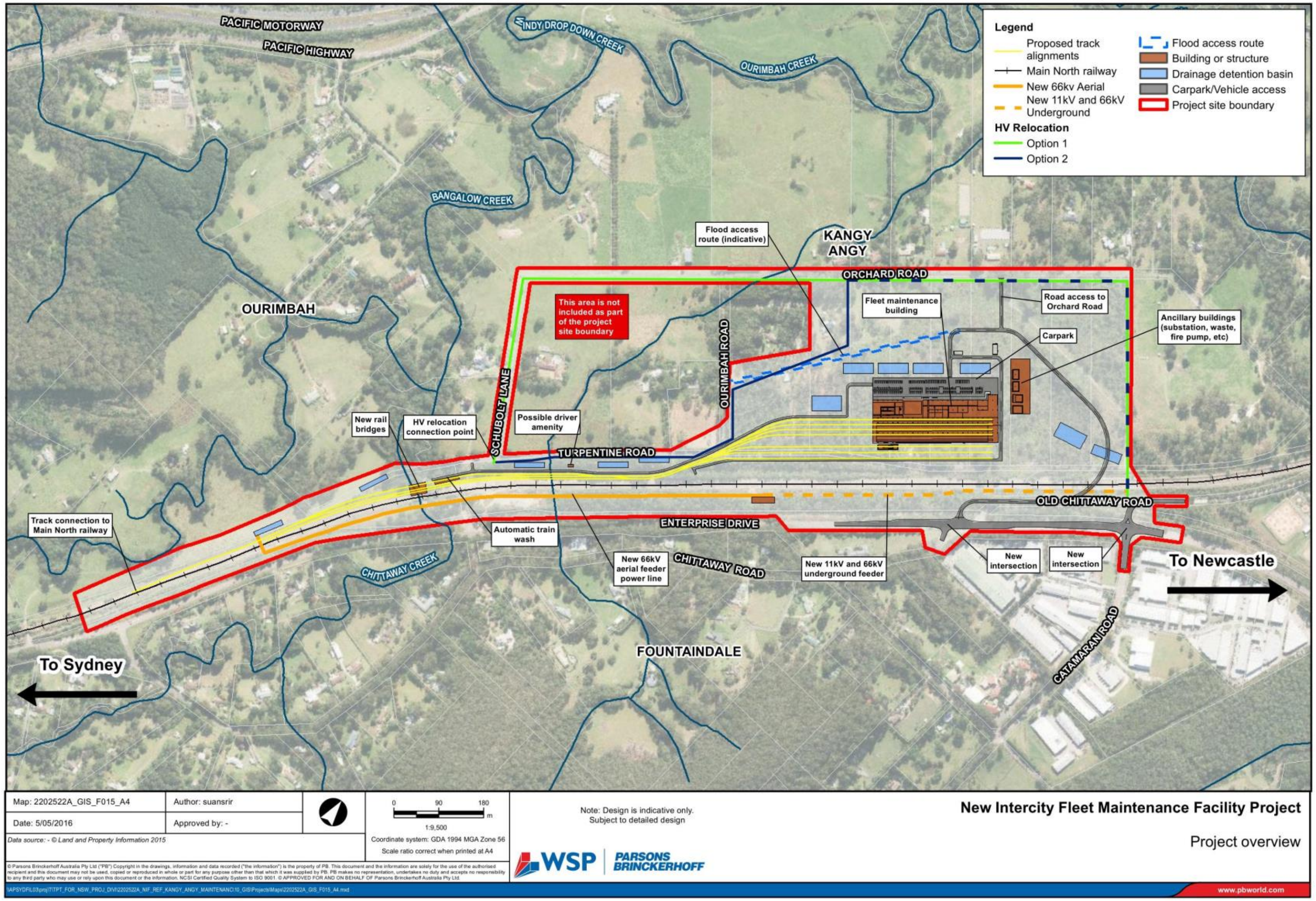
The Proposal will involve construction across the former alignment of Old Chittaway Road. This alignment is no longer evident, and no archaeological remains are likely to be present.

The Proposal will involve works along the current, post-c.1890 alignment of Old Chittaway Road. It will involve removal of fabric post-dating c1954, but this is not considered to be integral to the significance of the road. No archaeological remains from the earlier part of the twentieth century are likely to be present. The c.1890 alignment will remain evident.

Table 3: Summary of impacts and mitigation measures

Item	Impacts to fabric	Impacts to archaeological remains	Impacts to setting
Main Northern Line	Nil The fabric to be affected is modern.	Nil No archaeological remains are likely to be present.	Nil The setting of the Line in general in this area has not been identified as being of heritage significance.
Turpentine Road / Chittaway Creek underpass	Nil The intact fabric of the bridge will be retained	Nil No archaeological remains are likely to be present.	Minor The setting of the underpass will be impacted.
Old Chittaway Road	Nil The fabric to be affected is modern.	Nil No archaeological remains are likely to be present.	Minor The c1890 alignment will be slightly altered.

Figure 10: Proposed development (WSP│Parsons Brinckerhoff).



7.0 CONCLUSIONS AND RECOMMENDATIONS

The study found that the proposed development will not impact on any listed non-Indigenous heritage items, or potential historical archaeological relics. It will affect two non-listed items of heritage significance:

- Turpentine Road / Chittaway Creek underpass. The proposed impact to this item is considered to be minor in nature. However, this section of the rail line, which is likely to include original fabric and demonstrate the date of the railway line, will no longer be evident from the northern side of the line.
- Old Chittaway Road. The proposed impact to this item is considered to be minor in nature.

As these items are not listed, and do not comprise archaeological relics, there are no statutory requirements regarding their management. Management recommendations have been based on the assessed significance of the items, and the nature of the proposed impact.

The following recommendations are made:

- If the proposed development is changed to affect areas not included in the present report, further assessment of potential non-Indigenous heritage impact should be undertaken.
- Prior to commencement of works, a photographic archival record should be completed of the Turpentine Road / Chittaway Creek underpass. Copies of the record should be lodged with Sydney Trains, Wyong City Council, the local historical society and the Heritage Division, if those agencies are happy to accept the copy.
- Unexpected archaeological relics remain protected by the *Heritage Act 1977*. If a potential relic is found in the course of the work, work should cease in the vicinity, and the heritage Division of the Office of Environment and Heritage should be contacted for advice.

8.0 REFERENCES

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Appendix E

ABORIGINAL ARCHAEOLOGICAL SURVEY REPORT

New Intercity Fleet Maintenance Facility, Orchard Road, Kangy Angy

Aboriginal Archaeological Survey Report

Report to WSP | Parsons Brinckerhoff

May 2016

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EXECUTIVE SUMMARY

Transport for New South Wales (TfNSW) proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. Artefact has been commissioned by WSP│Parsons Brinckerhoff (WSP/PB) on behalf of TfNSW to prepare the Aboriginal Heritage Impact Assessment, or Archaeological Survey Report (ASR) for the Project. The purpose of the ASR is to support the Review of Environmental Factors (REF) for the Project.

Overview of findings

There are no registered Aboriginal sites within or in close proximity to the study area. The investigation undertaken for the present ASR did not result in the identification of any Aboriginal objects within the study area.

A due diligence assessment found that the railway corridor within the study area had been subject to high levels of ground disturbance in the historical period, and that the corridor therefore had low Aboriginal archaeological potential (Biosis 2015). Most of the remainder of the study area was assessed as having high archaeological potential. Subsequent geotechnical investigation and the results of the present investigation support this assessment.

With regard to potential archaeological impact, the study area can be divided into two parts:

- The railway corridor is considered to have low archaeological potential. The proposed development in this part of the study area is unlikely to result in harm to Aboriginal objects.
- The remainder of the study area is considered to have moderate archaeological potential. Deposits within this part of the study area may be of high archaeological significance. Test excavation would be required to confirm the assessed archaeological potential and significance. The proposed development in this part of the study may result in harm to Aboriginal objects (if present).

Recommendations

The following recommendations are made:

- If the extent and nature of the proposed development is altered, additional archaeological assessment should be undertaken to address this.
- No further archaeological investigation is required for the railway corridor within the study area.
- An Aboriginal cultural heritage assessment report (ACHAR) should be completed for the remainder of the study area, and should include Aboriginal community consultation and archaeological test excavation. This process should be undertaken in accordance with the guidelines issued by the Office of Environment and Heritage:
    - *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011).

    - *Code of practice for archaeological investigation of Aboriginal objects in New South Wales* (DECCW 2010).
    - *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010).
- In accordance with the results of the Species Impact Statement undertaken for the project, the relevant approval and REF determination should be in place prior to completion of the archaeological test excavation component of the ACHAR.
- If the results of the ACHAR confirm that Aboriginal objects are present and will be harmed by the proposed development, it will be necessary to apply for an Aboriginal Heritage Impact Permit prior to commencement of works.

Recommendations made by Darkinjung Local Aboriginal Land Council and Guringai Tribal Link Aboriginal Corporation are included in the appended reports (Appendices C and D).

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FIGURES

TABLES

1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

Transport for New South Wales (TfNSW) proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. Artefact has been commissioned by WSP│Parsons Brinckerhoff (WSP/PB) on behalf of TfNSW to prepare the Aboriginal Heritage Impact Assessment, or Archaeological Survey Report (ASR) for the Project.

It is expected that the proposed development will be assessed under Part 5 of the *Environmental Planning and Assessment Act 1979*. On behalf of TfNSW, WSP/PB is preparing the required Review of Environmental Factors (REF). The purpose of the ASR is to support the REF for the Project.

1.2 Study area

The study area is shown in Figure 1. It consists of part or all of eight lots known as 11 and 12 Ourimbah Road and 53 and 55 Orchard Road, Kangy Angy (32/1033784, 121/874784, 34-41/2877). It also includes Orchard Road, Schubolt Lane, and the adjacent railway corridor. The study area is located within the Wyong Local Government Area (LGA), and is within the boundary of the Darkinjung Local Aboriginal Land Council (LALC). It is in the Parish of Tuggerah, County of Northumberland.

1.3 Study objectives

The ASR has been completed in accordance with the *Code of practice for archaeological investigation of Aboriginal objects in NSW* (DECCW 2010). The main objectives of this study include:

- A description of the proposal and the extent of the study area.
- A description of Aboriginal community involvement and Aboriginal consultation.
- Discussion of the environmental context of the study area.
- Discussion of the Aboriginal historical context of the study area.
- A summary of the archaeological context of the study area including a discussion of previous archaeological work in the area.
- Development of an archaeological predictive model.
- Description of Aboriginal sites within the study area.
- Development of a significance assessment for these sites addressing archaeological values.
- Impact assessment for Aboriginal sites in the study area.
- Recommendations for management and mitigation measures for Aboriginal sites.

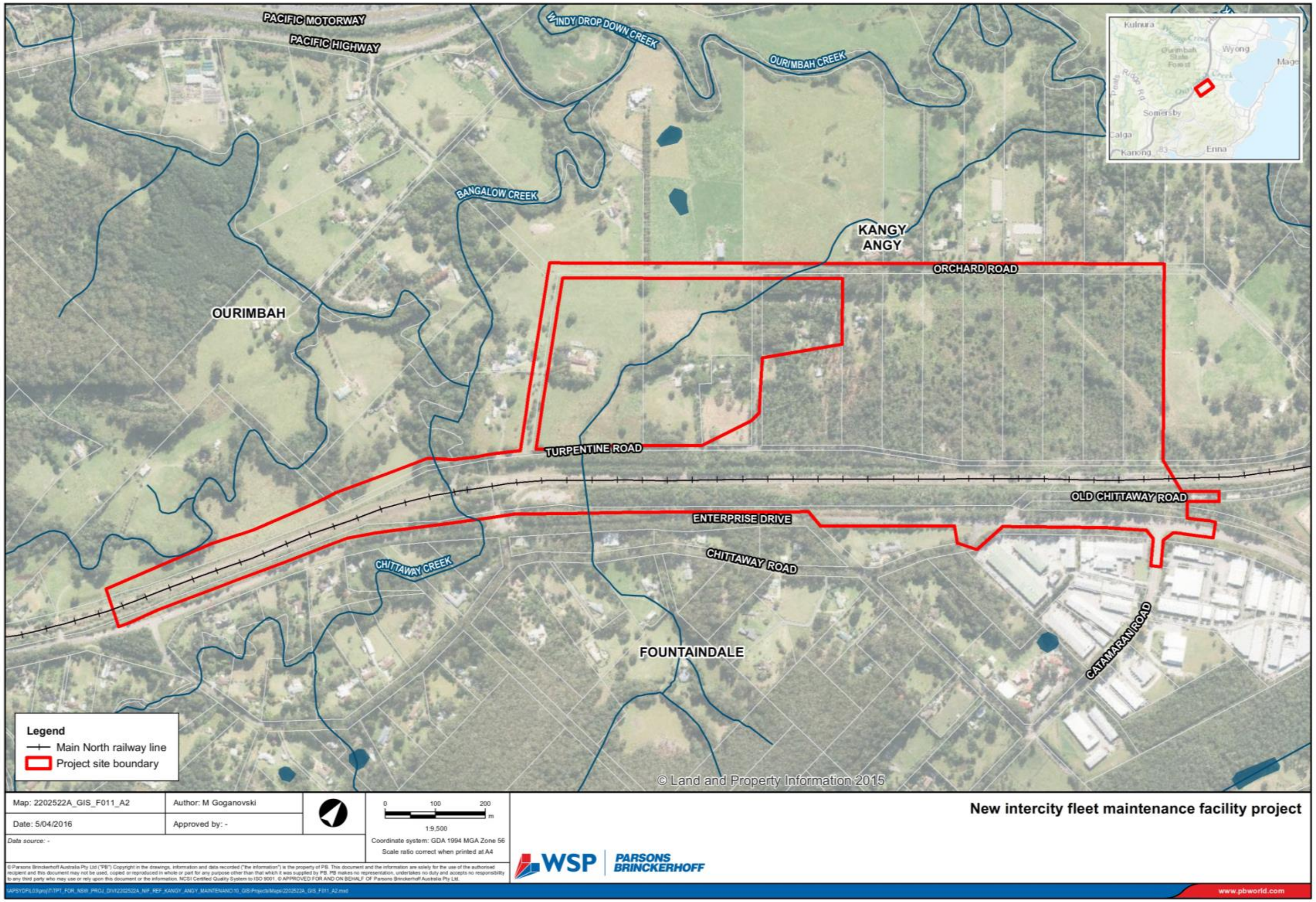
1.4 Authorship and acknowledgements

Fenella Atkinson and Alyce Haast prepared this report. Josh Symons (Principal) provided management input and reviewed the report. The survey was undertaken by Atkinson, Haast, Lee Davison (Darkinjung Local Aboriginal Land Council) and Tracey Howie (Guringai Tribal Link Aboriginal Corporation). The assistance of the following people is gratefully acknowledged:

- Jarryd Barton and Alex McDonald, WSP│Parsons Brinkerhoff.

- Robert Parkinson, Land and Property Information.

Figure 1: The study area, outlined in red.



2.0 LEGISLATIVE CONTEXT

This study has been undertaken in the context of several pieces of legislation that relate to Aboriginal heritage and its protection in New South Wales.

2.1 National Parks and Wildlife Act 1974

The *National Parks & Wildlife Act 1974* (the Act), administered by the Office of Environment and Heritage (OEH), provides statutory protection for all Aboriginal 'objects' (consisting of any material evidence of the Aboriginal occupation of NSW) under Section 90 of the Act, and for 'Aboriginal Places' (areas of cultural significance to the Aboriginal community) under Section 84.

The protection provided to Aboriginal objects applies irrespective of the level of their significance or issues of land tenure. However, areas are only gazetted as Aboriginal Places if the Minister is satisfied that sufficient evidence exists to demonstrate that the location was and/or is, of special significance to Aboriginal culture.

The Act was recently amended (2010) and as a result the legislative structure for seeking permission to impact on heritage items has changed. A s.90 permit is now the only Aboriginal Heritage Impact Permit (AHIP) available and is granted by the OEH. Various factors are considered by OEH in the AHIP application process, such as site significance, Aboriginal consultation requirements, ecologically sustainable development (ESD) principles, project justification and consideration of alternatives. The penalties and fines for damaging or defacing an Aboriginal object have also increased.

As part of the administration of Part 6 of the Act, OEH has developed the *Code of practice*, the *Guide to Investigating and Reporting on Aboriginal Cultural Heritage in NSW 2010* (herein referred to as the Guide) and *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (herein referred to as the Consultation Requirements) in accordance with the 2010 amendment to the Act.

2.2 Environmental Planning & Assessment Act 1979

The *Environmental Planning & Assessment Act 1979* (EP&A Act) is administered by the Department of Planning and Environment and provides planning controls and requirements for environmental assessment in the development approval process. The EP&A Act has three main parts of direct relevance to Aboriginal cultural heritage. Namely, Part 3 which governs the preparation of planning instruments, Part 4 which relates to development assessment process for local government (consent) authorities and Part 5 which relates to activity approvals by governing (determining) authorities.

Planning decisions within LGAs are guided by Local Environmental Plans (LEPs). Each LGA is required to develop and maintain an LEP that includes Aboriginal and historical heritage items which are protected under the EP&A Act and the *Heritage Act 1977*.

2.3 Aboriginal Land Rights Act 1983

The *Aboriginal Land Rights Act 1983* is administered by the NSW Department of Human Services - Aboriginal Affairs. This Act established Aboriginal Land Councils (at State and local levels). These bodies have a statutory obligation under the Act to; (a) take action to protect the culture and heritage of Aboriginal persons in the council's area, subject to any other law, and (b) promote awareness in the community of the culture and heritage of Aboriginal persons in the council's area.

2.4 Native Title Act 1994

The *Native Title Act 1994* was introduced to work in conjunction with the Commonwealth *Native Title Act 1993*. Native Title claims, registers and Indigenous Land Use Agreements are administered under the Act. In general, a claim relates only to unoccupied Crown Land within the claim boundaries.

The study area is within the area subject to the registered Native Title Claim made by the Awabakal and Guringai People (Tribunal No. NC2013/002).

3.0 ENVIRONMENTAL CONTEXT

3.1 Geology, soils and vegetation

The study area is located in the Central Coast Lowlands, within an infilled river valley (Coffey Feb 2016: 6). The valley is mapped as an area of the Yarramalong Soil Landscape. This consists of deep alluvial soils overlying Quaternary Alluvium (Murphy 1993). In general, rock outcrop is not present. Although the underlying bedrock is laminate, shale and sandstone of the Terrigal Formation, this is located at some depth (Coffey Feb 2016: 6). Within this soil landscape, stream bank erosion is common along the main drainage lines; Wyong, Jilliby Jilliby and Cedar Brush Creeks.

The alluvial valley is flanked by the more rugged terrain of the Narrabeen sandstone country. In the vicinity of the study area, the valley is relatively narrow, about 1-1.5km across. In terms of associated natural resources that would have been available to the past Aboriginal occupants of the area, Vinnicombe has noted that kaolin is procurable at Pipe Clay Point at the northern end of Tuggerah Lake, and red ochre is available at Norah Head (Vinnicombe 1980: x:7).

Geotechnical investigation for the project has included drilling 18 boreholes and digging 34 test pits. It resulted in the identification of alluvial deposits up to 43m in depth (Coffey Feb 2016: 6). It was noted that the sedimentary sequence observed may represent fluvial delta sands / muddy sands being deposited over estuarine basin muds (lake or swamp deposits) that were deposited during a period of higher sea levels. The upper sandy layers may belong to the post-glacial, Holocene period. The subsurface units are described in Table 1.

The ecological study has identified two plant community types in the study area (EMM 2015: 11):

- Swamp Mahogany – Broad-leaved Paperbark – Swamp Water Fern – Plume Rush swamp forest on coastal lowlands of the Central Coast and Lower North Coast (Swamp Mahogany Forest).
- Jackwood – Lilly Pilliy – Sassafras Warm Temperate Rainforest of the Central Coast (Jackwood Lilly Pilly Rainforest).

Table 1: Subsurface geotechnical units identified within the study area (Coffey Feb 2016: 7).

Unit	Description
1	Topsoil. A thin layer of silty sand and sandy silt containing organic material
2	Fill. Primarily found in the rail corridor as embankment and access track material. The fill comprised heterogeneous mixtures of fine-grained, brown, silty sand and medium to coarse grained angular gravel (rail ballast).
3a	Alluvium, fluvial delta/alluvial plain deposits. Comprising layers of silty sand, clay and sandy clay. These materials range from medium dense to dense or stiff to very stiff in consistency.
3b	Alluvium, estuary basin muds. This unit comprises silty clay, clayey silt and sandy silt. These materials are likely normally consolidated and range from soft to firm consistency. Unit 3b occurs where the depth to bedrock is greater than 8 m and likely represents an underlying layer of normally consolidated estuarine mud from a time when sea level was higher.

3c	Alluvium, Pleistocene deposits. This unit is found in the deeper portions of the alluvial channels (where depth to rock is greater than 20m) and comprises stiff silty clay and sandy clay with higher strength properties than Unit 3b. This unit can be difficult to distinguish from Unit 4.
4	Residual soil. Derived from weathering of the underlying sandstone rock, and generally comprising fine to medium grained clayey sand or low to medium plasticity sandy clay having very stiff consistency. In many places, however, this unit is relatively thin or absent due to the geological erosion process (eg on the slopes of the in-filled valley).
5a & 5b	Bedrock. Comprising sandstone ranging from extremely weathered to fresh, extremely low to medium strength, with occasional laminite bands (up to 2.5 m thick). This unit has been subdivided based on rock strength, as follows: · 5a – extremely low to very low strength sandstone · 5b – low to medium strength sandstone

3.2 Landforms and hydrology

The Yarramalong Soil Landscape consists of alluvial plains and terraces, with local relief of 0-10m and slopes of 0-3 percent (Murphy 1993). The study area itself is located on an alluvial plain within a broad valley. There is a small rise located just to the south of the study area, south of Schubolt Lane, but the study area consists of gentle slopes (Figure 2).

The study area is located approximately 350m from Ourimbah Creek, and includes parts of two tributaries of the Creek; Chittaway Creek, and an unnamed second-order watercourse (Figure 3). Much of the Ourimbah Creek catchment is prone to flooding, and parts of the study area are subject to flooding during a 1:100 year, or even more frequent flooding events. This is likely to be influenced, to some degree, by the historical development of the local area. However, the topography of the study area indicates that it is likely also to have been affected by flooding in the pre-historic past.

Ourimbah Creek runs east to discharge into Chittaway Bay within Tuggerah Lake, located approximately 3.5km from the study area. The Bay is part of Tuggerah Lake, a shallow salt water lake with extensive sand dunes along its eastern side, and large areas of marsh land on its western margins (Dallas 1983: 4). Tuggerah Lake is an important breeding and feeding ground for birds, and is seasonally rich in fish and prawns (Vinnicombe 1980: x:6).

3.3 European land use history

The 1954 aerial photograph indicates that, with the exception of the railway line, development of the study area has been very limited (Figure 4). At this time, most of the study area was covered with vegetation, although there were some tracks through the area. The photograph shows an area of erosion adjacent to the railway line.

Most of the study area (55 Orchard Road) was subsequently cleared of vegetation, and may have been used for cattle grazing (Coffey Jan 2016: 2). The two properties to the west, 53 Orchard Road and 11 Ourimbah Road, have not been entirely cleared, but a house has been built on each, with associated outbuildings.

Construction of the railway line is likely to have involved substantial earthworks, and is likely to have resulted in the removal of any Aboriginal archaeological remains in this specific location. However, known development across the remainder of the study area has involved only limited earthworks. Given the likely depth of the soil profile, it is unlikely that such development would have entirely removed any archaeological deposits.

Figure 2: Contour mapping (10m intervals), with the study area outlined in red.

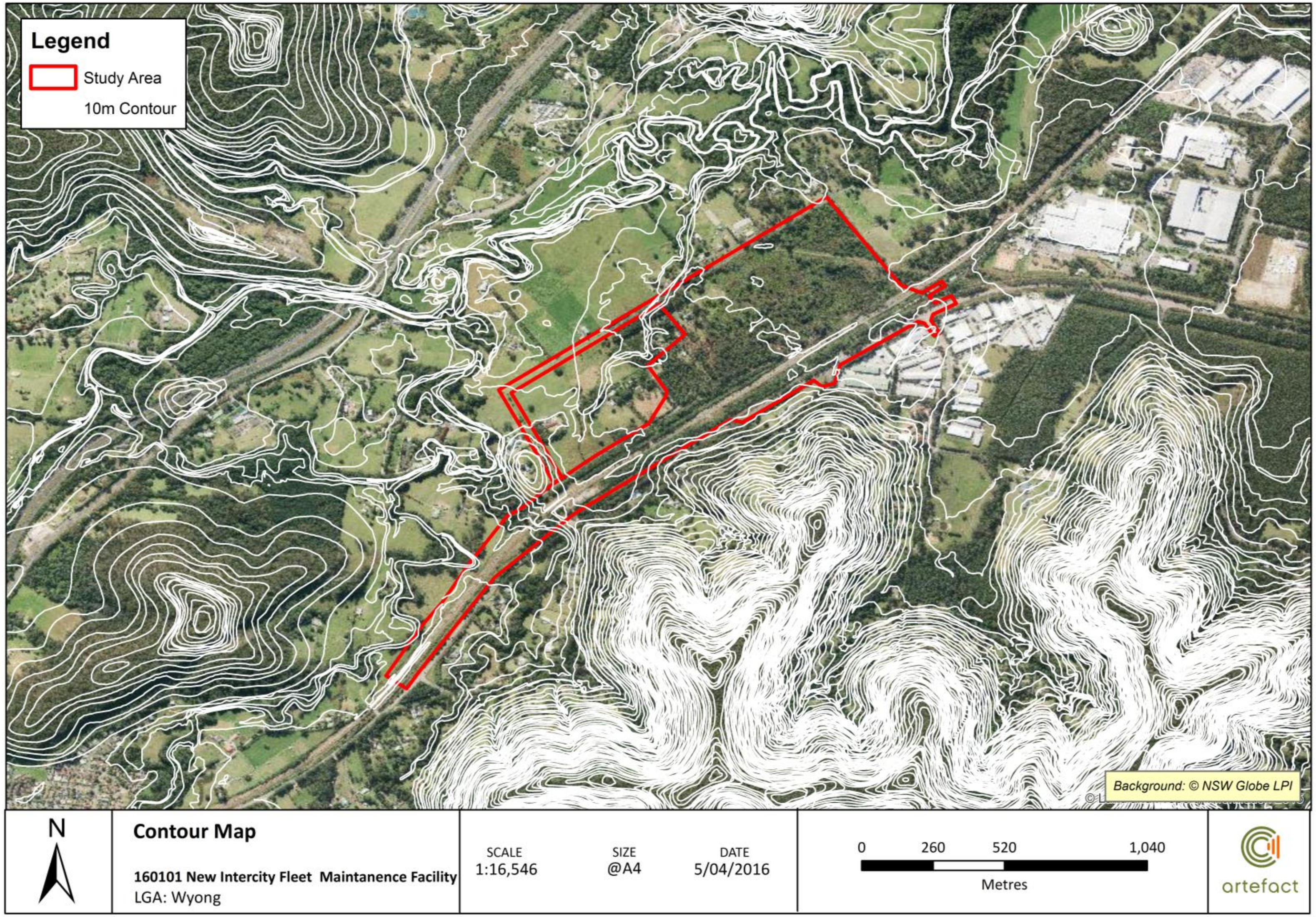


Figure 3: Topographic mapping showing the study area, outlined in blue, in relation to landforms and watercourses (LPI SIXMaps).

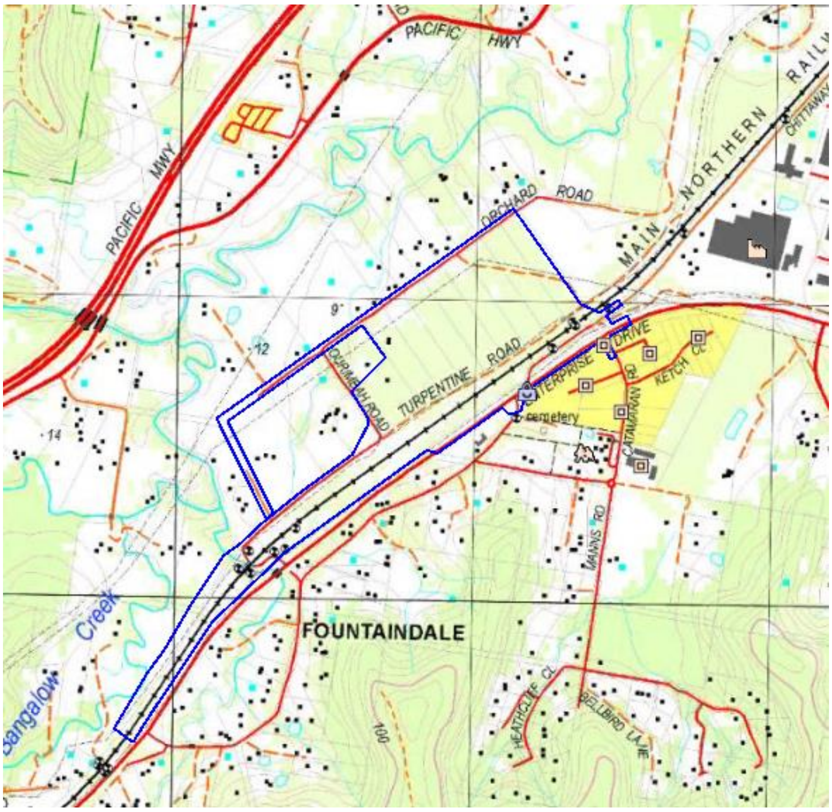


Figure 4: The study area in 1954 (LPI).

4.0 ABORIGINAL ARCHAEOLOGICAL CONTEXT

4.1 Previous archaeological investigations

A number of previous archaeological investigations have been undertaken in the region, and across the study area specifically. The results of available studies are summarised below.

The Gosford-Wyong Region (Vinnicombe 1980)

Vinnicombe (1980) prepared a study of the Aboriginal archaeology of the Gosford and Wyong LGAs on behalf of the National Parks and Wildlife Service, to inform planning for the future development of the area. In general, it was found that water was not a critical determinant in site location, as it is seldom more than a kilometre away in this region. Site location patterns were described as follows (as summarised in Dallas 1980):

Open middens	Occur on sand, alluvium and sandstone, often at the junction between valley bottom and hillslope. They are in protected positions near water.
Open camp sites	They can occur in any position where the terrain is sufficiently flat and water is available.
Rock shelters with evidence of Aboriginal occupation	Occur most frequently immediately below ridge ops and above the watercourses along or just above the valley floors. They can also occur anywhere up the slopes where sandstone is exposed. Habitation sites are more likely to occur near the valley floor, while art sites tend to occur in large shelters below the ridge tops. Availability of water is not a factor in site selection.
Grinding grooves	Where Hawkesbury Sandstone is dominant, the majority of grinding sites occur at the heads of valleys in the creek beds. They also occur around rock pools on ridge tops and rock platforms. They are almost always associated with a ready water supply.
Art sites	These can occur anywhere on sandstone or along the ridges. There is a small preference for shelters immediately below the ridge tops
Engravings	Mostly found on ridge tops and on saddles between ridges, on high platforms with extensive views on or near the heads of valleys.

Wyong Shire Sewerage Scheme (Dallas 1983)

Dallas (1983) prepared an archaeological survey of a proposed pipeline route running from Tuggerah to Norahville, along the northern shore of Tuggerah Lake. The commencement point was located approximately 2.5km to the north-east of the present study area. The analysis of background information suggested the following pattern for Aboriginal occupation surrounding Tuggerah Lake:

> *Large and repeatedly occupied sites occur along the rocky coast and along the foreshore of the Lake with small occasional hunting excursions into the marshy areas. The wetlands are rich sources for waterfowl, snakes, eels and eggs and although covered in thick scrub movement through them would have been facilitated by annual burn offs.*

A predictive model was developed for the three environmental zones in the study area; rocky coast, lake and estuarine shoreline, and marshland:

Occupation sites	These sites are likely to occur on dry relatively flat landforms. Repeatedly or continuously occupied sites with accumulated deposits are likely to be near or along the lake on higher ground. Thin surface scatters of artefacts may be the results of mobile hunting activities. Single occurrences might relate to tool loss or abandonment or tool maintenance.
Estuarine shell middens	These are accumulations of shellfish remains often containing other cultural material adjacent to or near natural sources.
Burials	Burials can occur collectively in shell midden deposits or individually almost anywhere. Generally, they are found in soft sediments such as sand or sandy loam.
Scarred trees	Given the lack of sandstone over most of the area bark shelters were most probably made here. Canoes would have allowed access to the marshland food resources. Scarring on a tree is unlikely to be of Aboriginal origin if the tree is less than 100 years old.

Wyong Shire (Dallas 1987)

Dallas (1987) conducted a study to provide an overview of the Aboriginal archaeological resource of the Wyong LGA, and assist in future planning and management. The area was divided into three landscape units; coast and lakes system, creek systems and wetlands, and foothills and plateau. The present study area falls into the second of these units. The review of previous archaeological investigation resulted in the following summary for the ‘creeks and wetlands’ unit:

> *The only known site types known to be located along the creeks or adjacent to swamp or marsh are open camp sites and axe grinding grooves.*
>
> *There are only 6 open camp sites and all but one are located in the lower reaches of Wyong and Ourimbah Creek close to Tuggerah Lake. One of these sites is situated near a series of axe grinding grooves in a rare lowland exposure of sandstone.*
>
> *The upper reaches of the creeks have no known sites. The valley floors have been subject to rural land practices and no archaeological survey involving substantial areas has been undertaken. Shelter sites are located on the sharply rising foothills above the creeks in the upper reaches, but in contexts which suggest the elevated ground and ridge lines were the focus, not the major creeks.*

Wyong Road and Pacific Highway Intersection, Tuggerah (Artefact 2012)

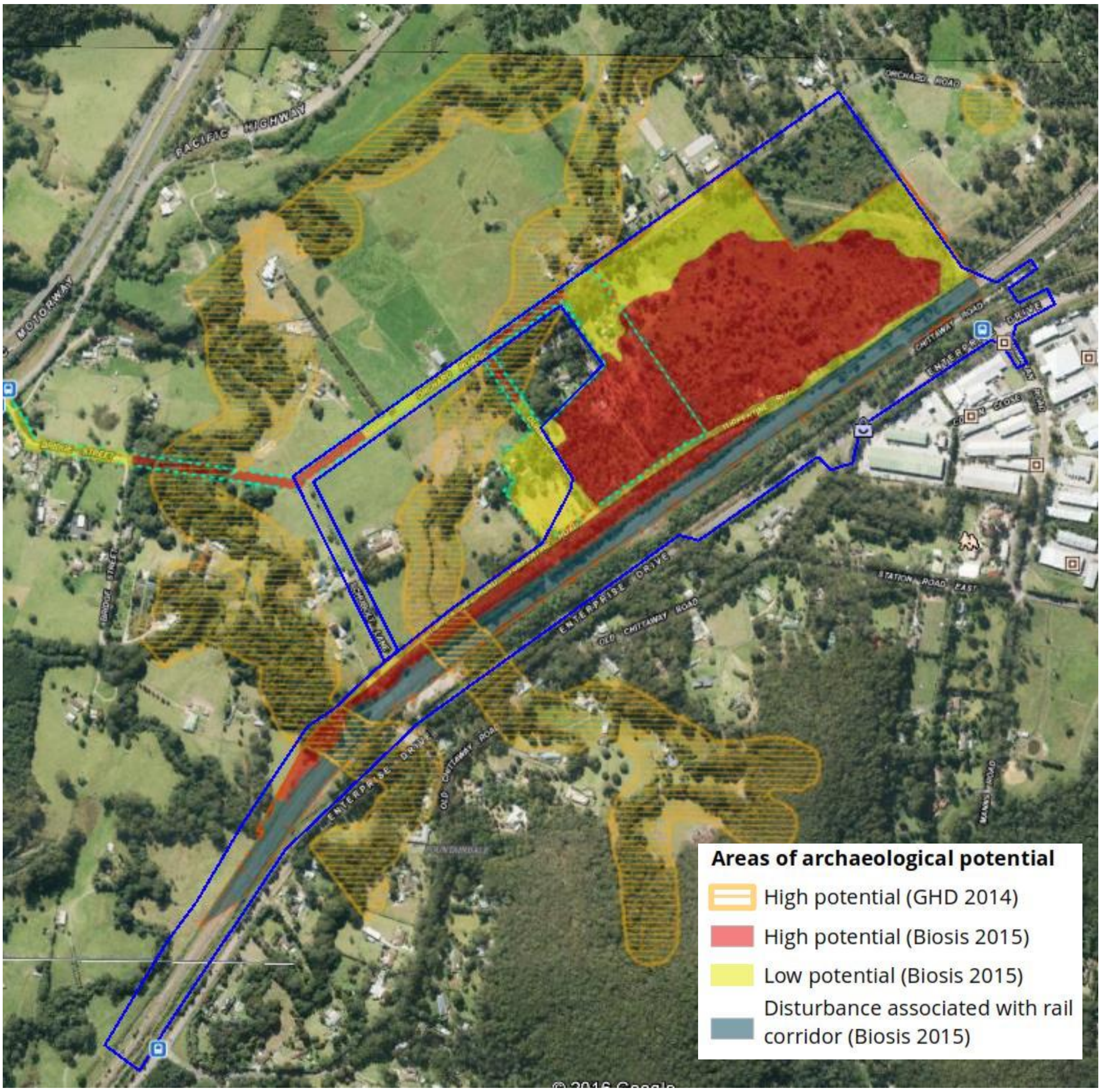
An Aboriginal archaeological survey was undertaken prior to the proposed upgrade of the intersection of Wyong Road and the Pacific Highway, in Tuggerah, about 2.4km to the north of the study area. Although an Aboriginal site was recorded in the vicinity of the intersection, it was found that the area itself had low archaeological potential, due to substantial levels of previous ground disturbance.

New Intercity Fleet Maintenance Facility (Biosis 2015)

A due diligence assessment of the proposed NIF Maintenance Facility location was completed in 2015, and covered approximately the same area as the present study area. The study resulted in the identification of an area of potential archaeological deposit (PAD) across an elevated area overlooking a watercourse, within Lot 82. Previous disturbance of this area appeared to be minimal and the location in proximity to permanent water suggested that there was potential for the presence of Aboriginal objects.

In general, high archaeological potential was identified across most of the study area, corresponding with locations that appeared to have been subject to relatively low levels of historical ground disturbance. The study also identified a moderate potential for the presence of scarred trees in uncleared areas, and high potential for the presence of grinding grooves or rock engravings on suitable sandstone outcrops.

Figure 5: Mapping of archaeological potential, with the current study area outlined in blue (Biosis 2015).



New Intercity Fleet Maintenance Facility: Geotechnical testing (RPS 2015a & 2015b)

To assist in planning for the proposed development, TfNSW undertook geotechnical investigation, comprising both test pits and boreholes within the study area. A due diligence assessment of this investigation was completed beforehand. The assessment resulted in a revision of the identified area of high potential (Figure 6). Part of this area was found to be disturbed and another part flood prone; these two sections were re-assessed as having low potential.

The assessment recommended no further work for the boreholes, where the small size of impact was considered not to require mitigation; or for the test pits located in previously disturbed areas, where archaeological potential was low. For the remaining testing locations, it was recommended that monitoring be undertaken during works.

The monitoring program included 19 geotechnical test pits, each up to 2m in length and 0.35-0.45m in width. No Aboriginal objects were identified during the works. In general, the soil profile revealed consisted of silty sands and sands, to depths varying from 20 to 160cm. In most cases, the underlying material was clay, but in a few cases it was sandstone. In a few cases, the base of the sand was not reached, as the water table was encountered, at 120-180cm below the ground surface. The presence of ash or charcoal was noted in two test pits. It was noted that evidence of flooding events or waterlogging was present, and it was suggested that this indicated that the area was frequently uninhabitable in the past.

Figure 6: The 19 test pit locations subject to archaeological monitoring (RPS 2015b).

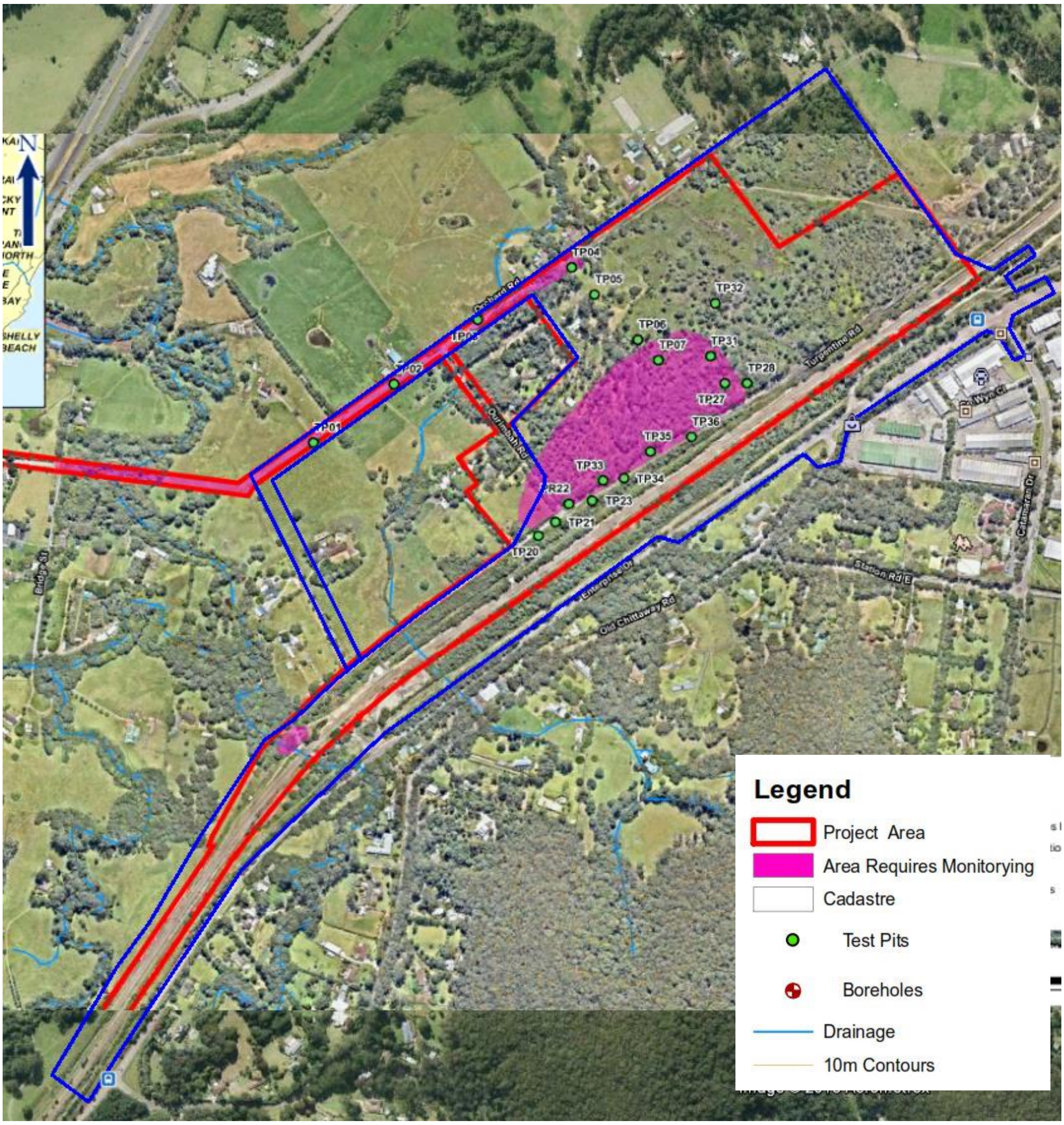


Table 2: Soil profiles within the monitored geotechnical test pits.

No.	Description	Depth below surface (cm)
TP01	Dark brown silty sand	20-30cm
	Charcoal inclusions Gradual increase in clay content	30-50cm
	Increase in orange clays	50-130cm
TP02	Compact dark brown silty loam	10-15cm
	Dark brown clayey silt with charcoal inclusions	15-40cm
	Very compact orange brown clay	40-120cm
	Yellowish sands	120-170
TP03	Possible fill – friable clayey silt	0-70
	Sandy clay	70-100
	Dark grey-brown clay, with gravel inclusions	100-?
TP04	Dark brown silty sand	0-?
	Light brown silty sand	?
	Yellow clayey sand	?-180
TP05	Compact homogeneous dark brown very silty sand	0-64
	Coffee-brown silty sand	64-?
	Mottled orange-grey sandy clay	?-170
TP06	Dark grey moist sandy topsoil	0-30
	Light grey sand	30-80
	Light grey sand with iron-rich sandstone inclusions, sandstone boulder encountered at 100cm	80-150
TP07	Very dark brown to black peaty sand, with ash and charcoal inclusions	0-20/30
	Grey sand	20/30-80
	Yellow-orange sand, becoming yellow-white with depth	80-180
TP20	Compact, well sorted, very dark brown-grey sand	0-50
	Lighter grey sand	50-100
	Ferrous sedimentary rock	100
TP21	Loose, very dark grey / grey-brown silty sand	0-20
	Light grey sand, with iron-rich rock inclusions from 70cm	20-130

TP22	Dark grey silty sand	0-40
	Light grey sand, becoming brown from 80cm	40-100
	Red-brown silty sand	100-160
TP23	Dark grey-brown silty sand, with ash inclusions and lenses of grey sand	0-70
	Red-brown silty sand, with ferrous rock and gravel inclusions	70-120
	Clay	120
TP24	Dark brown-grey sand	0-20/30
	Light grey sand	20/30-50
	Compact orange sand	50-150
	Soft brown sand	150
TP25	Dark grey-brown silty sand	0-50
	Yellow-white sand, with orange clay nodule inclusions	50-130
TP27	Friable mottled orange / grey silty sand	0-5/10
	Mottled orange sand	5/10-?
	Compact, coarse-grained orange-white silty sand, with occasional dark red-orange streaking	?
TP28	Compact grey sand	0-20
	Mottled orange / red / white / black clay, with iron-rich sandstone inclusions from 100cm	20-170
	Very coarse-grained white sandy clay	170
TP31	Friable grey sand	0-40
	Yellow sand, with high gravel content, including quartz	40-100
	Orange clay, with darker orange streaks	100-160
TP32	Very dark brown silty sand, with a lens of grey fill, and a concentration of charcoal.	0-50
	Orange clay?	50-190
TP33	Dark grey sand	0-20
	Lark grey sand, becoming white with depth	20-100
	Dark red-brown coarse sand	100-120
TP34	Dark grey-brown silty clayey sand	0-10
	Lighter grey clayey sand	10-30
	Orange-brown mottled clay, becoming more yellow with depth	30-194

4.2 Registered Aboriginal sites

The locations and details of Aboriginal sites are considered culturally sensitive information. It is recommended that this information and associated maps are removed from the report if it is to be made publically available.

An extensive search of the Aboriginal Heritage Information System (AHIMS) database was conducted on 15 January 2016 for sites registered within the following parameters:

GDA 1994 MGA 56	345800mE – 355800mE 6305700mN – 6315700mN
Number of sites	31
AHIMS Search ID	207659

The AHIMS search area encompasses the wider region around the study area, in order to give context to the findings in the study area. The distribution of recorded sites within the AHIMS search area is shown in Figure 7. See Appendix A for a glossary of site types and Appendix B for the results of the search.

There are 31 sites recorded within the search area. Of these, one has since been determined not to be a site, leaving 30. No registered sites are located within the study area.

OEH lists 20 standard site features that can be used to describe a site registered with AHIMS, and more than one feature can be used for each site. The frequency of site features is summarised in Table 3 below. A total of 37 instances of seven site features has been recorded. About half of the sites are recorded as artefacts. However, there is a smaller number, but relatively wide variety, of other site features.

The site features recorded are likely to relate to the nature of past Aboriginal occupation of the area, but also to the impact of historical occupation on the archaeological record, and the nature of the archaeological investigation that has been undertaken so far. Most of the sites within the search area have been recorded in the hills of the Narrabeen Sandstone country, to the north and south of the valley containing the study area. All of the site features associated with sandstone (grinding groove, art, water hole, quarry) are located in the hills. However, a number of sites have also been recorded on the alluvial land alongside Wyong and Ourimbah Creeks. The site feature recorded for all of these sites is ‘artefact’.

The closest of these sites to the study area is AHIMS No. 45-3-1146 (Tangy Dangy), located approximately 200m to the north-east. When recorded, the site consisted of 24 flaked stone artefacts, made on chert, rhyolite and quartzite. These were located on the ground surface, over an area of 50 x 6m along a bulldozed track. The site was located approximately 250m from Ourimbah Creek, but was on a ridge which was interpreted as the bank of a former channel of Ourimbah Creek. The property owner had previously found an edge-ground axe on the same landform.

Table 3: Frequency of site types from AHIMS data.

Site feature	Frequency	Percentage
Artefact	19	51.4
Grinding groove	9	24.3
Art	5	13.5
Modified tree	1	2.7

Site feature	Frequency	Percentage
Shell	1	2.7
Stone quarry	1	2.7
Water hole	1	2.7

Figure 7: Location of AHIMS sites in the search area, with the study area outlined in red.

Note: This image has been removed for confidentiality purposes

5.0 SURVEY

5.1 Predictive model

Three previous assessments of the Aboriginal archaeological potential of the study area have been made, and demonstrate a developing understanding of this, as further information has become available (see Figure 8). The initial mapping appears to have been based on desktop research only (GHD 2014, reproduced in Biosis 2015). This mapping was restricted to identifying a 50m-wide corridor along watercourses as having Aboriginal heritage sensitivity. Previous research has identified that past Aboriginal occupation did in general have a focus on freshwater resources. However, it is unlikely the consequent archaeological sensitivity can be narrowed to a 50m corridor in this case. The OEH due diligence guidelines indicate that Aboriginal objects can be expected within 200m of water. In addition, previous assessments of the Gosford / Wyong area note that fresh water is relatively readily available, and that site location is therefore less likely to be constrained by this resource. That is, sites are likely to be more widely distributed, rather than focussed largely on freshwater sources.

The due diligence assessment undertaken by Biosis in 2015 made the following statement with regard to potential (Biosis 2015: 5):

> *There is a high potential for artefact scatters to be present within minimally disturbed elevated areas overlooking creeklines. There is also a moderate potential for scarred trees to be present within uncleared areas of the study area which were unable to be surveyed due to restricted access. There is also a high potential for grinding grooves or rock engravings to be present within suitable sandstone outcrops within the study area.*

Some parts of the study area, in particular the rail corridor, have been subject to historical period ground disturbance. Biosis (2015: 30) considered that Aboriginal objects were unlikely to be present in these locations.

The due diligence report subsequently undertaken by RPS, specifically for the geotechnical testing, resulted in a refinement of the identified area of archaeological potential (RPS 2015a: 2). The eastern part of the area identified by Biosis as having high archaeological potential was reassessed as having low potential. Part of this location had been subject to substantial disturbance and landform modification, resulted in the exposure of B-horizon clay in places. It also included an inundated area, which was considered likely to have been unsuitable for occupation in the past. The report supported the assessment of the remainder of the area as demonstrating high archaeological potential.

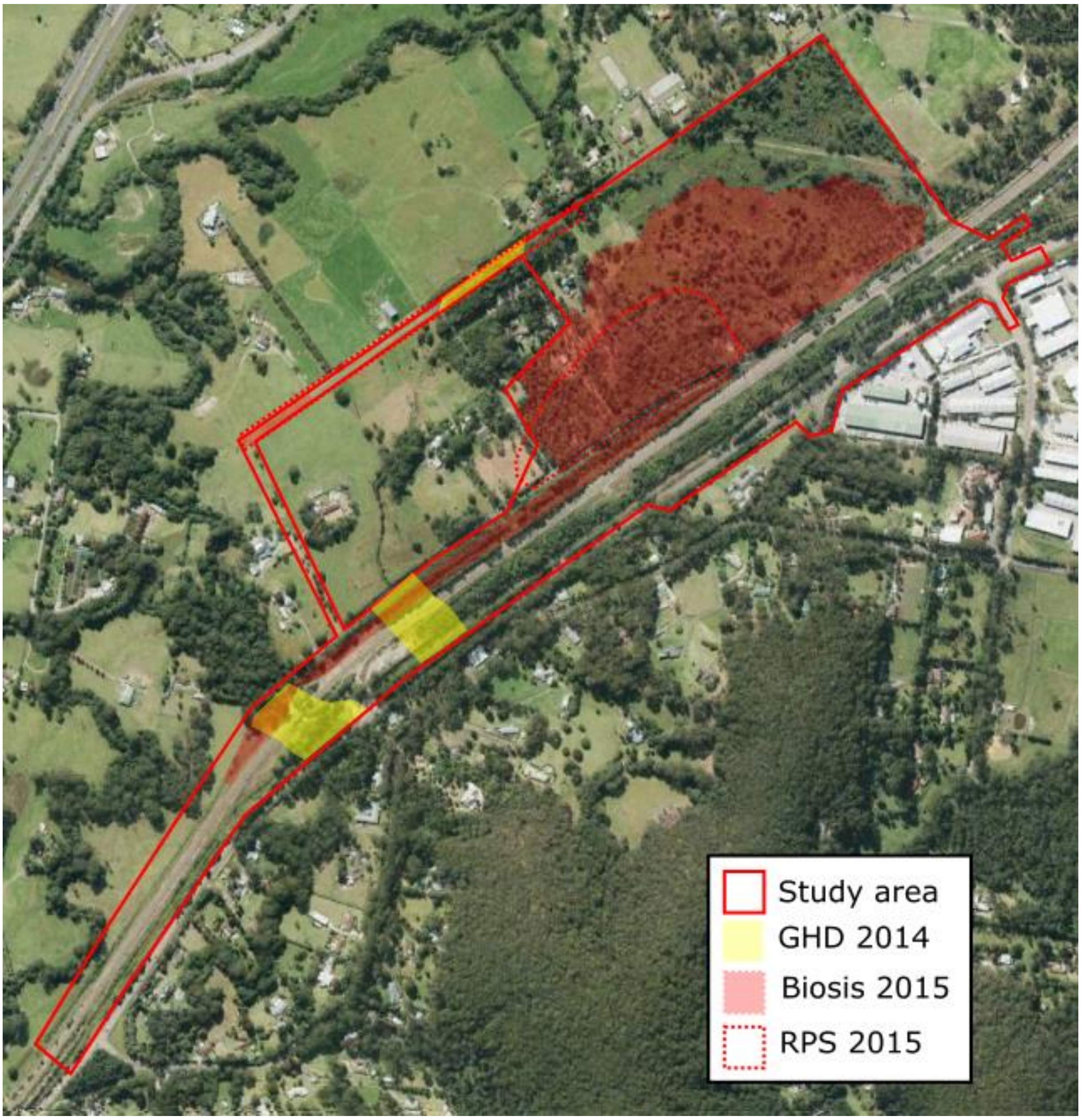
The results of monitoring by RPS indicated that deep and relatively undisturbed sand deposits were present within the area of high archaeological potential (RPS 2015b: 14). No Aboriginal objects were identified, although there would generally be low expectation of identifying stone artefacts with this type of methodology. In addition, evidence of flooding and/or waterlogging indicated that the area may not have been suitable for past Aboriginal occupation.

The results of the previous investigations undertaken indicate the following:

- The study area is located within a region that would have provided rich and varied resources to the Aboriginal people of the area. It is in close proximity to the freshwater of Ourimbah Creek, the saltwater of Tuggerah Lake, and the shelters of the Narrabeen sandstone country.

- Much of the study area itself is low-lying and floodprone, and would not have been suited to long-term or repeated occupation. Occupation would have been focussed on areas of relatively high ground, if any are present within the study area.
- Across most of the study area, any archaeological deposits that were created in the past are likely to have remained through to the present, because of the low levels of historical disturbance and deep soil profile. However, Aboriginal objects are unlikely to be present within the railway corridor, as a result of the high levels of disturbance within this corridor specifically.
- Aboriginal objects present within the study area are likely to consist of stone artefacts, present either on the ground surface or within subsurface deposits.
- There is some limited potential for the presence of scarred trees and grinding grooves. However, most of the original vegetation of the study area is thought to have been cleared in the late twentieth century, and rock outcrop is unlikely to be present in this soil landscape except adjacent to watercourses.

Figure 8: Previous assessments of archaeological potential within the study area.



5.2 Site definition

An Aboriginal site is generally defined as an Aboriginal object or place. An Aboriginal object is the material evidence of Aboriginal land use, such as stone tools, scarred trees or rock art. Some sites, or Aboriginal places can also be intangible and although they might not be visible, these places have cultural significance to Aboriginal people.

OEH guidelines state in regard to site definition that one or more of the following criteria must be used when recording material traces of Aboriginal land use:

- The spatial extent of the visible objects, or direct evidence of their location

- Obvious physical boundaries where present, e.g. mound site and middens (if visibility is good), a ceremonial ground
- Identification by the Aboriginal community on the basis of cultural information.

For the purposes of this study an Aboriginal site was defined by recording the spatial extent of visible traces or the direct evidence of their location.

PADs are areas where sub-surface stone artefacts and/or other cultural materials are likely to occur (DECCW 2010: 38). These areas may be associated with recorded sites but are often greater in extent, taking in areas around the visible artefacts where there is a potential for further buried artefacts to exist. PADs may also be present where no visible artefacts are located. This may be the case when there is no ground surface visibility, but the area is seen to have a high likelihood of containing subsurface artefacts.

5.3 Methodology

A survey of the study area was conducted by Fenella Atkinson and Alyce Haast (Artefact Heritage), Lee Davison (Darkinjung LALC) and Tracey Howie (Guringai Tribal Link Aboriginal Corporation) on 19 February 2016.

The survey was conducted in accordance with the OEH *Code of practice*. The survey was conducted on foot, using a handheld GPS as well as physical maps. A photographic record was kept of all sections of the study area. Photographs were taken to record different aspects of the landform units within the study area, vegetation, levels of disturbance and potential for Aboriginal sites.

The reports completed by Darkinjung LALC and Guringai Tribal Link Aboriginal Corporation are included as Appendices C and D.

5.4 Results

The study area was divided into three survey units:

1. Rail corridor, Turpentine Road and easement, Old Chittaway Road.
2. 55 Orchard Road (Lots 34-40 DP 2877), and Orchard Road.
3. 53 Orchard Road (Lot 41 DP 2877), 11 Ourimbah Road (Lot 32 DP 1033784), 12 Ourimbah Road (Lot 121 DP 874787), Ourimbah Road, Orchard Road and Schubolt Lane.
4. Enterprise Drive and Catamaran Drive – Not surveyed

Effective survey coverage is outlined in Table 4 and landform survey coverage is outlined in Table 5. In general, ground surface visibility was very low. Most of the ground surface was covered with dense grass and low vegetation, and road pavements were also present. The survey did not result in the identification of any Aboriginal objects.

Table 4: Effective survey coverage

Survey unit	Landform	Survey unit area (sq m)	Visibility (%)	Exposure (%)	Effective coverage Area (sq m)	Effective coverage (%)
1	Alluvial flat Two drainage lines	220,571	40	10	8,822.44	4
2	Alluvial flat	218,844	40	20	17,507.52	8
3	Alluvial flat One drainage line Mid-slope	81,127	30	30	7,301.43	9

Table 5: Landform survey coverage

Landform	Landform Area (sq m)	Area effectively surveyed (sq m)	% of landform effectively surveyed	Number of sites
Alluvial flat	467,542	30,200	6.5	0
Drainage line	28,000	1,816	6.5	0
Mid slope	25,000	1,614	6.5	0

Survey Unit 1: Rail corridor, Turpentine Road and easement, Old Chittaway Road

The rail corridor was not accessed for the survey, but was visible from some locations. The railway line in general runs along a substantial embankment (Plate 1 and Plate 2). Enterprise Drive runs roughly parallel to the line, along the southern side, and also runs along an embankment in places, creating a substantial channel between the two. An unsurfaced access track runs along the northern side of the railway line (Plate 3). Beside the rail line and access track, the rail corridor is densely vegetated with grass, shrubs and trees.

Turpentine Road to the west of Ourimbah Road has an asphalt surface (Plate 4). There are no formed kerbs or gutters, but a drainage ditch on either side of the road, and powerpoles for overhead cable. The road reserve on the northern side is covered with dense grass. On the southern side, between the road and rail corridor, it has been planted with shrubs and small trees. The road is generally flat, but crosses a rise just west of Schubolt Lane (Plate 5). This is the southern part of a small hill that is located outside of the study area, to the west of Schubolt Lane.

Turpentine Road then slopes down towards Chittaway Creek, and both pass under the railway line by way of an underpass (Plate 6). At the time of the site inspection, the Creek was flowing but shallow (Plate 7). The bed and banks of the Creek appear to have been heavily modified in this location, presumably due to the construction of Turpentine Road and the underpass. A flood marker placed at the underpass indicates that the Creek occasionally floods. This was confirmed by the resident of 12 Ourimbah Road, who advised that it was not uncommon for Turpentine Road to be closed at this point due to flooding. To the south of the underpass, Turpentine Road bends and follows the slope back up from the Creek. Sandstone bedrock was exposed on one of the bends (Plate 8).

To the east of Ourimbah Road is an unsurfaced maintenance track (Plate 9). The ground exposed is a sandy soil, that has been heavily disturbed by vehicle movements. At the time of the survey, the track was covered in standing water in places (Plate 10). An overhead powerline runs parallel to the road, on the southern side.

Survey Unit 2: 55 Orchard Road (Lots 34-40 DP 2877)

This part of the study area has been cleared in the past, probably for use as cattle pasture, but is presently covered in dense vegetation, largely comprising young trees and undergrowth (Plate 11). In the northern part of the property is a large area that was very poorly drained (Plate 12). It was difficult to tell whether this was a former dam or a natural swampy area. However, there was an area of spoil to the south, suggesting that it may have been a dam.

An electricity easement runs through this part of the study area (Plate 13). Along the east-west section of the easement, vegetation has been cleared in the past, but has since regrown. Along the northwest-southeast section, an unsurfaced track runs under the line (Plate 14). The track follows the natural slope down to the south towards the railway line. In places, brick and building rubble has been introduced to surface the track. In the southern part of this property, adjacent to the Turpentine Road corridor, there are occasional dumps of building material and spoil (Plate 15).

Survey Unit 3: 53 Orchard Road (Lot 41 DP 2877), 11 Ourimbah Road (Lot 32 DP 1033784), 12 Ourimbah Road (Lot 121 DP 874787), Orchard Road and Schubolt Lane

Orchard Road, running along the north-western boundary of the study area, has an asphalt pavement (Plate 16). There is some evidence of earthworks for construction of the road, but in general it follows the slope of the land, following a slight rise up to the east of Ourimbah Road. To the west of Ourimbah Road, the asphalt pavement continues for about 250m. The road reserve then continues to meet Schubolt Lane, but this area is grassed, and it does not appear that a road has ever been built through here (Plate 17).

The northern part of 53 Orchard Road has been developed with a house and a number of freestanding outbuildings and sheds, and fenced to create several small yards (Plate 18). The northern part of this property appears to occupy a slight rise. An asphalt driveway leads into the property off Orchard Road, and through to the house and sheds. The ground in this area is otherwise covered with dense short grass; where visible it is a sandy soil. There are sparse small to large trees, most young, becoming denser towards the south of the property.

To the south of the outbuildings and yards is an area which appears to have been subject to ground disturbance; there are mounds of soil in this area, and pieces of broken concrete (Plate 19). Temporary tracks have been made through this area by vehicles used for the geotechnical testing.

In the north-eastern corner of 11 Ourimbah Road is a single-storey house on piers (Plate 20). The southern part of the property is densely vegetated with young trees and undergrowth, which appear to be regrowth native vegetation (Plate 21). Ground surface visibility was relatively low, due to undergrowth and leaf litter, but a sandy soil was visible in places (Plate 22).

The adjacent section of Ourimbah Road has an asphalt pavement, with drainage ditches on either side, and an overhead powerline running along the western side (Plate 23).

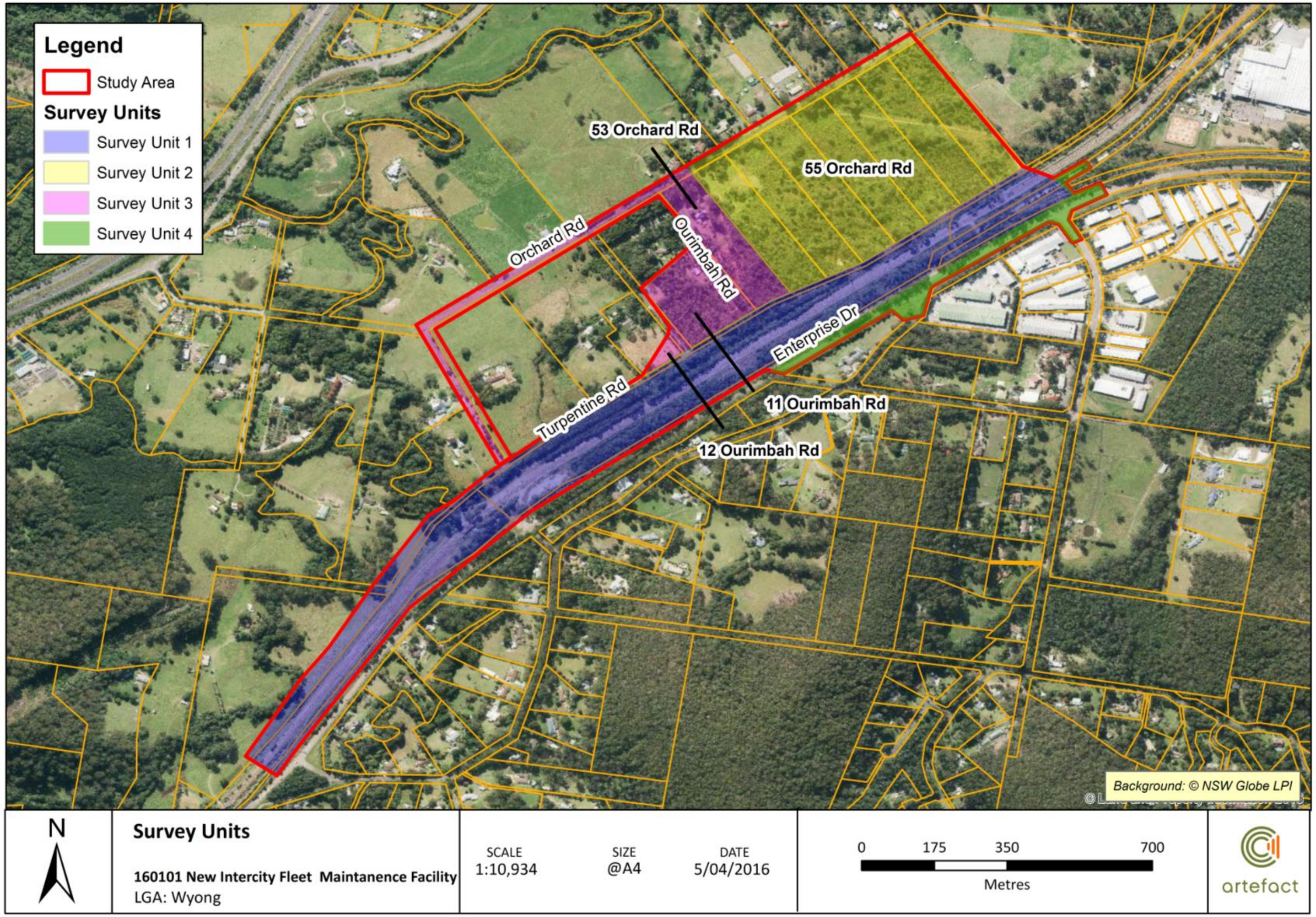
The south-eastern corner of 12 Ourimbah Road is included in the study area (Plate 24). This location is covered in dense long grass, with a few young trees. The property is bordered by larger trees.

The southern part of Schubolt Lane, to the north of Turpentine Road, runs across the mid slope of a small hill that is located outside the study area (Plate 25). This part of the Lane has a narrow asphalt pavement, and has been constructed through cut-and-fill.

Survey Unit 4: Enterprise Drive and Catamaran Drive

Survey unit 4 was added to the study area following the site visit and consequently not surveyed. Desktop assessment of the area indicates that Enterprise Drive and Catamaran Drive are comprised of asphalt pavement with the road corridor surrounded by a lining of trees and manicured grasses. The roads appear to have been constructed or resurfaced relatively recently.

Figure 9: The study area, divided into three survey units.



Survey Unit 1: Rail corridor, Turpentine Road and easement, Old Chittaway Road

Plate 1: Rail embankment.

Plate 2: Rail embankment.

Plate 3: Access track alongside the railway line.

Plate 4 Turpentine Road, west of Ourimbah Road.

Plate 5: Turpentine Road, showing the rise west of Schubolt Lane.

Plate 6: Turpentine Road / Chittaway Creek rail underpass.

Plate 7: Chittaway Creek.

Plate 8 Exposed sandstone bedrock adjacent to Turpentine Road.

Plate 9: Access track, east of Ourimbah Road.

Plate 10: Water over access track.

Survey Unit 2: 55 Orchard Road (Lots 34-40 DP 2877

Plate 11: 55 Orchard Road, vegetation cover.

Plate 13: Electricity easement running through 55 Orchard Road.

Plate 15: Building material in the south of 55 Orchard Road.

Plate 12: Swamp area in the northern part of 55 Orchard Road

Plate 14: Track along the electricity easement

Survey Unit 3: 53 Orchard Road (Lot 41 DP 2877), 11 Ourimbah Road (Lot 32 DP 1033784), 12 Ourimbah Road (Lot 121 DP 874787), Orchard Road and Schubolt Lane

Plate 16: Orchard Road, east of Ourimbah Road

Plate 17: The western end of the Orchard Road reserve

Plate 18: 53 Orchard Road, looking north.

Plate 19: Concrete in the disturbed area on 53 Orchard Road.

Plate 20: 11 Ourimbah Road, view of the house.

Plate 21: 11 Ourimbah Road, southern part.

Plate 1: 11 Ourimbah Road, ground surface visibility.

Plate 2: 12 Ourimbah Road.

Plate 3: Ourimbah Road.

Plate 25: Schubolt Lane

6.0 SCIENTIFIC SIGNIFICANCE ASSESSMENT

6.1 Analysis of archaeological potential

The archaeological potential of an area is determined by its landform, its location and the level of disturbance. Certain landforms, such as gentle slopes, are conducive to Aboriginal occupation and the survivability of sub-surface archaeological deposit, while others, such as steep slopes, are not. The location of appropriate landforms in relation to natural resources, in particular their proximity to permanent water sources, increases their archaeological potential. Correlations between site location and proximity to permanent water have been proven in previous archaeological investigations where the number of sites and their densities is highest in close proximity to watercourses. In areas where there is a high level of disturbance however, the archaeological potential is lowered.

Archaeological potential can be assessed according to the following levels:

- High: Intact archaeological material is likely to be found in this area.
- Moderate: Intact archaeological material may be found in this area.
- Low-Moderate: Limited potential for intact archaeological material in this area.
- Low: Unlikely that intact archaeological material will be found in this area.

There are no registered Aboriginal sites within or in close proximity to the study area. The investigation undertaken for the present ASR did not result in the identification of any Aboriginal objects within the study area. With regard to archaeological potential, the study area can be divided into two parts (Figure 10):

- Low archaeological potential.

The railway corridor has been subject to substantial earthworks for construction, upgrade and maintenance of the railway line. It is considered likely that this work has removed any earlier archaeological evidence that was present in this part of the study area.

- Moderate archaeological potential.

The remainder of the study area has been subject to lower levels of disturbance. These have resulted from clearing vegetation, use of some of the study area for pasture, and development of discrete locations for the construction of houses and outbuildings, roads and installation of services. A deep soil profile is present across the study area, and it is therefore unlikely that this type of development would have resulted in complete removal of any archaeological material present.

The study area is within a locality that was rich in varied natural resources. Previous investigations indicate that the past Aboriginal occupation of the locality is represented in a range of site types. The available evidence suggests that much of the study area itself is prone to flooding and waterlogging. Aboriginal occupation of such an area would have been focussed on raised landforms, rather than widespread. No clearly defined raised landforms are present within the study area, but higher ground is present in the vicinity of Schubolt Lane and the northern part of the property 53 Orchard Road.

Very little investigation of sub-surface archaeological deposits has been undertaken in the locality. Because of the deep soil profile, any such deposits present in the study area have the potential to be stratified and to provide information about the history, as well as the nature, of past Aboriginal occupation.

6.2 Assessment criteria

Archaeological significance refers to the archaeological or scientific importance of a landscape or area. This is characterised by using archaeological criteria such as archaeological research potential, representativeness and rarity of the archaeological resource and potential for educational values. These are outlined below:

- Research potential: does the evidence suggest any potential to contribute to an understanding of the area and/or region and/or state's natural and cultural history?
- Representativeness: how much variability (outside and/or inside the subject area) exists, what is already conserved, how much connectivity is there?
- Rarity: is the subject area important in demonstrating a distinctive way of life, custom, process, land-use, function or design no longer practised? Is it in danger of being lost or of exceptional interest?
- Education potential: does the subject area contain teaching sites or sites that might have teaching potential?

An item or place may also have heritage significance related to cultural values. In general, the cultural values of Aboriginal items and places are assessed in conjunction with the Aboriginal community.

6.3 Archaeological significance assessment

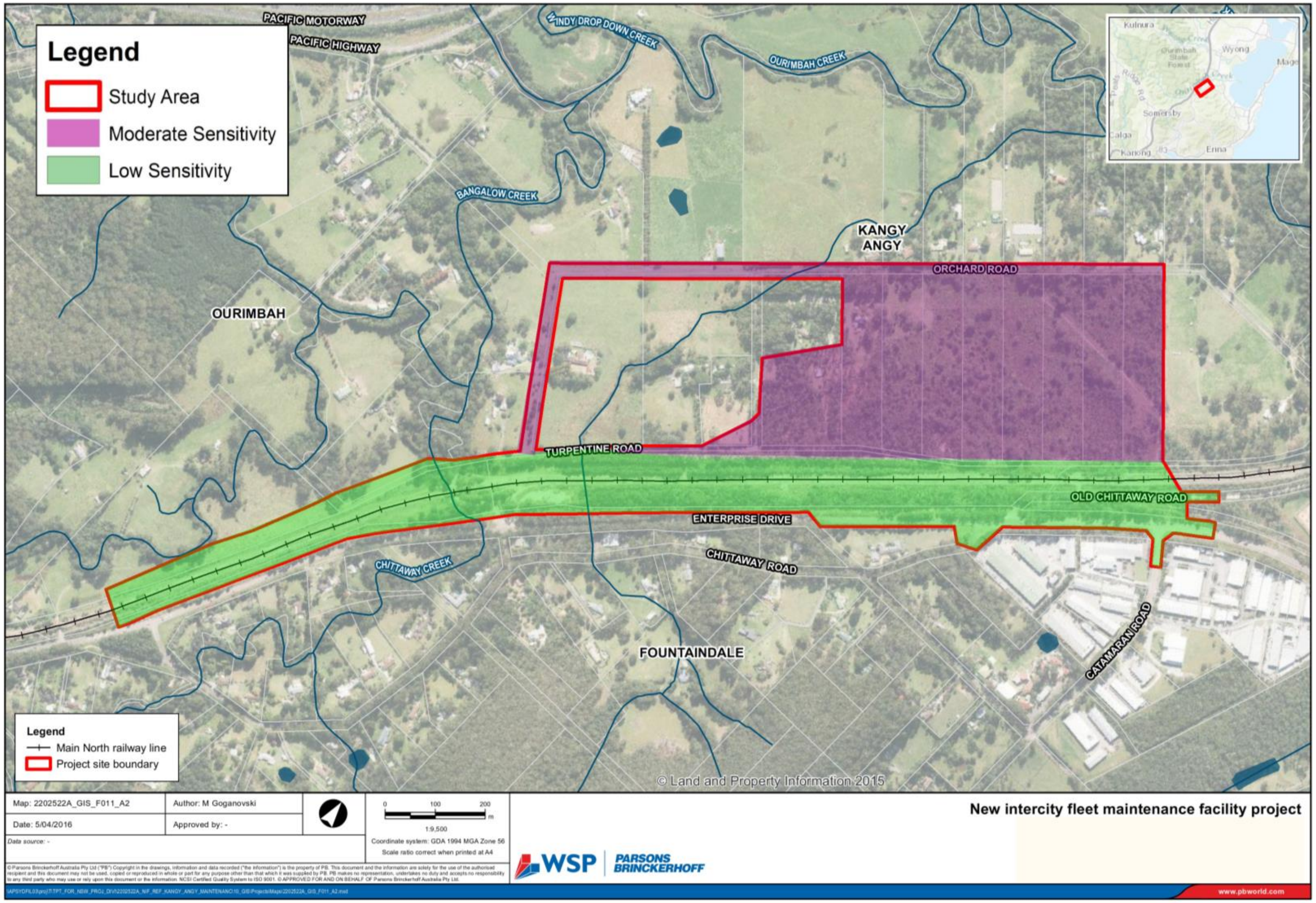
The railway corridor within the study area has low archaeological potential and is considered to have no archaeological significance.

The remainder of the study area has moderate archaeological potential. Intact archaeological deposits in this area have high research potential for three reasons:

- A substantial amount of information is available regarding a range of surface Aboriginal sites in the locality, including grinding grooves, art, modified trees, middens and a quarry. Some relevant ethnographic information is also available. The information derived from a subsurface archaeological deposit would be analysed in conjunction with this known material, providing a deeper understanding of past Aboriginal occupation.
- Any subsurface archaeological deposit present within the study area is likely to be relatively deep and stratified. The information that can be derived from such a deposit bears on the chronology as well as the nature of Aboriginal occupation.
- Little archaeological excavation has been undertaken in the region. Investigation of any subsurface deposit that is present within the study area is therefore likely to provide information that has previously been unavailable.

It should be noted that this assessment of archaeological significance is based on the results of background research and survey only. Subsurface investigation would be required to confirm the assessment.

Figure 10: Archaeological sensitivity of the study area.



7.0 IMPACT ASSESSMENT

7.1 Proposed development

TfNSW proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. The facility would undertake light and heavy train maintenance activities for the New Intercity Fleet, including but not limited to:

- Regular maintenance/servicing
- Repair/replacement of train components
- Interior and exterior cleaning

The proposed facility would include about six kilometres of electrified railway (in total), would be seven tracks wide at its widest point, covering an area of approximately 48 hectares, and would be bounded by a perimeter fence. The proposed facility would include the following key elements (Figure 11:

- Maintenance facility:
    - Maintenance building
    - Auxiliary workshops
    - Electronic clean room
    - Material storage, including flammable liquid storage
    - Wheel lathe
    - Train wash
    - Site access roads
- Ancillary facilities:
    - Security
    - Administration
    - Facilities for presentation and train maintenance staff
    - Operational control
    - Training rooms
    - Train simulator
    - Power supply (traction power, bulk power, signalling power supply and backup generators)
    - Detention basins
    - Car parks
    - Access roads

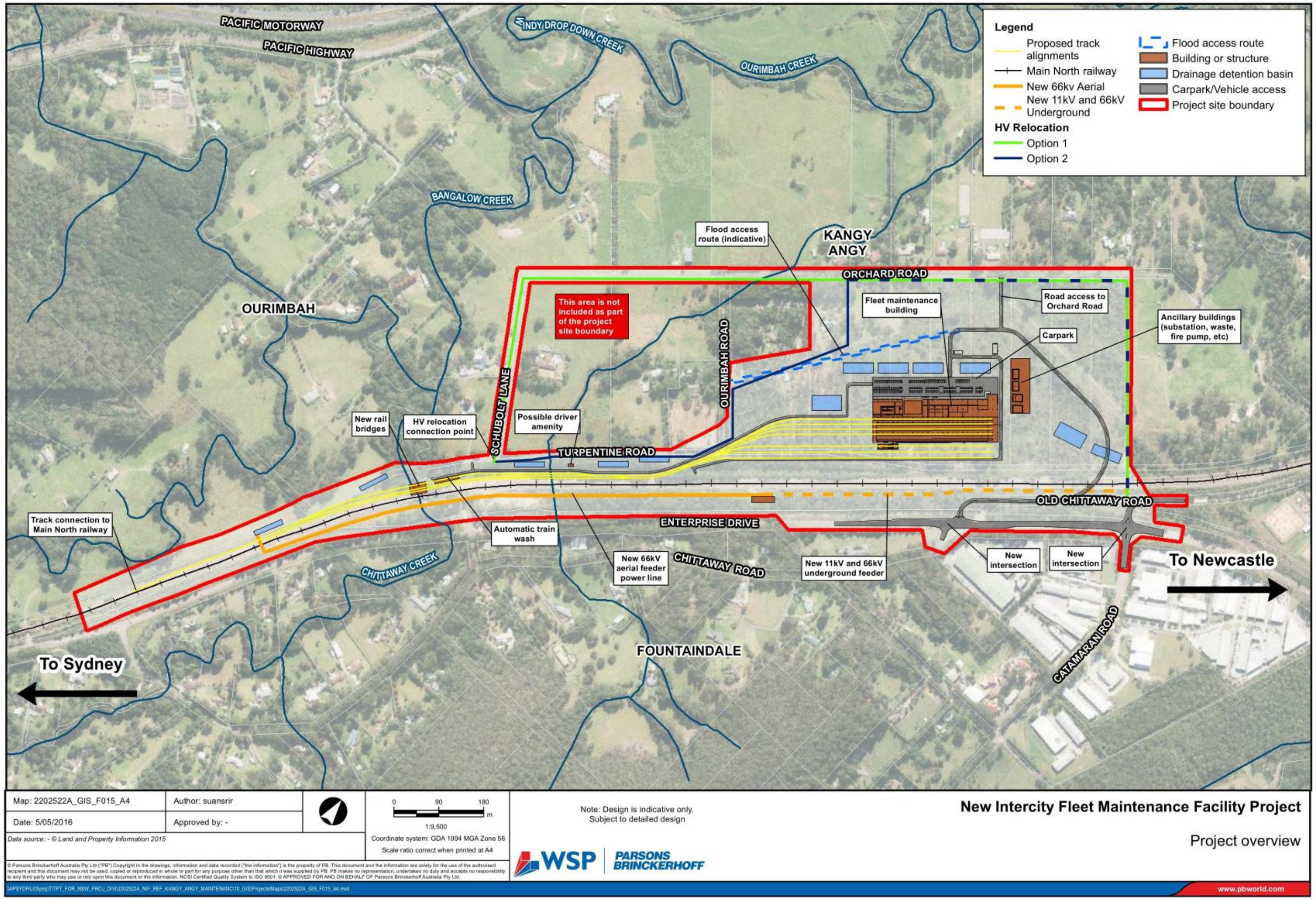
The proposed work will require excavation to a depth of 1 to 1.5m across the main site, with deeper excavation of up to 4m for some elements. The required depth of excavation for foundation piles has not yet been determined, but is likely to be deeper.

7.2 Potential Aboriginal heritage impact

The proposed works within the railway corridor are unlikely to result in harm to Aboriginal objects. This part of the study area has been assessed as having low archaeological potential.

The remainder of the study area has been assessed as having moderate archaeological potential, although this has not been confirmed. The proposed works within this part of the study area could result in harm to Aboriginal objects (if confirmed to be present), as excavation may involve removal of archaeological deposit that may be present in this part of the study area. The depth of the soil profile varies across the study area, and it may not be necessary to excavate across the whole of the footprint. It is therefore possible that the proposed works may not result in complete removal of any archaeological deposit.

Figure 11: Proposed development.



8.0 RECOMMENDATIONS

8.1 Management and mitigation measures

Mitigation measures recommended vary depending on the assessment of archaeological significance of an area, which is based on the research potential, rarity, representativeness and educational value. Where no archaeological evidence is recorded for a site area, preliminary assessment of archaeological significance considers the potential significance of an area as a guide to future work. In general, the significance of a site would involve the following mitigation measures, should the presence and significance of the site be confirmed.

- Low archaeological significance – No further investigations required.
- Moderate archaeological significance – Conservation where possible. If conservation was not practicable further archaeological investigation may be required.
- High archaeological significance – Conservation as a priority. Further archaeological investigation would be required.

Part of the study area is considered to have moderate archaeological potential and are possibly of high archaeological significance, although this has yet to be confirmed. The recommendations below are based on this assessment. However, it should be noted that the potential presence of Aboriginal objects has not been confirmed, and that sub-surface investigation would be required to confirm the assessment. Recommendations would be revised following the additional investigation.

8.2 Aboriginal community consultation

Representatives from Darkinjung LALC and Guringai Tribal Link Aboriginal Corporation participated in the survey. Darkinjung LALC has also provided comments on the previous reports completed by Biosis and RPS in 2015 (Appendix C). Comments made during the survey and in the reporting are summarised as follows:

- No further archaeological investigation of the railway corridor is required.
- Further archaeological investigation of the remainder of the study area is required, as visibility during survey was very low.
- Any earthworks within areas of Aboriginal archaeological sensitivity should be managed in consultation with the local Aboriginal community.
- The ecological values of the study area should also be considered to have importance to the Aboriginal community.

8.3 Recommendations

The recommendations are based on consideration of:

- Statutory requirements under the *National Parks and Wildlife Act 1974*
- The results of the background research, site survey and assessment.
- The interests of Aboriginal stakeholder groups.
- The likely impacts of the proposed development.

The following recommendations are made:

- If the extent and nature of the proposed development is altered, additional archaeological assessment should be undertaken to address this.
- No further archaeological investigation is required for the railway corridor within the study area.
- An Aboriginal cultural heritage assessment report (ACHAR) should be completed for the remainder of the study area, and should include Aboriginal community consultation and archaeological test excavation. This process should be undertaken in accordance with the guidelines issued by the Office of Environment and Heritage:
    - *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011).
    - *Code of practice for archaeological investigation of Aboriginal objects in New South Wales* (DECCW 2010).
    - *Aboriginal cultural heritage consultation requirements for proponents* (DECCW 2010).
- In accordance with the results of the Species Impact Statement undertaken for the project, the relevant approval and REF determination should be in place prior to completion of the archaeological test excavation component of the ACHAR.
- If the results of the ACHAR confirm that Aboriginal objects are present and will be harmed by the proposed development, it will be necessary to apply for an Aboriginal Heritage Impact Permit (AHIP) prior to commencement of works.

Recommendations made by Darkinjung Local Aboriginal Land Council and Guringai Tribal Link Aboriginal Corporation are included in the appended reports (Appendices C and D).

9.0 REFERENCES

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10.0 APPENDICES

10.1 Appendix A: Site Types

Material traces of Aboriginal occupation exist throughout the landscape and are known as Aboriginal sites. The primary site types that are found in the region are as follows:

- Stone artefacts – Flaked and ground stone artefacts are the most common trace of Aboriginal occupation in NSW. Aboriginal people used particular techniques to flake stone and these changed over time. The approximate age of a tool can often be diagnosed by the way that it was made. Stone artefacts are most often found in scatters that may indicate an Aboriginal campsite was once present. Stone artefacts may also be found as isolated finds. Stone tools in the Sydney region are most often made from raw materials known as silcrete, tuff and quartz. These are all easily flaked and form sharp edges, which can be used for cutting or barbing spears.
- Rock shelters with deposit – Rock shelters were used by Aboriginal people for habitation, rest places and as art or ceremonial sites. Deposits can build up on the floor of these shelters over time and bury traces of Aboriginal occupation. If these deposits are not disturbed, rock shelters can provide an intact stratigraphy that can tell us about the way Aboriginal occupation changed through time.
- Shell middens – Shell middens are remains of campsites in which the primary traces are shell and/or bones of fish. Shell middens are often found close to rivers or streams and are either along banks or within enclosed shelters.
- Rock engravings/Rock art – Rock engravings are often found in Hawkesbury geologies on flat sandstone platforms. Shapes of animals, ancestor figures or other symbols were carved into the sandstone. Weathering has affected the visibility of many rock engravings. Other rock art of various forms has also been recorded in the Sydney basin. Stencils, charcoal drawings and paintings are examples of the techniques used by Aboriginal people. Rock art is relatively rare, but is more common on sandstone geologies than on the plains of western Sydney.
- Axe grinding grooves – Axe grinding grooves are created when axe blanks (often basalt cobbles) are shaped by rubbing the stone across an abrasive rock such as sandstone, often using water. Sharpening axes and other tools also forms them. Axe grinding grooves are often found on the banks of streams or rock pools.
- Scarred trees – Aboriginal people practiced tree marking or scarring for a variety of reasons. Large scars are often the result of a tree being debarked for a canoe blank and smaller scars may have been the result of making shields or coolamons (storage vessels). Tree marking may have been the result of ritual practices, or associated with burial. Scarred trees that remain today would be over 150 years old and the scar would retain certain characteristics that enable its identification as cultural.

- Post-contact sites – Sites with evidence of early interaction between Aboriginal people and Europeans. Artefacts found may include flaked glass or ceramic. This site type is usually known from historical records or knowledge within the local community.
- Quarries – Quarries are areas where people procured resources for the manufacture of stone artefacts (Hiscock and Mitchell 1993). Raw materials often occurred in the form of cobbles. Cobbles were reduced on site and made into smaller cores, which could be transported. Tool manufacture may also occur at quarry sites (JMcD CHM 2006).
- Potential Archaeological Deposit (PAD) – Areas are classified as PADs if there is a likelihood of archaeological material existing below the ground surface, or on the ground surface but obscured from view. An Aboriginal object does not need to be recorded for an area of PAD to be specified.
- Aboriginal ceremony and dreaming –Such sites are important and many were recorded in the early years of the NSW Aboriginal Site Register.
- Burial sites – Aboriginal burials are found in a variety of landscape types throughout NSW, although most frequently they are found in middens, sand dunes, lunettes and other sandy/soft sedimentary soils.

10.2 Appendix B: AHIMS Search

Note: This appendix has been removed for confidentiality purposes

10.3 Appendix C: Darkinjung LALC report

Aboriginal Cultural Heritage Assessment Report

Local Aboriginal Land Council
DARKINJUNG

New Intercity Fleet Maintenance Facility Kangy Angy

Report for
Artefact Archaeology

February 2016

Darkinjung Local Aboriginal Land Council
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Aboriginal Cultural Heritage Assessment Report

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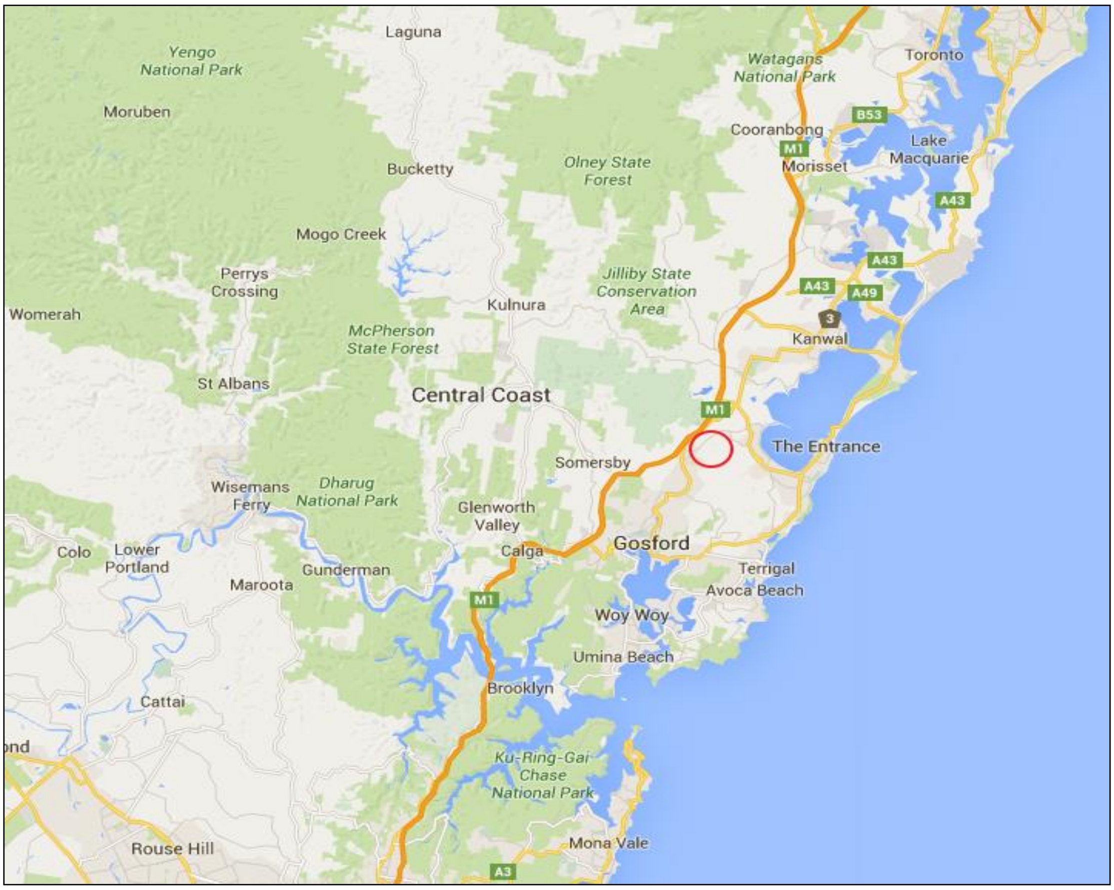

Figure 1: Location of the proposed project area within the Central Coast region, as indicated by the red circle.

Source: Google Maps.

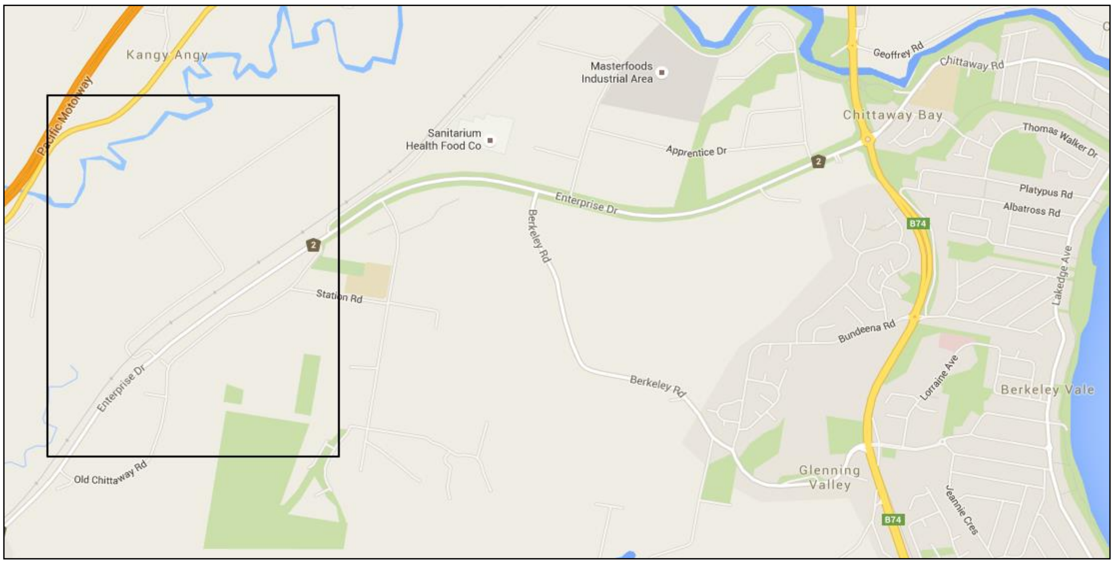

Figure 2: Approximate location of the assessment site.

Source: Google Maps.

1. Introduction

This report has been prepared as part of an Aboriginal Cultural Heritage Assessment by Darkinjung Local Aboriginal Land Council (DLALC) as a part of an ongoing site assessment, for Artefact Archaeology.

The assessment was undertaken over one day on the 19th February 2016.

The aim of the assessment was to inspect lands within the vicinity of Enterprise Drive, Turpentine Road, Ourimbah Road and Orchard Road, Kangy Angy. The assessment site has undergone previous surveying works by Biosis in October 2015 for the purpose of Aboriginal Cultural Heritage Due Diligence Assessment. Further investigation was required (Geotechnical Test Pit Monitoring) conducted by RPS which was aimed to determine whether Aboriginal objects as a result of Aboriginal occupation is present within the subsurface of the assessment area.

The inspection was to identify any Aboriginal Cultural Heritage, places, or objects, of significance to the Aboriginal community, and for the site's developer to meet the statutory obligations and requirements under the *National Parks and Wildlife Act* (1974) and the *Environmental Protection Act* (1979).

2. Description of the Assessment Area and Development Proposal

Transport for New South Wales (TfNSW) propose to construct a maintenance facility as part of the New Intercity Fleet Program.

The assessment area is situated within the boundaries of the Darkinjung Local Aboriginal Land Council (DLALC). DLALC is located on the Central Coast of New South Wales, its boundaries stretch from Catherine Hill Bay to the Watagan Mountains to the North, Hawkesbury River to the South and Pacific Ocean to the east while the western boundary stretches along Judge Dowling Range from Bucketty to Spencer (Darkinjung Local Aboriginal Land Council).

The assessment site is situated within the suburb of Kangy Angy on the Central Coast NSW and is located within approximately six (6) km south-west of Wyong.
Kangy Angy is surrounded by the suburbs of Tuggerah, Chittaway Bay, Fountaindale, Ourimbah and Palmdale within the Wyong Shire.

The landscape and vegetation in the area of the assessment site is largely influenced by the coastal hinterland which includes urban and rural development. The topography of the area includes flood plain disturbance for rural pastures.

3. Description of Impact

Any future development could negatively impact the site.

Future development impacts to the assessment site, such as the construction of the proposed New Intercity Fleet Maintenance Facility will result in the clearing of vegetation and soil excavation.

Future development may impact the area through exposing soil and exposing or destroying any potential Aboriginal cultural heritage sites. Potential erosion may also expose Aboriginal cultural heritage sites and/or material. Other negative impacts to consider include, labour to access the site, treadage, transportation of materials and tools and damage from machinery used on and to access the site (Hodgetts 2015 :8).

Construction tools and materials have the potential to expose and/or destroy artefacts on top of, or below the soil surface. Impacts can also include the destruction of vegetation and the surrounding landscape which can contain Aboriginal cultural heritage, material remains or cultural places. Other impacts associated with this type of project and disturbance to soil may include alteration to the water and drainage patterns in the area (Hodgetts 2015:8).

The Aboriginal cultural heritage most at risk from this type of works is predominantly Aboriginal artefact knapping sites, sites of occupation (camp sites) and axe grinding grooves, scarred trees, open sites, isolated artefacts and Aboriginal Shell Middens. Other forms of Aboriginal sites at risk include cultural and spiritual places.

These impacts could occur during the various phases of a project, while after completion impacts are also a threat and can be a result of altered runoff and natural water movement. The greatest impact on Aboriginal heritage places in NSW occurs in the form of soil erosion (Byrne 1997:1). Runoff and erosion can potentially cause siltation and/or exposure and destruction of Aboriginal cultural heritage sites. Indirect impacts may occur in the form of alterations to drainage and erosion patterns (Byrne 1997:2 cited in Hodgetts).

Trampling and treadage has had a significant impact on Aboriginal sites in NSW. The impact of treadage on open sites can result in displacement and damage to individual artefacts. Treadage can also initiate soil erosion (Byrne 1997:3) including for example people damaging the vegetation and exposing the soil surface and workers unknowingly walking over sites or being in the vicinity of sites that may be sensitive, sacred or mythical (Hodgetts 2015:8).

4. Statutory Requirements and Legislation

Aboriginal heritage and places are protected by law under Legislation. Two basic pieces of legislation concerned with Aboriginal Heritage Management are the National Parks and Wildlife Act 1974 (*NPW Act*) and *The Environmental Planning and Assessment Act* 1979 (*EP&A Act* cited in Hodgetts 2015:8).

Section 84 of the *National Parks and Wildlife Act* 1974 provides protection for 'Aboriginal Places'. The act defines Aboriginal places as 'areas of cultural significance to the Aboriginal Community'. Section 90 of this Act gives protection for all 'Aboriginal Relics'. The act defines Aboriginal relics as 'any material evidence of the Aboriginal occupation of New South Wales'. The Minister will gazette areas as Aboriginal places if satisfied that adequate evidence exist to show that the area was or is of special importance to the Aboriginal community.

The *National Parks and Wildlife Act* 1974 does not structure any formal mechanisms to make sure that areas with potential to contain Aboriginal sites or places of special significance are evaluated before impact on those areas. It is the *Environmental Planning and Assessment Act* 1979 (*EP&A Act*) which carries out this function.

The *EP & A Act's* principal function is to consider 'environmental impacts' in land use and decision making. Environmental impacts include impacts on Aboriginal heritage. There are three main sections in the EP&A Act which are applicable to Aboriginal heritage. Part 3, administrates the preparation of planning instruments; Part 4 relates to the development evaluation process for local government (consent) authorities; and Part 5 which communicates activity approvals by Government (determining) authorities.

Part 3 of the Act governs the preparation of the following three planning instruments: 1. State Environmental Planning Policies (SEPPs); 2. Regional Environmental Plans (REPs); 3. Local Environmental Plans (LEPs). These planning instruments dictate allowable uses and potential constraints on land use. When preparing planning instruments the Department of Urban Affairs and Planning have guidelines which should be followed. These guidelines list Aboriginal sites and places of significance to the Aboriginal community as values which should be assessed.

Part 4 of the legislation governs the decision making process by local government authorities during a development application. Section 90 of the Act lists impacts which must be considered before development approval is granted. Under section 90 (1) 9b consideration must be given for 'the impact of that development on the environment (whether or not the subject of an environmental impact statement)'. Section 90 (1) 9b includes Aboriginal sites and heritage.

Part 5 of the legislation governs the decision making process by State Government authorities for activities conducted by that agency or under authority from the agency controlled by Part 5 of the *EP&A Act*. It is mandatory for these agencies to consider environmental impacts of proposed activities, and then determine whether the level of impact is adequate to necessitate the planning of an Environmental Impact Statement (EIS). Environmental impacts include Aboriginal sites and places. The Department of Planning New South Wales has created a set of guidelines for explaining Section 112 which requires that Aboriginal heritage is assessed as part of the process (Byrne 1997: 2-3 cited in Hodgetts 2015:11).

There are number of amendments to the *NPW Act* 1974. The amendments include a number of guidelines. These guidelines can be viewed on the NSW Office of Environment and Heritage (OEH) website.

The process of due diligence under the OEH guidelines require that a proponent of a development assess impacts of the proposed activity.

Below is a brief explanation of the process from the OEH web site:

The purpose of due diligence is to identify whether Aboriginal objects are present in an area, and to determine whether a proposed activity will have impacts on Aboriginal objects. Therefore it is essential to identify and understand all the expected impacts of the proposed activity.

There are two categories of activity used for assessing impacts:

(1) Activities involving no additional surface disturbance.
(2) Activities causing additional surface disturbance.

For activities causing additional surface disturbance, it is necessary to determine whether an activity is proposed for:

a) a developed area or a previously disturbed area, or
b) an undisturbed area.

For activities in previously developed or disturbed areas, it is then necessary to determine whether the new activity will create significant additional surface disturbance. If it will, then the process for undisturbed areas will apply'.

Due diligence involves taking reasonable and practicable measures to determine whether your actions will harm an Aboriginal object and if so avoiding that harm (Office of Environment and Heritage formally NSW Department of Conservation Climate Change and Water cited in Hodgetts 2015:12).

Note: Any works that may disturb, damage, or destroy Aboriginal Cultural Heritage requires an Aboriginal Heritage Impact Permit (AHIP) from OEH, this includes impacts to both registered and unknown Aboriginal sites that may require excavation or disturbance to the soil of any kind. Prosecution may result if works are carried without a relevant permit (Hodgetts 2015:12).

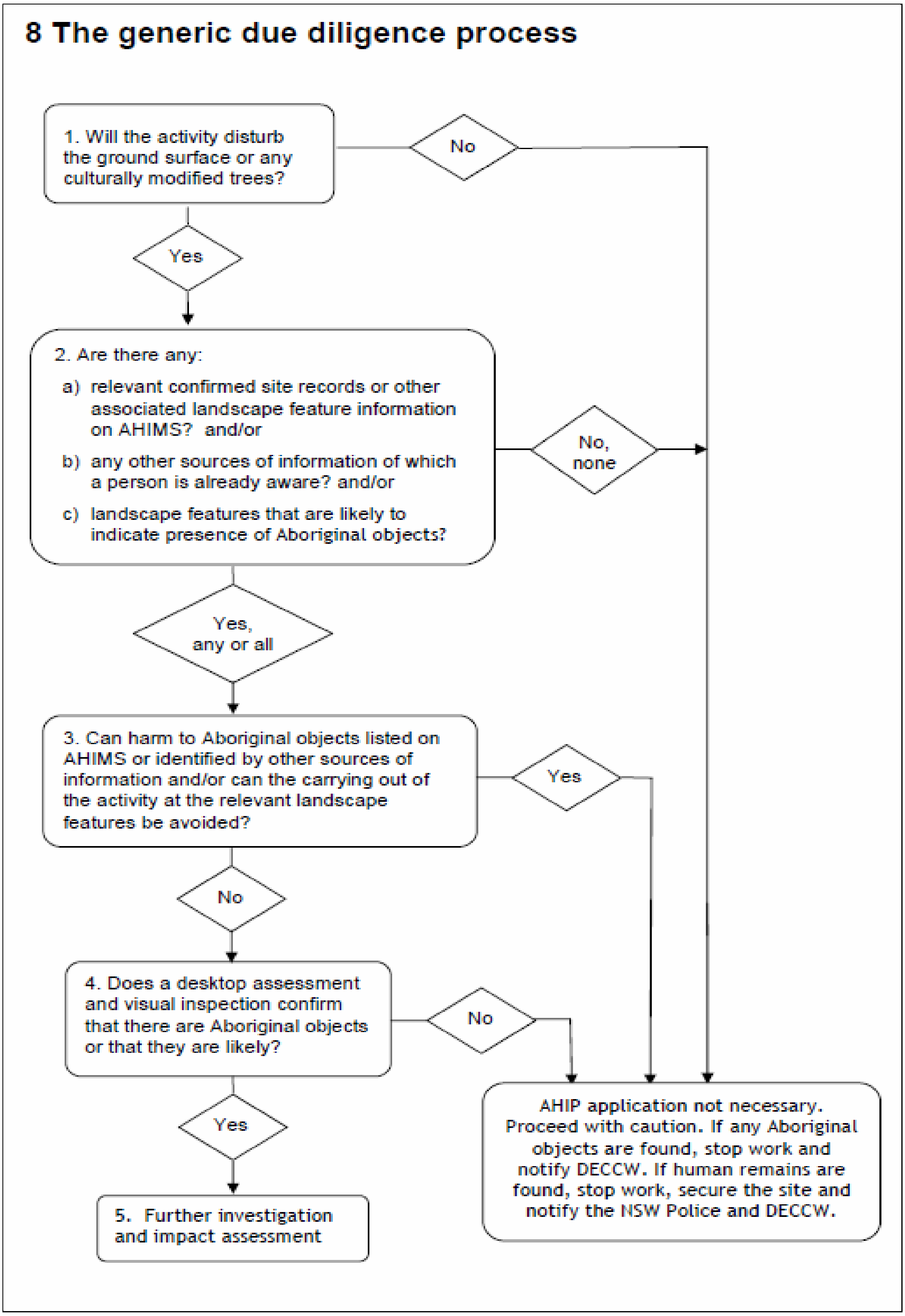

Figure 3: Diagram of the generic due diligence process from the Office of Environment and Heritage's *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales.*

Source: Office of Environment and Heritage, cited in Hodgetts 2015:13.

5. Aboriginal Cultural Heritage, Values and Significance

Aboriginal people have inhabited Australia between 50,000 and 60,000 years, evidence for this can be found from material dated from Malakunanja and Nauwalabila rock shelter in the Northern Territory (Mulvaney & Kamminga 1999:141 cited in Hodgetts 2015:14).

In the Sydney region some early occupation dates come from a rock shelter near the Nepean River of around 14,000 years BP (Attenbrow 2002: 153 Hodgetts 2015:14).

The first inhabitants of the Central Coast region were members of the Darkinjung (Darginung, Darginyung) language group. Several researchers and publications show tribal or language group boundaries within similar areas, but exact boundaries are unlikely. (Hodgetts 2015:14).

Stone artefacts in the Upper Mangrove Creek area of the Central Coast have been dated between 10,000 to 12,000 years old (Attenbrow 2002: 153). These provide some reliable evidence of Aboriginal people's occupation of the region. (Hodgetts 2015:14).Upper Mangrove Creek is situated approximately 27 km to the north-west of Kangy Angy.

European exploration of the Central Coast area began soon after the arrival of the First Fleet in 1788. Settlement of the Hawkesbury River began about 1794 and in 1820 the area between the Hawkesbury and the Hunter Rivers become available for settlement (Brisbane Water National Park Plan of Management 1992:19 cited in Hodgetts 2015:14).

Evidence for Aboriginal habitation, includes middens, which consist of shell, bone, charcoal, tools and sometimes burials. A midden is likely to contain only a selection of shell fish species available in the local environment. It may contain a high proportion of individuals of edible size, stone artefacts, charcoal from camp fires, pumice, coral, faunal bone and human burials (Byrne 1997:5 cited in Hodgetts 2015:14-15). Shell middens are also important scientifically as they provide precious information about Aboriginal use of the environment and changes in behaviour over time. Other evidence of Aboriginal occupation include fish traps and stone arrangements, deposits in sandstone shelters, including artefact, charcoal, shell and bone remains, rock engravings and pigment art. Additional forms of Aboriginal cultural evidence can consist of abraded channels, grooves and grinding stones, axe grinding grooves, scarred and carved trees, water holes, quarry sites, open sites or camp sites, stone artefact scatters, graves, earth mound, walking trails along trading routes, mythological and ceremonial sites. In some cases landscape modification can provide evidence of Aboriginal people's occupation (Hodgetts 2015:14-15),(e.g. fish traps, areas used for initiations of young men).

For many of the Aboriginal groups in NSW including the Darkinjung, Baiame is the Creator God from the Dreaming. Daramulan (often depicted with one leg) is the son of Baiame. Daramulan is associated with ceremonies (usually men's). Ceremonial sites with engraved or pigment art of images of Anthropomorphic like figures which represent Baiame or Daramulan are considered to have very high culture heritage significance (Hodgetts 2015:15).

The landscape surrounding an Aboriginal place or site can be seen in a spiritual sense and is very important to Aboriginal people. The landscape can be an extension of a site, or the landforms and features within the landscape can be the site. Aboriginal sites can also be connected through sight lines to other sites or places of significance. These features are all part of the cultural landscape (Hodgetts 2015:15).

Some sites are associated with sight lines and tracks, their purpose and associated stories connect these sites with other sites across Darkinjung country and should not be viewed in isolation of each other. Considering this, changing the context of an Aboriginal site by landscape degradation compromises the spiritual and cultural connection that Aboriginal people have to the land and/or the site. In many cases landscape destruction can be considered, destruction of an Aboriginal site and the Darkinjung cultural landscape (Hodgetts 2015:15).

Recent research of certain areas of the Central Coast has revealed an intricate network of Aboriginal cultural heritage sites, connected by Aboriginal walking trails and routes which have been utilised over hundreds and in some cases thousands of years. These tracks were utilised to access seasonal resources, carry out trade, teaching and ceremonies. These sites are connected and form part of a complex Aboriginal Cultural Landscape. The significance of many of these sites and the significance of the connection they have to each other and the landscape has been highlighted as very important for Aboriginal people both culturally and spiritually (Hodgetts 2015:15).

The Darkinjung people were fishers, hunters and gatherer of plants and animals of the land, rivers, estuaries and sea. These places including the hills, valleys, creeks, wetlands, lakes and coastline provided food, medicines, and raw material for tools, weapons, shelter and decoration. These environments and landforms also provided the basis for spiritual and cultural life and are of value and significance to the local Aboriginal community. Certain environments can be considered to have a higher Aboriginal cultural heritage potential because of their ecology and landform and the associated flora, fauna and other resources needed for everyday life. The proposed development site lies in an area with a high Aboriginal cultural heritage value. This is because of the surrounding, mountains, lakes, creeks, coastline and associated woodland and wetland habitats. These environments and ecological zones provided the local Aboriginal population with many foods and other natural resources (Hodgetts 2015:15).

Therefore considering the long Aboriginal occupation of Australia and the Central Coast it could be predicted that most areas, particularly those with minimal disturbance have the potential to contain Aboriginal cultural heritage material or places (Hodgetts 2015:15-16).

Aboriginal people's occupation of the Central Coast region shown through archaeology, Aboriginal cultural heritage material and spiritual places provides the local Aboriginal community with a connection to the land, the people and culture. These materials and places present tangible evidence of the past and should be conserved.

Aboriginal sites are connected to each other within the landscape, a number of places and sites hold spiritual and cultural importance to the local Aboriginal community through their physical link to ancestors and the past. This connection attaches the community to land, traditions and strengthens bonds within the Aboriginal community. Safe guards need to be put in place to protect the spiritual and environmental integrity of a site and the cultural landscape (Hodgetts 2015:16).

6. The Site

The assessment site is located on the western side of the existing rail corridor that runs along Enterprise Drive in Kangy Angy approximately six (6) km south-west of Wyong and covers an area of approximately 31 ha.

The site is surrounded by Chittaway Creek to the south, Ourimbah Creek to the north, Orchard Road to the west and the north/south railway line to the east.

Transport for New South Wales (TfNSW) proposes to construct the New Fleet Maintenance Facility within this area.

The assessment site consists of areas that are prone to flooding. Surrounding the valley floor are vegetated ridge lines to the south-east, west and north.

The assessment site is situated approximately 3.4 km south of Mardi Dam and approximately 4.7 km south from Wyong River and approximately 3.5 km west of Tuggerah Lake within the coastal hinterland, surrounded by various hills, ranges, valleys, creeks, wet lands, lakes and coast line. As shown previously these types of environments and the resources they provided to local Aboriginal people were very important.

The area surrounding the proposed facility is the location of a number of recorded Aboriginal sites, and lies within an area which is rich in Aboriginal cultural heritage.
The Darkinjung LALC Asset Governor Management System incorporating the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) register have identified four (4) of these registered Aboriginal sites within a 2 km radius of the assessment site.

Most areas of the assessment site have undergone previous disturbance due to past land clearing for roads, railway corridor, and agriculture and grazing.
All parts of the assessment site are considered to have potential for Aboriginal sites or artefacts which may be concealed by thick vegetation or be covered by leaf litter, sand and silt. The areas of the assessment site with a higher potential for Aboriginal cultural heritage include places where there has been minimal disturbance, areas with intact soil and vegetation and within close proximity to creek lines.

Parts of the assessment site with a lower potential for Aboriginal cultural heritage sites include disturbed areas such as where there has been previous vegetation clearing, excavation or farming development, roads and the rail corridor. In the past these activities in and around the assessment site could have negatively impacted on, or destroyed a number of Aboriginal cultural heritage sites.

Site Name	AHIMS Number	Site Type/Contents
Tangy Dangy	45-3-1146	Open Camp Site/Artefacts
Tangy Dangy, Sydney	45-3-0816	Stone Quarry/Artefacts
Ourimbah	45-3-1143	Open Camp Site/Artefacts
Berkeley Rd 1	45-6-2338	Open Camp Site/Artefacts

Table 1: Details of four (4) registered Aboriginal sites within approximately 2 km radius of the study area.

Source: Darkinjung LALC Asset Governor and OEH AHIMS Database.

Figure 4: Map shows the area of the assessment site shown within the yellow shaded area.

Source: Google Earth.

7. Site Topography and Vegetation

The landscape and vegetation in the area of the assessment site is largely influenced by the coastal hinterland which includes urban and rural development. The area is largely influenced by valley floor and associated ecosystems The vegetation within the assessment site is mainly native species of trees, shrubs and pastoral ground cover.

The assessment site has undergone previous disturbance through land clearing for the purposes of roads, railway corridor, residential buildings, agriculture and grazing. The ridgeline areas that surround the assessment site may have undergone timber getting in the past.

Many of the native plant, faunal and aquatic species found within the area are considered a valuable food and material resource for the local Aboriginal people. Flowering plants also provide Aboriginal people with seasonal indicators, when to move to a new area to obtain a particular food source or when certain marine of faunal species may be available, for example when Sydney Golden Wattle (*Acacia longifolia*) comes into flower it indicate to fish for Mullet (Stewart & Percival 1997:8 cited in Hodgetts 2015: 20).

Many of the Gum Trees (*Eucalyptus, Angophora, Corymbia* spp) provide resources from various parts of the plant. These include string, tools, weapons, shelter, canoes, food, medicinal and spiritual uses (Hodgetts 2015:22).

The examples above show that the assessment site, including the surrounding area has the potential to provide Aboriginal people with abundant, reliable food and material resources that are within close proximity. Therefore, the assessment site is considered to have potential for Aboriginal cultural heritage sites or artefacts which may be concealed by deposits of soil, sand, vegetation and leaf litter.

8. Assessment Methodology

Prior to any Aboriginal site survey, assessment or monitoring carried out in the field, a desk top analysis of the area is carried out. This involves consulting the relevant topographical, council and survey maps, and the DLALC Asset Governor incorporating OEH Aboriginal Heritage Information Management System (AHIMS) Data.

It should be noted in regards to the AHIMS database, many Aboriginal sites listed often are not situated within the location as shown on maps referring to the AHIMS information. Therefore it can be difficult to relocate the precise position of many registered Aboriginal sites due to some of the following reasons:

- Registered sites were recorded before the introduction of GPS units.
- In the past many registered Aboriginal sites were recorded on a topographical map with a scale of 1:25000. The co-ordinates were acquired by cross references to easting and northing figures located along the side of the map. The site was then marked as a point on the map and as a result of this, the co-ordinates could be up to 1 millimetre off, on the map, which then results in the sites location recorded as an error of up to 250 metres on the ground.
- Sites were frequently recorded in different datum, for example: Some site were recorded in AGD which has now changed to GDA 94, therefore the site could be out by as much as 200 metres on the ground.
- Human error, locations of Aboriginal sites may have been incorrectly recorded.
- Inability to visually relocate sites due to thick bush, vegetation, leaf litter, silt and other debris, and hazardous or inaccessible topography.

Having considered the above points, it should also be noted that sites recorded more recently are often situated in the correct location given.

The main strategy used to assess the area was to first consult the relevant maps and DLALC Asset Governor incorporating AHIMS database and information as shown above, then secondly to visually inspect the area and soil surface (Hodgetts 2015 :23).

9. Assessment Fieldwork

The inspection of the assessment site for Aboriginal cultural heritage sites and places was conducted on Friday the 19th February 2016.

Involved in the assessment of the site was Lee Davison (Project Officer, Culture and Heritage, DLALC) Fenella Atkinson (Senior Heritage Consultant, Artefact), Alyce Haast (Heritage Consultant, Artefact) and Tracey Howie Guringai Tribal Link Aboriginal Corporation (GTLAC).

The inspection of the proposed maintenance facility site was required so that any Aboriginal Cultural Heritage material or sites located within the area could be assessed, protected and properly managed.

Day One

Weather conditions: Good.

The site survey commenced on the corner of Orchard Road and Ourimbah Road. The survey team walked south-east on Ourimbah Road and continued south-west on Turpentine Road. To inspect the south-western corner of the assessment area the survey team walked under the rail line overpass and traversed south-west on Enterprise Drive and under the rail line again as Figure 5 indicates.

The survey team then returned to Turpentine Road via Enterprise Drive to inspect the paddock on the corner of Ourimbah and Turpentine Roads.

The survey team then continued on to Orchard Road and entered a private property 230m north-east of Ourimbah Road. The property had been subject to disturbance in the form of a driveway and equestrian arena at the front, a residential building and fenced horse paddocks at the rear.

The survey team continued a further 75-80m north-east on Orchard Road and entered a gate, on the south-eastern side of Orchard Road. A cleared, short grassed area was inspected before the survey team continued north-east through thick vegetation before meeting the power line easement and heading east to the rail corridor. The team then walked along a four wheel drive track parallel to the rail corridor, periodically inspecting tracks and other disturbances until Ourimbah Road was reached.

The south-western end of Orchard Road was the final area to be inspected. Ground surface visibility was good along the dirt tracks within the study area, although it was very poor within the paddocks of private properties due to grass cover, leaf litter and dense vegetation such as trees, shrubs and long grass.

The assessment site has undergone previous disturbance through clearing of four wheel drive tracks, electricity easement, railway corridor, sealed roads, residential buildings and clearing for timber and grazing.

Figure 5: The assessment site and transects walked

Source: Google Earth/Garmin Base Camp

10. Photographs

Figure 6: Ourimbah Road, view south-east.

Figure 7: Rail line over Turpentine Road and tributary of Ourimbah Creek. View south-west.

Figure 8: Turpentine Road, Schubolt Lane and cleared land for producing cattle feed.
View north-east.

Figure 9: Dense vegetation between Orchard Road and the rail corridor.
View north.

Figure 10: Paddock on the corner of Turpentine and Ourimbah Roads, used to produce cattle feed. Small dam situated on the right of photo.

Figure 11: Disturbed lands for horse paddocks of a property between Orchard Road and the rail corridor. View south-west.

Figure 12: Power line easement and no ground visibility between Orchard Road and the rail corridor.

Figure 13: Rail corridor south-east of Orchard Road at the north-eastern section of the study area. View south-west.

Figure 14: Cleared land for grazing and what looks to be a natural plateau where a residential building is located. View south.

11. Fieldwork Results

No Aboriginal sites or objects were identified during the site assessment.

12. Discussion and Recommendations

The assessment site is situated within 1km south-east of the Pacific Motorway, on the north-western side of Enterprise Drive and is bordered by Orchard Road to the north-west and the railway line to the south-east in Kangy Angy.

Biosis had undertaken archaeological site survey works in 2015 and identified areas of low and high potential for Aboriginal cultural heritage, RPS conducted monitoring of geotechnical excavations in 2015 as a result. No Aboriginal artefacts were identified during Biosis' survey or RPS' geotechnical monitoring.

The assessment site consists of a valley floor and creek surrounded by vegetated ridge lines that rise steeply to the south-west, west and north.

The study area has sections of cleared open paddocks with stands of native species of trees, shrubs and ground cover. This area has been disturbed in the past generally through selective clearing of the vegetation for agriculture and grazing. The vegetation is predominately remnant native species of trees and shrubs.

Disturbed and modified areas of the assessment site have a low possibility to contain objects or sites of Aboriginal cultural heritage, while areas of higher Aboriginal cultural heritage potential are those areas with minimal disturbance and in the vicinity of creek lines.

According to the AHIMS Register there are approximately four (4) recorded Aboriginal sites located within a 2 km radius of the assessment site.

Although the site has undergone previous disturbance, considering the information above there is a possibility for further objects or sites of Aboriginal cultural heritage within the assessment area. It is possible that Aboriginal cultural heritage such as stone artefacts could lie beneath the top soil surface and ground cover vegetation of the assessment site.

Therefore the following is recommended for the proposed New Fleet Maintenance Facility.

Further archaeological inspection should be undertaken during or after vegetation removal, should the project go ahead as Aboriginal artefacts may be concealed beneath.

TfNSW must give notice to Darkinjung LALC 30 days prior to any commencement of construction work. When recommended they must engage a Darkinjung LALC Culture and Heritage Officer to monitor any earthworks or excavations on the assessment site until such time it is satisfied that there is very little or no possibility of any further Aboriginal cultural heritage material identified. This is due to the possibility of uncovering Aboriginal objects/items of significance while vegetation removal and excavation takes place. Allowing Darkinjung LALC 30 day's prior notice to commencement of construction work also ensures that Darkinjung LALC is aware of when works are underway. This is of relevance in case there is a discovery of any Aboriginal cultural heritage that may arise during works.

All site personnel should receive basic training in the recognition of Aboriginal cultural heritage sites and material and have an awareness of the importance of such material and places to both the Aboriginal and non-Aboriginal community. When any soil excavation, vegetation clearing and leaf litter removal activities are carried out workers involved with the project should be observant and keep a look out for surface shell, bone, rocks or any other Aboriginal cultural heritage material.

If any Aboriginal cultural heritage sites or material are found including bone, work should cease immediately in that area and the Office of Environment and Heritage (OEH) and Darkinjung LALC be notified immediately. Work should only recommence when an appropriate and approved management strategy has been agreed to by OEH and Darkinjung LALC.

Any negative impacts to an area containing Aboriginal cultural heritage will require the application of an Aboriginal Heritage Impact Permit (AHIP) from the Office of Environment and Heritage (OEH).

Finally the Registered Aboriginal site information contained in this report is considered confidential.

Overview of recommendations:

1. Due to dense vegetation and low ground visibility, monitoring during or after vegetation removal.

2. The site developers must give notice to Darkinjung LALC 30 days prior to any commencement of construction work.

3. All site personnel involved in construction activities should receive basic training in awareness and the recognition of Aboriginal cultural heritage material and sites.

4. When any soil excavation, earth works, vegetation clearing and leaf litter removal activities are conducted workers should be observant and keep a look out for surface shell, bone, rocks or any other Aboriginal cultural heritage material.

5. In the case of Aboriginal cultural heritage sites or material being discovered, work should cease. The area should then be avoided and the Office of Environment and Heritage (OEH) and Darkinjung LALC should be contacted immediately. If human remains are discovered the Police are to be contacted immediately.

6. Any impacts, including excavations to an area, containing an Aboriginal cultural heritage site will require the application for an Aboriginal Heritage Impact Permit (AHIP) from the Office of Environment and Heritage (OEH).

7. Please Note. Under the *National Parks and Wildlife Act (1974)* it is an offence to harm (destroy, deface, or damage) or desecrate an Aboriginal object or Aboriginal place, or in relation to an object, move the object from the land on which is has been situated. Penalties range from $275,000 and 1 year imprisonment to $555,000 and 2 years imprisonment for an individual up to $1,100,000 for a Corporation.

8. Penalties for failure to notify OEH of the location of an Aboriginal object range from $11,000 to $22,000 including from $1,100 to $2,000 for each day the offence continues.

9. Registered Aboriginal Site information in this report is confidential and not to be made public.

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14. Acknowledgments

Fenella Atkinson, Artefact Archaeology
Alyce Haast, Artefact Archaeology
Tracey Howie, Guringai Tribal Link Aboriginal Corporation (GTLAC).

Photographs: Lee Davison

10.4 Appendix D: Guringai Tribal Link Aboriginal Corporation report

Guringai Tribal Link
Aboriginal Corporation
ABN 18 351 198 069. ICN 4270
(Traditional Owners of the NSW Central Coast)

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24th March, 2016

Fenella Atkinson
Senior Heritage Consultant
ARTEFACT
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PYRMONT NSW 2009

Emailed to:Fenella.Atkinson@artefact.net.au

Dear Fenella,

Please find following;
* GTLAC report for Proposed New Intercity Fleet Maintenance Facility, Kangy Angy NSW.

Thank you for including the Guringai Mob in this project.
We look forward to working with you in the future,

Tracey Howie
Director
Senior Female
Cultural Heritage Officer
(contacts above)

ABORIGINAL CULTURAL HERITAGE DUE DILIGENCE ASSESSMENT
for
Transport NSW
NEW INTERCITY FLEET MAINTENANCE FACILITY, KANGY ANGY NSW

Prepared by Tracey Howie-Guringai Tribal Link Aboriginal Corporation
24th March, 2015

Cover image: indicating geotech test pit

ABORIGINAL CULTURAL HERITAGE
DUE DILIGENCE REPORT
PROPOSED NEW INTERCITY FLEET
MAINTENANCE FACILITY, KANGY ANGY NSW

INTRODUCTION;
Guringai Tribal Link Aboriginal Corporation (GTLAC) was contacted by Artefact in regards to an Aboriginal Cultural Heritage Due Diligence Assessment for the proposed New Intercity Fleet Maintenance Facility for Transport NSW at Kangy Angy, NSW.
This survey was focused on the identification of areas of potential artefact deposits (PAD), previously unrecorded (on the Aboriginal Heritage Management System (AHIMS) Database, held with the Office of Environment and Heritage (OEH)) Aboriginal sites, Places and objects/materials (as defined in NPW Act 1974) cultural resources and areas culturally sensitive to the Guringai community, that have the potential to be impacted from the proposed works.
Representatives on site for the assesment were; Tracey Howie - GTLAC, Lee Davison - Darkinjung LALC, Fenella Atkinson and Alyce Haast - Artefact.

STUDY AREA;
The Study Area is located within the Wyong Local Government Area, Parish of Tuggerah, County of Northumberland. The Project Area includes 11 Ourimbah Rd - Lot 32 DP1033784, 12 Ourimbah Rd - Lot 121 DP 874784, 53 Orchard Rd - Lot 41 DP 2877, 55 Orchard Rd - Lots 34-40 DP 2877, railway corridor along Enterprise Dr and Turpentine Rd and covers approximately 48 hectares.
The study area consists of, private rural/residential properties, railway corridor, swamps, flood plains and wetlands, tributaries of Ourimbah & Chittaway creeks and several permanent and paper roads.
Vegetation, therefore varies dramatically throughout the study area. From manicured gardens and pastural paddocks to remnant stands and sensitve to endangered ecological communities.

PROPOSED ACTIVITIES:
Transport NSW propose to develop the New Intercity Fleet Maintenance Facility to undertake train maintenance activities including, servicing, repairs, internal and external cleaning of trains and train components at the Kangy Angy site. The proposed Facility will also include;
*Approx. 6kms of electrified railway line * Maintenance building * Auxiliary workshops *Wheel lathe
* Electronic clean room * Materials storage facility * Train wash * Site access roads * Security provisions
* Administration building * Operations & Control * Training /Presentation facilities * Staff Common Araes
* Train simulator * Detention basins * Car parks * Associated infrastructures ans services.

METHODOLOGY:
Ground surface visibility was >5% over majority of the study area due to dense leaf litter coverage, road verge or thick vegetation. Transects were walked with spacings of approx. 2mts between Rep’s where possible.

HISTORICAL INFORMATION;

The study area for the proposed works/development, has been and still is, home to the Guringai Mob (Wanangine, Walkaloa, Garigal), for thousands of generations, with seasonal and ceremonial occupation of the Awabakal and Darginyung people. Pre and post European settlement.

Well known and documented members of the Guringai mob were; Boongaree/Bungaree, Matora, Mosquito, Jewfish, Cora (aka, Gooseberry), Flathead, Long Dick, Sophy, Kitty and Charlotte Ashby(nee.Webb), only to name a few.

Thier presence in this area was initially recorded by Europeans pre 1790. References to these Guringai people are located on Government Blanket lists and Court Bench records taken in theWyong and Gosford areas and Colonial Secretary minutes, which are held at Gosford Library. 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 several other publications.

The traditional areas occupied by the Guringai 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 ridgeline along Peats Ridge, following along the range through to Kulnura, as well as the Lakes of the Central Coast to lower Lake Macquarie.

Charlotte Webb was the very first *recorded* Guringai birth on the Central Coast. She was born in 1823 in Gosford. Charlotte was the daughter of Sophy (Booranger), daughter of Bungaree and Matora. Sophy had relations with Ship-building merchant, James Webb. Charlotte was the result of this union.

RECOMMENDATIONS:

GTLAC recommend that the Proposed development of the New Intercity Fleet Maintenance Facility for Transport NSW, be relocated to a more appropriate area. The current proposed location is one of the most ecologically sensitve areas in the Wyong Shire, containing several endanged, threatened and vulnerable species in pristine condition. To proceed with the current proposal in this location would be an environmental disaster of catastrophical proportions and extremely detrimental and a disjustice to the existing community.

No further investigations would be required within the highly disturbed areas, such as formalised roadways and the railway corridor.

Further investigations, including Test excavations (in accordance with OEH Guidelines)would be required throughout the remainder of the study area, and an extensive flora and fauna habitat survey, due to the known presence of several endangered and threatened species within and around the study area, prior to commencement of proposed works.

The results of the investigations would determine whether an AHIP, in consultation with GTLAC, would be required for earthworks.

All staff and contractors associated with the proposed works for this project, should participate in an Aboriginal Cultural Heritage Awareness Induction and be fully informed of their statutory obligations in relation to Aboriginal Cultural Heritage sites and objects.

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.

Statutory Considerations.

<u>Aboriginal and Torres Strait Islander Heritage Protection Act 1984. (Commonwealth)</u>

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.

<u>National Parks and Wildlife Act. 1974. (NSW)</u>

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 defined as;
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. 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.

Attachment 1. *pg 1*

BRIEF DESCRIPTION OF ABORIGINAL SITES and OBJECTS:

(Please note that not all Aboriginal site types and materials 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 compexes/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;
Spear 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 were and more accurate than just throwing them with a bare hand.

Attachment 1. pg 2

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 (OEH), 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 permant 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 lide 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.

Attachment 2

Access road adjacent to railway corridor. Poor ground surface visibility

Remnant swamp lands adjacent to railway corridor, south of rail underpass

Access road with maximum of ground surface visibility across the study area

Southern extent of study area, facing north

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Appendix F

TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

TRANSPORT FOR NSW

New Intercity Fleet Maintenance Facility

Traffic and Transport Impact Assessment

MAY 2016

New Intercity Fleet Maintenance Facility

TRAFFIC AND TRANSPORT IMPACT ASSESSMENT

Transport for NSW

Project no: 2202522A-REP-ENV-005-RevB.docx
Date: May 2016

REV	DATE	DETAILS
	31/03/2016	Draft
A	8/04/22016	Final
B	5/05/2016	Revised Final

AUTHOR, REVIEWER AND APPROVER DETAILS

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GLOSSARY

BA	Type BA (Basic) intersection
DoS	Degree of Saturation
HV	Heavy vehicle
HV	High voltage
LoS	Level of Service
LV	Light vehicle
REF	Review of Environmental Factors
Roads and Maritime	Roads and Maritime Services
TfNSW	Transport for NSW
TTIA	Traffic Transport Impact Assessment
vpd	Vehicles per day
vph	Vehicles per hour

1 INTRODUCTION

WSP | Parsons Brinckerhoff has been commissioned by Transport for NSW (TfNSW) to prepare the Traffic and Transport Impact Assessment (TTIA) for the proposed New Intercity Fleet Maintenance Facility Project (hereafter, referred to as 'the Project'). The purpose of the TTIA is to support the review of environmental factors (REF) for the Project.

This TTIA is one of a number of technical reports supporting the REF for the Project.

TfNSW proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. The facility would be used to undertake light and heavy train maintenance activities for the New Intercity Fleet, including but not limited to:

- Regular maintenance/servicing
- Repair/replacement of train components
- Interior and exterior cleaning.

The proposed facility would include about six kilometres of electrified railway (in total), would be seven tracks wide at its widest point and cover an area of approximately 48 hectares fully bounded by a perimeter fence. The proposed facility would include the following key elements:

Maintenance facility:

- Maintenance building
- Auxiliary workshops
- Electronic clean room
- Material storage, including flammable liquid storage
- Wheel lathe
- Train wash
- Site access roads.

Ancillary facilities:

- Security
- Administration
- Facilities for presentation and train maintenance staff
- Operational control
- Training rooms
- Train simulator
- Power supply (traction power, bulk power, signalling power supply and backup generators)
- Detention basins
- Car parks
- Access roads.

1.1 Site location and study area

The site is located in the suburb of Kangy Angy, within the Wyong Shire local government area on the New South Wales Central Coast. The site is generally bordered by the Main North Rail Line rail corridor to the south, and Orchard Road to the north-west. Residential receivers on rural properties generally surround the site to the north, south and west, with industrial precincts to the south east and north-east (on the opposite side of the rail corridor to the site). The M1 Pacific Motorway is located approximately 0.85 kilometres to the north-west, and Tuggerah Lake is approximately 3.5 kilometres to the east of the site. Chittaway Creek crosses the project at the southern end and Ourimbah Creek is to the north of the site

The study area for this traffic and transport impact assessment includes the area highlighted in Figure 1.1 and site context shown in Figure 1.2.

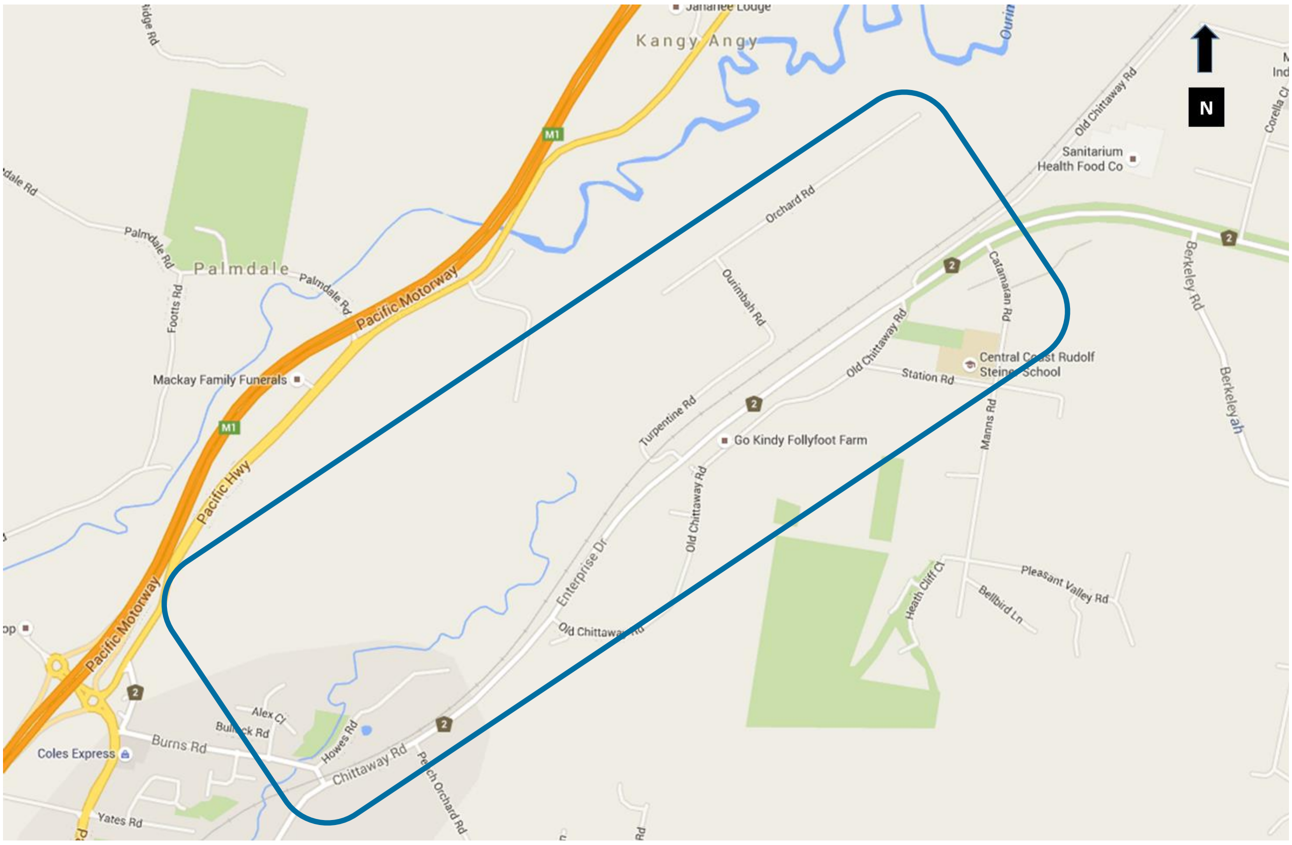


Figure 1.1 Project study area

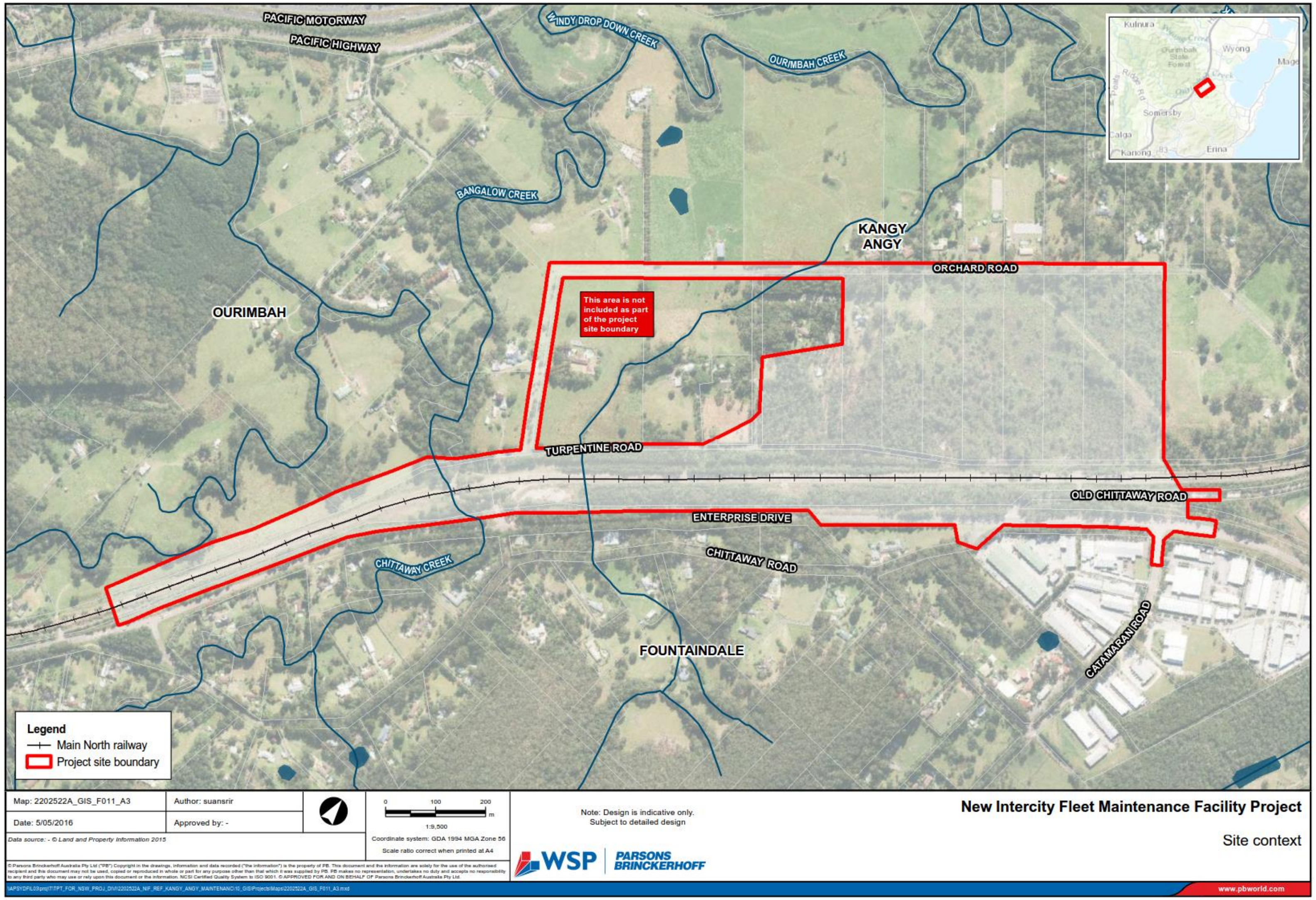


Figure 1.2 Site context

1.2 Study scope

The scope for this traffic and transport impact assessment includes:

- A review and assessment of existing road and traffic conditions in the study area
- A description of the Projects proposed traffic generation, distribution and access routes
- A review and assessment of future road and traffic conditions in the study area
- Analysis of future intersection performance during both construction and operation stages
- Identification of potential traffic or road safety concerns
- Identification of any likely Project related impacts to all road users
- Preparation of suitable mitigation measures to ameliorate or remove any Project related impacts.

1.3 Site inspection

A site inspection was undertaken on Wednesday 10 February 2016 by WSP | Parsons Brinckerhoff staff to gain a better understanding of the Project site, existing road and traffic conditions, access requirements and general area familiarisation. The site inspection was undertaken in fine and sunny weather conditions in the morning.

1.4 Consultation

The following stakeholders were consulted in preparation of this report:

- Transport for NSW for details on Project traffic generation, workforce and hours during both the construction and operational stages
- Roads and Maritime Services for the provision of crash data information
- AECOM via Transport for NSW regarding the concept design of the Project.

1.5 Structure of the report

This report has the following structure:

- Section 2 describes the existing road, traffic, public and active transport situation
- Section 3 describes the proposed Project in detail
- Section 4 describes the future road and traffic situation
- Section 5 discusses the Project impacts
- Section 6 describes proposed mitigation measures to ameliorate or remove Project impacts
- Section 7 concludes the study.

2 EXISTING SITUATION

This section describes the existing road network including traffic conditions, volumes, road accesses, intersection type and operation, as well as public and active transport provisions. This section also discusses road related vehicle/travel restrictions including bridge clearance heights and road load limits.

2.1 Road network

The road network within the study area as shown in Figure 1.1 includes the following:

Enterprise Drive is a Regional Road which runs generally in an east-west direction between Wyong in the north and the Pacific Highway in the south. It is a two-lane, two-way undivided road with a posted speed limit of 90 kilometres per hour speed limit adjacent to the Project site. It has good horizontal alignment and 1 to 1.5 metres sealed shoulder lane marked with solid edge lines and bicycle logo pavement markings.

Old Chittaway Road (East) is a Local Road which runs along the western side of the railway track, linking Enterprise Drive to the south and Hereford Street to the north. This road has a sealed width which varies between four to five metres. The narrowness of the road offers minimal lateral clearance between passing vehicles.

Old Chittaway Road (West) is a Local Road that serves as an access to residential properties, and forms a priority controlled T-intersection with Enterprise Drive. It is a two-lane, two-way undivided road, approximately 5.5 metres wide with a posted speed limit of 60 kilometres per hour.

Turpentine Road, Ourimbah Road and Orchard Road are two-lane, two-way undivided no-though Local Roads that connect approximately 25 properties with the Enterprise Drive. These roads do not have a speed limit posted, although a 20 kilometres per hour speed limit has been applied adjacent to the railway overpass. Turpentine Road forms a priority controlled intersection with Enterprise Drive at the south-east section of the Project site.

Burns Road is a Local Road which runs generally in an east-west direction between the Pacific Highway in the west and Enterprise Drive/Chittaway Road in the east. It is a two-lane, two-way undivided road with a posted speed limit of 50 kilometres per hour. Immediately north of Chittaway Road, only single lane vehicle movements are allowed at the rail overpass. As a consequence, traffic approaching the rail overpass from west gives way to traffic entering from the other side. A five tonne load limit applies on Burns Road.

Catamaran Road is a Local Road that serves as an access to an industrial estate with dedicated U-turn area for heavy vehicles via mountable roundabout control and a school (Central Coast Rudolf Steiner School) with 40 kilometres per hour school zone. It is a two lane, two-way undivided wide road with a posted speed limit of 50 kilometres per hour.

Pacific Highway (SH10) is a State Road which runs in a north-south direction and provides connection to the M1 Pacific Motorway with both Chittaway Road and Burns Road linking Enterprise Drive. The Pacific Highway provides an alternate heavy vehicle access route to the site from the M1 Pacific Motorway or from the general Gosford area.

2.1.1 Intersections

The following existing intersections are likely to be utilised for site access purposes and include:

- **Turpentine Road and Enterprise Drive** – this is a priority controlled Type BA (Basic) T intersection which is two lane two-way undivided on Enterprise Drive with no turning or passing facilities and two lane two-way undivided and unmarked on Turpentine Road. Turpentine Road at Enterprise Drive has a widened pavement area which narrows further west of the intersection.
- **Burns Road and Chittaway Road** – this is a priority controlled Type BA (Basic) T intersection which is two lane two-way undivided on Enterprise Drive with no turning or passing facilities and two lane two-way undivided and unmarked on Burns Road. Burns Road at Enterprise Drive has a widened pavement area which includes a concrete centre median nose and narrows to one traffic lane (at the rail bridge) within a short distance west of the intersection. Vehicles travelling westbound from Enterprise Drive onto Burns Road have priority over those travelling eastbound on Burns Road approaching the rail bridge.

The vast majority of vehicles will access the site via a newly created intersection on Enterprise Drive as discussed in section 3. This intersection will accommodate all heavy vehicle traffic and be the primary access during construction and operation.

2.1.2 Rail corridor gate accesses

Several gated accesses to the rail corridor were observed during the site inspection including:

- Turpentine Road on the north-east and north-west sides of the rail bridge
- Accessed via the intersection of Turpentine Road and Ourimbah Road
- Several off Old Chittaway Road (East) that travels adjacent to the railway line.

2.2 Intersection and mid-block surveys

An intersection traffic survey was undertaken on 17 March 2016 over a 24 hour period utilising video cameras positioned at the staggered intersection of Enterprise Drive, Old Chittaway Road (East) and Old Chittaway Road (West).

A mid-block tube count (full classification) was undertaken on 15 March to 22 March 2016 over a 24 hour 7 day period on Enterprise Drive between Old Chittaway Road (East) and Old Chittaway Road (West).The average weekday daily traffic volume on Enterprise Drive is approximately 18,340 vehicles with 9,090 vehicles eastbound (northbound) and 9,250 vehicles westbound (southbound). Heavy vehicles comprise approximately five per cent of all vehicles. The 85th percentile vehicle speed recorded is 90 kilometres per hour.

Figures 2.1 and 2.2.show the existing intersection traffic volumes during the weekday AM and PM peak periods. The intersections traffic surveys indicated an AM peak between 7.45 am and 8.45 am and a PM peak between 4.45 pm and 5.45 pm.

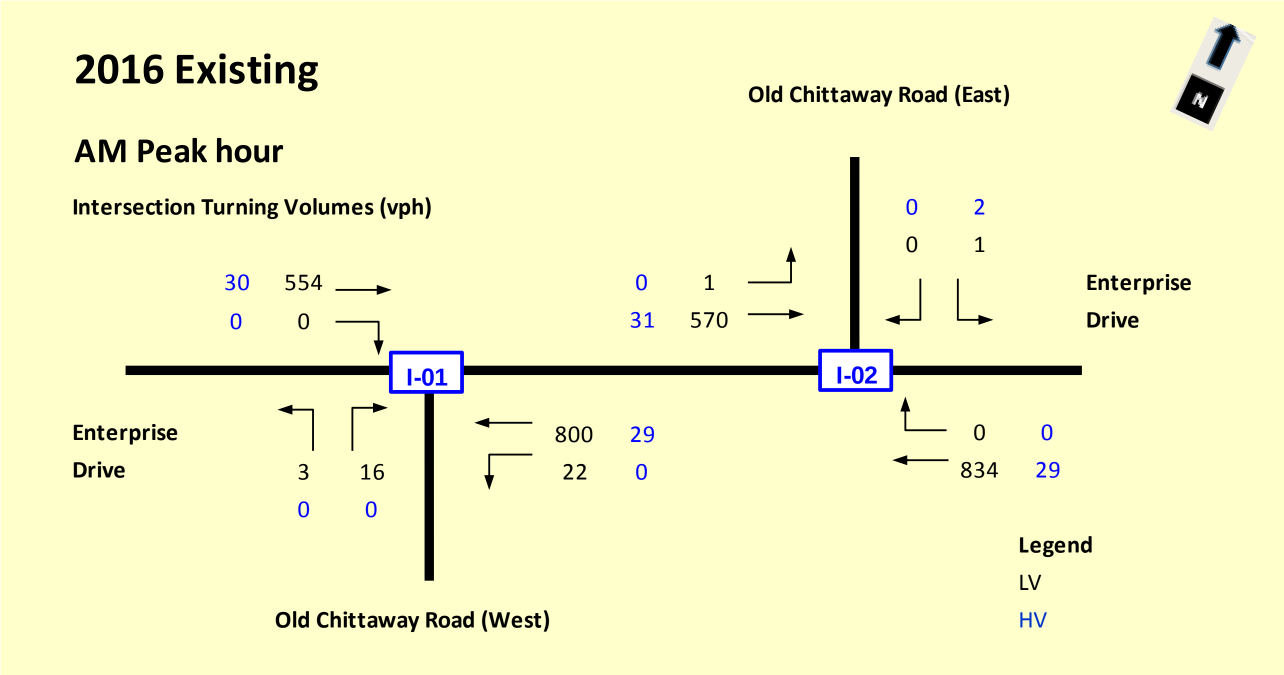


Figure 2.1 Existing intersection traffic volumes during the 2016 AM peak

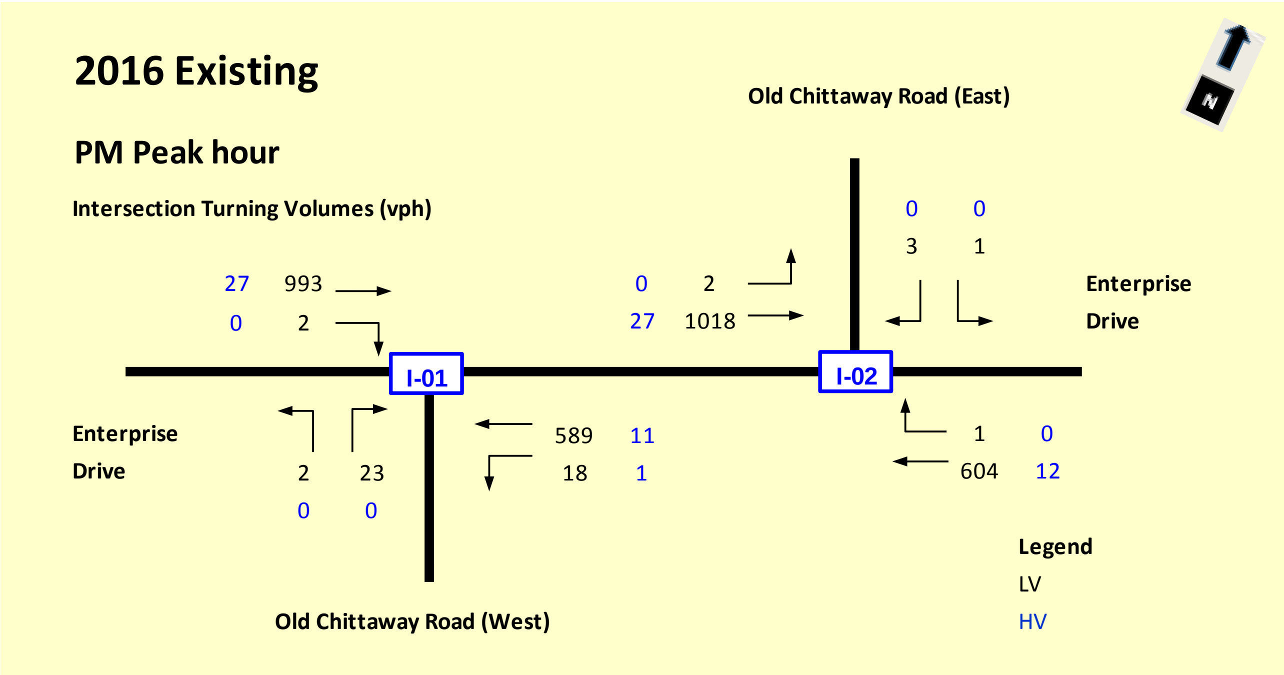


Figure 2.2 Existing intersection traffic volumes during the 2016 PM peak

2.3 Intersection performance parameters

The SIDRA intersection traffic modelling software was utilised to determine intersection performance. This software provides several useful indicators to determine the level of intersection performance. These are known as Level of Service (LoS), Degree of Saturation (DoS), Average Delay (seconds), and queue length (metres). The LoS criteria for intersections is summarised in Table 2.1.

Table 2.1 Level of Service Criteria for Intersections

LEVEL OF SERVICE	AVERAGE DEALY (SECONDS PER VEHICLE)	TRAFFIC SIGNALS, ROUNDABOUT	GIVE WAY AND STOP SIGNS
A	Less than 14	Good operation.	Good operation.
B	15 to 28	Good with acceptable delays and spare capacity.	Acceptable delays and spare capacity.
C	29 to 42	Satisfactory.	Satisfactory, but accident study required.
D	43 to 56	Operating near capacity.	Near capacity and accident study required.
E	57 to 70	At capacity. At signals, incidents would cause excessive delays. Roundabouts require other control mode.	At capacity; requires other control mode.
F	Greater than 71	Unsatisfactory with excessive queuing.	Unsatisfactory with excessive queuing; requires other control mode.

Source: Roads and Maritime Services *Guide to Traffic Generation Developments*

2.4 Intersection layouts and performance

The existing intersection layout as modelled in SIDRA is shown in Figure 2.3 below for the Enterprise Drive, Old Chittaway Road (East) and Old Chittaway Road (West) intersection. This intersection will be modified in the future to construct a new access road to the proposed facility.

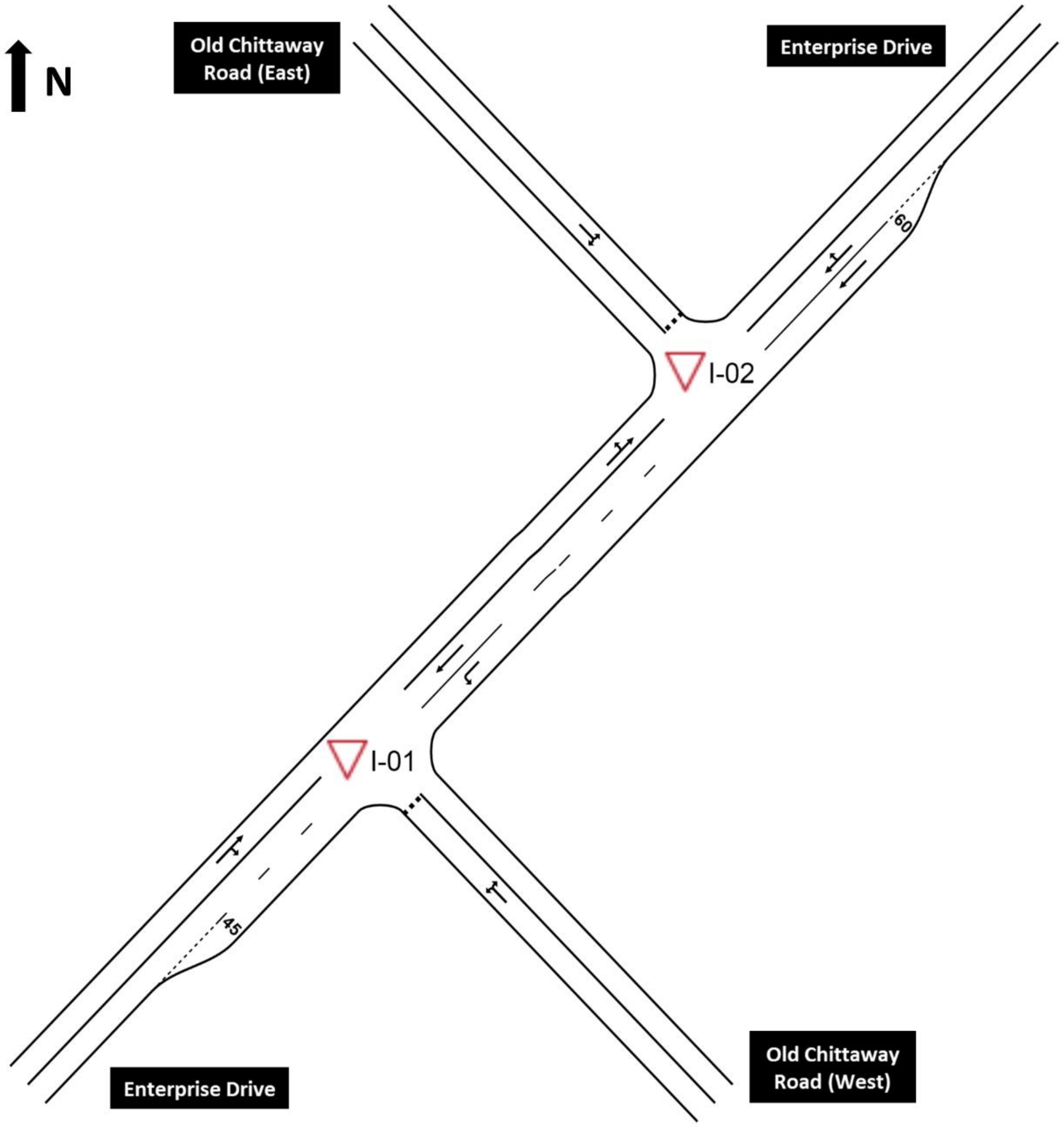


Figure 2.3 Existing intersection layout – Enterprise Drive, Old Chittaway Road (East) and Old Chittaway Road (West)

SIDRA intersection traffic modelling was undertaken to determine the performance of the intersection under existing layout and traffic conditions. The results are summarised in Table 2.2, whilst the SIDRA movement summaries are provided in Appendix A.

Table 2.2 Intersection Performance – Existing (2016)

INTERSECTION	CONTROL TYPE	PEAK PERIOD	DEGREE OF SATURATION	AVGERAGE VEHICLE DELAY (SECS)	LEVEL OF SERVICE	QUEUE (M)
Enterprise Drive and Old Chittaway Road (West)	Priority Control	AM (7.45–8.45)	0.46	26	B	2
		PM (4.45–5.45)	0.56	44	D	5
Enterprise Drive and Old Chittaway Road (East)	Priority Control	AM (7.45–8.45)	0.47	23	B	1
		PM (4.45–5.45)	0.58	35	C	1

Analysis of the intersection performance indicates that both intersections would perform satisfactorily, achieving a Level of Service (LoS) D or better during AM and PM peak hours. The right turning traffic from a side road would experience a minor delay, but the major though traffic movement on Enterprise Drive would achieve a LoS A. The Degree of Saturation (DoS) of below 0.6 indicates the existing intersection layout has considerable spare capacity to accommodate the existing traffic volumes.

2.5 Crash data review

WSP | Parsons Brinckerhoff obtained crash data from Roads and Maritime. The results of the crash data review are summarised below and detailed in Appendix B.

The latest crash data of the following road sections were obtained for the period from 1 January 2010 to 31 December 2015 to estimate the recent pattern of accident type in the study area.

- Enterprise Drive between Burns Road and Catamaran Road
- Turpentine Road, Ourimbah Road and Orchard Road.

A review of the crash data indicates that 31 reported crashes have been recorded on Enterprise Drive during the latest validated five-year period. These include one fatal crash, 16 injury crashes and 14 non-casualty crashes. There were no reported crashes occurring on Turpentine Road, Ourimbah Road and Orchard Road. The crashes are classified as shown in Table 2.3.

Table 2.3 Summary of crash data

CRASHES		COUNTS (%)		CASUALTIES		COUNTS (%)	
Fatal		1	3.2%	Killed		1	5.3%
Injury	Serious	2	6.5%	Injured	Seriously	2	10.5%
	Moderate	5	16.1%		Moderately	5	26.3%
	Minor/Other	2	6.5%		Minor/other	2	10.5%

CRASHES		COUNTS (%)		CASUALTIES		COUNTS (%)	
	Uncategorised	7	22.6%		Uncategorised	9	47.4%
Non-casualty		14	45.2%				
Total number of crashes		31		Total number of casualties		19	

Source: Roads and Maritime crash data

Analysis of the type of crashes indicates:

- Eighteen out of 31 crashes (58%) were recorded as occurring within 50 metres of intersections, while other 13 crashes (42%) occurred at mid-block locations along Enterprise Drive.
- Over the five years period, rear-end crashes were the most common crash type within the study area. Seven out of 31 crashes (23%) were reported as rear-end crashes.
- The fatality occurred approximately 600 metres north of Old Chittaway Road in fine and dry weather conditions during daylight hours as result of an off carriageway type accident.
- No crashes were reported involving pedestrians or cyclists on Enterprise Drive.
- Of the 10 crashes where the contributing factor was known, five crashes were attributed to speeding and another five to fatigue.

Figure 2.4 shows the number of crashes per crash movement within the study area for the period January 2010 to December 2015.

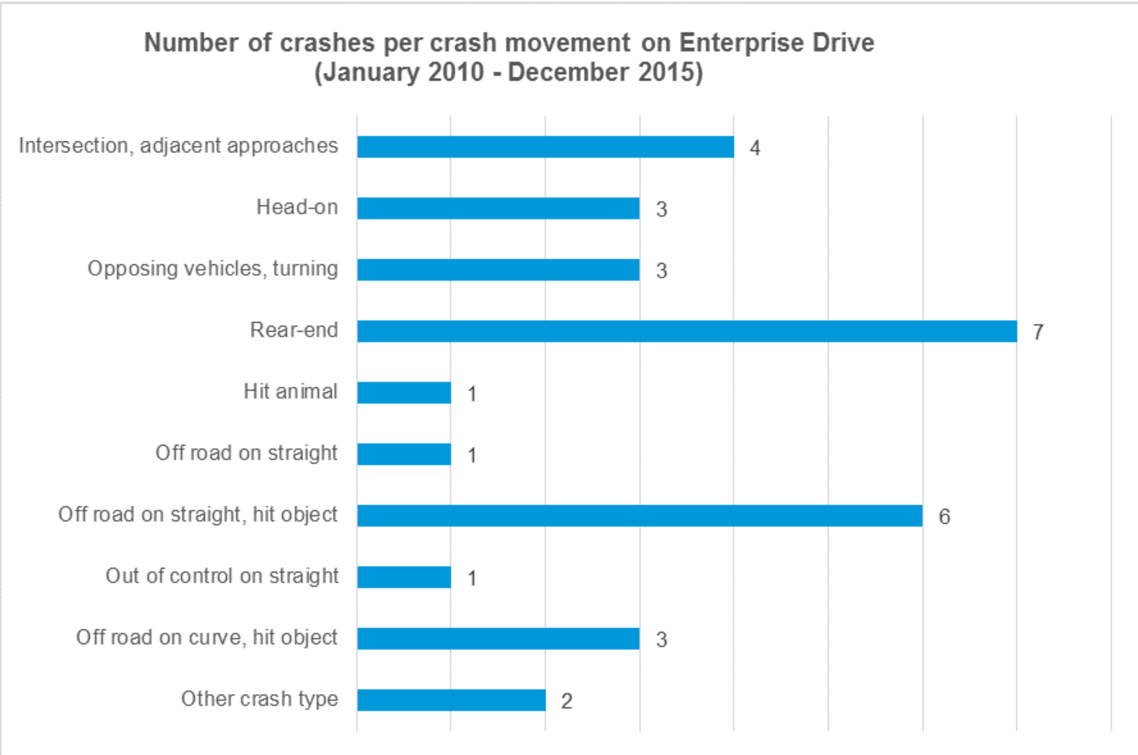


Figure 2.4 Enterprise Drive crash movement

2.6 Public transport

The following public transport services are provided within the study area.

2.6.1 Bus services

Bus services currently operate along Enterprise Drive and the Pacific Highway. The services are operated by Red Bus Services and include the Route 47 bus service. Existing bus services that operate in the study area are shown in Figure 2.5 and their route and frequency is detailed in Table 2.4.

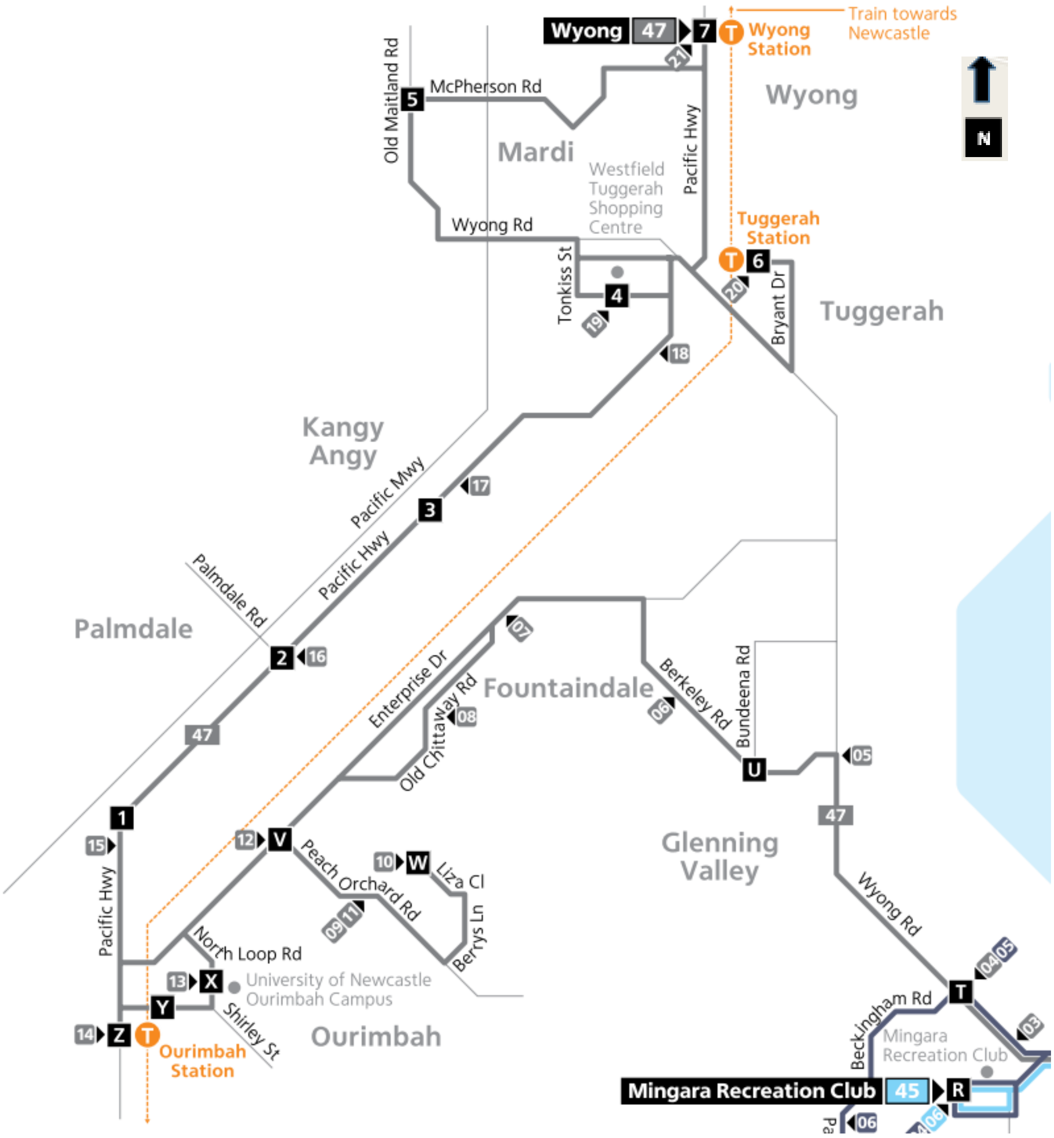


Figure 2.5 Bus services within the study area

Table 2.4 Bus service routes and frequency within the study area

BUS ROUTE	DESCRIPTION	HOURS OF OPERATION	NUMBER OF SERVICES
47	Bateau Bay Square to Wyong via Ourimbah University Service operates Monday to Friday	From Bateau Bay Square (from 7.10 am to 2.00 pm)	3 services a day AM peak: 1 Mid-day: 2 PM peak: 0
		From Wyong (from 8.25 am to 3.40 pm)	3 services a day AM peak: 1 Mid-day: 2 PM peak: 0

Source: Red Bus Services timetable

2.6.2 Rail services

The nearest railway stations for passenger services are located at Ourimbah, to the south at Tuggerah to the north. Both stations are well outside the study area extents.

2.7 Pedestrians and cyclists

The existing pedestrian and cycle network in close proximity of the project site are described below.

2.7.1 Pedestrians

No formalised pedestrian (concrete) footpaths exist adjacent to the Project site.

2.7.2 Cyclists

On road bicycle facilities are provided on both sides of Enterprise Drive between 50 metres south of Old Chittaway Road (south) and Wyong Road (further north of the study area) within 1 to 1.5 metres sealed shoulders.

2.8 Road safety deficiencies

The following road safety deficiencies were noted during the site inspection:

→ The majority of trees are located within the clear zone along both sides of Enterprise Drive, north of Turpentine Road for a 90 kilometres per hour speed limit zone. The location of trees may lead to increased accident severity if an errant vehicle leaves the roadway.

2.9 Rail bridge clearance heights and road restrictions

The following road and bridge related restrictions apply:

→ Low rail bridge height clearance of 3.3 metres on Turpentine Road

→ Low rail bridge height clearance of 3.0 metres on Burns Road

→ Single lane vehicle movement on Burns Road at rail bridge

→ Five tonne load limit on Burns Road.

2.10 Sight distance

A review of sight distances at intersections and along the proposed access routes was undertaken during the site inspections with the following observations noted:

- The intersection of Enterprise Drive and Turpentine Road has interrupted sight distance to the south due to vegetation and infrastructure positioning.
- The underpass at the rail bridge on Turpentine Road has restricted sight distances.
- The underpass at the rail bridge on Burns Road has restricted sight distances.

3 PROPOSED PROJECT DETAILS

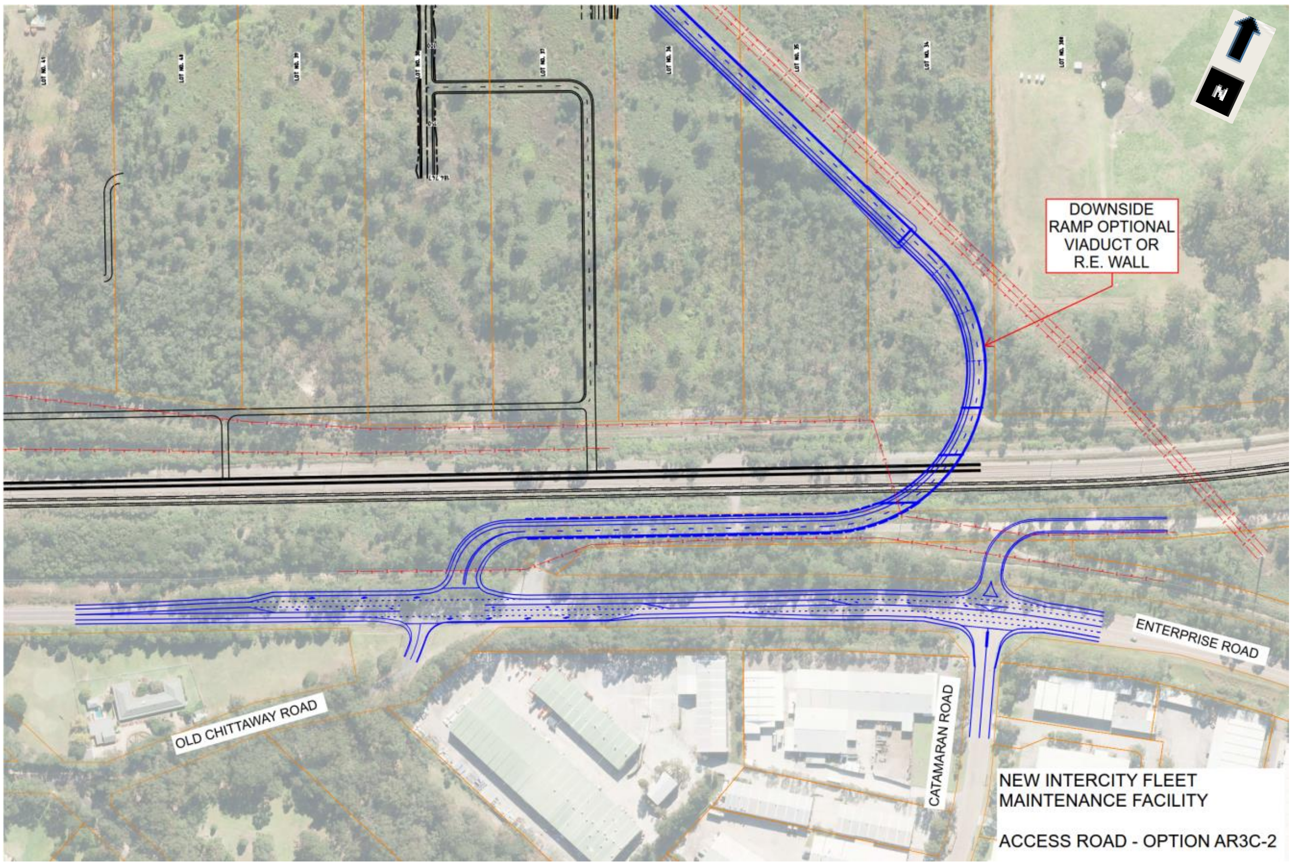
3.1 Proposal road access and construction facilities

The main access to the Project site will be via newly constructed access road which is to be configured as a two lane two-way road which forms a four way intersection with Enterprise Drive and Old Chittaway Road (West) as shown in Figure 3.1.

Old Chittaway Road (East) where it currently intersects with Enterprise Drive will be closed to traffic and realigned to intersect further north at the new built Enterprise Drive and Catamaran Drive intersection as shown in Figure 3.1. Old Chittaway Road (East) will be restricted to left in and left out movements only.

3.1.1 Access roads

The proposed site access road concept design is shown in Figure 3.1.

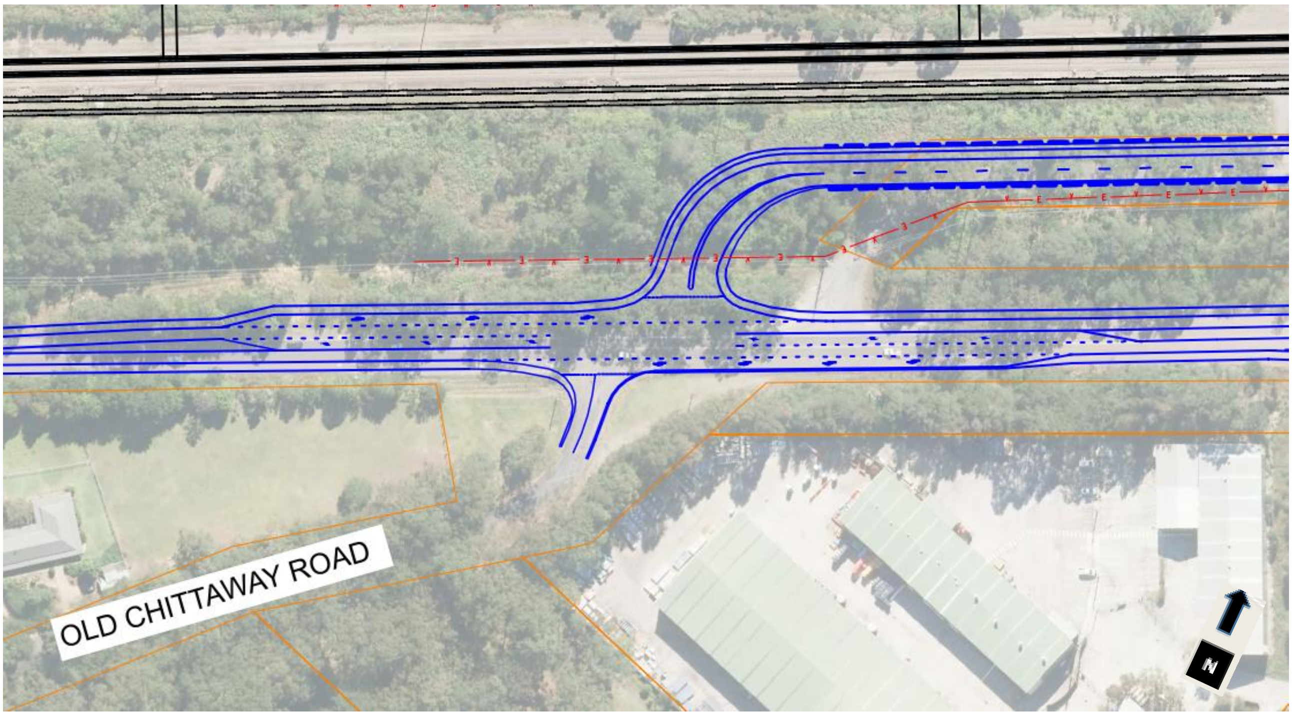


Source: Transport for NSW (2016)

Figure 3.1 Proposed site access road

3.1.2 Intersections

The concept design for the proposed site access road intersection with Enterprise Drive and Old Chittaway Road (West) is shown in Figure 3.2.



Source: Transport for NSW (2016)

Figure 3.2 Proposed site access road intersection with Enterprise Drive and Old Chittaway Road

3.2 Proposal program

Indicative construction and commissioning program and activities are provided in Table 3.1. Construction of the facility is expected to commence in Quarter 4 of 2016 with completion scheduled for Quarter 4 in 2019. It is assumed that the peak traffic activity will occur during construction in 2017.

Table 3.1 Indicative project staging program

STAGE	ACTIVITY	TARGET DURATION	YEAR
Project Enabling Works	Construction of external access road and bridge into site, HV and CSR relocation	10–12 months	2016/2017
Construction Works	Maintenance Facility	24 months	2018/2019

3.3 Proposed staffing

3.3.1 Construction (standard)

During construction, the maximum daily workforce on a standard day is anticipated to be 200 employees.

3.3.2 Construction (rail possessions)

When rail possessions are proposed during the construction period it is anticipated that the maximum daily workforce will increase to approximately 300 employees.

3.3.3 Operation

The facility would have a maximum of 200 employees over a 24 hour period during the operation stage, with 50 to 60 employees on duty at any one time. During the normal weekday day shift, this number could increase by a further 10 office staff.

3.4 Proposed working hours

The following construction and operation hours are proposed.

3.4.1 Construction (standard)

The New Intercity Fleet facility construction works are planned to mobilise during 2016 and be completed by 2019. The standard hours for construction would be:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm Saturday
- No work on Sundays or public holidays.

3.4.2 Construction (rail possessions)

Working hours during rail possessions are envisaged to occur on weekdays and potentially weekends outside of peak periods.

Activities that are rail possession dependant include:

- Erection of bridge deck for the new access road
- Relocation of HV crossing and connections
- Underbores under the rail corridor for elements such as communication and electrical connections
- New turnouts from main line
- Installation of over-head wires
- Commissioning activities.

3.4.3 Operation

Three eight hour shifts are likely during normal day to day operations and include:

- 6.00 am to 2.00 pm
- 2.00 pm to 10.00 pm
- 10.00 pm to 6.00 am.

3.5 Vehicle and staff parking

During construction of the access bridge, parking will be provided on Old Chittaway Road (East) in a designated car park. During the main construction period, parking will be provided on the Project site. Parking on local road will be minimised.

4 FUTURE SITUATION

This section describes the future situation of the road network due to the predicted increased traffic generated by the Project during both the construction and operational stages.

4.1 Trip generation and likely employee arrival/departure times

Employee numbers and service and delivery requirements have been provided by Transport for NSW which inform the anticipated trip generation due the Project during construction and operation. Table 4.1 provides a breakdown of the anticipated trip generation by vehicle type during both construction and operation stages for daily and peak hourly movements.

Table 4.1 Trip generation (one-way) during construction and operation

STAGE	DAILY (ONE-WAY)		AM PEAK # (ONE-WAY)		PM PEAK ## (ONE-WAY)	
	LV	HV	LV	HV	LV	HV
Construction – Standard	200	84	50	11	50	11
Construction – During Possessions	300	84	75	11	75	11
Operation – Standard ###	220	10	11	1	11	1

Source: Transport for NSW

The weekday AM background traffic peak occurs between 7.45 am and 8.45 am. This does not coincide with the Projects peak in the AM. For the purposes of this assessment it has been assumed that 25 per cent of the Projects construction traffic and 100 per cent of the general office based operational traffic (0 per cent shift based operational traffic) will coincide with the background traffic AM peak.

The weekday PM background traffic peak occurs between 4.45 pm and 5.45 pm. This does not coincide with the Projects peak in the PM. For the purposes of this assessment it has been assumed that 25 per cent of the Projects construction traffic and 100 per cent of the general office based operational traffic (0 per cent shift based operational traffic) will coincide with the background traffic PM peak.

This assumes three working shifts across a day where all staff vehicle movements occur outside of peak hour times. The only exception is general office based staff who are likely to work a standard day (9.00 am to 5.00 pm). Office based staff have been included as light vehicle trips for both the AM and PM peaks.

A further detailed description breakdown is provided below.

4.1.1 During construction

The following construction related vehicle trips are anticipated:

- 400 light vehicles for workers throughout per day (200 in/200 out)
- 600 light vehicles for workers at peak periods per day (300 in/300 out)
- 1,500 truck movements for concrete over a 12 month period (averaged at six per day, one per peak hour)

- 2,700 truck movements for imported fill over a six month period (averaged at 21 per day, two per peak hour)
- 1,900 truck movements for structural steel over a 30 month period (averaged at three per day, one per peak hour)
- 400 truck movements for concrete pumps over a 30 month period (averaged at one per day, one per peak hour)
- 6,000 truck movements for steel over a 12 month period (averaged at 23 per day, two per peak hour) – potentially transported by rail
- 1,000 truck movements for miscellaneous deliveries over 18 month period (averaged at three per day, one per peak hour)
- 3,500 truck movements for ballast over six month period (averaged at 27 per day, three per peak hour).

4.1.2 During operation

The following construction related vehicle trips are anticipated:

- 400 light vehicles for workers per day (200 in/200 out)
- In excess of 50 to 60 light vehicle trips at any one time (refer to shift status)
- 20 light vehicles for office based staff per day (10 per peak hour)
- 10 light vehicles for maintenance, service and delivery per day (one per peak hour)
- 10 heavy vehicles for maintenance, service and delivery per day (one per peak hour).
- A peak of 50 trucks per day once every 10 years (i.e. a one in 10 year spike). This is to allow for the delivery every 10 years or so that includes delivery of large maintenance equipment, new bogies, etc. and would be a rare occurrence delivery type. Typically one–five trucks per day (excluding worker vehicles).

4.2 Trip distribution

Employee trip distribution has been estimated and assumes the vast majority will travel from the nearby major centres of Newcastle and Wyong to the north and Gosford and Sydney to the south. We have assumed an even 50 per cent north and 50 per cent south split at Enterprise Drive for assessment purposes for both construction and operation phases.

4.3 Vehicle travel routes

The following vehicle routes are proposed to and from the site for both construction and operation phases as shown in Figure 4.1. The majority of the traffic accessing the site during construction will be directed to use the rail overbridge (primary access). The occasional vehicle may need to use Turpentine Road and Orchard Road via the Enterprise Drive and Turpentine Road intersection (secondary access).

Also there is likely to light and heavy vehicle traffic utilising Orchard Road, Ourimbah Road and Turpentine Road between the main facility and the western end of the Project as well as access from Enterprise Drive and Turpentine Road for installation of new bridges over Chittaway Creek.

Heavy vehicle access to the site will be via the following routes:

From the M1 Pacific Motorway:

- Exit at the Ourimbah Interchange

- Pacific Highway
- Chittaway Road
- Enterprise Drive
- Site Access Road.

From the Pacific Highway:

- Chittaway Road
- Enterprise Drive
- Site Access Road.

From Wyong Road:

- Enterprise Drive
- Site Access Road.

4.4 Vehicle and staff parking

Staff, visitor and service/delivery parking will be provided on-site during operation.

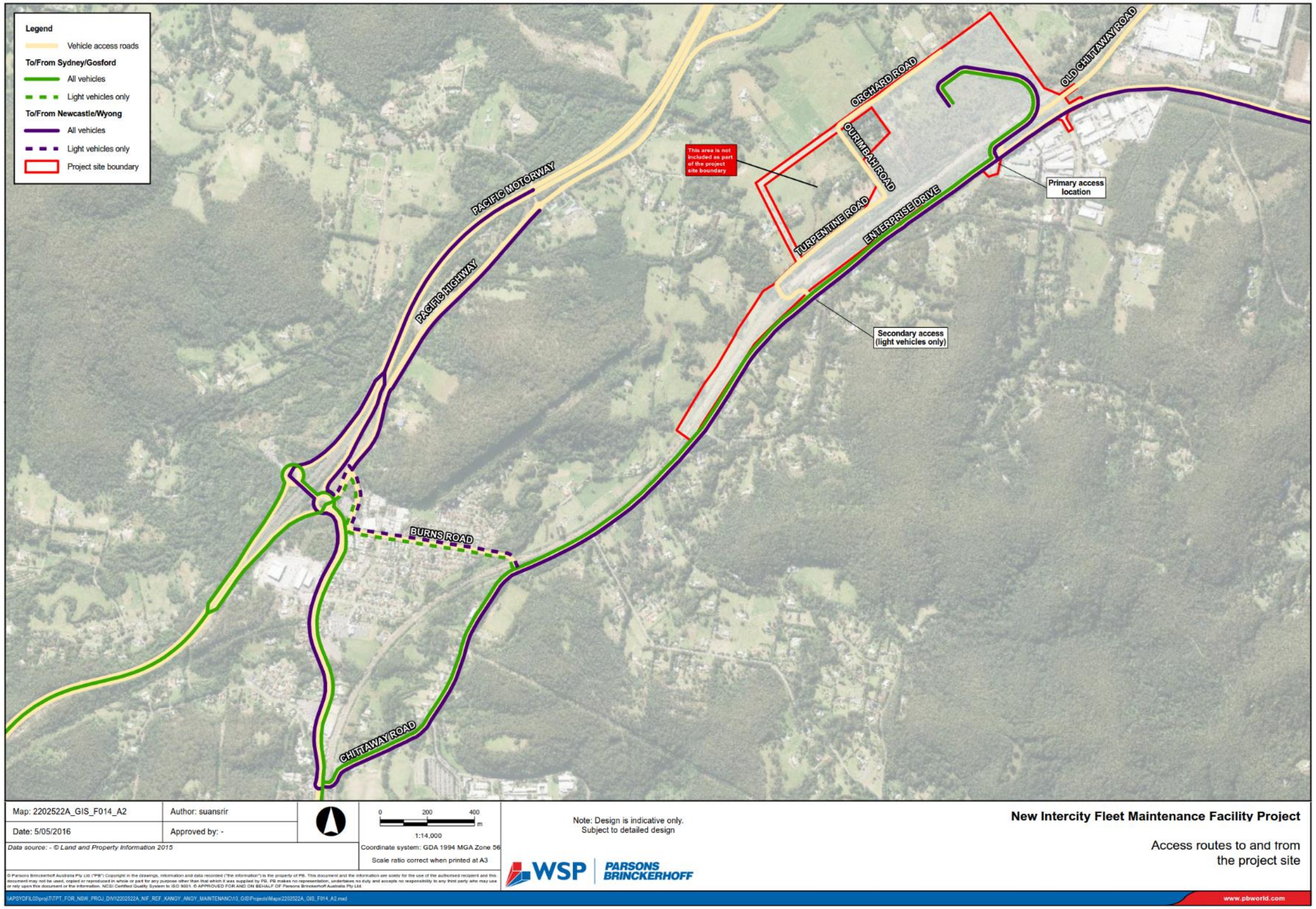


Figure 4.1 Vehicle travel routes to the Project site

5 PROJECT IMPACTS

The following impacts are anticipated during the construction and operation of the facility including impacts on intersection performance, road performance and all road users.

5.1 Intersection performance

Enterprise Drive/Old Chittaway Road (West)/Access Road

The proposed future intersection layout as modelling in SIDRA is shown in Figure 5.1 below for the Enterprise Drive, Old Chittaway Road (East) and Access Road intersection.

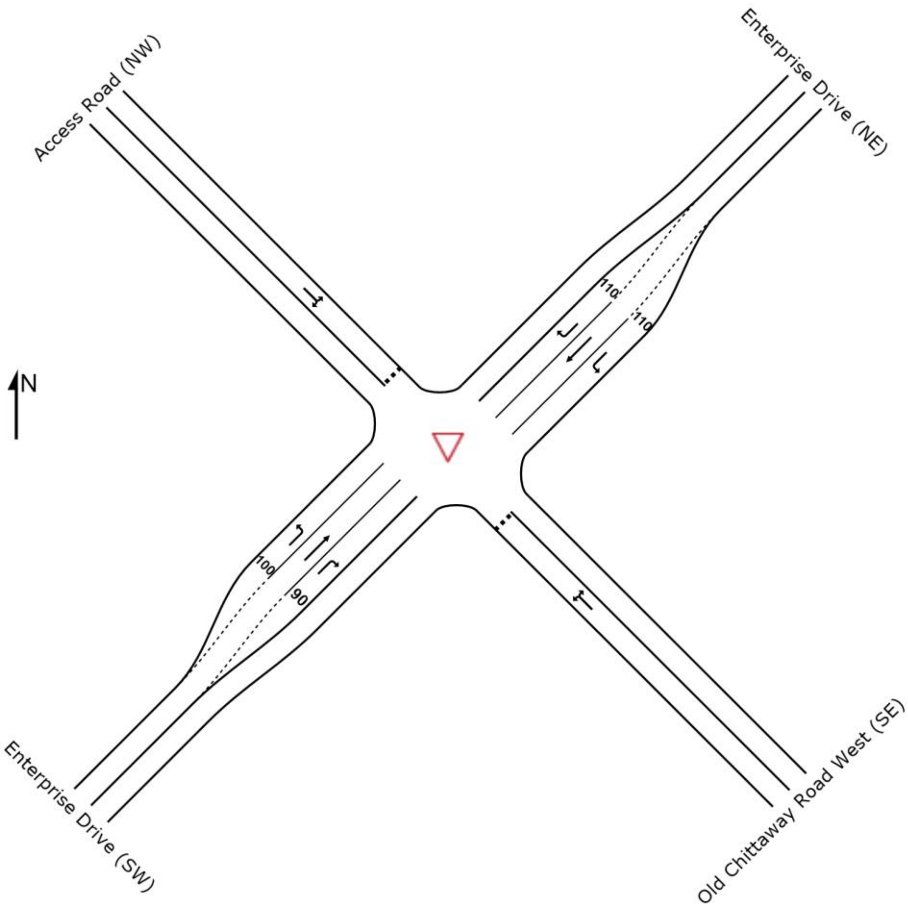


Figure 5.1 Future intersection layout – for Enterprise Drive, Old Chittaway Road (West) and Access Road modelled in SIDRA

Enterprise Drive/Old Chittaway Road (East)/Catamaran Road

As discussed in section 3.1, the newly built Enterprise Drive, Old Chittaway Road (East) and Catamaran Drive intersection will be restricted to left in and left out movements only to/from Old Chittaway Road (East). Based on the intersection traffic counts undertaken at the existing Old Chittaway Road (East) and Enterprise Drive intersection, approximately 40 vehicles are anticipated on a daily basis on Old Chittaway Road (East) and four vehicles during the AM peak (of which none are right turning in or out) and seven vehicles in the PM peak (of which three are right turning out and one right turning in). Traffic generated by the Project will not utilise Old Chittaway Road (East); however, will travel through this intersection as through movements on Enterprise Drive. This intersection is expected to perform at similar levels to the existing operation. No SIDRA intersection modelling has been undertaken at this intersection.

SIDRA intersection traffic modelling was undertaken to determine the performance of the intersection under the proposed future layout and traffic conditions. The results are shown in Tables 5.1 to 5.3, whilst SIDRA movement summaries are provided in Appendix A.

5.1.1 Future year do-nothing

WSP | Parsons Brinckerhoff has adopted a traffic growth rate of two per cent per annum in this study as a conservative approach to estimate the future background traffic volumes in 2017 (peak construction year) and 2019 (year of opening).

The intersection performance for a future year has been assessed to determine the future traffic conditions without development. The results of the intersection performance without the proposed New Intercity Facility development are presented in Table 5.1 and detailed SIDRA movement summaries are provided in Appendix A.

Table 5.1 Intersection Performance – Future year do-nothing

INTERSECTION	CONTROL TYPE	PEAK PERIOD	DEGREE OF SATURATION (DOS)	AVERAGE VEHICLE DELAY (SECS)	LEVEL OF SERVICE	QUEUE (M)
Enterprise Drive and Old Chittaway Road (West)	Priority Control	AM (7.45–8.45)	0.47	27	B	2
		PM (4.45–5.45)	0.58	48	D	6
Enterprise Drive and Old Chittaway Road (East)	Priority Control	AM (7.45–8.45)	0.48	24	B	1
		PM (4.45–5.45)	0.59	37	C	1

Analysis of the intersection performance indicates that both intersections would achieve similar operating conditions compared to the existing level. It is expected that the existing intersection layout has considerable spare capacity to accommodate the future background traffic volumes.

5.1.2 Future with construction

SIDRA intersection traffic modelling was undertaken to determine the performance of the concept design layout (as shown in Figure 3.2) of the Enterprise Drive, Old Chittaway Road and Access Road intersection during the peak construction period in 2017. The results are shown in Table 5.2.SIDRA movement summaries are provided in Appendix A.

Table 5.2 Intersection Performance – Future year with construction

INTERSECTION	CONTROL TYPE	PEAK PERIOD	DEGREE OF SATURATION (DOS)	AVERAGE VEHICLE DELAY (SECS)	LEVEL OF SERVICE	QUEUE (M)
Enterprise Drive, Access Road and Old Chittaway Road (West)	Priority Control	AM 7.45–8.45	0.47	142	F	10
		PM 4.45–5.45	3.26	2539	F	182

Table 5.2 shows that the proposed layout of the Enterprise Drive, Old Chittaway Road and Access Road intersection would operate at an unsatisfactory level of service (LoS F) with construction traffic for both the AM and PM peak hours in 2017.Even with low traffic volumes to and from the Project site, poor intersection performance is anticipated during peak periods.

Under a priority controlled intersection, the right turn movement from a side road is the critical movement through the intersection in terms of the delay and level of service. Under existing conditions, right turning traffic from side roads are only required to cross one or two lanes to turn into Enterprise Drive. However, due to the increased number of lanes on Enterprise Drive, right turning traffic from both Old Chittaway Road and Access Road would require longer crossing time to turn onto Enterprise Drive. As a result, the right turn movement from the side roads would experience long delays during both the AM and PM peak hours.

5.1.3 Future with operation

Intersection performance has been assessed to determine the impacts of the concept design layout for the opening year of the New Intercity Facility in 2019. The results from the analysis are summarised in Table 5.3 and detailed SIDRA summaries are provided in Appendix A.

Table 5.3 Intersection Performance – Future year with operation

INTERSECTION	CONTROL TYPE	PEAK PERIOD	DEGREE OF SATURATION (DOS)	AVGERAGE VEHICLE DELAY (SECS)	LEVEL OF SERVICE	QUEUE (M)
Enterprise Drive, Access Road and Old Chittaway Road West	Priority Control	AM 7.45–8.45	0.58	184	F	12
		PM 4.45–5.45	2.00	1368	F	92

Table 5.3 shows that the proposed layout of the Enterprise Drive, Old Chittaway Road and Access Road intersection would operate at an unsatisfactory level of service (LoS F) with operation traffic for both the AM and PM peak hours in 2019.

The number of vehicles that access the New Intercity Facility will be reduced compared to the construction period; however the right turning movement on the Access Road and Old Chittaway Road will continue to experience long delays.

5.2 Road performance

A mid-block capacity assessment has been undertaken for Enterprise Drive near Old Chittaway Road. The mid-block capacity has been based on the RMS Guide to Traffic Generating Developments and Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis guidelines. Both these guidelines state that a mid-block lane capacity of 1,400 vehicles per lane per hour can be achieved under normal urban interrupted flow conditions.

Section 5.2.1 of the Austroads Guide to Traffic Management Part 3: Traffic Studies and Analysis states that mid-block traffic volumes may increase to 1,200 to 1,400 vehicles per lane per hour on any approach road when the following conditions exist or can be implemented:

- Adequate flaring at major upstream intersections
- Uninterrupted flow from a wider carriageway upstream of an intersection approach and flowing at capacity
- Control or absence of crossing or entering traffic at minor intersections by major road priority controls
- Control or absence of parking
- Control or absence of right turns by banning turning at difficult intersections
- High volume flows of traffic from upstream intersections during more than one phase of a signal cycle
- Good co-ordination of traffic signals along the route.

Mid-block capacities and Levels of Service based on the number of lanes in one direction are shown in Table 5.4.

Table 5.4 Urban road peak hour flows per direction

LEVEL OF SERVICE	ONE LANE (VEH/HR)	TWO-LANE (VEH/HR)
A	200	900
B	380	1,400
C	600	1,800
D	900	2.200
E	1,400	2,800

Source: Roads and Maritime Services *Guide to Traffic Generating Developments (2002)*

Increases in mid-block peak hourly traffic volumes with and without the Project are shown in Table 5.5.

Table 5.5 Peak hourly mid-block traffic volumes

LOCATION	PEAK	ONE-WAY BASE VOLUME	CONSTRUCTION		OPERATION	
			HOURLY PROJECT ONE-WAY VOLUME	HOURLY TRAFFIC INCREASE (%)	HOURLY PROJECT ONE-WAY VOLUME	HOURLY TRAFFIC INCREASE (%)
Enterprise Drive between (Northbound)	AM	584	25	4.3	6	1.0
Enterprise Drive between (Southbound)		851	25	2.9	6	0.7
Enterprise Drive between (Northbound)	PM	1,022	25	2.4	6	0.6
Enterprise Drive between (Southbound)		619	25	4.0	6	1.0

Changes in mid-block peak hourly level of service with and without the Project are shown in Table 5.6.

Table 5.6 Peak hourly mid-block level of service

LOCATION	PEAK	ONE-WAY BASE VOLUME	LOS	CONSTRUCTION		OPERATION	
				BASE PLUS HOURLY PROJECT ONE-WAY VOLUME	LOS	BASE PLUS HOURLY PROJECT ONE-WAY VOLUME)	LOS
Enterprise Drive between (Northbound)	AM	584	B	609	C	590	B
Enterprise Drive between (Southbound)		851	C	876	C	857	C
Enterprise Drive between (Northbound)	PM	1,022	D	1,047	D	1,028	D
Enterprise Drive between (Southbound)		619	C	644	C	625	C

Increases in mid-block daily traffic volumes with and without the Project are shown in Table 5.7.

Table 5.7 Daily mid-block traffic volumes

LOCATION	PEAK	TWO-WAY BASE VOLUME	CONSTRUCTION		OPERATION	
			DAILY PROJECT TWO-WAY VOLUME#	DAILY TRAFFIC INCREASE (%)	DAILY PROJECT TWO-WAY VOLUME#	DAILY TRAFFIC INCREASE (%)
Enterprise Drive between (both directions)	DAILY	18,594	568	3.1	460	2.5

assumes one trip in and one trip out per vehicle daily

5.3 Proposed intersection layout

The proposed concept design layout of the Enterprise Drive, Old Chittaway Road and Access Road intersection will not achieve a satisfactory level of service during both the construction and operational periods of the Project. As a consequence, the following mitigation measures are proposed to be considered for the New Intercity facility traffic at this intersection during detailed design.

- Removal of existing northbound right turn movements from Enterprise Drive into Old Chittaway Road and conversion of this part of roadway into a southbound short merge lane for right turners out of the Access Road into Enterprise Drive
- Provide a seagull arrangement to improve right turn movement from the Access Road into Enterprise Drive
- Prohibiting right turn movements from Old Chittaway Road into Enterprise Drive
- Consider the use of a roundabout or signalised intersection.

This indicative proposed intersection layout incorporating some of the mitigation measures listed above is shown in Figure 5.2.

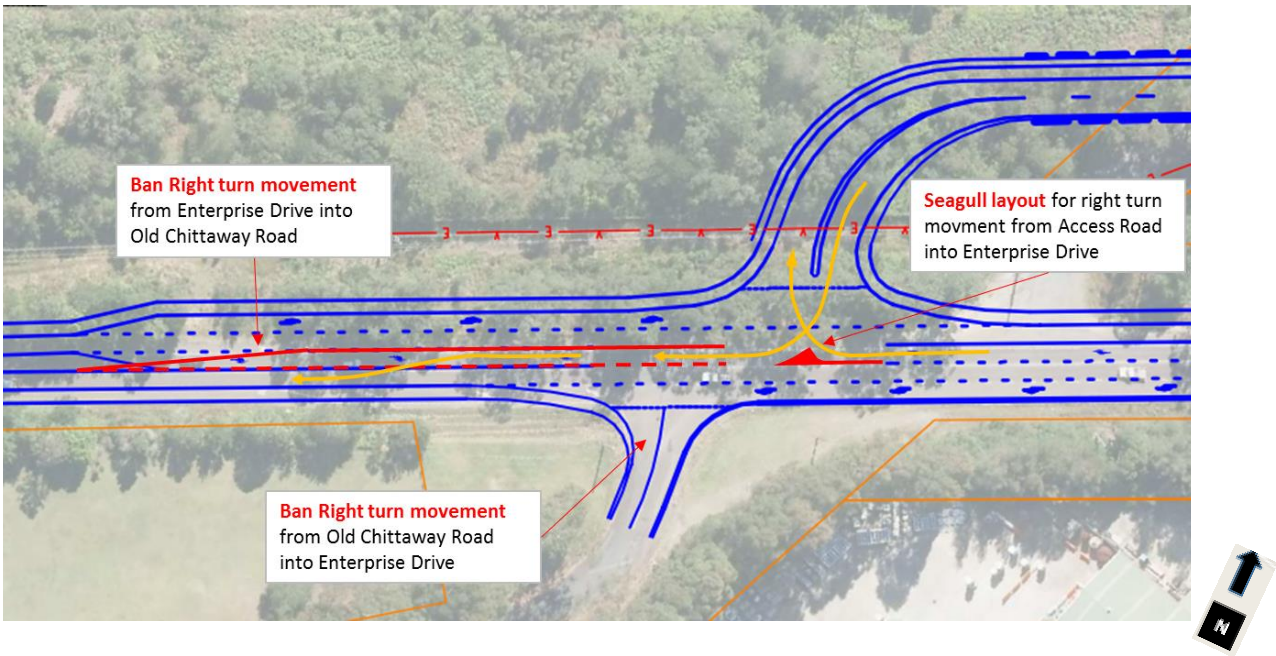


Figure 5.2 Proposed intersection layout

The implementation of the proposed intersection layout will improve the intersection performance compared to the concept design layout, and subsequently the intersection would operate at a satisfactory level of service (LoS D or better) for both AM and PM peak hours as shown in Table 5.8.

Table 5.8 Performance of proposed intersection layout

SCENARIO	CONTROL TYPE	PEAK PERIOD	DEGREE OF SATURATION (DOS)	AVGERAGE VEHICLE DELAY (SECS)	LEVEL OF SERVICE	QUEUE (M)
Future year with construction in 2017	Priority Control with seagull arrangement	AM 7.45–8.45	0.47	13	A	2
		PM 4.45–5.45	0.57	56	D	10
Future year with operation in 2019		AM 7.45–8.45	0.49	13	A	1
		PM 4.45–5.45	0.60	48	D	2

Consultation with the relevant road authority may be undertaken to convert this intersection to a signalised intersection or roundabout with the aim of improving operation, performance and safety. The implementation of traffic signals or a roundabout will provide improved intersection operation without limiting or restricting traffic movements. The implementation of traffic signals or a roundabout will provide good operation with good Level of Service A or B.

5.4 Road users

5.4.1 Road traffic

The concept intersection layout does not operate at a satisfactory level of service and has increased vehicle conflict points reducing the overall safety of the intersection.

The modified concept layout improves both the operation and safety of the intersection. However the layout compromises local traffic accessibility. The implementation of banned or restricted right turn movements from Enterprise Drive into Old Chittaway Road and right out of Old Chittaway Road into Enterprise Drive will lead to increased traffic at the Enterprise Drive intersections to the north with Catamaran Road and to the south with Old Chittaway Road.

Further design will be undertaken and this may include either traffic signal or roundabout controls at this intersection which will remove the need to implement vehicle movement restrictions.

5.4.2 Public transport

No impacts to public transport are anticipated. Bridge related works are proposed to be undertaken during possessions and would not impact regular rail passenger services.

5.4.3 Pedestrians and cyclists

No impacts to pedestrians or cyclists are anticipated. Suitable alternate facilities would be provided as required especially during the construction of the new access road intersection.

6 MITIGATION MEASURES

This section discussed the proposed mitigation measures.

6.1 During construction

Construction methods would seek to manage the construction traffic impacts for the following:

- Heavy vehicle traffic:
  - Minimise the number of heavy vehicle trips on road
  - Minimise the distance travelled by heavy vehicles by encouraging multi-drop delivery trips
  - Minimise disruption on the local road network by using nominated haulage routes, which aim to avoid sensitive areas such as schools (wherever possible)
  - Minimise the running of empty trucks.
- Construction worker traffic:
  - Encourage the use of alternative travel modes to the work sites. Encourage car ‘pooling’ where possible
  - Provide emergency vehicle parking within worksites.
- Temporary worksite access:
  - Use existing accesses wherever possible
  - Use traffic controllers to manage site access
  - Close and lock site access points/gates after construction hours
  - Minimise construction traffic during school start and end times near the following schools.
- Monitoring of intersection performance and safety.

As part of the Construction Traffic Management Plan (CTMP), traffic management plans would be developed to address construction traffic and transport management. The objectives would be to:

- Ensure public safety
- Ensure that affected local residents and businesses are advised of any disruption to traffic flows, parking and public transport services
- Ensure that disruptions to traffic flows on public streets are minimised and, where unavoidable, managed in consultation with the relevant road authority
- Minimise the exposure of the community to heavy construction vehicle traffic impacts and associated noise and vibration
- Ensure safe access to the work site including sight distance and clear any overgrown vegetation
- Ensure that road damage from construction traffic is monitored and addressed in consultation with the relevant road authority.

To ensure the key objectives are achieved, the following mitigation actions would be undertaken:

- Heavy vehicles would be restricted to the routes specified
- Signs would be provided at each access point to assist in deliveries to each work site
- Traffic controllers would be located at each access point, where required and direct vehicle movements, vehicle deliveries, pedestrians and cyclists
- Emergency response protocols would be included in the CTMP for construction traffic incidents. Police/emergency services would respond to emergencies
- A pre and post construction assessment of road pavement assets would be conducted in areas likely to be used by construction traffic
- Consideration of flooding on access roads and the use of alternative access roads
- Installation of environmental controls at access roads so that mud or gravel is not tracked onto the road network from the access roads by construction vehicles
- Public communications would be conducted to inform the community and local residents of vehicle movements and anticipated effects on the local road network relating to the site works
- Access to all private properties adjacent to the works would be maintained during construction
- During proposal inductions all heavy vehicle drivers would be provided with the emergency response plan for construction traffic incidents
- Undertake road safety audits as part of the development of the detailed design where required or deemed necessary
- Coordination of proposal staging, vehicle movement and scheduling, equipment and resourcing.

6.2 During operation

Some of the following mitigation measures are suggested during operation of the site:

- Undertake a road safety audit following the commencement of operation of a the new intersection to assess the intersection performance, and to validate the recommendations/requirements of the raod safety audit prepared as part of the detailed design development
- General site traffic:
  - Limit vehicle trips to outside of the road network peak hour for improved safety and intersection operation, where possible or practicable
  - Schedule delivery and service vehicles to the site out of peak hour periods, where possible or practicable
  - Inform staff and visitors to the site of the preferred travel route and primary site access
  - Monitor intersection access and obtain feedback from staff on its operation.
- Monitor any parking overflow on the surrounding road network (if any).

7 CONCLUSION

The proposed New Intercity Fleet Maintenance Facility Project (the Project) is anticipated to generate a considerable volume of traffic not only during the construction, but also during the operational stages of the Project. Due to the increased traffic volumes, existing intersection and road performance would be impacted.

An upgrade of the Enterprise Drive, Chittaway Road intersection and the site access road is recommended. The results from the intersection traffic modelling indicate that the current proposed intersection will not operate satisfactorily due to the inability of the layout to accommodate the traffic volumes generated by the Project and intensification of conflicting vehicle movements.

A new intersection layout was modelled which included turn restrictions and was found to operate at acceptable levels of service. The implication of that layout is restricted local road access. It is recommended that a review be undertaken of the intersection design in consultation with relevant road authorities.

The Project will not impact on existing road users including pedestrians, cyclists or public transport users. Several mitigation measure have been outlined to ameliorate or remove any Project related impacts.

8 REFERENCE

- New Intercity Fleet Maintenance Facility – Pre-Concept Design Report Draft Report (AECOM, 2016).
- New Intercity Fleet Maintenance Facility – Constructability Draft Report (AECOM, 2016).
- Guide to Traffic Generating Developments (Roads and Maritime Services, 2002).

Appendix A

SIDRA RESULTS

APPENDIX A SIDRA OUTPUTS

A1. 2016 EXISTING AM PEAK

A1.1 I-01 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD WEST

MOVEMENT SUMMARY

Site: I-01 EX AM

Network: 2016 Existing AM

Enterprise Drive / Old Chittaway Road West
2016 Existing AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)													
1	L2	3	0.0	3	0.0	0.108	10.7	LOS A	0.3	2.2	0.87	0.95	40.9
3	R2	17	0.0	17	0.0	0.108	25.9	LOS B	0.3	2.2	0.87	0.95	13.5
Approach		20	0.0	20	0.0	0.108	23.5	LOS B	0.3	2.2	0.87	0.95	20.3
NorthEast: Enterprise Drive (NE)													
4	L2	23	0.0	23	0.0	0.012	3.6	LOS A	0.0	0.0	0.00	0.58	40.9
5	T1	873	3.5	873	3.5	0.458	0.0	LOS A	0.0	0.0	0.00	0.00	89.7
Approach		896	3.4	896	3.4	0.458	0.1	NA	0.0	0.0	0.00	0.01	88.9
SouthWest: Enterprise Drive (SW)													
11	T1	615	5.1	615	5.1	0.328	0.1	LOS A	0.1	0.4	0.01	0.00	89.6
12	R2	1	0.0	1	0.0	0.328	18.9	LOS B	0.1	0.4	0.01	0.00	75.0
Approach		616	5.1	616	5.1	0.328	0.1	NA	0.1	0.4	0.01	0.00	89.5
All Vehicles		1532	4.1	1532	4.1	0.458	0.4	NA	0.3	2.2	0.01	0.02	87.7

A1.2 I-02 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD EAST

MOVEMENT SUMMARY

Site: I-02 EX AM

Network: 2016 Existing AM

Enterprise Drive / Old Chittaway Road East
2016 Existing AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
NorthEast: Enterprise Drive (NE)													
11	T1	908	3.4	908	3.4	0.466	0.0	LOS A	0.0	0.2	0.00	0.00	89.9
12	R2	1	0.0	1	0.0	0.466	12.8	LOS A	0.0	0.2	0.00	0.00	75.5
Approach		909	3.4	909	3.4	0.466	0.0	NA	0.0	0.2	0.00	0.00	89.8
NorthWest: Old Chittaway Road East (SE)													
1	L2	3	66.7	3	66.7	0.013	10.8	LOS A	0.0	0.4	0.70	0.80	34.5
3	R2	1	0.0	1	0.0	0.013	22.7	LOS B	0.0	0.4	0.70	0.80	19.0
Approach		4	50.0	4	50.0	0.013	13.7	LOS A	0.0	0.4	0.70	0.80	33.0
SouthWest: Enterprise Drive (SW)													
4	L2	1	0.0	1	0.0	0.336	3.6	LOS A	0.0	0.0	0.00	0.00	18.7
5	T1	633	5.2	633	5.2	0.336	0.0	LOS A	0.0	0.0	0.00	0.00	89.8
Approach		634	5.1	634	5.1	0.336	0.0	NA	0.0	0.0	0.00	0.00	89.6
All Vehicles		1547	4.2	1547	4.2	0.466	0.1	NA	0.0	0.4	0.00	0.00	89.4

A2. 2016 EXISTING PM PEAK

A2.1 I-01 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD WEST

MOVEMENT SUMMARY

Site: I-01 EX PM

Network: 2016 Existing PM

Enterprise Drive / Old Chittaway Road West
2016 Existing PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)													
1	L2	2	0.0	2	0.0	0.251	11.7	LOS A	0.7	5.0	0.93	0.99	30.7
3	R2	24	0.0	24	0.0	0.251	44.1	LOS D	0.7	5.0	0.93	0.99	8.5
Approach		26	0.0	26	0.0	0.251	41.5	LOS C	0.7	5.0	0.93	0.99	11.0
NorthEast: Enterprise Drive (NE)													
4	L2	20	5.3	20	5.3	0.011	3.6	LOS A	0.0	0.0	0.00	0.58	40.2
5	T1	632	1.8	632	1.8	0.328	0.0	LOS A	0.0	0.0	0.00	0.00	89.8
Approach		652	1.9	652	1.9	0.328	0.1	NA	0.0	0.0	0.00	0.02	88.8
SouthWest: Enterprise Drive (SW)													
11	T1	1074	2.6	1074	2.6	0.563	0.0	LOS A	0.1	0.7	0.01	0.00	89.6
12	R2	2	0.0	2	0.0	0.563	16.7	LOS B	0.1	0.7	0.01	0.00	75.0
Approach		1076	2.6	1076	2.6	0.563	0.1	NA	0.1	0.7	0.01	0.00	89.6
All Vehicles		1754	2.3	1754	2.3	0.563	0.7	NA	0.7	5.0	0.02	0.02	86.6

A2.2 I-02 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD EAST

MOVEMENT SUMMARY

Site: I-02 EX PM

Network: 2016 Existing PM

Enterprise Drive / Old Chittaway Road East
2016 Existing PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
NorthEast: Enterprise Drive (NE)													
11	T1	648	1.9	648	1.9	0.330	0.1	LOS A	0.1	0.5	0.01	0.00	89.4
12	R2	1	0.0	1	0.0	0.330	22.5	LOS B	0.1	0.5	0.01	0.00	75.3
Approach		649	1.9	649	1.9	0.330	0.1	NA	0.1	0.5	0.01	0.00	89.4
NorthWest: Old Chittaway Road East (SE)													
1	L2	1	0.0	1	0.0	0.033	13.7	LOS A	0.1	0.6	0.91	0.96	36.0
3	R2	3	0.0	3	0.0	0.033	34.7	LOS C	0.1	0.6	0.91	0.96	10.7
Approach		4	0.0	4	0.0	0.033	29.5	LOS C	0.1	0.6	0.91	0.96	19.6
SouthWest: Enterprise Drive (SW)													
4	L2	2	0.0	2	0.0	0.575	3.6	LOS A	0.0	0.0	0.00	0.00	18.6
5	T1	1100	2.6	1100	2.6	0.575	0.0	LOS A	0.0	0.0	0.00	0.00	89.5
Approach		1102	2.6	1102	2.6	0.575	0.0	NA	0.0	0.0	0.00	0.00	89.3
All Vehicles		1756	2.3	1756	2.3	0.575	0.1	NA	0.1	0.6	0.01	0.00	89.0

A3. 2017 FUTURE DO-NOTHING AM PEAK

A3.1 I-01 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD WEST

MOVEMENT SUMMARY

Site: I-01 FU DN AM

Network: 2016 Existing AM

Enterprise Drive / Old Chittaway Road West
2017 Future Do-nothing AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)													
1	L2	3	0.0	3	0.0	0.115	11.0	LOS A	0.3	2.3	0.88	0.95	39.9
3	R2	17	0.0	17	0.0	0.115	27.3	LOS B	0.3	2.3	0.88	0.95	13.0
Approach		20	0.0	20	0.0	0.115	24.7	LOS B	0.3	2.3	0.88	0.95	19.6
NorthEast: Enterprise Drive (NE)													
4	L2	23	0.0	23	0.0	0.012	3.6	LOS A	0.0	0.0	0.00	0.58	40.9
5	T1	891	3.5	891	3.5	0.467	0.0	LOS A	0.0	0.0	0.00	0.00	89.7
Approach		914	3.5	914	3.5	0.467	0.1	NA	0.0	0.0	0.00	0.01	88.9
SouthWest: Enterprise Drive (SW)													
11	T1	627	5.2	627	5.2	0.335	0.1	LOS A	0.1	0.4	0.01	0.00	89.6
12	R2	1	0.0	1	0.0	0.335	19.6	LOS B	0.1	0.4	0.01	0.00	75.0
Approach		628	5.2	628	5.2	0.335	0.1	NA	0.1	0.4	0.01	0.00	89.5
All Vehicles		1562	4.1	1562	4.1	0.467	0.4	NA	0.3	2.3	0.01	0.02	87.7

A3.2 I-02 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD EAST

MOVEMENT SUMMARY

Site: I-02 FU DN AM

Network: 2016 Existing AM

Enterprise Drive / Old Chittaway Road East
2017 Future Do-nothing AM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
NorthEast: Enterprise Drive (NE)													
11	T1	927	3.4	927	3.4	0.475	0.0	LOS A	0.0	0.2	0.00	0.00	89.9
12	R2	1	0.0	1	0.0	0.475	13.2	LOS A	0.0	0.2	0.00	0.00	75.5
Approach		928	3.4	928	3.4	0.475	0.0	NA	0.0	0.2	0.00	0.00	89.8
NorthWest: Old Chittaway Road East (SE)													
1	L2	3	66.7	3	66.7	0.013	11.0	LOS A	0.0	0.4	0.71	0.81	34.3
3	R2	1	0.0	1	0.0	0.013	23.9	LOS B	0.0	0.4	0.71	0.81	18.6
Approach		4	50.0	4	50.0	0.013	14.2	LOS A	0.0	0.4	0.71	0.81	32.7
SouthWest: Enterprise Drive (SW)													
4	L2	1	0.0	1	0.0	0.343	3.6	LOS A	0.0	0.0	0.00	0.00	18.7
5	T1	645	5.2	645	5.2	0.343	0.0	LOS A	0.0	0.0	0.00	0.00	89.8
Approach		646	5.2	646	5.2	0.343	0.0	NA	0.0	0.0	0.00	0.00	89.6
All Vehicles		1579	4.3	1579	4.3	0.475	0.1	NA	0.0	0.4	0.00	0.00	89.4

A4. 2017 FUTURE DO-NOTHING PM PEAK

A4.1 I-01 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD WEST

MOVEMENT SUMMARY

Site: I-01 FU DN PM

Network: 2016 Existing PM

Enterprise Drive / Old Chittaway Road West
2017 Future Do-nothing PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)													
1	L2	2	0.0	2	0.0	0.274	13.0	LOS A	0.8	5.5	0.94	1.00	29.0
3	R2	24	0.0	24	0.0	0.274	48.4	LOS D	0.8	5.5	0.94	1.00	7.8
Approach		26	0.0	26	0.0	0.274	45.6	LOS D	0.8	5.5	0.94	1.00	10.2
NorthEast: Enterprise Drive (NE)													
4	L2	20	5.3	20	5.3	0.011	3.6	LOS A	0.0	0.0	0.00	0.58	40.2
5	T1	644	1.8	644	1.8	0.334	0.0	LOS A	0.0	0.0	0.00	0.00	89.8
Approach		664	1.9	664	1.9	0.334	0.1	NA	0.0	0.0	0.00	0.02	88.8
SouthWest: Enterprise Drive (SW)													
11	T1	1096	2.7	1096	2.7	0.575	0.1	LOS A	0.1	0.7	0.01	0.00	89.6
12	R2	2	0.0	2	0.0	0.575	17.3	LOS B	0.1	0.7	0.01	0.00	75.0
Approach		1098	2.7	1098	2.7	0.575	0.1	NA	0.1	0.7	0.01	0.00	89.6
All Vehicles		1788	2.4	1788	2.4	0.575	0.8	NA	0.8	5.5	0.02	0.02	86.4

A4.2 I-02 – ENTERPRISE DRIVE / OLD CHITTAWAY ROAD EAST

MOVEMENT SUMMARY

Site: I-02 FU DN PM

Network: 2016 Existing PM

Enterprise Drive / Old Chittaway Road East
2017 Future Do-nothing PM
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Arrival Flows Total	Arrival Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	veh/h	%	v/c	sec		veh	m		per veh	km/h
NorthEast: Enterprise Drive (NE)													
11	T1	661	1.9	661	1.9	0.336	0.1	LOS A	0.1	0.5	0.01	0.00	89.4
12	R2	1	0.0	1	0.0	0.336	23.7	LOS B	0.1	0.5	0.01	0.00	75.2
Approach		662	1.9	662	1.9	0.336	0.1	NA	0.1	0.5	0.01	0.00	89.4
NorthWest: Old Chittaway Road East (SE)													
1	L2	1	0.0	1	0.0	0.036	14.3	LOS A	0.1	0.7	0.91	0.96	34.7
3	R2	3	0.0	3	0.0	0.036	37.4	LOS C	0.1	0.7	0.91	0.96	10.1
Approach		4	0.0	4	0.0	0.036	31.6	LOS C	0.1	0.7	0.91	0.96	18.7
SouthWest: Enterprise Drive (SW)													
4	L2	2	0.0	2	0.0	0.586	3.6	LOS A	0.0	0.0	0.00	0.00	18.6
5	T1	1122	2.6	1122	2.6	0.586	0.0	LOS A	0.0	0.0	0.00	0.00	89.5
Approach		1124	2.6	1124	2.6	0.586	0.0	NA	0.0	0.0	0.00	0.00	89.3
All Vehicles		1791	2.4	1791	2.4	0.586	0.1	NA	0.1	0.7	0.01	0.00	89.0

A5. 2017 FUTURE WITH CONSTRUCTION AM PEAK

MOVEMENT SUMMARY

Site: I-01 2017 CS New AM

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	3	0.0	0.008	12.8	LOS A	0.0	0.2	0.71	0.80	43.1
3	R2	17	0.0	0.471	142.4	LOS F	1.4	9.6	0.98	1.03	8.9
Approach		20	0.0	0.471	121.9	LOS F	1.4	9.6	0.94	0.99	10.7
NorthEast: Enterprise Drive (NE)											
4	L2	23	0.0	0.012	5.5	LOS A	0.0	0.0	0.00	0.58	45.2
5	T1	891	3.5	0.467	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	33	19.4	0.060	10.8	LOS A	0.2	1.8	0.60	0.80	38.3
Approach		946	4.0	0.467	0.6	NA	0.2	1.8	0.02	0.04	59.0
NorthWest: Access Road (NW)											
7	L2	1	0.0	0.002	9.2	LOS A	0.0	0.0	0.54	0.62	41.8
9	R2	1	0.0	0.030	99.1	LOS F	0.1	0.6	0.97	0.99	16.1
Approach		2	0.0	0.030	54.1	LOS D	0.1	0.6	0.75	0.80	21.4
SouthWest: Enterprise Drive (SW)											
10	L2	33	19.4	0.020	5.8	LOS A	0.0	0.0	0.00	0.57	48.4
11	T1	627	5.2	0.333	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
12	R2	1	0.0	0.003	12.6	LOS A	0.0	0.1	0.72	0.71	42.3
Approach		661	5.9	0.333	0.3	NA	0.0	0.1	0.00	0.03	59.4
All Vehicles		1629	4.7	0.471	2.0	NA	1.4	9.6	0.03	0.05	57.3

A6. 2017 FUTURE WITH CONSTRUCTION PM PEAK

MOVEMENT SUMMARY

Site: I-01 2017 CS New PM

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	2	0.0	0.004	9.5	LOS A	0.0	0.1	0.56	0.66	46.0
3	R2	24	0.0	1.449	814.0	LOS F	8.7	61.2	1.00	1.37	1.8
Approach		26	0.0	1.449	749.6	LOS F	8.7	61.2	0.97	1.32	2.0
NorthEast: Enterprise Drive (NE)											
4	L2	20	5.3	0.011	5.6	LOS A	0.0	0.0	0.00	0.58	45.0
5	T1	644	1.8	0.334	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	1	0.0	0.004	18.1	LOS B	0.0	0.1	0.83	0.83	32.6
Approach		665	1.9	0.334	0.2	NA	0.0	0.1	0.00	0.02	59.6
NorthWest: Access Road (NW)											
7	L2	33	19.4	0.204	28.0	LOS B	0.6	4.9	0.89	0.97	26.9
9	R2	33	19.4	3.260	2539.3	LOS F	22.2	181.5	1.00	1.49	0.9
Approach		65	19.4	3.260	1283.6	LOS F	22.2	181.5	0.95	1.23	1.4
SouthWest: Enterprise Drive (SW)											
10	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.00	0.58	49.1
11	T1	1096	2.7	0.572	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
12	R2	2	0.0	0.003	9.2	LOS A	0.0	0.1	0.56	0.64	45.3
Approach		1099	2.7	0.572	0.1	NA	0.0	0.1	0.00	0.00	59.7
All Vehicles		1856	2.9	3.260	55.9	NA	22.2	181.5	0.05	0.07	27.5

A7. 2019 FUTURE WITH OPERATION AM PEAK

MOVEMENT SUMMARY

Site: I-01 2019 OP New AM

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMo v	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	3	0.0	0.009	13.6	LOS A	0.0	0.2	0.74	0.82	42.4
3	R2	18	0.0	0.580	184.1	LOS F	1.7	12.0	0.99	1.04	7.1
Approach		21	0.0	0.580	158.5	LOS F	1.7	12.0	0.95	1.01	8.6
NorthEast: Enterprise Drive (NE)											
4	L2	24	0.0	0.013	5.5	LOS A	0.0	0.0	0.00	0.58	45.2
5	T1	926	3.5	0.486	0.0	LOS A	0.0	0.0	0.00	0.00	59.8
6	R2	7	14.3	0.013	10.3	LOS A	0.0	0.4	0.59	0.72	38.9
Approach		958	3.5	0.486	0.3	NA	0.0	0.4	0.00	0.02	59.5
NorthWest: Access Road (NW)											
7	L2	1	0.0	0.002	9.5	LOS A	0.0	0.0	0.56	0.63	41.4
9	R2	1	0.0	0.033	109.3	LOS F	0.1	0.6	0.97	0.99	15.0
Approach		2	0.0	0.033	59.4	LOS E	0.1	0.6	0.77	0.81	20.2
SouthWest: Enterprise Drive (SW)											
10	L2	7	14.3	0.004	5.7	LOS A	0.0	0.0	0.00	0.57	48.6
11	T1	653	5.2	0.346	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
12	R2	1	0.0	0.003	13.3	LOS A	0.0	0.1	0.74	0.73	41.7
Approach		661	5.3	0.346	0.1	NA	0.0	0.1	0.00	0.01	59.8
All Vehicles		1642	4.2	0.580	2.3	NA	1.7	12.0	0.02	0.03	57.1

A8. 2019 FUTURE WITH OPERATION PM PEAK

MOVEMENT SUMMARY

Site: I-01 2019 OP New PM

New Site
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMo v	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	2	0.0	0.004	9.5	LOS A	0.0	0.1	0.56	0.66	46.1
3	R2	25	0.0	2.005	1367.6	LOS F	13.1	91.6	1.00	1.42	1.1
Approach		27	0.0	2.005	1263.1	LOS F	13.1	91.6	0.97	1.37	1.2
NorthEast: Enterprise Drive (NE)											
4	L2	21	5.0	0.012	5.6	LOS A	0.0	0.0	0.00	0.58	45.0
5	T1	671	1.9	0.348	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	1	0.0	0.005	20.0	LOS B	0.0	0.1	0.85	0.86	31.3
Approach		693	2.0	0.348	0.2	NA	0.0	0.1	0.00	0.02	59.6
NorthWest: Access Road (NW)											
7	L2	7	14.3	0.050	27.4	LOS B	0.1	1.1	0.89	0.95	27.3
9	R2	7	14.3	0.871	768.6	LOS F	2.4	19.1	1.00	1.06	2.7
Approach		15	14.3	0.871	398.0	LOS F	2.4	19.1	0.94	1.01	4.3
SouthWest: Enterprise Drive (SW)											
10	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.00	0.58	49.1
11	T1	1140	2.7	0.595	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
12	R2	2	0.0	0.003	9.4	LOS A	0.0	0.1	0.57	0.65	45.0
Approach		1143	2.7	0.595	0.1	NA	0.0	0.1	0.00	0.00	59.7
All Vehicles		1878	2.5	2.005	21.7	NA	13.1	91.6	0.02	0.04	41.2

A9. 2017 FUTURE WITH CONSTRUCTION AM PEAK – NEW LAYOUT

MOVEMENT SUMMARY

Site: I-01 2017 CS New AM Proposed

Enterprise Drive / Old Chittaway Road West
2017 Future AM
Peak construction year with new intersection layout
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	3	0.0	0.008	12.5	LOS A	0.0	0.2	0.70	0.78	43.3
Approach		3	0.0	0.008	12.5	LOS A	0.0	0.2	0.70	0.78	43.3
NorthEast: Enterprise Drive (NE)											
4	L2	23	0.0	0.012	5.5	LOS A	0.0	0.0	0.00	0.58	45.2
5	T1	891	3.5	0.467	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	33	19.4	0.060	10.8	LOS A	0.2	1.8	0.60	0.80	38.3
Approach		946	4.0	0.467	0.6	NA	0.2	1.8	0.02	0.04	59.0
NorthWest: Access Road (NW)											
7	L2	1	0.0	0.002	9.0	LOS A	0.0	0.0	0.53	0.62	42.0
9	R2	1	0.0	0.003	12.6	LOS A	0.0	0.1	0.65	0.68	43.0
Approach		2	0.0	0.003	10.8	LOS A	0.0	0.1	0.59	0.65	42.5
SouthWest: Enterprise Drive (SW)											
10	L2	33	19.4	0.020	5.8	LOS A	0.0	0.0	0.00	0.57	48.4
11	T1	627	5.2	0.333	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
Approach		660	5.9	0.333	0.3	NA	0.0	0.0	0.00	0.03	59.4
All Vehicles		1612	4.8	0.467	0.5	NA	0.2	1.8	0.01	0.04	59.1

A10. 2017 FUTURE WITH CONSTRUCTION PM PEAK – NEW LAYOUT

MOVEMENT SUMMARY

Site: I-01 2017 CS New PM Proposed

Enterprise Drive / Old Chittaway Road West
2017 Future PM
Peak construction year with new intersection layout
Giveway / Yield (Two-Way)

Movement Performance - Vehicles											
Mov ID	ODMo v	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	2	0.0	0.003	9.1	LOS A	0.0	0.1	0.53	0.64	46.5
Approach		2	0.0	0.003	9.1	LOS A	0.0	0.1	0.53	0.64	46.5
NorthEast: Enterprise Drive (NE)											
4	L2	20	5.3	0.011	5.6	LOS A	0.0	0.0	0.00	0.58	45.0
5	T1	644	1.8	0.334	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	1	0.0	0.004	18.1	LOS B	0.0	0.1	0.83	0.83	32.6
Approach		665	1.9	0.334	0.2	NA	0.0	0.1	0.00	0.02	59.6
NorthWest: Access Road (NW)											
7	L2	33	19.4	0.189	25.9	LOS B	0.6	4.6	0.88	0.96	28.0
9	R2	33	19.4	0.369	55.8	LOS D	1.2	9.7	0.94	1.02	23.1
Approach		65	19.4	0.369	40.8	LOS C	1.2	9.7	0.91	0.99	24.8
SouthWest: Enterprise Drive (SW)											
10	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.00	0.58	49.1
11	T1	1096	2.7	0.572	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
Approach		1097	2.7	0.572	0.1	NA	0.0	0.0	0.00	0.00	59.8
All Vehicles		1829	3.0	0.572	1.6	NA	1.2	9.7	0.03	0.04	57.8

A11. 2019 FUTURE WITH OPERATION AM PEAK – NEW LAYOUT

MOVEMENT SUMMARY

Site: I-01 2017 OP New AM Proposed

Enterprise Drive / Old Chittaway Road West
2019 Future AM
Operation year with new intersection layout
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMo v	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	3	0.0	0.008	13.2	LOS A	0.0	0.2	0.72	0.80	42.8
Approach		3	0.0	0.008	13.2	LOS A	0.0	0.2	0.72	0.80	42.8
NorthEast: Enterprise Drive (NE)											
4	L2	24	0.0	0.013	5.5	LOS A	0.0	0.0	0.00	0.58	45.2
5	T1	926	3.5	0.486	0.0	LOS A	0.0	0.0	0.00	0.00	59.8
6	R2	7	14.3	0.013	10.3	LOS A	0.0	0.4	0.59	0.72	38.9
Approach		958	3.5	0.486	0.3	NA	0.0	0.4	0.00	0.02	59.5
NorthWest: Access Road (NW)											
7	L2	1	0.0	0.002	9.3	LOS A	0.0	0.0	0.55	0.63	41.7
9	R2	1	0.0	0.003	12.5	LOS A	0.0	0.1	0.65	0.68	43.0
Approach		2	0.0	0.003	10.9	LOS A	0.0	0.1	0.60	0.65	42.4
SouthWest: Enterprise Drive (SW)											
10	L2	7	14.3	0.004	5.7	LOS A	0.0	0.0	0.00	0.57	48.6
11	T1	653	5.2	0.346	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
Approach		660	5.3	0.346	0.1	NA	0.0	0.0	0.00	0.01	59.8
All Vehicles		1623	4.2	0.486	0.2	NA	0.0	0.4	0.00	0.02	59.5

A12. 2017 FUTURE WITH OPERATION PM PEAK – NEW LAYOUT

MOVEMENT SUMMARY

Site: I-01 2017 OP New PM Proposed

Enterprise Drive / Old Chittaway Road West
2019 Future PM
Operation year with new intersection layout
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMo v	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
SouthEast: Old Chittaway Road West (SE)											
1	L2	2	0.0	0.003	9.3	LOS A	0.0	0.1	0.55	0.65	46.2
Approach		2	0.0	0.003	9.3	LOS A	0.0	0.1	0.55	0.65	46.2
NorthEast: Enterprise Drive (NE)											
4	L2	21	5.0	0.012	5.6	LOS A	0.0	0.0	0.00	0.58	45.0
5	T1	671	1.9	0.348	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6	R2	1	0.0	0.005	20.0	LOS B	0.0	0.1	0.85	0.86	31.3
Approach		693	2.0	0.348	0.2	NA	0.0	0.1	0.00	0.02	59.6
NorthWest: Access Road (NW)											
7	L2	7	14.3	0.046	25.5	LOS B	0.1	1.0	0.88	0.95	28.3
9	R2	7	14.3	0.090	47.8	LOS D	0.3	2.0	0.93	0.97	25.3
Approach		15	14.3	0.090	36.6	LOS C	0.3	2.0	0.90	0.96	26.4
SouthWest: Enterprise Drive (SW)											
10	L2	1	0.0	0.001	5.5	LOS A	0.0	0.0	0.00	0.58	49.1
11	T1	1140	2.7	0.595	0.1	LOS A	0.0	0.0	0.00	0.00	59.8
Approach		1141	2.7	0.595	0.1	NA	0.0	0.0	0.00	0.00	59.8
All Vehicles		1851	2.5	0.595	0.5	NA	0.3	2.0	0.01	0.02	59.3

Appendix B

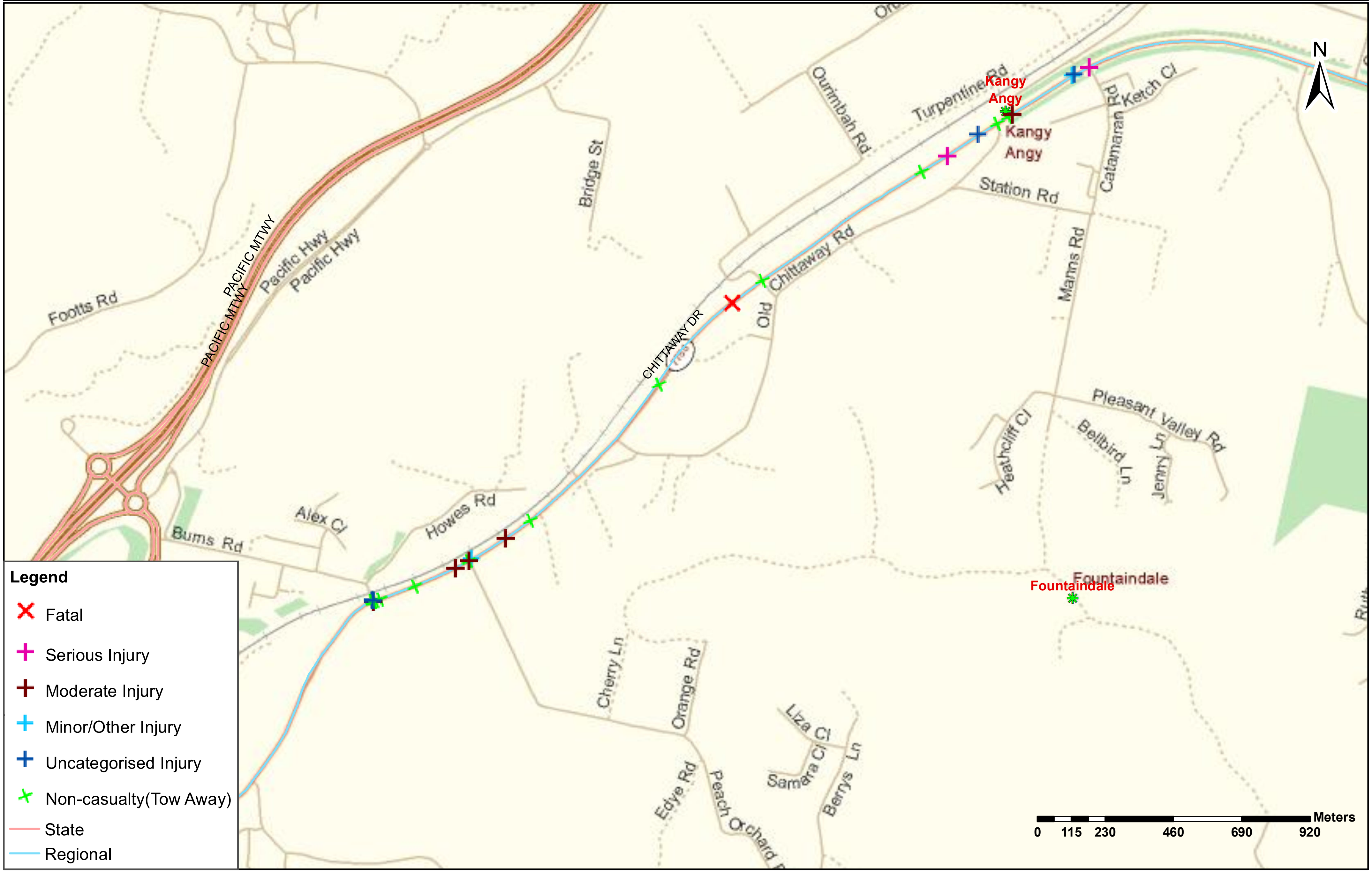
RMS CRASH DATA

Enterprise Drive: Burns Road to Catamaran Road, Fountaindale

Crash Period: 1st January 2010 to 31st December 2014 (Finalised Data)

Plus provisional data (which is incomplete & subject to change) to date

Roads & Maritime



Jason Gillett March 2016

Summary Crash Report

# Crash Type		
Car Crash	29	93.5%
Light Truck Crash	3	9.7%
Rigid Truck Crash	0	0.0%
Articulated Truck Crash	0	0.0%
'Heavy Truck Crash	*(0)*	*(0.0%)*
Bus Crash	1	3.2%
"Heavy Vehicle Crash	*(1)*	*(3.2%)*
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	3	9.7%
Pedal Cycle Crash	0	0.0%
Pedestrian Crash	0	0.0%

' Rigid or Artic. Truck " Heavy Truck or Heavy Bus
These categories are NOT mutually exclusive

Location Type		
*Intersection	18	58.1%
Non intersection	13	41.9%

* Up to 10 metres from an intersection

Collision Type		
Single Vehicle	14	45.2%
Multi Vehicle	17	54.8%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	0	0.0%
Other Classified Road	0	0.0%
Unclassified Road	31	100.0%

Contributing Factors		
Speeding	5	16.1%
Fatigue	5	16.1%

Weather		
Fine	26	83.9%
Rain	3	9.7%
Overcast	2	6.5%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	3	9.7%
Dry	28	90.3%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	0	0.0%
Daylight	27	87.1%
Dusk	0	0.0%
Darkness	4	12.9%

Crash Movement		
Intersection, adjacent approaches	4	12.9%
Head-on (not overtaking)	3	9.7%
Opposing vehicles; turning	3	9.7%
U-turn	0	0.0%
Rear-end	7	22.6%
Lane change	0	0.0%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	0	0.0%
Overtaking; same direction	0	0.0%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	0	0.0%
Permanent obstruction on road	0	0.0%
Hit animal	1	3.2%
Off road, on straight	1	3.2%
Off road on straight, hit object	6	19.4%
Out of control on straight	1	3.2%
Off road, on curve	0	0.0%
Off road on curve, hit object	3	9.7%
Out of control on curve	0	0.0%
Other crash type	2	6.5%

Speed Limit					
40 km/h or less	0	0.0%	80 km/h zone	0	0.0%
50 km/h zone	2	6.5%	90 km/h zone	12	38.7%
60 km/h zone	17	54.8%	100 km/h zone	0	0.0%
70 km/h zone	0	0.0%	110 km/h zone	0	0.0%

~ 07:30-09:30 or 14:30-17:00 on school days | ~ 40km/h or less 0 0.0% | ~ School Travel Time Involvement 10 32.3%

CRASHES	31	
Fatal	1	3.2%
Serious inj.	2	6.5%
Moderate inj.	5	16.1%
Minor/Other inj.	2	6.5%
Uncategorised inj.	7	22.6%
Non-casualty	14	45.2%

Self Reported Crash	2	6.45%

Time Group			% of Day
00:01 - 02:59	0	0.0%	12.5%
03:00 - 04:59	1	3.2%	8.3%
05:00 - 05:59	0	0.0%	4.2%
06:00 - 06:59	0	0.0%	4.2%
07:00 - 07:59	5	16.1%	4.2%
08:00 - 08:59	1	3.2%	4.2%
09:00 - 09:59	4	12.9%	4.2%
10:00 - 10:59	3	9.7%	4.2%
11:00 - 11:59	1	3.2%	4.2%
12:00 - 12:59	3	9.7%	4.2%
13:00 - 13:59	1	3.2%	4.2%
14:00 - 14:59	1	3.2%	4.2%
15:00 - 15:59	4	12.9%	4.2%
16:00 - 16:59	2	6.5%	4.2%
17:00 - 17:59	0	0.0%	4.2%
18:00 - 18:59	2	6.5%	4.2%
19:00 - 19:59	0	0.0%	4.2%
20:00 - 21:59	3	9.7%	8.3%
22:00 - 24:00	0	0.0%	8.3%

Street Lighting Off/Nil			% of Dark	
2	of	4	in Dark	50.0%

CASUALTIES	19	
Killed	1	5.3%
Seriously inj.	2	10.5%
Moderately inj.	5	26.3%
Minor/Other inj.	2	10.5%
Uncategorised inj.	9	47.4%
^ Unrestrained	0	0.0%

^ Belt fitted but not worn, No restraint fitted to position OR No helmet worn

Crashes		Casualties
3	2015	3
9	2014	6
7	2013	4
4	2012	2
7	2011	3
1	2010	1

McLean Periods			% Week
A	6	19.4%	17.9%
B	1	3.2%	7.1%
C	13	41.9%	17.9%
D	0	0.0%	3.5%
E	0	0.0%	3.6%
F	5	16.1%	10.7%
G	2	6.5%	7.1%
H	2	6.5%	7.1%
I	2	6.5%	12.5%
J	0	0.0%	10.7%

Day of the Week														
Monday	6	19.4%	Wednesday	4	12.9%	Friday	5	16.1%	Sunday	3	9.7%	WEEKEND	4	12.9%
Tuesday	8	25.8%	Thursday	4	12.9%	Saturday	1	3.2%	WEEKDAY	27	87.1%			

#Holiday Periods																	
New Year	0	0.0%	Easter	0	0.0%	Queen's BD	0	0.0%	Christmas	0	0.0%	Easter SH	1	3.2%	Sept./Oct. SH	0	0.0%
Aust. Day	0	0.0%	Anzac Day	0	0.0%	Labour Day	0	0.0%	January SH	2	6.5%	June/July SH	0	0.0%	December SH	0	0.0%

Crashid dataset Enterprise Drive: Burns Road to Catamaran Road, Fountaindale - 2010 to 2016*

Note: *Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.*
Crash self reporting, including self reported injuries began Oct 2014. Trends from 2014 are expected to vary from previous yrs. More unknowns are expected in self reported data.
Reporting yrs 1996-2004 and 2014 onwards contain uncategorised inj crashes.
Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Detailed Crash Report - sorted

Natural Lighting

S F

Crash No.	Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
Hunter Region					**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
698133	P	19/01/2010	Tue	09:20	200 m	S OLD CHITTAWAY RD	2WY	STR	Fine	Dry	90	1	CAR	M20	E in ENTERPRISE DR	120	Pull out opposite	I	0	1	S
E41450182						Daylight	RUM:	51	Out of control otake												
Hunter Region					**Wyong LGA**			**Ourimbah**							**Enterprise Dr**						
739553	P	17/01/2011	Mon	09:10	500 m	S TURPENTINE RD	2WY	STR	Fine	Dry	90	2	CAR	F18	S in ENTERPRISE DR	50	Proceeding in lane	N	0	0	
E43167033						Daylight	RUM:	30	Rear end				BUS	M36	S in ENTERPRISE DR	0	Stationary				
Hunter Region					**Wyong LGA**			**Ourimbah**							**Enterprise Dr**						
743955	P	03/03/2011	Thu	07:40	10 m	E PEACH ORCHARD RD	TJN	STR	Fine	Dry	60	2	CAR	F23	W in ENTERPRISE DR	70	Proceeding in lane	I	0	1	S
E43183420						Daylight	RUM:	30	Rear end				M/C	F40	W in ENTERPRISE DR	10	Proceeding in lane				
Hunter Region					**Wyong LGA**			**Ourimbah**							**Burns Rd**						
752928	P	18/05/2011	Wed	12:30		at CHITTAWAY RD	TJN	CRV	Fine	Dry	60	2	CAR	M55	W in CHITTAWAY RD	10	Turning right	I	0	1	
E45074267						Daylight	RUM:	21	Right through				WAG	F42	E in CHITTAWAY RD	60	Proceeding in lane				
Hunter Region					**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
753697	P	23/05/2011	Mon	12:30	300 m	N OLD CHITTAWAY RD	2WY	STR	Fine	Dry	90	1	4WD	F18	S in ENTERPRISE DR	Unk	Proceeding in lane	I	0	1	F
E142363698						Daylight	RUM:	71	Off rd left => obj				Drain/culvert								
Hunter Region					**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
795966	P	15/06/2011	Wed	09:50		at OLD CHITTAWAY RD	TJN	STR	Raining	Wet	90	2	CAR	M22	E in ENTERPRISE DR	60	Proceeding in lane	N	0	0	
E44965766						Daylight	RUM:	32	Right rear				CAR	F52	E in ENTERPRISE DR	10	Turning right				
Hunter Region					**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
770749	P	10/10/2011	Mon	09:15	600 m	N BURNS RD	2WY	CRV	Fine	Dry	60	1	TRK	F41	S in ENTERPRISE DR	60	Proceeding in lane	N	0	0	S F
E662571390						Daylight	RUM:	81	Off left/rt bnd=>obj				Tree/bush								
Hunter Region					**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
770788	P	13/10/2011	Thu	15:10		at TURPENTINE RD	TJN	STR	Fine	Dry	90	1	4WD	M32	N in ENTERPRISE DR	80	Proceeding in lane	N	0	0	F
E46157666						Daylight	RUM:	71	Off rd left => obj				Tree/bush								
Hunter Region					**Wyong LGA**			**Ourimbah**							**Enterprise Dr**						
783804	P	07/02/2012	Tue	18:20	300 m	N BURNS RD	2WY	STR	Fine	Dry	60	2	CAR	F19	N in ENTERPRISE DR	50	Incorrect side	I	0	1	
E48853280						Daylight	RUM:	20	Head on				4WD	F55	S in ENTERPRISE DR	60	Proceeding in lane				
Hunter Region					**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
788929	P	24/03/2012	Sat	04:30	300 m	S OLD CHITTAWAY RD	2WY	STR	Fine	Dry	60	1	CAR	M39	S in ENTERPRISE DR	60	Proceeding in lane	N	0	0	
E47231975						Darkness	RUM:	67	Struck animal				Riderless horse								

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Natural Lighting

Crash No. / Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
																				S F
Hunter Region			**Wyong LGA**				**Ourimbah**							**Chittaway Rd**						
795202 P	15/05/2012	Tue	12:29	25 m E	BURNS RD	2WY	STR	Fine	Dry	60	1	CAR	M26	W in CHITTAWAY RD	55	Proceeding in lane	N	0	0	F
E50275983					Daylight	RUM: 73	Off rd rght => obj					Utility pole								
Hunter Region			**Wyong LGA**				**Fountaindale**							**Enterprise Dr**						
800989 P	22/06/2012	Fri	11:55	500 m E	BURNS RD	2WY	CRV	Overcast	Dry	90	1	CAR	F60	E in ENTERPRISE DR	70	Proceeding in lane	I	0	1	
E48389764					Daylight	RUM: 66	Object on road					Other non fixed object								
Hunter Region			**Wyong LGA**				**Fountaindale**							**Enterprise Dr**						
817463 P	01/02/2013	Fri	07:45	600 m N	OLD CHITTAWAY RD	2WY	CRV	Fine	Dry	90	1	CAR	M53	N in ENTERPRISE DR	90	Proceeding in lane	F	1	0	S F
E50588203					Daylight	RUM: 81	Off left/rt bnd=>obj					Tree/bush								
Hunter Region			**Wyong LGA**				**Fountaindale**							**Catamaran Dr**						
836636 P	09/04/2013	Tue	07:30	at	ENTERPRISE DR	TJN	STR	Raining	Wet	90	2	WAG	F40	E in ENTERPRISE DR	20	Turning right	I	0	1	
E51243761					Daylight	RUM: 21	Right through					CAR	F55	W in ENTERPRISE DR	90	Proceeding in lane				
Hunter Region			**Wyong LGA**				**Fountaindale**							**Enterprise Dr**						
835226 P	24/04/2013	Wed	07:05	at	PEACH ORCHARD RD	TJN	STR	Fine	Dry	60	2	CAR	M37	E in ENTERPRISE DR	60	Proceeding in lane	I	0	1	
E51922963					Daylight	RUM: 32	Right rear					TRK	M51	E in ENTERPRISE DR	0	Wait turn right				
Hunter Region			**Wyong LGA**				**Ourimbah**							**Chittaway Rd**						
839307 P	02/06/2013	Sun	20:47	150 m E	BURNS RD	2WY	CRV	Raining	Wet	60	1	WAG	M29	E in CHITTAWAY RD	50	Proceeding in lane	N	0	0	S
E51434422					Darkness	RUM: 81	Off left/rt bnd=>obj					Utility pole								
Hunter Region			**Wyong LGA**				**Ourimbah**							**Burns Rd**						
839350 P	04/06/2013	Tue	07:00	at	CHITTAWAY RD	TJN	CRV	Fine	Dry	60	2	CAR	F21	S in BURNS RD	10	Proceeding in lane	N	0	0	
E51426936					Daylight	RUM: 10	Cross traffic					CAR	M20	E in CHITTAWAY RD	50	Proceeding in lane				
Hunter Region			**Wyong LGA**				**Berkeley Vale**							**Enterprise Dr**						
851092 P	01/09/2013	Sun	21:15	at	OLD CHITTAWAY RD	TJN	STR	Fine	Dry	90	1	CAR	M40	E in ENTERPRISE DR	90	Proceeding in lane	N	0	0	
E52435104					Darkness	RUM: 71	Off rd left => obj					Tree/bush								
Hunter Region			**Wyong LGA**				**Fountaindale**							**Chittaway Dr**						
1011063 P	02/12/2013	Mon	15:30	300 m W	CATAMARAN RD	2WY	STR	Fine	Dry	90	1	CAR	M46	E in CHITTAWAY DR	80	Proceeding in lane	I	0	1	
E53364803					Daylight	RUM: 71	Off rd left => obj					Tree/bush								
Hunter Region			**Wyong LGA**				**Ourimbah**							**Burns Rd**						
1017624 P	09/03/2014	Sun	16:35	2 m N	CHITTAWAY DR	TJN	CRV	Fine	Dry	50	2	CAR	M24	S in BURNS RD	5	Proceeding in lane	I	0	1	
E54692642					Daylight	RUM: 31	Left rear					M/C	M55	S in BURNS RD	0	Waiting turn left				

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Crash No. Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
				Natural Lighting																S F
Hunter Region				**Wyong LGA**			**Ourimbah**							**Chittaway Dr**						
1021383 P	10/03/2014	Mon	18:02	at	BURNS RD	TJN	CRV	Fine	Dry	60	2	WAG	F52	S in CHITTAWAY DR	Unk	Incorrect side	N	0	0	
E54812363					Daylight	RUM:	20	Head on				CAR	M54	N in CHITTAWAY DR	60	Proceeding in lane				
Hunter Region				**Wyong LGA**			**Ourimbah**							**Chittaway Rd**						
1023957 P	10/04/2014	Thu	08:51	at	BURNS RD	TJN	CRV	Fine	Dry	60	2	CAR	F19	S in BURNS RD	10	Turning right	I	0	1	
E54995551					Daylight	RUM:	13	Right near				CAR	F36	E in CHITTAWAY RD	40	Proceeding in lane				
Hunter Region				**Wyong LGA**			**Ourimbah**							**Chittaway Rd**						
1025239 P	29/04/2014	Tue	10:45	at	BURNS RD	TJN	STR	Fine	Dry	60	2	WAG	F19	S in BURNS RD	Unk	Turning right	I	0	2	
E55516078					Daylight	RUM:	13	Right near				CAR	M51	E in CHITTAWAY RD	60	Proceeding in lane				
Hunter Region				**Wyong LGA**			**Ourimbah**							**Chittaway Rd**						
1033246 P	21/07/2014	Mon	21:20	10 m E	BURNS RD	TJN	STR	Fine	Dry	60	1	CAR	F21	E in CHITTAWAY RD	60	Proceeding in lane	N	0	0	
E194842597					Darkness	RUM:	70	Off road to left												
Hunter Region				**Wyong LGA**			**Ourimbah**							**Chittaway Rd**						
1036088 P	25/07/2014	Fri	14:25	at	BURNS RD	TJN	STR	Overcast	Dry	60	1	M/C	F55	S in BURNS RD	15	Proceeding in lane	I	0	1	
E54726909					Daylight	RUM:	74	On road-out of cont.												
Hunter Region				**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
1037721 P	01/08/2014	Fri	10:00	50 m W	CATAMARAN RD	2WY	STR	Fine	Dry	90	1	CAR	M47	W in ENTERPRISE DR	70	Proceeding in lane	I	0	1	
E55961042					Daylight	RUM:	71	Off rd left => obj				Tree/bush								
Hunter Region				**Wyong LGA**			**Ourimbah**							**Burns Rd**						
1042031 P	29/08/2014	Fri	13:40	5 m W	CHITTAWAY DR	TJN	STR	Fine	Dry	50	2	CAR	M46	E in BURNS RD	20	Proceeding in lane	N	0	0	
E57564687					Daylight	RUM:	30	Rear end				4WD	M43	E in BURNS RD	0	Stationary				
Hunter Region				**Wyong LGA**			**Fountaindale**							**Chittaway Dr**						
1045820 P	08/10/2014	Wed	15:20	at	PEACH ORMOND RD	TJN	STR	Fine	Dry	60	2	TRK	F34	N in PEACH ORMOND RD	30	Turning right	N	0	0	
E56002526					Daylight	RUM:	13	Right near				CAR	F66	W in CHITTAWAY DR	60	Proceeding in lane				
Hunter Region				**Wyong LGA**			**Fountaindale**							**Enterprise Dr**						
1059849 P	03/02/2015	Tue	15:10	75 m W	OLD CHITTAWAY RD	2WY	STR	Fine	Dry	90	2	CAR	F24	E in ENTERPRISE DR	70	Incorrect side	I	0	2	
E57082656					Daylight	RUM:	20	Head on				VAN	M54	W in ENTERPRISE DR	70	Proceeding in lane				
Hunter Region				**Wyong LGA**			**Ourimbah**							**Chittaway Dr**						
1062260 S	03/03/2015	Tue	10:00	at	BURNS RD	TJN	CRV	Fine	Dry	60	2	CAR	M52	S in CHITTAWAY DR	Unk	Turning right	N	0	0	
E57438646					Daylight	RUM:	21	Right through				CAR	F27	N in CHITTAWAY DR	Unk	Proceeding in lane				

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Crash No. / Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors

Natural Lighting — S F

Hunter Region — **Wyong LGA** — **Ourimbah** — **Chittaway Dr**

Crash No. / Data Source	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
1087125 S	29/10/2015	Thu	16:00	at	BURNS RD	TJN	STR	Fine	Dry	60	2	CAR	M41	S in BURNS RD	Unk	Proceeding in lane	I	0	1	
E59658847					Daylight	RUM: 30	Rear end					4WD	F62	S in BURNS RD	0	Stationary				

Report Totals: Total Crashes: 31 Fatal Crashes: 1 Injury Crashes: 16 Killed: 1 Injured: 18

Crashid dataset Enterprise Drive: Burns Road to Catamaran Road, Fountaindale - 2010 to 2016*

Note: *Ordered by: Crash Date. Data for the 9 month period prior to the generated date of this report are incomplete and are subject to change.*

Crash self reporting, including self reported injuries began in Oct 2014. Trends from 2014 are expected to vary from previous years. More unknowns are expected in self reported data. For further information refer to Data Manual or report provider.

Appendix G

SOCIO-ECONOMIC IMPACT ASSESSMENT

TRANSPORT FOR NEW SOUTH WALES

NEW INTERCITY FLEET MAINTENANCE FACILITY

SOCIO-ECONOMIC IMPACT ASSESSMENT

MAY 2016

New Intercity Fleet (NIF) Maintenance Facility Planning Approvals

SOCIO-ECONOMIC IMPACT ASSESSMENT

Transport for New South Wales

Project no 2202522A
Date: May 2016

REV	DATE	DETAILS
A	18/04/2016	Draft
B	03/05/2016	Final

AUTHOR, REVIEWER AND APPROVER DETAILS

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ABBREVIATIONS

ABS	Australian Bureau of Statistics
ACHAR	Aboriginal Cultural Heritage Assessment Report
AHIP	Aboriginal Heritage Impact Permit
CBD	Central Business District
CCTV	Closed-circuit television
CIC	Construction Induction Card
CSR	Combined Services Route
DA	Development Application
EPA	Environment Protection Authority
ERP	Estimated Resident Population
km	kilometre
km^2	square kilometres
LAC	Local area command
LEP	Local environment plan
LALC	Local Aboriginal Land Council
LGA	Local government area
m	metres
m^2	square metres
NSW	New South Wales
OEH	Office of Environment and Heritage
PhD	Doctor of Philosophy
RDA	Regional Development Australia
REF	Review of Environmental Factors
RMS	Roads and Maritime Services (NSW)
SEIFA	Socioeconomic Indexes for Areas
SES	State Emergency Service
TAFE	Technical and Further Education

1 PROPOSAL BACKGROUND

1.1 Background

Transport for New South Wales (Transport for NSW) proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of New South Wales (NSW) to support the procurement of the New Intercity Fleet. The facility would be used to undertake light and heavy train maintenance activities for the New Intercity Fleet, including but not limited to:

- regular maintenance/servicing
- repair/replacement of train components
- interior and exterior cleaning.

The proposed facility would include about six kilometres of electrified railway (in total), would be seven tracks wide at its widest point, would cover an area of approximately 500,000 square metres and would be bounded by a perimeter fence.

The key features of the proposed maintenance facility would comprise the following key elements:

- key maintenance facility elements:
  - fleet maintenance building
  - four enclosed maintenance roads and three external standing roads to accommodate the new trains within the site
  - auxiliary workshops
  - electronic clean room
  - material storage, including flammable liquid storage
  - wheel lathe
  - automatic train wash
  - site access roads
- miscellaneous buildings:
  - administration
  - facilities for presentation and train maintenance staff
  - operational control
  - security
  - training rooms
  - train simulator
  - power supply (traction power, bulk power, signalling power supply and backup generators).
- other infrastructure including:
  - new railway track infrastructure on the western side of the existing rail corridor to allow for trains to enter and exit the maintenance facility site from the Main North railway
  - two new rail bridges over Chittaway Creek and Turpentine Road

- a new access roadway to the maintenance facility site off Enterprise Drive
- a new flood access road between Orchard Street and the proposed new access roadway
- a series of drainage detention ponds
- staff car park
- relocation of the existing high voltage power transmission line and Combined Services Route (CSR).

1.2 Purpose of the assessment

WSP | Parsons Brinckerhoff have been commissioned by Transport for NSW to prepare the socio-economic assessment for the proposed New Intercity Fleet Maintenance Facility proposal (hereafter, referred to as 'the proposal'). The purpose of this socio-economic assessment (assessment) is to support the review of environmental factors (REF) for the proposal.

This assessment is one of a number of technical reports supporting the REF for the proposal. The assessment:

- provides a baseline for the social and economic environment of the proposal area, both locally and regionally. This baseline is compared to against the State of NSW (hereafter, referred to as 'State')
- considers the social and economic benefits and impacts across the proposal's lifecycle
- identifies measures to enhance benefits and mitigate impacts of the proposal.

2 STUDY AREA

This chapter defines the geographical and social statistical areas used in this assessment. It also considers benefits and impacts under the following geographic/statistical areas:

- immediate/local
- regional.

2.1.1 Immediate/local area of impact

The immediate area of impact is considered to be any property or neighbouring property that is impacted by the development of the proposal. Impacts are considered to be direct if they relate to the acquisition, use of land or placement of site infrastructure on a property. Indirect impacts would be experienced by near neighbours who notice flow on effects such as noise, air quality or visual impacts.

The site of the proposed facility lies within a semi-rural suburb (Kangy Angy) within the Wyong Shire Local Government Area (LGA), with residential receivers on rural properties generally surrounding the site to the north, south and west, with industrial precincts to the south east and north-east (on the opposite side of the rail corridor to the site). The immediate area of impact lies principally within the suburb of Kangy Angy to the north and north-west and the suburb of Fountaindale to the south and south-east. The Sydney–Newcastle railway line forms the boundary between these two suburbs. Properties to the south-west of the proposal site are within the suburb of Ourimbah. Figure 2.1 shows the location of the proposal site in relation to these suburbs.

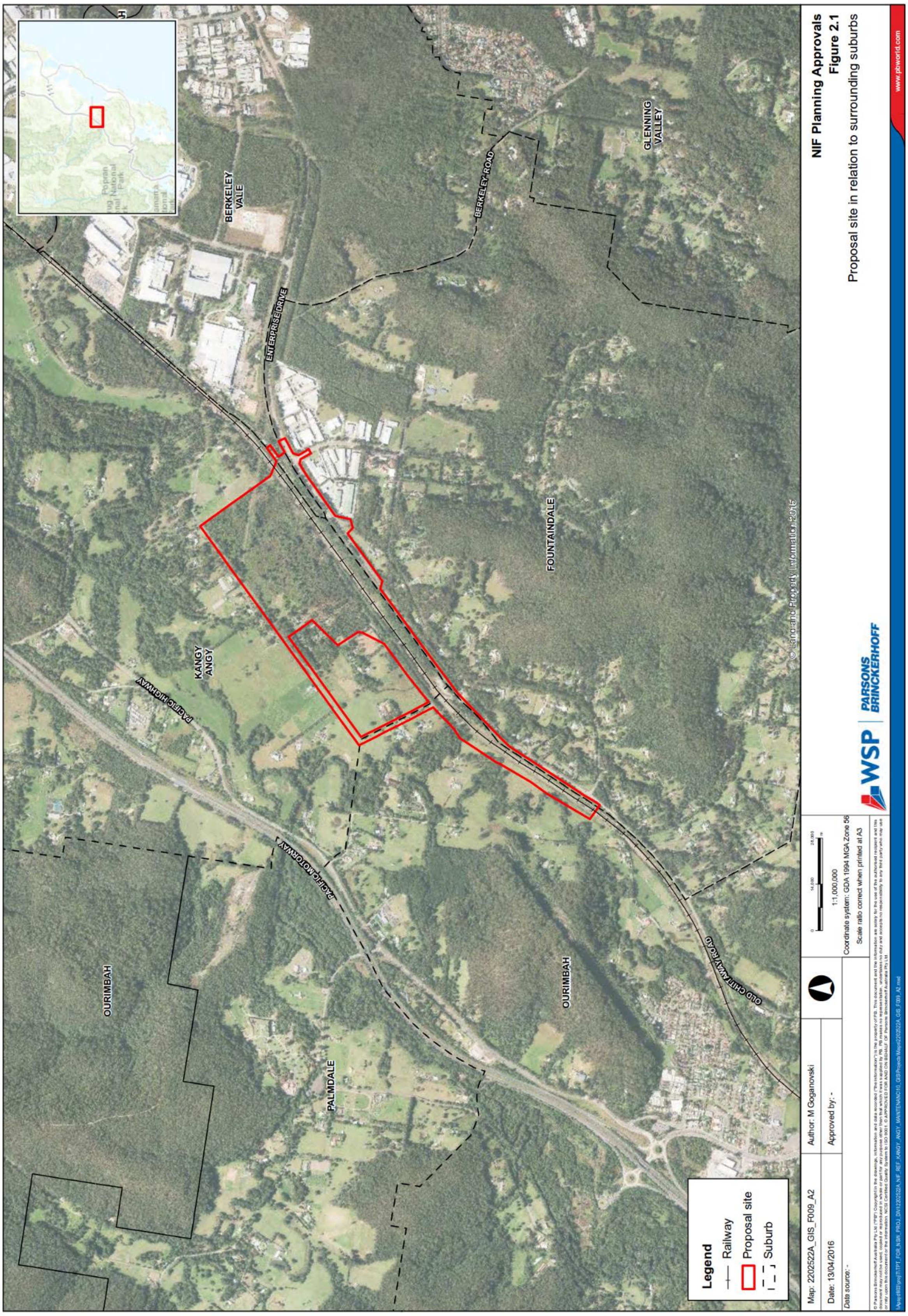
The immediate area is semi-rural, with development generally concentrated along the transport corridor formed by the Pacific Highway and the Sydney–Newcastle railway line. Along this corridor land use includes residences, small farms, State Forest and light industry. The M1 Pacific Motorway is located approximately 850 m to the north-west, and Tuggerah Lake is approximately 3.5 km to the east of the site.

The study area includes rural residential, open farmland, remnant woodland, a rail corridor and industrial estate. Land use in areas near the proposal is predominantly rural with expanding residential areas towards the east and some industrial and commercial land use. A number of residential sensitive receivers are within 200 m of the rail corridor of the Sydney–Newcastle railway line. An industrial estate is also present (at a distance of approximately 400 m) to the east of the corridor along Old Chittaway Road. The industrial estate includes large lots with manufacturing factories for Mars Food/Masterfoods Australia, Sanitarium Health Food Company and other engineering and technology firms.

The area surrounding the proposal is generally zoned as:

- E2: Environmental Conservation
- E3: Environmental Management
- IN1: General Industrial
- SP2: Infrastructure (road and traffic facility).

The majority of the proposal site is located on the E2 and E3 zones (land to the north of the rail corridor) and within the existing rail corridor on land zone SP2 Infrastructure under the Wyong Local Environment Plan (LEP) 2013.


NIF Planning Approvals
Figure 2.1
Proposal site in relation to surrounding suburbs
Legend
Railway
Proposal site
Suburb
BERKELEY VALE
GLENNING VALLEY
FOUNTAINDALE
KANGY ANGY
OURIMBAH
OURIMBAH
PALMDALE
ENTERPRISE DRIVE
BERKELEY ROAD
PACIFIC HIGHWAY
PACIFIC MOTORWAY
OLD CHITTAWAY ROAD
Map: 2202522A_GIS_F009_A2
Date: 13/04/2016
Data source: -
Author: M Goganovski
Approved by: -
1:1,000,000
Coordinate system: GDA 1994 MGA Zone 56
Scale ratio correct when printed at A3
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2.1.2 Region

The proposal is located within the Wyong Shire LGA and is within 5 kilometres of the boundary of the Gosford LGA. For the purposes of this assessment, the local area has been defined as the LGA of Wyong Shire. The Wyong Shire LGA is located within the Central Coast of NSW, between 60 and 90 kilometres north of Sydney. The Central Coast region, comprising Gosford City and Wyong Shire LGA, is located along the coast of NSW, between Newcastle and Sydney. In 2014, the population of the Central Coast was 331,007 residents, covering a land area of 1,680 square kilometres (profile.id, 2016a). Wyong Shire LGA represents almost half of the Central Coast regional and has a population of 159,015 (ABS 2014).

The Wyong Shire LGA encompasses a total land area of approximately 740 square kilometres and is a growing residential area of which agriculture and parkland purposes are the dominant land use. Rural land is predominately used for farming, mining, electricity generation and timber-getting (profile.id, 2016b). Residential non-private dwellings comprise short and long term accommodation including hospitals, nursing homes, hotels, motels, hostels, army barracks and prisons (profile.id, 2016b).

Settlement in the LGA is generally based around the major service centres of Wyong and Tuggerah and numerous townships surrounding lakes of Tuggerah, Budgewoi, Munmorah and Macquarie. These areas are serviced by road and rail infrastructure of the Sydney–Newcastle Freeway, the Pacific Highway and the Sydney–Newcastle railway line (profile.id, 2016b). The Wyong Shire LGA includes the coast strip from Bateau Bay to Budgewoi. The site of the proposed development is located approximately 8 kilometres from coastal development around Shelly Beach and Bateau Bay.

2.1.3 State

Where applicable the State of NSW has been used to provide a comparison for the local and regional community and demographic profiles.

3 CONSULTATION

Consultation activities undertaken to date for the proposal, have been conducted by Transport for NSW and Elton Consulting on behalf of Transport for NSW. These activities are outlined in Table 3.1.

The main issues of concern to residents in the immediate area of the proposed development, as highlighted through a door-knock event undertaken in January 2016 include:

- visual impact including visual amenity, vegetation clearing and landscape changes from having a cleared site and the changes the development would bring to the general amenity of the area
- change in feel of area and reduction in rural lifestyle
- location of proposed site not suitable or appropriate, as it has access and flooding issues
- property devaluation.

Table 3.1 Overview of consultation activities undertaken to date for the proposal

WHAT	WHEN	CONSULTATION UNDERTAKEN BY	WHO WAS CONSULTED	ISSUES RAISED
Targeted stakeholder engagement with affected landholders (requiring property to be acquired)	Ongoing	Transport for NSW	Affected landholders	Concern regarding the impact of the project on neighbouring properties which have livestock such as horses and cattle. Concern that the proposed bridge to the highway will create flooding. Concern regarding impacts from possible new rail bridge to span across the rail tracks to get access to facility.
Community notifications to residents and businesses	Sept 2015, Nov 2015, Dec 2015, Mar 2016	Transport for NSW	Residents and businesses	Concern that the NSW Government will rezone existing environment/conservation land to industrial. Should consider a location where private properties not impacted. Identified that the facility will be located a short distance from a child care and school.
Newsletter (email)	Mar 2016	Elton Consulting	Property owners, sensitive receivers, business owners, managers, directors, chairpersons, Mayor, Deputy Mayor, Federal Minister for the Environment, Members of Parliament	Questioned why the Darkinjung land was not suitable for the site. Concern regarding the size of footprint required and associated road work impacts. Noted that just terms and fair compensation should be provided. Concern that the proposal will devalue properties. Perceived lack of community consultation about the site selection process and project. Concern regarding pollutants such as oil, grease, chemicals seeping into the ground. Security of air borne pollutants not affecting water supply from water collected from roofs into water tank systems.

WHAT	WHEN	CONSULTATION UNDERTAKEN BY	WHO WAS CONSULTED	ISSUES RAISED
Newsletter (hardcopy	Mar 2016	Elton Consulting	Approximately 300 properties within the defined catchment area	Identification of existing flooding impacts. Concern that the project may affect flooding to adjacent properties. Concern that the project will affect the local watercourses.
Door-knock	Mar 2016	Elton Consulting	26 properties (including adjacent landholders, sensitive receivers, Central Coast Rudolf Steiner School and Follyfoot Farm Child Care Learning Centre)	Note that the area has flood twice since 2015. Suggested alternative access from Turpentine Road through to Enterprise Drive to eliminate the proposed bridge. Concern regarding increase in traffic during construction and operational stages, including increases in heavy vehicle movements on local streets. Identified the need to maintain access to Orchard Road, Turpentine Street and Ourimbah Road. Concern regarding the safety of children from increased heavy vehicles. Concern regarding the disruption to the rural neighbourhood. Visual impacts to adjacent properties and residents. Disturbance at night from lighting at the facility. Concern regarding overall noise and vibration impacts. Concern regarding 24 hour operational impacts. Identified the need to introduce a buffer between the facility to minimise noise to neighbouring properties. Impacts to endangered species. Impacts to yabbies in the creek and similar ecology across the site. Identified the need to minimise the extent of vegetation clearing on the site. General unease and unhappiness with the proposal. Culture shock overall from proposal. Interruption and disruption to relaxed lifestyle. Many people moved to area to escape city pressures and do not want to live in an area with industrial activities. Property owners left behind (one in particular) will be completely surrounded by the proposal.

As outlined in Table 3.1, preliminary consultation with immediately affected landowners has commenced. Community consultation will continue in the lead up to the exhibition of the REF in mid-2016. At this time, additional community feedback in the form of submissions on the proposal will be invited. The feedback received during the exhibition of the REF will be described in a Submissions Report.

Since the preferred site location was announced in September 2015, the proposal has generated media interest. Generally this media interest has been negative, with residents in Kangy Angy expressing their dislike and concern for the proposal due to the proposal location and possible proposal impacts to the character and lifestyle of the area. These media articles have also highlighted concern for the proposal in relation to the area being prone to flooding (Simkin 2015; McCarthy 2016).

4 METHOD

This chapter describes the methodology undertaken for this socio-economic assessment.

4.1 Profiling and baseline studies

A range of published data were reviewed to profile the demographics, social and economic environment of the defined study area (comprising geographical/statistical areas of Kangy Angy, Fountaindale, Wyong Shire LGA and the State of NSW (refer to section 2)). The state suburb of Ourimbah has not been included in the baseline study as the area of impact in Ourimbah is very small in comparison to the whole suburb area. As a result statistical data for Ourimbah would not be representative of the area of impact (refer to Figure 2.1).

The following data were reviewed to profile the demographics, social and economic environment of the three defined geographical/statistical areas (refer to section 2):

- population and demographics
- employment and education
- families
- housing and accommodation
- relative socioeconomic disadvantage
- regional planning
- community values
- social infrastructure.

4.2 Impact assessment

The social and economic impact assessment was based on qualifying if the benefit or impact that is likely to occur, and the consequence of these benefits or impacts locally and regionally. Where benefits and impacts have been identified, enhancement or management measures have been proposed.

4.3 Management measures

Management measures have been developed based on the principles of impact avoidance, in preference to impact management. The strategies also consider beneficial enhancement. Where unique issues, benefits and impacts are identified, potential management measures are suggested (refer to Chapter 7). Some of these measures may require further development and consultation prior to construction. They would also need reviewing against the proposal's completed technical studies, concepts and detailed design to ensure they remain relevant.

4.4 Data sources

The main quantitative and qualitative data sources referenced in this assessment include:

- statistical information from various sources including Australian Bureau of Statistics (ABS) 2011 census data and the ABS Estimated Resident Population (ERP) data for 2014
- social service provider information, held by local councils and relevant government authorities relating to education, health, employment and emergency services
- local and regional planning instruments including community and social plans from local and state government agencies
- completed technical assessments relating to the proposal.

4.5 Assumptions and limitations

This assessment has been prepared using a number of assertions and assumptions. This section describes the assumptions and limitations regarding availability to information and the desktop assessment.

4.5.1 Assumptions

This assessment has been prepared under the following assumptions:

- the socio-economic assessment is a desktop assessment only
- where relevant the results from consultation undertaken by Elton Consulting on behalf of Transport for NSW have been incorporated
- where relevant the results from technical studies and reports prepared for the proposal have been incorporated including:
  - New Intercity Fleet Maintenance Facility Noise and Vibration Impact Assessment (April 2016) – WSP | Parsons Brinckerhoff (REF Appendix B)
  - New Intercity Fleet Maintenance Facility Landscape Character and Visual Impact Assessment (April 2016) – Clouston Associates (REF Appendix C)
  - New Intercity Fleet Maintenance Facility, Orchard Road, Kangy Angy: Non-Aboriginal Heritage Impact Assessment (April 2016) – Artefact Heritage (REF Appendix D)
  - New Intercity Fleet Maintenance Facility, Orchard Road, Kangy Angy: Aboriginal Archaeological Survey Report (April 2016) – Artefact Heritage (REF Appendix E)
  - New Intercity Fleet Maintenance Facility Traffic and Transport Impact Assessment (April 2016) – WSP | Parsons Brinckerhoff (REF Appendix F)
  - New Intercity Fleet Maintenance Facility – Air Quality Report (April 2016) – Pacific Environment Limited (REF Appendix I).

4.5.2 Limitations

While all due care was taken during the preparation of this assessment, several unavoidable data-related limitations may be present.

The census data used to assess the existing socio-economic environment is five years old. Where possible, more up to date information has been sourced from local and regional websites to present a more accurate assessment of the local and regional environment. While a new census will be undertaken in August 2016, the results of this are unlikely to be available until early 2017.

The ABS uses ‘introduced random error’ to ensure that individuals cannot be identified within the census data. Introduced random errors are evident in the reported local level data. This is because the corresponding local population (as measured statistically) is small and therefore potentially skewed. Despite this error, the report averages any data to ensure that the conclusions are relevant and valid. ABS summary table totals and sub-totals are also subject to small adjustments, which include modifications to preserve the ability to total figures within tables. Although each modified table is internally consistent, some minor discrepancies may arise when comparing tables that contain similar data.

At time of writing this report, only preliminary consultation and stakeholder engagement had been undertaken. Consultation which has occurred for the proposal is outlined in section 3 of this report.

As consultation for the proposal is at an early stage, this assessment has used available desktop information and statistics to develop an understanding of the affected and broader community. Community and stakeholder concerns and feedback about the proposal will be actively sought and will be invited through the public exhibition of the REF in mid-2016. This feedback will be collated, reviewed and responded to in a formal Submissions Report.

5 COMMUNITY PROFILE AND BASELINE

This chapter describes the social and economic characteristics of the geographical/statistical areas described in section 2. Establishing this baseline allows the proposal's benefits and impacts to be identified.

5.1 Socio-economic baseline

This section describes the demographics of the various geographical/statistical areas, including:

- people (refer to section 5.1.1)
- employment and education (refer to section 5.1.2)
- families and households (refer to section 5.1.3)
- housing and accommodation (refer to section 5.1.4).

5.1.1 People

Table 5.1 describes the population and demographics of the suburbs of Kangy Angy and Fountaindale and compares these to the Wyong Shire LGA and state of NSW.

Table 5.1 Population and demographics

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG SHIRE LGA	CENTRAL COAST REGION	NSW
Population	316	631	159,015 (updated 2014)	331,007 (updated 2014)	7,618,200 (updated 2015)
Males (%)	51.6%	49.3%	48.3%	48.3%	49.3%
Females (%)	48.4%	50.7%	51.7%	51.7%	50.7%
Indigenous popn (%)	2.2%	2.7%	3.6%	2.9%	2.5%
Median age (years)	47	44	40	41	38
0–14 years (%)	19.0%	16.5%	20.2%	19.4%	19.2%
15–64 years (%)	62.6%	69.6%	61.0%	61.6%	66.1%
65 years + (%)	18.3%	14.1%	18.8%	19.0%	14.7%
Ancestry (Top 3):					
Australian (%)	37.8%	36.8%	33.6%	31.9%	25.0%
English (%)	31.7%	29.0%	31.5%	31.5%	24.2%
Irish (%)	8.5%	10.0%	8.4%	8.8%	7.4%

Source: Profile.id (2016a; b), Australian Bureau of Statistics (2013)

At the time of the 2011 Census the resident population of Kangy Angy and Fountaindale was 316 people and 631 people respectively. As at 2014, the Wyong Shire LGA had a resident population of 159,015 people.

NSW Department of Planning and Environment population projections show that the regional population will continue to steadily increase according to population projections provided at five yearly intervals, until 2031. The Department estimates that during 2026 to 2031, approximately 11,050 people will move into the Wyong Shire LGA. This represents an annual population growth of 1.2 per cent over this five year period. The wider regional population is also projected to increase with Gosford City LGA also showing steady, population growth. The population in Gosford City LGA is expected to increase from 184,950 to 189,050 between 2026 and 2031 with approximately 4,100 people moving into the Gosford City LGA within this period. This projection combined with the Wyong Shire LGA projected population represents an increase in the wider regional population of more than 15,000 residents between 2026 and 2031.

At the time of the 2011 census, the local area and regional demographic profile was broadly consistent with the state demographic profile. The few differences are in regards to age of population, the proportion of the Indigenous population and ethnicity of the population.

The median (average) age of population of Kangy Angy (47 years) and Fountaindale (44 years) was higher than the median age of the population within the Wyong Shire LGA (40 years) and the state of NSW (38 years).The median age in Ourimbah is lower, at 35 years, compared to the local or regional areas. This suggests that there is an ageing populating in the immediate/local and regional area and for Kangy Angy and Wyong LGA in particular this is supported by the greater percentage of retirees (people over 65 years of age) within the population (18.3 per cent and 18.8 per cent respectively compared to 14.7 per cent for the state of NSW) and a smaller percentage of people of working age (15–65 years) within the population (62.6 per cent for Kangy Angy and 61 per cent for Wyong LGA compared to 66.1 per cent for the state of NSW). The proportion of the population of Fountaindale over 65 years of age (14.1 per cent) was similar to the state of NSW. The greatest proportion of the Fountaindale population was found to be within the 45 to 54 years age bracket, accounting for 21.1 per cent of the population. The same age bracket accounted for 14.6 per cent of the Kangy Angy population. The greatest proportion of the Kangy Angy population were within the 55 to 59 years age bracket, accounting for 10.8 per cent of the population.

Another important demographic is that there is a greater percentage of indigenous people in the local Fountaindale population and regional population compared to the state average (i.e. 2.7 per cent in Fountaindale and 3.6 per cent in Wyong Shire LGA compared to 2.5 per cent across the state). The percentage of indigenous people within Kangy Angy is less than the state at 2.2 per cent.

There are also significantly more people of Australian and English ancestry within the local area and regional compared to the state. While the area is probably not as culturally diverse as other areas of the state, within Kangy Angy in particular, this is probably a reflection of the area being founded in timber and citrus industry, and later being taken up in small land holdings. As such, it is likely that there has not been a lot of new in-migration of people into the area and reflects locally settled families going back a few generations and others moving into the area for lifestyle purposes.

5.1.2 Employment and education

Table 5.2 describes the employment and education profile of the suburbs of Kangy Angy and Fountaindale and compares these to the Wyong Shire LGA region and the state of NSW.

Table 5.2 Employment and education

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG LGA SHIRE	CENTRAL COAST REGION	NSW
Employed (full time, part time, away from work) over 15 years (%)	96.7%	93.9%	92.1%	93.1%	94.1%
Unemployed over 15 years (%)	3.4%	6.7%	7.8%	6.9%	5.9%

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG LGA SHIRE	CENTRAL COAST REGION	NSW
Median age of employment (years):					
Full time	45	49	41	42	41
Part time	56	44	40	41	40
Occupations (Top 4) (%):					
Technicians and trades	14.0%	12.9%	16.7%	15.7%	13.2%
Professionals	17.5%	20.1%	14.3%	17.9%	22.7%
Clerical and administrative workers	17.5%	17.0%	13.8%	14.6%	15.1%
Labourers	12.6%	8.5%	12.1%	10.3%	8.7%
Education (%)					
Pre school	6.4%	5.2%	7.4%	7.1%	5.9%
School	56.3%	59.1%	52.1%	50.7%	46.8%
Technical or other	9.6%	11.5%	9.5%	9.5%	10.3%
University or tertiary institution	12.8%	15.7%	8.1%	9.7%	14.2%
Not stated	14.9%	8.4%	22.9%	23.0%	22.8%

Source: Australian Bureau of Statistics (2013)

The employment and education data shows that the median age of the employed population with the suburbs of Kangy Angy (45 years) and Fountaindale (49 years) is higher than that for the Wyong Shire and NSW as a whole (41 years), consistent with median population age in the local suburbs.

Technicians and Trade Workers (16.7 per cent) followed by Professionals (14.3 per cent) and Clerical and Administrative Workers (13.8 per cent) were the main occupational categories within Wyong Shire LGA region.

By comparison, the main occupation categories in Kangy Angy and Fountaindale were:

- Kangy Angy:
  - Clerical and Administrative Workers (20.3 per cent)
  - Professionals (17.5 per cent)
  - Technicians and Trade Workers (14.0 per cent)
- Fountaindale:
  - Professionals (20.1 per cent)
  - Managers (17.0 per cent)
  - Clerical and Administrative Workers (17.0 per cent).

The large percentage of professionals within Fountaindale (and also Ourimbah where 19.8 per cent of the population are also employed in this occupation) is likely to be associated with the teaching profession. In Fountaindale 7.8 per cent the employed population work in the school education industry. The suburb of Ourimbah hosts three higher education facilities including a university, TAFE and community college. Also within the local area there are seven primary and secondary schools (refer to Table 5.6). These occupations and industries of employment are reflective of the fact that a greater percentage of the Fountaindale population (15.7 per cent) has completed university or tertiary level of education, compared to 12.8 per cent for Kangy Angy and 8.1 per cent for the Wyong Shire LGA region.

By comparison the largest industry of employment within the suburb of Kangy Angy is Residential Building Construction (5.6 per cent) followed by Building Installation Services (2.8 per cent) and School Education (2.7 per cent). The largest industries of employment within the Wyong Shire LGA were Cafes, Restaurants and Takeaway Food Services (4.6 per cent), School Education (4.2 per cent) and Supermarket and Grocery Stores (3.6 per cent).

Kangy Angy and the regional population includes a smaller percentage of people that have been technically educated compared to the state average. This suggests that there is a higher proportion of the workforce which has not been formally trained.

The above data show that unemployment within suburb of Fountaindale and region is higher than the state average. Within the suburb of Fountaindale 6.7 per cent of people of working age are unemployed compared to 5.9 per cent in NSW. The percent of people of working age unemployed in the Wyong Shire LGA was 7.8 and 6.9 per cent within the wider Central Coast region. By comparison, unemployment within the suburb of Kangy Angy was relatively low at 3.2 per cent. Within the local area and region, the top four occupations are technicians and trades, professionals, clerical and administrative workers and labourers. The top two occupations in Kangy Angy are professionals and clerical and administrative workers, whereas the top two in Fountaindale are professionals and managers. This is likely to be due to employment being at the three higher education services within Ourimbah of a community college, university and TAFE.

5.1.3 Families and households

Table 5.3 describes the family and household profile of the suburbs of Kangy Angy and Fountaindale and compares these to the Wyong Shire LGA region and state of NSW.

Table 5.3 Families and households

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG SHIRE LGA	CENTRAL COAST REGION	NSW
Married (%)	51.7%	59.5%	46.4%	47.6%	49.4%
Separated (%)	4.2%	2.6%	4.1%	3.8%	3.1%
Divorced (%)	11.0%	7.9%	10.8%	10.6%	8.3%
Widowed (%)	4.9%	4.3%	7.5%	7.5%	5.8%
Never married (%)	28.1%	25.5%	31.1%	30.5%	33.5%
Couple families without children (%)	42.7%	39.0%	37.4%	37.8%	36.6%
Couple families with children (%)	40.4%	52.2%	40.0%	41.3%	44.6%
One parent family (%)	16.9%	8.8%	21.3%	19.6%	16.3%

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG SHIRE LGA	CENTRAL COAST REGION	NSW
Other family (%)	0%	0%	1.3%	1.3%	1.7%
Average children per family	2	1.9	1.9	1.9	1.9
Median weekly household income	$843	$1,617	$934	$1,003	$1,237

Source: Australian Bureau of Statistics (2013)

The above data show that the percentage of married people locally is higher than both the regional and state averages. The data also showed there are fewer separated or widowed people or people who have never married within the local populations compared to the region and state. The level of divorce within Kangy Angy and the Wyong Shire LGA region is however higher that within the Fountaindale or state populations.

The most prevalent family type within Fountaindale is couple family with children comprising 52.2 per cent of all families. The most prevalent family type in Kangy Angy is couple families without children comprising 42.7 per cent of all families.

Household incomes were notably less within Kangy Angy and the region than the state average. In contrast household incomes in Fountaindale are notably greater than the regional and state averages. This suggests that there is a certain level of disadvantage within Kangy Angy and the LGA and region compared to the state and the suburb of Fountaindale.

5.1.4 Housing and accommodation

Table 5.4 describes the housing and accommodation profile of the suburbs of Kangy Angy and Fountaindale and compares these to the Wyong Shire LGA region and the state of NSW.

Table 5.4 Housing and accommodation

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG SHIRE LGA	CENTRAL COAST REGION	NSW
All private dwellings	120	216	63,643	134,743	2,736,637
Average people per household	2.4	2.9	2.5	2.5	2.6
Median weekly household income	$843	$1,617	$934	$1,003	$1,237
Median monthly mortgage repayments	$1,300	$1,972	$1,733	$1,820	$1,993
Median weekly rent	$235	$260	$260	$270	$300
Average motor vehicles per dwelling	2.4	2.4	1.7	1.6	1.6
Separate houses (% of all occupied private dwellings)	71.1%	100%	83.7%	89.0%	69.5%
Family households (%)	69.6%	84.6%	71.0%	69.5%	71.9%
Single (lone) person households (%)	30.4%	13.9%	26.2%	27.7%	24.2%

INDICATOR	KANGY ANGY STATE SUBURB	FOUNTAINDALE STATE SUBURB	WYONG SHIRE LGA	CENTRAL COAST REGION	NSW
Group households (%)	0%	1.5%	2.7%	2.8%	3.8%

Source: Australian Bureau of Statistics (2013)

Weekly rents and monthly mortgage repayments were generally comparable locally within the suburb of Fountaindale and regionally, both of which were similar to the state average. Notably however, weekly rents and monthly mortgage repayments were less for residents residing in the suburb of Kangy Angy. These statistics are reflective of the median house prices for the suburbs. The median house price in Fountaindale is $880,000 compared to $662,500 for Kangy Angy. There is also high demand for properties within Fountaindale with on average 2095 visits per property recorded compared to 682 visits per property for Kangy Angy and 582 visits per property in the state of NSW (RealEstate.com.au 2016).

Within Fountaindale all dwellings were separate houses, which is reflective of the rural-residential nature of the suburb. By comparison 71.1 per cent of dwellings within the suburb of Kangy Angy were separate houses. While the majority of this suburb would be considered rural-residential there is a small cluster of housing adjacent to the Pacific Highway associated with the Tuggerah Village (a manufactured home village offering different lifestyle options and targeted towards those over 50 years of age). The village currently has 48 homes and more are being constructed (Tuggerah Village 2016). The presence of this village would account for the lower percentage of separate houses in this area as well as the high percentage of occupations geared towards residential building construction and building installation services.

The most prevalent household type within the local area and region is family households. The suburb of Fountaindale has the highest proportion of this household type (84.6 per cent), which is greater than the region (71 per cent) and the state (71.9 per cent). By comparison 69.6 per cent of all households within the suburb of Kangy Angy were family households.

Slightly more people live in each household locally (2.4) compared to the region and across the state. Within Fountaindale, this is reflective of the lower percentage (13.9 per cent) of households which ae lone person households. Notably, Kangy Angy has a high percentage of lone person households (30.4 per cent) and is attributed to the Tuggerah Village. There are no group households in Kangy Angy and very few in Fountaindale (1.5 per cent).

5.1.5 Relative socio-economic disadvantage

The ABS has developed the Index of Relative Socio-economic Disadvantage (SEIFA) that summarises key economic and social information about people and households within a defined area. The index also identifies the community and social resources available in a given area. The index helps identify areas that require funding and services, provide new business opportunities, and/or contribute to other research (ABS, 2013).

The index ranks each LGA based on income, qualifications, low-skilled jobs, and unemployment, among other factors. A low rank (1) indicates that the area’s population is more disadvantaged. Table 5.5 shows the index ranking for the Wyong Shire LGA compared to the rest of the state and across Australia. The table compares the rank against the least disadvantaged LGA in the state (Ku-ring-gai) and the most disadvantaged LGA in the state (Brewarrina Shire).

Table 5.5 Index of relative socioeconomic disadvantage in 2011

CHARACTERISTIC	DISADVANTAGE			
	Rank within Australia (out of 564)	Decile	Rank within NSW (out of 153)	Decile
Wyong Shire LGA	231	5	72	5
Ku-ring-gai LGA	563	10	152	10
Brewarrina Shire LGA	36	1	1	1

Source: Australian Bureau of Statistics (2013)

The SEIFA ranking suggests the Wyong Shire LGA is not that disadvantaged as it sits within the top 50% of LGA's within Australia and NSW. In addition, the Wyong Shire LGA is within decile 5, where 1 is the most disadvantaged and 10 is the least disadvantaged. This shows that the Wyong Shire LGA is average within Australia and NSW. This is supported by the level of employment in the region and the housing structure, with a high proportion of separate houses.

5.2 Community values

The Central Coast Regional Plan 2015–2017 (Regional Plan) forms part of an Australian Government and NSW Government initiative. The Regional Plan is published by Regional Development Australia (RDA) and is for the Central Coast region of NSW. Within the Regional Plan, four priorities areas for the Wyong Shire LGA were identified, being:

- greater stability for the local economy via a broader industry/investment base
- build investor confidence ensuring the area is geared to respond to wider market demand
- create local employment opportunities and attract/retain the talent and skills to fill the workforce demands of this new economy
- achieve sustainability for the region's economy, community, environment and lifestyle.

Within the Wyong Shire LGA, several other planning policies, strategies and controls have been created which highlight the importance of cultural, community and heritage values in the local area (refer to section 5.2 below):

- Planning strategies:
  - Wyong Shire Cultural Plan
- Land use and planning policies:
  - Community Gardens
  - Green Corridors
  - Public Art Policy and Implementation Plan.

The Wyong Shire LGA describes the area as having has a strong sense of culture, community and heritage, as evident by the community groups, events and cultural policies within the region. Within the Wyong Shire LGA there are more than 460 community groups or community events within arts and culture; leisure and sport; environment and conservation; hobbies and interest; community committees; volunteering and service clubs; support services; sport and recreation groups; government offices; learning and education and positive ageing organisations. These groups highlight the importance of local culture and community to the residents of the LGA (refer section 5.2.1).

The local community is described by the Wyong Shire Council as identifying strongly with the area's heritage and cultural assets. The cultural assets within the Wyong Shire LGA include: cultural infrastructure; heritage, organisation and events, cultural diversity, music, theatre, dance, visual arts, craft, photography, adult education centres, cultural professionals, writing, speaking and literature. The local community also value the natural environment and the area features a number of parks, open spaces and reserves.

The consultation with stakeholders undertaken to support the preparation of the Regional Plan also identified the need to create economic growth and job creation; improve skill development and educational outcomes; enhance regional collaboration the population, business community and economic environment in the region.

Local challenges which the LGA face include a high level of youth unemployment and a high proportion of out-commuting. Out- commuting is relatively high within the LGA and is at a level of 25 per cent. This causes issues for the economy and business competition. The Regional Plan seeks to establish local jobs to minimise the number of residents commuting to work outside of the LGA.

The Central Coast Regional Action Plan (NSW Department of Premier and Cabinet, 2012) has objectives for the region. Some of these objectives could be partly satisfied or fulfilled by the construction and operation of the proposal including:

- grow the economy of the Central Coast and provide sustainable employment
- improve transport connectivity and regional roads
- improve the region's external connections
- improve public transport connectivity across the Central Coast, making public transport a more attractive option.

Locally and regionally, there is a strong commitment to tourism, commercial activity and local business as this supports the community. A number of local and regional facilities and business also help sustain the community by providing goods and services as well as employment opportunities.

5.2.1 Social infrastructure

EDUCATION

Within Wyong Shire LGA there are 40 education facilities. However, there are no schools within the suburb of Kangy Angy, where the preferred proposal site is located. There is one school within Fountaindale, which is Central Coast Rudolf Steiner School which is within 200 metres of the proposal footprint. Also within Fountaindale is the Follyfoot Farm Child Care Learning Centre, which is located within 50 metres of the proposal footprint. There are seven schools within a five kilometres radius of the preferred site, and these are listed in Table 5.6 outlining school enrolment details for these education facilities.

Table 5.6 School enrolment details for schools within five kilometres of the proposal site

EDUCATION FACILITY	ENROLMENT VACANCIES	SCHOOL AGES	ENROLMENT	SCHOOL LEVEL	SCHOOLTYPE
Tuggerah Public School	Not stated	Year 1 to year 6	491	Primary school	Public school
St Peter's Catholic College	Yes	Year 7 onwards	1,100	High school	Catholic school
Chittaway Bay Public School	Yes	Kindergarten to Year 6	358	Kindergarten and primary school	Public school

EDUCATION FACILITY	ENROLMENT VACANCIES	SCHOOL AGES	ENROLMENT	SCHOOL LEVEL	SCHOOLTYPE
Tuggerah Lakes Secondary College (TLSC) Berkeley Vale Campus	Yes	Year 7 onwards	749	High school	Public school
Berkeley Vale Public School	Yes	Kindergarten to Year 6	782	Primary school	Public school
Ourimbah Public School	Yes	Kindergarten to Year 6	430	Primary school	Public school
Central Coast Rudolf Steiner School	Subject to availablity	Early kindergarten onwards	270 plus	Early kindergarten, kindergarten, primary school, high school	Independent school

Source: CCRSS, 2016; St Peter’s Catholic College, 2016; Education NSW, 2016

There are three higher education facilities in the wider area of the proposal, being the University of Newcastle Central Coast Campus, Central Coast Community College and Hunter Technical and Further Education (TAFE) Ourimbah Campus.

The University of Newcastle Central Coast Campus provides courses over undergraduate, honours, postgraduate and PhD levels. These courses are offered across faculties of business and law, education and arts, engineering and built environment, health and medicine, science and information technology and English language and foundation studies.

The Central Coast Community College is located within the University of Newcastle and provides a range of short courses, long courses, certificate courses and night skill classes in a wide range of disciplines such as languages, sports, art, accounting, beauty, health and safety, information technology, massage and lifestyle and leisure.

The Hunter TAFE Ourimbah Campus is also joint to the University of Newcastle Facility and provides courses ranging from certificates, diplomas and bachelor degrees, covering a wide range of disciplines including administration and business; building services; hospitality; fitness; outdoor recreation; horticulture; information technology and creative industries.

HEALTH SERVICES

Within Wyong Shire LGA there two health facilities of the Wyong Hospital and Long Jetty Health Care Centre. Also within the Wyong Shire LGA, is the private Berkeley Vale Private Hospital. This hospital is a member of Ramsay Health Care and is a medium sized hospital with 75 beds. This hospital provides rehabilitation, general medical and surgical services which are supported by x-ray facilities, operating theatres, allied health services and a hydrotherapy pool (Berkeley Vale Private Hospital, 2016).

Table 5.7 Health service provisions within the Wyong Shire LGA

WYONG SHIRE LGA	
Medical facilities	
Wyong Hospital (Large size hospital – between 200 and 500 beds) Surgeries and procedures include: → Emergency → Elective surgery → Cancer surgery → Gynaecological → Orthopaedic → Cardiovascular → Childbirth → Urological → Other surgeries: ▪ Appendix removal ▪ Ear, nose and throat surgery ▪ Eye surgery ▪ Gallbladder removal ▪ General surgery ▪ Neurosurgery ▪ Plastic surgery ▪ Vascular surgery → Services include: ▪ Alcohol and drug unit ▪ Coronary care unit ▪ Emergency department ▪ Geriatric assessment unit ▪ Maintenance renal dialysis unit ▪ Obstetric unit ▪ Oncology unit ▪ Paediatric service ▪ Psychiatric unit ▪ Rehabilitation unit	Long Jetty Health Care Centre (Medium size hospital – Fewer than 50 beds) Surgeries and procedures include: → Cardiovascular → Services include: ▪ Geriatric assessment unit.

Source: My Hospitals, 2016.

EMERGENCY SERVICES

Within Wyong Shire LGA there several emergency services including police, fire and ambulance services. Table 5.8 describes the provision of local emergency services within the Wyong Shire LGA.

Table 5.8 Emergency service provisions within the Wyong Shire LGA

WYONG SHIRE LGA
Police Services There are a total of three polices stations within the Tuggerah Lakes Police Local Area Command, the centre for the northern region command is situated in Wyong.
Tuggerah Lakes Local Area Command: → The Entrance Station → Toukley Station Wyong Station.
Emergency Services Wyong Shire LGA is located within the Hunter Central Coast Emergency Management Region.
→ Fire: ▪ Doyalson Fire Station ▪ Wyong Fire Station → Ambulance: ▪ NSW Ambulance – Wyong. State Emergency Services

COMMUNITY FACILITIES

More than 20 different sports are catered for in the Wyong Shire LGA including netball, basketball, tennis, bocce, BMX riding, skate boarding and fitness. The Wyong Shire Council provides libraries, sporting fields and complexes, skate parks, community fitness facilities, memorial gardens, animal care facilities, events, halls, centres and venues and open space. There are no recreation facilities, community facilities, sports grounds or parks located in Kangy Angy or Fountaindale, however there are three parks, one reserve, a soccer club and one community hall within Ourimbah (Wyong Shire Council, 2016).

It is estimated that there are over 460 community groups within the LGA under the categories of arts and culture; leisure and sport; environment and conservation; hobbies and interest; community committees; volunteering and service clubs. Also there are support services, sport and recreation groups, government offices, learning and education and positive ageing organisations locally. These groups cater for everyone in the community including seniors, young people, people with a disability, children, families, women, men, animals, carers, indigenous peoples and lesbian, gay, bisexual and transgender people.

Support services include: health care, mental health, home care, employment, homelessness, neighbourhood, education, transport, crisis aid, financial and legal, accommodation and business. Sport and recreation organisations include: sporting teams, special interest, facilities, club houses, camps and programs, associations and events. Education and learning organisations within the LGA include arts and culture, social and conservation, parenting, leisure and sporting, technology, education, early mothers groups, employment, tutoring or tuition, road safety, environment, safety or conservation, volunteering, community involvement, hobbies and interest, libraries and learning venues. Positive ageing groups include social support, hobbies and interest, volunteering, help and support, health, cultural diversity and aged care facilities. Government offices and support within the area is in the realm of emergency, welfare, health, education, revenue and regulation.

PLACES OF ABORIGINAL HERITAGE AND SIGNIFICANCE

As of 2014, about 159,015 people lived in the Wyong Shire LGA (refer to Table 5.1), with Aboriginal people comprising 3.6 per cent of the local population. This accounts for around 5,725 people within the LGA. There is a higher percentage of Aboriginal people living locally than regionally (3.6 per cent compared to 2.9 per cent). This is consistent with the wider Central Coast region which also has a higher percentage of indigenous people than the state percentage of 2.5 per cent. Within the suburb on Kangy Angy and Fountaindale the percentage of Aboriginal people is closer to the state average, being 2.2 per cent and 2.7 per cent respectively.

The original custodians of the land in the area were the Darkinyung (Darkinjung*)* people. The Wyong Shire LGA and Gosford City LGA are both covered by the Darkinjung Local Aboriginal Land Council (LALC). Between these two LGAs it is estimated that there is an indigenous population of approximately 7,012 people (Darkinjung LALC, 2016). Since the creation of the Darkinjung LALC in 1984, the main focus has been improving the lives, health and wellbeing of the community and achieves this through implementing policies and procedures in accordance with the *Aboriginal Land Rights Act 1983.* The implementation of such policies and procedures aim to provide more services to the community and empower the community in social, cultural and financial ways.

During field surveys as part of the Aboriginal heritage assessment (Appendix E), consultation was undertaken with representatives from Darkinjung LALC and Guringai Tribal Link Aboriginal Corporation. Representatives from these parties participated in the field surveys for the assessment and provided comments on reports. These surveys found that part of the proposal study area has archaeological potential (refer to 7.6).

PLACES OF NON-ABORIGINAL HERITAGE AND SIGNIFICANCE

The Wyong Shire LGA has a strong sense of community and commitment to cultural heritage and the community at large. The Wyong Shire LGA has more than 460 community groups, community events and policies such as the Wyong Shire Cultural Plan (2005) and Wyong Shire Heritage Strategy (2014–2017). Each year, Wyong is home to the Central Coast Country Music Festival at The Entrance (attracting 25,000 visitors) and the Gathering of the Clans at Toukley (attracting 15,000 visitors). These events, groups and policies highlight the local importance of culture and heritage within the LGA as a home to festivals.

The Wyong local heritage inventory includes 97 sites and items of heritage significance in the LGA. If recommendations from a review to include additional heritage items on the local heritage inventory are passed, the local heritage inventory could have up to 159 items (Wyong Shire Council, 2014). Items are generally contained within the Wyong Local Environmental Plan (LEP), however, some items are of state significance and can be found within the NSW State Heritage Register. Items contained in the inventory date back as early as the 1800s and are from domestic, community, commercial, industrial and agricultural sectors. These are mainly sites of built environment such as buildings (houses, churches, schools, hotels); infrastructure (buildings, lighthouses) and agricultural silos or maritime heritage. Within the LGA there are two heritage groups of Wyong Historical Society and Brisbane Water Historical Society (Wyong Shire Council, 2005). There is a list of cultural assets for the Wyong Shire LGA which includes various categories of assets such as cultural infrastructure; heritage, organisation and events, cultural diversity, music, theatre, dance, visual arts, craft, photography, adult education centres, cultural professionals, writing, speaking and literature.

The Wyong Shire Council Heritage Strategy 2014–2017 provides a range of actions which ensure that heritage is conserved and appropriately managed. Such actions include: establishing a heritage committee; identifying heritage items; appointing a Heritage Advisor; managing local heritage in a positive manner; establishing a local heritage fund; introducing a Heritage Main Street Program; providing education and promotion; managing places owned and operated by Council and sustainable development. These actions aim to:

→ *'Increase community participation, awareness and appreciation of heritage in the Wyong Shire area.*

- → *Increase knowledge and proactive management of heritage in the Wyong Shire area.*
- → *Assist Council in the conservation and management of heritage items in the Shire.*
- → *Ensure a proactive and positive approach is undertaken to manage heritage in the Shire.*
- → *To encourage owners to undertake conservation and maintenance works and to be involved in heritage related projects such as interpretation and education.*
- → *To encourage Council, owners and the community to actively participate in attractive and well managed heritage main streets.*
- → *Ensure proactive heritage and sustainable development within the Wyong Shire region' (*Wyong Shire Council, 2014).

The Wyong Shire Cultural Plan 2005 was produced after collaborative input between Wyong Shire Council, residents, community groups, art practitioners and government agencies. This Plan provides and immediate and long-term direction for culture and arts within the LGA. Heritage plans within the Plan include:

- → *'Develop Wyong township heritage walking trail*
- → *Develop street naming strategy for Indigenous and European heritage*
- → *Establish exhibition on Indigenous heritage in a library branch*
- → *Establish oral history project with schools/seniors/family history groups*
- → *Conduct a heritage forum to develop a coordinated approach to collecting heritage material*
- → *Develop a heritage driving trail of the Shire*
- → *Establish a walking track at Tacoma incorporating public art on the heritage of the area'* (Wyong Shire Council 2005).

During field surveys as part of the non-Aboriginal heritage assessment (Appendix D) it was found that the proposal area contained no listed items of heritage significance, however, the proposal would impact two unlisted items of heritage significance (refer to 7.6).

5.3 Summary of the community profile

The suburb of Kangy Angy is characterised by an aging population and has a higher percentage of residents in the 65 (and above) age group of 18.3 per cent compared to 14.7 per cent for the state on the whole. This could be attributed in part to Tuggerah Village, adjacent to the Pacific Highway which provides different lifestyle and housing options and is targeted towards those over 50 years of age. Kangy Angy overall has a relatively small population of 316 people. Coupled with Tuggerah Village (with 48 accommodation units (Tuggerah Village, 2016)), this could have an influence on the overall statistics for Kangy Angy.

By comparison the suburb of Fountaindale is characterised by a substantial proportion of the working population employed as professionals. While the unemployment rate within this suburb is higher than the state average, household incomes are noticeably greater than the state average. In addition, all dwelling types comprise separate dwellings and the prevalent household type is family households mainly couple families with children.

Steady population growth of around 1.2 per cent/annum is expected for the Wyong LGA region. Key challenges faced by the region include an unemployment rate higher than the state average, particularly youth unemployment as well as out-commuting from the area for work purposes.

6 PROPOSAL DESCRIPTION

6.1 Workforce requirements

6.1.1 Construction

It is anticipated that approximately 200 construction staff are required throughout the construction period with around 300 construction staff needed during peak times or rail close down periods. Construction is expected to commence with site establishment and early works in the first quarter 2017 and is expected to finish by the third quarter of 2019. Early works and demobilisation works would begin in the last quarter of 2017 and would be completed by the third quarter in 2019.

6.1.2 Operation

Testing, commissioning and the commencement of proposal operation is expected to occur in the third quarter of 2019. It is estimated that the maximum number of employees required for operation of the facility would be 200, with 50 to 60 people on site at any one time.

It is assumed the facility would operate 24 hours a day using three shifts starting at 6 am, 2 pm and 10 pm.

6.1.3 Workforce skills and availability

Construction of the proposal would require people with administrative, cleaning, delivery, management, construction, tradesman or surveyor skills.

The operation workforce is likely to include administrative staff, cleaning staff, delivery crew, maintainers and mobile maintainers, management, signalling staff, sub-contractors and staff employed by sub-contractors, train controllers and train technicians.

6.1.4 Accommodation of the workforce

The proposal is located within the state suburb of Kangy Angy which is located approximately 15 kilometres (18 minutes' drive) from Gosford and 1 hour and 15 minutes (85 kilometres) from Sydney. As the proposal is located within the Wyong Shire LGA and within proximity to the Gosford LGA (with a combined population of more than 300,000 people) is it assumed that the majority of the construction and operation workforce would be local residents or come from within the region. This assumption is supported by the demographic statistics which highlight that the suburb of Fountaindale along with the Wyong LGA and the Central Coast Region have unemployment levels in excess of the state average. Slightly more people within the Wyong LGA and the wider Central Coast region have occupations as Technicians and Trades and Labourers compared to the state.

Given the proximity of the proposal to Gosford, Wyong and Sydney it is expected that local accommodation for the construction and operation workforce would not be required. Short-term accommodation may be required for specialists coming from further afield but this would be covered by accommodation available within the Central Coast area which includes over 50 accommodation options ranging from hotels, motels, hostels, self-contained units and bed and breakfasts (Central Coast Tourism 2016). There are no accommodation facilities within Kangy Angy or Fountaindale, however there are three facilities within Ourimbah, being a motel, valley farm stay and self-contained cottage (VisitNSW 2016). Accommodation providers in Ourimbah, particularly the motel, may benefit from the proposal.

6.2 Transportation

6.2.1 Construction

Construction traffic would comprise heavy vehicles transporting equipment, materials and spoil, as well as light vehicles transporting workers. Light vehicle movements would occur before 7 am and after 6 pm (when employees arrive and depart from the work site) Monday to Friday, before 8 am and after 1 pm on Saturday. Additional light vehicles would arrive and depart during the day as required. No traffic would be generated from the proposal on Sundays or public holidays.

The number of vehicle movements during construction is anticipated as follows (note these numbers are indicative and would be refined as part of the ongoing design of the proposal and preferred construction methodology):

- 400 light vehicles for workers throughout per day (200 in/200 out per day)
- 600 light vehicles for workers at peak periods per day (300 in/300 out per day)
- 1,500 truck movements for concrete over a 12 month period (averaged at 6 per day, 1 per peak hour)
- 2,700 truck movements for imported fill over a 6 month period (averaged at 21 per day, 2 per peak hour)
- 1,900 truck movements for structural steel over a 30 month period (averaged at 3 per day, 1 per peak hour)
- 400 truck movements for concrete pumps over a 30 month period (averaged at 1 per day, 1 per peak hour)
- 6,000 truck movements for steel over a 12 month period (averaged at 23 per day, 2 per peak hour) – potentially transported by rail
- 1,000 truck movements for miscellaneous deliveries over 18 month period (averaged at 3 per day, 1 per peak hour)
- 3,500 truck movements for ballast over 6 month period (averaged at 27 per day, 3 per peak hour) (refer to REF Appendix F).

6.2.2 Operation

Operation of the maintenance facility would include worker vehicles and trucks for the delivery of operating materials and equipment. Three eight hour shifts are likely during normal day to day operations and include 6 am to 2 pm; 2 pm to 10 pm and 10 pm to 6 am. The majority of light vehicle movements would occur in the hour prior to the commencement of shits and the hour following the end of shifts.
Vehicle movements during operation are expected to be:

- 400 light vehicle movements per day for workers
- Up to 50 to 60 light vehicle trips at any one time at change of shift
- 20 light vehicle for office based staff
- 10 light for maintenance, service and delivery
- 10 heavy vehicle movements per day for maintenance, service and delivery
- Once every 10 years, there would be approximately 50 trucks per day to allow for the delivery of large maintenance equipment. This would be a rare occurrence delivery type and would only occur once every 10 years.

6.3 Construction timeframe

The majority of the proposed construction works would be undertaken during the standard construction hours contained in the Interim Construction Noise Guideline (2009) of:

- 7 am to 6 pm Monday to Friday
- 8 am to 1 pm on Saturdays
- No work on Sundays or public holidays, with the exception of works undertaken during rail closedowns.

Exemptions and approval for works outside of the standard construction hours may be required during the following circumstances:

- works required by utility service providers or where impacts to services cannot be reasonably managed
- works requiring rail closedowns (typically night and/or weekends)
- oversized deliveries/unloading of machinery than can only travel between hours specified by the police or the Roads and Maritime Services
- where works can be undertaken so as to be inaudible at the nearest residential receivers
- as otherwise agreed with the Environment Protection Authority (EPA) in the issuing of an environmental protection licence for licensable works
- erection of bridge deck for the new access road
- relocation of HV crossing and connections
- underbores under the rail corridor for elements such as communication and electrical connections
- new turnouts from main line
- installation of over-head wires.

7 BENEFITS AND IMPACTS

The chapter describes the direct and indirect socio-economic benefits and impacts that may arise from constructing and operating the proposed maintenance facility.

7.1 Local amenity, character, environment

The site of the proposed facility lies within a semi-rural suburb (Kangy Angy), which has a total population of 316 people (ABS 20111). Residential receivers on rural properties generally surrounding the site to the north, south and west, with industrial precincts to the south-east and north-east (on the opposite side of the rail corridor to the site). The suburb of Fountaindale, which has a total population of 631 people (ABS 2011), borders the proposed site to the south and south-east. The Sydney–Newcastle railway line forms the boundary between these two suburbs. In addition, properties to the south-west of the proposed site are within the suburb of Ourimbah, which has a population of 4,162 people (ABS 2011).

Land use for areas surrounding the proposal are predominantly rural, with expanding residential areas towards the east and some industrial and commercial land uses. The existing environment includes open farmland, remnant woodland, a rail corridor and an industrial estate. The industrial estate includes large lots with manufacturing factories for Mars Food/Masterfoods Australia and Sanitarium Health Food Company.

A number of residential sensitive receivers are within 200 metres of the rail corridor of the Main Northern Railway line. The closest sensitive receivers who could be adversely impacted by the proposal include the residents of dwellings along Old Chittaway Road and Enterprise Drive who would have direct views of the proposed access bridge and the proposed facility. There are also several sensitive receivers located to the rear of the proposal, along Orchard Road.

The proposal has the potential to impact on the local amenity and character of the local environment of Kangy Angy and Fountaindale through changes to visual amenity, air quality and noise impacts. Each of these values have been assessed separately as separate technical papers to the REF and are summarised in the following sections.

7.1.1 Visual amenity

The Landscape Character and Visual Impact Assessment (Clouston Associates 2016) (REF Appendix C) has identified that the proposal would change the landscape and visual amenity within the area.

The existing landscape in the area comprises open farmland, remnant woodland, rural residential, transport corridors and industrial development. The landscape character assessment identified that the overall impact from the proposal on open farmland or industrial development landscapes would be low. However, the overall impact on remnant woodland would be high, the overall impact to rural residential areas moderate/high and the overall impact to transport corridor landscapes moderate/low (Clouston Associates 2016).

The visual impact assessment (refer REF Appendix C) assessed potential impacts from three public viewpoints (one along Enterprise Drive and two along Turpentine Road) and seven private viewpoints (along Schubolt Lane, Orchard Road and Ourimbah Road). These areas were assessed as having the greatest potential for visual impact. Residences and the industrial estate along Enterprise Drive and Old Chittaway Road, were found to have limited views towards the proposed site due mainly to the presence of remnant vegetation between the Sydney–Newcastle rail line and Enterprise Drive. The most visible element of the Project from Enterprise Drive would be the new elevated access road at up to 14 metre high.

Of the sites assessed, one public viewpoint had a low impact rating, with the other two having a moderate/low impact rating. Three of the seven private viewpoints had a moderate impact rating and the remaining four viewpoints had a moderate/high impact rating (Clouston Associates 2016). The moderate/high impact ratings are associated with properties close to the proposal, namely dwellings located along Ourimbah and Orchard Roads. It was recognised that these properties would have filtered views of the site and visually prominent site elements such as warehouse buildings, light poles and fences (Clouston Associates 2016).

CONSTRUCTION

Construction of the proposal has the potential to adversely affect the local amenity, character and environment of the immediate local area, through land clearing and site works and the construction of industrial elements within a predominantly rural environment.

Visual impacts during the construction phase of the proposal would include views of tall construction cranes, site equipment, storage areas and construction traffic. These impacts are likely to be experienced at those areas identified as having a moderate/high impact rating (refer to above), however these impacts are likely to be temporary in nature. Due to the extent of earthworks and the introduction of equipment such as tall cranes and site equipment, construction of the proposal would generally have larger visual amenity impacts than the operation phase.

OPERATION

Once the proposal is operational, the visual impact is likely to be lessened as management measures to reduce visual impacts (i.e. screening vegetation) are implemented and become established. Landscaping and trees would provide a buffer and barrier to the proposal, minimising visual impacts to surrounding sensitive receivers.

As the proposed maintenance facility may involve a 24 hour, seven day a week operation, lighting would be required onsite. Light spill resulting from the proposal would potentially affect sensitive receivers located along Orchard and Ourimbah Roads. During detailed design, various design elements would be incorporated to ensure that light spill is minimised and complies with Australian Standards for lighting.

7.1.1.1 MANAGEMENT MEASURES

To reduce the impact upon local amenity, character and environment by the proposal it is recommended that the following management measures be implemented:

- Implementation of all mitigation measures proposed in the Landscape Character and Visual Impact Assessment (REF Appendix C), particularly the retention and enhancement of the vegetated buffer that currently surrounds the site.
- Consultation with sensitive receivers and adjacent residents about their concerns and suggestions for reducing the proposals impact, such as type of fencing, screening vegetation etc.
- Ensure that consideration is given to lighting impacts from the proposal and that where possible lighting spill is directed away from surrounding residents.

7.1.2 Air quality

An air quality construction impact assessment for the proposal was prepared by Pacific Environment Limited in March 2016 (REF Appendix I). This assessment reviewed the existing air quality environment and the potential impact as a result from construction activities. The assessment consisted of a desktop review using available information and did not include proposal specific air quality monitoring. The assessment was conducted for the construction impacts of the proposal only and did not account for operational air quality emissions.

CONSTRUCTION

The proposal has the potential to adversely impact air quality through the generation of nuisance dust and visible dust plumes due to dust generating activities and exhaust emissions from diesel-powered equipment. Dust can be generated during demolition, earthworks, construction and track-out stages, particularly at times of high winds. Dust is a common impact arising from construction sites involving earthworks, demolition, vegetation removals, surface compaction, vehicle movement and machinery use. Disturbed and exposed areas including haul roads, embankments and cuttings and stockpiles also have the potential to generate dust during windy conditions.

The Air Quality Report (refer to REF Appendix I) found that the proposal may impact sensitive receivers within the immediate vicinity of the proposed site through occasional dust soiling impacts. This assessment noted that dust emissions from construction activities are difficult to quantify, due to the variability of the weather making it impossible to predict what the weather conditions would be when specific construction activities are undertaken. Any effects of construction on airborne particle concentrations would also generally be temporary and relatively short-lived. Moreover, mitigation would be straightforward, as most of the necessary measures are routinely employed as ‘good practice’ on construction sites.

OPERATION

Operation of the proposal is not likely to generate air quality impacts as upon completion of construction activities as dust generating sources should be removed. The facility would service electric passenger trains only. No diesel trains would be serviced onsite. All trafficable areas would be sealed. The facility would maintain and repair the trains within enclosed or covered areas. A small amount of gaseous emissions would be expected from some of the site equipment, and from the additional vehicle travel for staff during operation of the facility however this increase is unlikely to result in any significant air quality impacts. A small amount of gaseous emissions may also be generated during the actual maintenance works within the site during operation.

7.1.2.1 MANAGEMENT MEASURES

To reduce the impact upon air quality on surrounding residences it is recommended that the following management measures are implemented:

→ implementation of all mitigation measures proposed in the Air Quality Report (REF Appendix I)

→ develop and maintain a mechanism for recording and responding to complaints from the community with respect to air quality impacts on sensitive receptors

→ consult with and inform all sensitive receptors regarding the timing of construction activities and provide advanced notice for particularly dusty activities.

7.1.3 Noise and vibration

The proposal has the potential to create noise impacts to sensitive receivers immediately surrounding the proposed facility during both construction and operation of the proposal. These impacts have been assessed through a separate Noise Impact Assessment (refer to REF Appendix I) and are summarised below.

CONSTRUCTION

The majority of the proposed construction works would be undertaken during the standard construction hours as outlined in the Interim Construction Noise Guideline (2009), refer to section 6.3. However, exemptions and approval for works outside of the above standard construction hours would be required (refer to section 6.3). The noise impact assessment predicts that during construction, noise level exceedances would be experienced at a number of surrounding sensitive receptors, with the two worst activities being associated with bulk earthworks and the laying of tracks (refer to REF Appendix B).

Construction activities would also occur outside of standard hours. These activities, both within and outside of the standard construction hours would impact sensitive receivers along Orchard, Ourimbah, Turpentine and Old Chittaway Roads, Schubolt Lane and Bridge Street. Impacts to the closest sensitive receivers of Orchard, Ourimbah, Turpentine and Old Chittaway Roads would include possible sleep disturbance and exceedance of L_{eq} and L_{max} levels. Night works and noisy construction activities (such as bulk earthworks and track laying) would have the greatest impact and has the potential to disturb sleep of surrounding receivers. The noise impact assessment concluded that the Central Coast Ruldolf Steiner School would not be impacted be impacted by construction noise from the facility, however, Follyfoot Farm Childcare Learning Centre would be impacted when construction activities occur close to the centre.

Cumulative noise impacts are likely to occur as a result of construction activities combining with existing noise from the railway line. It is likely that there would be an increase in the frequency of sleep disturbing events as a result of the proposal, to the nearest sensitive receivers (of Orchard, Ourimbah, Turpentine and Old Chittaway Roads) (refer to REF Appendix B).

There is a minimal risk of damage, as a result of vibration caused by construction of the proposal.

OPERATION

Operational noise of the proposal would include noise associated with the maintenance facility, and would affect sensitive receivers at Orchard, Ourimbah, Turpentine and Old Chittaway Roads. Standing, arrival and departure of trains and the train wash facility are expected to generate the most noise and have the largest impact to sensitive receivers during operation of the proposal.

Exceedance of sleep disturbance criteria is predicted to occur at sensitive receivers located at Ourimbah Road and Old Chittaway Road, however, mitigation measures have been proposed to manage these impacts (refer to REF Appendix B).

As the proposal is classified as an industrial noise source, the noise monitoring criteria were adjusted to account for cumulative effects during assessment. Cumulative impacts are not expected during operation with the implementation of mitigation measures described in REF Appendix B.

There is a minimal risk of cosmetic damage as a result of vibration caused by operation of the proposal.

7.1.3.1 MANAGEMENT MEASURES

To reduce the impact upon noise and vibration by the proposal it is recommended that the following management measures are implemented:

- consult with and inform all sensitive receptors regarding the timing of construction activities and provide advanced notice for particularly noisy activities or night works
- develop and maintain a complaints register to monitor noise and vibration impacts on sensitive receivers
- ensure all mitigation measures proposed in REF Appendix B are implemented.

7.2 Property value

The impact of the proposal on property values was raised as a concern by a number of property owners in the immediate vicinity of the proposal site. While all of the land required for development of the proposal is currently being acquired, landowners are concerned that the construction and operation of the facility would have an adverse impact on the value of properties in the immediate vicinity. In particular, the suburb of Fountaindale is a highly sought after locality with property prices averaging around $800,000. Average prices for properties within the suburb of Kangy Angy are in the order of $660,500. Ensuring that the design of the facility is as sensitive as possible to the amenity of the surrounding landscape, particularly through the retention and enhancement of vegetative screening of the facility from surrounding residents. This would assist with minimising potential adverse impacts on property values.

7.2.1.1 MANAGEMENT MEASURES

To reduce the impact upon property values created by the proposal the following management measures are recommended:

- ensure that the design of the facility is as sensitive as possible to the amenity of the surrounding landscape, particularly through the retention and enhancement of vegetative screening of the facility from surrounding residents
- implementation of all measures outlined in section 7.1.1 to ensure that local and visual amenity impacts are minimised.

7.3 Access and traffic

The road network around the proposal includes: Enterprise Drive (regional road); Old Chittaway Road (East), Turpentine Road, Ourimbah Road, Orchard Road and Burns Road (local roads) and Pacific Highway (SH10) (State road). The main access route to the site would be the new rail overbridge to be constructed as part of the project. Two other existing intersections may be used infrequently as an access route to the proposal site include Turpentine Road/Enterprise Drive and Burns Road and Chittaway Road (WSP | Parsons Brinckerhoff, 2016).

Bus services currently operate along Enterprise Drive and the Pacific Highway. The nearest railway station for passenger services is located at Ourimbah (south) and Tuggerah (north). On-road bicycle facilities are provided along both sides of Enterprise Drive between 50 metres south of Old Chittaway Road (south) and Wyong Road (further north of the study area) within between 1.0 and 1.5 metres sealed shoulders. There are no formalised pedestrian paths adjacent to the preferred proposal site.

Enterprise Drive is located adjacent to Follyfoot Farm Child Care Learning Centre. Access to the Central Coast Rudolf Steiner School may also come off Enterprise Drive or Old Chittaway Road before travelling onto Catamaran Road of Station Road East into the school grounds. It is expected that privately own vehicles for school transport would use these roads as there are no dedicated bus routes to the Central Coast Rudolf Steiner School (Transport Buses, 2016).

CONSTRUCTION

Construction traffic would comprise heavy vehicles transporting equipment, materials and spoil, as well as light vehicles transporting workers. Light motor vehicles would be limited to the number of workers anticipated on the site. This has been estimated at approximately 200 construction staff throughout the construction period with around 300 construction staff during peak times/during rail close down periods. During a typical working day it is assumed that all these light vehicle movements would occur in a 60 minute period prior to 7 am (when employees arrive at work) and after 5 pm (when employees depart from work). Additional light vehicles would arrive and depart during the day as required. During rail closedown periods the arrival and departure of construction staff is anticipated to occur late at night and early in the morning. It is further expected that up to 6 heavy vehicles per hour on average could be arriving and departing from the site. These vehicles would be delivering construction materials and equipment (AECOM 2016).

The main transportation route to the site is the M1 Pacific Motorway which is located less than 1 kilometre to the west of the site, with the local road network encompassing Enterprise Drive, Old Chittaway Road (East), Old Chittaway Road (West), Turpentine Road, Orchard Road and Burns Road (WSP | Parsons Brinckerhoff 2016). Heavy vehicle access to the site during construction would be via the following routes:

- From the M1 Pacific Motorway:
  - Exit at the Ourimbah Interchange
  - Pacific Highway
  - Chittaway Road

  - Enterprise Drive
  - Site Access Road.
- From the Pacific Highway:
  - Chittaway Road
  - Enterprise Drive
  - Site Access Road.
- From Enterprise Drive:
  - Enterprise Drive
  - Site Access Road.

The majority of the traffic accessing the site during construction would be directed to use the new access road as the primary access. The occasional light vehicle may need to use Turpentine Road and Orchard Road via the Enterprise Drive and Turpentine Road intersection (as a secondary access) however this would be limited to light vehicles. There is also likely to be some form of traffic crossing on Orchard Road and Turpentine Road between the main facility and the western end of the facility.

Anticipated trip generation by vehicle type during construction are summarised in Table 7.1.

Table 7.1 Trip generation (one-way) during construction

STAGE	DAILY (ONE-WAY)		MORNING PEAK[1] (ONE WAY)		AFTERNOON PEAK[2] (ONE WAY)	
	Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle
Construction – Standard	200	84	50	11	50	11
Construction – During Possessions	300	84	75	11	75	11

Note 1 *The weekday AM background traffic peak occurs between 7.45 am and 8.45 am. This does not coincide with the Projects peak in the AM. For the purposes of this assessment it has been assumed that 25% of the Projects construction traffic and 100% of the general office based operational traffic (0% shift based operational traffic) will coincide with the background traffic AM peak.*

Note 2 *The weekday PM background traffic peak occurs between 4.45 pm and 5.45 pm. This does not coincide with the Projects peak in the PM. For the purposes of this assessment it has been assumed that 25% of the Projects construction traffic and 100% of the general office based operational traffic (0% shift based operational traffic) will coincide with the background traffic PM peak.*

With the new access road and intersection from Enterprise Drive to facilitate the movement of large vehicles to the site, and the Pacific Motorway being a major transport network it is unlikely that the proposal would create any adverse impacts to access and traffic routes during construction of the proposal. The proposal would have no anticipated impacts to public transport services (with the exception of the scheduled possessions for the Main North railway), pedestrians or cyclists during construction.

Given the proximity of the site to the Follyfoot Farm Childcare Learning Centre and Central Coast Rudolf Steiner School to the site care should be taken with the movement of large vehicles to the site particularly prior to the construction of the new access road and bridge.

OPERATION

Operational traffic would generally comprise light vehicles transporting workers with the occasional heavy vehicle movements. The operation workforce is expected to comprise around 200 employees, with 50 to 60 employees on site at any one time. It is expected that the facility would operate with three shifts (6 am, 2 pm and 10 pm) and therefore the majority of traffic movements would occur within the hour prior to the commencement of shifts and the hour after shifts finalise.

Based on the above, Table 7.2 provides a summary of the anticipated trip generation by vehicle type during construction for daily and peak hourly movements.

Table 7.2 Trip generation (one-way) during operation

STAGE	DAILY (ONE-WAY)		MORNING PEAK (ONE WAY)		AFTERNOON PEAK (ONE WAY)	
	Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle	Light vehicle	Heavy vehicle
Operation – Standard [1]	220	10	11	1	11	1

Note 1 This assumes three working shifts across a day where all staff vehicle movements occur outside of peak hour times. The only exception is general office based staff who are likely to work a standard day (9.00 am to 5.00 pm). Office based staff have been included as light vehicle trips for both the AM and PM peaks.

As all of these traffic movements would occur via the new access road and bridge, vehicles would not be directly passing sensitive receptors and therefore traffic impacts during operation should be minimal. Parking for staff, visitors and heavy vehicles and circulation roadways would be provided onsite. Adequate facilities would be provided onsite for loading and/or unloading.

The provision of the new access road and flood free access from Ourimbah Road would also provide improved access for local residents during flooding, or other emergencies where the existing access via Turpentine Road is affected.

7.3.1.1 MANAGEMENT MEASURES

To reduce access and traffic impacts created by the proposal, measures proposed in Appendix F would be implemented, including development of a traffic management plan which would:

- minimise disruption on the local road network by using nominated haulage routes, which aim to avoid sensitive areas such as schools, where possible (particularly the Central Coast Rudolf Steiner School and Follyfoot Farm Child Care Learning Centre)
- separate and/or control construction traffic by limiting vehicle speed
- ensure construction traffic enters the site via access road and bridge to limit impacts on sensitive receivers and local residents.

7.4 Community services and infrastructure

It is expected that there would be limited changes to local services as a result of the proposal. The majority of the workforce for the construction and operation of the proposal are expected to come from the region and therefore limited numbers of people are expected to move into the area. The number of workers who choose to relocate are not considered to be significant and therefore not enough to alter the demand for services within the area.

Development of the proposal would provide a high standard of maintenance facility which would improve rail transportation for commuters within the wider regional area. This is a direct benefit of the proposal.

Rail closedowns would occur during construction and operation of the proposal. A rail closedown refers to a period of time where part of the rail network is temporarily shut down in order to facilitate maintenance, construction or emergency works in a safe manner when trains are not operating. During these periods rail services and access to train services would be suspended and replacement buses would operate (AECOM, 2016). Rail closedowns are normally conducted when patronage is lower such as weekends or holiday periods to minimise impact and are scheduled throughout the Sydney Trains network throughout the year.

7.4.1.1 MANAGEMENT MEASURES

To reduce impacts created by the proposal to local community services and infrastructure, customers would be notified in advance of any rail closedown periods as part of these scheduled periods (managed by Sydney Trains).

7.5 Cultural values

Heritage assessments Aboriginal and non-Aboriginal heritage were conducted by Artefact Heritage in March 2016 (refer REF Appendices D and E). The assessments included field surveys and desktop studies. During the Aboriginal heritage assessment, consultation was undertaken with representatives from Darkinjung LALC and Guringai Tribal Link Aboriginal Corporation. Representatives from these parties also participated in the field surveys for the assessment and provided comments on reports.

7.5.1 Aboriginal heritage

The proposal site is within the boundary of the Darkinjung Local Aboriginal Land Council (LALC).

No registered sites were located within the immediate proposal site boundary. However artefacts (19 sites), grinding grooves (nine sites) and art sites (five sites) and single instances of the following items – a modified tree; shell site; stone quarry site; and a water hole, were identified from the wider area. High archaeological potential was identified across most of the wider study area, corresponding with locations that appeared to have been subject to relatively low levels of historical ground disturbance. The proposal site itself was assessed as having moderate archaeological potential.

CONSTRUCTION

The proposed works within the railway corridor are unlikely to result in harm to Aboriginal objects as this part of the study area has been assessed as having low archaeological potential.

The remainder of the proposal project site has been assessed as having moderate archaeological potential. The proposed works within this part of the proposal site could result in harm to Aboriginal objects (if confirmed to be present), as excavation may involve removal of archaeological deposits that may be present. However, the depth of the soil profile varies across the site, and it may not be necessary to excavate across the whole of the footprint. It is therefore possible that the proposed works may not result in complete removal of any archaeological deposit.

An Aboriginal cultural heritage assessment report (ACHAR) would be completed for the remainder of the proposal site, and would include Aboriginal community consultation and archaeological test excavation (Refer to REF Appendix E).If the results of the ACHAR confirm that Aboriginal objects are present and would be harmed by the proposed development, it would be necessary to apply for an Aboriginal Heritage Impact Permit (AHIP) prior to commencement of works.

OPERATION

There would not be expected to be any impacts to Aboriginal heritage generated by the operation of the facility. Work at the site would take place within the facility and the rail corridor and would not be expected to disturb other Aboriginal heritage sites.

7.5.2 Non-Aboriginal heritage

The Non-Aboriginal heritage assessment found that there were no listed heritage items occurring within or close to the study area, and that listed heritage items would not be impacted by the proposal. However, four unlisted heritage items were identified within the proposal study area, with two being assessed as having heritage significance. These two items were the Main Northern Railway and Turpentine Road/Chittaway Creek underpass (state heritage significance) and Old Chittaway Road (local heritage significance). Both of these heritage items may be impacted by the proposal.

No other cultural issues are expected to result from the construction or operation of the proposal.

CONSTRUCTION

The proposal would impact two non-listed items of heritage significance, being the Turpentine Road/ Chittaway Creek underpass and Old Chittaway Road. Impacts from the proposal to the Turpentine Road/ Chittaway Creek underpass would result from replacement works. These impacts are considered to be minor in nature. Impacts to Old Chittaway Road would result from realignment works, and are considered minor. As these heritage items are not-listed, they are not protected under statutory requirements. In addition, these items do no comprise archaeological relics. However, based upon the significance of these items, management measures to conserve these items, where possible have been recommended (refer to 7.5.3 below).

OPERATION

Operation of the proposal is not likely to cause impacts or affect cultural values associated with non-Aboriginal heritage.

7.5.2.1 MANAGEMENT MEASURES

To reduce the impact upon cultural issues by the proposal it is recommended that the following management measures are implemented:

- ensure all mitigation measures proposed in the Appendix D are implemented
- ensure all mitigation measures proposed in Appendix E are implemented.

7.6 Health and wellbeing

CONSTRUCTION

The construction of the proposal is likely to cause impacts to noise and vibration, air quality and visual amenity. These impacts have the potential to cause stress and anxiety to local residents, which in turn could potentially impact on their health and wellbeing.

In addition, it is likely that parents and caregivers from children attending the Follyfoot Farm Child Care Learning Centre in Fountaindale would be concerned about excessive noise, dust and air emissions potentially affecting their child’s health. Mitigation measures have been proposed to ensure noise and air quality impacts are minimised at sensitive receptors (refer to REF Appendices B and I).

OPERATION

The operation of the proposal is likely to cause impacts to local amenity as described in section 7.1. These impacts have the potential to cause stress and anxiety to local residents who are opposed to the development, which in turn could potentially impact on their health and wellbeing.

7.6.1 Management Measures

To reduce the impact upon health and wellbeing by the proposal it is recommended that the following management measures are implemented:

- measures to ensure that local and visual amenity impacts are minimised
- measures to ensure that air quality impacts are minimised
- measures to ensure that noise and vibration impacts are minimised.

7.7 Business and employment

The development of the proposal would provide employment at the proposal site. It is assumed that the majority of these jobs would be filled from workers within the region. This would have a positive impact on the local and regional economy. The suburb of Fountaindale along with the Wyong LGA and the Central Coast Region have unemployment levels in excess of the state average (though it is worth noting that within Fountaindale this high level of unemployment may be due to one member of family households choosing not to undertake paid employment). Slightly more people within the Wyong LGA and the Central Coast Region have occupations as Technicians and Trades and Labours compared to the state. These statistics suggests that there would be opportunities for the proposal implement measures to maximise local employment opportunities. In addition, the main challenges faced by the Wyong LGA is high youth unemployment and high proportion of out commuting for work purposes.

Additionally, the proposal would ensure that state revenue created by public use of passenger trains is maintained or potentially enhanced through improved services.

Overall, the economic impact on the local, regional and state economies is expected to be positive.

CONSTRUCTION

Construction of the proposal would generate approximately 200 jobs, with a maximum of 300 employees required during the peak construction phase. 50 to 60 people working on site at any one time.

Construction employment opportunities may include, but are not limited to the following positions:

- administrative staff
- cleaning staff
- delivery crew
- management
- sub-contractors and staff employed by sub-contractors.

In addition, local businesses, particularly those catering to food and petrol and to a lesser extent accommodation could experience flow-on benefits from the increase in the number of workers coming into the locality on a daily basis.

OPERATION

Operation of the proposal would generation a maximum of 200 new jobs. There would be approximately 50 to 60 people on duty at any one time during the operational phase and it is expected that there would be three shifts per day, beginning at 6 am, 2 pm and 10 pm. These times and shift lengths are subject to change.

Construction employment opportunities may include, but are not limited to the following positions:

- administrative staff
- cleaning staff
- delivery crew
- maintainers and mobile maintainers
- management
- signalling staff
- sub-contractors and staff employed by sub-contractors
- train controllers
- train technicians.

7.7.1 Management measures

The proposal is likely to have a positive benefit on employment and business within the local and regional area. To enhance this benefit, it is recommended that the following management measures are implemented:

- Where possible Transport for NSW would ensure that employment opportunities for the local and regional population are maximised to ensure that the greatest benefit from the proposal flows to the immediate region
- Where possible Transport for NSW would look to target those sectors where unemployment is greatest, and maximise opportunities (through training opportunities) for youths and indigenous members of the community.

7.8 Safety and security

CONSTRUCTION

The main risk to public safety during construction of the proposal is the use of heavy machinery (e.g. bull-dozers, excavators), however, heavy machinery and equipment would be contained within the construction work site and is not likely to impact or pose a risk to the public under normal circumstances.

Overall, the proposal is unlikely to have a negative impact on safety and security.

OPERATION

It is unlikely that public safety would be adversely affected by the proposal. However, if unauthorised persons enter the site, the risk is high due to the possible conflict with trains and contact with overhead wires, however the risk of this is unlikely to be any greater than that which already exists with the presence of the existing Sydney to Newcastle rail line.

7.8.1 Management Measures

The proposal would adopt best practice safety practices and processes and compliance with a Workplace Health and Safety Management Plan and would be designed, constructed, and operated in accordance with the relevant safety standards and documents. The site would be fenced and secured at all times during construction and operation.

The following management measures to reduce the impact upon safety and security by the proposal are recommended to be implemented:

- fence off all construction areas and provide fencing and barriers to restrict access to public and restricted areas
- provide designs which clearly delineate public areas from restricted areas
- maintain clear sightlines throughout substations and stabling yards
- provide lighting design which conforms to Australian and RailCorp standards and provides well-lit and uniform lighting to maintenance facility, substation and stabling yard areas that promote passive and active surveillance
- keep vegetation in and around the sites well maintained and to a low height
- consider vandal resistant fittings and graffiti resistant surfaces as part of the detailed design
- provide security signage
- provide high security perimeter fencing to deter unauthorised access and to provide an effective barrier
- provide suitable vehicle and pedestrian gates at appropriate locations around the perimeter of the sites
- provide high security locking devices, window treatments such as security bars and grilles, and well-constructed doors, door frames and door hardware
- provide electronic access control to control access from public to restricted areas, and to provide an auditing function
- provide an intruder alarm system to monitor nominated restricted areas during nonoperational hours
- provide closed-circuit television (CCTV) to provide deterrence, surveillance and incidence capturing capabilities
- connect electronic security systems to the NSW trains wide area network to allow remote monitoring and response coordination
- provide personal duress alarms to staff that operate in high risk areas
- install help point systems to allow the public to call for assistance during emergency situations
- external lighting would be provided to vehicular and pedestrian movement areas, including roads, paths and car parks, in order to provide visibility and safety at night.

7.9 Summary

A summary of the socio-economic benefits and impacts associated with the proposed maintenance facility are summarised in Table 7.3 below.

Table 7.3 Summary of benefits and impacts associated with the proposed maintenance facility

ISSUE	POTENTIAL IMPACT	NATURE OF IMPACT	MANAGEMENT MEASURES
Local and visual amenity, character and environment	Yes Reduced visual amenity within the area which could change the character and environment of the suburb or Kangy Angy, in particular. Construction activities are anticipated to create nuisance noise and vibration impacts within the immediate area. Noise and vibration impacts may also be generated from cleaning and maintenance activities during the operation of the proposal. Air quality impacts are is expected to be reduced during construction of the proposal as a result of nuisance dust from construction activities. Air quality impacts are likely to be felt in the immediate area but are likely to be temporary in nature and primarily associated with dust generating construction activities.	Negative	Implementation of all mitigation measures proposed in the Landscape Character and Visual Impact Assessment (REF Appendix C), particularly the retention and enhancement of the vegetated buffer that currently surrounds the site. Consultation with sensitive receivers and adjacent residents about their concerns and suggestions for reducing the proposals impact, such as type of fencing, screening vegetation etc. Ensure that consideration is given to lighting impacts from the proposal and that where possible lighting spill is directed away from surrounding residents. Implementation of all mitigation measures proposed in the Air Quality Report (REF Appendix I). Develop and maintain a mechanism for recording and responding to complaints from the community with respect to air quality impacts on sensitive receptors. Consult with and inform all sensitive receptors regarding the timing of construction activities and provide advanced notice for particularly dusty activities. Consult with and inform all sensitive receptors regarding the timing of construction activities and provide advanced notice for particularly noisy activities or night works. Develop and maintain a complaints register to monitor noise and vibration impacts on sensitive receivers. Ensure all mitigation measures proposed in the Noise Impact Assessment (REF Appendix B) are implemented.
Property value	Yes The proposed development has the potential to cause property values to decline in the area immediately surrounding the proposal site due to reduced visual amenity, character and environment of the area.	Negative	Implementation of all measures outlined in section 7.1.1 to ensure that local and visual amenity impacts are minimised.
Access and traffic	Neutral Provided the recommended site access road and upgrades to road infrastructure as recommended in the Transport and Traffic Assessment (WSP | Parsons Brinckerhoff, 2016) are implemented, the effect of the proposal on access and traffic is expected to be neutral. However, if the	Negative	To reduce access and traffic impacts created by the proposal, measures proposed in Appendix F would be implemented, including development of a traffic management plan which would: → Minimise disruption on the local road network by using nominated haulage routes, which aim to avoid sensitive areas such as schools, where possible (particularly the Central Coast Rudolf Steiner School and Follyfoot Farm Child Care Learning Centre).

ISSUE	POTENTIAL IMPACT	NATURE OF IMPACT	MANAGEMENT MEASURES
	upgrades are not made, the proposal would negatively affect traffic and access within the immediate area.		→ Separate and/or control construction traffic by limiting vehicle speed. → Ensure construction traffic enters the site via access road and bridge to limit impacts on sensitive receivers and local residents.
Local community services and infrastructure	Neutral Changes to community services and infrastructure as a result of the proposal are likely to be limited. The proposal would provide a high standard of maintenance facility which would improve rail transportation within the region area. This is a direct benefit resulting from the proposal.	Positive	Ensure rail closedowns are scheduled when patronage is lower. Notify customers in advance of rail closedown periods.
Cultural issues	Yes The proposal is expected to have a neutral impact on cultural issues, however a positive impact as a result of the proposal could result if the local Indigenous population could be involved with conserving and preserving heritage values within the study area.	Neutral	Ensure all mitigation measures proposed in the Appendix D are implemented. Ensure all mitigation measures proposed in Appendix E are implemented.
Health and wellbeing	Yes There is potential for residents within the immediate area to experience negative health and well-being impacts as a result of stress and anxiety created by the proposed development as well as from dust created by construction activities.	Negative	Implement measures to ensure that local and visual amenity impacts are minimised. Implement measures to ensure that air quality impacts are minimised. Implement measures to ensure that noise and vibration impacts are minimised.
Business and employment	Yes The proposal would benefit the local and particularly the regional area as a result of business and employment as the proposal would have significant job creation impacts, with up to 200 new jobs created during construction and a further 200 by the operational phase of the maintenance facility.	Positive	Where possible Transport for NSW would ensure that employment opportunities for the local and regional population are maximised to ensure that the greatest benefit from the proposal flows to the immediate region. Where possible Transport for NSW would look to target those sectors where unemployment is greatest, and maximise opportunities (through training opportunities) for youths and indigenous members of the community.
Safety and security	Neutral The proposal is likely to have a neutral impact on safety and security as the main risk associated with the proposal, to	Neutral	Adopt best practices and processes and compliance with a Workplace Health and Safety Management Plan which is in accordance with safety standards and documents outlined in section 7.8.3.

ISSUE	POTENTIAL IMPACT	NATURE OF IMPACT	MANAGEMENT MEASURES
	the public is from heavy machinery, however this would be contained within the construction work site and it not likely to impact or pose a risk to the public.		Fence off all construction areas and provide fencing and barriers to restrict access to public and restricted areas. Provide designs which clearly delineate public areas from restricted areas. Maintain clear sightlines throughout substations and stabling yards. Provide lighting design which conforms to Australian and RailCorp standards and provides well-lit and uniform lighting to maintenance facility, substation and stabling yard areas that promote passive and active surveillance. Keep vegetation in and around the sites well maintained and to a low height. Provide vandal resistant fittings and graffiti resistant surfaces. Provide security signage. Provide high security perimeter fencing to deter unauthorised access and to provide an effective barrier. Provide suitable vehicle and pedestrian gates at appropriate locations around the perimeter of the sites. Provide high security locking devices, window treatments such as security bars and grilles, and well-constructed doors, door frames and door hardware. Provide electronic access control to control access from public to restricted areas, and to provide an auditing function. Provide an intruder alarm system to monitor nominated restricted areas during nonoperational hours. Provide closed-circuit television (CCTV) to provide deterrence, surveillance and incidence capturing capabilities. Connect electronic security systems to the NSW trains wide area network to allow remote monitoring and response coordination. Provide personal duress alarms to staff that operate in high risk areas. Install help point systems to allow the public to call for assistance during emergency situations. External lighting would be provided to vehicular and pedestrian movement areas, including roads, paths and car parks, in order to provide visibility and safety at night.

8 CONCLUSIONS

The site of the proposed facility lies within a semi-rural suburb (Kangy Angy), within the Wyong Shire local government area. The suburb of Fountaindale borders the proposed site to the south and south-east. The Sydney–Newcastle railway line forms the boundary between these two suburbs. In addition, properties to the south-west of the proposed site are within the suburb of Ourimbah.

Land use for areas surrounding the proposal are predominantly rural, with expanding residential areas towards the east and some industrial and commercial land uses. The existing environment includes open farmland, remnant woodland, a rail corridor and an industrial estate. The industrial estate includes large lots with manufacturing factories for Mars Food/Masterfoods Australia and Sanitarium Health Food Company.

A number of residential sensitive receivers are within 200 metres of the rail corridor of the Sydney–Newcastle railway line. The closest sensitive receivers who could be adversely impacted by the proposal include the residents of dwellings along Old Chittaway Road and Enterprise Drive who would have direct views of the proposed access bridge and the proposed facility as well as several sensitive receivers located to the rear of the proposal, along Orchard Road.

The suburb of Kangy Angy is characterised by an aging population. This could be attributed in part to Tuggerah Village adjacent to the Pacific Highway which provides different lifestyle options and is targeted towards those over 50 years of age. In addition, Kangy Angy has a smaller percentage of people who have been technically educated, low unemployment levels, lower household incomes and a higher percentage of lone person households.

By comparison the suburb of Fountaindale is characterised by a substantial proportion of the working population employed as professionals, most likely associated with the teaching profession. While the unemployment rate within this suburb is higher than the state average, household incomes are noticeably greater than the state average. In addition, all dwelling types comprise separate dwellings and the prevalent household type is family households mainly couple families with children. These characteristics suggest that the suburb of Fountaindale is relative affluent. The higher level of unemployment could potentially be attributed to families choosing to have one member not undertake paid employment.

The proposal is likely to generate a range of positive, neutral and negative impacts to the immediate/local and regional communities. The majority of negative impacts would be experienced by sensitive receptors in the local area close to the proposed facility. Conversely, the majority of the benefits would be experienced by the region, where economic benefits as a result of increased employment opportunities and associated flow-on effects are more likely to be felt.

The most significant impacts on the immediate area are:

- Changes to the visual amenity and character of the area as a result of the introduction of an industrial element into a predominantly rural landscape and the potential this may generate to negatively influence property prices within the area
- Air quality impacts, particularly the generation of dust during construction activities
- Noise impacts to surrounding sensitive receptors including the Follyfoot Farm Child Care Learning Centre during both construction and operation.

On the positive side, the proposal would benefit the regional area by providing employment through up to 200 jobs during construction and a further 200 jobs by the operational phase of the maintenance facility. Key challenges faced by the Wyong LGA include youth unemployment as. Therefore the proposal could benefit the region by directly addressing these key challenges. The proposal would also facilitate flow on benefits to local business particularly those associated with food and petrol and potentially accommodation as a result of the workers coming in to the local area.

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Appendix H

SURFACE WATER IMPACT ASSESSMENT

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MEMO

TO: Jarryd Barton

FROM: Sean McMahon

SUBJECT: **InterCity Maintenance Facility REF – Flooding, drainage and water quality technical assessment**

OUR REF: 2202522A-MEM-ENV-003-RevB

DATE: **22 April 2016**

1. INTRODUCTION

WSP | Parsons Brinckerhoff was engaged by Transport for NSW to undertake a flooding, drainage and water quality assessment of the New InterCity Maintenance Facility for the purpose of the Review of Environmental Factors (REF). The intent of the assessment is to provide a summary of the surface water environment and impacts that the proposed facility would have and identify potential mitigation measures to reduce the impacts. The Flooding, Drainage and Water Quality Assessment will form a section of the REF.

The proposed facility is located adjacent to the Main North railway line near Kangy Angy and is located on the Ourimbah floodplain within the Tuggerah Lake Catchment. The wider catchment is Lake Macquarie and Tuggerah Lakes Catchment.

Existing flood mapping shows that the majority of the maintenance facility site is located on an area of high ground that is not impacted by the 1:100 Annual Exceedance Probability (AEP) event from Ourimbah Creek and its tributaries. However, the connecting infrastructure, including access roads and sidings from the mainline will likely impact the floodplain and local drainage processes south-west and north east of the proposed facility. Particularly at Chittaway Creek rail over road crossing along Turpentine Road which is frequently flood affected from events less than the 20 per cent AEP event.

The catchment of Tuggerah Lake is susceptible to pollution, as the lake is a popular with recreational water activities, so development within its catchment must ensure there is negligible impact to water quality within the Lake.

1.1 Previous studies and reports

A desktop review of previous studies was undertaken to inform this assessment:

- New Intercity Fleet Maintenance Facility Draft Pre-Concept Report, AECOM 2016.
- Ourimbah Creek Catchment Flood Study, Catchment Simulation Solutions, October 2013.
- Water and Catchment Management, State of Environment Report, Wyong Council, 2003–2004 (Chapter 5).
- Draft Constructability Report, AECOM 2016.
- Practical Consideration of Climate Change in Floodplain Risk Management, Department of Environment and Climate Change (DECC), 2007.

2. EXISTING SURFACE WATER ENVIRONMENT

2.1 Regional flooding

The proposed maintenance facility is bounded by Ourimbah Creek and its flood plains to the north and east, Bangalow Creek and Chittaway Creek in the west and the Main North railway in the south. The topography typically falls south to north from the Main Northern Rail line into the Ourimbah Creek catchment which is part of the larger Tuggerah Lake catchment. Flows from Ourimbah Creek originate from Kulnura and flow through the State forest and rural bushland before passing beneath the Sydney–Newcastle M1 Pacific Motorway and Pacific Highway near Palmdale. It continues to flow in a northern and then easterly direction before passing beneath the Main Northern Railway Line and Wyong Road and eventually discharging into Tuggerah Lake at Chittaway Point (Ourimbah Creek Catchment Flood Study, 2013).

The Ourimbah Creek catchment also incorporates a number of substantial tributaries including Bangalow Creek, Cut Rock Creek, Chittaway Creek, Dog Trap Gully, Canada Drop Down Creek and Kangy Angy Creek. Typically the upper reaches of these catchments are covered by natural bushland, while the lower reaches comprise of low density urbanised areas.

The existing railway tracks adjacent to the proposed facility crosses over a number of existing drainage systems. Most critically the Turpentine Road railway underpass at Chittaway Creek (chainage 93.960 kilometres) which derives its headwaters from rural bush land along Brush Road and drains through Fountaindale. It then flows in a northerly direction beneath Old Chittaway Drive and then west beneath Enterprise Drive and the Main Northern Railway line before entering Bangalow Creek which then drains to its confluence with Ourimbah Creek.

Ourimbah Creek catchment is within the Lake Macquarie and Tuggerah Lakes Catchment. The River flow objectives as identified in the NSW Government River Flow Objectives, NSW OEH, 2006 for this catchment for uncontrolled streams are:

- Protect pools in dry times.
- Protect natural low flows.
- Protect important rises in water levels.
- Maintain wetland and floodplain inundation.
- Maintain natural flow variability.
- Manage groundwater for ecosystems.
- Minimise effects of weirs and other structures.

A number of flood studies have been carried out for Ourimbah Creek for Wyong and Gosford Councils, including the Lower Ourimbah Creek Floodplain Risk Management Study Review and Plan (Paterson Consultants, 2011) and more recently the Ourimbah Creek Catchment Flood Study (Catchment Simulation Solutions 2013).

According to the Ourimbah Creek Catchment Flood Study report, Chittaway Creek floods frequently at the Turpentine Road railway underpass and cuts access for local residence in minor storms events (less than the 20 per cent AEP event).

2.2 Local drainage

There are a number of existing drainage culverts under the Main North Line Rail Line which may be impacted by the proposed facility. The actually impacted structures will be assessed at a future design phase once all the existing local drainage systems have been identified. According to the New Intercity Fleet Maintenance Facility Draft Pre-Concept Report (AECOM, 2016) the following culverts in Table 2.1, are currently known or represent indicative cross drainage locations.

Table 2.1 Existing drainage culvert locations

MAIN NORTH LINE RAIL CHAINAGE LOCATION	DESCRIPTION
93.135 km	Major culvert connecting from Enterprise Drive, size unknown.
93.960 km to 93.980 km	Chittaway Creek
94.240 km	Minor pipe crossing for unnamed intermittent watercourse, 0.6 diameter pipe.
94.858 km	Pipe crossing opposite Lot 40, size unknown.
95.208 km	Possible pipe crossing opposite Lot 35, size unknown
95.435 km	Pipe crossing opposite north end of Lot 300, size unknown.

Further drainage culvert crossings may exist. The sizes of all existing drainage systems will be confirmed by detailed survey during further detailed design.

2.3 Water quality

2.3.1 Existing water quality

The site is located on the Ourimbah Creek catchment and is part of the larger Lake Macquarie and Tuggerah Lake catchment. The Water Quality Objectives as identified in NSW Government Water Quality Objectives, NSW OEH, 2006 for this catchment for uncontrolled streams are:

- Aquatic ecosystems
- Visual amenity
- Secondary contact recreation
- Primary contact recreation
- Livestock water supply
- Irrigation water supply
- Homestead water supply
- Drinking water at point of supply – Disinfection only
- Drinking water at point of supply – Groundwater
- Aquatic foods (cooked).

Wyong Council State of Environment Report (2003–2004) found that Ourimbah Creek and Wyong River total nitrogen and ammonia levels regularly exceed ANZECC guidelines. This may reflect the influence of farming fertilisers and animal waste. Turbidity was variable but usually below 20 NTU (Wyong Council, 2004).

Wyong Council State of Environment Report (2003–2004) found that Ourimbah Creek was unsuitable for recreational swimming because of high faecal coliforms and enterococci levels that exceeded ANZECC guidelines for recreational swimming.

Ourimbah Creek is under stress as a result of clearing of vegetation on land and creek banks, urban development, water extraction and stock access to creeks which have resulted in erosion, bank collapse and weed invasion around Ourimbah Creek.

Tuggerah Lakes drains a large catchment (670 square kilometres) and is prone to the build-up of nutrients and sediment as result of vegetation clearing and agricultural practices. The Lake also collects bacteria such as enterococci and faecal coliforms as a result of sewage and stormwater runoff. Tuggerah Lakes is estuarine and the balance of salt and fresh water is important for marine and bird life.

Tuggerah Lakes Catchment Monitoring Program has collected seven years of baseline data. The data defines the Lakes health as medium. Nitrogen levels are regularly above ANZECC guidelines for estuaries. High turbidity levels were noted in Tuggerah Lake and may be the due to wind mixing fine silt from the lake bed (Wyong Shire Council, 2004). This data has not been provided as part of this assessment.

No water quality sampling or assessment has been undertaken as part of this memo. It is recommended to undertake a baseline water quality assessment on Ourimbah Creek upstream and downstream of the confluence at Bangalow Creek prior to the commencement of construction.
It should also be noted that the report is more than 10 years that the water quality may change. According to the Wyong Council Tuggerah Lake Estuary report cards 2014, 2013 and 2012, (Wyong Shire Council) the estuary health grading is only fair (C) suggesting that the water quality has not been improved notably since 2004 study.

3. APPLICABLE POLICIES AND GUIDELINES

The following policies and guidelines are application to the management of the surface water in and around the proposed maintenance facility:

- ANZECC Guidelines (2000)
- 'Blue Book' Soils and Construction – Managing Urban Stormwater (Landcom, 2004)
- NSW Government River Flow and Water Quality Objectives, NSW OEH, 2006
- Floodplain Development Manual, NSW Government, 2005.

4. IMPACT ASSESSMENT

4.1 Adopted methodology

The flooding, drainage and water quality assessment for this memo was carried out based on a desktop assessment of existing studies and reports.

4.1.1 Assumptions

The assessment was carried out based on the following assumptions:

- Flood behaviour is based on available flooding reports and no modelling has been carried out. No flood models were reviewed as part of the study.
- No water quality sampling or assessment has been undertaken as part of this Technical Memo.

4.2 Proposed project

The proposed project includes the duplication of the track and turnout from the main line for egress into the maintenance facility. It is expected that the existing culvert structures will be retained with minor outlet works. The existing bridge along Turpentine Road at Chittaway Creek is also to be retained and additional spans will be added to suit the embankment widening. Catch drains will also be adjusted to suit the new track and formation widening.

The proposed local stormwater drainage network for the maintenance facility has been designed to direct runoff away from the Main Northern Line to the south-west, west and north. This is achieved by directing the runoff from the new rail lines to stormwater detention ponds placed around the low side of the facility via a series cess drains and regularly spaced carrier pipes perpendicular to the rail lines.

Stormwater runoff along assess roads and imperious areas will also be directed towards the detention ponds by open channel drains to attenuate the flow and capture sediment for water quality purposes.

According to AECOMs Maintenance Facility Concept Report (2016), the facility requires flood immunity from the 1:100 AEP event level, with an allowance for climate change. The climate change scenario is based on a 10 per cent increase in rainfall in accordance with the NSW Office of Water (NOW) guidance Practical Consideration of Climate Change (2007). Figure 1 depicts the flood extent for the 1 per cent AEP storm event with a 10 per cent increase in rainfall for climate change for the study area (AECOM 2016). The provided flood envelope was developed based on a cut down version of the regional model for Ourimbah Creek. The AECOM 1 per cent AEP storm and climate change flood envelope was used to assess the flooding impacts for the proposed facility.

The proposed access road comprises a road over rail bridge connection from Enterprise Drive as well as an extension of the existing rail over road and creek bridge at Chittaway Creek.

4.3 General impacts during construction

During construction, potential impacts would likely be focused on erosion and sediment as a result of land disturbance, which, if uncontrolled, could potentially result in the following impacts:

- Fluctuations in the stream flow characteristics
- Increased sediment load and organic matter as a result of construction site runoff, resulting in adverse impacts to benthic fauna (species that live on the bottom of water bodies)
- Reduction in photosynthetic productivity of water bodies from increasing turbidity
- Reduction in channel habitat from sediment deposition
- Scour of stream banks due to high discharge velocities and increased flows
- Gross pollutants entering receiving creeks
- Declining water quality from the influx of man-made substances
- Contamination of surface water due to contaminated soils entering the surrounding drainage network.

The project would also reduce the permeability of the site due to the compaction of soil as a result of earthworks and remediation works on site; however the site would remain permeable (such as between the tracks into and out of the maintenance facility. This would result in a minor increase in overland flows.

This increase is not considered to substantially impact upon the drainage of the site because drainage works would be undertaken early in the project construction phase meaning that overland flows would begin to be collected by the system during the construction activities proposed after earthworks are complete. Impacts of overland flows would also be minimised as diversion drains would be put in place to direct any upstream runoff around the site.

4.4 Regional flood impacts

According to AECOMs 1 per cent AEP storm and climate change flood envelope, the proposed facility is broadly unaffected by the flood waters during this extreme event. However, the connecting infrastructure, including access roads and sidings from the mainline will likely impact the floodplain and local drainage processes south west and north east of the proposed facility. Particularly at Chittaway Creek rail over road crossing along Turpentine Road. In its current condition, the Turpentine Road railway underpass at Chittaway Creek is predicted to be completely inundated during the 20 per cent AEP event, with predicted flow depths of around three metres (Catchment Simulation Solutions 2013). Accordingly, vehicle access along Turpentine Road would be not possible during any of the minor floods. Duplicating the track for the sidings and widening the rail bridge at this location needs to be assessed in more detail and if required, formulate suitable mitigation measures given the existing flood sensitivity and ongoing access requirement for local residents and construction plant.

A detailed Flood Impact Assessment is recommended as part of detailed design to assess the flood impact over a range of AEP events to better understand how the proposed bridge duplication could affect local drainage and flood plain processes.

A culvert crossing at an unnamed intermittent watercourse (chainage 94.240 kilometres) would also be inundated by the back waters of the Ourimbah Creek during the 20 per cent AEP event (Catchment Simulation Solutions, 2013). To the west of the proposed development, Bangalow Creek runs parallel to Main Northern railway. During the 20 per cent AEP event, the flood water overtops the banks of Bangalow Creek and presses against the existing rail embankment. Widening the rail embankment in these areas would reduce the available flood plain storage and would impact the existing flood plain and local drainage processes. The impacts would likely be minor but this would need to be confirmed in a detailed Flood Impact Assessment to be undertaken during detailed design.

4.4.1 Construction

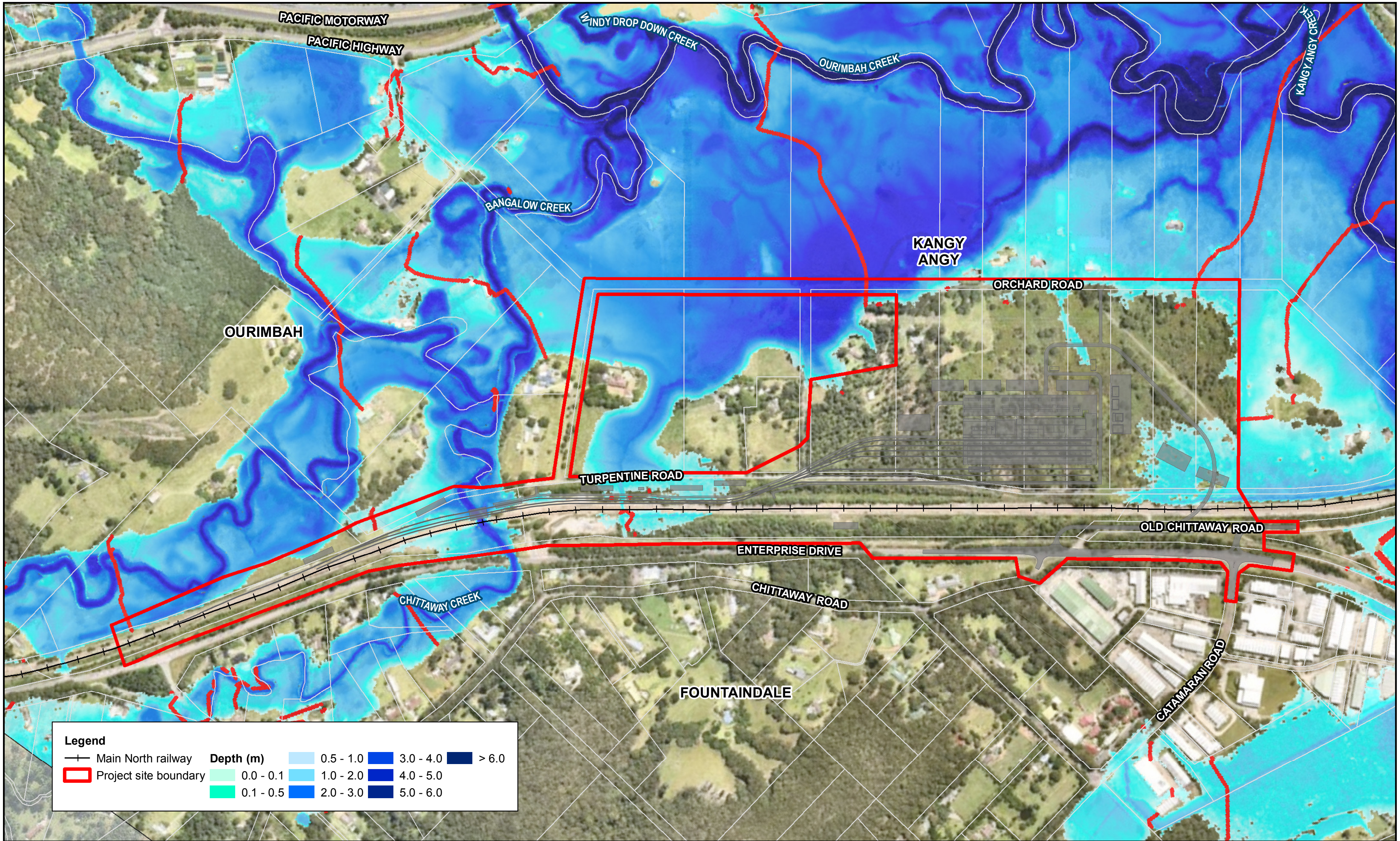
There could be temporary impacts to regional flooding behaviour during construction of the sidings and maintenance facility. These impacts could include temporary loss of floodplain storage and temporary redistribution of flood flows as a result of material stockpiles, machinery, equipment and works within flow paths and at culvert crossings. These impacts would be temporary and would depend on whether a flood event occurs during construction.

Based on the 1 per cent AEP and climate change flood envelope, part of the construction works at the Chittaway Creek bridge (chainage 93.960 kilometres) and a culvert crossing at an unnamed intermittent watercourse (chainage 94.240 kilometres) is at risk of flooding (should such an event occur during the construction period). Given the flat and low lying topography in these areas, a flood emergency management plan should be prepared for the construction period. The plan would provide a series of activities that need to take place should a flood event occur. These activities would firstly focus on the flood emergency and then during the recovery period to assist with starting work again as soon as possible after the flood event.

4.4.2 Operation and climate change

It is proposed to construct the turnout and sidings from the mainline at the same elevation as the existing, so that the existing flood immunity is preserved. Based on AECOMs' 1 per cent AEP storm and climate change flood envelope, this would assure the proposed sidings from the mainline have flood immunity greater than the 1 per cent AEP flood and climate change level.

It is expected that existing cross drainage locations will be retained with minor outlet works. Existing bridges will also be retained with parallel spans added. Bridge piers and abutments will be built directly in line with existing structures to minimise effects on water flow during a flood event. These changes will induce additional energy loss to the drainage system but is not expected to be significant. The proposed sidings from the mainline are to be built within the existing rail corridor and will require minor earthworks and involve regrading. Overall, the impacts of the proposed sidings will slightly reduce the available floodplain storage particularly on the downstream side of the proposed sidings. Given the low lying and relatively flat nature of the floodplain on the western side the actual impact to flood levels and flood behaviour will be minor.



Map: 2202522A_GIS_F022_A2

Author: goganovskiM

Date: 30/05/2016

Approved by: -

Data source: - © Land and Property Information 2015

0 100 200 m

1:9,500

Coordinate system: GDA 1994 MGA Zone 56

Scale ratio correct when printed at A4

Note: Design is indicative only.
Subject to detailed design

WSP | PARSONS BRINCKERHOFF

New Intercity Fleet Maintenance Facility Project
Figure 1
1:100 year flood level with 10% rainfall increase

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4.5 Local drainage and stormwater impacts

Local drainage and stormwater impacts refer to the impacts to cross drainage structures not associated with Ourimbah Creek or Chittaway Creek but structures that convey overland flows across the rail corridor from longitudinal drainage lines and small local catchment areas. It is understood that all existing cross drainage structures will be extended based on the existing size and longitudinal drainage lines will be provided along the edge of the new railway embankments.

4.5.1 Construction

Temporary diversions of local overland flows paths will not have any significant impact on the local stormwater system but should be maintained during the construction period.

4.5.2 Operation and climate change

Once the proposed works are constructed, there will be minimal impacts to local drainage since existing culverts will be retained and extended if required. Existing bridges will also be retained with additional spans being added. Bridge piers and abutments will be built directly in line with existing structures to minimise effects on water flow during a flood event. Scour protection at culvert outlets will be designed based on best practice guidelines using soft engineering solutions.

At a number of locations, the access and maintenance tracks will be closed and relocated. The waterway crossings at these locations will be replaced to provide like-for-like so that the current hydrologic regime is not altered from its current state and does not impact on the existing local drainage processes.

The proposed works will result in an increase in impervious surfaces, leading to more runoff from the rail corridor and maintenance facility, however stormwater runoff will be managed by the new drainage network and a combination of catch drains, cess drains, mitre drains and subsurface drains.

With respect to predicted climate change, the predicted change in rainfall intensity may increase the peak flows in the local drainage and track drainage systems, leading to an increased peak flow discharging into the downstream detention basin and subsequent waterways. The detailed design capacity of the track drainage and stormwater drainage networks should consider increased flows due to climate change. Scour protection design at culvert outlets should also consider increased flows and velocities due to increased rainfall intensity as a result of climate change predictions.

4.6 Water quality impacts

Stormwater runoff from both construction and permanent work areas would flow to Chittaway Creek and into Ourimbah Creek. The proposal has the potential to adversely impact water quality within the Ourimbah Creek catchment and floodplain, and Tuggerah Lake during construction and operation if activities are not appropriately managed.

The construction activities with the highest potential water quality impacts are:

- General earthworks, including stripping of topsoil, excavation or placement of fill
- Construction of drainage infrastructure
- Works in low lying areas or wet weather
- Leaks or spills from chemicals or fuels used.

The impacts from these activities could include:

- Sedimentation within the waterways
- Increased levels of nutrient, metals and other pollutants transported downstream
- Chemical, oil and grease and petroleum hydrocarbons in waterways from spills.

Permanent works impacts:

- Contaminants such as suspended solids, nutrients, oil and grease, hydrocarbons and litter
- Increased concentration in runoff resulting in increased erosion to creek banks.

5. MANAGEMENT AND MITIGATION MEASURES

The following management and mitigation measures would be implemented to minimise impacts on flooding, drainage and water quality:

5.1 Flooding

5.1.1 Construction

- It is recommended that site offices, staff facilities and construction compound be located at least above the 1 per cent AEP flood level, including an allowance for climate change. This may require these temporary structures to be installed on fill pads or piers.
- Any temporary flood diversion works should be sized for a 20 per cent AEP event since construction is expected to take between two to three years depending on the chosen option and construction method.
- A flood evacuation plan would be developed prior to any work commencing on-site as part of the construction documentation. Contractors would be responsible for implementing their own flood emergency management plan.
- To reduce the potential impacts to surface water systems, no stockpiles would be located within high/medium flood risk areas or adjacent to existing culverts.
- The proposed pier locations for the new rail bridge crossings would be situated so as to minimise the proposal's impact on surface water flows and flooding.

5.1.2 Operation and climate change

The new bridges are to be designed with piers and abutments directly in line with existing structures to minimise effects on water flow during a flood event. If the current bridge and culvert configuration are maintained so that the existing hydrologic regime is not altered the localised flooding impact is likely to be minor.

The new access road routes are to be constructed above the 1 per cent AEP event and climate change levels and adequate scour protection is to be provided in the flood affected areas. Culvert openings across the floodplain are to be sized to minimise the impact on the existing floodplain and local drainage processes.

A detailed Flood Impact Assessment of the site is recommended to confirm these assumptions and provide more certainty on the impact the proposed development has on the regional flood and local drainage processes.

5.2 Stormwater and drainage

An assumption has been made that additional structures with the same cross-sectional area as existing will not affect the existing drainage. However, a Hydrologic and Hydraulic assessment is recommended to confirm this during detailed design.

5.2.1 Construction

- All track drainage would be designed to meet Transport for NSW standards and Engineers Australia’s Australian Rainfall and Runoff.

- The existing track drainage system would remain operational throughout the construction of the main line siding and turnouts within the facility.

5.2.2 Operation and climate change

- All culvert extensions would be designed to match the existing culvert openings to minimise impacts to the capacity of existing drainage infrastructure.

5.3 Water quality

Water quality impacts will be managed during construction using the standard suite of mitigation measures for construction sites and would be detailed in the Project Construction Environmental Management Plan (CEMP).

During construction soil and water management measures would be identified in consultation with relevant government agencies and Council, and would be consistent with the principles and practises detailed in Landcom's Managing Urban Stormwater: Soils and Construction (2004). Water quality controls will need to be particularly strict around the cross drainage locations during construction to prevent pollutants entering the water course and leaving the site.

5.3.1 Construction

- Stabilisation of cut banks to minimise erosion and scour which contribute to higher sediment and nutrient runoff.
- Protect the banks and riparian vegetation of Chittaway Creek during construction.
- Control gross pollutant sources from the construction site such as litter and other waste.
- Installation of erosion and sediment control devices such as silt fences.
- Minimise ground disturbance.
- Disturbed surfaces will be stabilised and reinstated as quickly as practicable after construction.
- Sediment will be prevented from moving offsite and sediment laden water prevented from entering any watercourse.
- No stockpiles of materials or storage of fuels or chemicals would be located within high/medium flood risk areas or adjacent to the existing culverts.
- Vehicles and machinery would be properly maintained to minimise the risk of fuel/oil leaks.
- Routine inspections of all construction vehicles and equipment would be undertaken for evidence of fuel/oil leaks.
- All fuels, chemicals and hazardous liquids would be stored within an impervious bunded area in accordance with Australian standards and EPA Guidelines.
- Emergency spill kits would be kept on-site at all times. All staff would be made aware of the location of the spill kit and be trained in its use.
- Construction plant, vehicles and equipment would be refuelled off-site, or in a designated refuelling area.

5.3.2 Operation and climate change

- Scour protection would be provided at both ends of culvert extensions to reduce erosion and water quality impacts.
- Swales and detention ponds are recommended to reduce sediment loads and pollutants entering streams. These swales and detention ponds should be installed as early as possible.

- Stormwater from heavily polluted areas such as workshop facilities should be treated with oil interceptors or other treatment measures to ensure that the quality of discharged waters is in accordance with the requirements of the POEO Act.

6. SUMMARY AND CONCLUSION

The pre-concept design has minimised impacts to flooding and drainage by raising the proposed facility above the 1:100 AEP and climate change levels. It has also maintained the current bridge and culvert configuration so that the existing hydrologic regime is not altered. However, mitigation and management measures are required to be implemented during construction and operation to minimise impacts to regional and local flooding and water quality within the Ourimbah Creek catchment. The environmental risk during construction and operation is not considered significant provided appropriate environmental controls are implemented.

A Flood Impact Assessment of the site would be prepared prior to construction to confirm that the new bridges with piers and abutments directly in line with existing structures will not cause significant impacts on water flow during a flood event. The assessment would also confirm that the impact on the proposed culvert extensions do not impact the existing hydrologic regime.

Sean McMahon K Neilson

Yours sincerely
Sean McMahon & Katie Neilson
Civil Engineer

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Appendix I

GROUNDWATER ASSESSMENT

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MEMO

TO: Jarryd Barton

FROM: Angus McFarlane, Andrea Madden

SUBJECT: **Groundwater assessment – New Intercity Fleet Maintenance Facility**

OUR REF: 2202522A-ENV-MEM-004-RevC

DATE: **4 May 2016**

1. SCOPE OF WORKS

The scope of works for the groundwater desktop assessment for the New Intercity Fleet Maintenance Facility includes the following:

- Summary of the relevant legislation.
- Description of the existing groundwater environment and identification of groundwater-related environmental values (registered bore users and groundwater dependent ecosystems (GDE)), through a review of the following:
  - Geological maps, GDE Atlas, Department of Primary Industries | Water registered bore database, and acid sulphate soil maps.
  - Groundwater level and groundwater quality related to the site.
  - Climatic data for the site (rainfall, evaporation).
  - Previous investigation reports and data, particularly geology and groundwater information related to the site.
- Characterisation of the risks to groundwater, GDE's and stakeholders during the construction and operational phases of the project.
- Identification of mitigation measures to minimise potential impacts to the groundwater regime and users.

2. REGULATORY CONTEXT

The primary legislation for the management of water in NSW is the *Water Act 1912* and *Water Management Act 2000*. The *Water Act 1912* is being progressively phased out and replaced by the *Water Management Act 2000*. The main tool of the *Water Management Act 2000* are water sharing plans (WSPs), that contain rules for the sharing of water between water users and the environment and rules for the trading of water. Once a WSP has commenced, the *Water Act 1912* is repealed for that water source and existing licences are converted to new consents under the *Water Management Act 2000*.

The project area is located within the WSP's for the Central Coast unregulated and alluvial water sources and the Ourimbah Creek water source. The waters in the Ourimbah Creek water source exclude all water contained within underlying aquifers, with the governing WSP being the Central Coast unregulated and alluvial water sources.

The NSW Aquifer Interference Policy clarifies the requirements for obtaining water licences for aquifer interference activities and describes the assessment process for aquifer interference activities. An aquifer interference activity includes the penetration of an aquifer, the obstruction of groundwater flow in an aquifer, and the taking of water from an aquifer. All groundwater take during construction and during operation (ongoing take) needs to be accounted for, with measures to mitigate and avoid/prevent the take of water.

Very small water take, up to three megalitres per year, will typically not require a licence, provided that the amount of take can be demonstrated (Dent et al. 2015).

3. PHYSICAL SETTING

3.1 Topography and land use

The proposed New Intercity Fleet Maintenance Facility (the site) is located to the west of the northern railway line between Sydney and Newcastle, at Kangy Angy, NSW (Figure 1). The site covers an area of about 10 hectares and is located on an alluvial plain in a broad open valley that generally drains to the north-east. The hills flanking the valley are densely vegetated with rolling topography. The land within the valley is flat to slightly undulating with the ground surface between 8.5 metres and 15 metres Australian Height datum (AHD). Ourimbah Creek is located about 500 metres to the north-west of the site (Figure 1) and has cut into the alluvial plain to about five metres AHD (Coffey 2016a).

The existing land use on the project site is typically small, recreational farming and disused agricultural land with regrowth forest. The more elevated areas are covered by sparse forest and scrub. The low-lying areas, towards the eastern half of the site, are vegetated with paperbark forest and reeds in areas that appear to be ephemeral wetlands (Coffey 2016b).

3.2 Climate

The broader Wyong area is in a warm temperate climatic zone, with warm, wet summers and cool, dry winters. According to the Bureau of Meteorology (BoM) data from the Wyong (Kangy Angy (Ourimbah Creek)) weather station 061384, located 1.4 kilometres from the site, April has the highest average monthly rainfall since records commenced in December 2000 (149.3 millimetres), while August is the driest, with an average monthly rainfall of 37.9 millimetres. As shown in Figure 2, the total annual rainfall ranges from 615 millimetres in 2004 (although rainfall data in November and December are missing) to 1756 millimetres in 2011. The years 2003–2006 (inclusive) were also noted as years which received low rainfall levels.

The cumulative deviation from mean (CDFM) annual rainfall at BoM station 061384 is shown in Figure 2. The CDFM is the cumulative departure from the long term average rainfall, and helps explain the variations to groundwater levels in unconfined aquifers. Periods of below average rainfall are plotted as downward trending slopes while periods of above average rainfall are upward trending slopes. Periods of below average rainfall generally occurred between 2001 and 2009 whilst rainfall was generally above average from 2009 to 2015.

It should be noted that all groundwater level information presented hereafter was collected in January 2016, which was the second wettest month since records commenced at BoM station 061384.

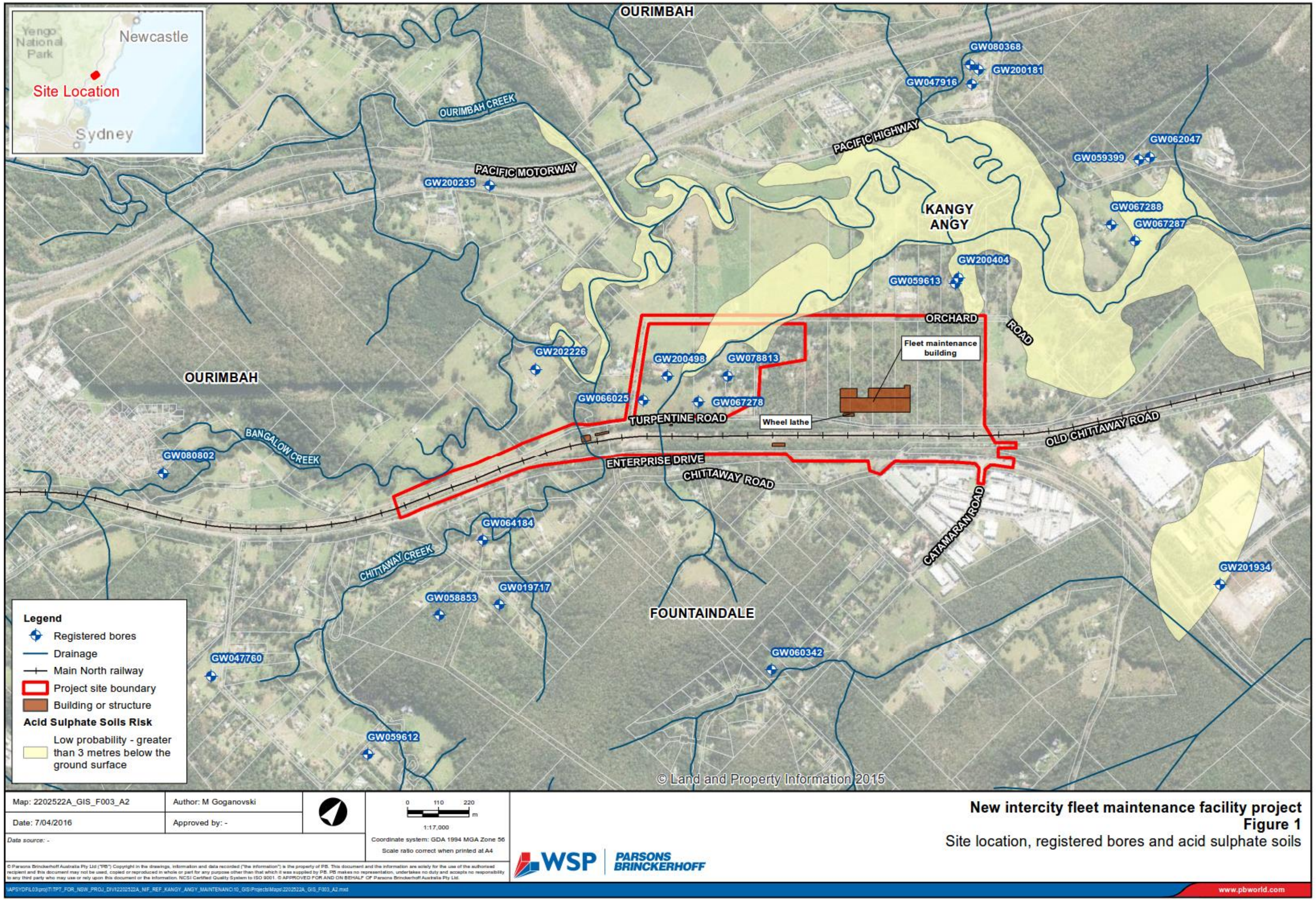

Figure 1 **Site location, registered bores and acid sulphate soils**

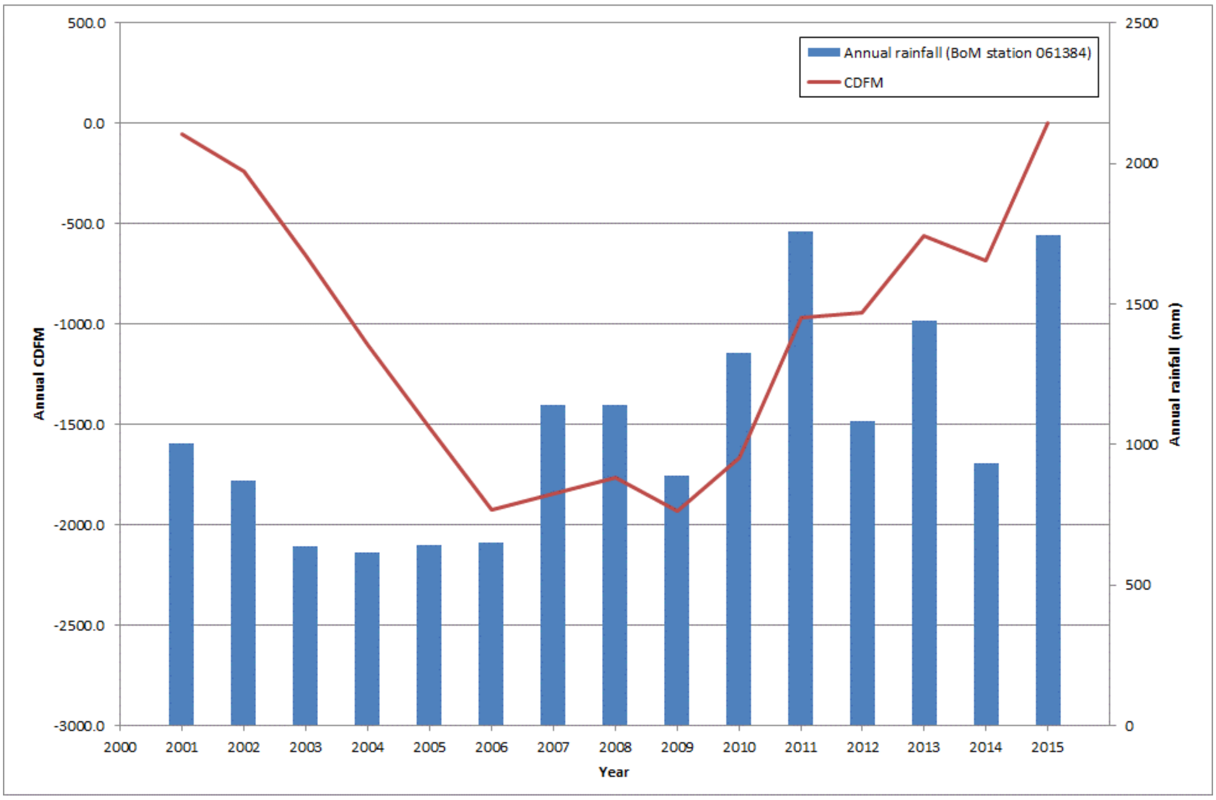

Figure 2 **Annual rainfall and cumulative deviation from mean (CDFM) annual rainfall at BoM station 061384**

3.3 Surface water

The site is bounded by Ourimbah Creek and its flood plains to the north and east, Bangalow Creek and Chittaway Creek in the west and the Main North railway to the south. The topography typically slopes from south to north from the Main Northern Rail line into the Ourimbah Creek catchment, which is part of the larger Tuggerah Lake catchment. Further details on the surface water environment are provided in the flooding and drainage technical assessment for the project.

3.4 Geology

The site is located inland and upstream of a coastal lake (Tuggerah Lake) in an in-filled river valley. The Gosford 1:100 000 scale geological sheet shows that the ancient valley is filled with Quaternary alluvium and that the underlying bedrock is the Terrigal Formation (Figure 3). The Quaternary alluvium is described as sands, silts and clays, which is consistent with both geotechnical and contamination investigations conducted by Coffey (2016a and 2016b). These investigations found alluvial deposits up to 43 metres deep overlying sandstone bedrock.

The Terrigal Formation bedrock is described in the Gosford 1:100 000 scale geological sheet as interbedded laminite, shale and fine to coarse grained quartz to quartz-lithic sandstone with minor red claystone. Coffey (2016a) described the bedrock as a heavily weathered fine to medium grained sandstone, is shallowest in the south western area of the site and dips to the north east. There are two sandstone bedrock outcrops near the start of Turpentine Road on the approach to the underbridge from Enterprise Drive. Laminate layers were observed in various cores taken as part of the geotechnical investigation across the site. The actual buried bedrock surface may vary as a series of sub-horizontal benches and sub-vertical cliff lines (Coffey 2016a).

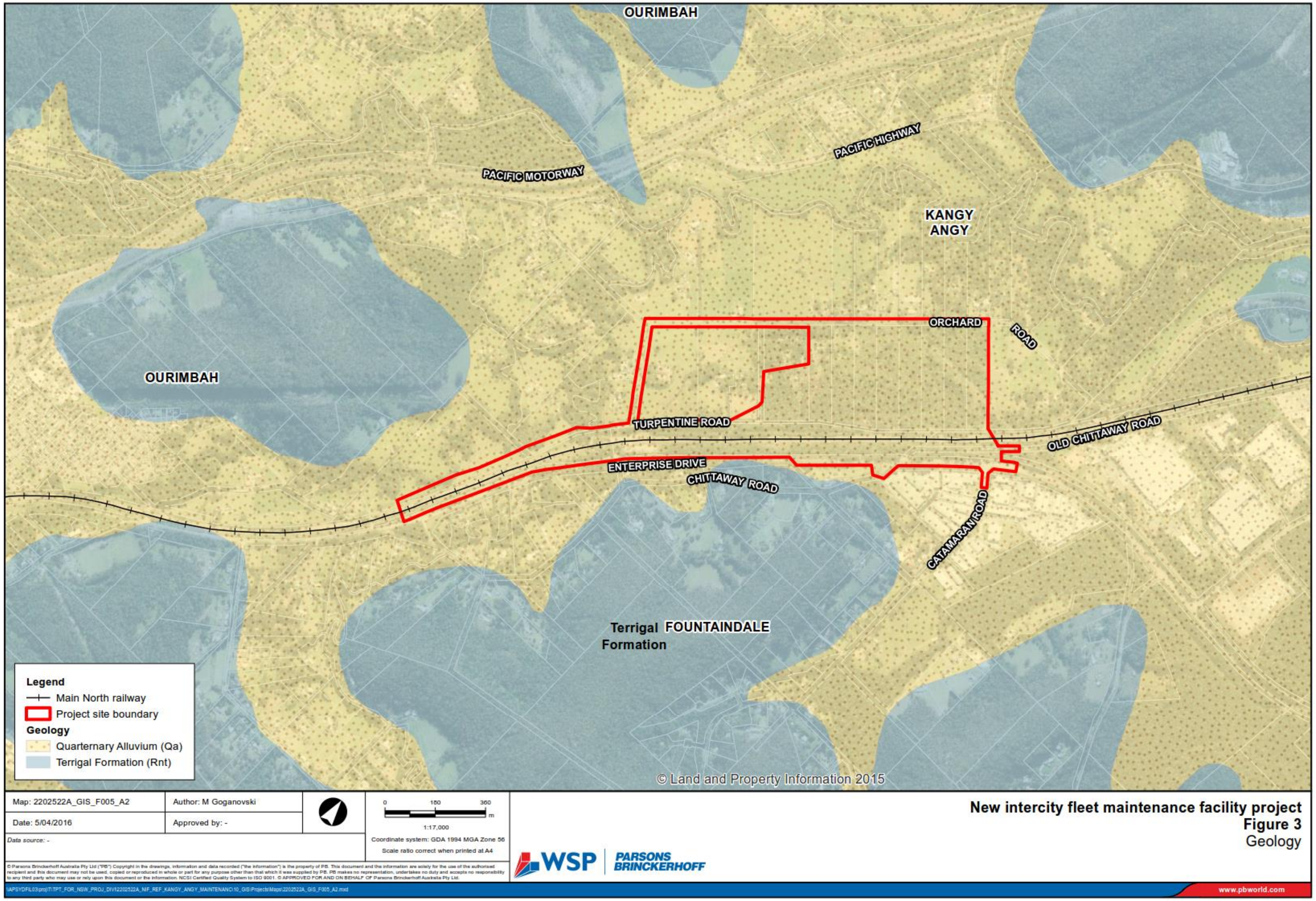

Figure 3 Geology

3.5 Acid sulphate soils

According to the NSW Office of Environment and Heritage acid sulphate soil risk map (Wyong Sheet, 2nd edition), there is one area within the project site boundary that has a low probability of acid sulphate soil occurrence in profiles greater than three metres depth from ground surface; near the corner of Ourimbah Road and Orchard Road (Figure 1).

4. GROUNDWATER

4.1 Aquifers

There are two aquifers associated with the Quaternary alluvium and the underlying Terrigal Formation (Figure 3), and are described as follows:

- Quaternary alluvium – The alluvial aquifer is unconfined, has a shallow water table, and groundwater movement is through pore spaces. The local groundwater flow is expected to follow the general topography and there is expected to be a level of connectivity between the groundwater and surface water. Alluvial aquifers tend to have a high hydraulic conductivity, however they also tend to be heterogeneous, with coarser sediment layers providing areas of high hydraulic conductivity, and clayey sediments with a low hydraulic conductivity and inhibiting localised flow. Recharge to the aquifer is through direct rainfall infiltration and stream discharge.
- Terrigal Formation – Groundwater flow in the Terrigal Formation is through pores and structural features such as bedding plane partings. The Terrigal Formation was typically considered to have low yields (average 0.4 litres per second (L/s)) and variable water quality, however higher yields and manageable water quality was found during the Gosford and Wyong Councils joint program of water investigations from 2004; the *Gosford–Wyong Councils Water Authority Joint Water Supply Scheme* (Cook 2009). The following hydrogeological properties were determined:
  - groundwater level – 1.1–6.2 metres below ground level (mbgl)
  - hydraulic conductivity – 0.3–35.3 metres per day (m/d)
  - pH – 6.0–8.0 pH units
  - total dissolved solids – 233–6520 milligrams per litre (mg/L) (Cook 2009).

4.2 Registered groundwater bores

A search of the NSW Department of Primary Industries | Water (DPI | Water) registered groundwater bore database identified 23 registered bores within a one kilometre radius of the project site. The summary of the search is presented in the Table 4.1 and the location of the bores have been shown in Figure 1.

The majority of the bores are used for stock or domestic purposes. The yields from these bores are low to moderate, at between approximately 0.3 and 2.5 litres per second.

Table 4.1 Summary of DPI | Water registered groundwater bores

BORE NUMBER	WATER LEVEL (mbgl)	PURPOSE	WATER QUALITY	YIELD (L/s)	SCREENED GEOLOGY	CONSTRUCTED DEPTH (mbgl)
GW200404	3	Domestic	Fresh	0.5	Coal	12.2
GW059613	3	Domestic	Fresh	0.5	Coal	12.2
GW078813	6	Stock, domestic	450 mg/L	1.0	Sand	30.0
GW067278	3	Stock, domestic	No data	1.9	No data	29.0

BORE NUMBER	WATER LEVEL (mbgl)	PURPOSE	WATER QUALITY	YIELD (L/s)	SCREENED GEOLOGY	CONSTRUCTED DEPTH (mbgl)
GW200498	4	Licence cancelled	Good	1.25	Sandstone	45.0
GW066025	4.1	Irrigation	Good	1.25	No data	45.0
GW202226	6	Domestic	500 mg/L	1.0	No data	66.0
GW200235	4	Stock, domestic	134-510 mg/L	2.0	Shale	66.5
GW080802	No data	Monitoring bore	No data	No data	No data	No data
GW047760	22	Domestic	No data	0.75	Shale	51.0
GW059612	3.6	Domestic	No data	2.5	Unknown	61.0
GW058853	26	Stock	No data	0.45	Sandstone	61.0
GW019717	No data	Stock	No data	0.75	Clay	5.4
GW064184	1.2	Domestic	No data	No data	Clay	7.0
GW060342	No data	Stock	No data	No data	No data	No data
GW201934	No data	Monitoring bore	No data	No data	No data	7.0
GW080368	No data	Domestic	No data	No data	No data	No data
GW200181	No data	Domestic	No data	No data	No data	No data
GW047916	No data	Licence cancelled	No data	0.31	Clay	45.0
GW059399	No data	Lapsed domestic	No data	No data	No data	112.0
GW062047	14	Lapsed irrigation	No data	0.55	Shale	92.0
GW067288	7.8	Domestic	No data	0.44	No data	73.0
GW067287	5.7	Farming	No data	1.63	No data	37.0

4.3 Groundwater levels

Groundwater levels were recorded during the borehole and test pitting phase of the geotechnical investigation for the concept design of the new intercity fleet maintenance facility (Coffey 2016a). The test pits were excavated into the alluvium only, whereas the boreholes typically extended beyond the alluvium, into the sandstone bedrock. The groundwater levels recorded from boreholes, piezometers and test pits are provided in Table 4.2 and have been shown in Figure 4. The most reliable data comes from the piezometers, for which there were three which provided this data. During this assessment, when multiple groundwater levels are located in close proximity, the groundwater levels recorded from the piezometers are favoured.

All groundwater levels were recorded after a period of heavy rain (January 2016). Deeper groundwater levels are expected during drier conditions.

The water table across the site is generally shallow, with groundwater levels ranging from the existing surface level (i.e. at a recorded level of 0 metres at BH06 and BH14) to approximately 5.2 metres below ground level (mbgl) at BH01. Shallow groundwater levels across the site is supported by the majority of the groundwater levels measured from the registered bores (section 4.2), with the bores in close proximity to the site measuring groundwater levels at between approximately three and six metres below ground level (GW078813, GW067278, GW200498 and GW066025).

Table 4.2 Groundwater levels (metres below ground level)

ID	Depth to water measured in boreholes	Depth to water measured in piezometers	Depth to water measured in test pits
BH01	5.20	5.23	N/A
BH03	2.00	1.17	N/A
BH04	1.00	N/A	N/A
BH05	0.00	0.75	N/A
BH06	0.00	N/A	N/A
BH08	1.80	N/A	N/A
BH12	1.80	N/A	N/A
BH13	1.70	N/A	N/A
BH14	0.00	N/A	N/A
BH15	4.70	N/A	N/A
BH16	4.50	N/A	N/A
TP03	N/A	N/A	1.20
TP07	N/A	N/A	1.80
TP22	N/A	N/A	1.60
TP24	N/A	N/A	1.30
TP25	N/A	N/A	1.38
TP30	N/A	N/A	1.60
TP33	N/A	N/A	1.40
TP34	N/A	N/A	1.20
TP35	N/A	N/A	1.48
TP36	N/A	N/A	1.18

4.4 Groundwater quality

Groundwater quality information has not been collected on site, however based on the water quality information available from the nearby registered bores (section 4.2), it appears that groundwater is relatively fresh in the alluvial aquifer (GW078813) and Terrigal Formation (GW200498).

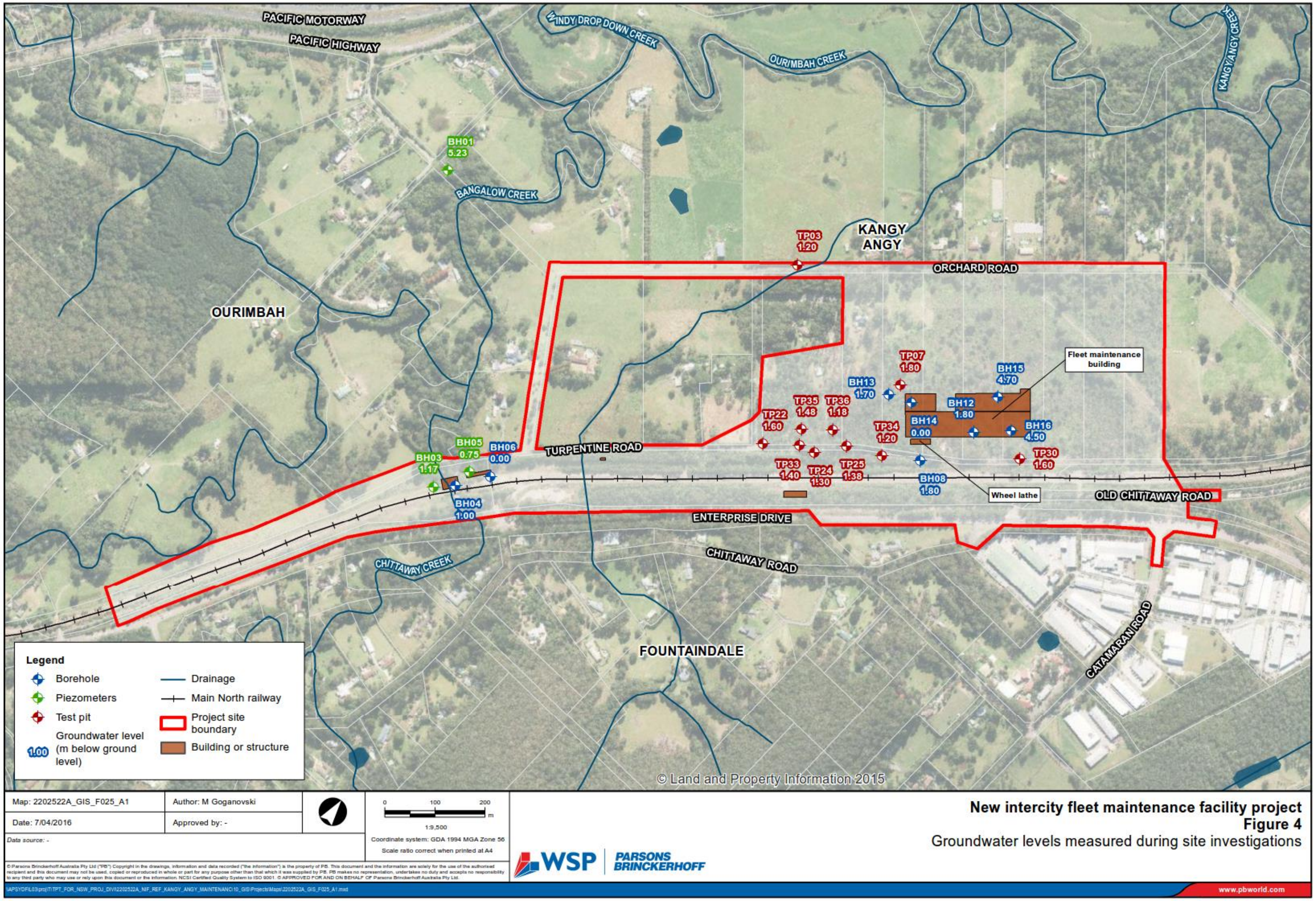

Figure 4 Groundwater levels measured during site investigations

4.5 Groundwater Dependant ecosystems

Groundwater dependant ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater. When considering GDEs, groundwater is generally defined as the saturated zone of the regolith (the layer of loose rock resting on bedrock, constituting the surface of most land) and its associated capillary fringe, however it excludes soil water held under tension in soil pore spaces (the unsaturated zone or vadose zone).

These ecosystems range from those entirely dependent on groundwater to those that may use groundwater while not having a dependency on it for survival (i.e. ecosystems or organisms that use groundwater opportunistically or as a supplementary source of water).

A review of the BoM Atlas of GDE's did not identify any GDE's within a three kilometre radius of the site. However as part of the *Biodiversity Assessment Report* (WSP | Parsons Brinckerhoff, 2016) prepared to assess the potential ecological impacts associated with the project, two plant communities within the subject site were determined as being groundwater dependent within the project site. These species are listed in Table 4.3.

Table 4.3 GDEs identified within the subject site

VEGETATION TYPE RECORDED[1]	GDE NAME[2]	GDE TYPE	SUBTYPE 1	SUBTYPE 2	HIGH ECOLOGICAL VALUE ECOSYSTEM
Melaleuca biconvexa – Swamp Mahogany – Cabbage Palm Forest	Melaleuca biconvexa/ Swamp Mahogany/ Cabbage Palm swamp forest of the Central Coast (40)	Coastal Freshwater Wetlands	Coastal floodplain swamps	Not identified	Yes
Jackwood – Lilly Pilly – Sassafras Rainforest	Jackwood/Lilly Pilly/ Sassafras riparian warm temperate rainforest of the Central Coast (32)	Perennial rivers and streams	Surface water riverine ecosystems	Continuous river	Yes

1) Vegetation communities as per the *Biodiversity Assessment Report* (WSP | Parsons Brinckerhoff, 2016).
2) Hunter-Central Rivers CMA high ecological value ecosystems.

5. POTENTIAL IMPACTS

5.1 Potential impacts during construction

5.1.1 Groundwater intersection and dewatering

Excavation on site is proposed and includes the following areas (refer to Figure 1):

- across the main portion of the site
- the main fleet maintenance building
- the wheel lathe (and associated pit).

Based on the current project design, the maximum excavation depths for these project elements are expected to be approximately 1.5 metres below ground level for the main site, approximately 2.0 metres below ground level for the main fleet maintenance building and up to approximately 4.0 metres below ground level for the wheel lathe/pit. Given the identified shallow groundwater table across the site, ranging from at surface to approximately 4.7 metres below ground level, the interception of groundwater is expected to occur as part of the project, particularly where groundwater occurs within a couple of meters from the existing surface and where areas of deeper excavation, such as the main buildings and wheel lathe, are proposed.

Based on existing information, the composition of the alluvium varies across the site and the groundwater levels are shallow (at surface (BH06 and BH14) to a maximum of 4.7 metres below ground level l at BH15), particularly in the south-western part of the site near Chittaway Creek (Figure 4). Given the excavation depth of approximately 1.5 metres below ground level for the main site, groundwater is likely to be intersected at a number of locations, particularly near the Chittaway Creek crossing and Main North railway.

Based on existing borehole information, the upper two metres of the alluvium at the location for the main fleet maintenance building is predominantly comprised of clayey sand (BH12), sandy clay/clayey sand (BH14), silty sand and clay (BH15) and silty clay (BH16). The groundwater level in this vicinity have been recorded at between surface level (BH14) and approximately 4.7 metres below ground level (BH15) (Figure 4). Given the excavation depth of approximately 2.0 metres below ground level for this building and the particularly shallow groundwater levels and permeable material towards the eastern section of this building, groundwater is likely to be intersected at this location and inflows to the excavation would be expected to be relatively high while the excavation is open.

The ground conditions in the location of the wheel lathe is comprised of clay to a depth of approximately 3.7 metres below ground level and underlain by weathered sandstone (BH11) (Coffey, 2016a). Existing groundwater levels at this location are approximately 1.80 metres below ground level (BH08 and BH12) (Figure 4). Given the proposed excavation depth of up to approximately 4.0 metres below ground level for the construction of the wheel lathe, and the lower permeability clay at this location, groundwater is likely to be intersected however inflows to the excavation are expected to be relatively low while the excavation is open.

The groundwater inflow rate into excavations is dependent on the permeability of the intersected geology and the groundwater level, as indicated above. The inflow would also depend on the size of excavation, duration the excavation would remain open and control measures used. Given the varied nature of the alluvial material (sand, sandy clay, silt and clay) of the shallow aquifer, discharge volumes would also vary across the site. Areas with deeper sand profiles (such as at BH03 and BH13) may experience higher inflow rates due to the higher permeability of the material. Excavation inflow rates would be significantly reduced in areas where there is a higher proportion of clay in the alluvial profile, such as at BH01, BH08 and BH11 (Figure 4).

The calculation or modelling of groundwater inflow rates and dewatering volumes would be undertaken during the detailed design phase. An assessment of potential impacts associated with dewatering would also be undertaken, including localised drawdown of the water table. The requirement for the obtaining of water licences would also be sought at this time, with DPI | Water consulted to ensure any required licences are obtained prior to construction activities commencing. As noted in section 2, a very small water take of up to three megalitres per year, will typically not require a licence (Dent et al. 2015).

5.1.2 Disposal of groundwater encountered during construction

Disposal of groundwater ingress is expected to be required during construction and would need to be managed and disposed of adequately to minimise potential environmental impacts. All groundwater encountered during construction would be managed in accordance with the waste classification guidelines (NSW EPA, 2014) and the water discharge and reuse guideline (Transport for NSW, 2015).

5.1.3 Impacts to registered bores

There are no registered groundwater bores on site (Figure 1), however there are 23 registered groundwater bores within a one kilometre radius of the project site (section 4.2). A breakdown of the different type of bores and the likely impacts, based on anecdotal information, are listed below:

- Minimal impact due to dewatering of the alluvium is expected to be experienced in the seven bores that are completed in the underlying hard rock (coal, sandstone and shale) (GW200404, GW059613, GW200498, GW200235, GW047760, GW058853 and GW062047).

- There are a number of bores that have no screened geology information (GW066025, GW202226, GW059612, GW059399, GW067288 and GW067287), however due to the depth of the bores, it is reasonable to assume that they are completed in the Terrigal Formation, and as such, minimal impact is expected.
- Due to the low permeability of clay, the three bores screened within this material (GW019717, GW064184 and GW047916) are also unlikely to be heavily impacted by short term excavation dewatering.
- There are a number of bores with insufficient data to assess the screened geology or other pertinent information (GW80802, GW06342, GW201934, GW080368 and GW200181), however given their distance from the site, impacts by short term alluvial dewatering are unlikely.
- Bores GW078813 and GW067278 are expected to be completed in sand and are in close proximity to the main building, where dewatering is expected. However given the groundwater levels at these bores are between approximately three and six metres below ground level and the maximum depth of excavation at the main building is approximately two metres below ground level, impacts to these bores are unlikely.

Overall, impacts to registered groundwater bores during the construction phase at the project are considered to be negligible.

Further consideration and assessment of the potential impacts to registered bores would be undertaken during detailed design, following the calculation or modelling of groundwater inflow rates, dewatering volumes and drawdown.

5.1.4 Impacts to groundwater dependent ecosystems

The project is likely to have impacts on two GDEs identified within the study area; Melaleuca biconvexa – Swamp Mahogany – Cabbage Palm Forest and Jackwood – Lilly Pilly – Sassafras Riparian Warm Temperate Rainforest.

Within the study area, the project would require the removal of vegetation from these GDEs and modifications to the existing hydrology within the study area. Changes in hydrology may include alteration of natural flow regimes as a result of installing culverts and water crossings. Additionally, excavation and earthworks associated with vegetation clearing and levelling of the land for the project may impact on the groundwater present, which could lead to modifications of the existing natural ecological function of these GDEs.

Further information regarding the potential impacts to GDEs is provided in the *Biodiversity Assessment Report* (WSP | Parsons Brinckerhoff, 2016).

5.1.5 Contamination of groundwater

Accidental spills and leakage of fuel, lubricants and oils from vehicles, equipment and the storage of liquids have the potential to contaminate groundwater. The potential for groundwater contamination can be managed through the use of appropriate control and emergency measures.

Given there is only a small area of low probability acid sulphate soils at greater than 3 metres below ground level, potential water quality impacts are not anticipated.

5.2 Potential impacts during operation

It is understood that there would be no new or residual excavations that would require dewatering through pumping during the operational phase. Therefore, there is considered to be a negligible potential for impact to groundwater during operational activity.

Accidental spills and leakages has the potential to contaminate groundwater. This risk would be reduced through hazardous material procedures, including spill mitigation measures (refer to section 6).

6. MANAGEMENT AND MITIGATION

6.1 Design

Measures to be implemented during the detailed design phase are as follows:

- Additional investigation and assessment of dewatering requirements associated with the excavation works.
- Quantification of groundwater inflows to excavations and determination of extent of drawdown.
- Preparation of a dewatering management plan, which would include information on the groundwater levels, excavation dimensions, quantification of amount of dewatering required and method of disposal of dewatered groundwater.
- Consultation with DPI | Water regarding their requirements, including licensing. In accordance with the NSW Aquifer Interference Policy, all groundwater take during construction (and operation), would need to be accounted for, with measures to mitigate and avoid/minimise the take of water.

6.2 Construction

Potential groundwater impacts associated with construction would be managed through the implementation of the following measures:

- Preparation of a construction groundwater management plan, which would detail the control measures that aim to reduce potential impacts to groundwater. A groundwater monitoring program would be included in the plan, and outline the monitoring network and baseline requirements (number of piezometers, groundwater levels, analytical suite) prior to the commencement of construction, enabling any changes to groundwater levels and quality during construction to be identified.
- Implementation of excavation techniques and other mitigation measures to minimise impacts to groundwater and reduce the take of water. Factors for consideration include the duration the excavation would remain open, particularly in areas of expected higher inflows; the size of the excavation; the water table depth; and the material to be excavated.
- Management and disposal of any encountered groundwater in accordance with the waste classification guidelines (NSW EPA, 2014) and the water discharge and reuse guideline (Transport for NSW, 2015).
- Preparation and implementation of hazardous material procedures, including procedures for managing spills and refuelling.

6.3 Operation

Similarly, during operation, hazardous material procedures, including procedures for managing spills and refuelling, would be developed and implemented to minimise groundwater contamination from chemical spills and leaks.

7. REFERENCES

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Appendix J

AIR QUALITY CONSTRUCTION IMPACT ASSESSMENT

Pacific Environment Limited

Consulting • Technologies • Monitoring • Toxicology

Report

New Intercity Fleet Maintenance Facility – Air Quality Construction Impact Assessment

WSP / Parsons Brinckerhoff

Job ID. 20897

6 April 2016

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1 INTRODUCTION

Pacific Environment has been commissioned by WSP|Parsons Brinckerhoff (WSP|PB) on behalf of Transport for NSW (TfNSW) to prepare the Air Quality Construction Impact Assessment for the proposed New Intercity Fleet Maintenance Facility Project (hereafter, referred to as 'the Project'). The purpose of the assessment is to support the review of environmental factors (REF) for the Project.

This Air Quality Construction Impact Assessment is one of a number of technical reports supporting the REF for the Project.

TfNSW proposes to deliver a new train maintenance facility at a site in Kangy Angy on the Central Coast of NSW to support the procurement of the New Intercity Fleet. The facility would be undertake light and heavy train maintenance activities for the New Intercity Fleet, including but not limited to

- Regular maintenance/servicing
- Repair/replacement of train components
- Interior and exterior cleaning

The proposed facility would include about six kilometres of electrified railway (in total), would be seven tracks wide at its widest point, covering an area of approximately 48 hectares, and would be bounded by a perimeter fence. The proposed facility would include the following key elements:

Maintenance facility:

- Maintenance building
- Auxiliary workshops
- Electronic clean room
- Material storage, including flammable liquid storage
- Wheel lathe
- Train wash
- Site access roads

Ancillary facilities:

- Security
- Administration
- Facilities for presentation and train maintenance staff
- Operational control
- Training rooms
- Train simulator
- Power supply (traction power, bulk power, signalling power supply and backup generators)
- Detention basins
- Car parks
- Access roads

1.1 Scope of Work

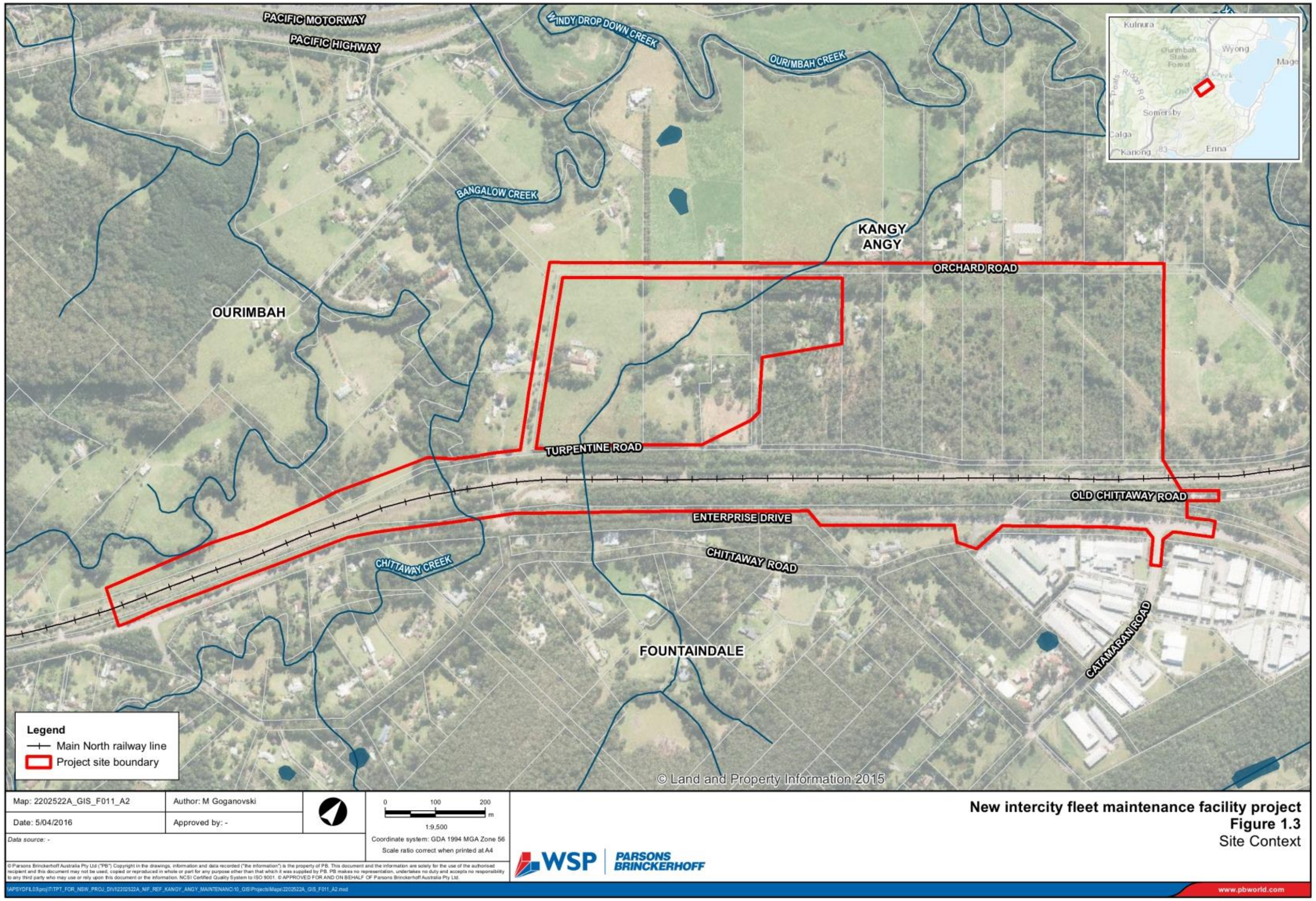
The following components of work will be completed as part of the assessment:

- Review of air quality monitoring data;
- Analysis of meteorological data;
- Completion of semi-quantitative risk-based construction assessment; and
- Recommendation for project specific air quality mitigation and management measures.

2 LOCAL SETTING

The site is located in the suburb of Kangy Angy, within the Wyong Shire local government area on the New South Wales Central Coast. The site is generally bordered by the Main North Rail Line rail corridor to the south, and Orchard Road to the north-west. Residential receivers on rural properties generally surround the site to the north, south and west, with industrial precincts to the south east and north-east (on the opposite side of the rail corridor to the site). The M1 Pacific Motorway is located approximately 0.85km to the north-west, and Tuggerah Lake is approximately 3.5 km to the east of the site. Chittaway Creek crosses the project at the southern end and Ourimbah Creek is to the north of the site.

Figure 2.2 shows the site location and local setting.



Source: WSP | Parsons Brinckerhoff, 2016

Figure 2.1: Local Setting

3 EXISTING ENVIRONMENT

3.1 Climate

The Bureau of Meteorology (BoM) collected climatic information in the vicinity of the study area between 1916 and May 2013 at Gosford, located approximately 9 km south-west of the Project. A summary of the climatic information is presented in **Table 3.1** (**BoM, 2016**).

The annual average maximum temperature recorded at the site is 23.0°C, the annual average minimum temperature is 11.1°C. The highest maximum temperature of 27.6°C is recorded in January, while the lowest minimum temperature of 4.8°C is recorded in July. The annual average humidity is 74% at 9am and 58% at 3pm. The annual average rainfall is 1,329 mm, falling throughout the year over approximately 122 rain days.

Table 3.1: Temperature, Humidity and Rainfall for Gosford BoM Station

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	22.9	22.3	20.7	18.3	14.3	11.7	10.5	12.9	16.4	19.1	20.4	22.3	17.7
Humidity	73.0	80.0	84.0	77.0	80.0	82.0	80.0	70.0	64.0	62.0	67.0	69.0	74.0
3pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	26.3	25.9	24.6	21.9	19.0	16.4	16.1	17.8	20.0	21.8	23.1	25.1	21.5
Humidity	59.0	63.0	62.0	61.0	61.0	62.0	55.0	48.0	51.0	54.0	59.0	59.0	58.0
Daily Maximum Temperature (°C)													
Mean	27.6	27.1	26.0	23.6	20.3	17.9	17.5	19.1	21.4	23.6	25.1	26.8	23.0
Daily Minimum Temperature (° C)													
Mean	16.9	17.2	15.4	11.9	8.3	6.5	4.8	5.4	7.7	10.7	13.2	15.3	11.1
Rainfall (mm)													
Mean	134.7	154.7	149.9	139.4	118.3	130.5	80.3	72.4	68.5	84.5	91.7	104.2	1328.8
Rain days (Number)													
Mean	11.3	11.1	11.5	11.4	10.5	10.4	9.3	8.4	8.5	9.4	10.1	10.1	122.0

Station number: 061087; Commenced 1916; Status: Closed May 2013; Elevation: 20 m AHD; Latitude: 33.39 °S; Longitude: 151.33 °E.
Source: **BoM (2016)**

3.2 Meteorology

3.2.1 Wind Speed and Direction

Air quality impacts are influenced by meteorological conditions, primarily in the form of gradient wind flow regimes, and by local conditions that are generally driven by topographical features and interactions with coastal influences, such as the sea breeze.

The closest BoM site that measures meteorological conditions commenced operating in June 2013 at Gosford, located approximately 12km south-southwest of the site. The annual and seasonal wind roses for the Gosford AWS in 2014 are presented in **Figure 3.1.** On an annual basis the predominant winds at Gosford are from the north-east, south and south-west. North-easterly winds dominate in summer and spring, with south and south-westerly winds prominent winter and autumn.

It is note that there is a high percentage of calms (winds less than 0.5 m/s) on an annual basis. These meteorological conditions will impact upon the dispersion of dust pollutants from the Project.

Data from the now-closed BoM Automatic Weather station (see **Section 3.1**), located approximately 2km from the current site were presented in "Northern Sydney Freight Corridor Gosford Passing Loops Air Quality Impact Assessment", produced for TfNSW that presents windroses for Gosford during the 2010 calendar year (**PB, 2012**) (see **Appendix A**). These windroses and those produced for 2014 are comparable, particularly with the high percentage of calms (approximately 40% for both years).

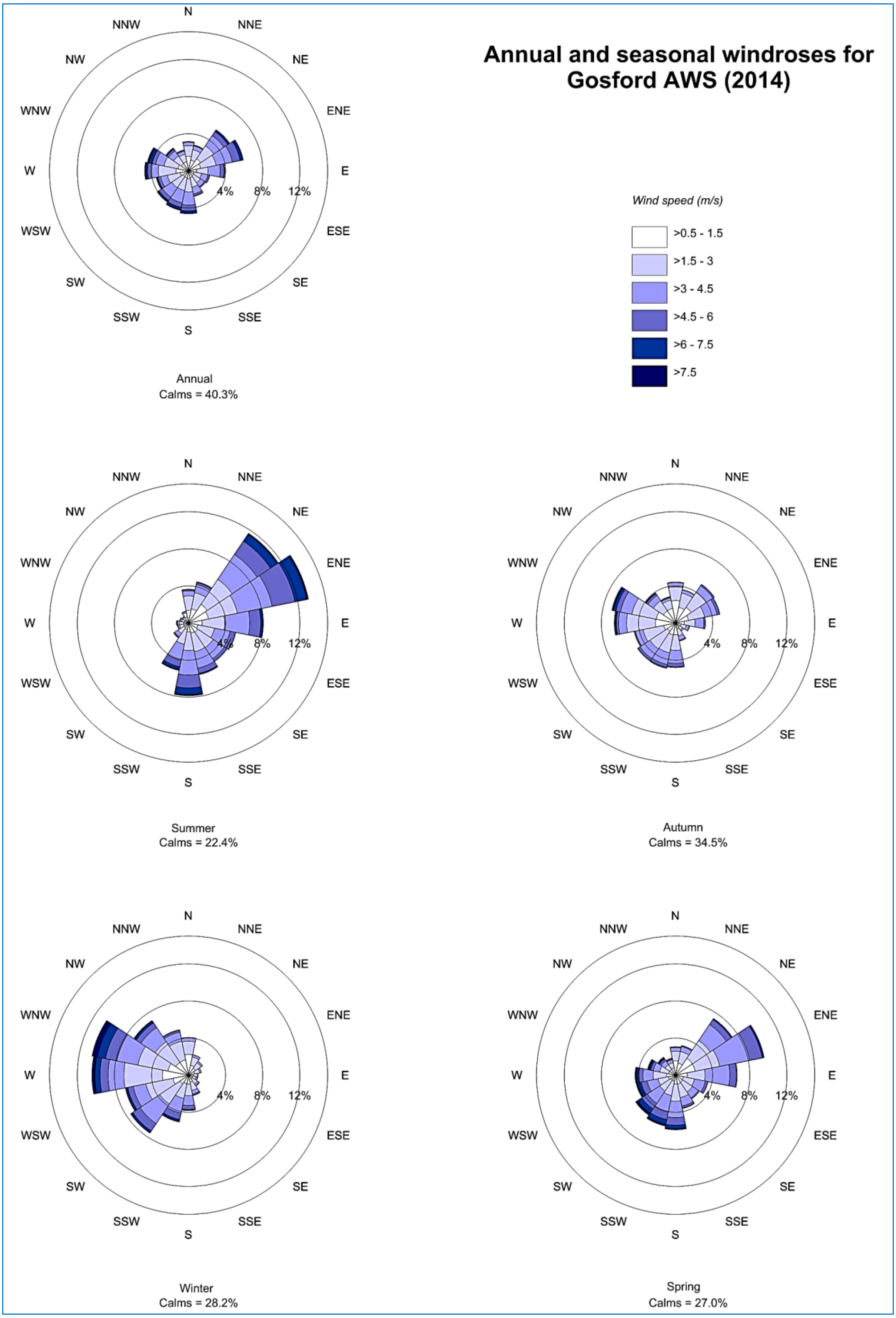


Figure 3.1: Annual and Seasonal Windroses for Gosford AWS (2014)

3.3 Local Air Quality

Air quality standards and goals refer to pollutant levels that include the contribution from specific projects and existing sources.

There has been no air quality monitoring undertaken specifically for this Project, and the closest NSW Office of Environment and Heritage (OEH) monitoring sites are located over 50 km away at Beresfield, Newcastle and Wallsend, north-east of the Project. These locations were considered more representative of the existing air quality in the Project area than monitoring locations south-west of the site in the Sydney region.

Data is collected at the Beresfield, Newcastle and Wallsend sites for the following pollutants which are of relevance to this study: particulate matter (PM_{10} and $PM_{2.5}$). These sites were selected as they are the closest OEH monitoring locations to the site. Further they are in comparable locations to the coastline and Pacific Highway. It is expected that these locations will have higher background ambient levels given the proximity to the industry in Newcastle, however this will be provide a conservative estimation for air quality at the proposed facility.

Monitoring data collected at these stations have been reviewed in this section with the most recent year of data (2015) used to obtain an indication of the ambient background levels in the proximity of the Project.

3.3.1 PM_{10} Concentrations

There are no onsite monitoring data for PM_{10}, $PM_{2.5}$, TSP or dust deposition. The closest and most representative site was deemed to be at Wallsend, which is approximately 52 km north-east of the proposed site. There are an additional two OEH monitoring sites located in close proximity to the Wallsend monitoring location at Newcastle and Beresfield. A summary of the data from these monitoring sites are presented in **Figure 3.2**.

The maximum 24-hour average PM_{10} concentrations occurred in April and September 2009 and are associated with regional dust storms that affected a widespread area of NSW (April 2009) and the eastern coast of Australia (September 2009). There is also an exceedance at all three sites on May 6th 2015 which is likely attributed to a dust storm experienced in Victoria and western NSW (**OEH, 2015**). Other exceedances may be attributed to bushfires, high winds or other local events. Though generally, the 24-hour average PM_{10} concentrations remain below the relevant air quality criteria (**NSW EPA, 2005**).

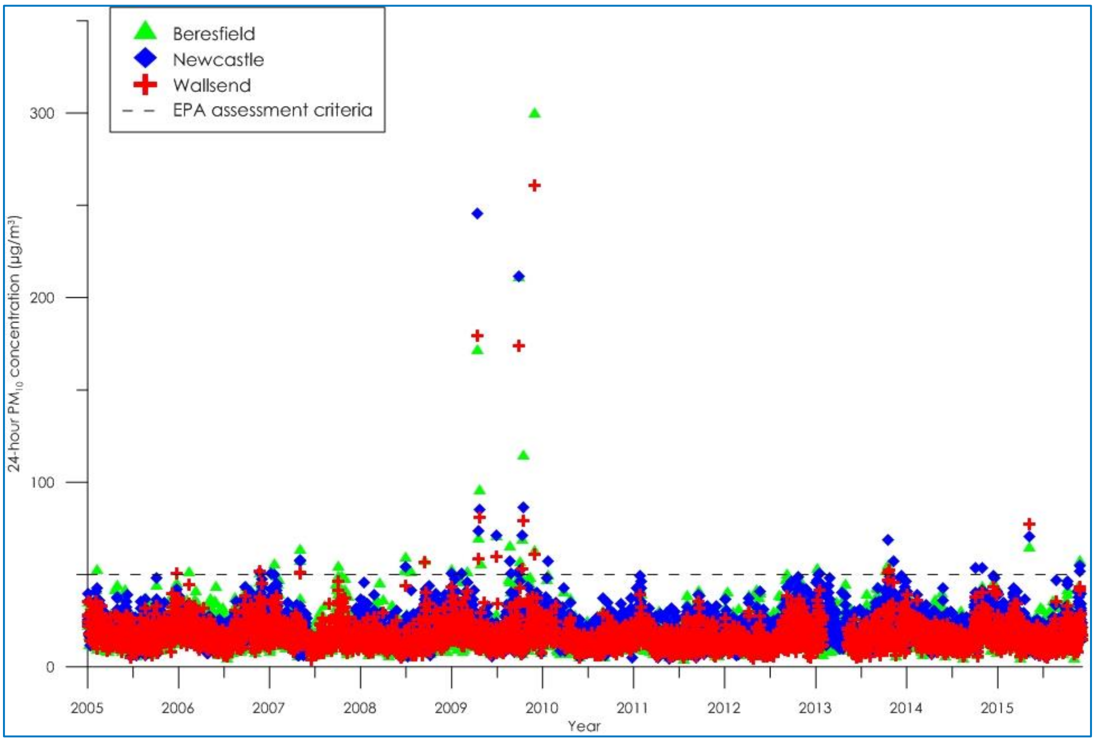


Figure 3.2: 24-hour average PM_{10} concentrations for Jan 2005 to Dec 2015

Annual average concentrations of PM_{10} are largely below the relevant air quality goals for the monitoring period, with the exception of Newcastle in 2009 (refer **Table 3.2**). Much of NSW experienced elevated average annual PM_{10} concentrations during 2009 as a result of generally drier and hotter conditions, and a number of significant dust storm events. The average annual PM_{10} at the monitoring site (Wallsend) is 17 µg/m³. Due to the surrounding residential and industrial sites in Wallsend, this is a highly conservative estimate of PM_{10} concentrations at the project site. Furthermore, for conservatism all stated exceedances have been maintained in the values used as background PM_{10} concentrations.

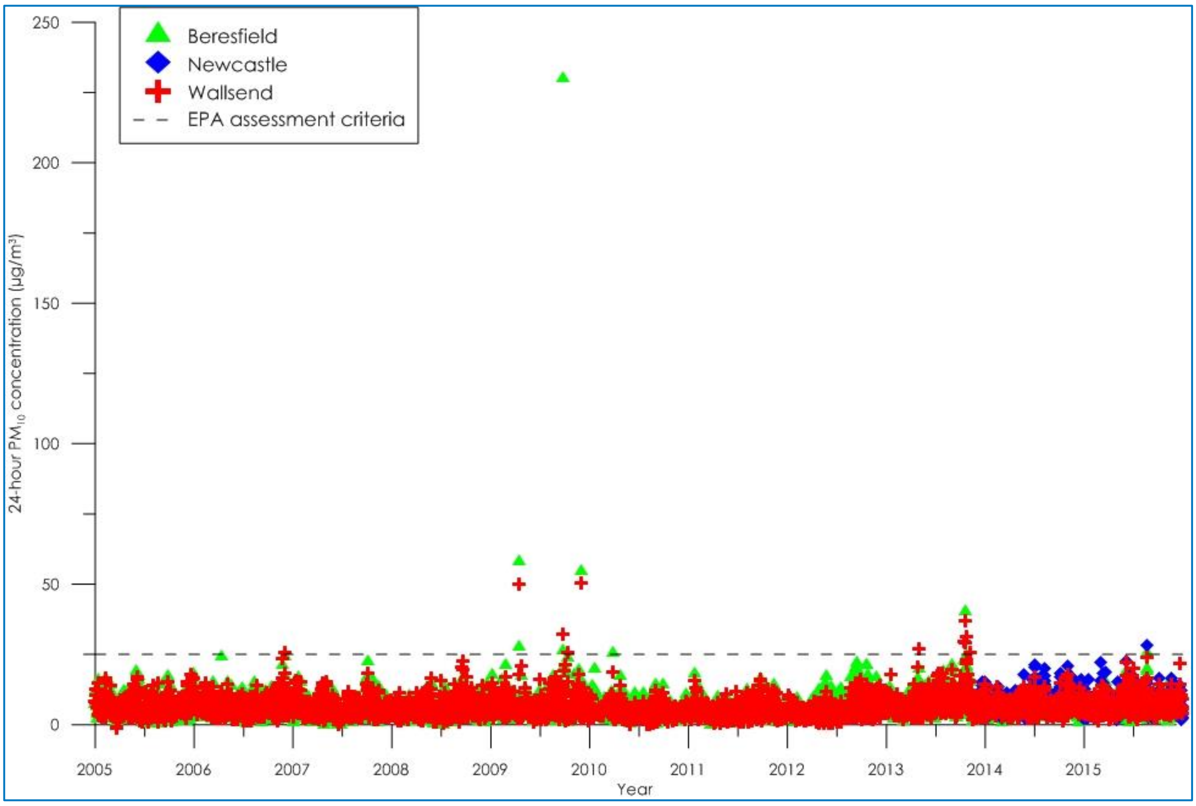
Table 3.2: Summary of Annual average PM_{10} from closest OEH Monitoring Sites

	Annual Average PM_{10} (µg/m³)		
Date	**Wallsend**	**Newcastle**	**Beresfield**
EPA Impact Assessment Criteria= 30 µg/m³			
2005	18.2	21.7	20.3
2006	18.6	21.1	21.2
2007	17.4	22.8	20.4
2008	15.7	20.5	18.4
2009	26.9	**31.9**	28.9
2010	14.7	18.6	16.6
2011	14.2	19.1	17.2
2012	14.9	20.6	21.3
2013	17.4	22.7	21.4
2014	16.9	21.4	19.4
2015	16.7	21.4	18.8
Average	**17.4**	**21.9**	**20.4**

3.3.2 $PM_{2.5}$ Concentrations

The closest publicly available $PM_{2.5}$ data are also from the OEH site at Wallsend. A summary of the Wallsend, Beresfield and Newcastle OEH data are presented in **Figure 3.3** and **Table 3.3**.

The maximum 24-hour average $PM_{2.5}$ concentrations occurred in April and September 2009 and are associated with regional dust storms that affected a widespread area of NSW (April 2009) and the eastern coast of Australia (September 2009). There is also an exceedance at all three sites on May 6th 2015 which can likely be attributed to a dust storm experienced in Victoria and western NSW (**OEH, 2015**). Any other exceedances such as those measured in 2013 might be caused by bushfires or other local events. Generally the 24-hour average $PM_{2.5}$ concentrations remain below the relevant air quality criteria.



Note: $PM_{2.5}$ data from Newcastle monitoring station only available from 20/12/2013.

Figure 3.3: 24-hour average $PM_{2.5}$ concentrations for Jan 2005 to Dec 2015

Annual average concentrations of $PM_{2.5}$ are generally below the relevant air quality goals for the monitoring period, with a few exceedances in 2009, 2013 and 2014 (refer **Table 3.3**). Much of NSW experienced elevated average annual $PM_{2.5}$ concentrations during 2009 for the reasons previously discussed in **Section 3.3.1**. The 2013 and 2014 exceedances may be due to major bushfire events and hazard reduction burns, or wood heater emissions. The average annual $PM_{2.5}$ at the closest monitoring site (Wallsend) is 6 µg/m³. For the purposes of this report the Wallsend average will be used, however as with the PM_{10} concentration adopted as background, this value is extremely conservative and all exceedances have been included for conservatism.

Table 3.3: Summary of annual average $PM_{2.5}$ from closest OEH monitoring sites

	Annual Average $PM_{2.5}$ (µg/m³)		
Date	**Wallsend**	**Newcastle**	**Beresfield**
EPA Criteria	**8 µg/m³**		
2005	6.5	-	6.8
2006	6.4	-	6.8
2007	5.8	-	6.3
2008	5.9	-	6.0
2009	**8.1**	**-**	**8.5**
2010	4.6	-	6.0
2011	4.8	-	5.5
2012	5.1	-	7.9
2013	7.7	**8.8**	**8.2**
2014	6.7	**8.1**	7.5
2015	7.3	7.8	7.3
Average	**6.2**	**8.0**	**7.0**

The Wallsend OEH site is the closest available data and has therefore been used as the background value for $PM_{2.5}$. This value is considered conservative as the data are influenced by local industrial activity and vehicle emissions

3.3.3 TSP Concentrations

No TSP concentration data are available in the vicinity of the Project. However, annual average TSP concentrations can be estimated from the PM_{10} measurements by assuming that 40% of the TSP is PM_{10}. This relationship was obtained from data collected by co-located TSP and PM_{10} monitors operated for long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**). In the absence of any other data, use of this relationship indicates that annual average TSP concentrations are in the order of 43 µg/m^3, which is less than the EPA assessment criterion of 90 µg/m^3.

3.3.4 Dust Deposition

Background values for dust deposition in close proximity to the Project are not available, so data from Calga Sands Quarry were used. The Calga Sands Quarry is located approximately 20 km south-west of the site on Peats Ridge Rd, Calga, currently operating under their Environmental Protection Licence (EPL 11295). Annual averages from 6 dust deposition gauges around the Calga Sands Quarry are shown in **Table 3.4** (**Hanson, 2007-2015**).

Table 3.4: Dust Deposition at Calga Sands Quarry (Hanson, 2006-2015)

Year	Insoluble Solids (g/m^2/month)					
	D1	D2	D3	D4	D5	D6
2007	1.2	1.7	0.9	1.2	0.9	1.2
2008	1.0	1.6	0.6	0.8	0.7	1.1
2009	2.0	2.6	1.6	1.3	1.3	2.0
2010	1.3	1.1	0.5	0.5	0.5	0.7
2011	2.0	0.8	0.8	0.4	0.3	0.5
2012	1.8	1.3	1.3	0.5	0.3	0.5
2013	1.4	2.3	2.4	0.5	0.4	0.6
2014	1.0	1.1	1.4	0.7	0.5	0.8
2015	1.3	1.8	0.8	0.6	0.6	0.6
Average	**1.4**	**1.5**	**1.1**	**0.7**	**0.6**	**0.9**

The data in **Table 3.4** shows that all of the six sites reported average levels below the EPA annual average 4 g/m^2/month dust fallout criterion. In terms of estimating an existing background deposition level the values for D4, D5 and D6 are furthest removed from the quarry and are more likely to be less influenced by the operations there. The average across these three gauges is approximately 0.7 g/m^2/month over the monitoring period presented. The average background dust deposition level for the project has therefore been estimated at 0.7 g/m^2/month.

3.3.5 Summary of Background Data

In summary, for the purposes of assessing potential air quality impacts, the following existing air quality levels are assumed.

- Annual average PM_{10} concentration of 17 µg/m3.
- Annual average $PM_{2.5}$ concentration of 6 µg/m3.
- Annual average TSP concentration of 43 µg/m3.
- Annual average dust deposition of 0.7 g/m^2/month.

4 CONSTRUCTION IMPACTS

4.1 Overview

This section deals with the potential impacts of the construction phase of the project. The main air pollution and amenity issues at construction sites are:

- Annoyance due to dust deposition (soiling of surfaces) and visible dust plumes.
- Elevated PM_{10} concentrations due to dust-generating activities[a].
- Exhaust emissions from diesel-powered construction equipment[b].

Very high levels of soiling can also damage plants and affect the diversity of ecosystems.

It is very difficult to quantify dust emissions from construction activities. Due to the variability of the weather it is impossible to predict what the weather conditions would be when specific construction activities are undertaken. Any effects of construction on airborne particle concentrations would also generally be temporary and relatively short-lived. Moreover, mitigation should be straightforward, as most of the necessary measures are routinely employed as 'good practice' on construction sites. It is therefore usual to provide a qualitative assessment of potential construction dust impacts. A largely qualitative approach has also been used, and the impacts of construction have not been specifically modelled. The approach used for this assessment is based on that described by **IAQM (2014)**. The aim is to identify risks and to recommend appropriate mitigation measures.

The IAQM guidance is designed primarily for use in the UK, although it may be applied elsewhere. Here, the guidance has been adapted for use in NSW, taking into account factors such as the assessment criteria for ambient PM_{10} concentrations.

4.2 Construction Activities

A wide range of construction equipment is likely to be used for the construction of the Project and the associated infrastructure. This includes:

- Cranes
- Excavators
- Piling rigs
- Heavy vehicles
- Rollers and compactors
- Front end loader

Construction of the maintenance facility is expected to commence in Quarter 3 of 2016, with completion scheduled for Quarter 2 in 2019. The assessment of each construction activity in isolation could lead to an underestimation of risk. Therefore, for the construction assessment the activities were combined according to the single worst case scenario.

[a] There are other potential impacts, such as the release of heavy metals, asbestos fibres or other pollutants during the removal of contaminated soils.

[b] Exhaust emissions from on-site plant and site traffic are unlikely to have a significant impact on local air quality, and in the majority of cases they will not need to be quantitatively assessed (**IAQM, 2014**).

4.3 Assessment Procedures

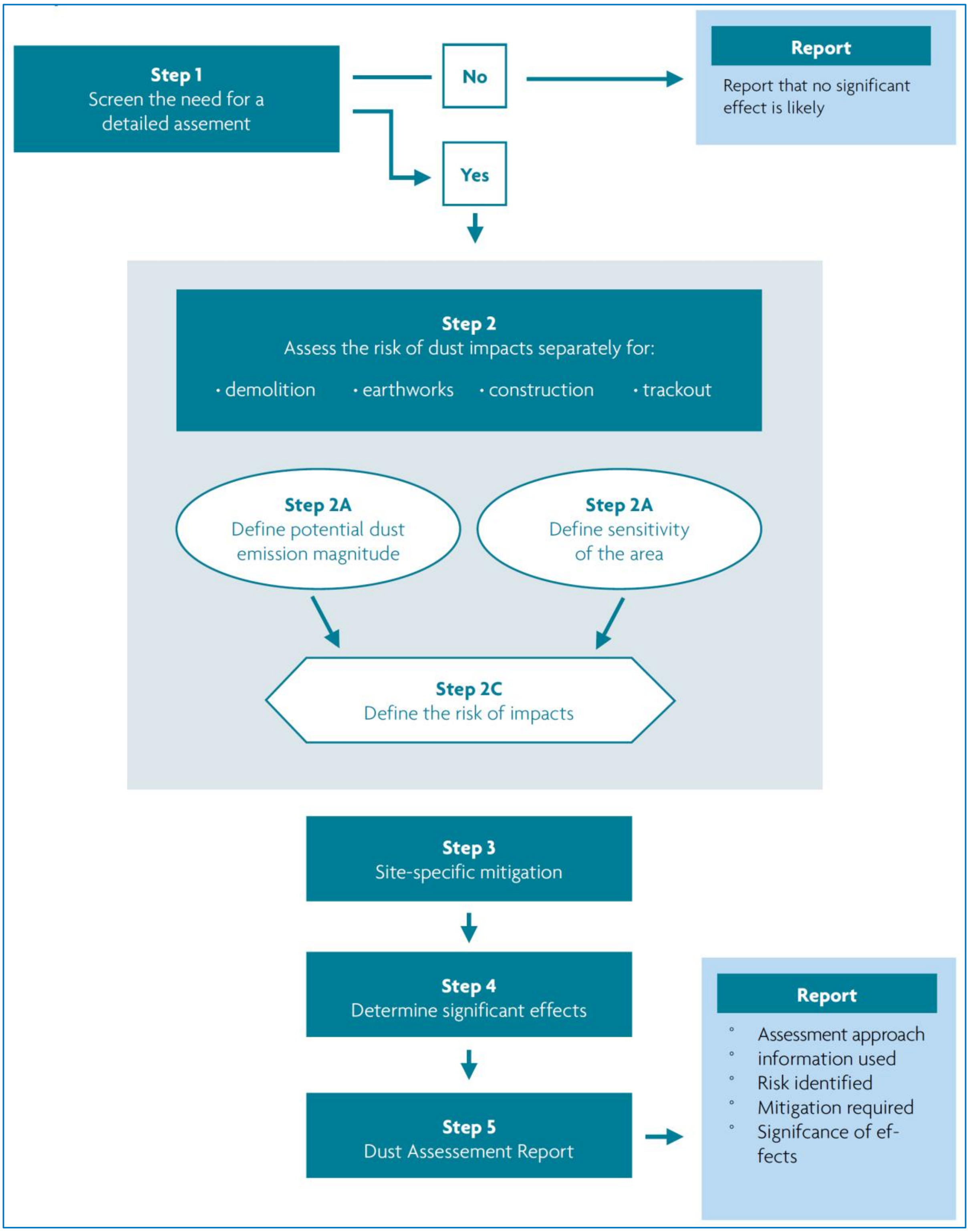
Activities on construction sites can be divided into four types to reflect their different potential impacts, and the potential for dust emissions is assessed for each activity that is likely to take place. These activities are presented in **Figure 4.1** and stated below.

- *Demolition*. Demolition is any activity that involves the removal of existing structures. This may also be referred to as de-construction, specifically when a building is to be removed a small part at a time.
- *Earthworks*. This covers the processes of soil stripping, ground levelling, excavation and landscaping. Earthworks will primarily involve excavating material, haulage, tipping and stockpiling.
- *Construction*. Construction is any activity that involves the provision of new structures, modification or refurbishment. A structure will include a residential dwelling, office building, retail outlet, road, *etc*.
- *Track-out.* This involves the transport of dust and dirt by HDVs from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network.

The assessment methodology considers three separate dust impacts:

- Annoyance due to dust soiling;
- The risk of health effects due to an increase in exposure to PM_{10}; and
- Harm to ecological receptors.

The assessment is used to define appropriate mitigation measures to ensure that there will be no significant effect.



Source: **IAQM, 2014**

Figure 4.1: Steps in an Assessment of Construction Dust

4.4 Step 1: Screening

A construction dust assessment will normally be required where:

- There are human receptors within 350 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).
- There are ecological receptors within 50 m of the boundary of the site and/or within 50 m of the route(s) used by construction vehicles on the public highway, up to 500 m from the site entrance(s).

A 'human receptor', refers to any location where a person or property may experience the adverse effects of airborne dust or dust soiling, or exposure to PM_{10} over a time period relevant to air quality standards and goals. In terms of annoyance effects, this will most commonly relate to dwellings, but may also refer to other premises such as buildings housing cultural heritage collections (e.g. museums and galleries), vehicle showrooms, food manufacturers, electronics manufacturers, amenity areas and horticultural operations (e.g. salad or soft-fruit production). An 'ecological receptor' refers to any sensitive habitat affected by dust soiling. This includes the direct impacts on vegetation or aquatic ecosystems of dust deposition, and the indirect impacts on fauna (e.g. on foraging habitats) **(IAQM, 2014).**

Construction activities for the development of the intercity fleet maintenance facility is expected to occur between the Pacific Highway and Enterprise Drive. There are a number of residential and commercial receptors in the vicinity of the proposed works and hence human receptors have been assessed in the construction assessment.

In addition to these human receptors, the proposed maintenance facility is located nearby to ecological receptor, Ourimbah Creek. Due to potential construction impacts on these identified receptors, a step two risk assessment has been performed in **Section 4.5** below. **Figure 4.2** presents a depiction of the nearest receptors (< 20 m from the works), based upon information provided in the Pre-Concept Design Report (**AECOM, 2016**).

Figure 4.2: Selected Receptors for the Construction Assessment

4.5 Step 2: Risk Assessment

In Step 2 the risk of dust arising in sufficient quantities to cause annoyance and/or health effects was determined separately for each scenario and each of the four activities (demolition, earthworks, construction, and track-out). Risk categories were assigned to the site based on two factors:

- The scale and nature of the works, which determines the magnitude of potential dust emissions. This is assessed in Step 2A.
- The sensitivity of the area. The proximity of sensitive receptors (*i.e.* the potential for effects). This is assessed in Step 2B.

These factors are combined in Step 2C to give the risk of dust impacts. Risks are described in terms of there being a low, medium or high risk of dust impacts for each of the four separate potential activities. Where there is risk of an impact, then site-specific mitigation will be required in proportion to the level of risk.

4.5.1 Step 2A: Potential for Dust Emissions

The criteria for assessing the potential scale of emissions based on the scale and nature of the works are shown in **Table 4.1**. Based on these criteria, the appropriate categories for the Project are shown in **Table 4.2**.

Table 4.1: Site Categories (scale of works) (from IAQM, 2014)

Type of Activity	Site Category		
	Large	Medium	Small
Demolition	Building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level.	Building volume 20,000–50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level.	Building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding, timber), demolition activities <10 m above ground and during wetter months.
Earthworks	Site area >10,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth-moving vehicles active at any one time, formation of bunds>8 m in height, total material moved >100,000 tonnes.	Site area 2,500-10,000 m^2, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4-8 m in height, total material moved 20,000-100,000 tonnes.	Site area <2,500 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4 m in height, total material moved <20,000 tonnes, earthworks during wetter months.
Construction	Total building volume >100,000 m^3, piling, on site concrete batching; sandblasting	Building volume 25,000-100,000 m^3, potentially dusty construction material (e.g. concrete), piling, on site concrete batching.	Total building volume <25,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Track-out	>50 HDV (>3.5t) OUTWARD movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.	10-50 HDV (>3.5t) OUTWARD movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50–100 m.	<10 HDV (>3.5t) OUTWARD movements in any one day, surface material with low potential for dust release, unpaved road length <50 m.

Table 4.2: Site Categories for New Intercity Fleet Maintenance Facility

Type of Activity	Construction Phase Category
Demolition	N/A (no/minor demolition)
Earthworks	Large
Construction	Large (accounting for bridge construction)
Track-out	Large

4.5.2 Step 2B: Sensitivity of Area

The sensitivity of the area takes into account the specific sensitivities of local receptors, the proximity and number of the receptors, and the local background PM_{10} concentration. Dust soiling and health impacts are treated separately.

4.5.2.1 Sensitivity of Area to Dust Soiling Effects on People and Property

The criteria for determining the sensitivity of an area to dust soiling effects are shown in **Table 4.3**. Based on the IAQM guidance[c] the receptor sensitivity was assumed to be 'high'.

Table 4.3: Criteria for Sensitivity of Area to Dust Soiling Effects (from IAQM, 2014)

Receptor Sensitivity	Number of Receptors	Distance from Source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

The number of receptors in each distance band were estimated from an aerial photograph of the site with receptor locations (**Figure 4.2**). The exact counting of the number of 'human receptors' is not required by the IAQM guidance. Instead it is recommended that judgement is used to determine the approximate number of receptors within each distance band.

The numbers of receptors for each scenario and activity, and the resulting outcomes are shown in **Table 4.4**.

Table 4.4: Results - Sensitivity to Dust Soiling Effects of People and Property

Scenario	Activity	Receptor Sensitivity	Number of Receptors by Distance from Source				Sensitivity of Area
			<20 m	20-50 m	50-100 m	100-350 m	
Construction	Demolition	N/A	N/A	N/A	N/A	N/A	N/A
	Earthworks	Medium	≈ 15	< 10	> 10	> 10	High
	Construction	Medium	≈ 15	< 10	> 10	> 10	High
	Track-out	Medium	≈ 15	< 10	> 10	> 10	High

[c] Professional judgement is used to identify where on the spectrum between high and low sensitivity a receptor lies. High sensitivity receptors can reasonably expect enjoyment of a high level of amenity. The appearance, aesthetics or value of their properties would be diminished by soiling, and the people or properties would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land. Indicative examples include dwellings, museums and other culturally important collections, medium and long term car parks and car showrooms.

4.5.2.2 Sensitivity of Area to Human Health Impacts

The criteria for determining the sensitivity of an area to health impacts are shown in **Table 4.5.** Based on the IAQM guidance[d] and existing air quality from **Section 3**, the receptor sensitivity was assumed to be 'high'. The numbers of receptors for each scenario and activity, and the resulting outcomes are shown in **Table 4.6**.

Table 4.5: Criteria for Sensitivity of Area to Health Impacts (from IAQM, 2014)

Receptor Sensitivity	Annual mean PM_{10} conc. (µg/m³)[(a)]	Number of Receptors	Distance from Source (m)				
			<20	<50	<100	<200	<350
High	>24	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-24	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	18-21	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<18	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

(a) Scaled to Sydney according to the ratio of NSW and UK annual mean standards (30 µgm/³ and 40 µgm/³ respectively).

Table 4.6: Results - Sensitivity to Health Impacts

Activity	Receptor Sensitivity	Annual mean PM_{10} conc. (µg/m³)	Number of Receptors by Distance from Source					Sensitivity of Area
			<20 m	20-50 m	50-100 m	100-200 m	100-350 m	
Demolition	Medium	< 18	N/A	N/A	N/A	N/A	N/A	N/A
Earthworks	Medium	< 18	≈ 15	< 10	> 10	> 10	> 10	Low
Construction	Medium	< 18	≈ 15	< 10	> 10	> 10	> 10	Low
Track-out	Medium	< 18	≈ 15	< 10	> 10	> 10	> 10	Low

4.5.3 Step 2C: Risk of Dust Impacts

The dust emission potential determined in Step 2A is combined with the sensitivity of the area determined in Step 2B to give the risk of impacts with no mitigation applied. The criteria are shown in **Table 4.7**.

[d] The sensitivity of people to the health effects of PM_{10} is based on exposure to elevated concentrations over a 24-hour period. High sensitivity receptors relate to locations where members of the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). Indicative examples include residential properties. Hospitals, schools and residential care homes should also be considered as having equal sensitivity to residential areas for the purposes of this assessment.

Table 4.7: Criteria for Sensitivity of Area to Health Impacts

Type of Activity	Sensitivity of Area	Dust Emission Potential		
		Large	Medium	Small
Demolition	High	High Risk	Medium Risk	Medium Risk
	Medium	High Risk	Medium Risk	Low Risk
	Low	Medium Risk	Low Risk	Negligible
Earthworks	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Medium Risk	Low Risk
	Low	Low Risk	Low Risk	Negligible
Construction	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Medium Risk	Low Risk
	Low	Low Risk	Low Risk	Negligible
Track-out	High	High Risk	Medium Risk	Low Risk
	Medium	Medium Risk	Low Risk	Negligible
	Low	Low Risk	Low Risk	Negligible

Source**: IAQM, 2014**

The final results for the Step 2 risk assessment are provided in **Table 4.8**. As there is no demolition to occur, air quality impacts are not applicable to this activity. The area is assessed as having low sensitivity to dust soiling, human health and ecological impacts caused by earthworks, construction and track-out. The risk of these impacts during all assessed works is predicted to be low.

Table 4.8: Summary of Risk Assessment for the Three Construction Scenarios

Type of activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of dust impacts		
		Dust soiling	Human health	Ecological	Dust soiling	Human health	Ecological
Demolition	Small	High	Low	N/A	Medium Risk	Negligible	N/A
Earthworks	Large	High	Low	Low	High Risk	Low Risk	Low Risk
Construction	Large	High	Low	Low	High Risk	Low Risk	Low Risk
Track-out	Large	High	Low	Low	High Risk	Low Risk	Low Risk

4.6 Step 3: Mitigation

Step 3 involved determining mitigation measures for each of the four potential activities in Step 2. This was based on the risk of dust impacts identified in Step 2C.

The results are shown in **Table 4.9** to **Table 4.13**. Most of the recommended measures are routinely employed as 'good practice' on construction sites. At the Project, particular attention should be paid to controlling dust generated by earthworks and track-out due to the potential risk level of these activities compared to construction (and demolition).Mitigation measures will be applied where reasonable and feasible during the construction phase of the Project.

A Dust Management Plan should be produced to cover the construction of the New Intercity Fleet Maintenance Facility. This should contain details of the site-specific mitigation measures to be applied. Additional guidance on the control of dust at construction sites in NSW is provided as part of the NSW

EPA Local Government Air Quality Toolkit[e]. Detailed guidance is also available from the UK **(GLA, 2006)** and the United States **(Countess Environmental, 2006)**.

Table 4.9: Mitigation for all sites: Communications

Mitigation measure		Action for site risk
1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	Highly recommended
2	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	Highly recommended
3	Display the head or regional office contact information	Highly recommended

Table 4.10: Mitigation for all sites: Dust management

Mitigation measure		Action for site risk
4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the local authority. The level of detail will depend on the risk, and should include as a minimum the highly recommended measures in this document. The desirable measures should be included as appropriate for the site. The DMP may include monitoring of dust deposition, dust flux, real time PM_{10} continuous monitoring and/or visual inspections.	Highly recommended
Site management		
5	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	Highly recommended
6	Make the complaints log available to the local authority when asked.	Highly recommended
7	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	Highly recommended
8	Hold regular liaison meetings with other high risk construction sites within 500m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.	Highly recommended
Monitoring		
9	Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.	Highly recommended
10	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked	Highly recommended

[e] http://www.epa.nsw.gov.au/air/lgaqt.htm

Mitigation measure		Action for site risk
11	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being out and during prolonged dry or windy conditions.	Highly recommended
12	Agree dust deposition, dust flux, or real-time PM_{10} continuous monitoring locations with the local authority. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	Highly recommended
Preparing and maintaining the site		
13	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	Highly recommended
14	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.	Highly recommended
15	Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period	Highly recommended
16	Avoid site runoff of water or mud.	Highly recommended
17	Keep site fencing, barriers and scaffolding clean using wet methods.	Highly recommended
18	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.	Highly recommended
19	Cover, seed or fence stockpiles to prevent wind whipping.	Highly recommended
Operating vehicle/machinery and sustainable travel		
20	Ensure all on-road vehicles comply with the requirements of the London Low Emission Zone and the London NRMM standards, where applicable	Highly recommended
21	Ensure all vehicles switch off engines when stationary - no idling vehicles.	Highly recommended
22	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.	Highly recommended
23	Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate)	Highly recommended
24	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	Highly recommended
25	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	Highly recommended
Construction Operations		
26	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	Highly recommended
27	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	Highly recommended

Mitigation measure		Action for site risk
28	Use enclosed chutes and conveyors and covered skips.	Highly recommended
29	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	Highly recommended
30	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	Highly recommended
Waste management		
31	Avoid bonfires and burning of waste materials	Highly recommended

Table 4.11: Mitigation Specific to Earthworks

Mitigation measure		Action for site risk
36	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	Highly recommended
37	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	Highly recommended
38	Only remove the cover in small areas during work and not all at once.	Highly recommended

Table 4.12: Mitigation Specific to Construction

Mitigation measure		Action for site risk
39	Avoid scrabbling (roughening of concrete surfaces) if possible.	Highly recommended
40	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	Highly recommended
41	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	Highly recommended
42	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.	Desirable

Table 4.13: Mitigation Specific to Track-out

	Mitigation measure	Action for site risk
43	Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.	Highly recommended
44	Avoid dry sweeping of large areas.	Highly recommended
45	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	Highly recommended
46	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	Highly recommended
47	Record all inspections of haul routes and any subsequent action in a site log book.	Highly recommended
48	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	Highly recommended
49	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	Highly recommended
50	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	Highly recommended
51	Access gates to be located at least 10m from receptors where possible.	Highly recommended

4.7 Step 4: Significance of Risks

Once the risk of dust impacts has been determined in Step 2C (see **Section 4.5.3**) and the appropriate dust mitigation measures identified in Step 3 (see **Section 4.6**), the final step is to determine whether there are residual significant effects arising from the construction phase of a proposed development. For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant' **(IAQM, 2014)**.

However, even with a rigorous Dust Management Plan in place, it is not possible to guarantee that the dust mitigation measures will be effective all the time. There is the risk that the on-site office buildings, as well as the small number of residential properties and businesses in the immediate vicinity of the site boundary, might experience some occasional dust soiling impacts. This does not imply that impacts are likely, or that if they did occur, that they would be frequent or persistent. Given the nature of the construction works and the distance of the majority of the receptors from the works, overall construction dust is unlikely to represent a serious ongoing problem. Any effects would be temporary and relatively short-lived, and would only arise during dry weather with the wind blowing towards a receptor, at a time when dust is being generated and mitigation measures are not being fully effective. The likely scale of this would not normally be considered sufficient to change the conclusion that with mitigation the effects will be 'not significant'.

5 CONCLUSIONS

Regardless of the predicted minimal air quality impact of the project's construction on local air quality, it is recommended that the following general mitigation measures be implemented during the 33 month construction period:

- Methods to monitor the effects of construction activities.
- Measures required to minimise dust and vehicle emissions during the construction of the project.

Recommended mitigation measures (in addition to those previously mentioned in **Section 4.6**) to reduce potential emissions during construction activities are listed below and represent best practice management tools for construction site dust control.

- The number and sizes of stockpiles will be kept to a minimum.
- Dust suppression shall be undertaken during construction and clearing activities, particularly during high wind conditions. Haul roads and other unsealed areas may be watered to suppress dust.
- Ensure that all vehicles and machinery are fitted with appropriate emission control equipment, maintained frequently and serviced to the manufacturers' specification.
- Minimise construction equipment idling time.

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