

## 6 Environmental impact assessment

Chapter 6 of the REF provides a detailed description of the likely environmental impacts associated with the construction and operation of the Proposal. For each likely impact, the existing environment is characterised and then an assessment is undertaken as to how the Proposal would affect the existing environment.

This environmental impact assessment has been undertaken in accordance with clause 228 of the EP&A Regulation. A checklist of clause 228 factors and how they have been specifically addressed in this REF is included at **Appendix B**.

### 6.1 Traffic and transport

This section assesses and describes the impacts of the proposal on traffic, transport and pedestrian and cyclist access surrounding Waterfall Station. This assessment is based on a desktop analysis. Detailed traffic counts and modelling were not considered necessary as the Proposal is focused on the station area and is unlikely to have a major impact on the surrounding road network.

#### 6.1.1 Existing environment

##### Waterfall Station and access

Waterfall Station is on the T4 Illawarra and South Coast Line, providing Waterfall with links into the city as well as services south to the Illawarra and beyond. It also provides people with the opportunity to access and transfer between transport modes and services including cycling and private car.

Waterfall Station is the 186th busiest station on the Sydney Trains network, with a total of 500 passengers entering the station and 480 passengers exiting the station over a 24-hour weekday period in 2018 (Transport Performance and Analytics (TPA), 2018). The number of rail services stopping at Waterfall Station during the week and on weekends is shown in **Table 6.1**.

The station consists of an island platform with platforms on each side (Platforms 1 and 2). Platform 1 is located on the western side and Platform 2 is located on the eastern side. Both platforms are currently used for train services in each direction.

The main station entrance is from Kooraban Street and is currently accessible by a non-DDA compliant ramp. However, a DDA compliant pathway is available via a lift for customers to access both platforms from Kooraban Street.

Within the station area there are a number of existing facilities for customers including wheelchair accessible lift, ticket machines, Opal card readers, toilets including a wheelchair accessible toilet, payphone, bike racks, commuter car park, emergency help point, wheelchair accessible car spaces and a kiss and ride stopping area.

**Table 6.1 Waterfall Station - number and frequency of train services**

Service to/from	Operating days	Numbers of services per day	Service frequency
Waterfall to Bondi Junction	Monday to Friday	56	Every 30 min (approx.) in off peak Every 15 min (approx.) in peak

Service to/from	Operating days	Numbers of services per day	Service frequency
Waterfall to Bondi Junction	Weekends and Public Holidays	48	Every 30 min (approx.)
Bondi Junction to Waterfall	Monday to Friday	52	Every 30 min (approx.) in off peak Every 15 min (approx.) in peak
Bondi Junction to Waterfall	Weekends and Public Holidays	50	Every 30 min (approx.)
Bomaderry or Port Kembla to Bondi Junction	Monday to Friday	25	Every 60 mins (approx.)
Bomaderry or Port Kembla to Bondi Junction	Weekends and Public Holidays	21	Every 60 mins (approx.)
Bondi Junction to Port Kembla or Bomaderry	Monday to Friday	32	Every 60 min (approx.) in off peak Every 30 min (approx.) in peak
Bondi Junction to Port Kembla or Bomaderry	Weekends and Public Holidays	21	Every 60 mins (approx.)

### Road network and traffic

The local road network surrounding Waterfall Station includes the Princes Highway to the west and Kooraban Street and McKell Avenue to the south. The portion of the Princes Highway through Waterfall is classified as a state road which is managed by Transport for New South Wales (formerly Roads and Maritime Services), however the road reserve, and the local roads of Kooraban Street and McKell Avenue, are managed by SSC.

Kooraban Street is local collector road with an east-west alignment (south of the station) providing access to the station from Warabin Street (local access road). It has one lane in each direction and crosses over the Princes Highway and the railway.

McKell Avenue is a local access road, with one traffic lane in each direction. This road has a north-south alignment and provides access to the southern extent of the Royal National Park.

### Parking

A number of car parking facilities are present around Waterfall Station. The commuter car park on the corner of Kooraban Street and McKell Avenue provides 207 untimed car parking spaces, including seven DDA-compliant car parking spaces. Street parking is also available along both Kooraban Street and McKell Avenue, south of the station. A small amount of parking is also present on the exit ramp from the Princes Highway.

### Taxi waiting areas and kiss and ride facilities

There is currently no formal taxi rank provided at the station however there is a formal kiss and ride zone on McKell Avenue (near the entrance to the commuter car park).

## **Bus services**

No public bus services stop within walking distance of Waterfall Station.

## **Bicycle network and facilities**

There are no formalised cycle paths within the vicinity of the station. There is however provision for cyclists to utilise the emergency lane along the Princes Highway. The Princes Highway and Kooraban Street are popular with recreational cyclists who use the overpass as a safe way to turn around and cycle back towards the city, particularly on weekends.

There are also a series of fire trails within Royal National Park to the east of the station which are accessible to cyclists.

A bicycle storage facility is provided within the station precinct.

## **Pedestrian facilities**

Pedestrian access to Waterfall Station is provided from Kooraban Street (south) and also the commuter carpark, via a non-DDA compliant ramp and DDA-compliant lift. Footpaths are present on the eastern side of McKell Avenue and on the northern side of Kooraban Street. A footpath is also present on the eastern side of Warabin Street.

### **6.1.2 Potential impacts**

#### **Construction phase**

##### *Customer and public access*

Construction of the Proposal is expected to cause temporary disruptions to existing pedestrian facilities. During construction of the platform extension, the northern extent of the platform would be closed to pedestrians. The proposal would generate additional heavy vehicle traffic within the local road network which could also present an increased safety risk to pedestrians.

Disruptions during construction have the potential for increased safety risks for cyclists and pedestrians due to the potential interactions with construction plant and vehicles. Impacts to cyclists and pedestrians during construction would be managed through the development of a construction Traffic Management Plan (TMP) and associated Traffic Control Plans (TCPs) by the Contractor.

Pedestrian movement on the platform would be temporarily affected by the reduced amount of space available on the platform, particularly during the platform extension. This may temporarily increase pedestrian congestion and reduce the amount of standing area for customers; however the magnitude of this impact is likely to be minor given the relatively low patronage at Waterfall Station. Appropriate signage would be provided to mitigate any potential impacts to pedestrian movement on the platform.

##### *Road network and traffic*

The Proposal would generate additional traffic in the local area during construction. This would include construction traffic accessing compound sites and laydown areas as well as work sites. Proposed access points for the construction ancillary facilities are shown on Figure 3.11 to Figure 3.13. The number of construction vehicles would fluctuate depending on the construction stage. Vehicle types are expected to generally consist of light vehicles from construction workers and heavy vehicles for delivery and removal of materials, plant and equipment.

Traffic modelling has not been prepared for this assessment however construction heavy vehicles have been estimated as approximately one to 12 vehicles per day, Monday to Saturday. During the approximate nine days of rail possession works and other pre-planned

rail possessions, it is estimated that there would be five to 20 vehicles per day. Minor temporary increases in traffic would arise due to:

- delivery of construction materials, plant and equipment
- excavation material (spoil) removal
- movement of construction personnel
- operation of train replacement buses during weekend possessions and the approximate nine day shutdown period.

Some works, such as the construction of the new amenities building, may require temporary or partial lane closures and/or traffic diversions which may require road occupancy licence(s) (ROL).

#### *Construction vehicle routes*

The Princes Highway would serve construction vehicles travelling to Waterfall Station and the construction ancillary facilities from the north and south. Proposed access points for the construction ancillary facilities are shown on **Figure 3.11** to **Figure 3.13**.

#### *Parking*

There is the potential that construction staff may utilise existing on-street parking during the construction phase. This impact would be lower during shutdown periods where commuter services will not be running and hence public demand for parking is expected to be dramatically reduced. TfNSW would endeavour to minimise impacts to on-street parking and the commuter carpark by providing parking for construction staff within the rail corridor where possible. Construction workers would also be encouraged to car-pool or utilise public transport services where and when available.

Overall, with the current availability of on-street and off-street parking surrounding Waterfall Station, the impact of a decrease in availability of on-street parking in the short term would be minor.

#### *Kiss and ride facility*

The Waterfall Station kiss and ride facility would remain operational but may be affected if temporary road diversions or closures are required. During shutdown periods the demand for this facility would dramatically decrease, heavily reducing the overall impact of any construction activities. Overall, the impact upon this function of this facility is considered to be negligible.

#### *Bicycle network and facilities*

As outlined above, the emergency lane of the Princes Highway may need to be temporarily closed during the construction of the amenities building and associated retaining wall. This would limit the use of this lane by cyclists and would force them to occupy a traffic lane through this area. This would present an increased safety risk to cyclists which would be managed via the TMP and TCPs.

The proposal would generate additional heavy vehicle traffic within the local road network which could also present an increased safety risk to cyclists.

### **Operational phase**

A summary of the operational traffic, transport and access impacts is presented below.

#### *Customer and public access*

The Proposal would not alter the existing public access to the station.

### *Road network and traffic*

As trains currently departing Waterfall have spare passenger capacity, the operation of the proposal would not be expected to induce further demand specifically as a result of increased service frequency. As such the Proposal would not substantially alter the existing surrounding road network or traffic levels.

The Proposal would require additional operational maintenance for the collection of rubbish from the new stabling yard, as well as deliveries and staff access for cleaning and maintenance. The additional traffic generated by these activities would be fewer than 20 vehicles per day, which would not substantially alter traffic levels.

### *Parking*

The Proposal would not directly alter the number of parking spaces available within or around the station. As outlined above, trains currently departing Waterfall have spare passenger capacity and as such the operation of the proposal (including increased service frequency) would not be expected to induce further demand. On this basis it is not expected that there would be any increased demand on the existing commuter car park and on-street and off-street parking around the station.

The proposal may also induce the requirement for additional cleaning, maintenance or security staff which may increase demand for parking at the station. Cleaning and security staff would however continue to utilise the eastern car parking facility within the rail corridor.

### *Kiss and ride facility*

The Proposal would not alter the operation of the existing kiss and ride facility.

### *Bus facilities*

There are no existing public bus services within the area surrounding the Proposal, however Waterfall Station forms part of the school bus route: S369 Sutherland Shire CS to Helensburgh via Holy Cross College.

### *Bicycle network and facilities*

The Princes Highway, Kooraban Street and McKell Avenue are commonly used by cyclists. The operation of the proposal would not alter cycling access to these roads, including any existing on-street parking.

At the existing truck stop on the Princes Highway one additional vehicle, a rubbish truck, would utilise this entry to the rail corridor. This would collect waste from a dumpster just inside the gate and would then reverse out before continuing south along the Princes Highway. This truck stop area is utilised by trucks and cars as a layover area. Given this level of existing use and that rubbish collection is expected to occur outside of peak periods, negligible impacts to cyclist safety are anticipated. The Proposal would therefore not have a significant impact on the bicycle network and facilities.

## **6.1.3 Mitigation measures**

The following mitigation measure would apply to the Proposal:

- a construction TMP would be prepared by the construction contractor in consultation with TfNSW and provided to SSC and Transport for New South Wales (formerly Roads and Maritime Services). The construction TMP would be the primary tool to manage potential traffic and pedestrian impacts associated with construction. At a minimum, the construction TMP would include:
  - ensuring adequate signage at construction work sites

- consideration of safety and accessibility for pedestrians and cyclists
  - ensuring adequate sight lines to allow for safe entry and exit from the site
  - managing impacts and changes to on and off street parking, and parking locations for construction workers
  - routes to be used by heavy construction-related vehicles to minimise impacts on sensitive land uses and businesses
  - details for relocating kiss and ride, taxi ranks and rail replacement bus stops if required, including appropriate signage to direct patrons, in consultation with the relevant bus/taxi operators. Particular provisions would also be considered for the accessibility impaired
  - measures to manage traffic flows around the area affected by the Proposal, including as required regulatory and direction signposting, line marking and variable message signs and all other traffic control devices necessary for the implementation of the TMP
- access to Waterfall Station, local businesses and residential properties would be maintained at all times (unless affected property owners have been consulted and appropriate alternative arrangements made)
  - consultation with the relevant road authorities would be undertaken during preparation of the construction TMP. The performance of all project traffic arrangements would be monitored during construction
  - communication would be provided to the community and local residents to inform them of changes to parking, pedestrian access and/or traffic conditions including vehicle movements and anticipated effects on the local road network relating to site works
  - heavy vehicle movements required as part of construction of the Proposal near Waterfall Public School would be restricted during peak times and school zone hours. It may also be necessary to undertake other construction activities, such as concrete pours, crane lifts and delivery of oversized materials, outside standard construction hours to minimise traffic disruption
  - access for emergency vehicles would be maintained in accordance with relevant requirements. Emergency services would be advised of all planned changes to traffic arrangements prior to applying the changes
  - road Occupancy Licences for temporary road closures would be obtained, where required.

Refer to **Table 7.1** for a full list of proposed mitigation measures.

## 6.2 Landscape and visual amenity

A Landscape Character and Visual Impact Assessment was undertaken by AECOM for the Proposal (AECOM, 2019). The assessment included desktop analysis, site inspection, visual envelope mapping, creation of photomontages and detailed impact assessment. The findings of the assessment are summarised in this section.

There is no accepted National published guidance on LVIA specific to Australia. Therefore, the industry typically refers to guidance from elsewhere for producing LVIA. The method for this assessment has been developed with reference to Guidelines for Landscape and Visual Impact Assessment (GLVIA3), Third Edition (2013), developed by the Landscape Institute and Institute for Environmental Management (UK). GLVIA3 is widely recognised as comprising an example of 'best practice' in this field. In accordance with this guideline, an impact grading matrix was used to assess both landscape and visual impacts. The sensitivity and magnitude

of the impact was determined to produce a combined impact rating of negligible, low, moderate-low, moderate, high-moderate and high (refer to **Table 6.2**).

**Table 6.2 Landscape character and visual impact grading matrix**

	Magnitude				
		High Change	Moderate Change	Low Change	Negligible change
Sensitivity	High	High	High-moderate	Moderate	Negligible
	Moderate	High-moderate	Moderate	Moderate-low	Negligible
	Low	Moderate	Moderate-low	Low	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

### 6.2.1 Existing environment

#### Landscape character

Waterfall Station is located in the suburb of Waterfall within the Sutherland Shire. The suburb comprises a small island of development within a large area of surrounding contiguous bushland, comprising Heathcote National Park and the Woronora Dam drinking water catchment to the west, and the Royal National Park to the east. Due to the close proximity of the two national parks, there is an abundance of native vegetation within close proximity of the Proposal. The suburb of Waterfall contains patches of urban exotic/native vegetation, primarily within private gardens and street verges.

The landscape character surrounding the western side of Waterfall Station is typical of a suburban residential setting. The residential area to the west of the station, along the Princes Highway, consists of low density housing and the local take-away store, 'Legendary Fish & Chips'.

South-east of the Proposal is the Waterfall Station car park, which includes an access to the Uloola Fire trail within the Royal National Park (for walkers and cyclists). The station is bounded by the Princes Highway to the west, which is the area's main vehicular thoroughfare, and Kooraban Street to the south, which provides a vehicular and pedestrian connection across the rail corridor and into the Royal National Park.

#### Visual receivers

Visual receivers are individuals and/or groups of people whose views may be affected by the Proposal. These include users of residential dwellings, commercial properties, community facilities, road corridors and pedestrian footpaths.

The area from which the Proposal can be seen is relatively small, broadly comprising:

- views from within the Waterfall Station precinct, largely confined by the elevation change between the station and the surrounding streets
- views from vehicles and pedestrians travelling along the Princes Highway, Kooraban Street and McKell Avenue

- views from the residences fronting the Princes Highway
- views from Legendary Fish and Chips on the Princes Highway.

Visibility of the Proposal from the broader area is limited due to:

- the relatively dense, generally single storey built form of Waterfall village, which generally results in visual obstruction to properties behind the first row
- mature vegetation within the Royal National Park which generally obstructs views to within 75 metres of the edge of the station precinct looking east
- the elevation differences between the station precinct and the neighbouring landscape.













The areas likely to be subject to visual impacts arising from the proposal are shown in **Figure 6.1**.

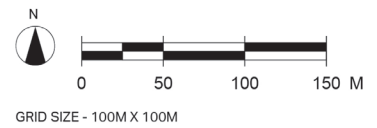




FIGURE 6.1 VISUAL ENVELOPE MAP SHOWING AREAS POTENTIALLY VISUALLY AFFECTED BY THE PROPOSAL

LEGEND

- |   |   |   |                      |   |                |
|---|---|---|----------------------|---|----------------|
|  | VISUAL ENVELOPE                           |  | STUDY AREA (PARTIAL) |  | RAILWAY TRACKS |
|  | PROPOSAL-AMENITIES BUILDING               |  | CADASTRE             |  | WATERBODY      |
|  | PROPOSAL-FOOTBRIDGE                       |  | ROAD                 |  | WATERCOURSE    |
|  | PROPOSAL-PLATFORM DEMOLITION              |  | WATERFALL STATION    |   |                |
|  | PROPOSAL-PLATFORM EXTENSION AND TRACKWORK |   |                      |   |                |



GRID SIZE - 100M X 100M

Four visual receiver locations have been identified to represent key viewpoints for the purposes of assessment. These are shown in **Figure 6.2** and described in **Table 6.3**.

**Table 6.3 Visual impact assessment receiver locations**

No.	Visual receiver	Description
1	Legendary Fish and Chips	Representative of the view from the outdoor eating area of the fish and chips shop, as well as passing vehicles and of residents along the Princes Highway
2	Kooraban Street bridge	Representative viewpoint for commuters travelling to and from Waterfall station
3	Waterfall Station platform	Representative of the view that commuters would receive as they wait for trains, as well as views for Sydney Trains staff
4	Princes Highway travelling south	Representative viewpoint for motorists passing through Waterfall

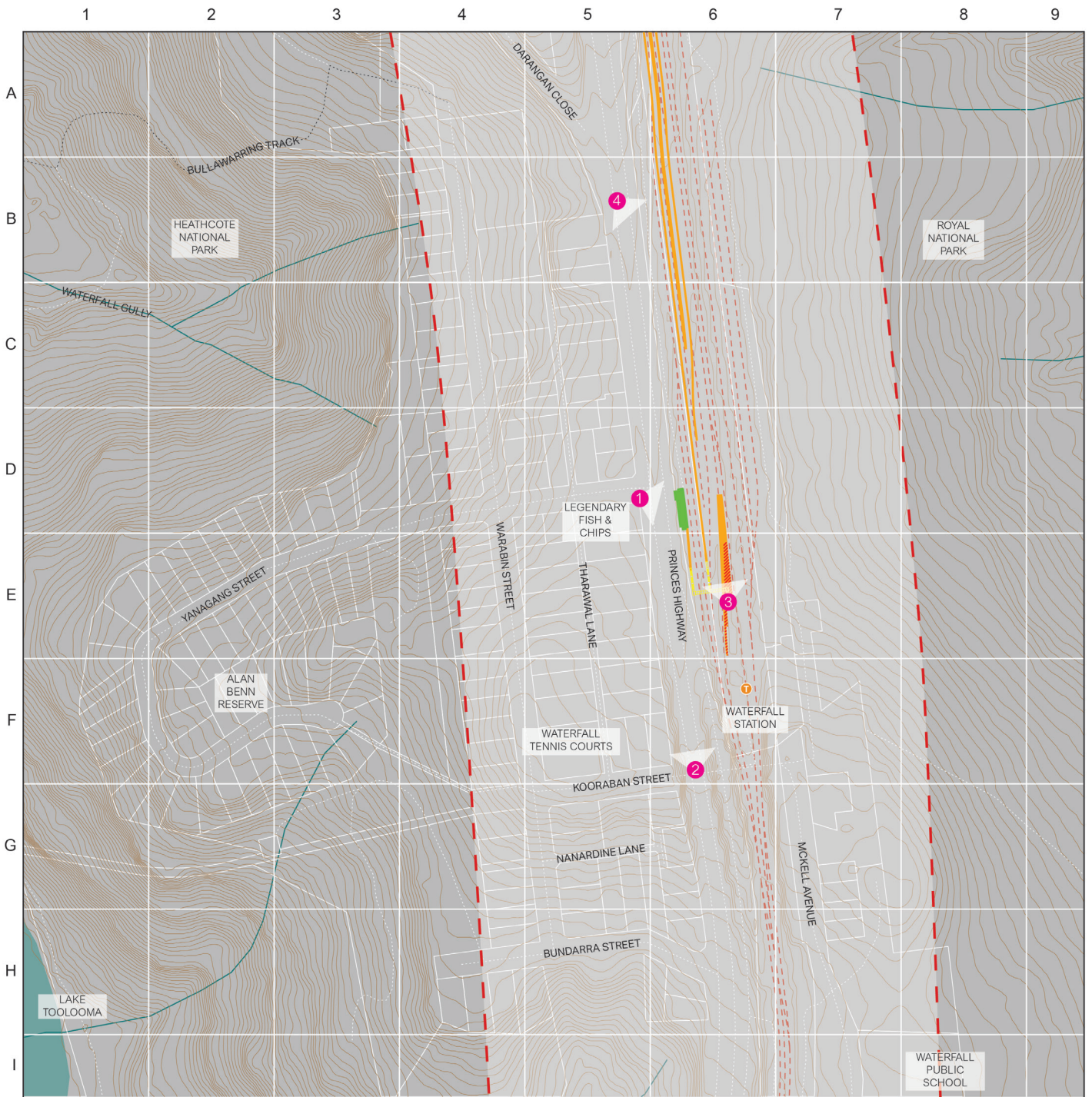
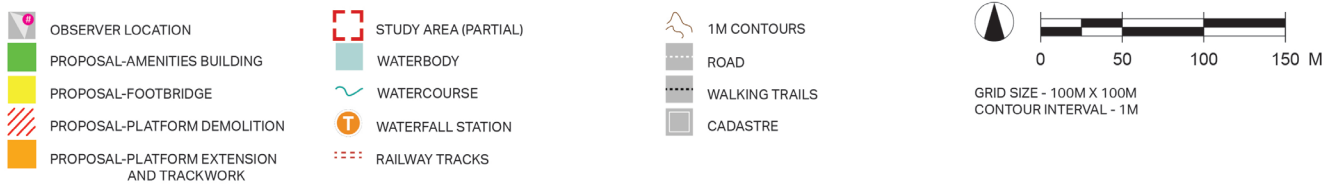


FIGURE 6.2 LOCATIONS OF THE FOUR VISUAL RECEPTORS

LEGEND



## 6.2.2 Potential impacts

### Construction phase

During construction activities would be temporary and transient in nature. Temporary elements likely to be introduced into the visual environment include:

- fencing and hoarding
- road barriers and signage
- construction equipment and vehicles
- site office and amenities.

Seven temporary site compounds and laydown areas would be required to accommodate construction. These temporary compounds would all be located within the rail corridor, to the north and south of the station. These compounds would be visible from within rail corridor, though most would be heavily screened for views from outside the corridor by the verge planting along the Princes Highway and rail corridor. The visual impacts would be transitory over a period of approximately two and a half years. Impacts during construction are described further in **Table 6.4**.

### Operational phase

#### *Landscape Character Assessment*

Six landscape character zones (LCZ) were determined as representative of the key land uses surrounding Waterfall Station, as outlined in **Figure 6.3**. The LCZs are characterised as:

- LCZ 1 - Rail corridor
- LCZ 2 - Road corridor
- LCZ 3 - National Parks
- LCZ 4 - Local open space
- LCZ 5 - Local centre
- LCZ 6 – Residential.

A landscape character assessment was undertaken for these zones (AECOM, 2019). Shown in **Figure 6.3** below, but excluded from the assessment, is LCZ 7 – Education. This was excluded due to its distance from the Proposal. This assessment showed that three of the six LCZs were subject to no change or negligible change from the Proposal. The significance of impact for the remaining LCZs was assessed as 'Moderate to Low' for LCZ 1, 'Moderate' for LCZ 2 and 'low' for LCZ 5. These impacts were not deemed to be significant in the context of the existing environment within these LCZs.

A summary of potential impacts to landscape character, utilising the impact grading matrix above, is provided in **Table 6.2**.

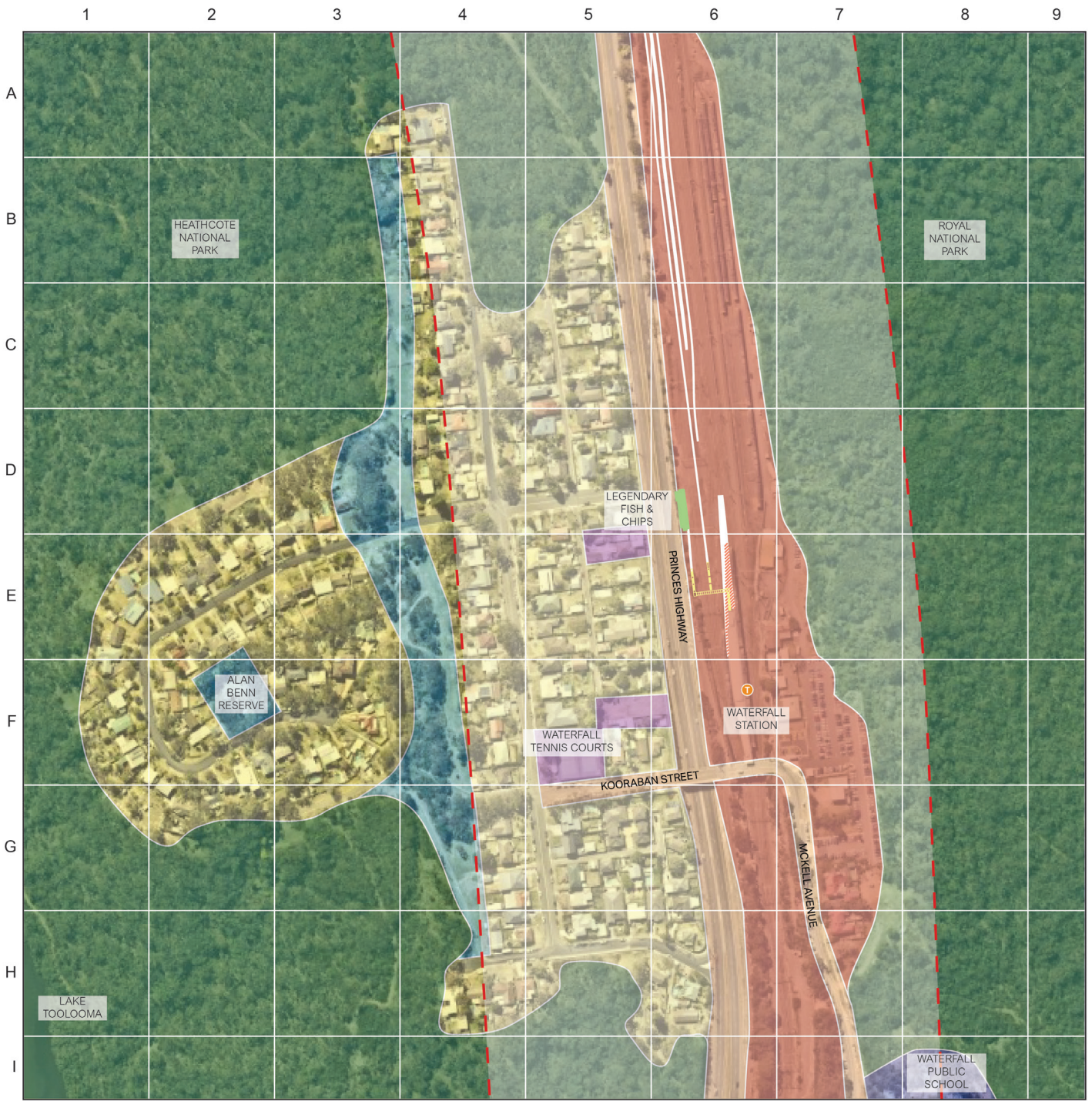
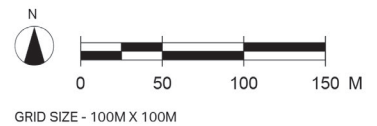


FIGURE 6.3 LANDSCAPE CHARACTER ZONES

LEGEND

- |   |                   |                        |                          |
|---|-------------------|------------------------|--------------------------|
| PROPOSAL-AMENITIES BUILDING               | CADASTRE          | ROAD                   | LCZ 4 - LOCAL OPEN SPACE |
| PROPOSAL-FOOTBRIDGE                       | WATERBODY         | WALKING TRAIL          | LCZ 5 - LOCAL CENTRE     |
| PROPOSAL-PLATFORM DEMOLITION              | WATERCOURSE       | LCZ 1 - RAIL CORRIDOR  | LCZ 6 - RESIDENTIAL      |
| PROPOSAL-PLATFORM EXTENSION AND TRACKWORK | WATERFALL STATION | LCZ 2 - ROAD CORRIDOR  | LCZ 7 - EDUCATION        |
| STUDY AREA (PARTIAL)                      | RAILWAY TRACKS    | LCZ 3 - NATIONAL PARKS |                          |



**Table 6.4 Impacts to landscape character zones**

Zone	Existing character	Potential impacts	Impact assessment	Significance of Impact
LCZ 1 - Rail corridor	Wide, open, rail infrastructure corridor that includes Waterfall Station, the entry steps and lift access from Kooraban Street and the associated car park and ancillary buildings along its eastern edge.	<ul style="list-style-type: none"> <li>• presence of seven temporary construction compounds located to the north and south of Waterfall Station, on both sides of the railway corridor</li> <li>• temporary fencing and hoarding, road barriers, signage, scaffolding, temporary ticketing office, toilets and machinery</li> <li>• platform demolition and subsequent replacement with new extension at the northern end of the station</li> <li>• introduction of a six-metre wide Sydney Trains staff footbridge</li> <li>• provision of a staff amenities building (approximately 30 metres long x 6 metres wide x 2.5 metres high, comprising of metal sheeting, with likely similar roof and walling colours to that of the existing station building)</li> <li>• removal of all vegetation over a length of about 460 metres along the western boundary of the LCZ</li> <li>• slewing of tracks, the construction of new retaining walls, the Up freight loop extension, a new stabling yard and the installation of a new water hydrant.</li> </ul>	<p>The upgrade work is relatively minor and would be most noticeable as a landscape character impact in the short term (i.e. during construction).</p> <p>During operation, the Proposal would represent a minor change to this landscape character zone given the distance to receivers, the amount of vegetation removed and the permanent structures installed (staff amenities and large footbridge over the LCZ).</p>	<i>Moderate to Low (adverse)</i>

Zone	Existing character	Potential impacts	Impact assessment	Significance of Impact
LCZ 2 - Road corridor	<p>Two road corridors that facilitate the majority of foot traffic and vehicular traffic within the area:</p> <ul style="list-style-type: none"> <li>Princes Highway – four lane arterial road divided by a median strip</li> <li>Kooraban Street (which turns into McKell Avenue) – local road.</li> </ul> <p>Both roads have parking on both sides, standard concrete footpaths and are lined with mature vegetation.</p>	<ul style="list-style-type: none"> <li>presence of one temporary construction compound (construction ancillary facility 4) located along the Princes Highway</li> <li>temporary fencing and hoarding, road barriers, signage, scaffolding, temporary ticketing office, toilets and machinery</li> <li>all vegetation within LCZ 1 located alongside the LCZ 2 boundary would be removed</li> <li>existing fence associated with the staff amenities building and staff footbridge replaced with a tall, fine mesh security fence</li> <li>the introduction of the staff footbridge.</li> </ul>	<p>The upgrade work is relatively minor and would be most noticeable as a landscape character impact in the short term (i.e. during construction).</p> <p>During operation, the Proposal would represent a minor change to this landscape character zone given the distance to receivers, the amount of vegetation removed and the permanent structures installed (staff amenities and footbridge visible from the LCZ).</p>	<i>Moderate (neutral)</i>
LCZ 3 - National Parks	Heavily forested National Parks (DPIE land)	The Proposal is unlikely to be visible from within the LCZ due to dense mature vegetation screening views out from the Royal National Park, and the minor nature of the Proposal relative to the area of the Royal National Park. Therefore, No Change in the landscape character of LCZ 3 is anticipated to arise from the Proposal.	<p>Views from this landscape character zone would generally not be available to the Proposal.</p> <p>No assessment has been undertaken for this LCZ.</p>	<i>No change in landscape character.</i>

Zone	Existing character	Potential impacts	Impact assessment	Significance of Impact
LCZ 4 - Local open space	<p>Two local open spaces: Alan Benn Reserve and a more informal length of land that houses an overhead transmission line and creates a vegetated connection between two points of National Park.</p> <p>Both open spaces serve local recreation with formal and informal equipment, vegetated with mature trees and shrubbery.</p>	<p>The closest part of LCZ 4 is located approximately 200 m west of the Proposal and visually unconnected with the Proposal. Therefore, no change in landscape character is anticipated to arise from the Proposal.</p>	<p>Views from this landscape character zone would not be available to the Proposal.</p> <p>No assessment has been undertaken for this LCZ.</p>	<p><i>No change</i> in landscape character.</p>
LCZ 5 - Local centre	<p>Waterfall does not have a specific local centre but does have key points of gathering including the Legendary Fish and Chips store, Waterfall Tennis Courts and associated parking.</p> <p>Legendary Fish and Chips is more visible to travelling vehicles and caters to truck drivers, tourists and locals, with outdoor tables, seating and shade umbrellas for gathering. It is physically distinct in terms of colouring from the surrounding residences.</p>	<ul style="list-style-type: none"> <li>• presence of temporary construction compounds (construction ancillary facility 4) located along the Princes Highway</li> <li>• all vegetation within LCZ 1 would be removed</li> <li>• existing fence associated with the staff amenities building and staff footbridge replaced with a tall, fine mesh security fence</li> <li>• the introduction of the staff footbridge.</li> </ul>	<p>The upgrade work is relatively minor and would be most noticeable as a landscape character impact in the short term (i.e. during construction).</p> <p>During operation, the Proposal would represent a moderate change to the landscape character zone as the aesthetic aspects would change, resulting in a hardening of the boundary potentially accompanied by a moderate increase in silhouette view of the Royal National Park, however, these aesthetic setting effects would not change the key characteristics of the LCZ.</p>	<p><i>Low (adverse)</i></p>



Zone	Existing character	Potential impacts	Impact assessment	Significance of Impact
LCZ 6 - Residential	<p>Detached, low density, single storey residences. The front yards of residences typically have mown lawns and general landscaping features such as shrubs and low planting as well as low fences with gates.</p> <p>The architectural styles of the residences often comprise of painted weather board with brick accents and conventionally angled roofs.</p>	<ul style="list-style-type: none"> <li>• presence of temporary construction compounds (construction ancillary facility 4) located along the Princes Highway</li> <li>• all vegetation within LCZ 1 would be removed</li> <li>• existing fence associated with the staff amenities building and staff footbridge replaced with a tall, fine mesh security fence</li> <li>• the introduction of the staff footbridge.</li> </ul>	<p>The upgrade work is relatively minor and would be most noticeable as a landscape character impact in the short term (i.e. during construction).</p> <p>During operation, the Proposal would represent a negligible change to the landscape character zone as no existing elements of the LCZ would be lost and the effect would generally be limited to the rooms facing onto the Highway and front garden areas therefore the proportion of the LCZ affected by the Proposal would be very low, estimated to be &lt;5%.</p>	<p><i>Negligible change in landscape character.</i></p>

## Operational phase

### *Visual Impact Assessment*

An assessment of the visual sensitivity and magnitude of each visual receiver location during the operational phase of the Proposal was undertaken. The results of this assessment are provided in **Table 6.7**. Overall, the Proposal would have a Moderate visual impact on the majority of people living, working in or travelling through the landscape surrounding Waterfall Station during operation.

**Table 6.5 Operational visual impact assessment**

No.	Visual receiver	Sensitivity	Magnitude	Rating
1	<p>Legendary Fish and Chips (refer to Figure 6.4 and Figure 6.5 for the existing and proposed views from this receiver).</p>	<p>The sensitivity of this receptor to the anticipated change in the view arising from the Proposal is considered to be Moderate as:</p> <ul style="list-style-type: none"> <li>• residents fronting onto the Princes Highway would have a change in outlook from their homes (vegetation removal, footbridge and fence)</li> <li>• customers of the fish and chip shop are likely to have a moderate interest in the landscape beyond the highway when sitting outdoors</li> <li>• staff of the fish and chip shop would have prolonged views of the proposal but would be busy with their task at hand and unlikely to pay considerable attention to areas beyond the immediate surrounds of their workplace.</li> </ul>	<p>The size or scale of change likely to be experienced in the view would be Moderate given:</p> <ul style="list-style-type: none"> <li>• the addition of the staff footbridge and staff amenities building are consistent with the function of the station</li> <li>• the staff amenities building would be mostly obscured from view</li> <li>• the Proposal would generally be viewed for relatively small periods of time</li> <li>• the Proposal would be only partially visible</li> <li>• the Proposal would be seen within the context of a substantially hardened foreground</li> <li>• the Proposal would reveal considerably more of the view to Royal National Park (although partially obscured by the mesh security fencing and passing trains)</li> </ul>	<p><i>Moderate (neutral)</i></p>

No.	Visual receiver	Sensitivity	Magnitude	Rating
2	Kooraban Street bridge	The sensitivity of this visual receptor to the anticipated change in the view arising from the Proposal is considered to be Low as recreational day visitors and pedestrians would be expected to pay low to moderate levels of attention to the view. The attention of rail commuter vehicle occupants and pedestrians would likely be more cursory given the regularity with which they would take in this view as part of their regular work commute.	The magnitude of visual effects arising from the Proposal is considered to be High as: <ul style="list-style-type: none"> <li>the staff footbridge would be visually prominent, projecting well above the skyline</li> <li>the existing vegetation seen alongside the rail corridor boundary (middle ground of view) would be removed and replaced with a hard edge comprising a tall fine mesh security fence.</li> </ul>	<i>Moderate (adverse)</i>
3	Waterfall Station platform	The sensitivity of this visual receptor to the anticipated change in the view arising from the Proposal is considered to be Low as recreational day visitors would be expected to pay low to moderate levels of attention to the view, whereas the attention of rail commuters would likely be more cursory given the regularity with which they would take in the view. However, the recreational day visitors are unlikely to be overly focused on this view as they are presumably travelling to and from the nearby national parks and would be focussed on making their way to the track head.	The magnitude of visual effects arising from the Proposal is considered to be High as: <ul style="list-style-type: none"> <li>the loss of all vegetation along an approximately 460 metre frontage of the rail corridor boundary with the Princes Highway, would provide wide, open views to the busy highway, mitigated to a degree by the wall of the rail cutting</li> <li>a staff footbridge would comprise the major element within the view, resulting in a loss of openness to the view</li> <li>the view would be seen for moderate to long periods of time waiting for trains and seen in full view.</li> </ul>	<i>Moderate (adverse)</i>

No.	Visual receiver	Sensitivity	Magnitude	Rating
4	Princes Highway	The sensitivity of visual receptors to the anticipated change in the view arising from the Proposal is considered to be High given the nature of the visual receptors travelling along the Princes Highway (travellers on road, rail or other transport routes) and the extent to which the attention or interest of motorists would be focused on this now open view across the rail corridor and Royal National Park.	<p>The magnitude of visual effects arising from the Proposal is considered to be High given the:</p> <ul style="list-style-type: none"> <li>• high level of change in the composition of the view</li> <li>• high proportion of the view opened up, primarily comprising the Royal National Park</li> <li>• addition of the staff footbridge and staff amenities building (noting these additions are consistent with the function)</li> <li>• Proposal would generally be viewed for a short period of time</li> </ul>	<i>High (beneficial)</i>



**Figure 6.4 Existing view looking east across the Princes Highway from the intersection with Yangan Street (Source: AECOM)**



**Figure 6.5** Photomontage looking east across the Princes Highway from the intersection with Yangan Street with the Proposal in Place (Source: AECOM)

### 6.2.3 Mitigation measures

The following mitigation measure would apply to the Proposal:

- establish TPZs around trees to be retained. Tree protection would be undertaken in keeping with AS 4970-2009 Protection of Trees on Development Sites and would include exclusion fencing of TPZs
- provide well-presented and maintained construction hoarding and site fencing with shade cloth (or similar material) (where necessary) to minimise visual impacts on key view points during construction and remove hoardings and site fencing following the completion of construction
- cut-off or directed lighting to be used with and outside of the construction site, with lighting location and direction considered to ensure glare and light spill is minimised
- construction personnel to keep the construction areas clean and tidy including refuse placed in appropriate receptacles
- measures taken to ensure no tracking of dirt and mud into public roads and other public spaces.

With the implementation of mitigation measures outlined above and in **Section 7.2** no impacts to DPIE land are anticipated as a result of the Proposal.

For a full list of additional mitigation measures, refer to **Section 7.2** and the Landscape Character and Visual Impact Assessment in **Appendix C**.

## 6.3 Noise and vibration

A Noise and Vibration Impact Assessment (**Appendix D**) (AECOM, 2019) was completed for the proposal and included the following scope:

- establish the noise management levels and vibration limits that would apply to the Proposal
- identification of predicted environmental noise and vibration levels at nearby residential and other sensitive receivers due to the construction and operation of the Proposal
- identification of predicted noise levels from additional off-site construction traffic generated by the Proposal
- recommend mitigation measures, where necessary, to reduce and manage noise and vibration impacts from the Proposal to comply with established noise management levels and vibration limits.

The findings of this assessment are summarised below.

### 6.3.1 Existing environment

The Proposal area extends from approximately 740 metres south of Waterfall Station to approximately 1.8 kilometres north. The Proposal is bounded by the Princes Highway and the Hanrob Pet Hotel to the west, the Royal National Park to the east and the T4 Eastern Suburbs and Illawarra Line to the north and south.

The acoustic environment is dominated by road traffic noise from the Princes Highway in addition to railway noise.

Residential and non-residential receivers potentially affected by the construction and operation of the proposal have been identified within the Proposal area and are shown in **Figure 6.6**.





FIGURE 6.6 - NOISE SENSITIVE RECEIVERS



Legend

- Residential Receiver
- Commercial Receiver
- School
- Not Assessed
- Noise monitoring location
- Proposed Rail Alignment

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### 6.3.2 Noise criteria

The EPA's *Interim Construction Noise Guideline* (ICNG) (Department of Environment and Climate Change, 2009) is the principal guideline for the assessment and management of construction noise in NSW. A quantitative assessment, based on likely construction scenarios, has been carried out for these works.

The ICNG recommends standard hours of construction as:

- Monday to Friday: 7am to 6pm
- Saturday: 8am to 1pm
- Sundays and public holidays: no works.

For residential receivers, the ICNG recommends that the noise management levels (NML) resulting from construction activities not exceed the applicable rating background level (RBL) + 10 dB(A) during standard construction hours. Where NMLs are predicted to be exceeded, the ICNG recommends feasible and reasonable measures to be implemented to minimise adverse impacts. Where construction noise levels are likely to reach 75 dB(A) or more at residences (during standard construction hours), residential receivers are be considered as 'highly noise affected'. In these circumstances, the proponent may be required to consider restricting hours of very noisy works to provide respite periods.

Outside of standard working hours, the ICNG recommends that the NMLs for residential receivers not exceed the applicable RBL + 5 dB(A).

The ICNG recommends separate NMLs for non-residential sensitive receivers, which applies when the applicable receiver is in use.

The construction NMLs developed for the Proposal for residential and non-residential sensitive receivers are listed in **Table 6.6** and **Table 6.7**.

**Table 6.6 Construction NMLs – Residential receivers**

Period	RBL, $L_{A90}$ dB(A)	Standard hours noise management levels, $L_{Aeq, 15min}$ , dB(A)	Out of hours noise management levels, $L_{Aeq, 15mins}$ , dB (A)
Day	60	70	65
Evening	53	-	58
Night	39	-	44

**Table 6.7 Construction NMLs – Non-residential receivers**

Land use	Noise management levels, $L_{Aeq, 15min}$ (applies when properties are in use)
Classrooms at schools and other educational institutions	Internal noise level 45 dB(A)
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dB(A)

Land use	Noise management levels, $L_{Aeq,15min}$ (applies when properties are in use)
Commercial premises (including offices, retail outlets)	70 dB(A)

### Sleep Disturbance Criteria

Sleep disturbance noise goals have also been established for residential receivers which are based on the *NSW Road Noise Policy* (Department of Environment, Climate Change and Water, 2011). Based on the Policy, the sleep disturbance criteria for the Noise Catchment Area (NCA) are a screening level of 54 dB(A) $L_{A1(1\text{ minute})}$  and an awakening reaction level of 65 dB(A)  $L_{A1(1\text{ minute})}$ .

### Construction Traffic Noise Criteria

To assess noise impacts from construction traffic an initial screening test should be undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A), in line with the Road Noise Policy. Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion then noise mitigation should be considered for those receivers affected.

### Construction Vibration Criteria

Vibration assessment criteria relate to human comfort (tactile vibration) and structural or building damage.

#### *Structural damage to buildings*

No Australian Standards exist for the assessment of building damage caused by vibration at present. The German standard (DIN 4150) provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in **Table 6.8**. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage.

**Table 6.8** DIN 4150: Structural damage safe limits for building vibration

Group	Type of structure	At foundation - Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz <sup>1</sup>	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s

Group	Type of structure	At foundation - Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz <sup>1</sup>	Vibration at the horizontal plane of the highest floor for all frequencies
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Group 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

Notes:

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values

### Human comfort

The assessment of intermittent vibration outlined in the NSW EPA guideline Assessing Vibration: A Technical Guideline is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDVs for intermittent vibration arising from construction activities are listed in **Table 6.9**. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

**Table 6.9 Preferred and maximum vibration dose values for intermittent vibration (m/s<sup>1.75</sup>)**

Location	Daytime <sup>1</sup> Preferred	Daytime Max	Night time Preferred	Night time Max
Critical areas (examples include hospital operating theatres and precision laboratories where sensitive operations are occurring)	0.1	0.2	0.1	0.2
Residences	0.2	0.4	0.13	0.26
Offices, schools, educational institutions, commercial premises and places of worship	0.4	0.8	0.4	0.8
Workshops or factory environments	0.8	1.6	0.8	1.6

Notes:

1. Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00 pm to 7:00 am

## Operational noise criteria – rail noise

The *Rail Infrastructure Noise Guideline* (RING) (EPA, 2013) provides the applicable noise trigger levels for the assessment of airborne noise. These trigger levels are considered non-mandatory and represent a point at which reasonable and feasible noise mitigation should be considered. It should be noted that this guideline does not apply to noise involving maintenance facilities for rolling stock (including stabling yards and shunting operations), which is assessed in accordance with the *NSW Noise Policy for Industry* (NPfI) (EPA, 2017).

The RING provides noise trigger levels for both new and redeveloped rail lines. Since work associated with the Proposal comprises a redevelopment of the existing T4 Illawarra and Eastern Suburbs Line and South Coast Line, all sensitive receivers surrounding the project area are subject to the redeveloped noise criteria.

The RING trigger levels apply where redevelopment of an existing rail line increases existing  $L_{Aeq(period)}$  rail noise levels by 2 dB or more, or existing  $L_{Amax}$  rail noise levels by 3 dB or more, *and* predicted rail noise levels exceed the trigger levels below.

**Table 6.10 Airborne heavy rail noise trigger levels for residential land uses**

Period	Noise trigger level dB(A)
Day (7am to 10pm)	65 $L_{Aeq(15hour)}$ OR 85 $L_{AFmax}$
Night (10pm to 7am)	60 $L_{Aeq(9hour)}$ OR 85 $L_{AFmax}$

In accordance with the RING, sensitive land uses other than residential have their own specific noise trigger levels for rail redevelopments, applicable when the facility or space is in use. These trigger levels apply where redevelopment of an existing rail line increases existing  $L_{Aeq(period)}$  rail noise levels by 2 dB or more, and resulting rail noise levels exceed 45  $L_{Aeq(1hr)}$  (internal) for schools, educational institutions and child care centres and 65  $L_{Aeq(15hr)}$  (external) for 'open space – passive use'.

## Operational noise criteria – stabling yard and amenities building

### *Intrusiveness noise levels*

The NPfI provides guidance in relation to acceptable noise limits for industrial noise emissions, which includes, but is not limited to, noise emissions from mechanical plant (NSW EPA, 2017).

The assessment procedure in the NPfI has two components:

- controlling intrusive noise impacts in the short term for residences. Intrusive noise criteria comprise the applicable  $RBL+5$  dB(A)
- maintaining noise level amenity for residences and other land uses. Recommended amenity noise levels are specified in Table 2.1 of the NPfI depending on land use.

Both components are assessed at the boundary of the noise sensitive receiver site, or if the site boundary is more than 30 metres from the noise sensitive building, a distance of 30 metres from the noise sensitive building.

The NPfI provides intrusiveness noise levels applicable to the operation of the Proposal which are summarised in **Table 6.11**.

**Table 6.11 Intrusiveness noise levels**

Period	RBL. $L_{A90}$ , dB(A)	Intrusiveness noise level (RBL + 5), dB(A)
Day	60	65
Evening	53	58
Night	39	44

Notes: In accordance with the NPfl, time of day is defined as follows:

**Day** – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays.

**Evening** – the period from 6 pm to 10 pm.

**Night** – the remaining periods.

### Protecting noise amenity

To limit continuing increases in noise levels, the maximum ambient noise level resulting from all industrial noise sources in an area should not normally exceed the acceptable levels specified in Table 2.2 of the NPfl. Using the definitions of receiver types in Table 2.3 of the NPfl and comparing with the zone types for Waterfall within Sutherland LEP 2015, residences are classed as ‘Rural residential’.

However, it was observed during attended and unattended noise monitoring that:

- road traffic noise from the Princes Highway was the dominant source of noise
- the existing  $L_{Aeq}$  period traffic noise level is 10 dB(A) or more above the amenity noise level for some receiver types
- it is unlikely that traffic noise will reduce over time.

Therefore, the high traffic noise provisions were applied in accordance with the NPfl, Section 2.4.1 for some receiver types. These were adopted in place of recommended amenity noise levels to derive the project amenity trigger levels as summarised in **Table 6.12**.

**Table 6.12 Recommended  $L_{Aeq}$  noise levels from industrial noise sources**

Type of receiver	Period	Recommended amenity noise level, $L_{Aeq(Period)}$	Measured $L_{Aeq,period}$ (traffic)	Project amenity noise level, $L_{Aeq,15min}$
Rural Residential	Day	50	72 <sup>1</sup>	60 <sup>1</sup>
	Evening	45	69 <sup>1</sup>	57 <sup>1</sup>
	Night	40	69 <sup>1</sup>	57 <sup>1</sup>
School classroom - internal	Noisiest 1-hour period when in use	45 <sup>2</sup>	-	48
School playground	When in use	55	-	58
Area specifically reserved for passive recreation (e.g. national park)	When in use	50	-	53
Commercial premises	When in use	65	-	68

*Notes:*

1. The existing  $L_{Aeq,period}$  traffic noise level is 10 dB(A) or more above the applicable recommended amenity noise level. Therefore, the high traffic noise provisions were applied in accordance with the NPfl, Section 2.4.1.
2. External noise levels are based on a 10 dB(A) reduction from outside to inside through an open window.

*Project noise trigger levels*

The project noise trigger level is the lower of the intrusiveness and the amenity noise levels. Provided in **Table 6.13** are the established project noise trigger levels for the assessment locations within the Proposal area. **Table 6.13** presents the project noise trigger levels for the day, evening and night-time periods.

**Table 6.13 Operational noise criteria**

Type of receiver	Assessment period	Intrusive noise levels, $L_{Aeq,15min}$	Amenity noise levels, $L_{Aeq,15min}$	Project noise trigger levels, $L_{Aeq,15min}$
Residential suburban	Day	65	60	60
	Evening	58	57	57
	Night	44	57	44
School classroom - internal	Noisiest 1-hour period when in use	-	48	48
School playground	When in use	-	58	58
Area specifically reserved for passive recreation (e.g. national park)	When in use	-	53	53
Commercial premises	When in use	-	68	68

*Maximum noise level assessment*

The NPfl requires the potential for sleep disturbance to be assessed by considering maximum noise level events during the night-time period.

Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$  40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- $L_{AFmax}$  52 dB(A) or the prevailing RBL plus 15 dB, whichever is the greater.

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in **Table 6.14**.

**Table 6.14 Night-time sleep disturbance screening levels**

Type of receiver	Measured night-time RBL, L <sub>A90,15min</sub> , dB(A)	Sleep disturbance screening levels	
		L <sub>Aeq,15min</sub>	L <sub>AFmax</sub>
Residential	39	44	54

### 6.3.3 Potential impacts

#### Construction

##### *Predicted construction noise levels*

Nine distinct work packages, each consisting of a number of construction activities, have been assumed for the Proposal. These work packages are listed above in **Table 3.1**.

In order to assess noise impacts from the site during construction, a noise model was created to represent a conservative worst case scenario. Construction noise was modelled in SoundPLAN Version 8.0, with the model being based on ground topography, ground absorption and reflection, buildings (residential and commercial), receivers (**Figure 6.6**) and from the use of plant and equipment listed in **Section 3.1.6**.

A summary of the number of receivers where construction noise levels are predicted to exceed NMLs during the loudest construction stages are presented for standard hours construction activities in **Table 6.15** and for out of hours construction activities in **Table 6.16**. Five receivers located along the Princes Highway to the north of Kooraban Street may be highly noise affected (experience noise levels  $\geq 75$  dB(A)) during standard hours track modification/stabling works. A number of receivers will experience exceedances of the NML during out of hours works as summarised in **Table 6.16**.

It is important to consider that this assessment is representative of the worst case 15 minute period of construction activity, while the construction equipment is at the nearest location to each sensitive receiver location. The assessed scenario does not represent the ongoing day to day noise impact at noise sensitive receivers for an extended period of time.

Particularly noisy activities, such as bored piling, are likely to persist for only a portion of the overall construction period.

**Table 6.15 Predicted construction noise impacts for residential receivers during standard construction hours**

Construction scenario	NML	Number of receivers where noise levels >10 dB(A) above NML	Number of highly noise affected receivers where noise levels $\geq 75$ dB(A)
Site establishment and enabling works	70	0	0
Utility works	70	0	0
Track modifications / stabling works	70	0	5
Retaining wall construction	70	0	0
Platform extension	70	0	0



Construction scenario	NML	Number of receivers where noise levels >10 dB(A) above NML	Number of highly noise affected receivers where noise levels ≥75 dB(A)
Staff amenities building construction	70	0	0
Pedestrian footbridge construction	70	0	0
Testing and commissioning	70	0	0
Demobilisation	70	0	0

**Table 6.16 Predicted construction noise impacts for residential receivers outside standard construction hours**

Construction scenario	NML	Number of receivers where noise levels may exceed the NML			
		NML exceedance <5 dB(A)	NML exceedance 5-14 dB(A)	NML exceedance 15-25 dB(A)	NML exceedance >25 dB(A)
Site establishment and enabling works	44	22	47	7	0
Utility works	44	36	48	24	1
Track modifications / stabling works	44	17	66	38	23
Retaining wall construction	44	14	4	0	0
Platform extension	44	15	38	9	0
Staff amenities building construction	44	12	15	4	0
Pedestrian footbridge construction	44	15	13	4	0
Testing and commissioning	44	23	33	13	0
Demobilisation	44	22	47	7	0

### *Sleep disturbance assessment*

A sleep disturbance assessment has been undertaken for the proposed night works. The noise modelling results are provided in **Table 6.17** below, with predicted noise levels compared with the sleep awakening reaction criterion.

A large number of exceedances of the sleep disturbance screening criteria have been predicted due to the night-time construction works associated with the proposal. These receivers are predominantly located along the Princes Highway north of Kooraban Street, and also include receivers on Tharawal Lane and Warabin Street. In addition, noise associated with some of the works will exceed the awakening reaction screening criterion. The exceedances are attributed to the close proximity of the construction site to residences.

It should be noted that the works will generally be progressive so that not all receivers would be affected at any one time, or for the overall duration of the works.

An effective communication plan and noise management measures will need to be developed during detailed design to minimise the impacts upon affected sensitive receivers.

**Table 6.17 Predicted sleep disturbance impacts at residential receivers**

Construction scenario	Sleep disturbance criteria, dB(A)	Maximum $L_{A1(1min)}$ noise level, dB(A)	Number of receivers where noise levels exceed	
			Sleep disturbance criteria	Awakening reaction criteria
Site establishment and enabling works	54	71	54	2
Utility works	54	75	73	22
Track modifications / stabling works	54	79	116	48
Retaining wall construction	54	60	4	0
Platform extension	54	69	38	8
Staff amenities building construction	54	66	16	2
Pedestrian footbridge construction	54	65	7	0
Testing and commissioning	54	65	35	0
Demobilisation	54	71	54	2

*Construction traffic assessment*

An assessment of construction traffic movements was completed based on indicative construction vehicle movements (in lieu of rigorously defined vehicle movements which would be determined during detailed design) and traffic counts for the existing daytime (7am – 10pm) and night-time (10pm – 7am) traffic flows along the nearest available major road to the proposal (Heathcote Road) as presented in **Table 6.18** below. It has been assumed that current traffic consists of 10 percent heavy vehicles during the daytime and 20 percent in the night-time.

**Table 6.18 Existing traffic flows and additional traffic flows due to construction traffic**

Road	Period	Existing traffic flow		Additional traffic flow		Relative noise increase, dB(A)
		Light	Heavy	Light	Heavy	
Heathcote Road	Daytime	16624	1847	50	50	0.1
	Night-time	3092	773	50	50	0.2

The results indicate that the predicted noise increases are substantially lower than the 2 dB(A) screening criteria presented in the RNP. As a result, no further consideration of construction traffic is required at this stage.

### Vibration

Vibration intensive work has the potential to occur as part of the construction work. Work may include the use of rock breaking, jackhammering and vibratory rolling activities.

Typical minimum working distances for the construction equipment that may be part of this proposal are provided in **Table 6.19**. Minimum working distances have been developed to meet the recommended levels of vibration in British Standard 6472-1992 and DIN 4150 and are based upon the safe working distances presented in TfNSW's Construction Noise and Vibration Strategy (CNVS) and AECOM's library of vibration data.

Minimum working distances should be adhered to when operating vibration intensive equipment near on-site buildings in order to minimise the risk of discomfort to occupants and structural damage.

**Table 6.19 Recommended minimum working distances for vibration intensive equipment**

Equipment	Rating/description	Safe working distance (metres)	
		Cosmetic damage	Human response
Small hydraulic hammer	(300 kg – 5-12 t excavator)	2	7
Medium hydraulic hammer	(900 kg – 12-18 t excavator)	7	23
Large hydraulic hammer	(1600 kg – 18-34 t excavator)	22	73
Piling rig – bored	≤ 800 mm	2 (nominal)	N/A
Jackhammer	Hand held	1 (nominal)	Avoid contact with structure

*Note: More stringent conditions may apply to heritage or other sensitive structures*

The minimum working distances presented in Table 6.19 assume individual items of plant would be operating independently. Concurrent operation of vibration intensive equipment should be avoided, however if it is necessary to operate multiple items of equipment concurrently close to the safe working distance then vibration monitoring is recommended.

The minimum working distances for cosmetic damage are general considered to be conservative and working within them would not necessarily result in damage. However, factors such as work practices and intervening ground conditions can affect vibration levels, so

vibration monitoring is recommended within these distances and should be carried out at the beginning of the work in order to refine the safe working distances for site specific conditions.

It is unlikely that vibration intensive equipment would be used within 30 m of sensitive receivers during construction of the Proposal.

## Operational phase

### *Predicted operational noise levels – rail passby noise*

In order to assess noise impacts from increased rail noise ‘no build’ (without the proposal) and ‘build’ (with the proposal) scenarios predicted noise levels were modelled using SoundPLAN v8.0 environmental noise modelling software. The model included ground topography, ground absorption and reflection, buildings (residential and commercial), receivers (**Figure 6.6**), terrain elevation contours, existing and future rail centrelines, train movement numbers, lengths, speeds and rolling stock types, track conditions, and rail noise source reference levels derived from TfNSW’s *Rail Noise Database*.

**Table 6.20** provides a summary of the predicted exceedances of the applicable RING criteria for both the ‘no build’ and ‘build’ scenarios. Detailed predicted noise levels at each assessment receiver is provided in Appendix D: Noise and vibration Impact Assessment.

It is noted that while there are some predicted exceedances of the overall  $L_{Amax}$  criteria, the change in noise levels between the ‘build’ and the ‘no build’ scenarios remains below the 3 dB(A) threshold outlined in the RING. Therefore, there are no predicted exceedances of the applicable RING criteria due to the operation of the proposal. As a result, no further mitigation is considered necessary.

**Table 6.20 Summary of predicted operational rail noise level exceedances – in accordance with RING criteria**

Scenario	Maximum daytime $L_{Aeq,15hr}$ noise level	Maximum night-time $L_{Aeq,9hr}$ noise level	Maximum $L_{Amax}$ noise level	Number of receivers where noise levels exceed:		
				$L_{Aeq,15hr}$ noise trigger levels	$L_{Aeq,9hr}$ noise trigger levels	$L_{Amax}$ noise trigger levels
No build	62	62	91	0	0	0
Build	62	63	93	0	0	0

### *Predicted operational noise levels – idling of freight locomotives*

A summary of the predicted operational noise impact associated with idling of freight locomotives at signals is presented for daytime and night-time in **Table 6.21**. The results of this assessment show that there are no predicted exceedances of the project noise trigger levels. Detailed predicted noise levels at each assessment receiver is provided in Appendix D: Noise and vibration Impact Assessment.

**Table 6.21 Summary of predicted noise levels for idling freight locomotives**

	Project noise trigger level, dB(A)	Maximum, worst case conditions $L_{Aeq}$ noise level, dB(A)	Number of receivers exceeding project noise trigger levels
Daytime	60	53	0
Night time	44	53	0

### Predicted operational noise levels – fixed facilities

In order to assess noise impacts from the operation of the stabling yard and amenities building in accordance with the NPfI, a noise model was created to consider two noise scenarios:

- **Scenario 1: Existing stabling facilities**

- six 8-car T-set trains (Tangara trains) would be stabled within the existing stabling facility located to the northeast of Waterfall station
- one of these trains would leave the stabling facility within any 15-minute assessment period. This train would sound its horn prior to departure
- all trains would be operational with air conditioners and inverter units running
- acoustic shielding from stabled trains has not been considered as a conservative assumption.

- **Scenario 2: Proposed fixed facilities**

- ten 8-car T-set trains would be stabled within the new stabling facility, in addition to the six 8-car T-set trains stabled in the existing stabling yard to the north-east of Waterfall station
- one train would leave the new stabling yard within the 15-minute assessment period. This train would sound its horn prior to departure
- all trains would be operational with air conditioners and inverter units running
- acoustic shielding from stabled trains has not been considered, in order to maintain a conservative approach
- rubbish collection would occur using a light vehicle driving along the access road from the proposed amenities building to the Princes Highway. Rubbish would be collected by a garbage truck just inside the gate – one light vehicle movement is assumed within a 15-minute period, with garbage truck collection to occur over a 2-minute period.

**Table 6.22** provides the typical noise levels for operational plant used in the assessment. Note that both standard and noise enhancing meteorological conditions were considered in accordance with the NPfI. Noise enhancing meteorological conditions refers to conditions when the wind is blowing from the direction of the noise source towards the receiver.

**Table 6.22 Stabling yard reference noise levels**

Source	Sound power level (SWL), dB(A)	Notes
Air conditioner	77 L <sub>Aeq</sub>	All trains in stabling yard – two units per car
Inverter	83 L <sub>Aeq</sub>	All trains in stabling yard – one at both ends of each 4-car set
Compressor	91 L <sub>Aeq</sub>	Trains leaving stabling yard – one unit at both ends of each 4-car set
Door test	68 L <sub>Aeq</sub>	Trains leaving stabling yard – all doors on train
Electro-pneumatic brake test	114 L <sub>A10, 1min</sub> <sup>1</sup>	Trains leaving stabling yard – one at both ends of each 4-car set
Horn	110 L <sub>A10, 1min</sub> <sup>2</sup>	Trains leaving stabling yard – one 1-second burst at each end of the train

Source	Sound power level (SWL), dB(A)	Notes
Light vehicle	93 L <sub>Aeq</sub>	One movement along access road to new amenities building – one movement includes one entry and one exit on the site
Garbage truck	102 L <sub>Aeq</sub> <sup>3</sup>	One collection event lasting 2 minutes to occur during a 15-minute period

Notes:

- 1 In the noise impact assessment this sound power level was adjusted for a 15-minute assessment period.
- 2 In the noise impact assessment this sound power level was adjusted for a 15-minute assessment period, assuming a 1-second burst.
- 3 Sound power level has been adjusted for a 15-minute assessment period, assuming a rubbish pickup to take 2 minutes

A summary of the predicted general noise impact associated with operation of the existing stabling yard noise (Scenario 1) and proposed fixed facilities (Scenario 2) is presented for daytime and night-time in **Table 6.23** through to **Table 6.26**.

**Table 6.27** and **Table 6.28** present a summary of the sleep disturbance noise levels associated with the operation of the existing stabling yard and proposed fixed facilities. These noise levels were predicted at nearby residential receivers within the Proposal area.

The assessment identified a number of exceedances of the adopted project noise trigger levels for the Proposal. These exceedances are generally alongside the Princes Highway, at the northern end of Waterfall village. These exceedances occur due to the proximity of stabling operations to residential receivers, in addition to the lower project noise trigger level during the night-time.

### **Scenario 1: Existing stabling yard (General noise emissions)**

**Table 6.23 Summary of predicted noise levels for existing stabling yard noise – day time**

Meteorological condition	Project noise trigger level, dB(A)	Maximum L <sub>Aeq</sub> noise level, dB(A)	Number of receivers exceeding project noise trigger levels
Standard meteorological conditions	60	48	0
Noise-enhancing meteorological conditions	60	48	0

**Table 6.24 Summary of predicted noise levels for existing stabling yard noise - night time**

Meteorological condition	Project noise trigger level, dB(A)	Maximum $L_{Aeq}$ noise level, dB(A)	Number of receivers exceeding project noise trigger levels
Standard meteorological conditions	44	48	11
Noise-enhancing meteorological conditions	44	48	11

**Scenario 2: Proposed fixed facilities (General noise emissions)**

**Table 6.25 Summary of predicted noise levels for operation of fixed facilities – day time**

Meteorological condition	Project noise trigger level, dB(A)	Maximum $L_{Aeq}$ noise level, dB(A)	Number of receivers exceeding project noise trigger levels
Standard meteorological conditions	60	52	0
Noise-enhancing meteorological conditions	60	52	0

**Table 6.26 Summary of predicted noise levels for operation of fixed facilities – night time**

Meteorological condition	Project noise trigger level, dB(A)	Maximum $L_{Aeq}$ noise level, dB(A)	Number of receivers exceeding project noise trigger levels
Standard meteorological conditions	44	52	14
Noise-enhancing meteorological conditions	44	52	18



### **Scenario 1: Existing stabling yard (Sleep disturbance)**

**Table 6.27** Summary of predicted  $L_{Aeq}$  and  $L_{Amax}$  noise levels for maximum noise level - existing stabling yard noise

Meteorological condition	Sleep disturbance $L_{Aeq}$		Sleep disturbance $L_{Amax}$	
	Screening level	Number of receivers exceeding $L_{Aeq}$ noise levels	Screening level	Number of receivers exceeding $L_{Amax}$ noise levels
Standard meteorological conditions	44	11	54	10
Noise-enhancing meteorological conditions	44	11	54	12

### **Scenario 2: Proposed fixed facilities (Sleep disturbance)**

**Table 6.28** Summary of predicted  $L_{Aeq}$  and  $L_{Amax}$  noise levels for maximum noise level assessment – Fixed facilities

Meteorological condition	Sleep disturbance $L_{Aeq}$		Sleep disturbance $L_{Amax}$	
	Screening level	Number of receivers exceeding $L_{Aeq}$ noise levels	Screening level	Number of receivers exceeding $L_{Amax}$ noise levels
Standard meteorological conditions	44	14	54	18
Noise-enhancing meteorological conditions	44	18	54	19

#### **6.3.4 Mitigation measures**

The following mitigation measures would apply to the Proposal:

- a Construction Noise and Vibration Management Plan (CNVMP) should be developed for the Proposal and implemented prior to commencement of construction activities. The CNVMP should include all feasible and reasonable safeguards to manage the noise emissions from the site and any complaints which may occur due to construction noise
- the CNVMP should include, as a minimum, the following:
  - identification of nearby residences and other sensitive land uses
  - description of approved hours of work
  - description and identification of all construction activities, including work areas, equipment and duration
  - description of what work practices (generic and specific) would be applied to minimise noise and vibration

- a complaints handling process
- noise and vibration monitoring procedures, including for heritage structures
- overview of community consultation required for identified high impact works
- construction works should be planned and carried out during standard construction hours wherever possible. The standard mitigation measures contained within the *Construction Noise and Vibration Strategy* (CNVS) (TfNSW, 2018) will be considered as mitigation measures as part of the CNVMP
- all residents and sensitive receivers impacted by noise levels from the Proposal which are expected to exceed the NML should be consulted prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works. The information provided to the receivers would include:
  - programmed times and locations of construction work
  - the hours of proposed works
  - construction noise and vibration impact predictions
  - construction noise and vibration mitigation measures being implemented on site.
- community consultation regarding construction noise and vibration would be detailed in a Community Liaison Management Plan for the construction of the Proposal and would include a 24-hour hotline and complaints management process
- TfNSW's CNVS provides practical guidance on how to minimise, to the fullest extent practicable, the impacts on the community from airborne noise, ground-borne noise and vibration generated during the construction of TfNSW projects. This is managed through the application of all feasible and reasonable mitigation measures. Where exceedances are still expected to occur after standard mitigation measures have been applied, the CNVS recommends the implementation of additional mitigation measures. These mitigation measures are specified within the CNVS and presented in **Table 6.29**.

The provision of additional mitigation is based on the predicted exceedances above RBLs and when the exceedances occur.

**Table 6.29 Additional mitigation measures matrix**

Construction hours	Receiver perception	dB(A) above RBL	dB(A) above NML	Additional management measures
<b>Standard hours</b>	Noticeable	5 to 10	0	-
Monday-Friday (7am-6pm)	Clearly audible	>10 to 20	<10	-
Saturday (8am-1pm)	Moderately intrusive	>20 to 30	>10 to 20	PN, V
	Highly intrusive	>30	>20	PN, V
	75 dB(A) or greater	N/A	N/A	PN, V, SN
<b>OOHW Period 1</b>	Noticeable	5 to 10	<5	-
Monday-Friday (6pm-10pm)	Clearly audible	>10 to 20	5 to 15	PN
Saturday (7am-8am, 1pm-10pm)	Moderately intrusive	>20 to 30	>15 to 25	PN, V, SN, RO
Sunday/Public Holiday (8 am-6 pm)	Highly intrusive	>30	>25	PN, V, SN, RO, RP#, DR#
<b>OOHW Period 2</b>	Noticeable	5 to 10	<5	PN
Monday-Saturday (12am-7am, 10pm to 12am)	Clearly audible	>10 to 20	5 to 15	PN, V
Sunday/Public holiday (12am-8am, 6pm-12am)	Moderately intrusive	>20 to 30	>15 to 25	PN, V, SN, RP, DR
	Highly intrusive	>30	>25	PN, V, SN, AA, RP, DR

Notes: PN = Project notification  
V = Verification monitoring  
RP = Respite period  
AA = Alternative accommodation

SN = Specific notification, individual briefings, or phone call:  
DR = Duration respite  
RO = Project specific respite order

\* SWLs used for the purpose of estimating noise impact shall be increased by 5 dB(A) where works will include: power saws for the cutting of timber, masonry & steel; grinding of metal, concrete or masonry; rock/line drilling; bitumen milling & profiling; jack hammering, rock hammering & rock breaking; or impact piling as a correction factor for noise with special audible characteristics.  
# Respite periods and duration reduction are not applicable when works are carried out during OOHW Period 1 Day only (i.e. Saturday 6am-7am & 1pm-6pm, Sundays / Public Holidays 8am-6am)

It is recommended that a noise reduction program as outlined in Section 6.2 of the NPfI be developed in order to provide a formal, structured approach to reduce noise to acceptable levels over time, by applying reasonable and feasible control measures. A noise reduction program would review the site-specific activities that would occur due to stabling operations and take into consideration the noise expectations of the community. The program may include:

- identification of noise levels and targets for the site
- time frame for implementation of measures

- an upper limit for new equipment
- an upper limit for partial upgrades of the site
- plans to eliminate problematic characteristics that have been identified, such as tonal and low-frequency noise
- a sound power target for relevant sections of the site
- operating practices to reduce tonal emissions
- training and awareness initiatives
- an ongoing monitoring program to evaluate noise emission levels
- communicating with the affected community using tools such as a complaints handling process, liaison group or newsletters.

Based on the outcomes of the operational noise and vibration assessment, the following key mitigation options should be examined during development of the noise reduction program:

- alternative methods to testing or sounding horns prior to departure should be considered, as has been adopted at other Sydney Trains facilities. This would enable the train driver to warn of impending train movement without sounding the train horn when entering or exiting the stabling yard
- prioritise moving trains out of the existing stabling facility first during noise sensitive periods. This would allow for greater distance between noise sources at the facility and receivers
- move trains out of the north of the proposed stabling facility instead of the south. This measure would allow for greater distance between noise sources at the facility and receivers
- stable quieter train sets wherever possible. This option would reduce overall noise emissions from the proposed facility
- turn off stabled trains completely when not in use. This would reduce overall noise emission from the proposed facility
- rolling stock modifications to reduce noise from compressors, etc. during testing and preparation procedures. This would reduce overall noise emission from the proposed facility
- reduce the number of trains leaving during noise sensitive periods. This would reduce the overall noise level of the facility in addition to reducing the number of maximum noise events that would occur
- rolling stock modifications to reduce noise from compressors, etc. during testing and preparation procedures
- construction of a noise barrier located along the southern extent of the stabling yard between the rail corridor and Princes Highway to provide a pathway noise control measure
- prioritise moving trains that are already sited behind other stabled trains in the facility. This would induce a shielding effect between the source and receiver
- at-receiver mitigation options such as architectural treatment at affected receivers.

Refer to **Section 7.2** for a full list of proposed mitigation measures.

## 6.4 Indigenous heritage

### 6.4.1 Existing environment

A due diligence assessment was undertaken for the Proposal in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW, 2010). A basic AHIMS search was undertaken for the area covered by the Proposal (the area around Waterfall Station) on 17 July 2019 (AHIMS Reference #60600277). The search parameters were GDA, Zone: 56, Eastings: 312660 - 317380, Northings: 6219665 - 6222420 with a Buffer of 0 meters. Ninety-eight Indigenous sites were recorded in or near the location.

An extensive AHIMS search for the above search was undertaken on 17 July 2019 to identify the exact location of these sites and establish if there are any sites in the immediate vicinity of the Proposal Area.

Three sites within 400 metres of the Proposal Area were identified. The closest site is about 140 metres north west of Waterfall Station. The three sites are described in **Table 6.30** below. Site cards have been obtained for these three sites.

**Table 6.30** Description and location of the Indigenous sites within 400 metres of Waterfall Station

Item number	Site type	Distance from Waterfall Station
52-2-0214	Open site, Art (Pigment or engraved)	140 metres north west
52-2-1294	Open site, Grinding Groove: Art (Pigment or Engraved)	230 metres east
52-2-1293	Open site, Grinding Groove	390 metres south east

The closest site (ID 52-2-0214) is in a residential setting. It is not within the Proposal area and would not be affected by the works. The extensive landscape modification and high level of disturbance that has occurred across the Proposal area suggests that the presence of culturally sensitive buried items is unlikely within the boundaries of the Proposal area.

The basic AHIMS search is included as **Appendix E**.

### 6.4.2 Potential impacts

#### Construction phase

Construction of the Proposal would involve some excavation and other ground disturbance for the following activities:

- platform extension
- construction of the staff amenities building
- relocation of utilities during platform reconstruction
- new tracks, OHW footings and services;
- construction of footings for the pedestrian bridge
- construction of the retaining wall adjacent to the Up freight loop.

As no known indigenous heritage items are located in the vicinity of the Proposal area, and due to the extensive landscape modification and high level of disturbance of the Proposal area, the potential for unknown items to be present is considered to be low. The Proposal is unlikely to affect Indigenous heritage during construction. The management measures recommended in **Section 6.4.3** would be implemented for the Proposal.

### Operational phase

The operation of the proposal would not result in any ongoing impacts upon Indigenous heritage.

#### 6.4.3 Mitigation measures

The following mitigation measures would apply to the Proposal:

- all construction staff would undergo an induction in the recognition of Indigenous cultural heritage material. This training would include information such as the importance of Indigenous cultural heritage material and places to the Indigenous community, as well as the legal implications of removal, disturbance and damage to any Indigenous cultural heritage material and sites
- if unforeseen Indigenous heritage objects are uncovered during construction, the procedures contained in TfNSW's Unexpected Heritage Finds Guideline (TfNSW, 2019b) would be followed, and works within the vicinity of the find would cease immediately. The Contractor would immediately notify the TfNSW Project Manager and TfNSW Environment and Planning Manager so they can assist in co-ordinating the next steps which are likely to involve consultation with an Aboriginal heritage consultant, DPC Heritage and the Local Aboriginal Land Council.
- if human remains are found, work would cease, the site secured and the NSW Police and DPC Heritage notified. Where required, further archaeological investigations and an Aboriginal Heritage Impact Permit would be obtained prior to works recommencing at the location.

Refer to **Section 7.2** for a full list of proposed mitigation measures.

## 6.5 Non-Indigenous heritage

### 6.5.1 Methodology

A Statement of Heritage Impact (SoHI) has been prepared by AECOM (2019) for the Proposal. This included a desktop assessment and site inspection of the Proposal site, which was undertaken on 12 April 2019. The SoHI is summarised in this section.

The study area for the SoHI included Waterfall Station (both internal and external), as well as the existing character of the Project area and surrounding land uses.

The SoHI is included in **Appendix F**.

### 6.5.2 Existing environment

A desktop search of historic registers including the World Heritage List, National Heritage List, Commonwealth Heritage List, the Register of National Estate (RNE) (non-statutory archive), NSW State Heritage Register, RailCorp's Section 170 Heritage and Conservation Register and the heritage schedule of the Sutherland LEP 2015 was undertaken for the Proposal Area and surrounds. The searches and their results are shown in **Table 6.31**.

## Database results

Heritage register searches identified that Waterfall Railway Station is immediately adjacent to the curtilage of the Nationally significant Royal National Park and Garawarra State Conservation Area (#105893).

Heathcote National Park is located approximately 65 metres to the west of the Proposal Area at its closest point. Heathcote National Park was previously listed as local heritage item A098 on the Sutherland LEP 2006, but has since been removed and is not listed on the currently active Sutherland LEP 2015. It is listed as a registered place for natural values on the non-statutory archived (RNE) (item #1530).

Waterfall Railway Station Group has local significance and is listed on the non-statutory archived RNE (item #101153). Items within the footprint of the station, including the Waterfall Turntable, Watering Facilities & Movable Items are part of the RailCorp Section 170 Heritage and Conservation Register listing (item #4801139).

Waterfall Railway Station is not listed as an item of environmental heritage in Sutherland LEP 2015. However, three items associated with the station are listed, two within its bounds, being the Waterfall Railway turntable (#A4003) and 'Row of 3 workers' cottages including Community Cottage' (#A4004). Approximately 200 metres north of the station is the listed item 'Watertank' (#A4005), which is also associated with the station and specified as an element of the Waterfall Railway Station Group listing.

Immediately adjacent to the southern side of the station curtilage is the item 'Pair of semi-detached houses' (#4001). Register searches were extended 100 metres from the curtilage of Waterfall Railway Station to establish if there were surrounding registered items or conservation areas that may be affected by the Proposal, however no further relevant listings were identified.

Heritage listed items within the vicinity of the Proposal site are listed in **Table 6.31** and shown in **Figure 6.7** and **Figure 6.8**.

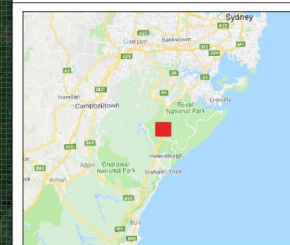
**Table 6.31 Summary of listed heritage items within and adjacent to the Project area**

Heritage list	Items within the Project site	Level of significance	Items adjacent to the Project area	Level of significance	Distance to Project area (metres)
World Heritage List	Nil	n/a	Nil	n/a	n/a
National Heritage List	Nil	n/a	Royal National Park and Garawarra State Conservation Area (#105893)	National	0
Commonwealth Heritage List	Nil	n/a	Nil	n/a	n/a
Register of the National Estate (non-statutory)	Waterfall Railway Station Group (#101153)	Local	Royal National Park and Garawarra State Conservation Area (#105893) Heathcote National Park (#1530)	National and State  Local	0  65
State Heritage Register	Nil	n/a	Nil	n/a	n/a
RailCorp s.170 Register	Waterfall Turntable, Watering Facilities & Movable Items (SRA#139); (SHI#4801139)	Local	Nil	n/a	n/a
Sutherland LEP 2015	Waterfall Railway turntable (#A4003) Row of 3 railway workers' cottages including Community College (#A4004) Watertank (#A4005)	Local  Local  Local	Pair of semi-detached houses (#4001)	Local	10

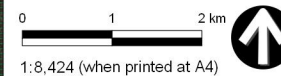


## Legend

- 100 m Search area
- Project area
- Heritage Listed Items**
- RNP and Garawarra State CA
- Heathcote National Park
- Watertank
- Waterfall Railway turntable
- Row of 3 railway workers' cottages
- Pair of semi-detached houses
- Waterfall Railway Station Group



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VERSION:	A



Royal National Park and Garawarra State Conservation Area

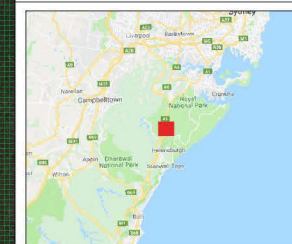
Heathcote National Park

A4005

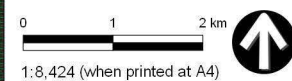
**Figure 6.7:** Heritage listed items in proximity to the Proposal Area

## Legend

- 100 m Search area
- Project area
- Heritage Listed Items**
- RNP and Garawarra State CA
- Heathcote National Park
- Watertank
- Waterfall Railway turntable
- Row of 3 railway workers' cottages
- Pair of semi-detached houses
- Waterfall Railway Station Group

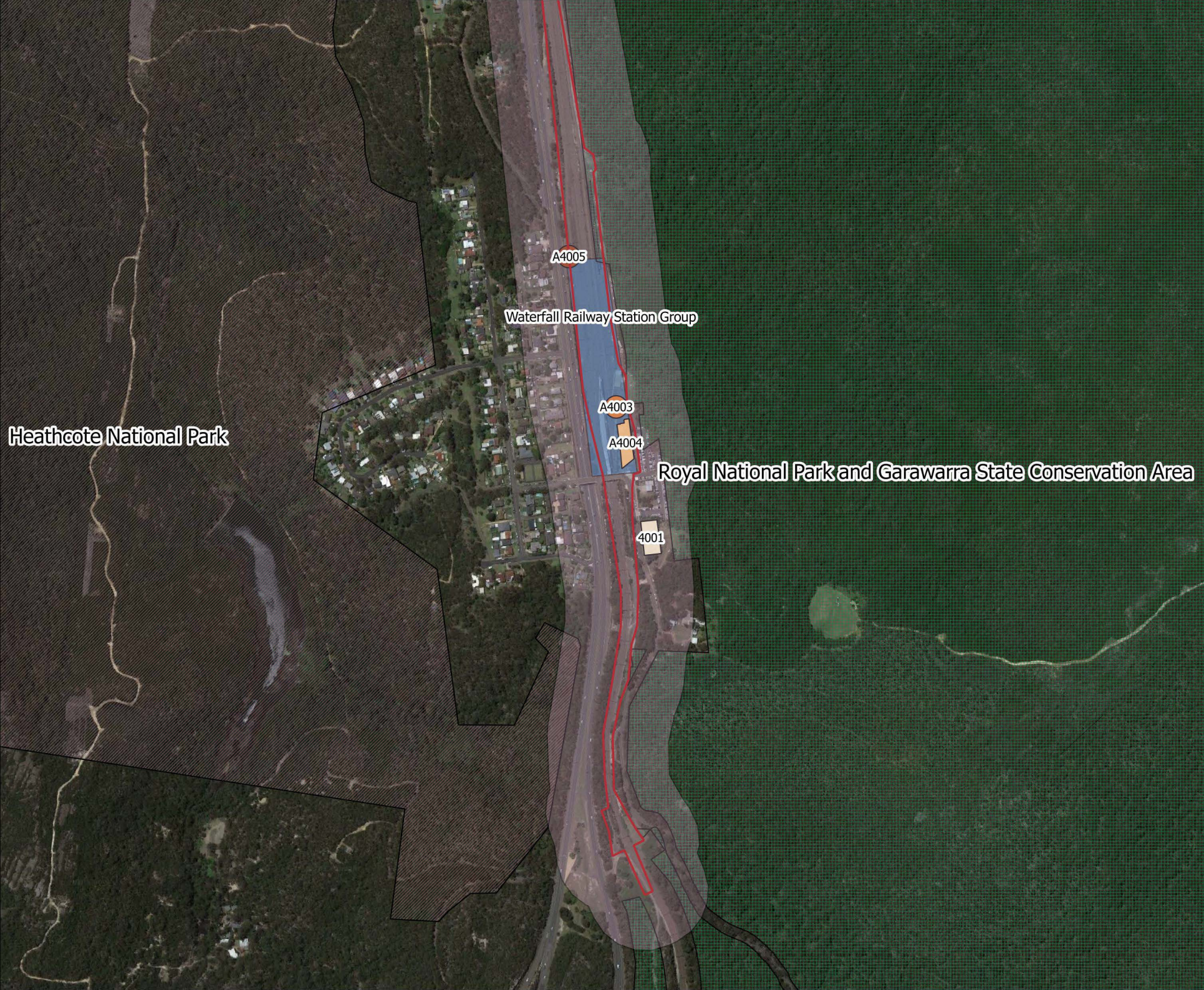


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**Figure 6.8:** Heritage listed items in proximity to the Proposal Area

Although not overtly stated in the existing heritage listings, it was noted during the inspection that the sidings and yards contribute to the heritage value of Waterfall Railway Station. The relevance of the extant heritage items (the turntable, water tank and water column) is enhanced by how they relate to each other and to the wider rail network. The visual landscape around them and the physical rails, yards and sidings that connect them are part of the historical landscape of steam engine use at Waterfall. Evidence of the historical relevance of Waterfall Railway Station can also be evidenced by plaques and interpretation boards currently displayed at the station.

### Site inspection

A visual inspection of the Project area was undertaken on 12 April 2019 by AECOM archaeologist Dr Darran Jordan. The purpose of the inspection was to identify the potential for direct or indirect impacts to historic heritage items. The inspection verified that the background listing information was correct in that the original platform building and the five residences that were located adjacent to Waterfall Railway Station had been demolished. Extant features and items including the turntable, water tank, water spout and pair of semi-detached houses were all found to be intact.

### Historical background

On 9 March 1886, Waterfall Railway Station (originally Waterfalls Station) opened for use, situated approximately 600 m south of its present location, with a single platform on its western side (OEH, 2019; Singleton, 1984). At this time, the station was the terminus for the Illawarra line, and its high elevation and proximity to water sources made it a useful location for watering the steam-powered trains. Line construction continued, and in 1888, the line was opened from Sydney through to North Kiama (Singleton, 1984).

By the end of 1890, the line between Hurstville and Waterfall was duplicated, requiring the movement of Waterfall Railway Station further north and the construction of a double platform (Singleton, 1984). A goods siding and storage yard were installed, followed by the installation of a locomotive turntable and railway residences in 1897, and an engine shed in 1899 (OEH, 2019).

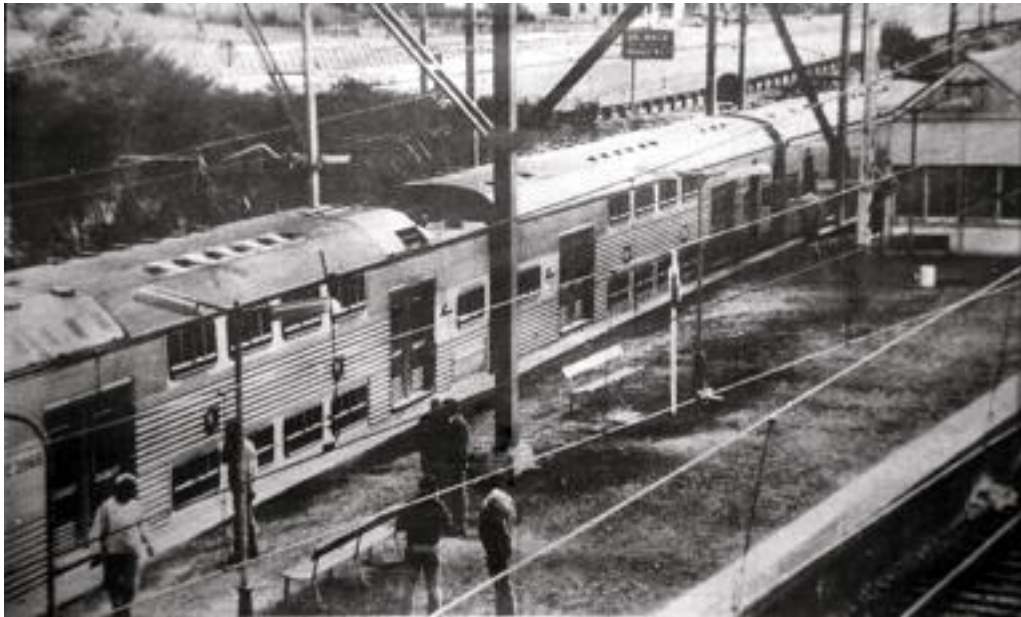
A third and final Waterfall Railway Station was constructed in 1905 (**Figure 6.9**) and consisted of an island platform and a marshalling yard, adjacent to the 1897 turntable. In addition to this, two semi-detached brick residences were built just south of the station, located at 7-10 McKell Avenue, to provide further housing for railway workers (OEH, 2019).



**Figure 6.9 Waterfall Railway Station third Platform Building c.1910 (OEH, 2019)**

Alterations occurred as the line underwent duplication to the south of Waterfall. The group of structures had expanded by 1914 to include four goods sidings, two turntables, coal stages and an engine and goods shed. The sidings were expanded in 1919 and a goods passenger lift was installed in 1921, providing access between the platform and overbridge. In the 1960s a carport was added to the Night Officer's residence.

The line was electrified in 1980, with changes made to the yard and rail layout at that time (**Figure 6.10**). In 1995 a steel and concrete platform building with access from the overbridge by modern concrete steps replaced the prior timber platform building at Waterfall Railway Station.



**Figure 6.10** First electric train at Waterfall Railway Station, 1980 (Source: Sutherland Shire Library)

Various minor alterations occurred post-2000 (**Figure 6.11**), including service fittings, the removal of sleepers from the perimeter wall of the turntable, the addition of a metal container in proximity to the turntable and skillion additions at the rear and/or sides of the residences. In 2011 the turntable was refurbished, including overgrowth removal and cleaning followed by adding an anti-corrosive coating and high-durability paint.



**Figure 6.11** Waterfall Railway Station 2017 Aerial. New buildings shown on the site of the former Row of 3 workers' Cottages including Community College (red)