15. Traffic and Access

15.1 Assessment Approach

15.1.1 Introduction

The Director-General's Environmental Assessment Requirements identify traffic and access issues as key issues for the Environmental Assessment. This chapter identifies the potential impacts of the Project on traffic and access and the management measures proposed to reduce these impacts. Table 15-1 outlines the Director-General's Environmental Assessment Requirements relating to traffic and access and where they have been addressed.

Traffic impacts, taking into account the *Road Design Guide* (RTA) and relevant AUSTROADS guidelines and Australian Standards, have been assessed within a detailed Traffic Study and are included in Appendix J.

Table 15-1 Director-General's Environmental Assessment Requirements – Traffic and Access

Director-General's Environmental Assessment Requirements	Where addressed
General Construction Impacts	
Assess and present a management framework for traffic and access, including a considered approach to minimising construction traffic impacts on public and private access. Consideration should be given to:	
◗ Local and regional community access (vehicle and pedestrian) to property, community facilities and business services,	Section 15.3
◗ Route identification and temporary haul roads,	Chapter 7
◗ The number, frequency and size of construction related vehicles,	Chapter 7
◗ The nature and frequency of existing traffic on construction access routes,	Chapter 7
◗ The need to close, divert or otherwise reconfigure elements of the road network associated with construction of the project, and	Chapter 7
◗ A strategy for managing traffic impacts, with a particular focus placed on those activities identified as having the greatest potential for adverse traffic flow, access or safety implications, and a broader, more generic approach developed for day-to-day traffic management.	Section 15.4 and Chapter 7

Director-General's Environmental Assessment Requirements	Where addressed
Land Use and Access	
◗ Interaction with existing and proposed rail and road infrastructure including the Hunter Expressway, taking into account the *Road Design Guide* (RTA) and relevant AUSTROADS guidelines and Australian Standards.	Section 1.3

15.1.2 Methodology

The traffic and access assessment comprised the following steps:

- Description of existing road network conditions.
- Estimation of the volume of construction traffic to be generated.
- Impact assessment.
- Mitigation measures.

15.2 Existing Road Network Condition

15.2.1 Regional Road Network

The Project area passes through three local government areas: Maitland, Cessnock and Singleton. The study area starts at Telarah, at the southern end and follows the Main Northern Railway to Minimbah, near Belford in the north.

The New England Highway is part of the National Highway route, designated National Highway 15. The highway is an arterial route which carries the majority of traffic through the Upper Hunter Valley to Newcastle (Figure 15.1). In the study area, the highway follows a similar path to the north of the Main Northern Railway. The highway passes through the townships of Lochinvar, Greta and Branxton.

Wine Country Drive is designated as State Route 82, connecting Branxton to Cessnock via Rothbury and several wineries. The road is also referred to as Bridge Street in the vicinity of the Main Northern Railway overbridge in Branxton.

There are a number of roads that connect the New England Highway and the Main Northern Railway corridor, crossing the railway at level crossings or at grade-separated crossings (Figure 15.1). Project construction and maintenance vehicles would be required to travel on the New England Highway and these roads to gain access to the Project.

Table 15-2 lists the streets within the study area and provides a general description.

Table 15-2 Streets Within the Study Area

Road	Description
Wollombi Road, Telarah	Wollombi Road is a divided carriageway road between New England Highway and Green Street with direct property access to residential dwellings on both sides. The posted speed limit for this section is 60 km/hr. South of the Green Street roundabout, Wollombi Road is a two-lane two-way sealed road and continues to Cessnock after approximately 30km. The road passes under the Main Northern Railway at a rail overbridge with a clearance of 4.2 metres.
Winders Lane, Lochinvar	Winders Lane is a two-lane, two-way sealed road allowing access from the New England Highway to rural residential lots. Winders Lane terminates at access gates to the Main Northern Railway Line approximately 1.5km south of the New England Highway.
Station Lane, Lochinvar	Station Lane is a two-lane two-way sealed road connecting New England Highway and Old North Road and providing access to Lochinvar Railway Station. It passes through a residential area, signposted speed 60km/hr for the first 650 metres and proceeds to a rural residential area with posted speed 80km/hr and connects to Old North Road. Station Lane will cross the Main Northern Railway at a grade separated overbridge approximately 200 metres west of the existing level crossing. This overbridge will replace the level crossing and construction is expected be complete by the time of construction of the Project.
Old North Road, Allandale, Lochinvar and Farley	Old North Road is a two-lane two-way rural road that originally connected Allandale Road and Wollombi Road but is now discontinuous at the railway crossing between Allandale Road and Station Lane. It provides access to rural residential properties. It has a posted speed limit for most of its length of 80 km/hr.
Allandale Road, Allandale	Allandale Road is a two-lane two-way rural road. The road provides access to a number of rural properties and connects the New England Highway to several vineyards. Allandale Road has a signposted speed of 80km/hr and intersects with Old North Road approximately 1.5 kilometres south of the New England Highway then passes under the Main Northern Railway at an underbridge 50 metres south of this intersection. The bridge has a clearance of 4.5 metres
Nelson Street, Greta	Nelson Street south of the New England Highway is a two-lane, two-way sealed road which provides access to a number of residential dwellings and connecting streets. Nelson Street crosses the Main Northern Railway at a two lane overbridge and provides access to Greta Railway Station. Nelson Street then becomes Mansfield Street and services a number of residential properties and continues on to Cessnock. The posted speed limit is 50 km/hr
Station Street, Branxton	Station Street is a two-lane, two-way road providing access to a primary school, church and cemetery at the northern end. At the southern end of Station Street are a number of residential properties. Station Street also provides access to Branxton Railway Station and does not cross the Main Northern Railway. The posted speed limit is 50 km/hr

Road	Description
Standen Drive (Rix's Road), Belford	Rixs Road intersects with the New England Highway at Standen Drive. Rixs Road is an unsealed and is an access road and crosses the Main Northern Railway at a private level crossing. This crossing is approximately 500 metres south of the New England Highway
Hermitage Road, Belford	Hermitage Road is a two lane-two way road through a rural residential area. Hermitage Road links the New England Highway to Broke Road, Broke. The posted speed limit is 100km/hr and will cross the Main Northern Railway at a grade separated overbridge approximately 200 metres south of the New England Highway and 85 metres west of the existing level crossing. This overbridge will replace the level crossing and construction is expected be complete by the time of construction of the Project.

15.2.2 Existing Road Performance

The performance of the existing road network surrounding the study area has been measured in terms of Level of Service (LOS). The LOS criteria has been based on peak hour flows per direction for urban roads and two-way peak hour flows for rural roads as defined in RTA's Guide to Traffic Generating Developments. A LOS of A means that the road is operating at a good level of service with extra capacity available, while a LOS rating of F means that the road is considered to be failing.

The performance of the existing road network surrounding the study area is shown in Table 15-3.

Table 15-3 Existing Road Network Performance

Road	Road Class	Peak Two-way Flow (Vehicles per hour)	Peak Direction Flow (Vehicles per hour)	Existing LOS *
Wollombi Road	Urban	127	75	A
Station Lane, Lochinvar	Urban	68	35	A
Old North Road, Farley	Rural	79	44	B
Allandale Road, Allandale	Rural	168	86	B
Nelson Street, Greta	Urban	310	171	A
Wine Country Drive, Branxton	Urban	659	339	B
Hermitage Road, Belford	Rural	218	112	B

* as per the RTA's *Guide to Traffic Generating Developments*.

Overall, the existing road network investigated has a good LOS with extra capacity available.

15.2.3 Existing Intersection Performance

The volume of traffic using key intersections within the study area was surveyed. Traffic volumes at these intersections were measured in 15 minute increments in the morning between 6.30 am and 9.30 am and afternoon between 3.00 pm and 6.00 pm. The four consecutive 15 minute sections with the highest traffic volume were used to identify the peak hour volume.

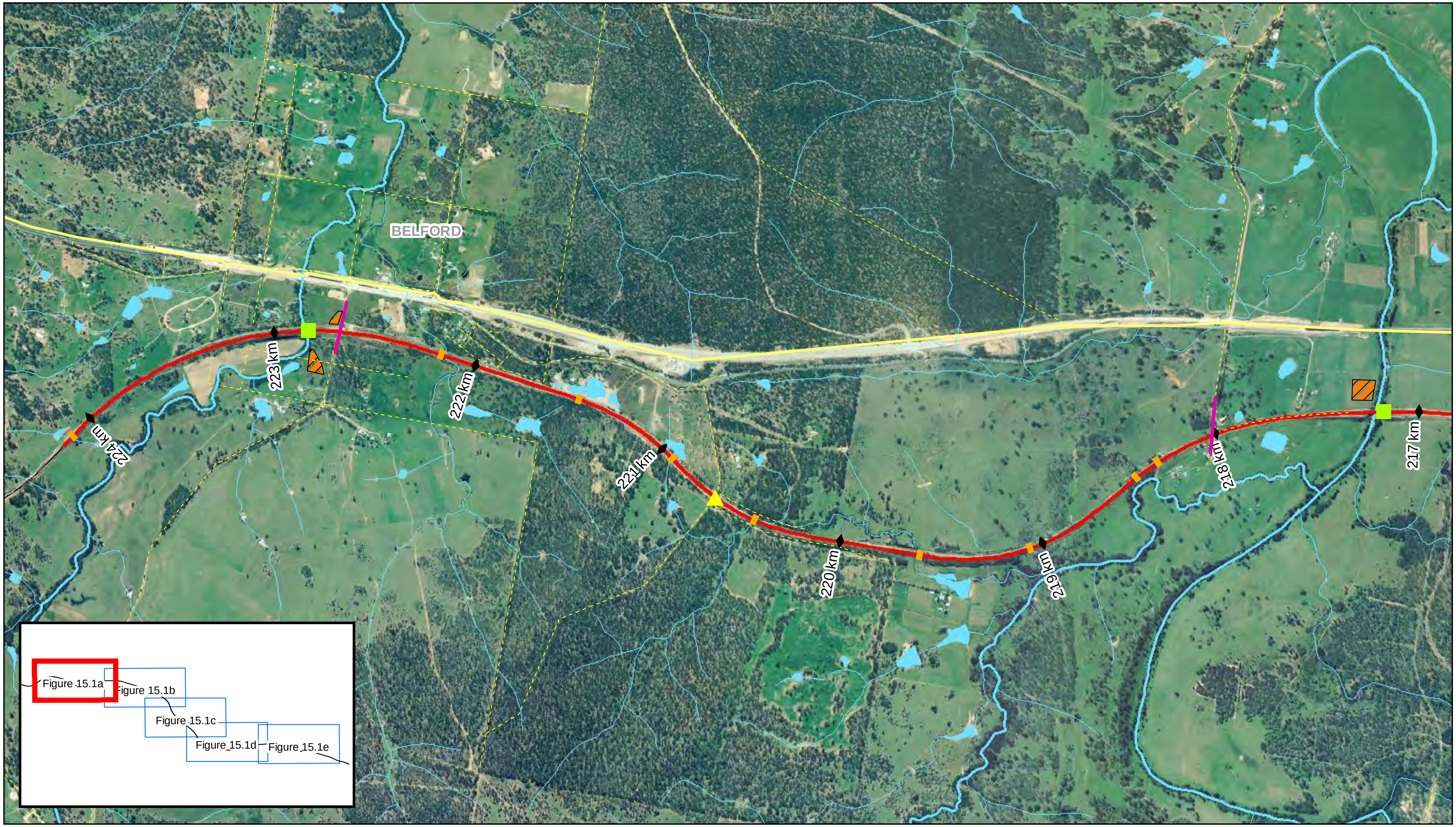
The key intersections were modelled using SIDRA Intersection 3.2 (SIDRA) traffic modelling software, based on the volumes from the surveyed turning movement counts. The layout and lane arrangement of each intersection was assessed using aerial photographs, survey and site observations.

The existing Level of Service (LOS) of each intersection was modelled for the morning and afternoon peak and a summary of the results of the modelling are given Table 15-4.

Table 15-4 Key Intersection Performance Results

New England Highway Access	Suburb	Current Intersection Performance	Comments
Wollombi Road	Telarah	LOS F	Over capacity on right turn from Wollombi Road
Station Lane	Lochinvar	LOS D	PM Nearing Capacity for all movements to/from Station Lane
Nelson Street	Greta	LOS E	PM At Capacity Nelson St through and right turn movements
Station Street	Branxton	LOS D	AM nearing capacity out of Station St
Rixs Road	Belford	LOS A	Good operation
Hermitage Road	Belford	LOS B	Good operation

The intersection performance is based on the worst intersection movement. Typically, the analysis results indicate that traffic on the New England Highway traffic is unimpeded and that side street traffic at sign-controlled junctions experience substantial delays.



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0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Underbridge
- Existing Overbridge
- Existing Culvert
- Highway
- Roads
- Non Formed Roads
- Built up Areas
- Site Compounds
- Level Crossings
- Watercourse
- Watercourse Area
- Project Location

Hunt8r ALLIANCE

Maitland To Minimbah Third Track
Environmental Assessment

Job Number	22-14471
Revision	A
Date	May 2010

Local Road Network

Figure 15.1a

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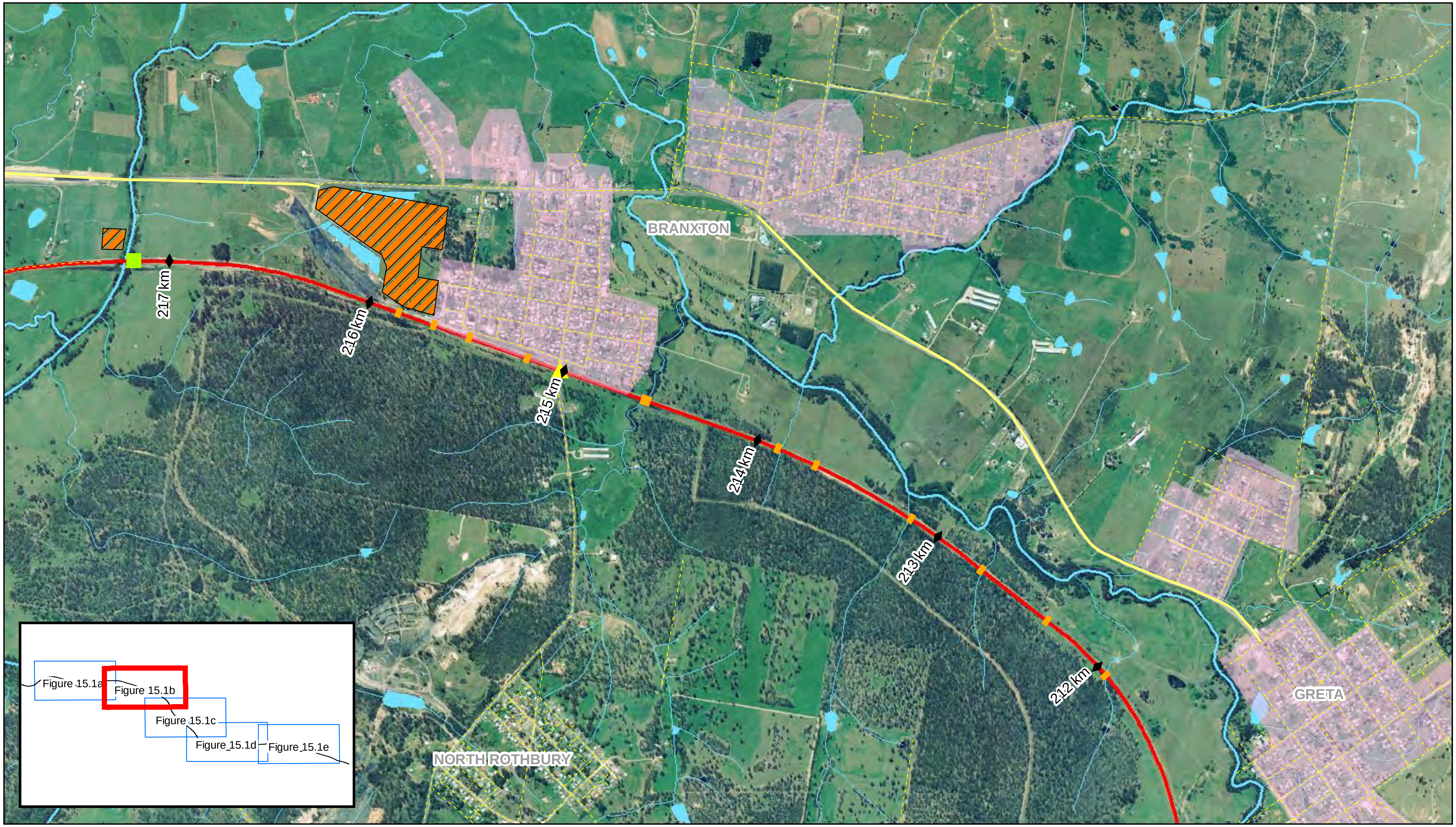
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Underbridge
- Existing Overbridge
- Existing Culvert
- Highway
- Roads
- Non Formed Roads
- Built up Areas
- Site Compounds
- Level Crossings
- Watercourse
- Watercourse Area
- Project Location

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Maitland To Minimbah Third Track
Environmental Assessment

Job Number 22-14471
Revision A
Date May 2010

Local Road Network

Figure 15.1b

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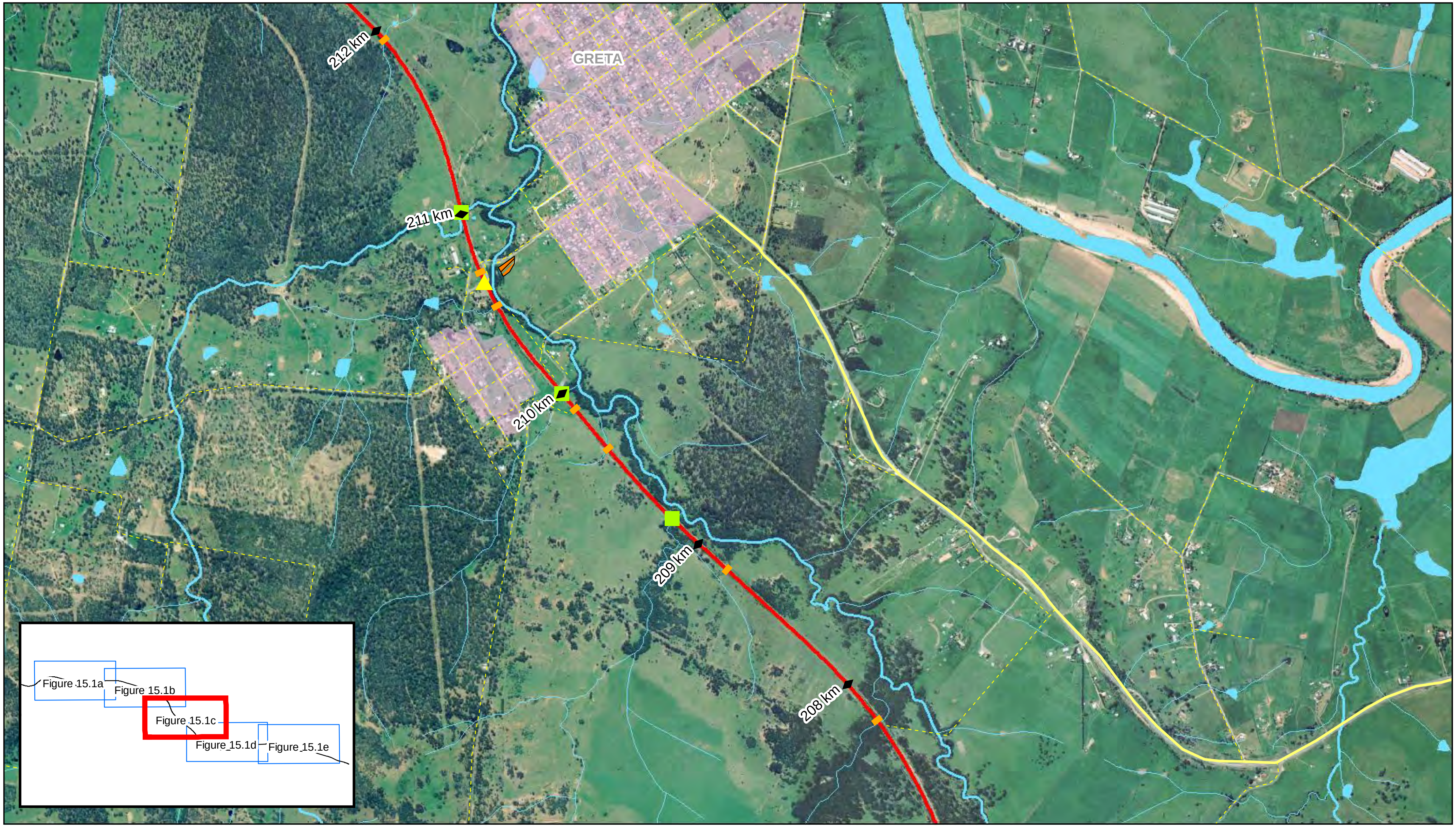
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Underbridge
- Existing Overbridge
- Existing Culvert
- Highway
- Roads
- Non Formed Roads
- Built up Areas
- Site Compounds
- Level Crossings
- Watercourse
- Watercourse Area
- Project Location

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Maitland To Minimbah Third Track
Environmental Assessment

Job Number | 22-14471
Revision | A
Date | May 2010

Local Road Network

Figure 15.1c

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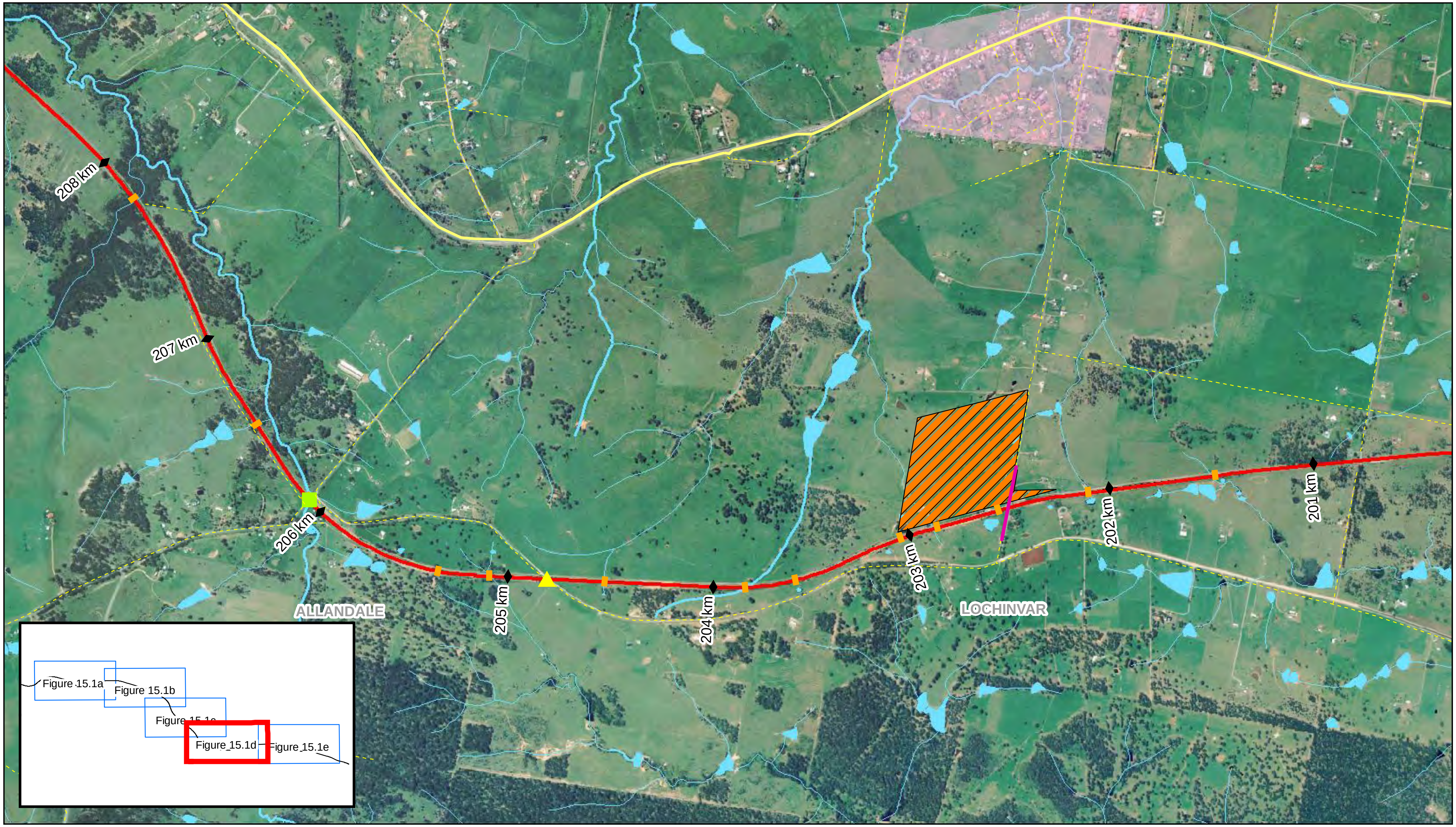
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Underbridge
- Existing Overbridge
- Existing Culvert
- Highway
- Roads
- Non Formed Roads
- Built up Areas
- Site Compounds
- Level Crossings
- Watercourse
- Watercourse Area
- Project Location

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Maitland To Minimbah Third Track
Environmental Assessment

Job Number	22-14471
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Local Road Network

Figure 15.1d

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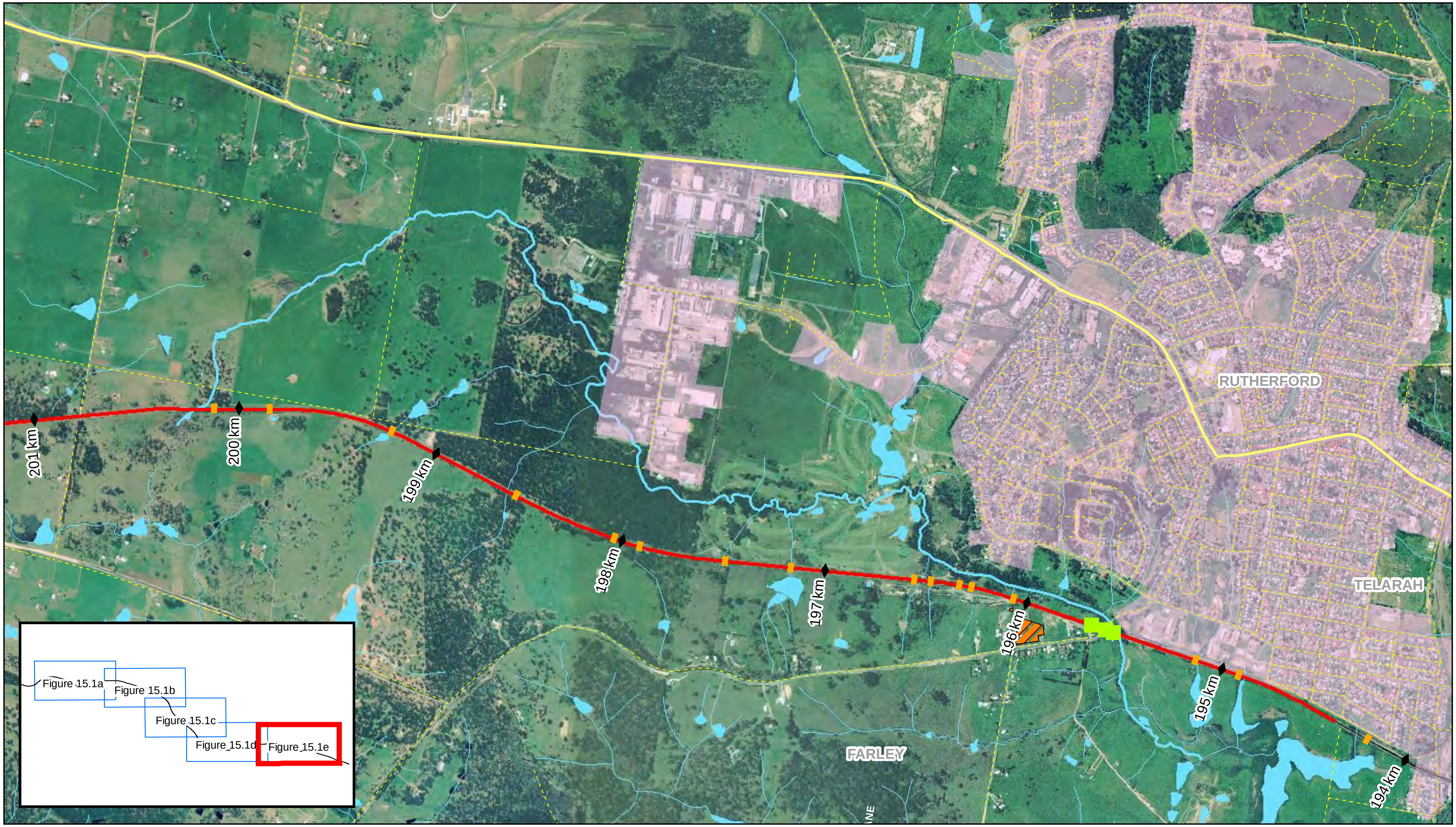
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



1:25,000 (at A4)

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Existing Underbridge
- Existing Overbridge
- Existing Culvert
- Highway
- Roads
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Maitland To Minimbah Third Track
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Local Road Network

Figure 15.1e

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

15.2.4 Public Transport

Bus

There is one public bus route operating in the area. Hunter Valley Buses operates nine services each way on weekdays and three services on Saturdays from Singleton Heights to Woodberry.

The primary route for all road transport services is along the New England Highway, however some services travel via Bridge Street / Wine County Drive to access North Rothbury then returning to the New England Highway.

There is one coach service operating in the area. Greyhound Australia operates twice daily along the New England Highway in the vicinity of the Project for services GX 242 and GX 424.

School bus services utilise similar routes as the public bus services. The public bus and school bus services would not be required to take an alternate route during construction. The bus services would, however, be subject to a reduced speed limit where passing through or adjacent to construction works in accordance with a traffic management plan.

Rail

There are railway stations located at Lochinvar, Greta and Branxton. The number of trains stopping at these stations is shown in Table 15-5. The number of passengers using each railway station was obtained from discussions with CityRail.

Table 15-5 Daily Train and Passenger Movements at Railway Stations

Station	Weekday			Weekend	
	No. Trains to Newcastle	No. Trains from Newcastle	Passengers	No. Trains to Newcastle	No. Trains from Newcastle
Lochinvar	4	4	20	2	2
Greta	4	4	<10	2	2
Branxton	4	4	40	2	2

There are a small number of passengers which use the railway stations. The Construction Traffic Management Plan would include measures to provide for safe passenger movements at stations during the construction period.

15.3 Construction Traffic

It is anticipated that construction activities would occur over an approximate 18 month period between 2010 and 2012. These activities would involve earthworks, trackwork and drainage works. Most work would be required on the Up side of the rail corridor. Traffic volumes generated by the movement of construction personnel and by materials delivery would vary depending on the construction timetable which is yet to be finalised.

15.3.1 Hours of Operation

Standard hours of construction for the duration of the Project are proposed to be 7:00 am to 6:00 pm, Mondays to Fridays, inclusive, 8:00 am to 1:00 pm Saturdays, and no works on Sundays or public holidays.

The current ARTC Environment Protection Licence (EPL) 3142 allows for maintenance and construction works to be undertaken outside business hours providing it is undertaken in accordance with specific conditions contained in the EPL. It is proposed that a new EPL for construction of the Project, would include similar conditions.

Specific activities would need to be completed outside the standard hours for works in track possession periods where trains are not operating. These periods are generally for a period of 36 to 60 hours.

15.3.2 Proposed Construction Compounds

Construction traffic impact would be influenced by the location and size of construction compounds and the activities being performed. For the purposes of this assessment, several types of compounds have been considered as shown in Table 15-6.

Table 15-6 Peak Hour Vehicle Trips at Construction Compounds

Type	Light Vehicles	Heavy Vehicles
Primary	150	35
Secondary	30	20
Satellite	15	18

The proposed locations of construction compounds and the local roads providing access the New England Highway are shown in Table 15-7.

Light vehicles would primarily consist of employee and utility vehicles. It is anticipated that the heavy vehicles utilising haul roads are likely to include:

- Floats.
- Truck and Dog.
- B Doubles.
- Single Trucks.
- Utes.

Table 15-7 Proposed Construction Compounds

Location	Chainage (kms)	Compound Type
Wollombi Road, Rutherford	195.580	Secondary
Station Lane, Lochinvar	202.500	Primary
Nelson Street, Greta	210.700	Secondary
Station Street, Branxton	215.600	Primary
Black Creek, via Rixs Road, Belford	217.240	Satellite
Hermitage Road, Belford	222.848	Secondary

These compounds would be located adjacent to the rail corridor as shown on Figure 15.1. The primary compounds would incorporate car parking areas, administration buildings and construction equipment storage facilities. Accesses to compounds would be gated.

Construction traffic was assigned to the road network assuming that most traffic would access the New England Highway with 50% assumed to come from the west (Singleton) and 50% from the east (Maitland).

15.4 Potential Impacts

15.4.1 Construction Impact Assessment

The impact of the construction of the Project on the surrounding road network and road users can be determined with relation to the following:

- Impact to the capacity of the road network.
- Impact to road user safety.
- Impact as a result of construction activities occurring in areas currently designated as part of the road corridor.
- Cumulative road user impact as a result of neighbouring construction works occurring concurrently.
- Impact to the access of neighbouring land uses.
- Impact to existing pedestrian and cyclist access to the road network.

The capacity constraints of the road network have been identified where collector roads intersect with the New England Highway. The addition of construction traffic would increase the delay for traffic turning to and from the New England Highway and the exposure to crashes.

Construction Traffic Impacts on Key Intersections

A summary of the existing situation versus the proposed operation is given in Table 15-8. This includes a breakdown of light vehicle versus heavy vehicle peak hour traffic movements.

Table 15-8 Construction Traffic Impact on Intersection Capacity

New England Highway Access	Suburb	Current Intersection Performance	Additional Construction Traffic Intersection Performance
Wollombi Road	Telarah	LOS F -Over Capacity	LOS F - Over Capacity
Station Lane	Lochinvar	LOS D -Nearing Capacity	LOS F - Over Capacity
Nelson Street	Greta	LOS E - At capacity	LOS F - Over Capacity
Station Street	Branxton	LOS D - Nearing Capacity	LOS F - Over Capacity
Rixs Road	Belford	LOS A – Good	LOS F - Over Capacity
Hermitage Road	Belford	LOS B - Satisfactory	LOS D -Nearing Capacity

Table 15-8 demonstrates that four of the six intersections assessed are operating at or near capacity under existing traffic conditions. Five intersections are shown to be over-capacity with the addition of construction traffic and Hermitage Road would be nearing capacity.

The finalisation of the treatment of the affected intersections is subject to a number of issues, including detailed construction traffic number and route calculation, consultation with the RTA (including confirmation of construction traffic management for the Hunter Expressway and existing program for upgrade of any of these intersections) and the relevant local councils. Measures may include:

- Permanent traffic signals.
- Temporary traffic signals.
- Temporary line marking to provide median storage space for staged crossings.
- Left-in left-out only restriction for construction vehicles.
- Reduced speed limits on the approaches to intersections where appropriate.

Permanent signalisation of intersections would reduce delays for side road traffic, but would cause delays for through traffic on the New England Highway.

Temporary line marking to provide median storage space would allow space for staged crossings and increase the capacity of the right turns out of the side roads. These markings may be most cost effective where there is sufficient pavement width to avoid the cost of road widening.

Turning restrictions on construction vehicles would reduce right turn conflicts. Vehicles would be required to turn left at the New England Highway and perform a u turn to travel east. This measure would be only suitable where there is a roundabout to the left within reasonable proximity.

Speed restrictions on the New England Highway would reduce the severity of intersection crashes but would require monitoring to ensure its effectiveness.

Impact to Road User Safety

The construction phase of the Project is anticipated to impact road user safety in the following ways:

- Increased construction traffic in designated school zones at:
  - Station Lane, Lochinvar.
  - Station Street, Branxton.
- Rail corridor access gates would be altered at Wollombi Road, Farley and Allandale Road, Allandale to allow the replacement of rail overbridges. These accesses would need to be designed taking into consideration road user safety, sight distances and signage.
- The additional traffic entering or exiting the New England Highway to the Project construction corridor would increase conflict opportunities on the New England Highway in the vicinity of the construction works.

Construction impacts on formal parking locations at Lochinvar, Branxton and Greta Stations, and how these impacts would be managed, are discussed in Section 7.18. No other formal parking areas would be impacted by the Project.

Impact of Construction on Road Corridor

Amendment of Road Corridor

There would be several local roads where the Project would require amendment of the road corridor to cater for construction vehicles. The amendment would be a small acquisition of the road corridor and minor works (such as construction vehicle access tracks, drainage works and minor earthworks) within the existing road corridor. These would occur at:

- Railway Parade Telarah.
- Lismore Street, Telarah.
- Wentworth Street, Telarah.

Bridges

When construction commences on the Project, rail overbridges would have been constructed at:

- Station Lane, Lochinvar.
- Hermitage Road, Belford.
- Nelson Street, Greta (replacement of existing overbridge).

Station Lane, Lochinvar and Hermitage Road, Belford currently cross at the Main Northern Railway as at-grade level crossings, while the existing bridge at Nelson Street will be replaced and realigned. The impacts of the construction of these overbridges have been addressed in separate environmental assessments prepared under Part 5 of the EP&A Act. As construction of these bridges is to be done by the Hunter 8 Alliance any construction activities and associated management would be coordinated with the Project where appropriate.

There is an existing road overbridge at Old North Road, Allandale that would be removed as part of construction of the Project. No replacement bridge is proposed. The bridge provides access to one property on the southern side of Old North Road. Alternative access to the south side of the Main Northern Railway is located at Station Lane, approximately 2.5 kilometres to the east of the Old North Road bridge. Consultation has been undertaken with the affected property owner as discussed in Section 14.4.

Haul Roads

There would be locations where haul trucks would be required to cross or access public roads. These locations may be at:

- Wollombi Road, Farley.
- Station Lane, Lochinvar.
- Old North Road, Lochinvar.
- Allandale Road at Old North Road, Allandale.
- Nelson Street, Greta.
- Wine Country Drive (Bridge Street), Branxton.
- Hermitage Road, Belford.

The estimated maximum number of haul trucks anticipated for the above roads would be 200 movements per day in each direction.

With the addition of 'other plant' haulage movements, the total is estimated maximum of 500 movements per day. This equates to a maximum of 50 movements per hour.

It is anticipated that the typical heavy vehicles utilising haul roads are likely to include:

- Floats.
- Truck and Dog.
- B Doubles.
- Single Trucks.
- Utes.

Given this potential level of impact the haul road crossings would be addressed with site specific Construction Traffic Management Plans. Items that would be addressed in these plans are:

- Plan of proposed measures.
- Review of impact of proposed measures (on completion of the detailed construction plan).
- Provision for emergency vehicles, heavy vehicles, cyclists and pedestrians.
- Minimising disruptions to traffic flow.
- Mitigation measures to be adopted.

Impacts of Neighbouring Construction Works

Preliminary discussions with the RTA indicate that Hunter Expressway construction at Branxton would be concurrent with that of the Project.

An Environmental Impact Statement was prepared in 1995 by the RTA for the Hunter Expressway. The Design and Construct contract for construction of the Hunter Expressway is currently out to tender. A Construction Environmental Management Plan (including construction traffic management) for the Hunter Expressway would not be available until the contract is awarded after September 2010.

Consultation and co-ordination is underway between the Hunter 8 Alliance and the RTA and would continue as the construction program progresses for each project. It is likely that the Project would require the use of the same roads as the Hunter Expressway for construction vehicles. This would be mitigated through co-ordinated construction management plans as each project progresses.

Impact to the Access of Neighbouring Land Uses

Due to the location of the Project within or adjacent to the existing rail corridor, and through consideration of property access in Project design, minimal impact to the access of neighbouring land uses is expected as a result of the Project.

Access to neighbouring land would be retained with no or minimal constraints wherever possible during construction and would be addressed at each site where required in a Construction Traffic Management Plan.

Impact to Existing Pedestrian and Cyclist Access

There is potential impact to pedestrians and cyclists during construction of the following elements of the Project:

- Modification of Lochinvar Railway Station, Lochinvar.
- Modification of Greta Railway Station, Greta.
- Modification of Branxton Railway Station, Branxton.
- Modification of the third track rail underbridge at Wollombi Road.
- Modification of the third track rail underbridge at Allandale Road.

The impacts would consist of changed or restricted pedestrian access to the railway stations during construction and the potential for a reduction in pedestrian and cyclist access during the construction of the underbridges.

Pedestrian and cyclist access would be retained where possible during construction and would be addressed at each site in a Construction Traffic Management Plan.

Impact to Public Transport

Buses

All existing traffic would be allowed to travel on existing public roads. The public bus service through the construction zones may be impacted by reduced speed limits. This impact is not anticipated to result in amendment of bus routes and delays are expected to be minimal.

Construction traffic management plans would include consideration of the impacts of proposed works on bus lanes and bus stops and maintain the minimum applicable design standards for construction works.

Rail

Public access to railway stations would be retained. Parking facilities at Lochinvar, Greta and Branxton Railway Stations may be affected. Impacts on formal parking along the rail corridor would be limited to parking restrictions at railway stations. Alternative parking at stations would be provided during construction at locations in close proximity to the stations and that provide safe access between the station and the parking area.

15.4.2 Operation Impact Assessment

There is expected to be minimal traffic generation from the Project during the operational phase of the Project. Maintenance works are expected to be carried out on an as-needed basis, and the subsequent traffic generation is expected to occur at variable times throughout the day and night. Therefore the impact on the local road network as a result of a potential minor increase in maintenance activities is expected to be negligible.

The demolition of the bridge across the Main Northern Railway on Old North road at Allandale (as discussed in Section 7.15.4) would affect the access of one property over the rail corridor. However, as discussed in Section 15.4.1, alternative access is available across the rail corridor via Station Lane, and negotiations are continuing with the landholder regarding appropriate compensation for the loss of this access.

15.4.3 Summary

During the construction phase of The Project, it is expected that there would be an increase in the number of vehicles on the local public road network. These vehicles would impact on the level of service provided with intersections of collector roads with the New England Highway. Some of these intersections are already operating unsatisfactorily and the addition of construction vehicles further decreases the existing level of service. Mitigation measures are required to maintain a satisfactory level of service.

15.5 Mitigation Measures

15.5.1 Construction

To mitigate the potential impacts on traffic and access during construction, the following mitigation measures would be implemented.

Traffic Management Plans

The impacts identified along the Project would be addressed with site specific Construction Traffic Management Plans. Items to be addressed in such plans would be:

- Plans of proposed measures.
- Identification and assessment of impact of proposed measures.

- Provision for emergency vehicles, heavy vehicles, cyclists and pedestrians.
- Mitigation measures to be adopted.

Traffic Control Plans

Traffic Control Plans would be prepared for the road network surrounding the Project, including all primary and secondary access points. Traffic Control Plans would be produced for specific road construction staging scenarios, depicting vehicle, pedestrian, bus and cyclist restrictions and protection measures.

These plans would be done in accordance with *AS1742.3 Manual of uniform traffic control devices - Part 3: Traffic control for works on roads*.

Intersection Treatments

To mitigate the construction traffic impacts on the intersections with the New England Highway to be utilised during construction, the treatment measures listed in Table 15-9 are proposed. Table 15-9 also identifies the other options considered and the reasons why these were not preferred.

Table 15-9 Proposed Intersection Treatment Measures

New England Highway Access	Suburb	Proposed Intersection Treatment	Comment	Traffic Intersection Performance
Wollombi Road	**Telarah**	**Traffic Signals**	**Temporary or permanent signals, no widening required.** **Permanent signals here would address the existing low level of service for Wollombi Rd traffic and improve safety for pedestrians crossing New England Highway. Signals are likely to be required in the long term even with the reduction in traffic expected following the opening of the Hunter Expressway**	**LOS A**
		Alternatives Considered:		
		◗ *Roundabout*	*This would require major reconstruction of intersection and therefore not feasible as a short term option.*	*LOS C*
		◗ *Traffic Controllers*	*Not feasible to control traffic on this 4-lane section of the highway.*	*N/A*
		◗ *Left in – Left out restriction*	*Alternate access to New England Highway via traffic signals at Arthur Street would have adverse impact on residential amenity/safety. Not feasible.*	*LOS C*
		◗ *Do Nothing*	*Long term traffic levels on New England Highway will continue to exacerbate safety and congestion for Wollombi Road traffic.*	*N/A*

New England Highway Access	Suburb	Proposed Intersection Treatment	Comment	Traffic Intersection Performance
Station Lane	**Lochinvar**	**Traffic Controllers**	**Feasible in this low speed 2-lane environment.**	**N/A**
		Alternatives Considered:		
		◗ *Traffic Signals*	*Temporary or permanent traffic signals would improve safety and LOS for Station Lane traffic but would cause queuing and congestion through school zone.*	*LOS C*
		◗ *Left in – Left out restriction*	*Left turning traffic could use sealed shoulder as an auxiliary lane. Right turning traffic could turn left and use the U-turn bay at St Helena Close approx 1.2 kilometres to west. May require road widening at St Helena Close intersection for improved deceleration lane at left turn entry*	*LOS C*
Nelson Street	**Greta**	**Traffic Controllers**	Feasible in this low speed 2-lane environment.	N/A
		Alternatives Considered:		
		◗ *Traffic Signals*	*Temporary or permanent signals.* *This would provide safer access for vehicles and pedestrians as well as construction traffic and remove the need for the two way 'slip lane' on New England Highway to the south of the service station.*	*LOS C*

New England Highway Access	Suburb	Proposed Intersection Treatment	Comment	Traffic Intersection Performance
Station Street	**Branxton**	**Traffic Signals**	**Temporary traffic signals could be installed and coordinated with the signals at Wine Country Road**	**LOS C**
		Alternatives Considered:		
		◗ *Traffic Controllers*	*Queues from traffic signals at Wine Country Road frequently block Station Steet making traffic control difficult.*	*N/A*
		◗ *Left in – Left out restriction*	*Left turning traffic could use sealed shoulder as an auxiliary lane. Right turning traffic could turn left and use the U-turn bay at disused RTA compound approximately 0.8 kilometres to west.*	*LOS F*
Rixs Road	**Belford**	**Lane Reduction**	**Chevron (road markings that delineate traffic areas from non traffic areas) out the second lane on westbound approach to intersection to create improved median storage for stage crossings, improving safety**	**LOS B**
Hermitage Road	**Belford**	**None proposed**	**No treatment required**	**N/A**

LOS	**Give-Way and Stop Signs.**
A	Good operation.
B	Acceptable delays and spare capacity.
C	Satisfactory, but accident study required.
D	Near capacity and accident study required.
E	At capacity; requires other control mode.

Traffic Control Plans would be prepared for each of these locations that identifies the design of the measures, the details (such as hours of implementation and locations) of their implementation, and the appropriate warning signage informing motorists of the proposed measures. These would be prepared in consultation with, and for the approval of, the RTA and relevant council.

The detailed intersection design would be developed in coordination with, and for the approval of, the RTA and Maitland City, Cessnock City and Singleton councils as appropriate.

Proposed Mitigation Measures

- Signs would be erected warning of trucks entering at the following construction access points:
  - Wollombi Road, Farley.
  - Station Lane, Lochinvar.
  - Allandale Road, Allandale.
  - Nelson Street, Greta.
  - Station Street, Branxton.
  - Hermitage Road, Belford.
- Appropriate signs would be erected warning traffic of cyclist and pedestrian movements where existing shoulder or verge provisions are restricted due to construction activity.
- Pedestrian and cyclist access would be retained where possible during construction and would be addressed at each site in a Construction Traffic Management Plan or Traffic Control Plans.
- Vehicles transporting potentially dust and/or spillage generating material to and from the construction site should be covered immediately after loading (prior to traversing public roads) to prevent wind blown dust emissions and spillages.
- In the event of a spillage of materials from construction vehicles, spilled material would be removed as soon as practicable within the working day of the spillage.
- Arrangements including advance warning signs and emergency access arrangements would be implemented for any road closure.
- Access would be maintained to neighbouring land uses throughout the construction period, unless otherwise agreed by the landowner.
- The Hunter 8 Alliance would establish a policy promoting car-pooling for employees.
- Wherever possible, haulage vehicles would be filled to capacity to minimise vehicle movements.
- Preparation of Traffic Control Plans where the Project affects the road network.

15.5.2 Operation

No operational traffic mitigation measures are required.

16. Air Quality

16.1 Assessment Approach

16.1.1 Introduction

The Director-General's Environmental Assessment Requirements identify construction and operational air, noise and vibration as key issues for the Environmental Assessment. This chapter identifies the potential air quality impacts of the Project and the management measures proposed to reduce these impacts. Table 16-1 provides the Director General's Environmental Assessment Requirements relating to air quality and where they have been addressed. Issues relating to noise and vibration are addressed in **Chapter 17**.

Table 16-1 Director-General's Environmental Assessment Requirements – Air Quality

Director-General's Environmental Assessment Requirements	Where addressed
Operational Air, Noise and Vibration	
Air, noise and vibration impacts along the corridor associated with rail operations and ongoing maintenance. Including, where relevant, specific consideration of impacts to sensitive receivers (residences, schools, hospitals etc) and sensitive structures (particularly heritage structures and key utilities/infrastructure).	Section 1.2 and Chapter 17 Noise and Vibration)
Taking into account Assessing Vibration: *A Technical Guideline* (DEC), *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (DECC/DoP), *Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA).	Section 16.1
General Construction Impacts	
Assess and present a management framework for earthworks, including a considered approach to minimising impacts associated with the excavation, movement, stockpiling, rehabilitation and disposal of spoil and fill. Consideration should be given to:	
Air quality impacts on adjoining communities.	Section 16.3

16.1.2 Methodology

The following methodology was used to assess the potential impacts that the construction and operation of the Project may have on local air quality:

- Compile an emission inventory of the types and sources of air pollution associated with the construction and operation phases of the Project.
- Qualitative assessment to gauge the potential for impacts to air quality during the construction phase on the basis of local wind climate, receptor locations and analysis of publicly available literature pertaining to dust emission from construction activities.

- Air quality modelling was undertaken to assess the operation phase of the Project with consideration to DECCW's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.
- Recommend air quality mitigation measures.

The scope of work was conducted with consideration to the DECCW *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (2005). In particular:

- Section 3 – Emissions inventory techniques.
- Section 7 – Relevant air quality impact assessment criteria.

16.2 Existing Environment

16.2.1 Sensitive Receptors

The key sensitive receptors adjacent to and surrounding the Project route are:

- The residential areas of Telarah, Rutherford, Farley, Greta and Branxton, including other sensitive land uses such as schools, recreational areas, community halls and churches.
- Rural residences at various locations along the Project route.

Further details on sensitive land uses surrounding the Project are provided in **Chapter 14**.

16.2.2 Ambient Air Quality

The primary air pollution sources that influence local air quality in the vicinity of the Project are likely to be dust from agricultural activities, smoke from wood heaters, vehicle exhaust emissions from the road network (particularly the New England Highway) and existing operations on the Main Northern Railway. There is no site-specific air quality monitoring data collected inside or adjacent to the existing rail corridor with which to characterise baseline levels of air pollutants.

The nearest ambient air quality monitoring station is located at Beresfield, which is approximately four kilometres southeast of the southern end of the Project. This station is operated by Department of Environment, Climate Change and Water (DECCW) and forms part of their regional air quality monitoring network. A review of air quality monitoring data collected from this station over the years 2005 to 2007 revealed that local air quality is generally below DECC air quality goals. Maximum 24-hour average fine particulate matter (particles that are less than 10 micrometres in equivalent aerodynamic diameter) concentrations have on occasion exceeded the air quality goal of 50 microgram per cubic metre but these elevated short-term concentrations are typically influenced by regional events such as bushfires and drought conditions. Over an annual average, fine particulate matter concentrations comply with the DECCW air quality goal.

16.2.3 Local Meteorology

The transport and dispersion of the air emissions from the construction and operation of the proposed Project would be influenced by the prevailing wind climate.

A site-representative meteorological data file was synthesised for a location along the Project corridor near Farley. The data was generated using the Commonwealth Scientific and Industrial Research Organisation's (CSIRO) regional-scale prognostic meteorological model TAPM (The Air Pollution Model) Version 4. TAPM was configured with four nested grids at 1000 metres, 3000 metres, 10,000 metres, and 30,000 metres resolution, with 45 grid points. Observations from the DECCW monitoring station at Beresfield (March 2006 to February 2007) was first used for optimising and checking the performance of the prognostic model simulation and then wind speed and direction data from the station were assimilated into the prognostic model.

On an annual basis the prevailing winds are from the northwest and to a lesser extent from the west and southeast. Higher speed winds are typically associated with northwesterly synoptic flows. The highest frequency of light winds also occurs from the northwest and west, which corresponds with the regional scale cool air drainage flows down the Hunter Valley under stable atmospheric conditions. The lowest frequency of winds occurs from the north and northeast. The average wind speed is 2.7 metres per second. On a seasonal basis, southeasterly winds occur more frequently during summer (sea breeze), while northwesterlies dominate during the other seasons, in particular during winter.

16.3 Impact Assessment

16.3.1 Construction Sources

The types of emissions to air during the construction phase would primarily consist of:

- Dust emissions from both the mechanical disturbance and wind erosion of surface material.
- Exhaust emissions from the range of motor vehicle and mobile plant required for the Project.

The major potential dust sources during the construction phase are expected to include:

- Clearance of vegetation, rock and soil material.
- General surface earthworks and excavation works.
- Pneumatic rock-breaking.
- Top soil and soil handling (stockpiling, loading, dumping).
- Leveling and grading of disturbed soil surfaces.
- Passage of construction and administrative vehicles over unsealed sections of road or localised unconsolidated soil surfaces.
- Wind erosion of unstable/uncovered surfaces and stockpiles and other unconsolidated surfaces.

It is considered that the dominant sources of dust emissions during the construction works would be during activities that cause large mechanical disturbances during their operations, such as operations of a bulldozer, grader or scraper. This has generally been the case with construction of the Minimbah Bank Third Track Project.

16.3.2 Operation Sources

The primary source of air emissions during the operation phase of the Project is fugitive dust (dust derived from a mixture of diffuse sources) raised by the motion of the trains and wagons over unconsolidated surfaces and coal dust emissions from uncovered coal in wagons. A secondary source of air emissions includes train exhaust emissions from diesel locomotive engines.

Fugitive Coal Dust

An *Environmental Evaluation of Coal Dust Emissions* study on coal trains in the Central Queensland region was undertaken by Connell Hatch (2008) on behalf of Queensland Rail (QR) Limited. This report is present in Appendix R and identifies the following coal dust emission sources in the coal rail system:

- Coal surface of loaded wagons.
- Coal leakage from doors of loaded wagons.
- Wind erosion of spilled coal in corridor.
- Residual coal in unloaded wagons and leakage of residual coal from doors.
- Spilled coal load on sills, shear plates and bogies of wagons.

The primary mechanism for coal dust lift-off from coal trains is the erosion of the coal by the movement of air over the coal surface. The speed of the air passing over the coal surface, influenced by train speed and ambient wind speed, was found to be the key factor contributing to coal dust emission rates. The air speed based Total Suspended Particulate (TSP) emission factor equation detailed in the *Environmental Evaluation of Coal Dust* study was adopted in conjunction with the average local wind speed (9 kilometres per hour) and train speed (60 kilometres per hour) to provide an estimate of TSP emissions from loaded coal wagons of 0.17 grams per kilometre per tonne of coal hauled. The same assumptions applied to the abovementioned locomotive emission inventory were applied here with the resulting emission estimates shown in Table 16-2.

Table 16-2 Coal Wagon Dust Emission Rates

Pollutant	Emission Rate (kilograms/day)		
	2009	2012	2022
TSP	1,517	2,369	2,961
PM_{10} (1)	531	829	1,036

(1) PM_{10} emissions were assumed to comprise 35% of TSP emissions from coal wagons.

The projected increase in train movements translate, at worst, into a directly proportional increase in dust emissions, however, it should be noted that other factors contribute to emissions including mine-specific coal properties (such as dustiness, moisture content and particle size distribution), wagon vibrations, coal load profile, exposure to wind and precipitation. As such, the resulting emission inventory (and subsequent impact assessment) should be used for comparison purposes only.

A comparison of Table 16-1 and Table 16-2 reveals that total coal train PM_{10} emissions (locomotive emission plus coal wagon emissions) would be approximately two to three times greater than PM_{10} emissions from the diesel locomotive alone. This relationship is supported by data from an ambient monitoring study in Queensland that showed peak concentrations of dust associated with coal trains are about two times higher than those associated with trains that are not carrying coal freight (Connell Hatch, 2008).

Locomotive Exhaust

Exhaust emissions from diesel engines have been sourced from the National Pollutant Inventory (NPI) *Emissions Estimation Technique Manual for Railway Yard Operations version 2.0*, (NPI, 2008) and include carbon monoxide (CO), oxides of nitrogen (NOx), sulphur dioxide (SO_2), particulate matter less than 10 micrometres in equivalent aerodynamic diameter (PM_{10}) and trace hydrocarbons.

CO, NOx, SO_2 and PM_{10} emission rates from coal and freight locomotives were calculated based on daily movement profiles, diesel fuel consumption rates, published NPI emission factors and the following assumptions:

- Total one-way track distance was 30 kilometres (Project only).
- Average coal and freight train capacities are 7,200 net tonnes and 4,860 net tonnes.
- Coal train average diesel fuel consumption of 0.0064 litres per net tonne kilometer and a freight train average diesel fuel consumption of 0.005 litres per net tonne kilometer.
- Coal and freight train movements per day as follows:
  - 2012 – 33 on the Up track and 37 on the Down track;
  - 2012 – 38 on the Up track, 59 on the Down track and 23 on the Third track;
  - 2022 – 38 on the Up track, 74 on the Down track and 39 on the Third track.
- Six freight train movements per day for each of the above scenarios.
- Passenger train movements were not included in the assessment.

The resulting emission estimates are shown in Table 16-3.

Table 16-3 Locomotive Emission Rates

Pollutant	Emission rate (kilograms/day)		
	2009	2012	2022
NOx	3,841	5,996	7,495
CO	2,235	3,489	4,361
SO_2	1.4	2.3	2.8
PM_{10}	306	477	596

The projected increase in train movements translate, at worst, into a directly proportional increase in exhaust emissions. However, the Project does represent an improvement to the existing rail network, which is likely to reduce emissions from diesel engines as a result of improved traffic flow and improved operating efficiency for all vehicles (for example flattening of grades). Furthermore, future improvements in locomotive engine technology may also reduce vehicle emissions.

16.3.3 Potential for Dust Impact

Construction

Airborne particles (dust) are typically less than 100 micrometres in aerodynamic diameter and are referred to as Total Suspended Particulates (TSP). The fraction of these particles that are less than 10 micrometres in equivalent aerodynamic diameter is referred to as PM_{10}. The impact of dust emissions principally relates to the potential effect on human health on inhalation of particles in the air column, and it is the finer fraction that has the greater potential to cause respiratory health effects. A secondary effect relates to the deposition of the course fraction of dust onto surfaces (soiling of material surfaces), which is an impact on amenity. Typical, depositions effects are confined to short ranges, as the settling velocity of the course particles is significant and particulate matter drop out from the dust plume is local only.

Analysis of the local wind climate indicates a higher occurrence of wind from the northwest, which means sensitive receptors to the southeast of the Project corridor would have a higher frequency of exposure to dust potentially emitted from the Project construction. There is a significantly lower occurrence of wind from the north and northeast, which results in sensitive receptors located to the south and southwest of the Project would have a relatively lower frequency of potential dust exposure.

The potential for air quality impact is greatest at receptors located at the edge of the Project corridor or construction areas with the level of impact decreasing with distance from the construction areas. Based on previous experience with similar construction projects, sensitive land uses located less than approximately 500 metres should be only considered, with particular attention given to receptors located within approximately 100 metres.

Operation

Air quality modelling was undertaken using the regulatory approved dispersion model Ausplume (Version 6) with consideration to DECCW's *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*.

Potential air impacts were initially modelled as a generic one kilometre link in a series of orientations (such as north-south, east-west) to determine the worst case alignment under averaging periods of one-hour, 24-hour and one-year. Year-long simulations using the synthesised meteorology for the Project footprint were used for identifying worst-case impacts over hourly, daily and annual time periods

Preliminary model runs were also conducted using the near-road dispersion model AUSROADS (Version 1.0) as a screening model. Year-long simulations using the synthesised meteorology for the Project footprint were used for identifying worst-case impacts over hourly, daily and annual time periods for a series of alignment orientations. Results from the AusRoad simulations were also used to optimise the volume source configuration in Ausplume.

Once the worst-case alignment was determined, receptors were then set at 40, 50, 75, 100 and 200 metre intervals in the direction of poorest dispersion. In this case, a northwest-southeast track alignment was determined to be the worst-case scenario, which also turns out to be the most frequently occurring alignment for the Project. For model simplicity, all train movements were assumed to occur along a single rail track, which was considered to be a conservative approach.

Air emissions from the coal train were modelled as a series of sub-volume sources in order to more accurately model the lateral dispersion of emission from the train. Volume sources are commonly used in Ausplume to model fugitive emissions escaping from a structure. In this case individual coal carrying rail wagons were modelled as sub-volume sources with the cumulative volume source being the sum of the individual rail wagons. The total emission rate per kilometre was equally proportioned between the evenly spaced rail wagon sub-volume sources. The initial horizontal and vertical plume spread was assumed to be 10 metres and the height of plume release was assumed to be 4.5 metres above ground level.

Scenarios for the anticipated year of opening (2012) and ten years after opening (2022) were modelled.

Predicted carbon monoxide, nitrogen dioxide, sulphur dioxide and PM_{10} concentrations from the exhaust of diesel locomotives are shown in Table 16-4 to Table 16-7. The predicted TSP and PM_{10} concentrations and total deposited dust levels from the operation of diesel locomotives with coal train fugitive dust emissions added to the model are shown in Table 16-8 to Table 16-10.

Each of the following tables also shows the respective NSW DECCW Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales air quality trigger level and adopted existing background pollutant levels. Predicted peak operational incremental concentrations presented in bold text indicate when the total impact (predicted incremental plus background) may potentially exceed or be above the air quality goal. The background level is based on pollutant levels recorded at Wallsend (24 kilometres to the southeast of the southern end of the Project) and Beresfield (four kilometres to the southeast of the southern end of the Project). Therefore the adopted background level is considered conservative.

Table 16-4 Predicted Peak Incremental Carbon Monoxide Concentration (mg/m3)

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Maximum Background (1)	Predicted peak incremental concentration at distance from the track (m)				
					40	50	75	100	200
2012	15-minute	mg/m3	100	No data	0.47	0.42	0.31	0.23	0.11
	1-hour	mg/m3	30	4	0.36	0.32	0.24	0.18	0.08
	8-hour	mg/m3	10	2	0.17	0.14	0.10	0.07	0.04
2022	15-minute	mg/m3	100	No data	0.57	0.51	0.38	0.29	0.13
	1-hour	mg/m3	30	4	0.44	0.39	0.29	0.22	0.10
	8-hour	mg/m3	10	2	0.21	0.18	0.12	0.09	0.05

(1) Based on CO monitoring data recorded at the DECCW monitoring station at Wallsend.

Table 16-5 Predicted Peak Incremental Nitrogen Dioxide Concentration (µg/m3)

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Maximum Background (2)	Predicted peak incremental concentration at distance from the track (m) (1)				
					40	50	75	100	200
2012	1-hour	µg/m3	246	68	174	152	113	88	41
	Annual	µg/m3	62	18	14	12	10	8	5
2022	1-hour	µg/m3	246	68	**213 (3)**	**186**	138	107	50
	Annual	µg/m3	62	18	17	15	12	10	6

(1) Directly emitted NO2 from vehicles is not significant in atmospheric NO2 concentration. Predicted peak nitrogen dioxide are therefore based on air quality data that indicates that 28% of NOx is emitted as NO2 (Yao et al., 2005). Given the short range between source and receptor the atmospheric conversion of nitric oxide to nitrogen dioxide should be insignificant.

(2) Maxima values recorded at DECCW Beresfield monitoring station (March 2006 to February 2007)

(3) Bold indicates when adopted background plus predicted peak incremental is greater than the DECCW Criterion

Table 16-6 Predicted Peak Incremental Sulphur Dioxide Impacts (µg/m3)

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Maximum Background	Predicted Peak Incremental Concentration at Distance from the Track (m)				
					40	50	75	100	200
2012	1-hour	µg/m3	570	107	0.24	0.21	0.16	0.12	0.06
	24-hours	µg/m3	228	107	0.05	0.04	0.03	0.03	0.02
	Annual	µg/m3	60	5	0.02	0.02	0.01	0.01	0.01
2022	1-hour	µg/m3	570	107	0.29	0.26	0.19	0.15	0.07
	24-hours	µg/m3	228	107	0.06	0.05	0.04	0.03	0.02
	Annual	µg/m3	60	5	0.02	0.02	0.02	0.01	0.01

(1) Annual average and maximum 1-hour SO_2 concentrations recorded at DECCW Beresfield monitoring station (March 2006 to February 2007).

Table 16-7 Predicted Peak Incremental PM_{10} Impacts (µg/m3) – Locomotive Exhaust Only

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Background (1)	Predicted Peak Incremental Concentration at Distance from the Track (m)				
					40	50	75	100	200
2012	24-hour	µg/m3	50	26	11	9	7	6	3
	Annual	µg/m3	30	22	4	3.5	3	2	1
2022	24-hour	µg/m3	50	26	13	11	9	7	4
	Annual	µg/m3	30	22	5	4	3.5	3	2

(1) Annual average and 70 percentile 24-hour PM_{10} concentrations recorded at the DECCW Beresfield monitoring station (March 2006 to February 2007). The maximum 24-hour average concentration (below the 50 µg/m^3 criterion) was 49 µg/m^3.

Table 16-8 Predicted Peak Incremental PM_{10} Impacts (µg/m3) - Locomotive Exhaust and Coal Train Dust

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Background (1)	Predicted Peak Incremental Concentration at Distance from theTrack (m)				
					40	50	75	100	200
2012	24-hour	µg/m3	50	25	**30**	25	19	16	9
	Annual	µg/m3	30	21	**11**	9	8	7	4
2022	24-hour	µg/m3	50	25	**36**	**31**	23	19	11
	Annual	µg/m3	30	21	**13**	**12**	9	8	5

(1) Annual average and 70 percentile 24-hour PM_{10} concentrations recorded at DECCW Beresfield monitoring station (March 2006 to February 2007).

Table 16-9 Predicted Peak Incremental TSP impacts (µg/m3) – Locomotive Exhaust Plus Coal Train Dust

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Background (1)	Predicted Peak Incremental Concentration at Distance from the Track (m)				
					40	50	75	100	200
2012	Annual	µg/m3	90	44	23	21	17	14	8.4
2022	Annual	µg/m3	90	44	28	25	21	18	10

(1) No TSP data was available. Therefore, TSP annual average assumed to equal two times the annual average PM_{10} concentration recorded at DECCW Beresfield monitoring station (March 2006 to February 2007).

Table 16-10 Predicted Peak Incremental Dust Deposition (g/m²/month) – Locomotive Exhaust and Coal Train Dust

Scenario	Averaging Period	Units	DECCW Trigger Level	Adopted Background	Predicted Peak Incremental Dust Deposition at Distance from the Track (m)				
					40	50	75	100	200
2012	Annual	g/m2/month	4	1	1.5	1.3	1.2	0.8	0.4
2022	Annual	g/m2/month	4	1	1.8	1.6	1.4	0.9	0.5

Maximum predicted (100 percentile) ground level carbon monoxide, sulphur dioxide and TSP concentrations were predicted to be well below the DECCW criteria as shown in Table 16-4 to Table 16-6 and Table 16-9.

Total dust deposition rates were also predicted to be below the DECCW criterion of four grams per square metre per month and also below the maximum incremental dust deposition level of two grams per square metre per month as shown in Table 16-10.

The maximum predicted (one-hour average) ground level nitrogen dioxide concentrations were predicted to be below the DECCW criterion as shown in Table 16-5.

Impacts from PM_{10} emissions attributed to diesel locomotive exhaust are predicted to comply with the respective DECCW trigger level as shown in Table 16-7. The predicted 24-hour average ground level concentration falls rapidly with increasing distance from the train track. For example, the predicted incremental ground level PM_{10} concentrations (24-hour average) for the 2012 scenario represents 18% of the DECCW criterion at 50 metres from the rail track and only 6% at 200 metres.

Maximum predicted (1-hour average) ground level nitrogen dioxide concentrations were found to be below the DECCW trigger level. However, the predicted annual average concentrations were predicted to be slightly above the DECCW criterion within 40 and 50 metres of the track for the 2012 and 2022 scenarios respectively. This is considered to be marginal given the conservative nature of the assessment, including adopted emission rates and approach to modelling. Furthermore, nitrogen dioxide emissions from rail infrastructure are not expected to be a significant contributor to total nitrogen dioxide emissions in the Hunter Valley.

Predicted cumulative (incremental plus background) PM_{10} impacts attributed to aggregate emission of diesel locomotive exhaust and fugitive dust from coal wagons may potentially exceed the DECCW trigger level within 75 metres of the rail line as shown in Table 16-8. The predicted incremental PM_{10} (24-hour average) concentrations for the 2012 scenario represents 10% or less of the DECCW trigger level of 50 $\mu g/m^3$ at distances 50 metres from the rail track, and the 2022 scenario represents less than 12% of the DECCW trigger level of 50 $\mu g/m^3$ at distances 50 metres from the rail track. Beyond this distance the predicted emissions do not exceed the DECCW trigger level.

Emission of diesel locomotive exhaust and fugitive dust from coal wagons on their own are not predicted to exceed the criterion, but the cumulative emissions result in the predicted exceedences within 50 metres of the third track.

It is therefore considered that the incremental increase in nitrogen dioxide and PM_{10} associated with operation of the third track is not considered a significant impact, especially with consideration of the operation phase mitigation measures discussed in Section 1.4.2.

16.4 Mitigation Measures

16.4.1 Construction

Mitigation measures to address potential air quality impacts during construction would include the following:

- Site managers would be provided with daily weather updates that would contain warnings of the onset of strong winds. The site manager could then take steps to pre-water construction areas and stockpiles before they are disturbed and continue watering during any activities where fugitive dust may be produced. Earthmoving activities should be suspended during times of high winds when dust emissions cannot be controlled, particularly when dust plumes are directed towards sensitive receptors.
- Dry material to be watered prior to it being loaded for haulage.
- Physical barriers to be constructed to act as windbreaks for the construction site or for stockpile areas where practicable.
- Dust screens would be installed on construction site boundaries that are adjacent to sensitive receptors where practicable.
- Stockpiles would be placed, where possible, in areas protected from the wind and away from public places. Spoil stockpiles should be water sprayed regularly and dry material stockpiles should be covered, if generating windborne dust and practicable.
- Existing vegetation would be retained where possible. Where clearing is required, cleared areas no longer subject to construction activities and stockpiles would be seeded with fast growing species for rapid coverage to temporarily or permanently stabilise soil, where and as soon as practicable.
- Construction traffic would be controlled by designating specific routes for haulage and access. Vehicle speeds would be limited to suit site conditions and as sign posted as part of the Traffic Control Plan.
- All trucks hauling dirt, sand, soil or other loose materials (materials that could generate dust emissions or result in spillages) to and from the construction site would be covered.
- Cattle grids or ballast beds would be installed where vehicles enter and exit unpaved roads onto paved roads, to minimise mud and dirt being tracked onto public roadways by trucks and any equipment leaving the site. Material spillage on roads and pathways would be cleaned up immediately.
- All construction vehicles, mobile plant and machinery to be maintained and operated in accordance with the manufacturers' specifications to minimise exhaust emissions.
- A line of communication would be established with the local community prior to the start of construction as part of a complaints management system. All complaints lodged by nearby residents to be recorded on a complaints register and addressed accordingly. The complaints register should document the investigation into the source of the emission giving rise to the complaint and any corrective actions taken to rectify the cause of complaint.

- Dust control would be linked to real-time dust and weather monitoring, including a real-time monitor to provide a warning (via an audible or visible signal) to a delegated responsible officer at the construction site so that enhanced dust mitigation actions could be taken at the target location, which could include:
  - Increase watering rate or consider application of chemical stabilisers to create an artificial crust on the surface by binding unconsolidated material.
  - Earthmoving and other high dust generating activities to be suspended during times when dust plumes are blowing towards sensitive receptors, unless otherwise agreed with the sensitive receptor.
  - Contact to be established with the local residents and the construction program and progress communicated, particularly to provide advance warning of significant dust generating activities being undertaken in close proximity to sensitive receptors.

16.4.2 Operation

Mitigation measures to address potential air quality impacts during operation would include the following:

- Railway verges and other exposed surfaces would be re-vegetated where possible or covered using cobbles or coarse gravel to reduce fugitive dust emissions.
- Trains would minimise idling near sensitive receivers where possible.
- Where practicable and available, consideration would be given to maintaining or establishing a stand of trees or other suitable vegetation on properties adjacent to the Project.

The ARTC Environment Protection Licence (No 3142) requires preparation of a Pollution Reduction Program (PRP) for reduction of coal dust emissions from locomotive loads on the ARTC network covered by the licence. The PRP (which is currently under preparation) has the objective to significantly reduce coal dust emissions from locomotive coal loads on the rail network through the implementation of appropriate abatement technology by coal mines and locomotive operators.

The PRP and applicable measures would be implemented to the entire ARTC network covered by the licence, including the Project area.

17. Noise and Vibration

17.1 Assessment Approach

The Director-General's Environmental Assessment Requirements identify operational air, noise and vibration as key issues for the Environmental Assessment. General construction impacts including noise and vibration are also identified as key issues. This chapter identifies the potential noise and vibration impacts of the Project and the management measures proposed to reduce these impacts. The Noise and Vibration Impact Assessment is included in Appendix K.

Table 17-1 outlines the Director General's Environmental Assessment Requirements relating to noise and vibration and where they have been addressed. Issues relating to air quality are addressed in Chapter 16.

Table 17-1 Director-General's Environmental Assessment Requirements – Noise and Vibration

Director-General's Environmental Assessment Requirements	Where Addressed
Operational Air, Noise and Vibration	
Assess air, noise and vibration impacts along the corridor associated with rail operations and ongoing maintenance: ◗ Including, where relevant, specific consideration of impacts to sensitive receivers (residences, schools, hospitals etc) and sensitive structures (particularly heritage structures and key utilities/infrastructure). ◗ Taking into account Assessing Vibration: A Technical Guideline (DEC), Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DECCW/ DoP), and Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in New South Wales (EPA).	Sections 17.4 and 17.5
General Construction Impacts	
Assess and present a management framework for noise and vibration, including a considered approach to undertaking works outside standard construction hours. Consideration should be given to:	
Scheduling construction works having regard to the nature of construction activities (including transport, blasting and tonal or impulsive noise-generating works).	Sections 17.5 and 17.6
The intensity and duration of noise and vibration impacts, the nature, sensitivity and impact to potentially-affected receivers and structures.	Sections 17.5 and 17.6
The need to balance timely conclusion of noise and vibration-generating works with periods of receiver respite.	Sections 17.5 and 17.6

Director-General's Environmental Assessment Requirements	Where Addressed
Other factors that may influence the timing and duration of construction activities.	Sections 17.5 and 17.6
A strategy for managing construction noise and vibration, with particular focus placed on those activities identified as having the greatest potential for adverse noise or vibration impacts, and a broader, more generic approach developed for lower risk activities.	Section 17.6

17.2 Noise Monitoring

Attended and unattended noise monitoring was undertaken to assess the level of background noise in the vicinity of the Project. Monitoring locations are provided in Table 17-2 and Figure 17.1. These locations were selected with consideration to potential sensitive receivers, the spread of receivers along the Project route and land access issues.

Table 17-2 Noise Monitoring Locations

Noise Monitor ID	Allocated Receiver No.	Lot/Address	NCA	Distance to Near Track (m)
L1	MMU-003.5	Lot 241 DP 710251	U1	90
L2	MMU-012	Lot 523 DP 1033311	U3	80
L3	MMU-013	Lot 4 DP 621181	U3	205
L4	MMD-007	POR 41 DP 755209	D3	160
L5	MMU-021	B DP 395546	U4	70
L6	MMU-028	Lot 12 Sec 4 DP 8123	U4	40
L7	MMU-039	Lot 20 DP 706407	U5	70
L8	MMD-018.3	1 DP 37026	D7	100
L9	Not Allocated	Lot 106 DP 250308	D7	90
L10	MMU-053	Lot 66 DP 1076981	U6	85
L11	MMD-026	Lot 1 DP 852322	D10	105
L12	Not Allocated	Lot 30 DP 848387	D10	275
L13	MMD-029	Lot 80 DP 1003006	D11	35
L14	MMU-062	Lot 1 DP 778909	U8	55
L15	Not Allocated	13 Dumont Close, Rutherford	U10	100

Noise Monitor ID	Allocated Receiver No.	Lot/Address	NCA	Distance to Near Track (m)
L16	MMD-041	Lot 1 DP 778987	D12	30
L17	Not Allocated	65 Wentworth Street, Farley	U11	50

17.3 Noise and Vibration Goals

17.3.1 Construction Noise Goals

Construction noise is assessed with consideration to the Department of Environment, Climate Change and Water Interim Construction Noise Guidelines (ICNG) (DECCW July 2009). The ICNG recommend standard hours for construction activity are detailed in Table 17-3.

Table 17-3 ICNG Recommended Standard Hours for Construction Work

Work Type	Recommended Standard Hours of Work
Normal Construction	◗ Monday to Friday: 7 am to 6 pm. ◗ Saturday: 8 am to 1 pm. ◗ No work on Sundays or Public Holidays.
Blasting	◗ Monday to Friday: 9 am to 5 pm. ◗ Saturday: 9 am to 1 pm. ◗ No work on Sundays or Public Holidays.

The current ARTC Environment Protection Licence 3142 (EPL) allows for maintenance and construction works to be undertaken outside business hours in accordance with specific conditions contained in the EPL.

Additionally, further works outside these hours are anticipated during track possession periods which occur for up to 72 hours.

Communications with the local community with regards to out-of-hours work would be conducted in accordance with the relevant provisions of the ARTC EPL, as outlined in Section 17.6.1.

The ICNG provides noise management levels for construction noise at residential receivers. These management levels are to be calculated based on the adopted rating background level (RBL) at nearby residential locations, as shown in Table 17-4.

Table 17-4 ICNG Construction Noise Criteria at Residential Receivers, dB(A)

Time period	Management Level $L_{Aeq(15\ min)}$
Recommended standard hours	Noise affected level: RBL + 10 Highly noise affected level: 75 dB(A)
Outside recommended standard hours	Noise affected level: RBL + 5

The above levels apply at the boundary of the most affected residential properties or within 30 metres from the residence where the property boundary is more than 30 metres from the residence.

The *noise affected level* represents the point above which there may be some community reaction to noise. Where the *noise affected level* is exceeded, all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact. The *noise affected level* is the background noise level plus 10 dB(A) during recommended standard hours and the background noise level plus 5 dB(A) outside of recommended standard hours.

The *highly noise affected level* represents the point above which there may be strong community reaction to noise and is set at 75 dB(A). Where noise is above this level, the relevant authority may require respite periods by restricting the hours when the subject noisy activities can occur, taking into account:

- Times identified by the community when they are less sensitive to noise (such as mid-morning or mid-afternoon for works near residences).
- If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Based on the above, and the RBL determined from site monitoring (refer to Table 17-2), construction noise goals have been derived at various logging locations, as shown in Table 17-5 and Figure 17.1.

Table 17-5 Construction Noise Goals $L_{Aeq(15min)}$

Monitor ID	Within Recommended Standard Hours dB(A)	Outside Recommended Standard Hours	
		Evening (6pm-10pm) dB(A)	RBL Night (10pm-7am) dB(A)
L1	49	45	37
L2	51	47	43
L3	48	48[1]	39
L4	51	49	44
L5	49	40	36

Monitor ID	Within Recommended Standard Hours dB(A)	Outside Recommended Standard Hours	
		Evening (6pm-10pm) dB(A)	RBL Night (10pm-7am) dB(A)
L6	46	40	35
L7	48	44	40
L8	49	49	44
L9	44	40	35
L10	49	44	41
L11	47	39	38
L12	42	39	35
L13	50	43	39
L14	50	46	44
L15	45	40	35
L16	52	46	42
L17	44	41	36

Note: When determining construction noise goals from Table 17-12 RBL, RBL decimals less than 0.5 have been rounded down, while decimals 0.5 and greater have been rounded up.

[1] Adjusted down to Recommended Standard Hours goal.

17.3.2 Operational Rail Noise Goals

Operational rail noise goals are derived from the *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (IGANRIP).

Within NSW, in the area where works associated with a rail infrastructure project are likely to occur, the interim guideline presents non-mandatory noise goals that trigger the need for a project assessment to be conducted. Such an assessment would address potential noise impacts and consideration of possible mitigation measures that may be reasonably and feasibly applied to ameliorate these impacts.

Under the terms of the IGANRIP, the Project qualifies as the redevelopment of existing rail lines. For residential receivers, the noise trigger levels for absolute levels of rail noise have two components, L_{Aeq} and L_{Amax}. The L_{Aeq} contribution level of rail noise is assessed over the day or night period and the maximum noise level (L_{Amax}) from pass by events. Typically, exceedance of the trigger values shown in Table 17-6 must be met to initiate an assessment of rail noise impacts and investigation of mitigation measures.

Where trigger levels are already exceeded, noise attenuation options would be investigated to reduce noise levels towards IGANRIP levels as far as practical and reasonable.

Table 17-6 Airborne Rail Traffic Noise Trigger Levels for Residential Land Uses

Type of Development	Noise Trigger Levels dB(A)		Comment
	Day (7:00–22:00)	Night (22:00–7:00)	
Redevelopment of existing rail line	Development increases existing rail noise levels ***and*** resulting rail noise levels exceed:		These numbers represent external levels of noise that trigger the need for an assessment of the potential noise impacts from a rail infrastructure project. An 'increase' in existing rail noise levels is taken to be an increase of 2 dB(A) or more in LAeq in any hour or an increase of 3 dB(A) or more in LAmax.
	65 $L_{Aeq(15h)}$ 85 L_{Amax}	60 $L_{Aeq(9h)}$ 85 L_{Amax}	

Clause 6.1.1 (General Noise Limits) of the ARTC Environmental Protection Licence 3142 states "*It is an objective of this Licence to progressively reduce noise levels to the goals of 65 dB(A)Leq, (day time from 7am – 10pm), 60 dB(A)Leq, (night time from 10pm – 7am) and 85dB(A) (24 hr) max pass-by noise, at one metre from the façade of affected residential properties through the implementation of the Pollution Reduction Programs*." These levels are consistent with the IGANRIP trigger levels noted in Table 17-6.

17.3.3 Vibration Goals

With regards to vibration, it is considered in this assessment that human comfort goals are specific to operation of the rail line as construction vibration impacts are temporary in nature.

In terms of structural damage, ground vibration goals pertain to both construction and operation of the rail line. However, blasting vibration issues are specific to construction.

17.3.4 Human Comfort

The publication, *Assessing vibration: A technical guideline* 2006 (DECCW 2006) outlines methods of assessing potential impacts and ways to manage vibration from rail operations such as ground induced vibration created by rolling stock movements.

Assessing vibration: a technical guideline is based on guidelines contained in BS 6472:1992 *Evaluation of human exposure to vibration in buildings (1–80 Hz).*

Typically, construction activities generate ground vibration of an intermittent nature. Under BS 6472:1992 intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 17-7 for residential receivers.

Table 17-7 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26

Note: 1. Daytime is 7:00 to 22:00 and night-time is 22:00 to 7:00.

17.3.5 Structural Damage

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance of limiting vibration values is attained from reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures.*

Short-term peak particle velocity guideline values are presented in Table 17-8.

Table 17-8 Guideline Values for Vibration Velocity to be Used When Evaluating the Effects of Short-Term Vibration on Structures

Line	Type of Structure	Guideline Values for Velocity, $v_i(t)$[1] [mm/s]		
		Vibration at the Foundation at a Frequency of		
		1Hz to 10 Hz	10Hz to 50Hz	50Hz to 100Hz[2]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Notes to the above table:

1. The term v_i refers to vibration levels in any of the x, y or z axes.
2. At frequencies above 100Hz the values given in this column may be used as minimum values.

17.3.6 Blasting Overpressure and Vibration

Typically, when dealing with potential blasting noise and vibration, DECCW refers to Australian and New Zealand Environment Conservation Council (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990). This guideline recommends the noise and vibration limits listed in Table 17-9.

Table 17-9 ANZECC (1990) Blasting Limits

Airblast Overpressure	Ground Vibration
115 dB(lin) peak	5mm/s Peak Particle Velocity
The level of 115 dB(lin) may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120 dB(lin) peak.	The level of five mm/second may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10 mm/s.

17.4 Existing Environment

As discussed in **Chapter 14**, the existing environment adjacent to the rail corridor consists primarily of rural and rural residential land uses with some residential and industrial development. The sensitive noise receivers along the Project route are essentially residential receivers, with minimal industrial and commercial receivers. The Noise and Vibration Impact Assessment in (Appendix K) provides additional detail on the methodology and results of the studies and monitoring.

Table 17-10 and Table 17-11 present the noise catchment areas identified on the Up side and Down side of the Project, respectively, including land which has been approved or has entered the approval process for residential development but is not built-up yet. The noise catchment areas are shown in Figure 17.1.

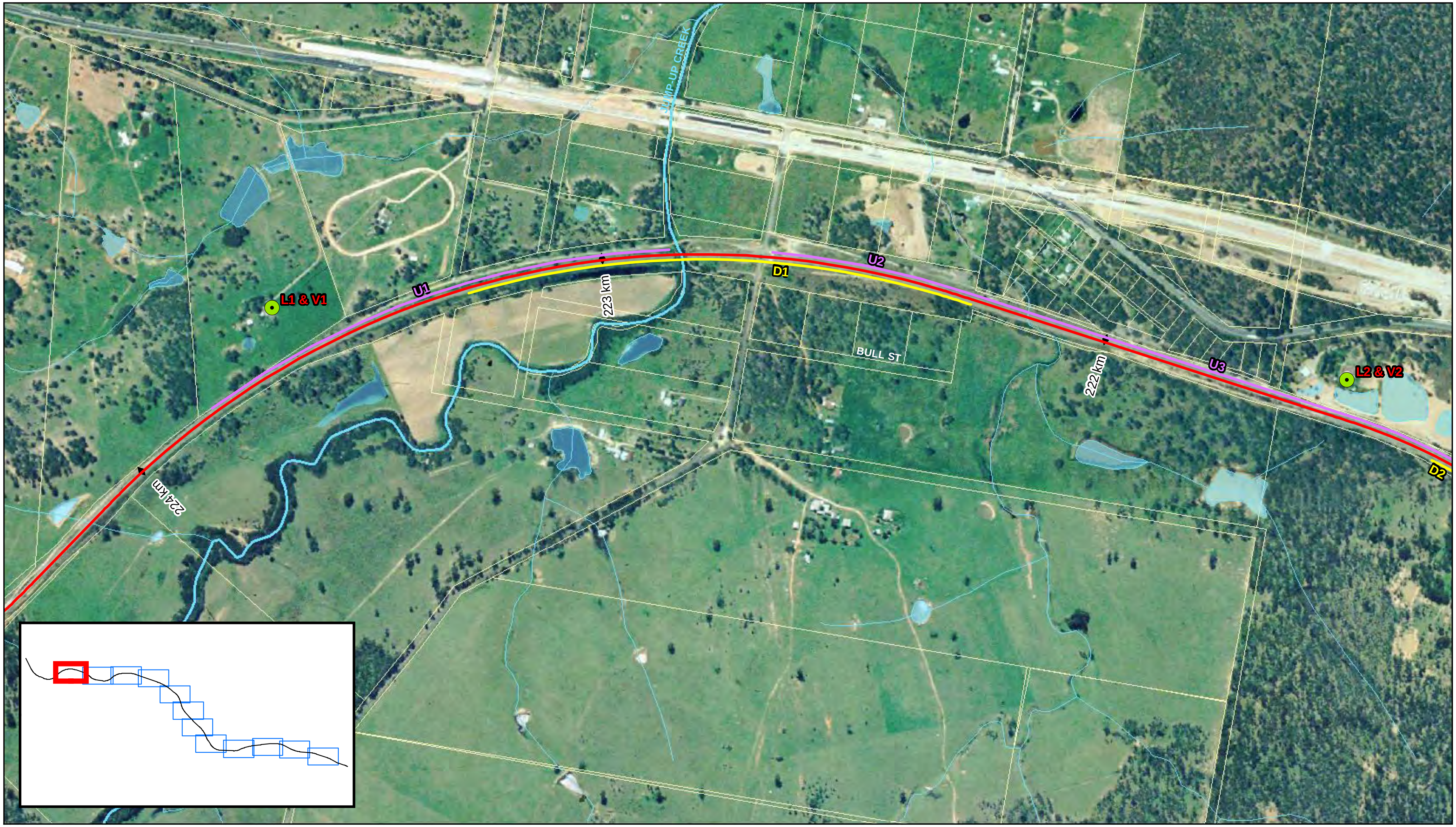
Table 17-10 Noise Catchment Areas – Up Side

Chainage	NCA ID	Land Description
222.900 – 223.850	U1	Three scattered residences on rural land, west of Hermitage Road, Belford.
222.300 – 222.700	U2	Proposed Service Centre and Motel (approved).
220.350 – 222.300	U3	Eight scattered residences from Pothana Lane to Hermitage Road, Belford.
214.100 – 215.350	U4	Built-up residential area between Thomas Street and Short Street, Branxton.
210.000 – 210.950	U5	Scattered residences and proposed residential subdivision off Nelson Street and Florence Street, Greta.
205.100 – 206.500	U6	Two residences on rural (grazing) land off Allandale Road, Allandale.
202.050 – 202.500	U7	One residence on rural (grazing) land off Station Lane, Lochinvar.
200.250 – 201.100	U8	Three scattered residences on rural (grazing) land off Winders Lane, Farley/Lochinvar.

Chainage	NCA ID	Land Description
196.200 – 197.600	U9	Heritage Green residential development.
195.600 – 196.200	U10	Built-up residential subdivision between Wollombi Road and Heritage Green.
194.400 – 194.750	U11	Built-up residential area between South Street and Lismore Street, Telarah.

Table 17-11 Noise Catchment Areas – Down Side

Chainage	NCA ID	Land Description
222.300 – 223.300	D1	Three scattered residences off Hermitage Road.
221.000 – 221.350	D2	Two - three isolated residences west of Pothana Lane.
219.250 – 219.700	D3	Pothana Winery (including residence).
218.000 – 218.150	D4	One isolated residence at the end of Standen Drive.
215.650 – 217.200	D5	Proposed Huntlee Residential Development
214.850 – 215.100	D6	Two residences off Wine Country Road, Branxton.
209.850 – 210.900	D7	Built-up residential area in Greta.
206.750 – 209.850	D8	Greta Estates Pty Ltd land (approved residential development masterplan).
205.750 – 206.300	D9	Three residences on rural land at intersection of Allandale Road and Lovedale Road.
203.050 – 205.100	D10	Seven scattered residences on rural land off Old North Road.
200.800 – 202.500	D11	Eight scattered residences off Old North Road, east of Station Lane.
195.600 – 196.250	D12	Residences off Wollombi Road.



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
- Watercourse
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Watercourse Area

Maitland To Minimbah Third Track
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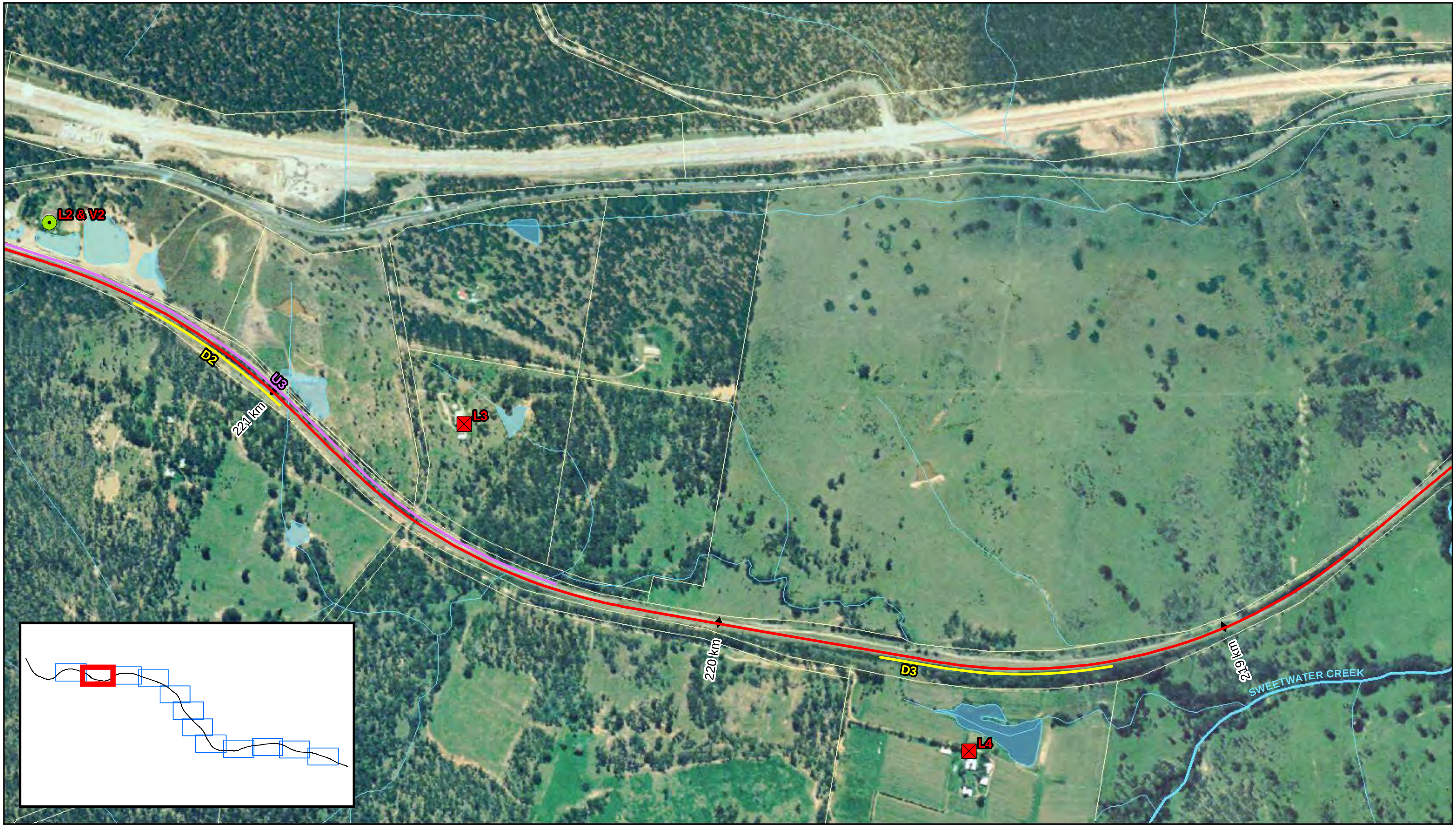
Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1a

G:\22\14471\GIS\Maps\Deliverables\EA\EA_Noise_Monitoring_Locations_20091202_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
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Figure 17.1b

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

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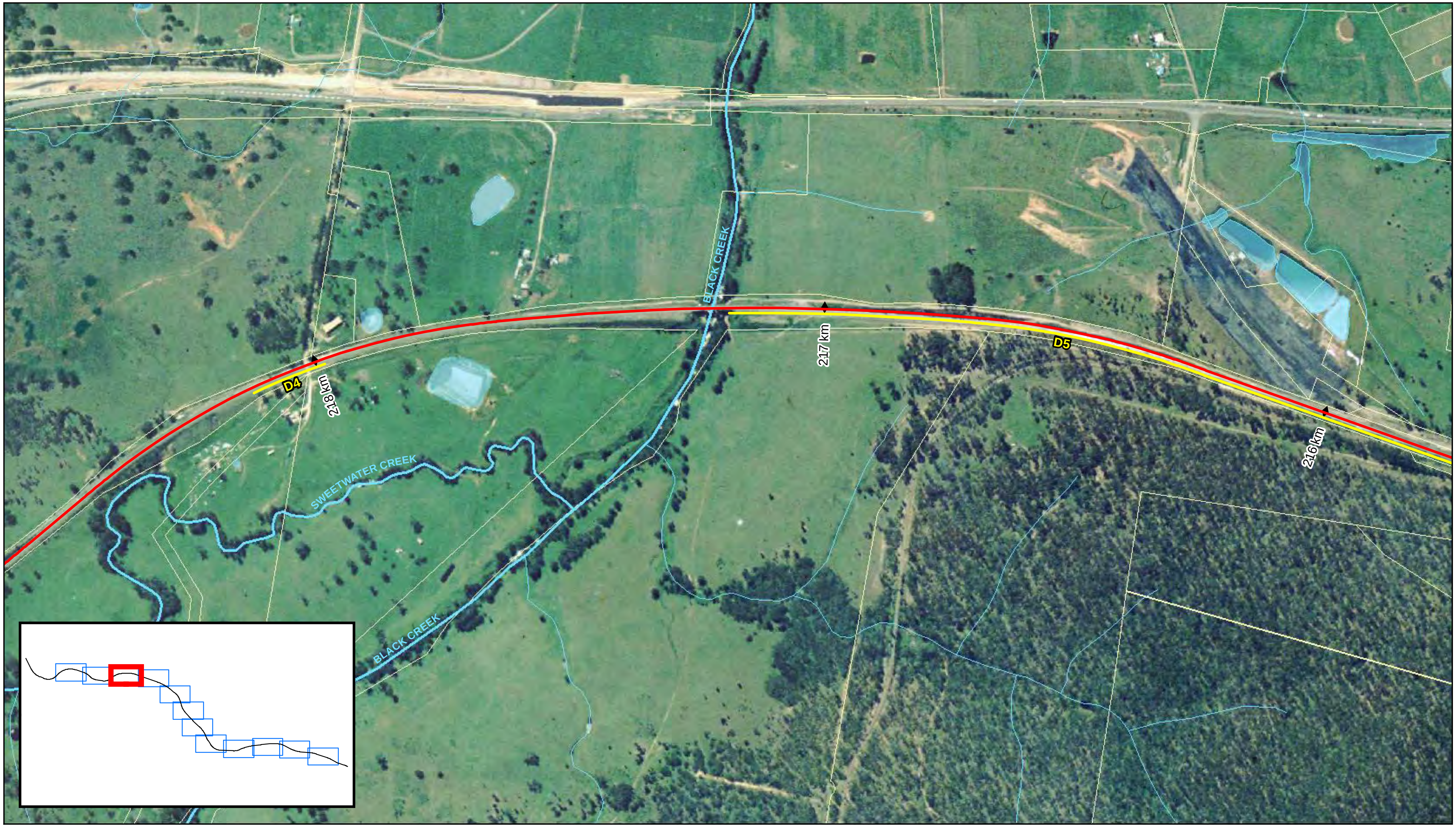

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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

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LEGEND

- Project Location
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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1c

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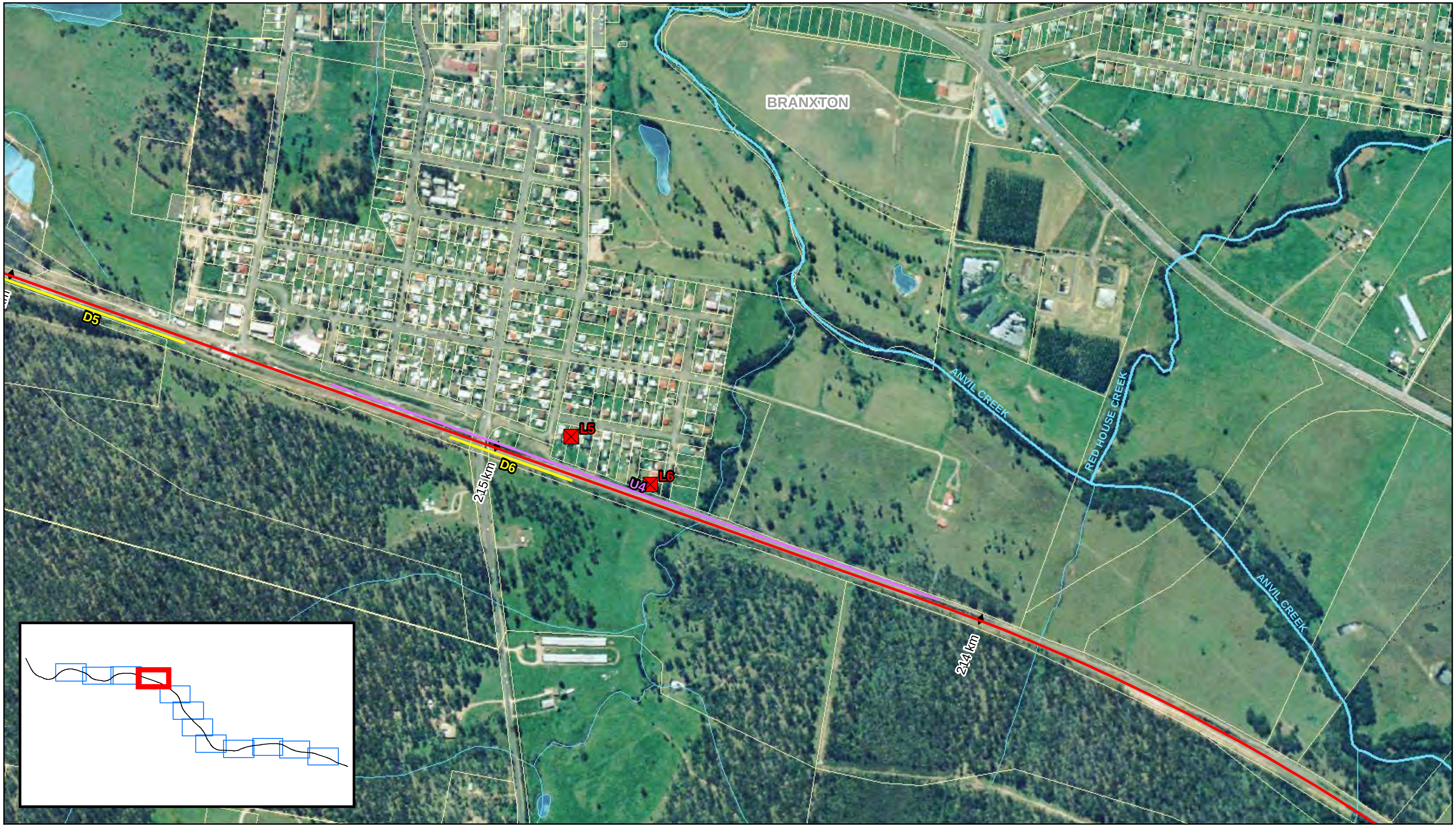
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
- Watercourse
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1d

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1e

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

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LEGEND

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1f

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

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- Noise & Vibration Monitoring Locations
- Watercourse Area

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

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Figure 17.1g

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

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- Noise & Vibration Monitoring Locations
- Watercourse Area

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1h

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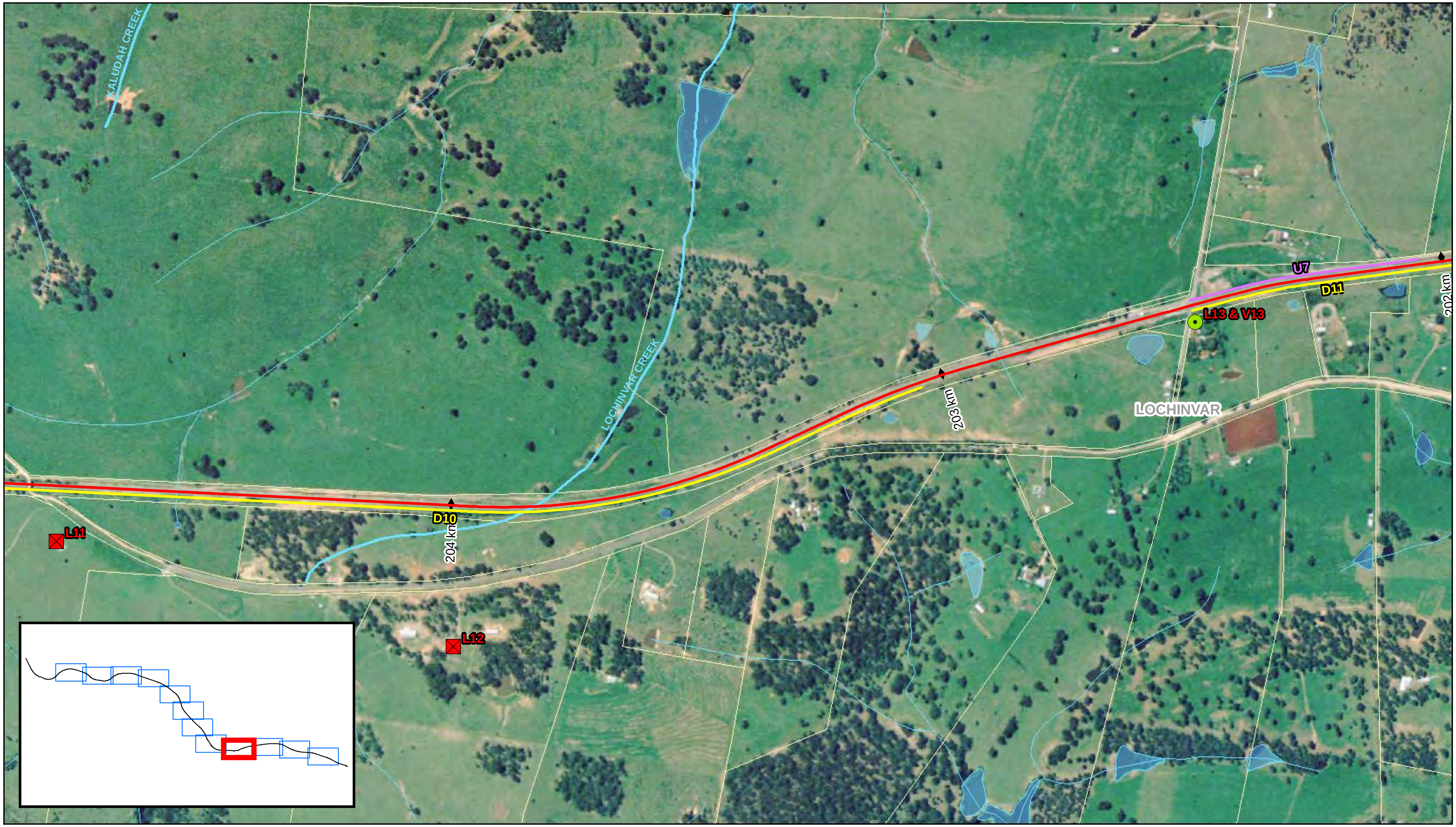
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
- Watercourse
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Watercourse Area

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1i

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
- Watercourse
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Watercourse Area

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1j

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

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0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
- Watercourse
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Watercourse Area

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1k

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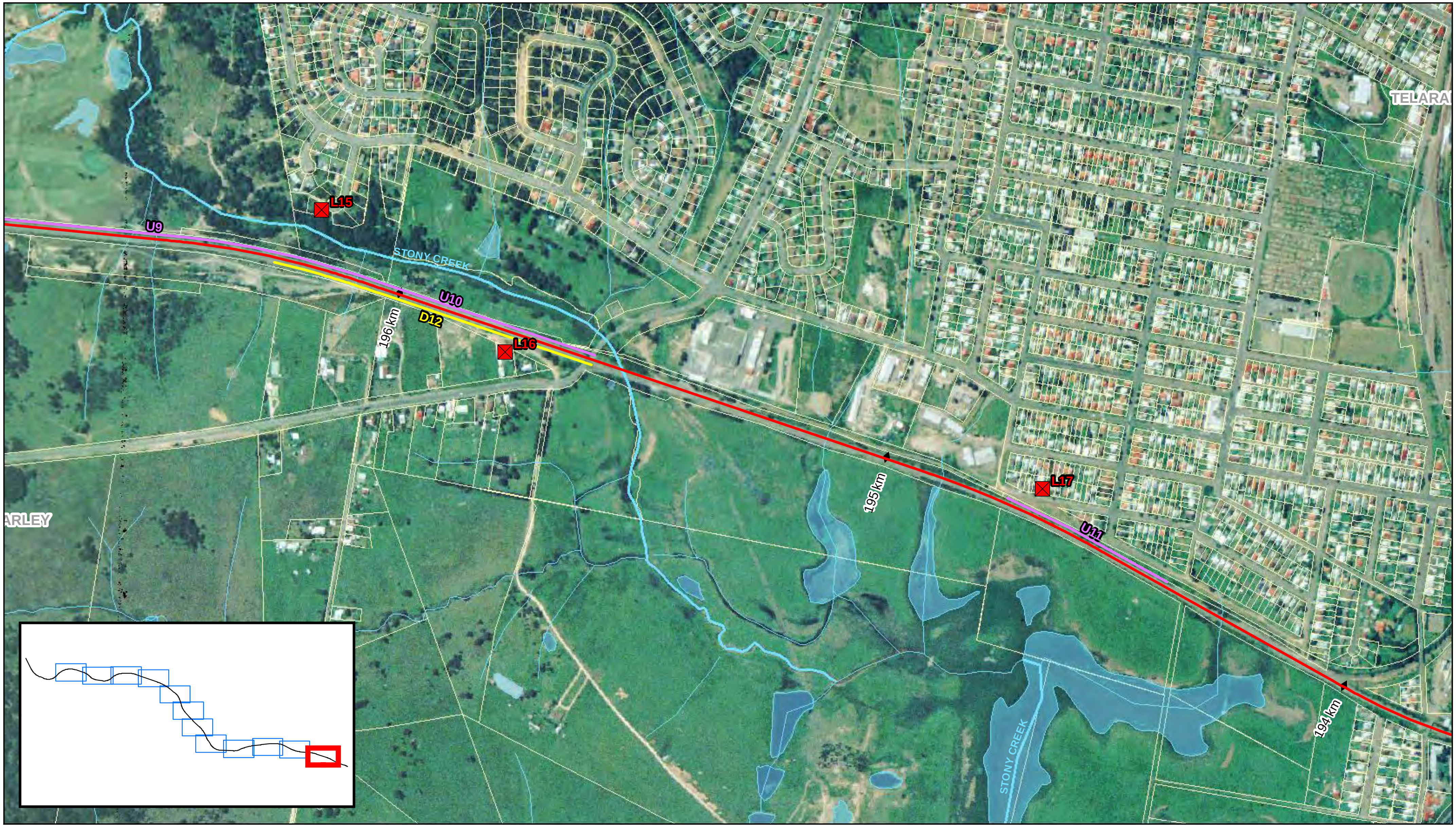
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Project Location
- Watercourse
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Watercourse Area

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Noise and Vibration Monitoring Locations and Noise Catchment Areas

Figure 17.1I

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

17.4.1 Noise Monitoring

Unattended noise monitoring was undertaken for a period of at least one week at the above locations between July and September 2009.

Logger data results of the rating background level (RBL), $L_{Aeq(15hr)}$, and $L_{Aeq(9hr)}$ noise levels are summarised in Table 17-12, and detailed in the Noise and Vibration Impact Assessment (Appendix K).

Table 17-12 Summary of Noise Logging Results dB(A)

Monitor ID	RBL Day	RBL Evening	RBL Night	$L_{eq,15hr}$	$L_{eq,9hr}$
L1	38.9	39.5	32.3	61.3	59.8
L2	40.6	42.3	38.0	57.1	58.0
L3	38.0	43.9	34.0	52.0	48.7
L4	40.9	44.3	38.5	58.3	59.2
L5	38.7	35.0	31.0	55.9	53.0
L6	35.6	35.1	30.3	55.4	51.9
L7	37.5	38.8	34.8	59.0	59.9
L8	39.0	44.0	38.8	57.2	57.6
L9	34.0	34.9	29.5	61.3	61.8
L10	38.8	39.0	36.0	59.7	60.4
L11	36.7	33.5	32.5	53.7	52.3
L12	32.0	34.2	30.0	51.3	51.9
L13	39.8	37.8	34.0	68.9	69.6
L14	39.5	40.8	38.5	59.9	59.8
L15	35.1	34.8	30.3	60.6	61.4
L16	42.3	40.5	37.0	62.4	63.3
L17	33.7	36.3	31.4	65.0	65.5

Attended noise monitoring was undertaken at all logging locations to further detail train pass-by noise levels along the Project route. Pass-by measurements were taken between July and September 2009, alongside noise logging.

A minimum of 10 train pass-bys was measured at each location. Measurement results are detailed in the Noise and Vibration Impact Assessment (Appendix K) and summarised in Table 17-13.

Table 17-13 Summary of Pass-by Noise Monitoring Results dB(A)

Noise Logger ID	Up/Down	Train Type	Number of Passbys	Average Duration (min:sec)	Average L_{eq}	L_{max} Range
L1	Up	Coal	5	02:30	68.5	70.7 - 95.6
	Down	Empty Coal	6	02:43	69.1	77.4 - 85.3
	Up/Down	Passenger	1	00:16	66.1	74.7
L2	Up	Coal	4	02:37	61.8	66.8 - 77.3
	Down	Empty Coal	7	01:38	65.8	66.5 - 77.4
	Up/Down	Passenger	1	00:29	58.9	67.0
L3	Up	Coal	5	03:03	49.3	56.5 - 59.0
	Down	Empty Coal	5	02:01	55.4	60.3 -69.1
	Up/Down	Passenger	2	00:23	49.4	55.8 - 60.0
L4	Up	Coal	8	02:38	63.5	69.6 - 79.9
	Down	Empty Coal	6	01:44	68.2	71.1 - 81.4
	Up/Down	Passenger	2	00:23	64.8	65.1 - 72.6
L5	Up	Coal	4	02:11	60.6	68.3 – 76.2
	Down	Empty Coal	6	01:23	60.5	62.9 – 70.3
	Up/Down	Passenger	2	00:12	55.3	59.0 – 62.7
L6	Up	Coal	2	02:15	63.4	70.7 – 78.7
	Down	Empty Coal	8	02:20	65.4	68.9 – 91.0
	Up/Down	Passenger	2	00:29	52.3	59.7 – 60.4
L7	Up	Coal	5	02:29	69.6	76.3 – 85.0
	Down	Empty Coal	5	01:39	63.4	66.9 – 73.9
	Up/Down	Passenger	1	01:40	54.7	66.1
L8	Up	Coal	5	01:52	65.4	71.2 – 77.9
	Down	Empty Coal	6	01:33	67.1	70.8 – 76.1
	Up/Down	Passenger	1	00:20	67.5	75.6

Noise Logger ID	Up/Down	Train Type	Number of Passbys	Average Duration (min:sec)	Average L_{eq}	L_{max} Range
L9	Up	Coal	6	01:49	65.8	74.4 – 79.3
	Down	Empty Coal	4	01:43	68.5	74.7 – 78.2
	Up/Down	Passenger	2	00:30	59.5	61.1 – 70.0
L10	Up	Coal	5	02:25	67.3	71.9 – 81.6
	Down	Empty Coal	9	01:48	63.0	64.8 – 92.2
	Up/Down	Passenger	2	00:07	53.7	57.1 – 58.0
L11	Up	Coal	6	02:56	55.0	59.1 – 69.7
	Down	Empty Coal	9	02:18	58.9	60.7 – 74.5
	Up/Down	Passenger	2	00:20	49.1	49.3 – 60.1
L12	Up	Coal	5	02:26	57.5	59.3 – 73.6
	Down	Empty Coal	4	01:41	60.4	65.0 – 66.9
	Up/Down	Passenger	2	00:16	55.0	50.3 – 64.3
L13	Up	Coal	9	02:12	76.8	84.9 – 100.7
	Down	Empty Coal	8	01:57	77.6	82.6 – 90.9
	Up/Down	Passenger	3	00:11	76.9	80.6 – 82.3
L14	Up	Coal	4	02:46	66.9	76.2 – 81.1
	Down	Empty Coal	5	01:34	67.4	75.5 – 81.9
	Up/Down	Passenger	1	00:13	58.9	64.4
L15	Up	Coal	5	02:37	65.7	68.4 – 80.9
	Down	Empty Coal	5	02:22	71.3	78.9 – 96.0
	Up/Down	Passenger	2	00:32	62.3	67.6 – 72.3
L16	Up	Coal	6	02:48	68.8	73.0 – 90.4
	Down	Empty Coal	7	01:36	72.7	80.3 – 86.2
	Up/Down	Passenger	1	00:13	65.7	74.8
L17	Up	Coal	4	03:11	72.9	82.6 – 89.2
	Down	Empty Coal	7	02:02	74.6	75.2 – 92.3
	Up/Down	Passenger	1	00:16	62.1	76.2

When considering the results in the previous tables the following should be noted:

- The reported number of measured pass-bys included a few freight trains. However, they are infrequent compared to the number of coal trains using the rail line.
- Similarly, passenger train pass-bys were relatively infrequent. Passenger train pass-by durations were very short due to the train length and speed on the line, the only exception being L7 where passenger trains stopped at the nearby Greta Railway Station. As such, passenger trains have been grouped regardless whether they were passing by on the Up or Down side.

17.4.2 Vibration Monitoring

Monitoring Locations

Unattended vibration monitoring was undertaken at the locations listed in Table 17-14 and shown in Figure 17.1. These locations were selected with consideration to the potentially most sensitive receivers and land access issues.

Table 17-14 Vibration Monitoring Locations

Monitor ID	Allocated Receiver No.	Lot/Address	NCA	Distance to Near Track (m)
V1 (L1)	MMU-003.5	Lot 241 DP 710251	U1	83
V2 (L2)	MMU-012	Lot 523 DP 1033311	U3	73
V10 (L10)	MMU-053	Lot 66 DP 1076981	U6	50
V13 (L13)	MMD-029	Lot 80 DP 1003006	D11	35
V14 (L14)	MMU-062	Lot 1 DP 778909	U8	25

Unattended vibration monitoring was undertaken between July and August 2009.

Review of the vibration monitoring results indicates the following:

- Train pass-by peak particle velocities at locations V1, V2 and V10 generally do not significantly exceed background levels. High peak particle velocities levels captured at V1 and V2 are attributed to extraneous sources for the following reasons:
  - The high peak particle velocities are considered too high to be generated by trains over such distances (in excess of 70 metres).
  - These high peak particle velocities are only found at either V1 or V2 at any one time, whereas it would be expected they would occur at both, given the measurement site’s relative proximity, similar topography and distances to the track.
- Due to the shorter distances to the rail track (25 metres to 35 metres), train passby peak particle velocities levels can be more easily distinguished from background levels at locations V13 and V14 compared to other monitoring locations.

17.5 Impact Assessment

17.5.1 Proposed Construction Hours

The Hunter 8 Alliance proposes that the standard hours for construction activities associated with the Project would be:

- 7:00 am to 6:00 pm, Mondays to Friday, inclusive.
- 8:00 am to 1:00 pm on Saturdays.
- No works Sundays or public holidays.

The current ARTC Environment Protection Licence 3142 (EPL) allows for maintenance and construction works to be undertaken outside business hours providing it is undertaken in accordance with specific conditions contained in the EPL. It is proposed that a new EPL for construction of the Project would include similar conditions. Communications with the local community with regards to out-of-hours work is discussed in Section 17.6.1.

17.5.2 Construction Noise and Vibration Impacts

Construction Activities

It is anticipated that construction activities would occur over an approximately 24 month period between 2010 and 2012.

Construction Equipment

Indicatively, the plant and equipment to be used during key construction activities are shown in Table 17-15.

Table 17-15 Typical Construction Equipment

Project Component	Description of Works
Mobilisation / Facilities	◗ Cranes.
	◗ Road Trucks.
	◗ Dump Trucks.
	◗ Generators.
	◗ Clearing equipment (Excavators, Bulldozers).

Project Component	Description of Works
Earthworks, Capping, Drainage, Retaining Walls	◗ Excavators.
	◗ Bulldozers.
	◗ Road Trucks.
	◗ Dump Trucks.
	◗ Small Machinery (such as compressors, jackhammers).
	◗ Backhoe.
	◗ Compactors.
	◗ Blasting.
Road Works and Bridge Works	◗ Cranes.
	◗ Excavators.
	◗ Road Trucks.
	◗ Dump Trucks.
	◗ Concrete Pumps.
	◗ Concrete Saws.
	◗ Piling rig.
	◗ Pavers.
	◗ Breakers.
Trackwork	◗ Track Laying Plant.
	◗ Road Trucks.
	◗ Dump Trucks.
Demobilisation	◗ Cranes.
	◗ Road Trucks.
	◗ Dump Trucks.

Construction Noise

At the present stage of design, there is not enough detail on construction activities to accurately assess noise impacts along the Project route. Therefore it is proposed that construction noise impacts be assessed as design and construction progress in Noise and Vibration Impact Statements (NVIS) prepared for discrete work areas. The purpose of the NVIS would be to:

- Determine construction noise impacts at sensitive receivers from specific construction activities.
- Outline specific control measures where exceedances of the construction noise and vibration goals are anticipated.

Based on the experience of the Minimbah Bank Third Track Project, following is a non-exhaustive list of NVIS that would be prepared:

- Site compounds.
- Crushing Plants.
- Blasting.
- Clearing and stripping.
- Track possession work.
- Drainage and Capping.
- Cut and fill (including blasting, if applicable).
- Topsoil and seeding.
- Bridgeworks.

The magnitude of off-site noise impact associated with construction would be dependent upon a number of factors:

- The intensity of construction activities.
- The location of construction activities.
- The type of equipment used.
- Existing local noise sources.
- Intervening terrain.
- The prevailing weather conditions.

In addition, construction machinery would likely move about the study area, variously altering the directivity of the noise source with respect to individual receivers. During any given period, the machinery items to be used in the study area would operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at their maximum sound power levels at any one time. Finally, certain types of construction machinery would be present in the study area for only brief periods during construction.

As shown in Table 17-5, construction noise goals during standard hours are consistently in the order of 45 to 50dB(A). Table 17-16 presents the distance from which construction activities with a noise level of 50dB(A) could have an impact, These figures are based on the noise predictions carried out as part of the preparation of the Minimbah Bank Third Track noise and vibration impact statements. These are graphically presented in Appendix K.

Table 17-16 50dB(A) Impact Distance for Specific Construction Activities

Activity	50dB(A) Impact Distance (m)	Proposed Activity Locations (Chainage)
Site Compounds	250	195.900 – 196.000 202.250 – 203.000 210.600 – 210.700 215.700 – 216.200 217.250 – 217.350 222.700 – 222.800
Crushing Plant (assumed to be located near blasting locations)	300	195.360 - 195.380 195.960 - 195.980 204.740 - 204.860 205.280 - 205.400 211.540 - 211.760 213.460 - 213.620 214.100 - 214.180 214.940 - 215.100 216.340 - 216.600 216.700 - 216.920 218.740 - 218.960 221.160 - 221.320 221.640 - 221.940 222.480 - 222.680
Clearing and Stripping	200	All
Retaining Wall	250	194.500 – 194.750 195.250 – 195.550 195.600 – 195.700 215.550 – 215.600
Drainage and Capping	300	All
Cut and Fill	350	All
Topsoiling and Landscaping	250	All

Activity	50dB(A) Impact Distance (m)	Proposed Activity Locations (Chainage)
Bridgeworks (including culvert extensions)	300	194.900, 195.100,195.550, 195.600, 195.650, 196.050,196.300, 196.350, 196.500, 196.550, 197.150, 197.500, 197.900, 198.050, 198.600, 199.250, 199.850, 201.500, 202.100, 202.550, 202.900, 203.050, 203.600, 203.850, 204.550, 205.100, 206.050, 206.550, 207.750, 208.800, 209.150, 209.700, 209.900, 210.000, 210.550, 210.700, 211.000, 211.950, 212.350, 212.700, 213.200, 213.700, 213.850, 214.550, 215.000, 215.200, 215.500, 215.700, 215.850, 217.150, 218.300, 218.450, 219.100, 220.400, 220.950, 221.500, 222.150, 222.850, 224.150

Short-term construction noise monitoring conducted throughout the Minimbah Bank Third Track Project suggests that the above estimates are conservative. It should also be noted that some activities are isolated (such as bridgeworks) while others cover the entire project route (such as topsoiling and landscaping). However, they provide an indication of the areas that are likely to be impacted by construction noise.

Construction Vibration

Vibration impacts discussed below essentially focus on potential structural damage to properties in close vicinity of the study area and/or potentially affected by construction activities.

It is possible that local sensitive receivers may perceive construction vibration at times. The level of annoyance, however, would depend on individuals. Conservative vibration estimates are shown in Table 17-17.

Table 17-17 Typical Vibration Levels – Construction Equipment

Vibration Source	Distance to Source (m) / Peak Particle Velocity (mm/s)				
	10	25	50	75	100
Piling	12.0	5.8	3.3	2.4	1.9
Loader Breaking Kerbs	8.0	3.8	2.2	1.6	1.3
15 Tonne Compactor	8.0	3.8	2.2	1.6	1.3
7 Tonne Compactor	7.0	3.4	1.9	1.4	1.1

Vibration Source	Distance to Source (m) / Peak Particle Velocity (mm/s)				
	10	25	50	75	100
Roller	7.0	3.4	1.9	1.4	1.1
Pavement Breaker	6.0	2.9	1.7	1.2	1.0
Dozer	6.0	2.9	1.7	1.2	1.0
Backhoe	4.0	1.9	1.1	0.8	0.6
Jackhammer	0.5	0.2	0.1	0.1	0.1

When compared to the structural vibration goals outlined in Table 17-8, the above table indicates that structural damage may occur within 10 to 50 metres from buildings, depending on the activities being carried out.

As such, it is important that this risk is captured and managed in the project construction noise, vibration management plan.

Blasting

Potential blasting locations are listed in Table 17-18 and Figure 17.2.

Table 17-18 Potential Blasting Locations

Chainage Start	Chainage Finish	Side
195.360	195.380	Up and Down
195.960	195.980	Up and Down
204.740	204.860	Up and Down
205.280	205.400	Up and Down
211.540	211.760	Up and Down
213.460	213.620	Up and Down
214.100	214.180	Up and Down
214.940	215.100	Up and Down
216.340	216.600	Up and Down
216.700	216.920	Up and Down
218.740	218.960	Up and Down
221.160	221.320	Up and Down
221.640	221.940	Down only
222.480	222.680	Down only

Blasting would typically involve:

- Drilling a hole in the rock to the required depth.
- Placing an amount of explosives into the blasthole.
- Placing aggregate in the blasthole on top of the explosives.
- Detonating the explosives.

Blasting overpressure and vibration impacts largely depend on parameters such as the following:

- Distance to the nearest receivers.
- Geotechnical properties of the soil between the blast location and receivers.
- Explosive charge.

Figure 17.2 shows the potential blasting locations and receivers located within 500 metres from the blast. Potential adverse blasting impacts (using the listed typical methodology) are generally restricted to receivers within 500 metres of the blasting location.

Where sensitive receivers are within 500 metres of a blasting location, a full blasting design would be produced for all such locations. This design will ensure that in these areas, less charge (shot) is released for any one instantaneous moment. This will assist in minimising noise and vibration impacts from blasting.

The amount of charge to be used would not be decided until the final blast design has been completed. This would not occur until the full geotechnical design and confirmation of property acquisition and locations are finalised.

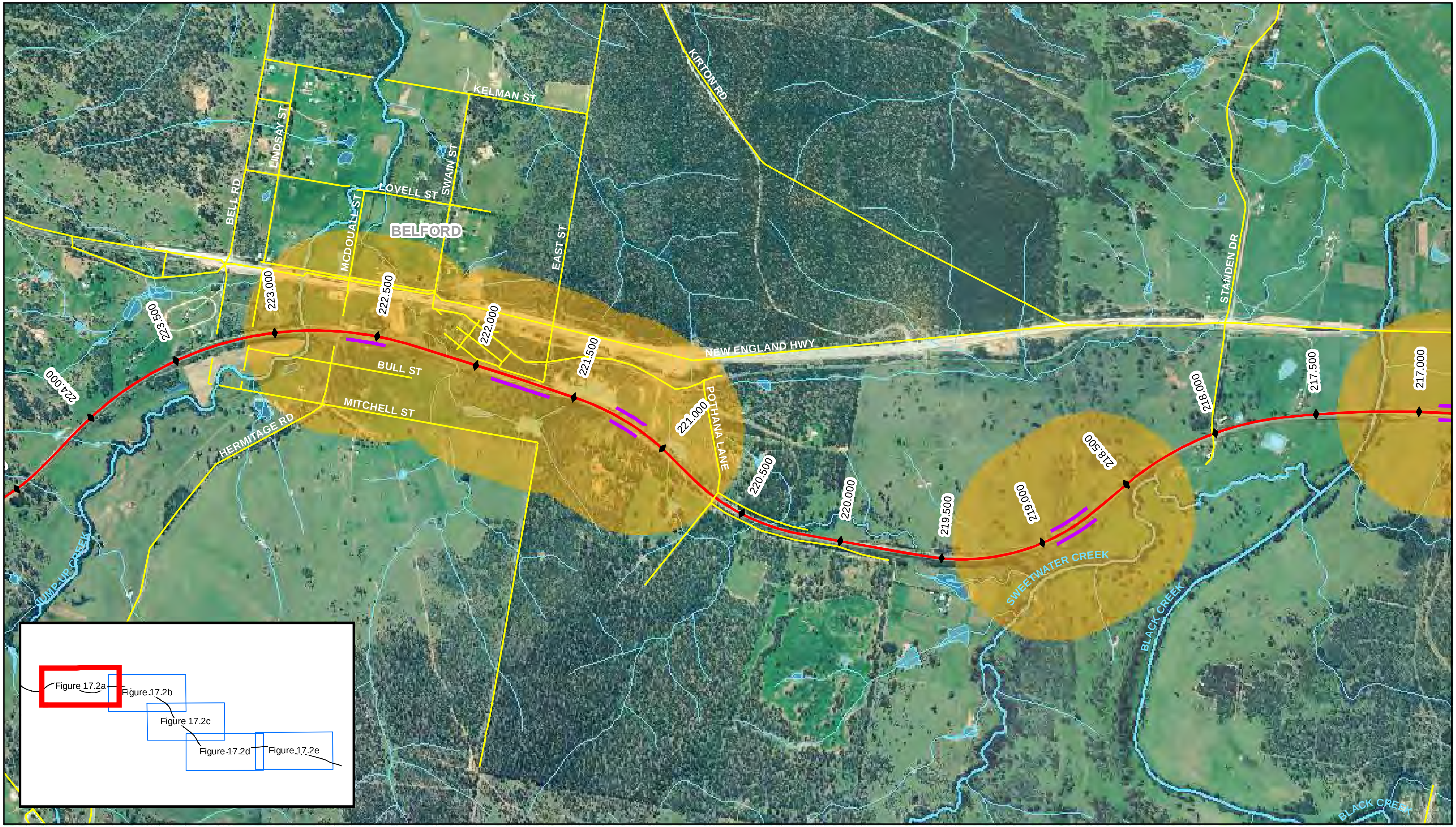
The design parameters of each blast, such as the depth and diameter of the blasthole and the type and amount of explosives, would be determined by the blasting contractor based on a number of factors, including the type of rock present and the distance to the nearest receivers.

It is anticipated that the following measures would be implemented to minimise potential impacts from blasting (where appropriate):

- Applying a minimum face burden. A face burden is the distance from a blasthole to the free face in front of it, and controls the movement of material and control overpressure.
- Applying a minimum design stemming height. Stemming is the aggregate placed in the blasthole on top of the explosive product to confine the energy and optimize blast performance while reducing environmental impact. This measure would control overpressure and flyrock.
- Covering any presplit blasts with a blanket of heavy clay to control flyrock and overpressure.
- Delaying any presplit holes to be fired in groups of holes rather than instantaneously to reduce overpressure.

- Monitoring overpressure and vibration at the nearest residences.
- Notifying neighbours of blasting events and providing the opportunity for feedback.
- Minimising the number of blasting events.

The blasting design would be carried out by a licensed blasting contractor. It would be reviewed and included in the Blasting NVIS.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Potential Blasting Location
- Road Centre Line
- 500m Buffer
- Proposed Third Track
- Watercourse area
- Watercourse

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Potential Blasting Locations

Figure 17.2a

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Proposed_Blasting_locations_500m_Buffer_20100524.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

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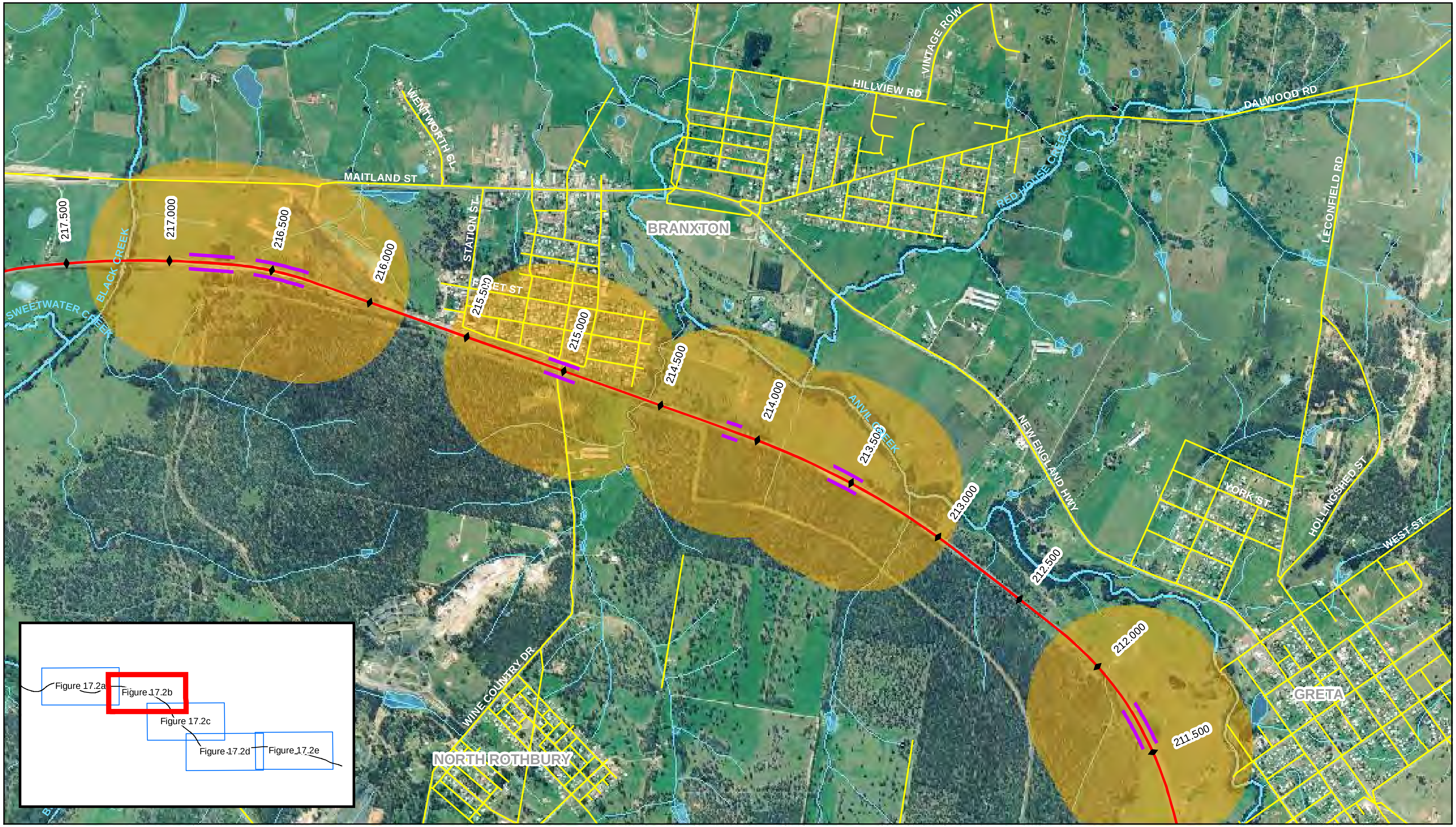

1:25,000 (at A4)

0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Potential Blasting Location
- Road Centre Line
- 500m Buffer
- Proposed Third Track
- Watercourse area
- Watercourse

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Potential Blasting Locations

Figure 17.2b

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Proposed_Blasting_locations_500m_Buffer_20100524.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

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0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
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N

LEGEND

- Potential Blasting Location
- Road Centre Line
- 500m Buffer
- Proposed Third Track
- Watercourse area
- Watercourse

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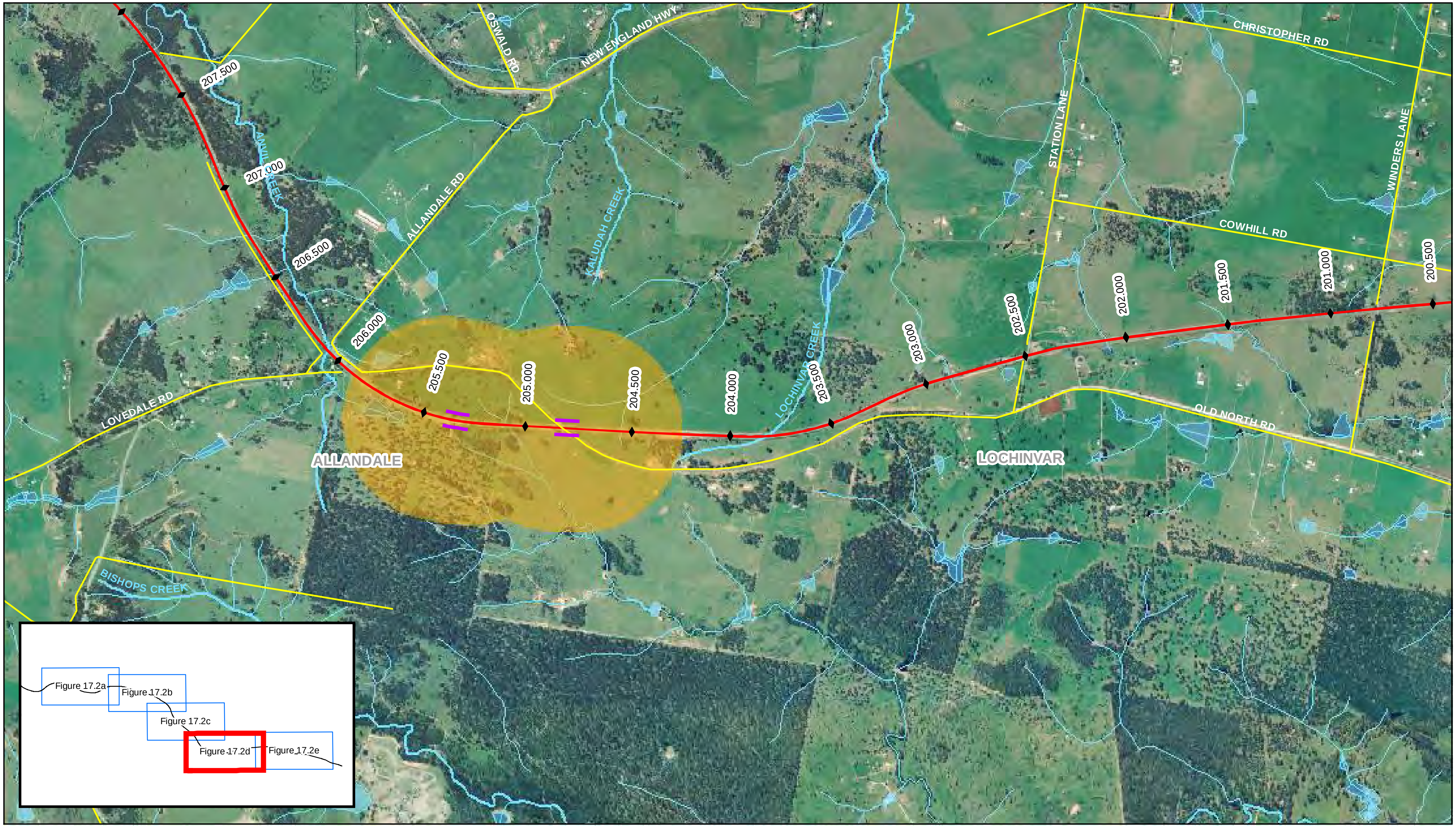
Potential Blasting Locations

Figure 17.2c

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Proposed_Blasting_locations_500m_Buffer_20100524.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton, fmackay



1:25,000 (at A4)

0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

Potential Blasting Location	Proposed Third Track
Road Centre Line	Watercourse area
500m Buffer	Watercourse

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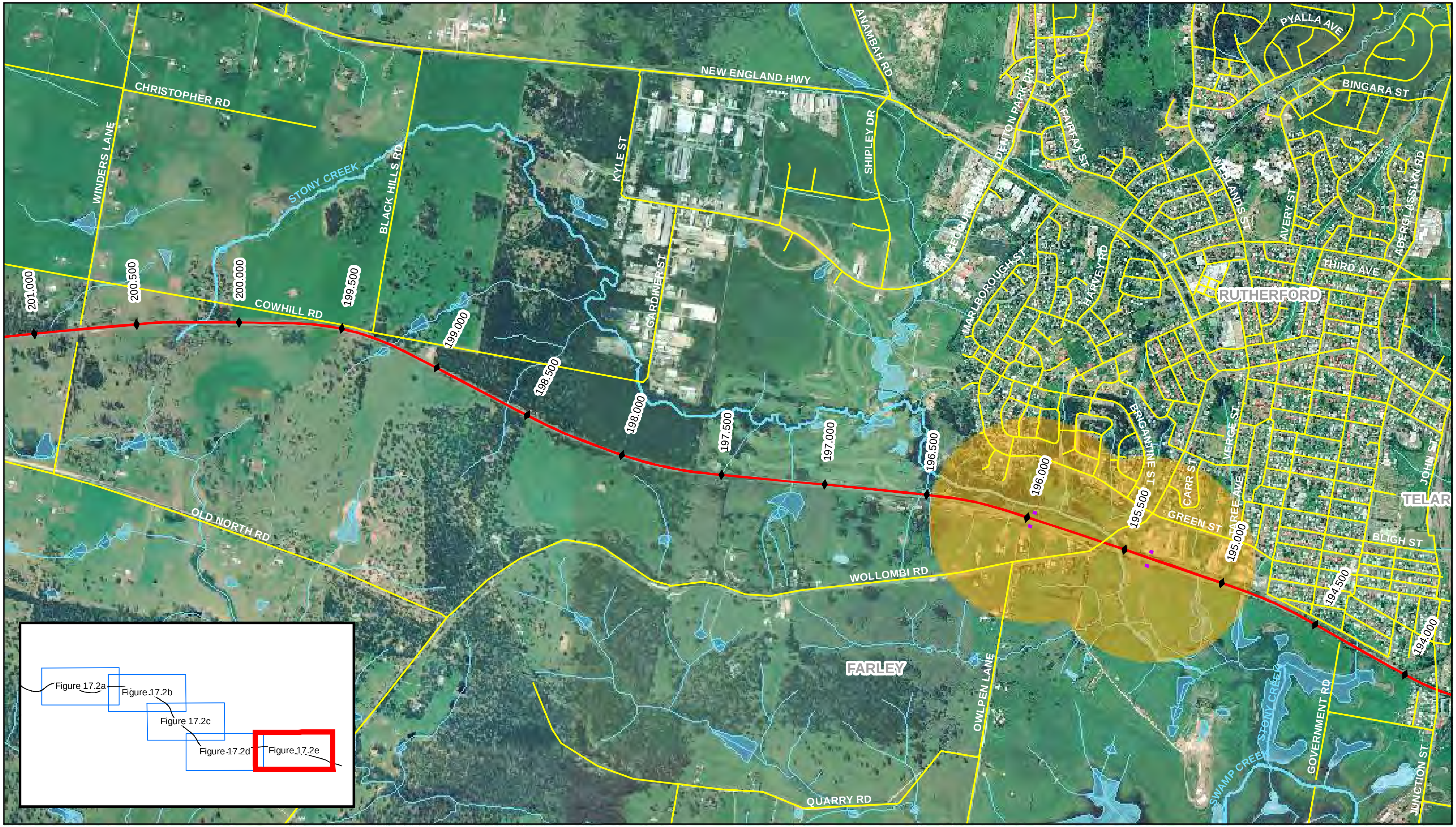
Potential Blasting Locations

Figure 17.2d

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Proposed_Blasting_locations_500m_Buffer_20100524.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton, fmackay



1:25,000 (at A4)

0 100 200 400 600 800

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

LEGEND

- Potential Blasting Location
- Road Centre Line
- 500m Buffer
- Proposed Third Track
- Watercourse area
- Watercourse

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Potential Blasting Locations

Figure 17.2e

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Proposed_Blasting_locations_500m_Buffer_20100524.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton, fmackay

17.5.3 Operational Noise and Vibration

Rail noise modelling has been conducted based on the current state of the design for the following operational scenarios:

- Existing (2009).
- Year 2012.
- Year 2022.

Table 17-19 and Table 17-20 present the extent of receivers where IGANRIP is triggered (the IGANRIP trigger levels are predicted to be exceeded, and the existing noise levels increased by 2dB(A) or more). It also identifies when such exceedances of the IGANRIP trigger levels are first predicted to occur. Note that existing rail noise levels already exceed of the IGANRIP trigger levels at some receivers. The noise catchment areas are shown in Figure 17.1.

The identified receivers as outlined in Table 17-19 and Table 17-20 are shown in Figure 17.3.

Table 17-19 Affected Receivers per Noise Catchment Areas – Up Side

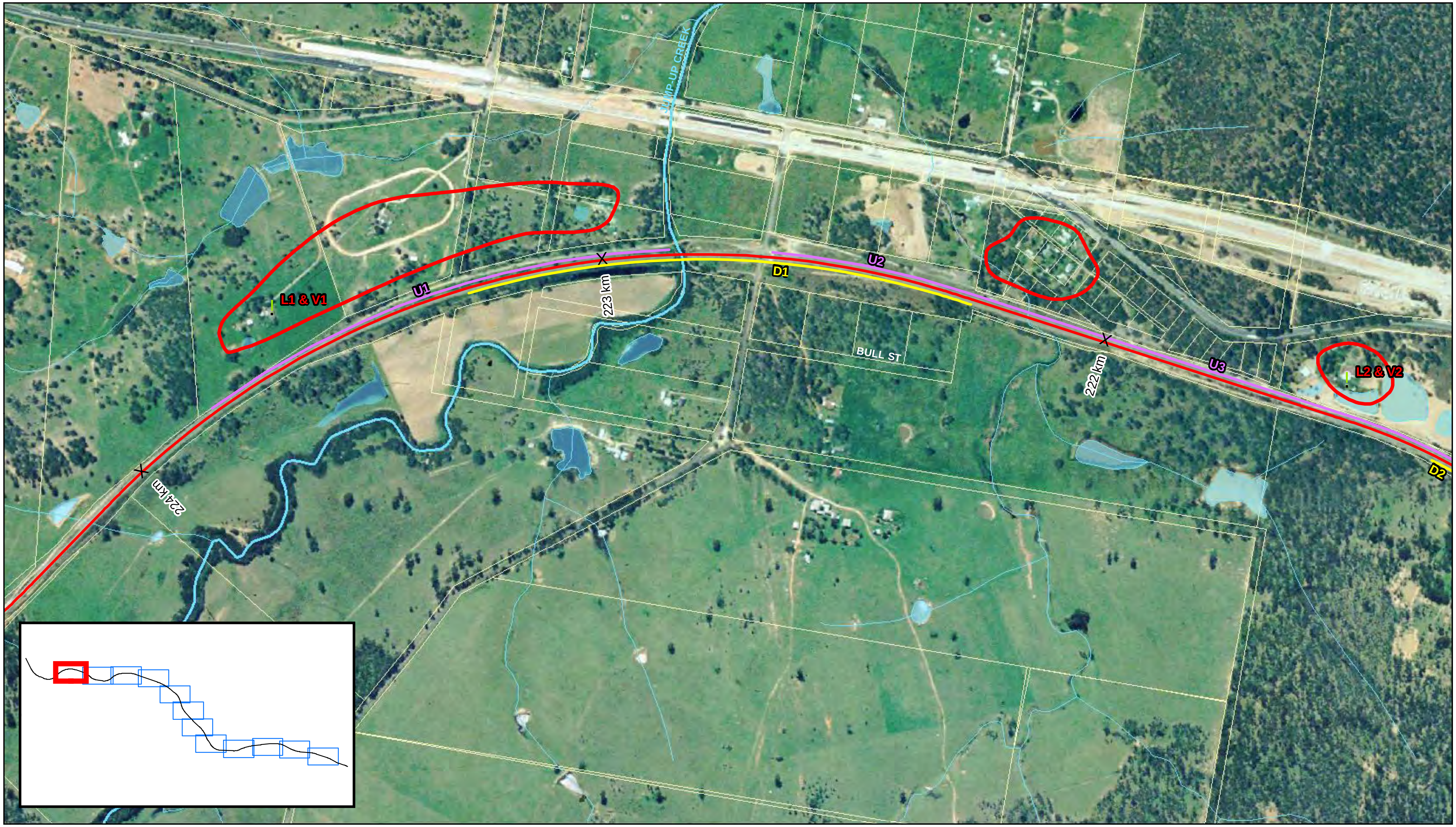
Chainage	Noise Catchment Area ID	Affected Receivers	IGANRIP Trigger (Y or N)	IGANRIP Exceedance (2022)	Predicted Initial Year of Trigger
222.900 – 223.850	U1	All three residences in U1 (MMU-003.5, MMU-004, MMU-005).	Y	5 dB(A)	2012
222.300 – 222.700	U2	All land located between the 60dB(A) contour and rail corridor if proposed for residential development.	Dependant on the proposed site development and layout.		
220.350 – 222.300	U3	Six residences in U3 (MMU-012, Lot 1 and 2 Sec 7 / DP 758078, Lot 8 to Lot 10 Sec 7 / DP 758078).	Y	3 to 6 dB(A)	2012
214.100 – 215.350	U4	IGANRIP compliance predicted	N	-	-
210.000 – 210.950	U5	Nelson Street (MMU-039, MMU-040) and John Street (MMU-046) residences, Greta.	Y	3 to 6 dB(A).	2012
205.100 – 206.500	U6	Both residences in U6 (MMU-053 and Lot 6 / DP 1112171).	Y	3 dB(A) at MMU-053. 5 dB(A) at Lot 6 / DP 112171.	2022 at MMU-053 2012 at Lot 6 / DP 112171

Chainage	Noise Catchment Area ID	Affected Receivers	IGANRIP Trigger (Y or N)	IGANRIP Exceedance (2022)	Predicted Initial Year of Trigger
202.050 – 202.500	U7	Single residence in U7 (MMU-057).	Y	3 dB(A).	2022
200.250 – 201.100	U8	All three residences in NCA U8 (MMU-060 to MMU-062). MMU-061 is the most affected residence in this NCA.	Y	Up to 10dB(A) at MMU-061. 3 to 5 dB(A) at MMU-060 and MMU-062.	2010 (existing) at MMU-061 2012 at MMU-062 2022 at MMU-060
196.400 – 197.400	U9	All land located between the 60dB(A) contour and rail corridor if proposed for residential development.	Dependant on the proposed site development and layout.		
195.600 – 196.200	U10	Residences on the southern side of Regiment Road and on Dumont Close.	Y	Up to 7dB(A)	2010 (existing) for southernmost Dumont Close residence 2012 for other Dumont Close residences (southern end) 2022 for Regiment Road residences
194.500 – 194.800	U11	All houses directly exposed to the rail lines on Railway Parade and Wentworth Street, Telarah.	Y	Up to 10dB(A).	2010 (existing)

Table 17-20 Affected Receivers per Noise Catchment Areas – Down Side

Chainage	Noise Catchment Area ID	Affected Receivers	IGANRIP Trigger (Y or N)	IGANRIP Exceedance (2022)	Predicted Initial Year of Trigger
222.300 – 223.300	D1	IGANRIP compliance predicted	N	-	-
221.000 – 221.350	D2	IGANRIP compliance predicted	N	-	-
219.250 – 219.700	D3	Pothana Winery (MMD-007)	Y	5 dB(A)	2012

Chainage	Noise Catchment Area ID	Affected Receivers	IGANRIP Trigger (Y or N)	IGANRIP Exceedance (2022)	Predicted Initial Year of Trigger
218.000 – 218.150	D4	Single residence in D4 (MMD-008)	Y	5 dB(A)	2012
215.650 – 217.200	D5	All land located between the 60dB(A) contour and rail corridor if proposed for residential development.	Dependant on the proposed site development and layout.		
214.850 – 215.100	D6	Existing residences in D6 have been acquired by the NSW RTA for demolition.	N	-	-
209.850 – 210.900	D7	Lloyd Street residences (Lot 81 DP 607773, Lot 106 DP 250308, Lots 4 and 5 DP 976366). Two residences off Mansfield Street (MMD-018.3 and Lot 104 DP 250308). MMD-017, Lot 1 DP 882276, Lot 2 DP 882276.	Y	3 to 6 dB(A).	2012
206.750 – 209.850	D8	All land located between the 60dB(A) contour and rail corridor if proposed for residential development.	Dependant on the proposed site development and layout.		
205.950 – 206.300	D9	Two residences east of Lovedale Road (MMD-024 and Lot 261 DP / 755211). One residence west of Lovedale Road (Lot 1 DP 434185).	Y	13 dB(A) at MMD-024 and Lot 261 DP / 755211. 4dB(A) at Lot 1 DP 434185.	Existing (2010) at MMD-024 and Lot 261 DP / 755211 2022 at Lot 1 DP 434185
203.050 – 205.100	D10	One residence in D10 (Lot 5 DP 845201).	Y	2 dB(A)	2022
200.800 – 202.500	D11	Clifton House (MMD-029)	Y	10 dB(A).	Existing (2010)
195.600 – 196.250	D12	Two residences at the eastern end of Wollombi Road (including MMD-041)	Y	8-9 dB(A)	Existing (2010)



1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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IGANRIP Noise Exceedance Area (2012)

Figure 17.3a

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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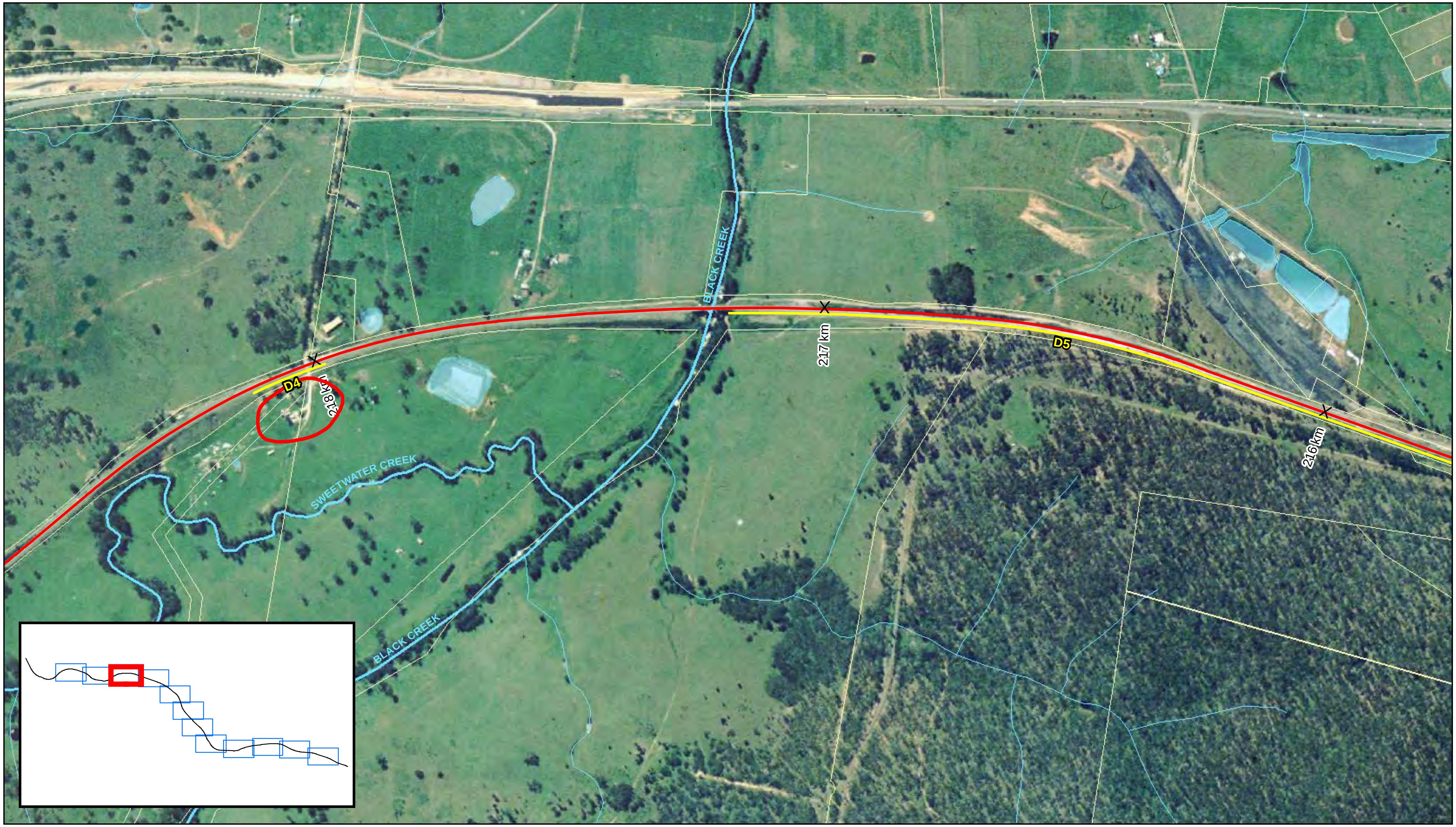
Figure 17.3b

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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IGANRIP Noise
Exceedance Area (2012)

Figure 17.3c

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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IGANRIP Noise Exceedance Area (2012)

Figure 17.3d

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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IGANRIP Noise
Exceedance Area (2012)

Figure 17.3e

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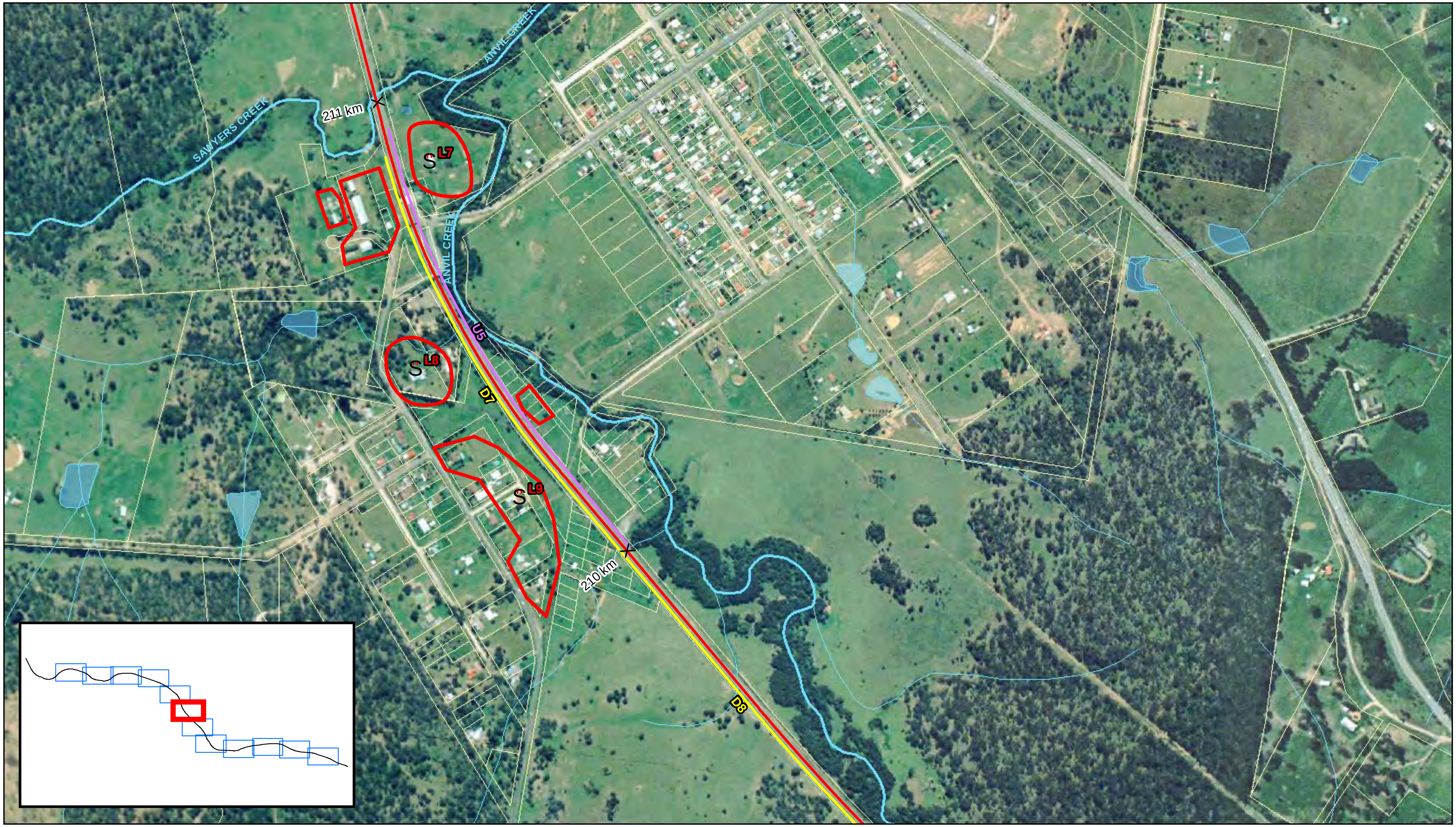
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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IGANRIP Noise Exceedance Area (2012)

Figure 17.3f

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
- Modelled IGANRIP Exceedance Area

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IGANRIP Noise
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Figure 17.3g

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
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IGANRIP Noise Exceedance Area (2012)

Figure 17.3h

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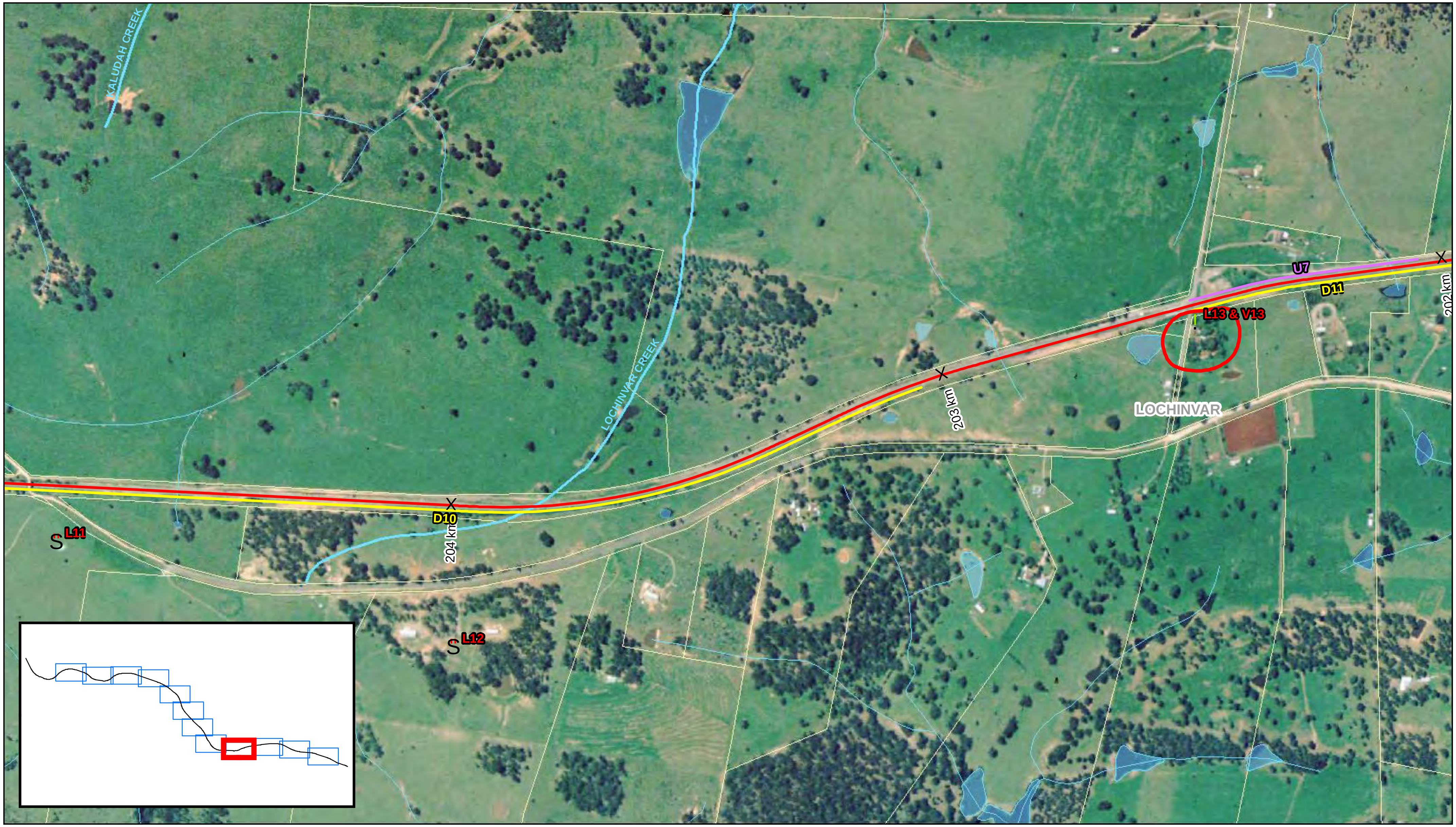
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
- Downside Noise Catchment Areas
- Upside Noise Catchment Areas
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IGANRIP Noise
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Figure 17.3i

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
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- Noise & Vibration Monitoring Locations
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IGANRIP Noise Exceedance Area (2012)

Figure 17.3j

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

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- Noise & Vibration Monitoring Locations
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- Upside Noise Catchment Areas
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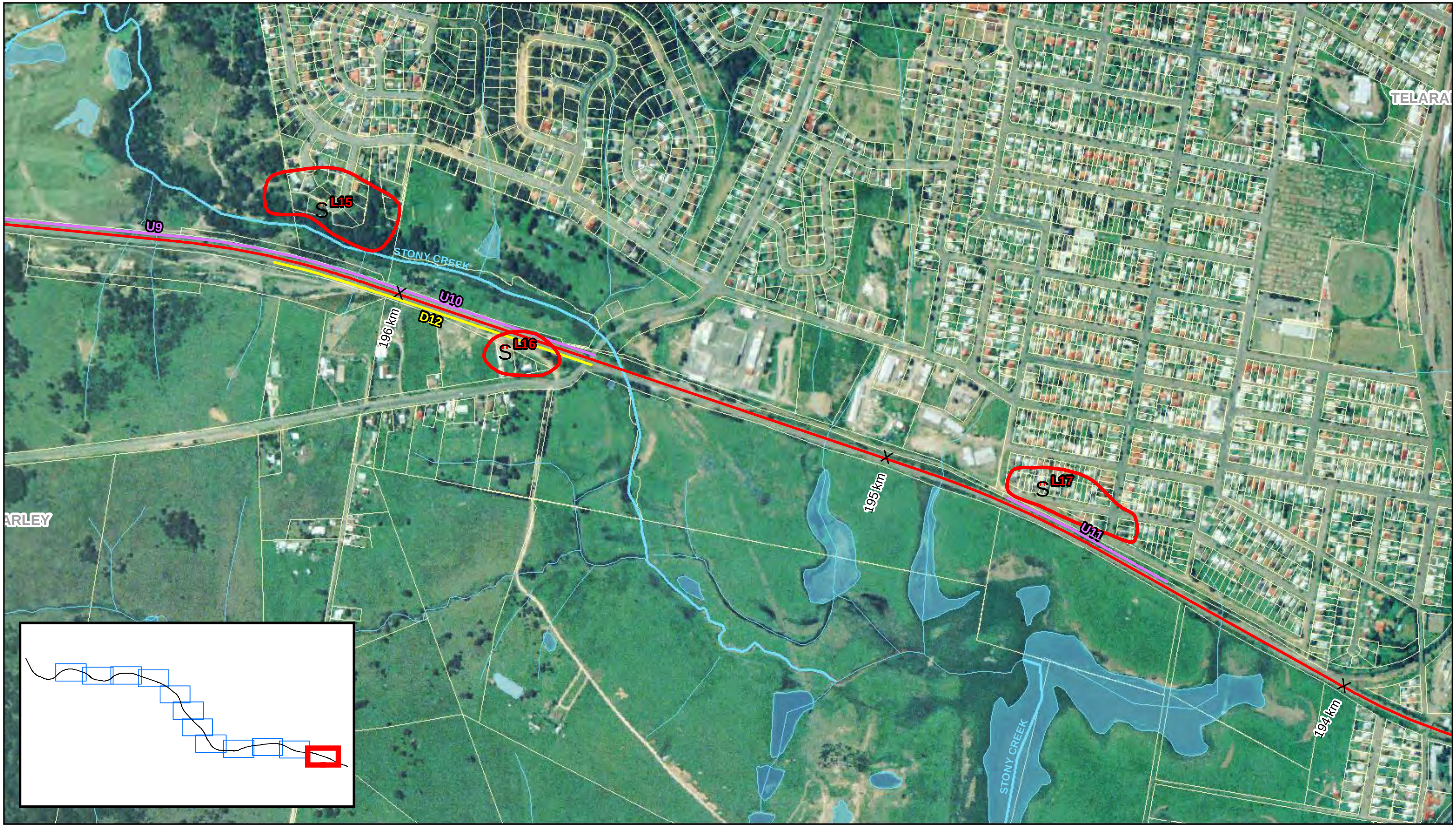
Figure 17.3k

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton



1:10,000 (at A4)

0 40 80 160 240 320

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

LEGEND

- Project Location
- Noise Monitoring Locations
- Noise & Vibration Monitoring Locations
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- Upside Noise Catchment Areas
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IGANRIP Noise
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Figure 17.3I

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Noise_Attenuation_Areas_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, tmorton

Vibration measurements were positioned so as to simulate the distance between the third track and nearest structures. These measurements were taken at a number of monitoring locations and indicate that, when applied to the location of the third track, existing train pass-by vibration levels are well below the vibration limits for structural damage.

However, it is considered that there may be a risk for human comfort goals to be exceeded for dwellings located within approximately 40 metres from the rail line once the third rail track is in operation. This involves the following:

- Two residences east of Lovedale Road (MMD-024 and Lot 261 DP / 755211) in NCA D9.
- Clifton House (MMD-029) in NCA D11.
- One residence at the end of Winders Lane, Lochinvar (MMU-061) in NCA U8.
- Two residences at the eastern end of Wollombi Road (including MMD-041) in NCA D12.
- Western-most residences on Wentworth Street and Railway Parade, Telarah in NCA U11.

17.6 Mitigation Measures

17.6.1 Construction Noise and Vibration

Construction activities would be conducted consistent with the provisions of Environment Protection Licence 3142 for construction activities, complaint management and reporting conditions.

Construction noise and vibration impacts would be managed in accordance with a Construction Noise and Vibration Management Plan (CNVMP) which would be developed for the Project. The main management measures, which would be detailed in the management plan, are outlined below.

Hours of Operation

The Hunter 8 Alliance proposes that the standard hours for construction activities associated with the Project would be:

- 7:00 am to 6:00 pm, Mondays to Friday, inclusive.
- 8:00 am to 1:00 pm on Saturdays.
- No works on Sundays or public holidays.

The current ARTC Environment Protection Licence 3142 (EPL) allows for maintenance and construction works to be undertaken outside business hours providing it is undertaken in accordance with specific conditions contained in the EPL. It is proposed that a new EPL for construction of the Project would include similar conditions.

Communications with the local community with regards to out-of-hours work should be conducted in accordance with the relevant provisions of EPL 3142, which are as follows:

- (O3.2) – Hunter 8 Alliance must notify residents of any construction activity which is to be conducted outside normal business hours and which is likely to create offensive noise for those residents.

- (O3.3) – The notification required by condition O3.2 must be provided at least five days prior to the commencement of the applicable construction activities.
- (O3.4) – Hunter 8 Alliance must provide a central telephone contact number to DECCW whereby the following details regarding any construction activities conducted outside normal business hours can be accessed:
  - Dates and times of a proposed activity.
  - Location of a proposed activity.
  - Type(s) of work to be performed in conducting the activity.
  - Plant and equipment to be used.
  - Contact name and telephone number of a person who would be on site during the carrying out of the activity and who is authorized by Hunter 8 Alliance to take action, including the cessation of the activity or any part of it, if so directed by DECCW. A contact person must be contactable 24 hours a day via the supplied telephone number(s) during the whole of the period that the activity takes place outside normal business hours.

The mitigation measures, including the preparation and implementation of Noise and Vibration Impact Statements, would be implemented to further minimise any potential impacts from construction activities outside of standard business hours.

Standard Construction Mitigation Measures

- All construction vehicles and machinery would be fitted with manufacturer supplied noise suppression devices maintained in accordance with manufacturers' guidelines, where applicable.
- Every practical and reasonable measure would be implemented to minimise the noise and vibration impacts of construction activities on local sensitive receivers.
- Noise and Vibration Impact Statements would be prepared for discrete areas that identify the works that would be undertaken in the vicinity of sensitive receivers and the specific strategies that would be implemented at these locations to minimise the impacts on these sensitive receivers. This would be submitted to the DoP and DECCW prior to the commencement of construction within that specific area.
- A Pile Vibration Control Plan for driven piles and Blasting Vibration Control Plan would be included in the Noise, Vibration and Blasting Impact Statements, as appropriate.
- Contact would be established with the local residents and the construction program and progress communicated on a regular basis, particularly when noisy or vibration-generating activities are planned. Affected receivers would be notified of the intended work, its duration and times of occurrence. This may include:
  - Website featuring updates on construction activities and consultation events.
  - Community update newsletters.
  - Community update newspaper advertisements.
  - Local community update letters for specific construction activities.

- The Community Relations Team would provide a community liaison phone number and permanent site contact so that noise and/or vibration related complaints, if any, can be received and addressed in a timely manner.
- The contact details for the Project are outlined in **Chapter 4**.
- For any work that would take place outside of the proposed hours, such as track possessions, residents potentially affected by such activities would be notified at least five days before hand, as outlined in O3.2 and O3.3 in EPL 3142.
- All site workers (including subcontractors and temporary workforce) would be informed of the potential for noise and vibration impacts upon local residents and encouraged to take practical and reasonable measures to minimise noise during the course of their activities.
- Work methods would be reviewed with a preference for quieter and non-vibration generating methods wherever reasonable and feasible. This is particularly important for any out-of-hours and night-time activities.
- Where practical, material dumps would be located as far as possible from the nearest residences, and whenever possible, loading and unloading areas would be located as far as possible from the nearest residences.
- As far as possible, materials dropped from heights into or out of trucks would be minimised.
- All plant on site would be operated in accordance with the manufacturer's instructions.
- Where practical, fixed equipment (pumps, generators, compressors) would be located as far as possible from the nearest residences.
- Where practical, all pneumatic tools operated near a residence must be fitted with an effective silencer on their air exhaust port.
- Noise labels would be affixed to new mobile air compressors and pavement breakers. The unit with the lowest noise rating which meets the requirements of the job would be used where work is conducted in proximity of noise sensitive locations.
- All mechanical plant would be silenced by best practical means. Noise suppression devices would be maintained to the manufacturer's specifications. Internal combustion engines would be fitted with a suitable muffler in good repair.
- Where possible, no plant or equipment would be left idling when operating adjacent to residential areas.
- All construction vehicle movements to and from the site must comply with the requirements of the appropriate regulatory authority for such activities.
- Where practicable, all typically noisy construction activities that could impact on sensitive receptors would be kept within the daytime working hours.
- Building condition surveys would be undertaken at all potentially impacted dwellings prior to commencement of vibration generating works (such as pile-driving). These would be repeated at works completion.

- Any noise and vibration monitoring would be undertaken by a qualified professional and with consideration to the relevant standards and guidelines. Attended noise and vibration monitoring would be undertaken in the following circumstances:
  - If vibration-generating activities are conducted within 30 metres of a residence. If a building damage risk is identified, alternative work methods would be implemented so the vibration impacts are reduced to acceptable levels.
  - Any noise and/or vibration complaint would be addressed in accordance with the Hunter 8 Alliance complaint management system. Based on the Minimbah Bank Third Track Project systems, this would include:
- Provision of a written response to a complaint within seven days.
- Provision of an email response to an electronic complaint within two days if the complaint cannot be resolved by an initial response.
  - Monitoring would be undertaken and reported to the Alliance within five days of receiving a complaint, if that activity is continuing, so that the monitoring findings can be incorporated to the written response provided to the complainant.
  - If exceedances are detected, corrective actions would be implemented, included in the response to the complainant and recorded.

Noise and Vibration Impact Statements

Noise and Vibration Impact Statements (NVIS) would be prepared for discrete work areas in order to predict the noise impacts of specific activities at the most potentially affected receivers.

Based on the experience of Minimbah Bank Third Track Project, following is a non-exhaustive list of NVIS that would be prepared:

- Site compounds.
- Crushing Plants.
- Blasting.
- Clearing and stripping.
- Track possession work.
- Drainage.
- Cut and fill (including blasting, if applicable).
- Capping.
- Topsoil and seeding.
- Bridgeworks.

The statements would form the basis for determining the specific noise, vibration and blasting management mitigation measures that would be required to be implemented for a given activity. The statements would be prepared progressively as construction of the Project progresses.

The statements would be prepared by an acoustic consultant and address construction related works including:

- A description of each construction activity including ancillary, and their associated noise sources.
- Identification of all potentially affected noise sensitive receivers.
- Confirmation of the applicable noise, vibration and blasting objectives for each identified noise sensitive receiver.
- Assessment of potential noise and vibration impacts from the proposed construction methods.
- Where applicable, blasting noise and vibration control plan, including blasting trials.
- Examination of all reasonable and feasible mitigation measures including the use of alternative construction methods where impact exceeds the relevant objectives.
- Description and commitment to work practices, which limit noise and vibration impacts.
- Description of specific noise and vibration mitigation treatments and time restrictions including respite periods.
- Justification for any activities outside of the approved construction hours.
- Noise, vibration and blasting monitoring proposed and consideration of additional reasonable and feasible mitigation measures prior to construction commencement.
- Description of key personnel and responsibilities for the implementation of the Statement measures and procedures.
- Procedures for notifying residents of construction activities that are likely to affect their noise and vibration amenity.

Mitigating Exceedances of Construction Noise and Vibration Objectives

The controls outlined in the sections above are expected to significantly reduce construction impacts. However, in the case NVIS findings indicate noise and vibration objectives are anticipated to be exceeded, additional mitigation measures would be implemented as described below.

The approach to mitigating exceedances of construction targets is substantially extracted from Transport Infrastructure Development Corporation's *Construction Noise Strategy 2007* with variations specific to this Project.

Where it is found that standard and NVIS specific mitigation measures are not sufficient to reduce noise and vibration impacts to acceptable levels, additional mitigation measures would be implemented. These are described in Table 17-21 and the contexts in which they should be implemented are described in Table 17-22 and Table 17-23.

Table 17-21 Additional Mitigation Measures

Mitigation Measure	Description
Alternative Accommodation (AA)	Alternative accommodation options should be considered for residents living in close proximity to construction works that are likely to incur noise levels significantly above the applicable level.
Monitoring (M)	The monitoring methodology is described in Appendix K.
Individual briefings (IB)	Individual briefings are used to inform stakeholders about the impacts of high noise activities and mitigation measures that would be implemented. Communications representatives from the Hunter 8 Alliance would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. Individual briefings provide affected stakeholders with personalised contact and tailored advice, with the opportunity to comment on the Project.
Phone calls (PC)	Phone calls detailing relevant information would be made to identified/affected stakeholders within seven days of proposed work. Phone calls provide affected stakeholders with personalised contact and tailored advice, with the opportunity to provide comments on the proposed work and specific needs.
Specific Notifications (SN)	Specific notifications are letterbox dropped or hand distributed to identified stakeholders no later than seven days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications.

The implementation of the above measures is determined by use of the Additional Mitigation Measures Matrices (AMMM) shown in Table 17-22 and Table 17-23.

Table 17-22 AMMM – Airborne Construction Noise

<table>
<tr><th colspan="2" rowspan="3">Time Period</th><th colspan="4">Mitigation Measures</th></tr>
<tr><th colspan="4">$L_{Aeq(15\ min)}$ Noise Level above Background (RBL)</th></tr>
<tr><th>0 to 10dB(A)</th><th>10 to 20dB(A)</th><th>20 to 30dB(A)</th><th>>30dB(A)</th></tr>
<tr><td rowspan="3">Standard</td><td>Mon –Fri (7am – 6pm)</td><td rowspan="3">-</td><td rowspan="3">-</td><td rowspan="3">M</td><td rowspan="3">M</td></tr>
<tr><td>Sat (8am – 1pm)</td></tr>
<tr><td>Sun/Pub Hol (Nil)</td></tr>
</table>

Time Period		Mitigation Measures			
		$L_{Aeq(15 min)}$ Noise Level above Background (RBL)			
		0 to 10dB(A)	10 to 20dB(A)	20 to 30dB(A)	>30dB(A)
OOHW[1]	Mon –Fri (6pm – 10pm) Sat (1pm – 10pm) Sun/Pub Hol (8am – 6pm)	-	-	M	M, IB, PC, SN
OOHW[1]	Mon –Fri (10pm – 7am) Sat (10pm – 8am) Sun/Pub Hol (6pm – 7am)	-	M	M, IB, PC, SN	AA, M, IB, PC, SN

Note: [1] OOHW: Out-of-hours Work

Table 17-23 AMMM – Ground Borne Construction Vibration

Time Period		Mitigation Measures
		Predicted Vibration Levels Exceed Maximum Levels
Standard	Mon –Fri (7am – 6pm) Sat (8am – 1pm) Sun/Pub Hol (Nil)	M
OOHW[1]	Mon –Fri (6pm – 10pm) Sat (1pm – 10pm) Sun/Pub Hol (8am – 6pm)	M, IB, PC, SN
OOHW[1]	Mon –Fri (10pm – 7am) Sat (10pm – 8am) Sun/Pub Hol (6pm – 7am)	AA, M, IB, PC, SN

Note: [1] OOHW: Out-of-hours Work

Letters in table relate to mitigation measures in Table 17-21.

17.6.2 Operational Noise and Vibration Mitigation

Rail Operations

In broad terms, there are three main strategies to reducing noise and vibration impacts from rail operations:

- Controlling noise and vibration at the source.
- Controlling noise and vibration on the source to receiver transmission path.
- Controlling noise and vibration at the receiver.

The IGANRIP recommends that the principles of 'best management practice' (BMP) and 'best available technology economically achievable (BATEA) be followed in implementing noise and vibration mitigation. BPM and BATEA are further described in the Noise and Vibration Impact Assessment (Appendix K).

As noted in Section 1.3.1, the ARTC Environment Protection Licence has an objective for the ARTC to progressively reduce noise levels to the goals of 65 dB(A)Leq, (day time from 7am – 10pm), 60 dB(A)Leq, (night time from 10pm – 7am) and 85dB(A) (24 hr) max pass-by noise, at one metre from the façade of affected residential properties,. These levels are consistent with the IGANRIP trigger levels. The ARTC is currently investigating its network and identifying areas where works may be required to meet this objective.

An Operation Noise Management Plan for the Project is currently under development. The Plan would include the following procedures:

- A noise barrier to be constructed between chainages 194.340 and 194.880 kilometres to attenuate the urban residences at Telarah prior to the operation of the third track through this section. The noise wall would be approximately 4.5 metres in height, which would provide an estimated 10 dB(A) in noise attenuation.
- A noise monitoring program for those rural residential locations predicted to trigger IGANRIP trigger levels in 2012. In the event that monitoring confirms that IGANRIP would be triggered at these rural residential locations in 2012, the following attenuation options are available and applicable:
  - Noise barriers.
  - Architectural treatment.

  These attenuation methods are described below.
- Assessment and selection of reasonable and feasible noise attenuation measures at locations where noise monitoring confirms exceedence of the IGANRIP trigger levels. This assessment and selection process would depend on a number of issues, including:
  - Level of noise reduction required.
  - Outcomes of consultation with affected land holders and residents.
  - Ongoing Project detailed design.
  - Cost of construction and ongoing maintenance.

  - The potential environmental, visual and social impacts of the proposed attenuation measure.
  - Consultation with other stakeholders, including DECCW, train operators and ARTC Maintenance and Operations.
- A noise monitoring program to confirm the level of noise reduction provided by the attenuation measures.
- A similar noise monitoring program and assessment and selection of reasonable and feasible noise attenuation measures would be implemented for those locations predicted to trigger IGANRIP trigger levels in 2022.

The following are options that have been included in the project design or would be considered in the Operation Noise Management Plan for the Project.

Controlling Noise and Vibration at Source

A number of measures have been included in the track design and operation that result in noise reductions. It should be noted that these measures have not been incorporated into the noise modelling discussed in Section 1.5.3 and therefore the actual noise levels are likely to be lower than those presented in Table 17-19 and Table 17-20.

Glued Insulated Joints

Glued insulated joints are joints in the rails required for the signalling system for the Project. The joint includes a gap between two rails that is filled with an elastic material that provides electrical isolation of one rail to the next. Signalling cables are connected to each rail and connected through a signal box/location hut adjacent to the track. The break in the rail creates noise as the train passes.

The signalling for the Project would use primarily Audio Frequency Track Circuits in lieu of glued insulated joints. The Audio Frequency Track Circuits do not include any break in the rail but rely on an electronic box located adjacent to the track that detects train movement using radio and electronic technology. Therefore the noise generated by the Project would be less than included in the data collected for the existing operations.

Turnouts

Trains passing across turnouts create more noise than straight track as the turnout includes sharper radius rails (wheel squeal) and breaks in the rails. The Project includes removing one new turnout at the Minimbah end, installing one new turnout at the Farley and replacing two old turnouts at Branxton. The new turnouts include improved geometric design (less wheel squeal) and therefore reduce the noise generated compared to old technology turnouts.

Track Alignment

The vast majority of the third track forms the Up Relief track, which would be utilised by fully laden coal trains. The Up relief track has been designed to optimise coal train operation including radii and cant (superelevation or slope from one rail to the other). Therefore, less noise would be generated by coal trains on the Up Relief Main compared to coal trains operating on the existing Up Main or Down Main.

Removal of Level Crossings

As discussed in Section 7, the Project would replace two existing level crossings (Hermitage Road at Belford and Station Lane at Lochinvar) with overpasses. The level crossing at Rix's Road would be removed. The closure of these would remove a number of noise sources, including the gate warning bells, the warning horn from the locomotive as it approaches the crossing (standard locomotive operation procedure), and the sound of the train passing through the level crossing. It also reduces motor vehicle noise as vehicles no longer stop, idle and accelerate at the gates.

Controlling Noise and Vibration to Receiver Transmission Path

Noise Barriers

Noise barriers are typically constructed on the edge of the rail corridor in order to shield sensitive receivers from rail vehicles. Depending on the situations, in particular local topography and barrier height, noise barriers can achieve 10 to 15dB(A) attenuation.

Noise barriers often incur significant costs and visual impacts. They would generally be considered to reduce noise in built-up areas where they can achieve significant noise attenuation at a number of receivers at once.

Controlling Noise and Vibration at Receiver

Architectural Treatment

Architectural treatment essentially consists of soundproofing residences in order to meet internal noise levels. The DoP *Development Near Rail Corridors and Busy Roads Interim Guideline* recommends the internal noise levels shown in Table 17-24.

Table 17-24 Internal Noise Goals – Residential Buildings

Type of Occupancy	Noise Level dB(A) L_{eq}	Applicable Time Period
Sleeping areas (bedroom)	35	Night 10 pm to 7 am
Other habitable rooms (excluding garages, kitchens, bathrooms and hallways)	40	At any time

Practically, this would generally involve retrofitting of thicker glazing, roof insulation, door and windows acoustic seals and the like, along with air conditioning to allow windows to remain closed. This could also include boundary fences if it is found they could reduce impacting rail noise levels.

Table 17-25 identifies the potential architectural treatment options, the estimated level of noise attenuation and comments on the potential restrictions to its effectiveness.

Table 17-25 Potential Architectural Treatment Options

Architectural Treatment Option	Estimated Noise Attenuation	Comments
Building Insulation/ Air Conditioning	10 to 15 dB(A) compared to without insulation and with windows open.	Dependant on materials used on building construction.
Property boundary fence (typical 1.8 metre solid fence)	Up to 5dB(A) at ground level. Less than 2dB(A) for upper levels.	Effectiveness is reduced where adjacent track is on an embankment/ higher than the property.

Noise attenuation would depend on the condition and design of the residences considered for treatment but can be a substantial cost. Architectural treatment may also include fitting of mechanical/forced ventilation so that windows can be kept closed if the occupant so desires.

In the context of the Project, architectural treatments could be considered for isolated and scattered residences where other options are not effective enough. This is anticipated to be a primary noise control solution on the Project given the distribution of the affected receivers along the Project route.

Rail Vibration Control

There is a limited array of rail vibration control options available for the Project. While rail dampers would reduce vibration transmission to some extent, common solutions consist of resilient rail fastenings, rail pads and ballast mats. Vibration control would essentially aim at limiting future vibration levels to the existing levels.

Vibration control would be considered where dwellings are located within approximately 40 metres from the nearest rail track, which involves the following receivers:

- Two residences east of Lovedale Road (MMD-021 and Lot 261 DP / 755211) in NCA D9.
- Clifton House (MMD-029) in NCA D11.
- One residence at the end of Winders Lane, Lochinvar (MMU-061) in NCA U8.
- Two residences at eastern end of Wollombi Road (including MMD-041) in NCA D12.
- Westernmost residences on Wentworth Street and Railway Parade, Telarah in NCA U11.

The following would be undertaken upon design finalisation:

- Review the noise model to accommodate design changes.
- Confirm noise and vibration attenuation requirements.
- Evaluate mitigation options against cost, practicality and reasonableness.
- Establish final noise and vibration control strategy for implementation.

Maintenance Activities

Maintenance activities would be undertaken in accordance with the ARTC's EPL as outlined in Section 17.3 including notification of sensitive receivers for maintenance works during track possessions.

Laden coal trains are to use the majority of the proposed third track, which has been designed to have capacity for such trains. As such maintenance requirements for the third track would reduce. As the number of laden coal trains utilising the existing tracks would significantly reduce, the maintenance requirements for these tracks would also reduce. This would therefore reduce the need for track possession activities, including night time activities.

18. Surface Water

18.1 Assessment Approach

18.1.1 Introduction

This chapter provides a summary of the Surface Water Assessment undertaken by the Hunter 8 Alliance. The Surface Water Assessment is provided in Appendix L.

This chapter identifies the potential hydrology, hydraulic and water quality impacts of the Project and the management measures proposed to reduce these impacts.

The Director-General's Environmental Assessment Requirements identify hydrology as a key issue for the Environmental Assessment. Table 18-1 outlines the Director-General's Environmental Assessment Requirements relating to hydrology and where they have been addressed.

Table 18-1 Director-General's Environmental Assessment Requirements – Hydrology

Director-General's Environmental Assessment Requirements	Where Addressed
Hydrology	
Project effects on flood characteristics (on surrounding land, property and infrastructure) and effects of flooding on the project with specific reference to the Hunter River Floodplain. A range of flood events (including the PMF) shall be assessed in all flood prone areas within and adjoining the corridor.	Section 18.3 No impact assessment of the Hunter River Floodplain is included as the Project does not encroach into the floodplain.
General Construction Impacts	
Assess and present a management framework for earthworks, including a considered approach to minimising impacts associated with the excavation, movement, stockpiling, rehabilitation and disposal of spoil and fill. Consideration should be given to:	Section 18.4.1
Erosion and sedimentation control measures at excavation, storage and placement locations to protect adjoining watercourses, including during flood events and from the blockage or alteration of flow paths.	Section 18.4.1
A strategy for managing earthworks with a particular focus on those works that have the greatest potential to disturb soils that are contaminated, have a high erosion and run off hazards and adverse impacts on watercourses, and a broader, more generic approach for ongoing construction management.	Section 18.4.1

18.1.2 Methodology

Waterway Crossings and Catchment Identification

Waterway crossings and catchments which could potentially be impacted by the Project were identified based on Department of Land's topographic information in accordance with the *Water Management Act* 2000.

Waterway crossings were numbered from W1 to W59 (east to west) along the Project route. The waterway crossings were then classified based on:

- The catchment area draining to the crossing location.
- The Strahler stream order at the crossing location.
- The channel and valley form (referred to as channel definition).

The parameters for waterway classification are summarised in Table 18-2.

Table 18-2 Waterway Crossing Classification Descriptions

Waterway Classification	Catchment Area (ha)	Stream Order*	Valley/Channel Definition
Drainage Line	< 20	Unmapped to first order	No defined channel and valley floor fill < 10 metres wide
Minor Waterway	20 to 100	First to second order	Defined channel and/or valley floor fill > 10 metres wide.
Major Waterway	> 100	Second order and higher	Defined channel and/or valley floor fill > 10 metres wide.

* Based on Department of Lands 1:25,000 drainage layer.

Waterway Geomorphic Condition Assessment

An assessment was undertaken to identify the waterway crossings and general existing conditions. Inspections of major waterway crossings were undertaken in October 2009 which forms the basis of an existing waterway geomorphic condition assessment.

Waterway condition observations do not reflect changes in response to seasonal variation. The site inspections sought to document the general environmental condition at each waterway crossing location. Wider surveys of the catchment and downstream receiving waters were not undertaken. However, where information was available, references to broader environmental values in a catchment context have been included.

Water Quality

A review of publicly available water quality information was undertaken to establish the existing water quality conditions for the catchments potentially impacted by the Project, and therefore the water quality at the water crossings.

Hydrologic Assessment

A hydrologic assessment of each waterway crossing was undertaken to determine existing flood condition flood hydrographs. The hydrologic assessments included both Probabilistic Rational Method (PRM) calculations and the compilation of XP-RAFTS models. The model simulated 100 year Annual Risk Interval (ARI) events for all waterway crossings, while Probable Maximum Flood was also modelled for major waterway crossings.

Probabilistic Rational Method

The PRM is recommended in *Australian Rainfall and Runoff* (Institute of Engineers Australia 1998) as a method for peak flow estimation for small to medium sized catchments. It is a good method for deciding peak flow rates in ungauged catchments.

A preliminary estimation of the peak flow rate for each waterway crossing was undertaken using the PRM. This calculation was used for comparative purposes against the peak flow rates determined through the XP-RAFTS modelling.

XP-RAFTS Modelling

XP-RAFTS is a rainfall-runoff model designed that uses non-linear runoff routing to develop hydrographs from either actual or design storm events.

XP-RAFTS models (Version 7.0) were established for the catchments associated with the Project. For the major waterways of Stony Creek, Anvil Creek and Jump Up Creek, the total contributing catchment was further divided into sub-catchments. With respect to Black Creek, no XP-RAFTS model was developed as an existing model was available.

The remaining major waterways, minor waterways and drainage lines were also modelled as single catchment areas within XP-RAFTS.

Finally, potential hydrologic change was calculated for the four major catchments that intersect the Project to determine whether the Project is likely to alter flow regimes.

Hydraulic Assessment

A hydraulic assessment of Stony Creek, Anvil Creek, Black Creek and Jump Up Creek was undertaken using HEC-RAS (Version 4). HEC-RAS is a 1-dimensional depth averaged model developed by the US Army Corp of Engineers.

Stony Creek, Anvil Creek, Black Creek and Jump Up Creek each contribute to the Hunter River, a regionally significant waterway system. The distance to the Hunter River varies considerably for each waterway. A review of the distance to the Hunter River system was undertaken to determine if it acts as a downstream boundary condition for these waterways. A normal depth boundary condition was adopted for waterways where the effects of the downstream control levels did not extend to the site boundary. Further details on the values and levels adopted are provided in Appendix L of this Environmental Assessment.

The HEC-RAS models were established using the existing topographic survey data, downstream controls and peak flow rates from the XP-RAFTS modelling. This was used to determine the existing peak flood levels.

The estimated probable maximum flood (PMF) was simulated to determine whether the existing rail embankment would be overtopped in a PMF event.

18.2 Existing Environment

18.2.1 Waterway Catchments

The Project passes through seven waterway catchments. These major waterways and their catchments are listed in Table 18-3.

Table 18-3 Major Waterway Catchments

Waterway	Approximate Catchment Area (hectares)
Stony Creek	1520
Anvil Creek	4600
Black Creek	38,000
Jump Up Creek	6000

The minor contributing catchments are Lochinvar Creek, Bishops Creek and an un-named tributary of Swamp Creek.

18.2.2 Waterway Crossings

59 waterways intersect the Project, consisting of 12 major waterways, 11 minor waterways and 36 drainage lines. Six of the waterways are named creeks, including Stony, Lochinvar, Anvil, Sawyers, Black and Jump Up Creeks. Stony, Anvil, Sawyers, Black and Jump Up Creeks are perennial waterways. All other waterways are ephemeral in nature.

A summary of the waterway crossings is provided in Table 18-4 and in Figure 18.1.

Table 18-4 Summary of Waterway Crossings

Contributing Catchment	Major Waterway Crossings	Minor Waterway Crossings	Drainage Line Crossings
Stony Creek	W3 (Stony Creek)	W2, W12, W13	W1, W4, W5, W6, W7, W8, W9, W10, W11, W14, W15, W16
Un-named Tributary of Swamp Creek			W17
Lochinvar Creek		W23 (Lochinvar Creek)	W18, W19, W20, W21, W22, W24
Bishops Creek			W25, W26

Contributing Catchment	Major Waterway Crossings	Minor Waterway Crossings	Drainage Line Crossings
Anvil Creek	W27 (Anvil Creek), W30, W31, W37 (Sawyers Creek), W41, W44	W28, W34, W35, W38, W40, W48	W29, W32, W33, W36, W39, W42, W43, W45, W46, W47
Black Creek	W49 (Black Creek), W53, W54	W52	W50, W51, W55
Jump Up Creek	W57, W58 (Jump Up Creek)		W56, W59

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Date May 2010

Waterway Crossings

Figure 18.1a

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Waterways_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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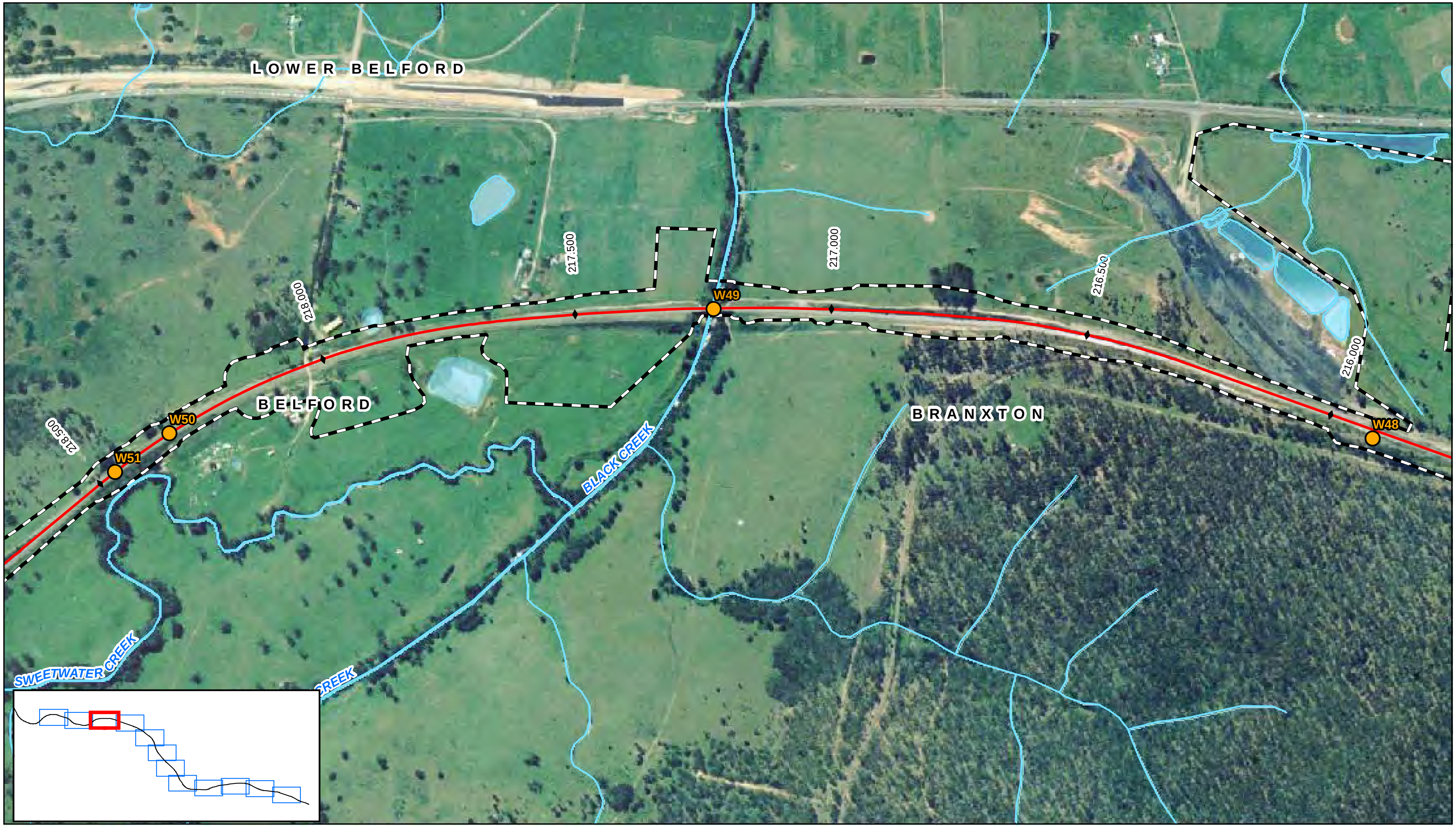
Waterway Crossings

Figure 18.1b

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Waterways_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay



1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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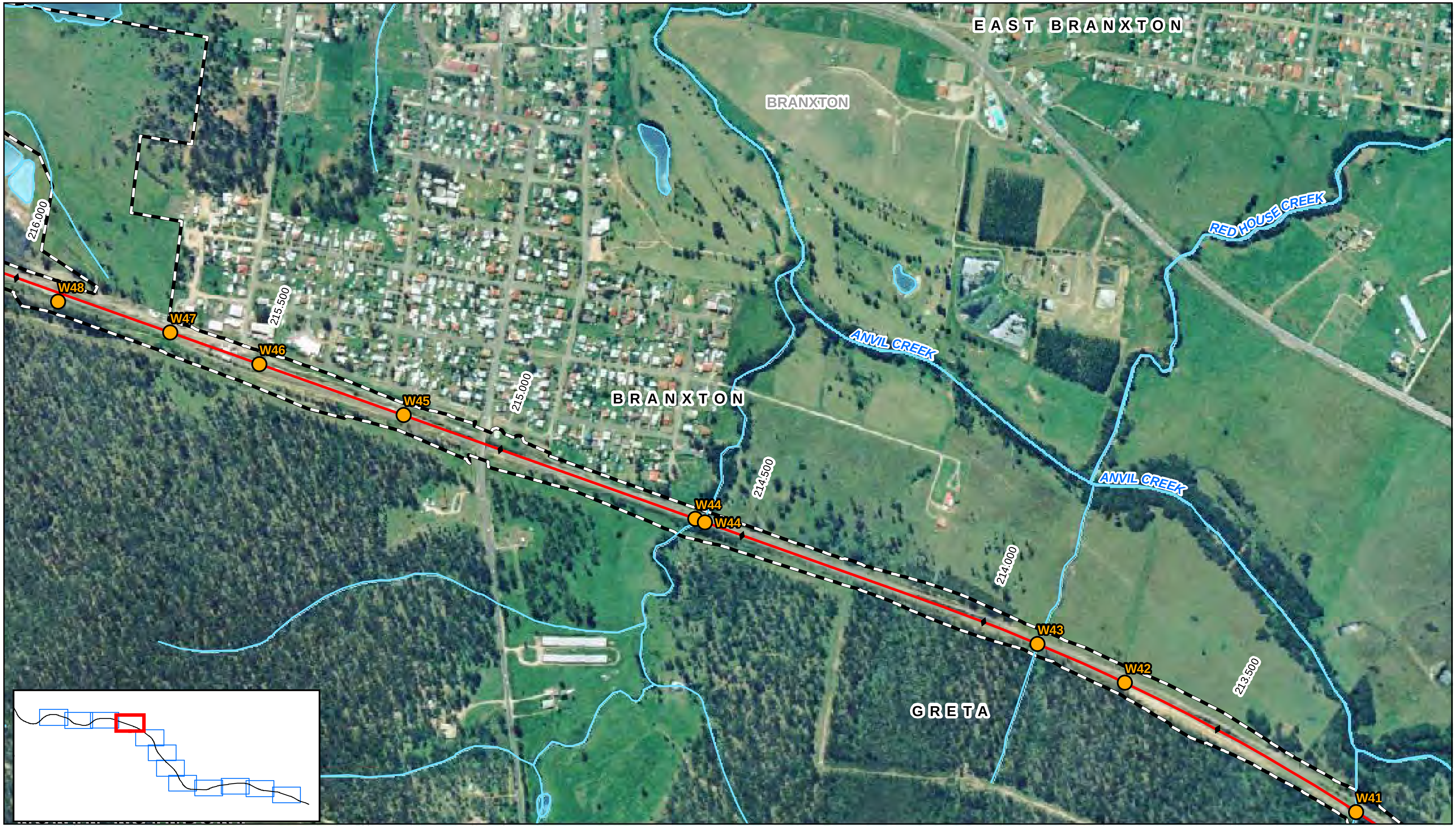
Waterway Crossings

Figure 18.1c

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Waterways_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay



1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Environmental Assessment

Waterway Crossings

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Figure 18.1d

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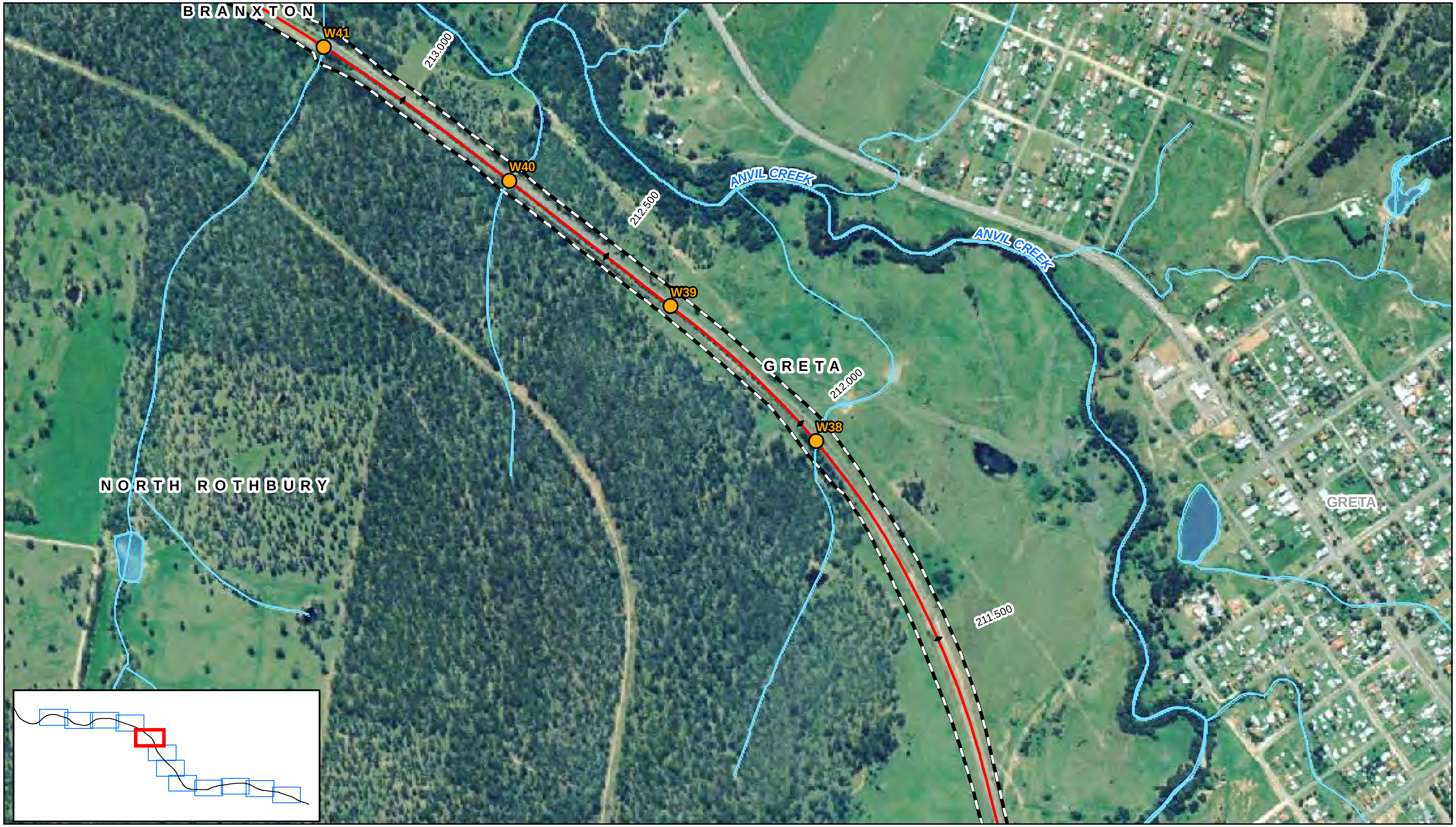
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay



1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

Hunt8r ALLIANCE

Maitland To Minimbah Third Track
Environmental Assessment

Waterway Crossings

Job Number 22-14471
Revision A
Date May 2010

Figure 18.1e

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Waterways_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Maitland To Minimbah Third Track
Environmental Assessment

Waterway Crossings

Job Number	22-14471
Revision	A
Date	May 2010

Figure 18.1f

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

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1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Maitland To Minimbah Third Track
Environmental Assessment

Job Number | 22-14471
Revision | A
Date | May 2010

Waterway Crossings

Figure 18.1g

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Waterway Crossings

Figure 18.1h

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Maitland To Minimbah Third Track
Environmental Assessment

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Waterway Crossings

Figure 18.1i

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay

1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Environmental Assessment

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Date May 2010

Waterway Crossings

Figure 18.1j

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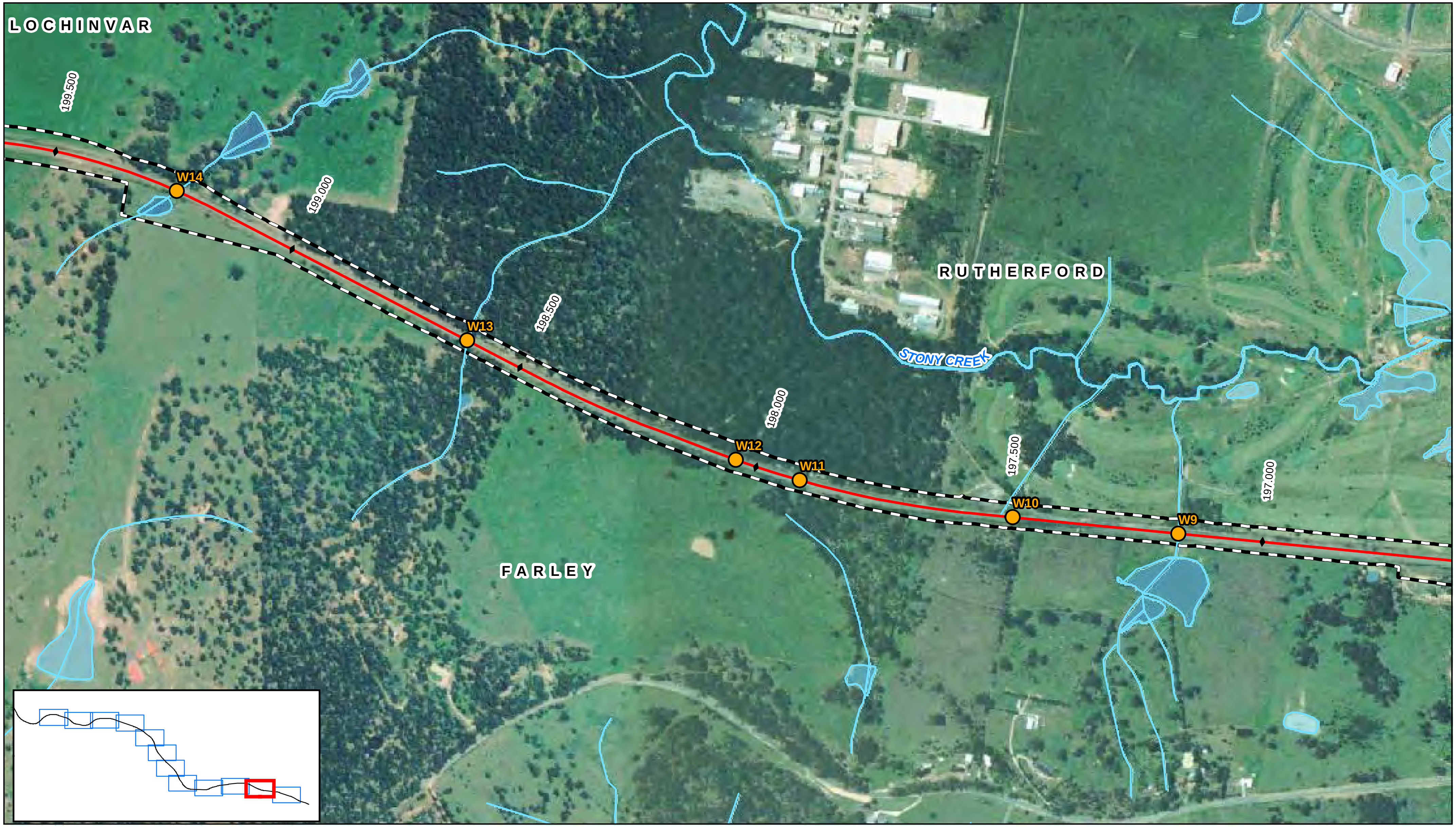
Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay



1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Maitland To Minimbah Third Track
Environmental Assessment

Waterway Crossings

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Figure 18.1k

T:\Hunter8 GIS\Gis\Maps\Deliverables\EA\EA_Waterways_20100524_A.mxd

Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 **T** 61 2 4979 9999 **F** 61 2 4979 9988 **E** ntlmail@ghd.com.au **W** www.ghd.com.au

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1:10,000 (at A4)

0 50 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Australian Geodetic Datum 1966
Grid: Integrated Survey Grid, Zone 56-1

N

Legend

- Existing Waterway Crossings
- Watercourse
- Watercourse Area
- Project Location
- Project Area

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Environmental Assessment

Waterway Crossings

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Figure 18.1l

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Level 3, GHD Tower, 24 Honeysuckle Drive, Newcastle NSW 2300 T 61 2 4979 9999 F 61 2 4979 9988 E ntlmail@ghd.com.au W www.ghd.com.au

Data Source: DPT of Lands: DCDB - 2007, Aerial Photography - 2006. Created by: msmiljkovski, gmcdiarmid, fmackay

For each waterway crossing (except W29) there is an associated structure to convey surface water through the existing rail corridor. There is a total of six underbridges and 53 culverts (crossing W44 comprises two culverts for the same waterway).

The location, type and size of each waterway crossing are detailed in Table 18-5.

Table 18-5 Location, Type and Size of Drainage Structures

Waterway	Approximate Chainage (kilometres)	Structure Type	Diameter or Size (millimetres)
W1	194.912	Brick arch culvert	900
W2	195.133	Brick arch culvert	1200
W3 - Stony Creek	195.555	Underbridge	
W4	196.069	Brick arch culvert	1520
W5	196.280	Brick arch culvert	1520
W6	196.34	Brick arch culvert	1520
W7	196.481	Brick arch culvert	1520
W8	196.561	Brick arch culvert	1520
W9	197.165	Brick arch culvert	1050
W10	197.487	Reinforced concrete pipe culvert	1220
W11	197.909	Helcor ribbed steel arch culvert	1200
W12	198.04	Sandstone brick arch culvert	1520
W13	198.516	Brick arch culvert	1800
W14	199.242	Brick arch culvert	1520
W15	199.85	Helcor ribbed steel arch culvert	900
W16	200.122	Helcor ribbed steel arch culvert	1520
W17	201.48	Brick arch culvert	900
W18	202.103	Brick arch culvert	900
W19	202.55	Reinforced concrete pipe culvert	900
W20	202.858	Brick arch culvert	900
W21	203.044	Reinforced concrete pipe culvert	850

Waterway	Approximate Chainage (kilometres)	Structure Type	Diameter or Size (millimetres)
W22	203.597	Reinforced concrete pipe culvert	900
W23 - Lochinvar Creek	203.844	Brick arch culvert	1520
W24	204.528	Reinforced concrete pipe culvert	900
W25	205.091	Brick arch culvert	1200
W26	205.342	Helcor ribbed steel arch culvert	610
W27 - Anvil Creek	206.090	Reinforced concrete box culvert	2400 x 1200
W28	206.519	Brick arch culvert	2400
W29	206.745	No structure	
W30	207.776	Twin brick arch culverts	2 x 2920
W31	209.174	Underbridge	4580 x 3550
W32	209.637	Brick arch culvert	1520
W33	209.889	Reinforced concrete pipe culvert	900
W34	209.989	Underbridge	
W35	210.522	Brick arch culvert	2440
W36	210.703	Brick arch culvert	900
W37 - Sawyers Creek	211.010	Underbridge	
W38	211.941	Brick arch culvert	1520
W39	212.333	Brick arch culvert	910
W40	212.735	Brick arch culvert	910
W41	213.158	Sandstone brick arch culvert	2500
W42	213.691	Sandstone box culvert	750 x 600
W43	213.892	Brick arch culvert	900
W44	214.566	Brick arch culvert	2440
W44	214.586	Brick arch culvert	1520
W45	215.189	Reinforced concrete box culvert	760 x 460
W46	215.487	Reinforced concrete	300

Waterway	Approximate Chainage (kilometres)	Structure Type	Diameter or Size (millimetres)
		pipe culvert	
W47	215.671	Reinforced concrete pipe culvert	450
W48	215.853	Brick arch culvert	1200
W49 - Black Creek	217.175	Underbridge	
W50	218.318	Brick arch culvert	910
W51	218.448	Brick arch culvert	1520
W52	219.071	Reinforced concrete pipe culvert	1200
W53	219.615	Brick arch culvert	2440
W54	220.439	Brick arch culvert and PE extension	1200
W55	220.942	Twin reinforced concrete pipe culverts	2 x 450
W56	221.486	Reinforced concrete pipe culvert	900
W57	222.19	Sandstone brick arch culvert	2400
W58 - Jump Up Creek	222.848	Underbridge	
W59	224.141	Ellipse brick arch	1520

18.2.3 Waterway Geomorphic Condition Assessment

The waterway crossings are predominantly set within a rural or semi-rural land use context and have been modified over time by land clearance, the existing Main Northern Railway and other agricultural practices. The majority of the waterways are ephemeral in nature and no flows were observed at the time of the site inspections. Additionally, the existing railway has influenced stream type, with many waterways exhibiting differing geomorphology upstream and downstream of the railway.

The waterway types observed during the site inspections included:

- Undefined systems - relatively undefined flow paths such that flows are largely derived from hillslope sheet flow rather than concentrated within a defined channel or valley.
- Valley fill systems - characterised by a relatively flat, unincised valley floor surface with substrates comprised of alluvial fine silts and muds.
- Incised valley fill systems - similar to valley fill systems but with a more defined watercourse and channel bank. It is likely that these were once valley fill systems but have been modified to convey flows from urbanised or industrialised catchments, or to drain land for agricultural use.

- Chain of ponds systems - a series of symmetrical ponds that occur at irregular intervals along the waterway. These are regarded to be relatively a rare and fragile waterway type.
- Partly confined low sinuosity systems - a single, trench-like and symmetrical channel with low sinuosity and moderate stability. Sinuosity refers to the degree a channel curves (or meanders). Cohesive fine-grained sediments dominate the bed and alluvial banks.
- Low sinuosity systems – a low sinuosity channel with wide, continuous floodplains and relatively stable cohesive banks of fine-grained material. The bed consists of fine-grained sediments with some sand and gravel sections creating moderate hydraulic diversity within the channel. The channel itself is of low gradient and usually low energy allowing a build up of fine-grained sediment.

Details of the 12 major waterway crossings are provided in Table 18-6.

Table 18-6 Major Waterway Geomorphic Conditions

Waterway crossing	Catchment area at crossing (hectares)	Comments	Photograph of Waterway Crossing
W3 - Stony Creek	1520	At the crossing and further upstream, Stony Creek exhibits a valley fill geomorphology that is well vegetated with macrophytes and typha. A large scour hole up to two metres deep and approximately 50 metres long has developed at the crossing. The banks of the scour hole are vertical and it appears that the hole is undergoing continued enlargement through headward retreat of its upstream extents. Downstream, the channel exhibits a low sinuosity, fine-grained geomorphology, with a narrow (three metre wide) channel inset within a broad floodplain. The channel is stable and vegetated with juncus. The floodplain is flat, featureless and dominated by pasture grasses.	
W27 - Anvil Creek	163	Upstream of the railway, the waterway is a valley fill system that is disturbed by dams and the Allandale Road crossing. Downstream, the waterway has a partly confined, low sinuosity geomorphology. The channel is approximately eight metres wide and 1.5 metres deep and appears to have been excavated in the past. Channel banks consist of cohesive fine-grained sediments and are grassed and stable. Instream features consist of small pools with fringing macrophtyes.	

Waterway crossing	Catchment area at crossing (hectares)	Comments	Photograph of Waterway Crossing
W30	292	Both waterways are left bank tributaries of Anvil Creek. The waterways have a partly confined, low sinuosity geomorphology upstream and downstream of the existing railway. The channel both upstream and downstream is relatively narrow (two to three metres wide) and is approximately one metre deep.	
W31	285	Banks are near vertical and undercut in sections. Scour pools are present although no standing water was observed at the time of inspection. The waterway at crossing W31 flows into Anvil Creek approximately 15 metres downstream of the existing railway.	
W37 - Sawyers Creek	578	Sawyers Creek has a partly confined, low sinuosity geomorphology and exhibits a defined channel with permanent pools. Downstream of the existing railway, the channel is approximately five metres wide and one metre deep and is affected by a private road causeway. Banks consist of cohesive, fine grained sediments and are stable although riparian vegetation is dominated by weed species. Upstream, the channel runs east along the existing railway embankment for approximately 70 metres prior to diverting to the south. The channel abutting the embankment is trapezoidal in cross-section suggesting the creek may have been diverted for construction of the existing railway. Blackberry and native shrubs dominate riparian vegetation. The floodplain is moderately well vegetated with native grasses and scattered eucalypts.	

Waterway crossing	Catchment area at crossing (hectares)	Comments	Photograph of Waterway Crossing
		A flood channel/backswamp complex is located on the western extent of the floodplain. This upstream section of Sawyers Creek requires realignment to accommodate the proposed third track. At the proposed diversion point a bedrock outcrop controls the channel bed and the creek exhibits an improvement in condition upstream both in geomorphic form and riparian vegetation associations.	
W41	208	The crossing is on a left bank tributary of Anvil Creek. The channel has a partly confined, low sinuosity geomorphology. The channel upstream is relatively narrow (two to three metres wide) and approximately one metre deep. Banks are near vertical and undercut in sections. Scour pools are present although no standing water was observed at the time of inspection. Downstream of the existing railway the channel enlarges, being approximately 15 metres wide and two to three metres deep. Here, the channel is crossed by the rail access track via a bridge structure with embankments protected by shotcrete. A further ten metres downstream, the channel is crossed again by a private track via a low level concrete causeway, forming a shallow pool upstream. Downstream of the causeway the channel exhibits a bedrock base and limited diversity in instream features. The grassed, graded banks are stable and floodplains are well-vegetated.	

Waterway crossing	Catchment area at crossing (hectares)	Comments	Photograph of Waterway Crossing
W44	312	The crossing is on a left bank tributary of Anvil Creek. The channel has a partly confined, low sinuosity geomorphology and exhibits a well vegetated and stable channel. Flows within this waterway are carried through two culverts approximately 20 metres apart. Upstream of the main culvert, the channel is up to ten metres wide and displays an inset low flow channel with dimensions of approximately one metre wide and one metre deep. The downstream side was inaccessible and was not assessed during the inspection. However, aerial imagery indicates a similar geomorphology downstream.	
W49 - Black Creek	30,400	Black Creek has a low sinuosity geomorphology, exhibiting extensive continuous floodplains. The channel at the crossing location is approximately 50 metres wide and eight to ten metres deep. A long pool is present extending both upstream and downstream of the crossing. Banks are graded, stepped and consist of fine-grained sediments. Banks are stable, being well-vegetated with pasture grasses and casuarinas (river oak).	
W53	197	Both crossings are located on an unnamed left bank tributary of Sweetwater Creek (a tributary of Black Creek). Upstream of crossing W54 and between the two crossings, this tributary exhibits chain of ponds geomorphology. The ponds are typically around 20 to 30 metres long and five to	

Waterway crossing	Catchment area at crossing (hectares)	Comments	Photograph of Waterway Crossing
W54	148	ten metres wide and are relatively well vegetated with native riparian species. As a result the ponds are largely stable, although channel incision between the ponds was noted at one location upstream of W53. Downstream of W53, the waterway flows into a farm dam prior to discharging into Sweetwater Creek and the chain of ponds geomorphology is no longer present.	
W57	309	The crossing is located on a right bank tributary of Jump Up Creek. The waterway has a valley fill geomorphology. Upstream of the railway the valley fill is intact, although salt scalds (bare ground due to die off of vegetation from high salinity levels) are present. Immediately downstream of the rail, a large pond is present extending for approximately 30 metres downstream. Beyond the pond and intact valley, a gully is retreating upstream forming a continuous, one to two metre deep channel within the valley fill.	
W58 - Jump Up Creek	2970	Jump Up Creek has a low sinuosity geomorphology, exhibiting extensive continuous floodplains. The channel at the crossing is approximately 20 to 30 metres wide and four to five metres deep. The crossing site is relatively disturbed as a result of the construction of a new rail bridge over Jump Up Creek. Upstream of the railway, a construction access track consisting of loose rock is present. Further upstream the creek exhibits a long pool and is well-vegetated.	

Waterway crossing	Catchment area at crossing (hectares)	Comments	Photograph of Waterway Crossing
		Downstream, the creek banks are protected with large loose rock for a distance of approximately 15 metres. The creek is then crossed by the existing rail access track. Downstream from this point, a natural channel is present with well-vegetated banks.	

18.2.4 Water Quality

The water quality within waterways is affected by the land uses within the wider catchment. A summary of the land uses within the catchments and potential types of pollutants for waterways is provided in Table 18-7.

Table 18-7 Contributing Catchment Land Uses and Potential Pollutants

Contributing Catchment	Land Use	Potential Pollutants
Stony Creek	Rural, residential, industrial, existing rail line.	Nutrients, sediment, oils, greases, metals.
Un-named tributary of Swamp Creek	Pasture, vineyards, existing rail line.	Nutrients, sediment.
Bishops Creek	Pasture, grazing, crop, existing rail line.	Nutrients, sediment.
Lochinvar Creek	Pasture, grazing, crop, existing rail line.	Nutrients, sediment.
Anvil Creek	Pasture, grazing, crops, urban, existing rail line.	Nutrients, sediment.
Black Creek	Pasture, grazing, vineyards, urban, existing rail line.	Nutrients, sediment, oils, greases, metals.
Jump Up Creek	Pasture, existing rail line.	Nutrients, sediment, oils, greases, metals.

18.2.5 Hydrologic Assessment

The hydrology for the Project has been assessed using XP-Rafts and PRM (Rational Method). Due to a lack of calibration data the flows from the two different methods have been used to calibrate each other. The results indicate that the flows estimated by XP-RAFTS are generally within 25 per cent of the peak flow rate estimated by the PRM and are therefore in the correct order of magnitude. Therefore, the flows generated in XP-RAFTS will be utilised as the inputs to the flood hydraulic models. The results from both the XP-RAFTS and PRM calculations for all waterway crossings and the results of the existing model for Black Creek are presented in the Surface Water Assessment in Appendix L.

18.2.6 Hydraulic Assessment

Downstream Hydraulic Control

A summary of the downstream boundary conditions for Stony, Anvil, Black and Jump Up Creeks is provided in Table 18-8.

Table 18-8 Downstream Boundary Controlled

Waterway	Downstream Receiving System	Distance to Downstream Receiving System	Downstream Boundary Controlled
Stony Creek	Wentworth Swamp	At boundary of hydraulic model.	Yes. Wentworth Swamp flood level 10.2 m AHD (1% AEP)
Anvil Creek	Black Creek	7.5 km (approx.)	No
Black Creek	Hunter River	7.5 km (approx.)	No
Jump Up Creek	Hunter River	10.8 km (approx.)	No

From this it can be determined that, with the exception of Stony Creek, the flood level at these waterway crossings is controlled by catchment runoff and not the flood level in the receiving waters. The flood level of Stony Creek is impacted by the water level in Wentworth Swamp.

Flooding

A summary of the existing flood levels for Stony Creek, Anvil Creek, Black Creek and Jump Up Creek is provided in Table 18-9. These flood levels would be maintained during construction and operation of the Project.

The flood level nominated for Stony Creek is on the basis of a 1% Annual Exceedence Probability (AEP) flood level within Wentworth Swamp. Consideration was also given to a 1% AEP occurring within the Stony Creek catchment without a 1% AEP flood level in Wentworth Swamp and the resulting flood level at Stony Creek was determined to be 10.5 metres AHD.

The flood level nominated for Anvil Creek is for an un-named tributary which intersects the Project at waterway crossing W34. It is considered that this is a more significant waterway crossing than the Anvil Creek crossing (W27) which is close to the headwaters of Anvil Creek.

Table 18-9 Existing 1% AEP Flood Level

Major Waterway	Existing 1% AEP flood level RL (m AHD)
W3 – Stony Creek	11.5
W34 – Anvil Creek (un-named tributary)	55.0
W37 – Sawyers Creek	49.3
W49 – Black Creek	29.3
W58 – Jump Up Creek	46.7

Probable Maximum Flood

The estimated Probable Maximum Flood flow for Stony, Anvil, Black and Jump Up Creeks is outlined in Table 18-10. From this it was determined that for the existing conditions, the rail embankment would be overtopped in the Probable Maximum Flood event.

Table 18-10 Probable Maximum Flood

Waterway	PMF (m^3/s)	Overtops Existing Rail Embankment
Stony Creek	690	Yes
Anvil Creek	830	Yes
Black Creek	5,015	Yes
Jump Up Creek	1,045	Yes

18.3 Impact Assessment

The Project involves the construction and/or modification of new and existing waterway crossing structures (bridges and culverts). There is potential for existing waterways to be impacted by these structures, as well as widening of the railway embankment. The main potential impacts during construction and operation are:

- Water quality decline.
- Increase in existing flood levels.
- Increase scour.

Details of potential impacts during construction and operation of the Project are provided below.

18.3.1 Construction

Construction of the Project may result in localised removal of riparian and instream vegetation and channel disturbance at waterway crossing locations. Poorly managed construction methods could impact bed and bank stability and increase the potential for channel erosion. The resulting accelerated erosion could threaten remnant riparian vegetation and adjoining infrastructure assets, and provide a source of sediment that could have an adverse impact on water quality.

Construction of the Project may also block low flows to the downstream environment and increase the risk of pollution from construction vehicle fuel spillages.

18.3.2 Operation

Hydrologic Change

Table 18-11 provides the results of the potential hydrologic change calculations for the major catchments. The results demonstrate that there would be minimal change in the hydrology of the surrounding catchments as a result of the Project. The predicted changes to the flood levels would also not adversely impact on private infrastructure (such as farm sheds) or public infrastructure such as roads (refer to Appendix L).

Table 18-11 Potential Hydrologic Change

Waterway	Area (ha)	Project Area (ha)	% Increase	Waterway 1% AEP (m^3/s)	Project Area 1% AEP (m^3/s)	% Increase
Stony Creek	1,520	11.8	<1%	104	1.5	1%
Anvil Creek / Sawyers Creek confluence	2,050	11.0	<1%	167	1.6	1%
Black Creek	30,400	7.7	<1%	925	2.1	<1%
Jump Up Creek	3,030	6.2	<1%	142.6	1.7	1%

It can also be determined from the estimated PMF flow for the major catchments that, provided the Project does not increase the height of the rail embankment, there would be no adverse impacts on the PMF.

The operation of the Project may result in changes in the hydraulic conditions of waterways and discontinuity of sediment transport processes due to the culvert extensions and realignment of Sawyers Creek. In addition to Sawyers Creek, there may be some other minor waterway realignments required. The extent of these realignments would be defined during the detailed design of the Project.

The potential impacts of these changes are:

- An increase in water levels and flood levels in areas upstream of new or extended waterway crossings due to the effective flow area at the crossing being less than the natural width of the stream immediately upstream of the crossing.
- Lowering of the stream bed elevation through ongoing erosion processes. This can impact waterway health through the loss of existing instream features and can result in destabilisation and the production of sediment that may have adverse downstream impacts.
- Net sediment deposition within the stream channel that results in an ongoing rise in bed elevation. This can lead to the decline in waterway health by smothering of bed forms and associated loss of bed diversity including pools, riffles and instream structure.

The ephemeral nature of many of the waterways implies that there are natural stream flow barriers to fish movement throughout the catchments. However, for perennial waterways or where there is evidence of regular flows, culvert extensions may represent a barrier to fish, preventing fish migration, isolating habitat and interfering with or preventing fish spawing. Blockage of low flows may also occur where the access track or haul road alignment crosses a waterway and a causeway is required. It is anticipated that this would primarily occur at locations where existing causeways are already in place.

The configuration of proposed causeways has been developed in consultation with the NSW Office of Water and includes either a bed level crossing through the invert of the waterway or a low level crossing with low flow culverts beneath to allow base flows to be conveyed.

Operation of the Project may also increase the risk of pollution from contaminants, such as particulate matter, nutrients, heavy metals and petroleum based products, being discharged to receiving waterways (as discussed in Section 19.1 (Topography, Soils and Geology), and Section 19.2 (Contamination)).

Afflux

The Project has the potential to result in afflux (an increase in water level on the upstream side of a structure or impediment) in areas upstream of new or extended waterway crossings during peak flow events thereby increasing flood levels. The impact of this would vary and be dependant on the works associated with the Project. However, as all culvert extensions and underbridges would maintain the existing waterway area (cross section of the flow area of a waterway, typically from bank to bank) the impact would be minimal.

The Project also has the potential to cause afflux in locations where the proposed embankment encroaches into existing waterway areas. The extent of impact would be directly related to the extent of encroachment into the waterway area. Within the investigation area, the locations where the encroachment of earthworks could potentially increase flood levels include Stony Creek, Allandale Road, waterway W30 (approximate chainages 209.250 kilometres and 209.650 kilometres) and Jump Up Creek. In locations where an afflux occurs, options such as increasing batter slopes or the inclusion of retaining walls would be considered such that there was no impact on flood levels that could lead to adverse impacts on the affected properties.

Detailed modelling has been undertaken for Stony Creek and the outcomes of this modelling indicate that for a local catchment 1%AEP rainfall event in conjunction with a 1%AEP downstream flood event, there is no increase in flood level. Through a review of the aerial photography and re-mapping of the flood extent, it was confirmed that there would be no impact on existing structures as a result of the Project.

Placement of Spoil

There are a number of locations along the Project route that have been identified as potential locations for the placement of spoil. The identified areas (as listed in Table 7-10) include the following chainages:

- 196.060 kilometres to 196.720 kilometres (the quarry).
- 202.760 kilometres to 203.100 kilometres (Station Lane, Lochinvar).
- 210.620 kilometres to 210.720 kilometres (Nelson Street, Greta).

- 217.250 kilometres to 218.050 kilometres (Black Creek, Branxton).
- 221.300 kilometres to 221.620 kilometres (Belford)

The placement of spoil within the quarry, and at Station Lane, Lochinvar and Belford would be undertaken such that surface flow paths would not be altered and catchment boundaries would be maintained.

The placement of spoil adjacent to Black Creek would be within the existing flood extents. Hydraulic modelling indicated that the placement of spoil would have no impact on the 50% AEP event. However for the 20%AEP and greater, there is an increase in flood extent. Flood levels would increase by a maximum of approximately 200 millimetres upstream of the Black Creek bridge structure in the 1% AEP. A review of the aerial photography confirmed that while there is a minor increase (approximately one percent) in the flood extent, there is no adverse impact on existing structures.

Additional details and figures are discussed in the Surface Water Assessment in Appendix L.

18.4 Mitigation Measures

18.4.1 Construction

A Spoil and Fill Management Plan (SFMP) would be prepared and implemented to minimise potential impacts on water quality during construction of the Project. This plan would incorporate the design and installation of erosion and sediment controls in accordance with *Managing Urban Stormwater, Soils and Construction Volume 2D Main road construction* (DECC 2008).

The SFMP would include the following measures:

- At the vegetation clearing stage, the vegetation would be stockpiled and then mulched and spread over disturbed areas to provide a natural erosion barrier and assist during rehabilitation upon completion of construction.
- Prior to commencement of earthworks there would be a range of erosion and sediment controls implemented which would include but would not be limited to:
  - Establishment of sediment filters, such as hay bales and sediment fences, sediment traps and/or sediment basins to capture sediment and prevent sediment laden water discharge to the downstream environment.
  - Construction of temporary catch and diversion drains to reduce erosion hazard and prevent clean water from upstream of the corridor flowing onto disturbed areas and hence become dirty water.
  - Stabilisation of exposed surfaces as soon as practicable following completion of construction in the vicinity of the works, including the stabilisation of disturbed soils through progressive revegetation.

- A number of controls outside the specific work area would be put in place and these would include but not limited to:
  - Refuelling of plant and machinery either by fuel trucks with spill trays or within bunded areas or off-site in appropriate locations wherever possible.
  - Minimisation of disturbed areas for the safe completion of construction activities so that the potential export of sediment is minimised.
  - Location of stockpiles clear of flood prone areas, stream banks, channels and stormwater drainage areas, and stabilisation of stockpiles that would be in place for longer than 10 days.
  - Diversion of flows around stockpiles by bunds and/or diversion drains, and around work areas where practicable.
  - Establishment of temporary creek crossings with a lower section for higher flows to pass with culverts extending beyond the toe of fill embankments.
  - Rehabilitation of the waterway once temporary creek crossings have been removed.
  - Establishment and maintenance of a limited number of construction compounds to reduce the areas of overall disturbance for the Project.
  - Establishment of construction compounds, including machinery, fuel and chemical storage areas with bunded areas away from drainage lines.
  - Appropriate storage of construction materials on site so as to prevent leaching, leaking or other transfer of material into waterways or onto land.
- An appropriate spill kit would be kept on site at all times and any spillage would be immediately and appropriately cleaned up. In the event of a large or hazardous spill, the Fire Brigade, Police, Ambulance and the Department of Environment, Climate Change and Water would be contacted as appropriate.
- All Project team members involved in the construction of the Project would be made aware of their environmental responsibilities and the measures to minimise impacts.

There is insufficient water quality data available for the seven catchments that the Project intersect. As such, it is proposed that a surface water quality monitoring program would be established prior to commencement of construction. This would inform the detailed design of the Project and would enable the compilation of background data over potentially a range of climatic conditions. Surface water quality monitoring would continue for the construction period to monitor water discharged from the construction site, and water quality upstream and downstream of the construction areas. A comparison between the pre-construction and ongoing monitoring data would then enable an assessment of the effectiveness of the erosion and sediment control measures.

The construction of the proposed Sawyers Creek realignment would occur while maintaining the existing waterway flow. Following construction of the realignment, riparian vegetation would be reinstated and geomorphic features, such as pools and riffles, provided where possible. Once the realignment is determined to be stable, and reinstatement of vegetation completed, connection to the existing creek would then occur. Any additional creek realignments required would be constructed in the same way.

18.4.2 Operation

To minimise the potential impacts during operation of the Project, the detailed design would appropriately address drainage to minimise ongoing impacts. Details of design and management measures to be incorporated into the Project to minimise impacts on surface water and waterways are provided in Sections 7.10.5 and 7.13.4.

Hunter ALLIANCE

19. Other Environmental Issues

This chapter addresses the other environmental issues not directly addressed through the Director-General's Environmental Assessment Requirements. The environmental issues included in this chapter are:

- Topography, Soils and Geology.
- Contamination.
- Groundwater.
- Energy and Greenhouse Gas Emissions.
- Social Impact Assessment.
- Visual.
- Waste.
- Hazards.

19.1 Topography, Soils and Geology

19.1.1 Assessment Approach

Introduction

An assessment of available geological and geotechnical information has been undertaken in order to obtain an appreciation of the ground conditions, identify potential geotechnical hazards and risks and to highlight potential geotechnical issues that may impact the detailed design of the Project. The desktop study assisted in determining the extent of additional investigation required, if any, for later stages of the Project.

Director- General Requirements

Table 19-1 outlines the Director-General's Environmental Assessment Requirements relating to Topography, Soils and Geology and where they have been addressed.

Table 19-1 Director-General's Environment Assessment Requirements – Topography, Soils and Geology

Director-General's Environmental Assessment Requirements	Where Addressed
General Construction Impacts	
Assess and present a management framework for earthworks, including a considered approach to minimising impacts associated with the excavation, movement, stockpiling, rehabilitation and disposal of spoil and fill. Consideration should be given to:	
◗ Soil characteristics, including acid sulfate soils and potential land contamination.	Section 19.1.1 and Section 19.2

Director-General's Environmental Assessment Requirements	Where Addressed
◗ Erosion and sedimentation control measures at excavation, storage and placement locations to protect adjoining watercourses, including during flood events and from the blockage or alteration of flow paths.	Section 19.1.4
◗ A strategy for managing earthworks with a particular focus on those works that have the greatest potential to disturb soils that are contaminated, have a high erosion and run off hazards and adverse impacts on watercourses, and a broader, more generic approach for ongoing construction management.	Section 19.1.4

Methodology / Scope

A search of archive geological / geotechnical information was undertaken to develop an understanding of the ground conditions along the alignment. Available geotechnical information along the alignment consists of 48 test pits (22 within the investigation area) and 18 boreholes (14 within the investigation area).

19.1.2 Existing Environment

Topography and Drainage

The natural topography along the Project route generally comprises low lying hills, valleys and broad open alluvial plains. The hills are typically undulating, with slopes of generally less than five degrees. The topography generally rises along the alignment from alluvial plains, associated with the Hunter Valley, near Maitland to the ridge between Allandale and Greta. The Main North Railway is either cut into or filled above the natural topography.

The drainage of the region is dominated by the Hunter River, approximately two kilometres to six kilometres to the north of the proposed alignment flowing west to east. Along the Project route, the drainage flows in a general northerly direction through creeks and tributaries of the Hunter River. The regional topography consists of flat alluvial plains, undulating hills and steep ridges.

Along the Project route there are two known floodplains. The main one is associated with Wentworth Swamp / Swamp Creek (approximate chainage 193.000 kilometres to 195.500 kilometres) and the other is a smaller floodplain at Jump Up Creek (approximate chainage 223.000 kilometres). Records indicate that Wentworth Swamp has flooded due to rising water levels in the Hunter River in 1955 and 2007. Several other tributaries have the potential to have very high water levels or flooding.

Geology

The Project is located within the Newcastle coalfield which forms the north-eastern portion of the onshore Sydney Basin. The Sydney Basin is the southern most part of the larger Sydney-Bowen Basin and it is located between the New England Fold Belt to the north-east and Lachlan Fold Belt to the south-west. The Basin is believed to have formed in the early Permian due to subsidence.

The geology along the Project alignment comprises the Maitland Group, Dalwood Group and Greta Coal Measures. The rocks of the Maitland and Dalwood Groups consist of sandstones, siltstones and conglomerates with minor occurrences of marl and basalt. The alignment crosses the Greta Coal Measures around approximate chainages 195.000 kilometres, 210.000 kilometres and 215.000 kilometres. The Greta Coal Measures comprise sandstones, conglomerate, siltstone and coal.

The Hunter Coalfield is bounded to the north by the Hunter-Mooki Thrust Fault, approximately 15 kilometres from the Project. To the north of this thrust is the New England Fold Belt. The sediments of the Newcastle Coalfield comprise a thick sequence of Early Permian to Middle Triassic alternating marine and terrestrial deposits that formed as a result of fluctuating sea level. The deposits are dominated by siltstones and sandstones. These sediments were locally intruded by Tertiary basalts. These rocks are then overlain in part by Quaternary alluvial and colluvial sediments.

The existing rail alignment lies in the northernmost part of the Sydney basin several kilometres south of the New England fold belt. This region contains a thick sequence of relatively undeformed sedimentary rocks mostly of the early to middle Permian age. The stratigraphy is predominantly of the Dalwood and Maitland group as well as a small area of the Greta coal measures. Some Quaternary alluvial sediments are found within river channels and floodplains.

The bedrock stratigraphy in the area is detailed in Table 19-2.

Table 19-2 Geological Stratigraphy

Group	Formation	Rock Types	Characteristics	Approximate Chainage
Maitland Group (Overlies the Greta Coal Measures)	Mulbring Siltstone (Pmm)	Siltstone, sandstone	Where exposed, is extremely to moderately weathered with low-high strength.	219 - 220.5 km
	Muree Sandstone (Pms)	Sandstone, conglomerate, minor clay	Where exposed, very low to high strength.	218.5 km, 220.5 km, 225 km
	Branxton Formation (Pmb)	Conglomerate, sandstone, siltstone	Rock increases in strength with depth from low to high strength. Weathering decreases with depth from extremely weathered to slightly weathered.	193.5 - 194.5 km, 210.5 - 218.5 km, 220.5 - 224.5 km

Group	Formation	Rock Types	Characteristics	Approximate Chainage
Greta Coal Measures (Pg) (overlies the Dalwood Group and outcrop on the limbs of the Lochinvar Anticline)		Sandstone, conglomerate, siltstone, coal	Farley – four coal seams Greta – two coal seams.	194.5 – 195 km, 210.5 km
Dalwood Group	Farley Formation (Pdf) (1.3 m thick band found)	Silty sandstone (Sandstone)	Extremely weathered and low strength; increases in strength and decreases in weathering with depth. More silty with depth.	195 – 195.5 km, 207 – 210 km
	Rutherford Formation (Pdr)	Siltstone, marl, minor sandstone	Extremely weathered and low strength; increases in strength (to high strength) and decreases in weathering with depth. On exposure, rock materials susceptible to breakdown to high plasticity soil profiles.	195.5 – 199 km, 205 – 207 km
	Allandale Formation (Pda)	Conglomerate, lithic sandstone	Low-medium strength.	199 – 199.5 km, 204 – 205 km
	Lochinvar Formation (Pdl)	Basalt, siltstone, sandstone	Weathered siltstone.	199 – 204 km

The current aerial photographs 1:25,000 Scale (NSW Department of Lands, 2004) were examined using stereoscopy which allows the photos to be viewed in 3D. This interpretation highlighted:

- Areas of potentially soft alluvial soils, with potentially high ground water levels.
- Localised areas of instability on existing rail embankments.
- Localised areas of potential instability in the natural terrain.
- Localised areas of erosion along the existing corridor and in the natural terrain.

- Areas of disturbed terrain, likely to be associated with fill and possibly soil contamination.
- Preferred drainage paths not shown on existing mapping.
- Areas prone to water logging.

Soil Landscape

Quaternary sediments are likely to exist along the proposed alignment at Farley associated with the Swamp Creek floodplain and elsewhere along valley flow areas associated with major drainage paths, such as Stony Creek, Anvil Creek, Jump Up Creek and Black Creek and secondary drainage lines (refer also **Chapter 18**). Due to the geomorphology of the alignment with undulating hills and gently incised river valleys, it is likely the extent of Quaternary sediments would be localized for the majority of the route. However, due to the adjacent wetlands and alluvial plain some more extensive alluvial soils may be expected between approximate chainages 193.900 kilometres and 199.000 kilometres.

Soil landscape maps have been prepared for the Newcastle and Singleton regions (Kovac and Lawrie 1991; Matthai 1995) that cover the Project area. These soil landscape maps categorise soil types (based on uniformity of grain size, type, colour and other characteristics) into soil landscape units. A description of each of these units including underlying geology, topography, soil descriptions and soil limitations is provided in Table 19-3.

Table 19-3 Soil Landscape Unit Descriptions

Unit	Topography	Soil Description	Soil Limitations	Approximate Chainage (km)
Rivermead (ri)	Extensive undulating alluvial terraces.	Deep well drained to imperfectly drained	High foundation hazard, localised flood hazard, seasonal waterlogging	193.80-194.85
Hunter variant a (hua)	Extensive alluvial plains	Deep moderately well to imperfectly drained and poorly drained clays, alluvial soils and siliceous sands (swampy back plains of Hunter soils landscape)	Flood hazard, foundation hazard, localised permanently high water tables and seasonal waterlogging	195.50 (small area south of rail line)
Bolwarra Heights (bh)	Rolling low hills	Moderately deep well drained to imperfectly drained	Moderate foundation hazard, water erosion hazard, high localised seasonal run-on and waterlogging, localised steep slopes with mass movement hazard	194.05-196.65, 197.05-197.35 (south of corridor)

Unit	Topography	Soil Description	Soil Limitations	Approximate Chainage (km)
Wallalong variant a (wga)	Alluvial fans and drainage plains	Moderately deep-to-deep, moderately to imperfectly drained	High water erosion hazard, foundation hazard, high-localised seasonal run-on and waterlogging.	196.30-197.60 (changes to Singleton sheet – Branxton classification)
Rothbury (ro)	Undulating to rolling hills	Moderately deep-to-deep, moderately to imperfectly drained	Moderate to very high erosion hazard, moderate to low fertility.	213.70-214.20, 217.70-218.20, 220.10-222.10, 222.45-222.70, 223.45-224.22
Branxton (bx)	Undulating rises to low hills and creek flats	Moderately deep-to-deep, moderately to imperfectly drained	Moderate to very high erosion hazard, moderate to low fertility.	197.60-199.30, 204.80-213.70, 214.05-217.70, 218.20-220.15, 222.10-222.45, 222.70-224.22
Lochinvar (lv)	Undulating rises with numerous drainage lines	Moderately deep-to-deep, moderately to imperfectly drained	Moderate to very high erosion hazard, moderate to low fertility.	199.30-204.95,

(Source: Kovac and Lawrie 1991; Matthai 1995).

Mine Subsidence

Coal mining has taken place in the region for over 100 years. Mining activities are currently on-going in the region and can be expected to continue into the foreseeable future, although the majority of significant longwall mining is taking place further to the north of the site. Subsidence due to mine workings may be related to both old abandoned mine workings and to current and future mine operations.

The Mine Subsidence Board advised the ARTC (letter dated 19 November 2008) that there are two areas of mine workings along the Project route:

- Between chainages 194.360 kilometres and 195.070 kilometres. In this area there are abandoned workings from three collieries: South Maitland, Old Maitland, and West Greta. Records indicate that there were two coal seams mined but the depth of the seams is not known.
- Between chainages 211.150 kilometres and 212.500 kilometres. In this area there are abandoned workings from Central Greta Colliery. Records indicate that there was one coal seam mined and the depth of the seam in the area varies from 22 metres to 128 metres.

The Mine Subsidence Board indicated that abandoned coal mine workings in the Greta Coal Measures exist close to or beneath the alignment in two locations, at Farley between chainages 194.000 kilometres and 196.000 kilometres and at Greta between chainages 211.000 kilometres and 213.000 kilometres.

Potentially Problematic Soils

The following sections present the potentially problematic soils that could be encountered along the route and any existing testing information available to date.

Acid Sulfate Soils

Potential Acid Sulfate Soils (PASS) were identified within the investigation area for the Project. These are soils that have a high likelihood of containing significant concentrations of pyrite. When these soils are exposed to oxygen in the presence of sufficient moisture, they oxidise resulting in the generation of sulfuric acid. The soils are then said to be ASS. There is no record of Actual Acid Sulfate Soils (AASS) within the investigation area.

Current acid sulfate risk maps produced by the Department of Infrastructure, Planning and Natural Resources indicates PASS approximately 40 metres south of the railway, between chainages 195.490 kilometres and 195.510 kilometres. At this location the environment on the maps is described as alluvial back swamp of elevation one to two metres AHD.

It is unlikely that this area would be disturbed by the Project.

Acid soils and Spontaneous Combustion

The coal seams within the Greta Coal Measures are characterised by a high sulfur content and have a greater propensity for self ignition and for generating acid mine water than the coal seams associated with the Newcastle, Tomago and Whittingham Coal Measures. Potential constraints associated with this are:

- Acid generation from excavated coal and carbonaceous spoil materials due to both oxidation of pyrite and the high sulfur content. The presence of acid generation from Greta Seam mine waste materials is a regional issue.
- Potential for spontaneous combustion when fresh coal materials are exposed to oxygen. This can occur within workings (generally operational workings where water levels were controlled by pumping and ventilation was introduced) and within mine waste dumps.
- Potential for mine subsidence associated with mine fires from spontaneous combustion resulting in pillar collapse. The risk of this in abandoned, sealed and most likely flooded workings is significantly less than when the collieries were operational with groundwater control and ventilation provided.
- Generation of methane and carbon monoxide gases from workings.

Reactive Soils

Reactive soils are soils that change volume in response to moisture change. There is reported evidence of engineering problems with reactive soils in the Hunter Region (Kovac and Lawrie 1991; Matthai 1995).

Along the alignment this is typically associated with high plasticity residual soils derived from fine grained siltstone rock or similar, in particular soils derived from the Rutherford Formation and the Mulbring Siltstone.

The results from the Atterberg Limits and Shrink Swell test carried out on selected samples from the Stage 1 investigation and a limited number along the length of the Project alignment indicate that the fill and the sandstone have a low swelling potential, residual soil and siltstone a medium swelling potential, and the alluvium has a high swelling potential. Californian Bearing Ratio test indicated that the residual soils and alluvium were reactive, including swelling..

Reactive soils with swelling potential present an increased risk of instability, which could increase potential for erosion, and damage to track and other infrastructure.

Controls that can be adopted to minimise the risk of reactive soils are outlined in the mitigation measures (Section 19.1.4).

Dispersive and Erodible Soils

Dispersive soils are soils in which the particles separate from one another (disperse) in contact with water. This means that soil particles can be transported away leading to erosion and piping. It is noted that there is a history of dispersive behaviour along the rail alignment with piping and extensive sheet (planar) and scour (localised rill) erosion along cuttings and access roads. In particular extensive erosion of cutting batters and cess drainage in the Mulbring Siltstone in the Minimbah area is indicative of dispersive or partially dispersive soils. Localised piping failures within cutting batters have occurred in downside batters at about 205.5 kilometres, 215.6 kilometres and 216 kilometres.

Existing cut batter erosion and sedimentation of cess drainage can be observed along the alignment in particular at Minimbah where cuttings occur in the Mulbring Siltstone Formation which is characterised by deep clay soil profiles and weathered siltstone rock. Both of these materials appear to be highly prone to sheet and scour erosion where exposed on cut batters (even where effective top drainage is present). This is due to the inferred dispersive or partially dispersive nature of the clay soils and the fretting of the siltstone rock on exposure to form a clayey gravel veneer that is susceptible to erosion. The erosive nature of these soils and weathered rock inhibits the establishment of vegetative cover. The siltation of the cess drains results in fouling of the ballast and poor drainage which generally leads to track formation problems. Appropriate batter treatment and protection measures in erosive materials are outlined below in the mitigation measures (Section 19.1.4).

19.1.3 Assessment Impacts

Construction

The Project would involve conventional earthworks with widening of existing embankments and cuttings. Potential geotechnical and soil erosion issues and risks associated with earthworks would include:

- Management of the material and drainage interface between existing older poor quality embankments and new engineered embankments and maintaining stability of existing embankments during excavation works.
- Management of scour and sheet erosion in areas disturbed by construction activities and in spoil disposal areas, particularly in areas of dispersive soils and near creeks and drainage lines.

- Maintaining stability of existing embankments during tie in excavation works. The key stability constraint is likely to be the temporary condition during initial foundation and tie in works for the proposed widening works as once constructed these works would provide stabilising berms for the older embankments.
- Hard rock excavation conditions in the sandstone and conglomerate rock materials present between Branxton and Minimbah. Approval for blasting adjacent to a rail line under use is unlikely and as such rock excavation and the production of oversize rock fill material is likely to be a key issue for further management.
- On-site processing of hard sandstone and conglomerate rock to produce structural and capping materials. All ballast and concrete aggregates are likely to require importation from the nearby hard rock quarries (such as Allandale).
- Management of drainage – particularly in rock cuttings. There is a history of mud pumping problems throughout the existing rock cuttings between Maitland and Minimbah and the construction of a third track would need to consider interception of seepage emanating from the existing poorly drained tracks.

Operation

General geotechnical maintenance issues (other than track) that would re-occur along the rail corridor during operation are likely to comprise:

- Cess drainage works.
- Drainage works – culvert clean out and repair, top drains, subsoil drainage and general earthworks.
- Loose rock and tree removal from cuttings.
- Embankment batter instability.

Cess Drainage and Erosion Siltation

There are a number of existing cuttings where erosion of soils and weathered rock materials results in periodic blockage of the cess drains. Existing cut batter gradients in the soils and weathered rock materials are generally too steep. This results in scour and sheet erosion and inhibits establishment of topsoil and vegetative cover.

Significant cut batter erosion and sedimentation of cess drainage occurs in the Mulbring Siltstone Formation which is characterised by deep clay soil profiles and weathered siltstone rock. Both of these materials appear to be highly prone to sheet and scour erosion where exposed on cut batters (even where effective top drainage present) due to the partially dispersive nature of the clay soils and the fretting of the siltstone rock on exposure to form a clayey gravel veneer that is susceptible to erosion.

The erosive nature of the soils and weathered rock inhibits the establishment of vegetative cover. The siltation of the cess drains can result in fouling of the ballast and poor drainage which generally leads to track formation problems.

Drainage Works

Recurrent drainage issues could include:

- Progressive sedimentation and blockage of cess drainage due to erosion of soil and weathered rock in poorly vegetated cut batters as discussed above.
- Mud pumping in the floor of rock cuttings associated with poor drainage.
- Poorly developed top drains along crests of cuts and toe drains along embankments.
- Localised breaches in top drains and bench drains associated with piping in dispersive soils.

Loose Rock Removal

The is no known occurrence of significant cutting instability events involving large scale soil slumps or rock falls along the section of line. The main issue in relation to cutting stability appears to be surface soil erosion / shallow slumping and localised small scale rock falls, associated with cuttings battered too steep for the materials present.

The main cause of rock falls from cuttings is considered to be the opening and loosening of rock along pre-existing joints and bedding planes associated with tree and tree root growth and preferential erosion and undercutting of siltstone/shale layers in the sandstone rock units. This creates overhanging sandstone blocks with open joints with the potential for toppling. In combination with tree wedging, this mechanism is the main cause of rock falls.

The majority of rock falls from cuts occur from the upper weathered rock zone where trees are able to establish and grow. Rock falls in the weathered zone are typically in the order of 0.3 metres to one metre in size, although larger falls are possible.

The treatment approach adopted to date to address rock fall risk has typically been removal of loose rock by trimming or excavation re-profiling rather than stabilisation by rock bolting or shotcrete.

Localised small scale slumps in clay soil and extremely weathered siltstone materials are relatively common following major rainfall events (such as June 2007) where cuttings in soil strength materials are battered steeper than about 1.5H:1V.

Embankment Batter Instability

The Hunter Region experienced a period of significant rainfall from 7 June to 9 June 2009 associated with a significant low pressure storm event. Rainfall totals over the three day period generally ranged from about 250 millimetres to 400 millimetres. During this event, localised instability was noted in the rail corridor, particularly along batter slopes on high and steeply battered fill embankments. Areas of batter failure on high free standing embankments during this event occurred at:

- Belford (Jump Up Creek) 222.900 kilometres - free standing embankment.
- Belford 225.030 kilometres - free standing embankment.
- Whittingham 229.730 kilometres - free standing embankment.

These instabilities were generally shallow failures involving poor quality and compacted fills over the outer batter surfaces and evidence of instability affecting the core embankment structure and the track were not noted.

There is however a history of poor embankment performance along the line. There are a number of areas where berms have been constructed along the embankment as stabilisation structures. The quality of material and level of compaction in these berm structures is likely to be poor. Generally, embankment instability is found in areas where previous embankment widening works have taken place, together with areas on the Upside of the Main North Railway. It is noted that in general the original line coincided with the down main with embankment widening subsequently undertaken at a later date to accommodate the up main.

19.1.4 Mitigation Measures

Measures to mitigate potential impacts on soil are listed below:

Construction

- Develop and implement a Spoil and Fill Management Plan which details erosion and sediment control measures including areas of higher risk.
- Detailing appropriate procedures for the handling, stockpiling and assessment of materials during the works and include a contingency plan for unexpected hazards that may be encountered during site works.
- Adoption of appropriate moisture and compaction controls where reactive soils are placed as general fill in embankments.
- Assessing site reactivity in accordance with AS2870 Residential Slabs and Footings for proposed small to medium scale structures.
- Widen cuttings where appropriate to provide a buffer from the track to manage sediment issues.
- Flattening back cut batter gradients where possible to promote vegetative cover and adoption of selective batter treatments as appropriate.
- Treatment of soils with gypsum or similar to inhibit dispersive characteristics.
- Implement of an Acid Sulfate Soil Management Plan as part of the CEMP including procedures consistent with Remediation Guidelines from DECCW.

Operation

- Undertake general geotechnical maintenance relating to culvert clean out and repairs, top drains, subsoil drainage and general earthworks.

19.2 Contamination

19.2.1 Assessment Approach

Introduction

A Preliminary Site Contamination Investigation was undertaken by the Hunter 8 Alliance as part of the preparation of this Environmental Assessment. This investigation is included in Appendix N and is summarised in the following sections. The purpose of this investigation was to assess the likely potential for contamination within the investigation area.

The scope of works for the assessment included a desktop review of site history and environmental features such as geology and hydrology, site walkover assessments and limited soil sampling within the land surrounding the rail line.

Director-General's Environmental Assessment Requirements

Table 19-4 outlines the Director-General's Environmental Assessment Requirements relating to contamination and where they have been addressed.

Table 19-4 Director-General's Environmental Assessment Requirements – Contamination

Director-General's Environmental Assessment Requirements	Where addressed
General Construction Impacts	
Assess and present a management framework for earthworks, including a considered approach to minimising impacts associated with the excavation, movement, stockpiling, rehabilitation and disposal of spoil and fill. Consideration should be given to:	
◗ Soil characteristics, including acid sulfate soils and potential land contamination.	Section 19.2.3
◗ A strategy for managing earthworks with a particular focus on those works that have the greatest potential to disturb soils that are contaminated, have a high erosion and run off hazards and adverse impacts on watercourses, and a broader, more generic approach for ongoing construction management.	Section 19.2.4

Methodology / Scope

The Hunter 8 Alliance collected soil samples from 55 test pit locations, and three surface samples, adjacent to the rail corridor and within surrounding grazing land to assess potential contamination issues. A random sampling pattern was applied for this investigation, along with some targeted sampling. Within the rail corridor significant disturbance has occurred. Several stockpiles within the corridor were also sampled. Due to access restrictions some potentially contaminated sites were unable to be sampled. Such areas would be sampled and analysed for contaminants prior to construction so that appropriate management measures can be developed if required.

The investigation program was considered sufficient to provide an indication as to the potential contamination likely to be encountered within the investigation area. However, the sampling density is not considered sufficient to delineate areas of contamination identified or to provide sufficient information to characterise material for off-site disposal. In addition, areas of unknown potential contamination may exist on the site not identified during this investigation.

19.2.2 Existing Environment

The typical soils encountered within the corridor during sampling were fill materials (consisting of ballast, silt, sand, and clay) many of which contained augmented natural materials. These were underlain with natural clay. Typical soils encountered adjacent to or within rural properties consisted of natural clays.

A search of the NSW Rail Transport Museum website indicated that the Main Northern Railway between Newcastle and Singleton was completed by the end of the 1860's. The historical review indicated that the areas surrounding the rail line are likely to have been used for residential and rural land use from 1908 to the present day, with the exception of a few commercial/industrial premises. No records relating to specific contamination or remediation were identified within Council and DECCW searches.

Based on the historical review and site inspection the most likely sources of contamination within the investigation area would be associated with the agricultural activities, imported fill and the rail line. Table 19-5 presents a summary of the potential contaminants of concern and associated sources.

Table 19-5 Potential Sources of Contamination

Area of Concern	Rational / Details	Potential Chemicals of Concern
Rural properties	Spraying for weed and pest control Use of fertilisers	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylene (BTEX) Polynuclear aromatic hydrocarbons (PAHs) Phenols Heavy metals Organochlorine pesticides (OCP) Organophosphate pesticides (OPP)
Rail corridor	Fill and ballast material Asbestos fibres from train brakes Spraying for weeds and pest control Fuels, oils and greases Asbestos and lead paint residues in former buildings Electrical transformers	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylene (BTEX) Polynuclear aromatic hydrocarbons (PAHs) Phenols Heavy metals Asbestos Organochlorine pesticides (OCP)

Area of Concern	Rational / Details	Potential Chemicals of Concern
		Organophosphate pesticides (OPP) Polychlorinated biphenyls (PCB)
Noise mounds	Fill and ballast material	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylene (BTEX) Polynuclear aromatic hydrocarbons (PAHs) Phenols Heavy metals Asbestos
Stockpiles	Fill and ballast material	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylene (BTEX) Polynuclear aromatic hydrocarbons (PAHs) Phenols Heavy metals Asbestos
Heritage Sites	Fill and ballast material Spraying for weeds and pest control Fuels, oils and greases Asbestos and lead paint residues in former buildings	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylene (BTEX) Polynuclear aromatic hydrocarbons (PAHs) Phenols Heavy metals Asbestos Organochlorine pesticides (OCP) Organophosphate pesticides (OPP)
Vineyards	Spraying for weeds and pest control Use of fertilisers	Organochlorine pesticides (OCP) Organophosphate pesticides (OPP)

Area of Concern	Rational / Details	Potential Chemicals of Concern
Industrial properties	Fill and ballast material Spraying for weeds and pest control Fuels, oils and greases Asbestos and lead paint residues in former buildings	Total petroleum hydrocarbons (TPH) Benzene, toluene, ethyl benzene and xylene (BTEX) Polynuclear aromatic hydrocarbons (PAHs) Phenols Heavy metals Asbestos Organochlorine pesticides (OCP) Organophosphate pesticides (OPP)
Acid sulfate soils	Potential for acidification, and mobilisation of heavy metals, if disturbed	pH Heavy metals ASS/PASS

19.2.3 Potential Impacts

Heavy metal concentrations were reported below the Health-Investigation Level for commercial/industrial exposure settings (referred to as HIL F levels) for all individual samples analysed.

While concentrations exceeding Ecological Investigation Level (EILs) may indicate some potential environmental impacts the “decision-making process for assessing urban redevelopment sites” from DEC 2006 does not require consideration of EILs when assessing the suitability of a site for commercial / industrial land use such as rail corridor and roads. Samples exceeding the EILs may present an ecological risk, but are not considered to restrict construction activities. These exceedences should be considered when determining potential re-use of excavated material along the route, particularly with respect to contamination of adjacent areas and waterways.

Organochlorine pesticides (OCPs), Polynuclear aromatic hydrocarbons (PAHs), Total petroleum hydrocarbons (TPH) and Benzene, toluene, ethyl benzene and xylene (BTEX) were reported below the HIL F or threshold concentrations.

Based on the investigations undertaken, soils excavated from the agricultural properties and rail corridor is considered suitable for use on site, with regards to potential contamination risk to human health and the environment. It should also be noted that areas of unknown potential contamination may exist on the site that were not identified during this investigation due to limitations, including sampling extent, variable soil conditions, non-homogenous contaminant distribution, and access restrictions.

The indicative waste classification based on the results to date indicates that soils would generally be classified as General Solid Waste. However, several samples exceeded the General Solid Waste guidelines without Toxicity Characteristic Leaching Procedure (TCLP) analysis. These results are indicative only, based on the insitu sampling undertaken and on the total concentrations of constituents. Incorporation of TCLP analysis is likely to result in a reduction in waste classification.

A detailed description of Acid Sulfate Soils (ASS) is outlined in Section 19.1 – Topography, Soils and Geology.

Operation

Operational impacts relating to contamination are considered unlikely. No potential impacts relating to contamination have been identified for the operational phase of the Project.

19.2.4 Mitigation Measures

Measures to mitigate potential impacts from contaminated soil are listed below:

Construction

- Develop and implement a Spoil and Fill Management Plan (SFMP) as part of the Construction Environmental Management Plan (CEMP) for managing possible contaminated materials not encountered and assessed during this investigation.
- The SFMP for the Project would detail appropriate procedures for the handling, stockpiling and assessing potentially contaminated materials during the works. The SFMP would also include a contingency plan for unexpected hazards that may be encountered during site works.
- All waste would be managed in accordance with relevant legislation.
- Should any signal huts or structures within the site area be scheduled for removal, a hazardous material survey would be undertaken prior to demolition. In the event that asbestos is identified in these structures, an Asbestos Management Plan would be developed and implemented.
- Implementation of an Acid Sulfate Soil Management Plan as part of the CEMP.

19.3 Groundwater

19.3.1 Assessment Approach

Introduction

This section describes the existing groundwater features in the vicinity of the Project and assesses the potential impacts of the construction and operation of the Project. It also outlines measures to mitigate these potential impacts. A Groundwater Impact Assessment was undertaken by the Hunter 8 Alliance as part of the preparation of this Environmental Assessment. The Groundwater Impact Assessment is included in Appendix M and the results of the assessment are discussed in this Section.

Director-General's Environmental Assessment Requirements

Table 19-6 outlines the Director-General's Environmental Assessment Requirement relating to groundwater and where they have been addressed.

Table 19-6 Director-General's Environmental Assessment Requirements – Groundwater

Director-General's Environmental Assessment Requirements	Where Addressed
General Construction Impacts	
Ecology – including: ◗ Vegetation clearing and resultant foraging, roosting and nesting habitat loss, fragmentation, connectivity and edge effects, increase in rail movements, and changes to watercourses and riparian zones.	Ecological Issues are dealt in Chapters 9-11 Groundwater Section 19.3
Hydrology – including: ◗ Project effects on flood characteristics (on surrounding land, property and infrastructure) and effects if flooding on the project with specific reference to the Hunter River Floodplain. A range of flood events (including PMF) shall be assessed in all flood prone areas within and adjoining the corridor.	Surface Water Issues are addressed in Chapter 18 Groundwater Section 19.3

Methodology / Scope

The following activities have been carried out as part of the Groundwater Study for the Project:

- Desktop review of existing reports, maps and data.
- Development of a groundwater monitoring network.
- Monitoring and testing of new groundwater bores.
- Risk Assessment based on the desktop review.

19.3.2 Existing Environment

Hydrology

The Project investigation corridor is within the Hunter-Central Rivers Catchment Management Authority (CMA) area where the Hunter River flows from west to east typically between around 2.5 and six kilometres north of the alignment. Around East Maitland, however, the river is approximately 1.5 kilometres due east of the investigation corridor at its closest point.

Surface water flow is generally in a southerly direction towards the Wentworth Swamps or in a northerly direction towards the Hunter River. A number of tributaries and un-named drainage channels of the Hunter River intersect the investigation corridor. The main water courses that intersect or run close to the alignment of the investigation corridor are, from east to west at the following chainages:

- Swamp Creek and associated floodplain (Wentworth Swamps) (south of the alignment at approximate chainage 193 kilometres).
- Telarah Lagoon (between chainages 193.550 – 193.700 kilometres).

- Stony Creek (between chainages 195.5 kilometres and 200.2 kilometres).
- Lochinvar Creek (chainage 203.8 kilometres).
- Anvil Creek and tributaries (chainage 206 kilometres and travels adjacent to rail corridor up to chainage 211 kilometres).
- Sawyers Creek (chainage 211 kilometres).
- Black Creek and tributaries (chainage 217.2 kilometres).
- Jump Up Creek and tributaries (chainage 222.85 kilometres).

Several of these tributaries have the potential to have very high water levels or flooding. Groundwater levels are indicated to be relatively shallow in the vicinity of the creeks, within around one to three metres of the ground surface, and likely to provide base flow to surface water courses, provide inflow to Wentworth Swamp and potentially provide a source of water to some terrestrial vegetation.

Typically, groundwater follows surface topography and local drainage patterns and flows from higher elevations towards lower elevations. Regional (deep) groundwater flow is likely to be towards the Hunter River, to the north and north-east, whilst local shallow groundwater flow in both alluvial deposits and bedrock is likely to follow the fall in topography and hence, flow towards the main creeks. A proportion of shallow groundwater (from alluvial deposits and/or bedrock) is likely to discharge to surface water.

Alluvial Deposits

Water bearing alluvial deposits are likely to be located along many of the creeks and water courses however Quaternary-aged alluvial sediments (clay, silt, sand and gravel) are only mapped at outcrop locations over two short sections of the corridor alignment; one in the vicinity of Stony Creek and Swamp Creek at the east end (south side) of the Project site and the other in the vicinity of reaches of Black Creek to the west of Branxton (shown at 1:100 000 scale on the Newcastle Coalfield Regional Geology map).

Bedrock

The published geology map shows that the bedrock along the length of the investigation corridor predominantly consist of sandstones, siltstones and conglomerates of the Permian-aged Maitland Group (Mulbring Siltstone, Muree Sandstone and Branxton Formation), Greta Coal Measures and Dalwood Group (Farley Formation, Rutherford Formation, Allandale Formation and Lochinvar Formation) and underlie the alluvial deposits (where present). The presence of licensed groundwater bores screened through bedrock and yield information from the DWE bore database indicate water bearing bedrock of typically low to moderate permeability.

Groundwater Recharge, Levels and Flows

The alluvial deposits would be recharged at outcrop via direct infiltration of precipitation or from infiltration of surface water following rainfall when surface water levels are higher than groundwater. Bedrock would be recharged via direct infiltration at outcrop and potentially also via infiltration from overlying alluvial deposits, where present.

Groundwater is expected to be relatively close to ground surface in the vicinity of the floodplains of the main drainage paths of Swamp Creek / Wentworth Swamp, Stony Creek, Anvil Creek, Jump Up Creek and Black Creek.

Groundwater Quality

Groundwater quality data for the licensed groundwater bores identified with five kilometres of the investigation corridor indicate typically fresh groundwater beyond the eastern end of the corridor within the Quaternary-age alluvial deposits (which include sands and gravels), with recorded salinity ranging from 0 to 500 parts per million (ppm) (DWE 2009). Elsewhere recorded groundwater salinity indicates typically brackish to saline groundwater, with measured salinity typically ranging from 501 to 7,000 ppm in both unconsolidated material (sand, gravel, silt and clay) and in bedrock (sandstone, shale and andesite), with groundwater at one location approximately 2.7 kilometres north of the corridor, recorded in the range 7,001 to 10,000 ppm (GW 061339).

Characteristics of Groundwater

Sources

Groundwater is found in:

- Alluvial deposits, particularly along creeks and water courses in Quaternary-aged alluvial sediments found in the vicinity of Stony Creek and Swamp Creek (east end, south side) and near Black Creek (west of Branxton). Also found between 0.6 – four metres thick at Jump Up Creek.
- Water bearing bedrock underlying alluvial deposits. Project is underlain by bedrock with typically low to moderate permeability.

Depth

Groundwater is expected to be relatively close to ground surface in the vicinity of the floodplains of the main drainage paths of Swamp Creek/Wentworth Swamp, Stony Creek, Anvil Creek, Jump Up Creek and Black Creek.

At a more localised scale, groundwater flow within the shallow alluvial deposits and bedrock is likely to follow the fall in topography and therefore, local flow directions are likely to vary along the length of the alignment.

Quality

Typically, fresh groundwater was found beyond the eastern end of the Project route within the Quaternary-age alluvial deposits (which include sands and gravels), with recorded salinity ranging from zero to 500 ppm (NSW Government DWE, 2009). Elsewhere, recorded groundwater salinity indicates typically brackish to saline groundwater, with measured salinity typically ranging from 501 to 7,000 ppm in both unconsolidated material (sand, gravel, silt and clay) and in bedrock (sandstone, shale and andesite), with groundwater at one location approximately 2.7 kilometres north of the corridor, recorded in the range 7,001 to 10,000 ppm (GW 061339).

Groundwater Vulnerability Mapping

Groundwater vulnerability mapping (NSW Government 2009) indicates low groundwater vulnerability for the majority of the Project alignment and surrounding area. Low-moderate vulnerability intersects the Project route at Black Creek (to the north and south of the Project route in the vicinity of Branxton and to the south of the Project route between Farley and Lochinvar). Moderate and high groundwater vulnerability areas abut the east end of the alignment, including the vicinity of Stony Creek and Swamp Creek to the south and the Hunter River to the east and north.

Potential Receptors

Receptors that have the potential to be impacted by the Project include:

- **Groundwater Dependent Ecosystems (GDE)** – three GDE categories are present within the study area including ‘terrestrial vegetation’, ‘base flows in streams’ and ‘wetlands’. Although there is no data to quantify the degree of dependency of ‘base flows in streams’ and ‘terrestrial vegetation’ on groundwater, it is likely there is some degree of interaction between groundwater and surface water, based on the desktop review. No Ramsar wetlands have been identified, however, Wentworth Swamp is located on the lower reaches of Stony Creek on the south side of the alignment and is likely to have some dependency on Shallow groundwater. It is likely that groundwater provides some base flow to reaches of creeks in the vicinity of the Project alignment and creeks that intersect the alignment (and in particular the main creeks of Jump Up Creek, Black Creek and Stony Creek). Shallow groundwater is also potentially used by some types of vegetation where groundwater is relatively close to ground surface, such as in the vicinity of the creeks. Further information regarding GDEs is provided in Chapters 9 and 10.
- **Licensed Groundwater Bores** – Of the 98 licensed groundwater bores identified within a five kilometres radius of the Project route, 14 are considered potential receptors. No licensed groundwater bores have been identified within the Project route. The closest licensed groundwater bores to the Project alignment down assumed gradient (potential receptors) are GW 200442, GW 034601, GW 080668, GW 078378, GW 051301 and GW 029088 (these bores are located down topographic slope and hence down assumed gradient (south) of the Project alignment between chainages 201.00 kilometres and 197.00 kilometres) and GW 078497, located in the valley of Jump Up Creek (approximately 1.3 kilometres down assumed gradient of the Project alignment and 230 metres west of Jump Up Creek).
- **Shallow Groundwater** – shallow groundwater beneath the investigation corridor and down assumed gradient of the Project alignment within alluvial deposits (clay, sand and gravel) and bedrock, particularly in the vicinity of the main creeks including Jump Up Creek, Black Creek, Anvil Creek, Stony Creek and Sawyers Creek is also considered a potential receptor.

Groundwater usage varies across the study area including:

- Domestic.
- Farming.
- Irrigation.
- Stock watering.

19.3.3 Potential Impacts

Construction

Construction of the Project would involve modifications to existing infrastructure and construction of new infrastructure (including culverts, cuttings, embankments and bridges) as well as short term, localised dewatering for construction purposes at Wollombi Road. The Project is not anticipated to impact on availability, depth, quality or flow of groundwater. The works would involve working within close proximity of groundwater sources but would not directly intercept groundwater. Temporary dewatering (lowering of the groundwater) would occur during construction of bridge piles in Stony Creek at the intersection with Wollombi Road. Due to the temporary nature of the dewatering (a few weeks) and that the impact is localised, it is unlikely to have any significant long term impact.

No potential impacts have been identified as posing an extreme, high or medium risk in the Risk Assessment for Groundwater, however a number of potential impacts have been identified, as discussed below.

The potential impacts on groundwater during the construction phase would be:

- Potential for localised and temporary water logging, as a result of groundwater level increases during the construction of any embankments, where existing groundwater levels are within one metre of the ground surface.
- Potential for a localised, temporary reduction in shallow groundwater levels in the vicinity of Stony Creek at the intersection with Wollombi Road as a result of temporary dewatering as part of bridge pile construction works. As discussed above, this is unlikely to have any significant long term impact.
- Potential for localised degradation of groundwater quality within alluvial deposits and/or bedrock that intersect, lie directly beneath or down gradient of the Project alignment if any accidental leaks or spills occur during construction. Licensed groundwater bores are unlikely to be impacted from construction given that the distances to the nearest licensed groundwater bores (GW 200442 and GW 034601) are more than 700 metres from the rail corridor.
- Construction impacts on groundwater dependant ecosystems are considered unlikely as no dewatering is proposed, apart from at Wollombi Road where localised and temporary lowering of the groundwater would occur during construction; this is considered unlikely to have an impact on GDEs.

Operation

Operational impacts on groundwater are considered unlikely. However, operational impacts that may occur would be associated with water quality due to the use of herbicides within the rail corridor as part of maintenance procedures or potential fuel spills. It is considered that this impact would be similar to the existing situation within the rail corridor, where herbicides are currently used in maintenance.

No potential impacts on groundwater levels have been identified for the operational phase of the Project.

19.3.4 Mitigation Measures

Measures to mitigate potential impacts on groundwater are listed below:

Construction

- Conduct groundwater monitoring (levels and quality), prior to the start of construction to establish baseline groundwater conditions at selected locations adjacent to the Project alignment to confirm groundwater quality and level action criteria against which to monitor conditions during construction.
- Conduct groundwater monitoring to monitor groundwater levels and quality of shallow groundwater adjacent to the Project alignment at selected locations, to monitor any groundwater impacts during the construction phase.
- Assess groundwater monitoring results against baseline groundwater conditions during construction and review mitigation measures and monitoring program if necessary.
- Storage areas for vehicles, machinery, equipment and chemicals during construction would have appropriate facilities to contain spills, leaks and surface water runoff to reduce the potential for contamination of groundwater through infiltration.
- A response plan to deal with accidental spills and leaks would be included as part of the CEMP.

Operation

- A response plan to deal with accidental spills and leaks would be included as part of the Operational Environment Management Plan.
- Storage areas for vehicles, machinery, equipment and chemicals during construction would have appropriate facilities to contain spills, leaks and surface water runoff to reduce the potential for contamination of groundwater through infiltration.

19.4 Energy and Greenhouse Gas Emissions

19.4.1 Assessment Approach

Introduction

A desk based assessment of the Greenhouse Gases has been undertaken in accordance with the Department of Planning's Draft Guidelines *Energy and Greenhouse in EIA* (August 2002).

The Alliance sought clarification of the greenhouse gas assessment required for the Project and the Department of Planning confirmed that a Level 1 Assessment of the construction phase only is required. This is an assessment based on energy consumption and methane generation potential.

Methodology / Scope

The Level one assessment considered:

- Energy use on the site.
- Electricity energy generated off site.

- Energy used for transport.
- Methane generated either on-site or off.

The Greenhouse gases considered within the assessment are:

- Carbon dioxide (CO_2).
- Nitrous Oxide (NO).
- Methane (CO).

There are three emission scopes for consideration when assessing greenhouse gases. Scope 1 emissions are greenhouse gas emissions created directly by a person or business from sources that are owned or controlled by that person. Scope 2 are indirect emissions created by sources related to but not owned or controlled by the electricity consumers and Scope 3 are wider community issues generated as a consequence of the persons business. For more detail on this please refer to Appendix Q.

19.4.2 Potential Impacts

Emissions for construction were categorised as energy used on site, transportation of raw materials to site and waste from site, and methane generation activities, in line with the requirements of a Level 1 assessment.

The Alliance estimated the fuel consumption, materials and waste produced to construct the feasibility design. There are a number of assumptions and exclusions associated with these estimations which are outlined in detail in Appendix Q.

The Level 1 greenhouse gas assessment indicated construction emissions of 18,000 tonnes of CO_2-e over the construction period.

Note that diesel generators are proposed to provide electricity for the site compounds and hence there is no electricity imported to any of the Project sites for construction activities.

The total annual greenhouse gas emissions for NSW reported in the DCC State and Territory Greenhouse Gas Inventories 2006 were 160 mtpa. The estimated Level 1 emissions associated with the construction of the Project are 0.01% of the total greenhouse gas emissions for NSW.

Energy used on site was estimated to contribute 99% of all Level 1 emissions associated with the Project, transportation 1%, and methane generated off site through the disposal of waste and wastewater was less than 1%.

19.4.3 Mitigation Measures

Mitigation of greenhouse gas emissions should follow a hierarchical approach:

- Avoid emissions source.
- Reduce consumption.
- Improve energy efficiency.
- Replace with low emissions alternative.
- Offset.

Diesel consumption by construction plant and equipment is estimated to contribute 96.2% of the total Level 1 emissions and petrol consumption in vehicles is estimated to contribute 2.6%.

The consumption of fuel is a necessary requirement of the Project, however, a reduction in the quantity of fuel consumed may be achievable through optimisation of construction activities and logistics. Optimisation of these activities may reduce the number of vehicles and/or trips required. This optimisation should be undertaken during the detailed project design and planning stage.

A small reduction in fuel consumption may be achieved through the use of more efficient plant and vehicles. Newer vehicle and plant models are typically more fuel efficient than the older models. The use of more recent vehicles and plant models would need to be part of a wider fuel management strategy that incorporates project planning, logistics, driver education and maintenance as any fuel reduction due to more efficient models may be outweighed by poor management in other areas.

The most appropriate greenhouse gas mitigation option for fuel related emissions is likely to be the use of biodiesel. Biodiesel blends (diesel that has a percentage of the fuel replaced with biodiesel) may reduce greenhouse gas emissions due to fuel consumption, however, this is dependent on a number of factors including the origin of the biodiesel feedstock.

The Hunter 8 Alliance would examine the opportunities for the use of biodiesel in consultation with construction machinery operators and manufacturers.

19.5 Social Impact Assessment

19.5.1 Assessment Approach

Introduction

A Social Impact Assessment (SIA) has been undertaken to provide an assessment of the social impacts of the Maitland to Minimbah Third Track Project as an input to the Environmental Assessment. The SIA report is included in Appendix O.

Director- General Requirements

The key objectives of the SIA report are to address the Director-General's Environmental Assessment Requirements particularly those relating to land use and access. These are outlined in Table 19-7.

Table 19-7 Director-General's Environmental Assessment Requirements – Social Impacts

Director-General's Environmental Assessment Requirements	Where Addressed
◗ Land use and access impacts to affected properties including acquisition, severance, business viability, and property infrastructure impacts	Land Use issues are dealt with in Chapter 14 Social Impacts - Section 19.5
◗ Local community (services, access and amenity) related changes and the potential to enhance station facilities.	Community Consultation is addressed in Chapter 4 Social Impacts - Section 19.5

Impacts on the community are inherent in a number of the Director-General's Environmental Assessment Requirements which have been listed and addressed in previous sections of the Environmental Assessment.

Methodology / Scope

The SIA has been undertaken addressing the Project's potential construction and operational social impacts at various levels, including:

- Direct property impacts affecting individuals, businesses and rural land uses, including land impacts and impacts relating to amenity and livelihoods.
- Impacts to the broader community.

The SIA has been undertaken drawing on qualitative and quantitative research approaches. Preparation of the SIA has involved:

- Preliminary site visits.
- Community profiling - utilising existing data and information (including State Government departmental information, local government planning literature, web-based reference materials and ABS census data) to develop profiles of the immediately affected (local) and broader regional communities in terms of their populations, demographic composition, income levels and other attributes.
- Information provided by the Hunter 8 Alliance technical specialists, including consultation with the land acquisition and consultation team to determine the extent of landholder and land user impacts.
- Direct landholder consultations – the social team developed a brief questionnaire and interview format to implement during landholder interviews to better understand the nature of land use and key landholder concerns/issues. In total, 87 landholder interviews were conducted for the purpose of informing the SIA.

The methodology used to predict, analyse and manage potential impacts follows four steps, including:

- Scoping (including identification of Project stakeholders, study areas and likely social impacts).
- Developing a local area profile (as a baseline to assist in identifying impacts and to serve as a benchmark against which social change can be monitored).

- Identifying potential social impacts (based on desktop research, stakeholder consultations and informed by Alliance technical specialists).
- Developing social impact mitigation and management measures.

Some of the potential social impacts that have been identified would depend on final construction methods (for example choice of plant and equipment) and details that are either not currently known or finalised. In these instances, consideration has been given to the proposed construction methods and based on these assumptions generic possible impacts and mitigations have been offered.

Impacts would vary from individual to individual and property to property. Impacts have been listed at a broader user-group scale, not on a case by case basis for individual properties or landholders. However, some of the mitigation measures would need to be at an individual level. The Hunter 8 Alliance would continue community engagement practices and landholder negotiations to account for this.

19.5.2 Existing Environment

The Project extends through the LGAs of Maitland, Cessnock and Singleton, and the alignment passes through urbanised areas at Maitland, Greta and Branxton, and a smaller urban area at Lower Belford. The total population across the study area is approximately 19,480, which includes all the ABS collection districts that the Project passes through.

Within the Project's local study area, Rutherford is clearly the most populated suburb, while Greta, Telarah and Branxton are the next most populated areas. As of the 2006 Census, 45% of the local study area's population was active in the workforce, with approximately 6% unemployment. Rutherford had the largest labour force (3763 persons) with Branxton, Greta and Telarah also recording notable labour forces. The most significant industry generating employment within the local study area was manufacturing (accounting for 5.63% of the total population). A high proportion of the local study area population were within middle range income brackets ($150-$799 per week) in 2006.

A high proportion of dwellings in the local study area are either being purchased (38% of total occupied dwellings or 2603 properties) or are fully owned (32% or 2228 properties), with a significantly lower proportion of dwellings functioning as rental properties (25% or 1763 properties). *The Lower Hunter Regional Strategy (Department of Planning 2006)* and subsequent local planning initiatives have identified various locations within the local study area as priority areas to accommodate regional population growth.

The local study area population appears to be heavily dependent on private motor vehicles for personal transportation. While trains were used to travel to work as a sole means of transportation or in combination with other transportation methods, in total only about 1.74% (or 115 people) of the local study area population used trains to get to work in 2006. There are currently four Hunter Line *CityRail* passenger trains servicing the local rail stations of Lochinvar, Branxton and Greta daily.

The major centres of Maitland, Cessnock and Singleton are well supported with community services and facilities. The smaller regional towns/centres within the local study area have a more limited range of services and rely on access to major centres for essential services.

19.5.3 Potential Impacts

The nature and scale of Project's construction and operational activities is likely to give *rise to several impacts on the local community. The potential social impacts have* been broadly categorised into construction impacts and operational impacts, and relate to direct impacts on private property (residents and businesses that constitute the Project's neighbouring landholders) and/or impacts on the broader community.

Construction

Potential impacts on the community during the Project's construction period include:

- Potential property impacts:
  - Land acquisitions.
  - Noise and Vibration.
  - Air Quality
  - Property damage.
  - Impacts on flora and fauna.
  - Changes to property infrastructure.
  - Reduced access to private property.
  - Reduced security.
- Potential community impacts:
  - Reduced road safety.
  - Reduced transport access - roads and traffic mobility, rail access and pedestrian access.
  - Construction employment opportunities.

Operation

Potential community impacts during the Project's operational period are listed below. The impact on the broader community brought about by the Project's operation would likely be less pronounced and result from indirect change processes.

- Potential community impacts:
  - Noise.
  - Vibration.
  - Dust.
  - Drainage.
  - Property devaluation.
  - Reduced viability of development plans.
  - Reduced access to private property.

19.5.4 Mitigation Measures

Construction

- A Construction Environmental Management Plan (CEMP) would be prepared and implemented to mitigate potential impacts on the local community. The CEMP and sub-plans would address a number of issues including:
  - Noise and vibration mitigation measures described in Section 17.6.
  - Air quality mitigation measures described in Section 16.4.
  - Traffic management measures (including maintaining access to residential properties and local businesses) described in Section 15.5.
- A Consultation Strategy would be prepared and implemented for the construction phase. This would include a number of strategies including:
  - Provide relevant stakeholders with sufficient information to enable them to understand the likely nature, extent and duration of construction and potential impacts.
  - Swift response to any stakeholder complaints and respond to stakeholder issues as they arise.
  - Communicate localised construction activities and timeframes to relevant stakeholders so they can take measures to minimise impacts on themselves and their properties if required.
  - Communicate future changes (such as via Project newsletter / updates, advertisements) to help the community understand what the Project site would look like after construction activities.
  - Communicate construction related road changes to relevant local residents to provide awareness of changed access arrangements.
  - Provide relevant stakeholders with sufficient information to enable them to understand the likely nature, extent and duration of noise and vibration impacts.
  - Where adverse light impacts on residences may occur implement attenuation measures, such as screening of sensitive receptors.
- The final design and construction methodology would be developed to minimise impacts on property adjoining the Project. This would include:
  - Avoid damage to property outside the construction zone.
  - Implement ARTC and construction contractor conduct protocols.
  - Monitor construction contractors' performance.
  - Addressing the visual mitigation measures in Section 19.6.

- Where the Project requires the disturbance and/ or acquisition of adjoining property, the following measures would be implemented:
  - Negotiate land acquisitions and implement appropriate compensations measures as described in Section 14.4.
  - Implement measures to compensate/offset significant impacts on private infrastructure (such as dams and buildings). Measures to be developed in consultation with affected landholders as discussed in Section 14.4.
- Include local employment in construction contactor recruitment, where suitable.

Operation

- Implement the noise and vibration mitigation measures described in Section 17.6.
- Implement mitigation/management measures outlined in Section 16.
- Maintain communication lines between ARTC and the community.

19.6 Visual

19.6.1 Assessment Approach

Introduction

A Landscape and Visual Impact Assessment (LVIA) was undertaken by the Hunter 8 Alliance as part of the preparation of this environmental assessment and is included in Appendix P.

Landscape and visual values and impacts of the Project are assessed separately, although they are closely interrelated. The assessment of the potential landscape impacts of a Project is carried out as an impact on an environmental resource (i.e. the landscape) whereas visual impacts are assessed as one of the interrelated impacts of a project on the viewing population.

The objective of this section is to outline the potential impact of construction and operation of Project on landscape character and visual amenity and proposed mitigation measures that would help to ameliorate these impacts during both the construction and operation stages of the Project.

Methodology / Scope

The visual impact assessment addresses the potential landscape and visual impacts associated with the Project, including:

- Review of existing information relevant to the visual environment, including existing landform, vegetation, and land use.
- A description of the Project and its visual components.
- An evaluation of the existing landscape and visual environment.
- Discussion of visual receptor sensitivity within the study area through the use of viewing locations.

- Assessment of the significance of impacts on visual landscape character and amenity at the viewing locations as a direct result of the Project.
- Proposed mitigation strategies.

The methodology for the identification of the existing environmental values of the area surrounding the site and the identification of the viewing locations is detailed below:

- Identification of the visual catchment, which is the area from which views of the Project and its associated works are potentially visible.
- Description of the landscape character of the visual catchment including the aspects of landform, land use, and vegetation.
- Identification of viewing locations from which elements of the Project would be visible and within the landscape character units and describing the visual outlook from these locations.
- Site verification with photographic recording to provide a representation of typical views and outlooks from the viewing locations.

19.6.2 Existing Environment

The following section provides an overview of the existing landform, land uses and vegetation in the vicinity of the Project site. These features all contribute to the existing landscape and visual character of the area.

Landform

The landform in the vicinity of the Project alignment is generally flat to gently undulating. The elevation of the Project alignment ranges from approximately 10 metres AHD near Rutherford in the east (approximate chainage 194.500 kilometres), to approximately 93 metres AHD at Harper's Hill, south east of Greta (approximate chainage 205.360 kilometres). Ridges and mountains to the north, beyond the Hunter River, form the background horizon of some views, while ridges and mountains to the south (Heaton State Forest and Watagans National Park) and south-west (Pokolbin State Forest) from the background in other views.

Landscaping and Vegetation

Much of the Project route is dominated by a rural cleared landscape that is typified by cleared grazing pasture and some scattered trees and low vegetation. These areas show much evidence of modification, both through the previous clearing of vegetation, primarily for grazing, and the introduction of pasture grasses. At other locations along the Project route, the landscape is more heavily vegetated, with patches of indigenous bushland and scattered groups of trees. These more heavily vegetated areas occur around Farley, Rutherford (west of the Rutherford industrial area), along Anvil Creek between Allandale and Greta, south of the railway line near Branxton and around Belford, in close proximity to the Belford National Park. Some examples of the typical local landscape characteristics are shown in the following photos and are further explained in the LVIA.

Figure 19.1 View to the North from Wollombi Road.

In Figure 19.1 the railway line can be seen at the edge of the vegetated area (approximate distance 500 metres) with the town of Rutherford visible beyond.

In Figure 19.2 the existing rail line and can be seen at a distance of approximately 150 metres from the nearest house. The existing bridge crossing is also visible from this location.

Figure 19.2 View to the West from Old North Road, Allandale.

19.6.3 Potential Impacts

The potential visual impacts are considered in the context of the sensitivity of the surrounding visual environment and the potential for viewing of the areas that have had changes to their visual outlook due to site works. The assessment of potential visual impacts of this project focuses on the visibility of both the construction and operation phases of the Project.

The landscape and visual impacts of the Project are assessed as being of moderate significance. A moderately significant impact is one that, whilst some noticeable impact would occur, it is within reasonable limits and not excessive or extreme. Due to the nature of the Project there would be a permanent impact on the visual landscape and amenity of some locations along the Project alignment. The landscape and visual impacts of the Project would occur both during the construction and operation phases of the Project.

An overview of the landscape and visual impacts during construction and operation are summarised below.

Construction

The majority of landscape and visual impacts would be a result of activities carried out in the construction phase of the Project. These activities include the clearance of vegetation which currently adds to the landscape character of an area, the presence of construction machinery and activities in an otherwise rural landscape and the construction of earthworks batters which, until vegetated, would be a visually obvious element in the landscape.

Operation

Some impacts would occur in the operations phase of the Project. In some locations, vegetation clearance during the construction phase would result in views of coal and commuter trains being made available to residences that currently do not have views to such elements. In other locations, earthworks batters would be located closer to residences than they currently are.

Figure 19.3 Photomontage Showing Indicative Representation of Third Track (Right Hand Side)

This photomontage shows an indicative representation of the view from Bridge Street, Branxton after the completion of all construction works. The proposed third track, wider batters, access tracks and vegetation clearing are shown in this view.

A summary of the outcomes of the LVIA are detailed in Table 19-8.

Table 19-8 Summary of Impacts

Viewing Location	Landscape Impact	Visual Sensitivity	Significance of Impact
1 – Wollombi Road, Farley	○	◑	○
2 – Station Lane, Lochinvar	◔	◕	◑
3 – Old North Road, Allandale	◔	◑	◔
4 – Clift Street, Greta	◑	◕	◕
5 – Mansfield Street, Greta	◑	◑	◔
6 – Wine Country Drive overpass, Branxton	◔	◔	○

Viewing Location	Landscape Impact	Visual Sensitivity	Significance of Impact
7 – Branxton railway station, Branxton	◔	◔	○
8 – Belford Street, Belford	◑	◑	◑
9 – Kirkton Street, Belford	◕	◑	◕

○ Negligible Landscape Impact / Negligible Visual Sensitivity / Not Significant Impact

◔ Small landscape Impact / Low Visual Sensitivity / Minor Significance of Impact

◑ Moderate Landscape Impact / Medium Visual Sensitivity / Moderate Significance of Impact

◕ Large Landscape Impact / High Visual Sensitivity / High Significance of Impact

● Major Significance of Impact

19.6.4 Mitigation Measures

Construction

- Development of a Landscape Rehabilitation Strategy and Landscape Strategy that draws together the outcomes of the integrated design and assessment process.
- Where possible avoid loss or damage to vegetation within the rail corridor and adjacent road reserves and private property including the protection of trees prior to construction and/or trimming of vegetation to avoid total removal. This includes vegetation that makes a significant and positive contribution to landscape character and/or provides screening to adjacent properties.
- Minimise light spillage through designing the construction and operation lighting so the sites are not over-lit and to minimise additional light spillage from the rail corridor into adjacent visually sensitive properties.
- Temporary hoardings, barriers, traffic management and signage to be removed when no longer required.
- Materials and machinery to be stored tidily during the works.
- Roads providing access to the rail corridor and work sites to be maintained free of dust and mud as far as reasonably practicable.
- Integration of infrastructure (such as structures, embankments/cuttings, and bridges) into the surrounding environment where possible.
- Early identification of landscape 'hot spots' and integration of mitigation strategies to minimise landscape and visual impacts.

- Demonstrate that environmental, landscape and urban design issues have been adequately considered as part of an integrated design process resulting in a positive legacy for the Project.
- Consultation with affected residents on screening options.
- Landscape solutions should be buildable within the site boundary from the outset unless agreed by adjoining landholders.
- Maintenance of screening planting following the establishment phase to ensure continual / improved visual screening over time.

19.7 Waste

19.7.1 Assessment Approach

Introduction

The Project has the potential to generate a number of different types of waste, which would require management and disposal in accordance with relevant state legislation and government policies.

Director-General's Environmental Assessment Requirements

Table 19-9 outlines the Director-General's Environmental Assessment Requirement relating to waste and where they have been addressed.

Table 19-9 Director-General's Environmental Assessment Requirements – Waste

Director-General's Environmental Assessment Requirements	Where Addressed in Environmental Assessment
General Construction Impacts	
Assess and present a management framework for earthworks, including a considered approach to minimising impacts associated with the excavation, movement, stockpiling, rehabilitation and disposal of spoil and fill. Consideration should be given to: - Quantification of bulk earthworks and spoil balance and the disposal of excess spoil.	Sections 19.7.2 and 19.7.3

Policy Framework

The following guidelines would be used throughout the Project for responsible waste management:

- *Construction and Demolition Waste Action Plan* (DEC, 1998).
- *Environmental Guidelines: Assessment, Classification and Management of Non Liquid and Liquid Waste* (DEC 1999).
- *Green Waste Action Plan* (DEC, 1997).
- *Waste Planning for Industry: A Guide* (Waste Management Authority of NSW) 1990.

Ecologically Sustainable Development principles in waste management would also be recognised in the construction of the Project through adherence to the waste hierarchy and by ensuring:

- The production or generation of waste does not exceed the assimilative capacity of the means / method of disposal and the environment.
- The adoption of a whole of lifecycle approach in formulating a waste minimisation and management plan for the Project.

The requirements of the *Protection of the Environment Operations Act* 1997, which are relevant to the Project include:

- Any hazardous waste must be stored in an environmentally safe manner and not come into contact with any incompatible waste.
- Waste must be transported to land that can lawfully receive that waste for example, unsuitable material may be transported to local properties that may legally accept the material for driveway construction, etc.
- Transport vehicles must be kept in a clean condition and be constructed and maintained so as to prevent waste spillage.
- Transport vehicles must be covered when loaded so as to prevent spilling and loss of waste and to prevent emission of odours.

19.7.2 Potential Impacts

Construction

The following wastes would be expected to be generated during construction:

- Cleared vegetation and landscaping materials.
- Demolition waste from existing structures (including concrete, bricks and steel).
- Construction materials (including concrete, bricks, crushed rock, rail, steel and timber).
- Liquid wastes (such as waste fuels, oils and chemicals).
- Surplus materials used during site establishment such as safety fencing and barriers which may include plastics and metals.
- Wastewater including site run-off and water used to control dust.
- Domestic waste including food scraps, aluminium cans, glass bottles, plastic and paper containers and putrescible waste generated by site construction personnel.
- Ablution waste including waste from toilets and basins.
- Waste oil and fuels.

Operation

A small quantity of waste would be generated by rail maintenance and repair activities. These wastes would include vegetation trimmed from remnant vegetation and landscaped areas, materials from track repairs, and oils and greases from maintenance vehicles. Rail users may also generate litter along the line and at stations.

19.7.3 Mitigation Measures

Construction

To determine waste management options, waste would be classified according to the DECC's Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes (1999) into the following categories:

- Inert – including virgin excavated material, vegetation, building and demolition waste, concrete and asphalt.
- Solid – such as food waste and litter.
- Industrial – such as asbestos.
- Hazardous – such as flammable liquids.
- Liquid – such as sewage.

A Waste Management Plan would be prepared as part of the construction environmental management plan and provide details of the requirements for handling, stockpiling and disposal of wastes.

Operation

- The Resource Management Hierarchy principles of the *Waste Avoidance and Resource Recovery Act* 2001 would be implemented as follows:
  - Unnecessary resource consumption would be avoided.
  - Avoidance would be followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery).
  - Disposal would only be undertaken as a last resort.

Where feasible, suitable waste would be recycled. Items for recycling would be sorted, collected and taken to a recycling depot in the region. Non-recyclable materials would be disposed of at licensed disposal facilities.

19.8 Hazards

19.8.1 Potential Hazards

The Environmental Risk Analysis presented in Chapter 8 identified the potential environmental hazards during the construction and operation of the Project. This has been discussed in detail within the body of this document.

There is the potential for human health risks and other hazards associated with the construction and operation of the Project. Some of these include:

- Possible injury to construction or maintenance staff.
- Possible collision with construction or maintenance vehicles and equipment.
- Possible contact with hazardous materials.

19.8.2 Hazard Management and Safeguards

Emergency Services

The Hunter 8 Alliance has developed a framework for managing risk that is compliant with John Holland, GHD and ARTC requirements. This framework considers emergency response procedures, appropriate consultation and communication with emergency services in areas of construction.

Human Health

A site specific Safety Management Plan would be developed by the Hunter 8 Alliance, along with Activity Method Statements and Task Risk Assessments prepared and implemented for construction activities. The Plan would identify hazards associated with work on the site and the hazard controls to be implemented so people are adequately protected from risk of injury or illness, including:

- Procedures to comply with all legislative and industry standard requirements for the safe handling and storage of hazardous substances and dangerous goods.
- Procedures for manual handling of heavy loads.
- Procedures for blasting activities.
- Procedures for operation and maintenance of site plant, including mobile plants.

Environmental

The Construction Environmental Management Plan and the supporting sub plans would address the relevant environmental risks and hazards. This would include:

- Details of the hazards and risks associated with the activity.
- Mitigation Measures and plans including those identified in this Environmental Assessment and environmental risk analysis sections.
- Contingency plans as required.

20. Cumulative Impacts

20.1 Assessment Approach

The Director-General’s Environmental Assessment Requirements require assessment of the key issues with regard to the cumulative impacts of construction and operation of the Project. This chapter discusses the potential cumulative impacts on the key issues due to construction and operation the Project, and how these potential impacts have been considered in the design of the Project and in the development of management and mitigation measures.

Cumulative impacts are the effect caused by successively and/ or concurrently adding the same impact to produce an accumulated effect.

The key potential sources of cumulative impacts are the construction and operational activities of the Project and other projects occurring concurrently and/ or successively.

A number of existing and proposed projects and activities could have a cumulative impact with construction and operation of the Project. These include (but are not limited to):

- Existing vehicular traffic on the New England Highway and other roads.
- The proposed Hunter Expressway and works on feeder roads.
- Proposed residential and industrial developments adjacent to and in the vicinity of the Project.
- The proposed Pacific National Provisioning Facility at Greta.
- The Minimbah Bank Third Track Project and other rail improvement projects being undertaken by ARTC.
- The rail overpasses at Station Lane Lochinvar and Hermitage Road Belford, and the bridge replacement at Nelson Street Greta.
- Maintenance activities with the existing rail corridor.

In addition, as construction of the Project would include activities occurring at a number of locations along the rail corridor, there is the potential for these to generate a cumulative impact.

20.2 Potential Impacts

Table 20-1 lists the key issues from the Director-General’s Environmental Assessment Requirements, the associated potential cumulative impacts, and how the Project has considered and addressed these potential impacts.

Table 20-1 Potential Cumulative Impacts and Project Response

Issue	Potential Cumulative Impact	Project Response
Key Issues		
General Construction Impacts:		
Noise and Vibration	Noise and vibration generated by construction of the Project has the potential to accumulate with the following noise and vibration sources: - Rail operations in the existing rail corridor. - Construction of the Hunter Expressway and connecting roads (at Branxton) - Construction of various residential developments adjacent to the rail corridor - Construction of the Pacific National Provisioning Facility.	The Noise and Vibration Impact Assessment (Appendix K) references the Interim Construction Noise Guidelines (DECCW, 2009), which notes that construction should result in noise levels no greater than 10dB(A) above background noise levels. Construction of the Project and the other projects in the area would all need to work in accordance with this objective, and therefore the noise from other activities would be considered. Working consistent with these guidelines would mean that noise from the existing activities would also be considered. Similarly, the noise and vibration generated by the various construction locations within the Project would be the subject of overall management via a Construction Noise, Vibration and Blasting Management Plan.
Traffic and Access	Traffic generated by construction of the Project has the potential accumulate with the following: - Existing traffic on the New England Highway and other roads. - Traffic generated by construction of the Hunter Expressway and connecting roads (at Branxton) - Traffic generated by construction of various residential and industrial developments adjacent to the rail corridor - Construction of the Pacific National Provisioning Facility.	The Traffic Study (Appendix J) has been undertaken to assess the impact of the Project construction traffic on existing and predicted traffic levels on the New England Highway and other roads. The recommendations of the Study have been developed to minimise impacts on the existing traffic. The Traffic Study also considers the potential cumulative traffic associated with the Hunter Expressway (programmed to be constructed concurrently) potentially impacting the same roads as the Project between Greta and Branxton. The Construction Traffic Management Plan would be developed in consultation with the RTA to minimise potential impacts and conflicts, and ongoing communications would be maintained with the RTA throughout the construction phase to maintain the coordinated approach to traffic management throughout the construction phase of both projects.

Issue	Potential Cumulative Impact	Project Response
		The current program for construction of the Project and residential and industrial developments appear to have minimal concurrence. Where there is concurrence, however, the key cumulative impact would be on the New England Highway, and therefore is likely to have a significant impact. The rail overpasses at Station Lane Lochinvar and Hermitage Road Belford, and the new bridge at Nelson Street Greta, would be completed prior to the proposed commencement of construction of the Project. These would provide a positive cumulative impact by removing major construction – road vehicle interfaces and the associated traffic and safety risks.
Air Quality	Dust is the key air quality issue during construction. Dust generated by construction of the Project has the potential to accumulate with dust potentially generated from the following: - Construction of the Hunter Expressway and connecting roads (at Branxton) - Construction of various residential developments adjacent to the rail corridor - Construction of the Pacific National Provisioning Facility	The Project's Construction Environmental Management Plan (CEMP) would include a number of dust management strategies (as discussed in Chapter 16). It is assumed that these other construction activities would also apply such dust control measures. In the event that an adverse dust event occurs in close proximity to the Project and another construction activity, consultation would be undertaken with the management of the other activity to determine an appropriate response.
Ecology	The vegetation clearance required for the Project and other developments in the area could result in a cumulative significant impact on Endangered Ecological Communities (EEC) and threatened flora and fauna.	The Ecological Assessment for the Project, including the Assessment of Significance, was undertaken on the assumption that the vegetation for the proposed Hunter Expressway and Huntlee residential development had been cleared. This ensures that the significance of the cumulative impact has been considered.

Issue	Potential Cumulative Impact	Project Response
Heritage:		
Aboriginal	The earthworks required for the Project and other developments in the area could result in a cumulative impact on Aboriginal heritage and cultural significance.	The local Aboriginal community has been involved throughout the environmental assessment for the Project. These groups may have been involved in the Aboriginal Heritage Impact Assessment for the other projects in the area. This involvement of the local Aboriginal community across these projects provides opportunity for any concerns regarding cumulative impacts on Aboriginal heritage and cultural significance to be identified.
Non-Indigenous	The disturbance to non-indigenous heritage items required for the Project and other developments could result in a cumulative impact on the heritage significance of these items.	The Station Lane rail overpass to be constructed by the ARTC would result in road traffic being further away from the heritage item Clifton House than currently, and therefore is unlikely to contribute to cumulative impacts with the Project.
Land Use and Access	As discussed in Chapter 14, the Project requires property acquisition and has the potential to impact on the use of adjoining properties. The Project has been designed to minimise impacts on property access during the operation phase. The Hunter Expressway has also required property acquisition, which has been ongoing for a number of years.	The land use impacts associated with the Project and the Hunter Expressway has been minimised, as the alignment of the Hunter Expressway has been a key consideration during the Project design. Further, the land surrounding the interaction between the rail corridor and the Hunter Expressway alignment is primarily owned by the Roads and Traffic Authority (RTA) and the Hunter 8 Alliance has undertaken extensive discussions with the RTA.
Operational Air, Noise and Vibration	Dust, exhaust emissions and noise and vibration generated by operation of the third track have the potential to have a cumulative impact with the following key sources: - The existing New England Highway and other roads. - The proposed Hunter Expressway and connecting roads.	The Noise and Vibration Impact Assessment includes noise modelling that predicts the noise level based on the existing noise environment combined with the predicted noise from operations within the rail corridor (including the third track). As such, noise from existing traffic on the New England Highway and other roads would have been appropriately captured.

Issue	Potential Cumulative Impact	Project Response
		The noise environment in the Branxton area of the Project is likely to change following completion of the Project and the Hunter Expressway. Noise attenuation currently provided along the rail corridor adjacent to residential areas at Branxton would be maintained, and a review of designs for the Hunter Expressway indicate that some noise attenuation is also proposed. It is therefore anticipated that as both projects are providing attenuation, the cumulative noise impacts on the sensitive receptors close to both projects would not be significant.
Hydrology	The earthworks (particularly filling) required for the Project and other developments could have an adverse impact on hydrology, particularly flooding and flows in watercourses.	The impact of the required earthworks for the Project have included consideration of potential impacts on hydrology as a key element. The potential impact on flooding associated with filling required for the embankment was modelled in combination with the embankment required for the new bridge at Nelson Street. The hydrological assessments have looked at the wider catchment for watercourses affected by the Project, and so have considered the cumulative issues rather than looking at the Project in isolation.
		There are a number of waterways that are potentially impacted by both the Project and the Hunter Expressway. For the purposes of the Surface Water Assessment, it has been assumed that the assessment of surface water for the Hunter Expressway would have considered similar aspects as considered in the Project's surface water assessment. Therefore, it has been assumed that the concept design of the Hunter Expressway includes measures to minimise the increase in runoff as a direct result of that Project and that scour protection and energy dissipation have also been incorporated.

Issue	Potential Cumulative Impact	Project Response
		Consideration was also given to the location of the Hunter Expressway in relation to the Project. The Hunter Expressway is located primarily upstream of, and in close proximity to, the Project. Therefore the flows generated from the Hunter Expressway would be controlled by the waterway structures within the Project. In the event that the Hunter Expressway flows were not within a reasonable range of the existing flows at that location, it is anticipated that the peak flow rate directed to the environment downstream of the Project would not be significantly increased due to this constriction. Additionally, the scour protection and energy dissipation provided as part of this Project should minimise any cumulative impacts on the downstream environment.
Other Issues		
Social	The Project and other developments in the area have the potential to have a number of cumulative impacts on the local and wider community, including: - Those issues discussed above - The direct and indirect employment and economic opportunities generated during the construction phase, and ongoing benefits from operation of the developments.	The measures described previously would manage the potential adverse cumulative impacts. The Project, as part of the 2009-2018 Hunter Valley Capacity improvement strategy, would contribute to improvements in freight capacity to the Port of Newcastle, and the associated employment and economic benefits that it provides. Through the implementation of the measures identified in the draft Statement of Commitments (Section 21.1) developed through the environmental assessment, the Project would result in a net cumulative benefit to the community
Visual	The Project and other developments in the area have the potential to have a cumulative visual impacts on the local environment due to earthworks, major infrastructure and vegetation clearance.	The potential cumulative impact of the third track with the existing rail corridor and associated infrastructure has been considered in the Visual Impact Assessment (Appendix P). As the Project is a widening of the rail corridor where it interacts with the Hunter Expressway, it is unlikely that the Project would contribute to a significant cumulative visual impact.

Issue	Potential Cumulative Impact	Project Response
		As noted above, the Project, the Hunter Expressway and the proposed residential and industrial developments would require clearance of native vegetation that could have a cumulative visual impact. However, the Project would include a range of measures to mitigate and offset vegetation clearance that would minimise the Project's contribution to the visual impact.

ARTC

Part D
Environmental Management

Hunter 8 Alliance

Part D - Environmental Management

21. Environmental Management

ARTC is committed to undertaking its activities in an environmentally responsible manner and effectively managing any risks that may lead to an impact on the environment.

21.1 Draft Statement of Commitments

Section 75F(6) of the EP&A Act states that '*the Director-General may require the proponent to include in an environmental assessment a statement of the commitments the proponent is prepared to make for environmental management and mitigation measures on the site*'.

A requirement of the Director-General's Environmental Assessment Requirements is that the Environmental Assessment include:

> *"a draft Statement of Commitments incorporating or otherwise capturing measures to avoid, minimise, manage, mitigate, offset and/or monitor impacts identified in the impact assessment sections of the Environmental Assessment. The Statement of Commitments must clearly articulate the desired environmental outcome of the commitment. The Statement of Commitments must be achievable, measurable (with respect to compliance), and time-specific, where relevant."*

In accordance with this requirement, ARTC's commitments for environmental mitigation, management and monitoring for the Project include the preparation of a draft Statement of Commitments. The draft Statement of Commitments incorporates measures to avoid, minimise, manage, mitigate, offset and monitor impacts identified throughout this Environmental Assessment.

The draft Statement of Commitments has been prepared as part of this Environmental Assessment and is located in Table 21-1. The draft Statement of Commitments outlines environmental issues, mitigation and management procedures associated with the following:

- Terrestrial Flora.
- Terrestrial Fauna.
- Aquatic Ecology.
- Aboriginal Heritage.
- Non-Indigenous Heritage.
- Land Use.
- Traffic and Access.
- Air Quality.
- Noise and Vibration.
- Surface Water.
- Topography, Soils and Geology.
- Contamination.
- Groundwater.

- Energy and Greenhouse Gas Emissions.
- Social.
- Visual.
- Waste.
- Risks and Hazards.

These measures are further detailed in the relevant chapter within this Environmental Assessment and the corresponding specialist report.

Table 21-1 Draft Statement of Commitments

Ref No.	Objective	Commitment	Timing
Flora			
SC1	Minimise the potential impacts that may occur to flora species and their habitats.	Management of adverse impacts arising from the Project is to be addressed according to the hierarchy of avoidance; mitigation and offsetting of adverse impacts, consistent with the approach outlined in the Part 3A Draft Guidelines for Threatened Species Assessment (DEC and DPI 2005).	Pre-construction
		Minimise vegetation clearing and retain mature trees where possible.	Construction
		Pre-clearance survey to flag: - Slaty Red Gum and Mountain Grevillea occurring within and adjacent to the study area, with the aim to avoid clearing these individuals. - The edge of EECs occurring in the vicinity of construction to avoid unnecessary impacts on these stands.	Pre-construction and Construction
		Habitat features that may be utilised by fauna such as fallen logs would be relocated into adjacent bushland where possible.	Pre-construction and Construction
		Provision of flagging, taping or similar marking method along the edge of the clearance area so that works would not encroach closer than necessary upon remnant bushland and minimise the footprint of construction works.	Pre-construction and Construction
		Use of existing disturbed corridors, such as paddocks, cleared areas, roads, tracks and existing easements, for set up of equipment, machinery turning circles, stockpile areas and site facilities where possible.	Pre-construction and Construction

Ref No.	Objective	Commitment	Timing
SC2	Minimise runoff and sedimentation	Development and implementation of a Spoil and Fill Management Plan. Erosion and sediment controls would be installed prior to earthworks and vegetation clearing, and would be maintained throughout construction, to minimise sediment entering EECs, creeks and drainage lines.	Pre-construction and Construction
SC3	Minimise impact from stockpiles	Separate stockpiling of topsoil and vegetation removed from various areas to delineate soils containing seeds from native or exotic species where possible.	Construction
		Placement of soil stockpiles outside of vegetated areas and outside the drip line of trees.	Construction
SC4	Rehabilitation of area	Rehabilitation and replanting of native vegetation for areas of newly-created bare soil following construction, such as batters.	Construction and Post-construction
		A revegetation plan would be prepared, including strategies for protection and rehabilitation of Slaty Red Gum and EECs that occur in the study area. The revegetation plan would also identify local native species appropriate for the revegetation of riparian areas surrounding creeks and drainage lines.	Pre-construction and Construction
		A specific revegetation plan for Sawyers Creek would be developed to reinstate riparian vegetation characteristic of Red Gum Open Forest, which extends upstream from the works site.	Pre-construction and Construction
SC5	Minimise impacts of noxious weeds	Weeds from areas cleared during construction would be sprayed with appropriate herbicides or removed from the site and not allowed to enter watercourses or moist areas such as drainage lines. A weed management strategy would be implemented, possibly as part of a vegetation management plan, for any retained or rehabilitated natural vegetation within the study area and any offset areas. All noxious weeds within the land would be treated in accordance with their weed Class as per the *Noxious Weeds Act* 1993.	Construction
SC6	Minimise the risk of importation of root-rot fungus	Protocols to prevent introduction or spread of *Phytophthora cinnamomi* would be implemented following DECCW guidelines.	Pre-construction and Construction

Ref No.	Objective	Commitment	Timing
SC7	Implementation of offset areas	A Compensatory Habitat Strategy would be developed that would contribute to the long term conservation of biodiversity. This would be developed in consultation with DECCW with the aim to set aside known habitat for Slaty Red Gum and EECs within the locality of the Project. Offset areas would be required to compensate for the loss of or disturbance to vegetation communities (fauna habitat areas) across the investigation area. Offset areas are further detailed in Chapter 9 (Terrestrial Flora) of this Environmental Assessment.	Construction and Operation
Fauna			
SC8	Minimise harm to fauna species during the clearing of trees for the Project	A tree felling protocol would be developed to minimise harm to all fauna species during the clearing of trees for the Project. The protocol would be developed by a suitably qualified and licensed ecologist with previous experience supervising the felling of trees.	Pre-construction and Construction
		All tree felling of habitat trees would be supervised by a suitably qualified and licensed ecologist with previous experience supervising the felling of habitat trees. Tree felling protocols are further detailed in Chapter 10 (Terrestrial Fauna) of this Environmental Assessment.).	Pre-construction and Construction
		The construction impact zone and areas of vegetation to be cleared would be clearly identified.	Pre-construction and Construction
SC9	Establishment of nest boxes	Nest boxes would be established and monitored as identified in Chapter 10 (Terrestrial Fauna) of this Environmental Assessment.	Pre-construction and Construction
SC10	Identify bridges and culverts that may be used for roosting/ nesting	Where bridges and culverts are to be removed or modified, an ecologist would inspect the bridge/culvert immediately prior to removal/modification for roosting bats, and fairy martin and welcome swallow nests.	Pre-construction and Construction
SC11	Wildlife friendly designs	Where culverts are to be replaced or constructed, they would not restrict the use of those culverts as movement corridors for fauna species through the rail corridor.	Construction
SC12	Minimise runoff and sedimentation	The commitments outlined in SC2 also apply to minimise run off and sedimentation impacts on fauna species and their habitats.	Construction and Operation
SC13	Rehabilitation of area	The commitments outlined in SC4 also apply to implement rehabilitation which would minimise impacts to fauna species and their habitats.	Construction and Post- construction

Ref No.	Objective	Commitment	Timing
SC14	Minimise impacts of noxious weeds	The commitments outlined in SC5 also apply to minimise impacts of noxious weeds on fauna species and their habitats.	Construction
SC15	Minimise the risk of importation of root-rot fungus	The commitments outlined in SC6 also apply to minimise impacts of root-rot fungus on fauna species and their habitats.	Pre-construction and Construction
SC16	Implementation of offset areas	The commitments outlined in SC7 also apply to implement offset areas which would minimise impacts to fauna species and their habitats.	Construction and Operation
Aquatic Ecology			
SC17	Minimise potential impacts to aquatic species and their habitats.	The commitments outlined in SC1 also apply to minimise impacts to aquatic species and their habitats. ◗ The construction areas would be clearly identified so that works would not encroach closer than necessary upon remnant riparian vegetation. ◗ Design new culverts for fish friendly crossings. ◗ No instream woody snags are to be removed from creeks or drainage lines except as required for structures or creek realignment. In the case of the Sawyer's Creek realignment, any woody snags that occur within the construction impact zone would be relocated or replaced up or downstream of the construction area dependant on site safety and access considerations.	Pre-construction and Construction
SC18	Minimise runoff and sedimentation	The commitments outlined in SC2 also apply to minimise runoff and sedimentation impacts to aquatic species and their habitats.	Pre-construction and Construction
SC19	Rehabilitation of area	The commitments outlined in SC4 also apply to implement rehabilitation which would minimise impacts to aquatic species and their habitats.	Construction and Post-construction
SC20	Minimise impacts of noxious weeds	The commitments outlined in SC5 also apply to minimise impacts of noxious weeds on aquatic species and their habitats.	Construction

Ref No.	Objective	Commitment	Timing
Aboriginal Heritage			
SC21	Minimise impacts on Aboriginal heritage	Provisions relating to Aboriginal heritage would be included in an Aboriginal Heritage Management Plan (AHMP), which would be a component of the CEMP. These provisions would be formulated in consultation with the registered Aboriginal stakeholders and DECCW, and specify the policies and actions required to manage the potential impacts of the Project on Aboriginal heritage after Part 3A Approval is granted. The primary elements of the AHMP are outlined below and further detailed in Chapter 12 (Aboriginal Heritage) of this Environmental Assessment.	Pre-construction and Construction
SC22	Implement a program of salvage	To mitigate the impacts of development and to retrieve and conserve samples of Aboriginal heritage evidence, a program of salvage would be undertaken within the Construction Impact Zone. This work would be undertaken by representatives of the registered Aboriginal stakeholders and qualified archaeologists. A detailed description of these management strategies are provided in Chapter 12 (Aboriginal Heritage) of this Environmental Assessment.	Pre-construction and Construction
SC23	Implement precautionary measures	Where impacts can be avoided to the identified Aboriginal heritage evidence, appropriate precautionary measures, such as informing relevant staff and contractors of the nature and location of the items and need to avoid impacts, along with temporary protective fencing and signage, would be implemented for those sites within close proximity of the area of works.	Pre-construction and Construction
SC24	Minimise impacts to areas with moderate or high aboriginal significance	Consideration would be given, where possible, to avoiding or minimising impacts to the high significance site and the zones where there is a moderate or high potential for sub-surface deposits of artefacts that may be in situ and/or of high research value in areas of lower ground disturbance.	Pre-construction and Construction
SC25	Heritage awareness training	All relevant contractors and staff engaged on the Project would receive heritage awareness training prior to commencing work on-site. Heritage awareness training is further described in Chapter 12 (Aboriginal Heritage) of this Environmental Assessment.	Pre-construction and Construction

Ref No.	Objective	Commitment	Timing
SC26	Implement archaeological survey	Archaeological survey would be conducted to sample all of the potential impact areas that could not be sampled during the present investigation or any subsequent amendments to the impact area outside of the investigation area. Archaeological survey details are provided in Chapter 12 (Aboriginal Heritage) of this Environmental Assessment.	Pre-construction and Construction
SC27	Management of previously unrecorded Aboriginal heritage sites	Provisions would be included to guide the management of any previously unrecorded Aboriginal heritage sites that may be identified within the Project area. Management provisions would vary in relation to the nature of any evidence identified, its significance and the nature of the proposed impacts, and may include temporary protection, avoidance of impacts, mitigation, monitoring or unmitigated impact.	Pre-construction and Construction
SC28	Management of skeletal remains	Should any skeletal remains be detected during the course of development, work in that location would need to cease immediately and the finds be reported to the appropriate authorities, including the Police, DECCW and Aboriginal stakeholders. Detection of skeletal remains is further detailed in Chapter 12 (Aboriginal Heritage) of this Environmental Assessment.	Construction
SC29	Use qualified and experienced archaeologists	Archaeological investigations would only be undertaken by archaeologists qualified and experienced in Aboriginal heritage, in consultation with the registered Aboriginal stakeholders, and occur prior to any development impacts occurring to those specific areas or sites. The registered Aboriginal stakeholders would be afforded the opportunity to be involved in any field studies as per the DECC (2004) *Interim Community Consultation Requirements for Applicants* policy.	Construction
SC30	Review of AHMP	The AHMP would be regularly reviewed to establish that it is functioning as designed to the standard required.	Construction
SC31	Consultation with Aboriginal stakeholders	The involvement of the registered Aboriginal stakeholders in the ongoing management of the Aboriginal heritage items within the Project area during construction would be promoted.	Construction

Ref No.	Objective	Commitment	Timing
Non-Indigenous Heritage			
SC32	Minimise impacts on Non-Indigenous heritage.	All Hunter 8 Alliance employees, contractors and sub-contractors are to be made aware of the provisions of the *Heritage Act 1977* and the requirements under the Act, including that if a relic is suspected or discovered, the person suspecting or discovering must notify the NSW Department of Planning, Heritage Branch or its delegate and suspend work that might have the effect of disturbing, damaging or destroying such relic until the requirements of Heritage Branch have been satisfied.	Pre-construction and Construction
		Where Project activity would have the capacity to obscure, move, modify, damage or destroy any part or component of a heritage resource within the study area, the resource would be archivally recorded prior to the commencement of any Project works. Project works would then be monitored by a suitably qualified archaeologist and an archival record completed for each resource. The record would comply with requirements set out in the NSW Heritage Guidelines.	Pre-construction and Construction
SC33	Manage the potential heritage impacts at Greta and Branxton Stations	At Greta and Branxton Railway Stations, a representative length of any of the original brick platform facing to be disturbed would be salvaged and reinstated on the new platform alignment, away from the dedicated passenger area. The re-erected brick facing would be distinguished from any original work by suitable marking or inscription detailing the date and nature of re-erection	Construction and Post-construction
SC34	Manage the potential heritage impacts at Allandale Wine Cellars/ Penfold's Winery	Where elements of the Allandale Wine Cellars / Penfold's Winery site located within the road reserve are to be disturbed, the resource would be archivally recorded prior to the commencement of any Project works. Project works would then be monitored by a suitably qualified archaeologist and an archival record completed for each resource. The record would comply with requirements set out in the NSW Heritage Guidelines.	Pre-construction and Construction
SC35	Minimise impacts on natural heritage	The fossiliferous horizon disturbed in the Allandale Area would be removed using the method outlined in Section 13.4 of the Environmental Assessment. This would make the material available for inspection for and removal of fossil material by palaeontologists and other interested parties for research purposes and to place on display.	Construction

Ref No.	Objective	Commitment	Timing
Land Use			
SC36	Manage the potential land use impacts of the Project.	Where required land would be acquired for the construction of the works and mutually agreed compensation made for any loss of productive agricultural land or facilities. A detailed description of these management strategies is provided in Chapter 14 (Land Use) of this Environmental Assessment.	Pre-construction
		Stock fencing would be provided along the newly defined property boundaries and be constructed prior to the removal of existing fencing or any works being carried out on the subject land, unless otherwise agreed with the landowner.	Pre-construction
SC37	Reduce impacts on individual properties and land users	Detailed management measures to reduce land use impacts on individual properties and land users would be developed in consultation with the individual landowners concerned during the detailed design and property acquisition negotiations. Access requirements for the construction phase of the Project would be discussed with individual landowners prior to the landowner's access being affected.	Pre-construction and construction
		Measures to mitigate amenity impacts such as noise, air, visual and social are outlined in Chapters 16 and 17, and Sections 19.5 and 19.6 respectively.	Construction
		Where a dam or groundwater bore would be disturbed or removed as a result of the Project, appropriate compensation or mitigation would be provided that is agreed to by ARTC, the landholder and the DECCW (responsible for the licensing of dams and groundwater bores).	Pre-construction and Construction
Traffic and Access			
SC38	Minimise construction traffic impacts on Intersection Capacity	The intersection treatment methods proposed in Section 15.5 would be implemented during the construction period to minimise impacts on the New England Highway and the associated intersections. The detailed design and planning for these methods would be discussed with the RTA and Singleton, Maitland and Cessnock Councils.	Construction
SC39	Manage the potential construction traffic impacts	A Construction Traffic Management Plan would be prepared dealing with the safe management of traffic during the construction phase of the Project.	Pre-construction and Construction

Ref No.	Objective	Commitment	Timing
SC40	Appropriate signage at haul roads and access points	Erect appropriate signs warning of trucks entering at the following construction access points: – Wollombi Road, Farley. – Station Lane, Lochinvar. – Allandale Road, Allandale. – Nelson Street, Greta. – Station Street, Branxton. – Hermitage Road, Belford.	Construction
		Appropriate signs would be erected warning traffic of cyclist and pedestrian movements where existing shoulder or verge provisions are restricted due to construction activity.	Construction
SC41	Management of construction vehicles	Wherever possible, haulage vehicles would be filled to capacity to minimise vehicle movements.	Construction
		Vehicles transporting potentially dust and/or spillage generating material to and from the construction site would be covered immediately after loading (prior to traversing public roads) to prevent wind blown dust emissions and spillages.	Construction
		In the event of a spillage of materials from construction vehicles, spilled material would be removed as soon as practicable within the working day of the spillage.	Construction
		Arrangements including advance warning signs and emergency access arrangements would be implemented for any road closure.	Construction
SC42	Implementation of traffic control plans	Traffic Control Plans would be prepared for the road network surrounding the Project, including all primary and secondary access points. Traffic control plans would be produced for specific road construction staging scenarios, depicting vehicle, pedestrian, bus and cyclist restrictions and protection measures. Specific control measures are provided in Chapter 15 (Traffic and Access) of this Environmental Assessment.	Pre-construction and Construction
SC43	Maintain property access	Access would be maintained to neighbouring land uses throughout the construction period, unless otherwise agreed by the landowner. Access would be maintained to all neighbouring properties impacted by the construction works, unless otherwise agreed by the landowner.	Construction
SC44	Manage pedestrian and cyclist access	Pedestrian and cyclist access would be retained where possible during construction and would be addressed at each site in a Construction Traffic Management Plan or Traffic Control Plans.	Construction

Ref No.	Objective	Commitment	Timing
SC45	Additional travel to site for construction employees	The Hunter 8 Alliance would establish a policy promoting car-pooling for employees.	Construction
Air Quality			
SC46	Minimise dust generation and adverse air quality impacts	Site managers would be provided with daily weather updates that would contain warnings of the onset of strong winds. The site manager could then take steps to pre-water construction areas and stockpiles before they are disturbed and continue watering during any activities where fugitive dust may be produced. Earthmoving activities would be suspended during times of high winds when dust emissions cannot be adequately controlled, particularly when dust plumes are directed towards sensitive receptors.	Pre-construction and Construction
SC47	Implementation of barriers and screens	Physical barriers would be considered to act as windbreaks for the construction site or for stockpile areas where practicable.	Construction
		Dust screens would be installed on construction site boundaries that are adjacent to sensitive receptors where practicable.	Construction
		Stockpiles would be placed, where possible, in areas protected from the wind and away from public places. Spoil stockpiles would be water sprayed regularly and dry material stockpiles would be covered, if generating windborne dust, and practicable.	Construction
SC48	Maintain existing vegetation	Existing vegetation would be retained where possible. Where clearing is required, cleared areas no longer subject to construction activities and stockpiles would be seeded with fast growing species for rapid coverage to temporarily or permanently stabilise soil, where practicable.	Construction
SC49	Reduce impacts associated with construction traffic	Construction traffic would be considered by designating specific routes for haulage and access. Vehicle speeds would be limited to suit site conditions and as sign posted as part of the Traffic Control Plan.	Construction
		All trucks hauling dirt, sand, soil or other loose materials (materials that could generate dust emissions or result in spillages) to and from the construction site would be covered.	Construction
		Cattle grids or ballast beds would be installed where required to minimise mud and dirt being tracked onto public roadways by trucks and any equipment leaving the site. Material spillage on roads and pathways would be cleaned.	Construction

Ref No.	Objective	Commitment	Timing
		All construction vehicles, mobile plant and machinery would be maintained and operated in accordance with the manufacturers' specifications to minimise exhaust emissions.	Construction
SC50	Management of air quality complaints	A line of communication would be established with the local community prior to the start of construction as part of a complaints management system. All complaints lodged by nearby residents would be recorded on a complaints register and addressed accordingly.	Construction
SC51	Enhanced mitigations for construction dust	Dust control would be linked to real-time dust and weather monitoring.	Construction
		Increase watering rate or consider application of chemical stabilisers to create an artificial crust on the surface by binding unconsolidated material.	Construction
		Earthmoving and other high dust generating activities would be suspended during times when dust plumes are blowing towards sensitive receptors, unless otherwise agreed with the sensitive receptor.	Construction
		Contact would be established with the local residents and the construction program and progress communicated, particularly to provide advance warning of significant dust generating activities being undertaken in close proximity to sensitive receptors.	Construction
SC52	Minimise emissions during the operation	Railway verges and other exposed surfaces would be re-vegetated or covered using cobbles or coarse gravel to reduce fugitive dust emissions.	Operation
		Trains would minimise idling near sensitive receivers (where possible).	Operation
		Where practicable and available, consideration would be given to maintaining or establishing a stand of trees or other suitable vegetation on properties adjacent to the Project to aid dispersion and potentially remove dust particles through impingement on the foliage.	Operation
Noise and Vibration			
SC53	Minimise construction noise impacts.	Construction activities would be conducted consistent with provisions of a new Environment Protection Licence for construction activities, complaint management and reporting conditions.	Construction
SC54	Construction hours	The standard hours for construction activities associated with the Project would be: ◗ 7:00 am to 6:00 pm, Mondays to Fridays, inclusive.	Construction

Ref No.	Objective	Commitment	Timing
		◗ 8:00 am to 1:00 pm on Saturdays. ◗ No works on Sundays or public holidays.	
SC55	Managing out-of-hours work	The current ARTC Environment Protection Licence 3142 (EPL) allows for maintenance and construction works to be undertaken outside business hours providing it is undertaken in accordance with specific conditions contained in the EPL. It is proposed that a new EPL for construction of the Project would include similar conditions.	Construction
		Communications with the local community with regards to out-of-hours work would be conducted in accordance with the relevant provisions of the EPL. Specific control measures for these are provided in Chapter 17 (Noise and Vibration) of this Environmental Assessment.	Construction
SC56	Inform all site workers of potential impacts	All site workers (including subcontractors and temporary workforce) would be informed of the potential for noise and vibration impacts upon local residents and encouraged to take practical and reasonable measures to minimise noise during the course of their activities.	Pre-construction and Construction
SC57	Development of Noise, Vibration and Blasting Impact Statements	Noise and Vibration Impact Statements would be prepared for discrete work areas in order to predict the noise impacts of specific activities at the most potentially affected receivers. A non-exhaustive list of NVIS requirements is provided in Chapter 17 (Noise and Vibration) of this Environmental Assessment.	Pre-construction
SC58	Development of control plans and work methods	A Pile Vibration Control Plan for driven piles and Blasting Vibration Control Plan would be included in the Noise, Vibration and Blasting Impact Statements, as appropriate.	Pre-construction
		Work methods would be reviewed with a preference for quieter and non-vibration generating methods wherever practical and feasible. This is particularly important for any out-of-hours and night-time activities.	Pre-construction and Construction
SC59	Mange movement of materials	Where practical, material dumps would be located as far as possible from the nearest residences, and whenever possible, loading and unloading areas be located as far as possible from the nearest residences.	Construction
		As far as possible, the practice of dropping materials dropped from heights into or out of trucks would be minimised.	Construction

Ref No.	Objective	Commitment	Timing
SC60	Correct use of tools and equipment	All plant on site would be operated in accordance with the manufacturer's instructions.	Construction
		All construction vehicles and machinery would be fitted with manufacturer supplied noise suppression devices maintained in accordance with manufacturers' guidelines, where practical.	Construction
		Where practical, fixed equipment (pumps, generators, compressors) would be located as far as possible from the nearest residences.	Construction
		Where practical, all pneumatic tools operated near a residential area must be fitted with an effective silencer on their air exhaust port.	Construction
		Noise labels would be affixed to new mobile air compressors and pavement breakers. The unit with the lowest noise rating which meets the requirements of the job would be used where work is conducted in proximity of noise sensitive locations.	Construction
		All mechanical plant would be silenced by best practical means. Noise suppression devices would be maintained to the manufacturer's specifications. Internal combustion engines would be fitted with a suitable muffler in good repair.	Construction
		Where possible, no plant or equipment would be left idling when operating adjacent to residential areas.	Construction
SC61	Minimise impacts from construction vehicles	All construction vehicle movements to and from the site must comply with the requirements of the appropriate regulatory authority requirements for such activities.	Construction
		Where practicable, all typically noisy construction activities that could impact on sensitive receptors would be kept within the daytime working hours.	Construction
SC62	Development of building condition surveys	Building condition surveys would be undertaken at all potentially impacted dwellings prior to commencement of vibration generating works (such as pile-driving). These would be repeated at works completion.	Pre-construction, Construction and Post-construction

Ref No.	Objective	Commitment	Timing
SC63	Construction Monitoring and Reporting Commitments	Any noise and vibration monitoring would be undertaken by a qualified professional, with consideration to relevant standards and guidelines. Noise and vibration monitoring would occur: ◗ If vibration-generating activities are conducted within 30 metres of a residence, and a building damage risk is identified, alternative work methods would be implemented so the vibration impacts are reduced to acceptable levels. ◗ Any noise and/or vibration complaint would be addressed in accordance with the Hunter 8 Alliance complaint management system. This would include: – Provision of a written response to a complaint within seven days. – Provision of an email response to an electronic complaint within two days if the complaint cannot be resolved by an initial response.	Pre-construction and Construction
		Monitoring would be undertaken and reported to the Alliance within five days of receiving a complaint, if that activity is continuing, so that the monitoring findings can be incorporated to the written response provided to the complainant. If exceedances are detected, corrective actions would be implemented, included in the response to the complainant and recorded. Specific monitoring and reporting measures are provided in Chapter 17 (Noise and Vibration) of this Environmental Assessment.	Pre-construction and Construction
SC64	Mitigating Exceedances of Construction Noise and Vibration	Where it is found that standard and NVIS specific mitigation measures are not sufficient to reduce noise and vibration impacts to acceptable levels, additional mitigation measures would be implemented. The approach to mitigating exceedances of construction targets is substantially extracted from TIDC's *Construction Noise Strategy 2007* with variations specific to the Project. The implementation of the measures is determined by use of the Additional Mitigation Measures Matrices (AMMM) shown in Chapter 17 (Noise and Vibration) of this Environmental Assessment.	Construction

Ref No.	Objective	Commitment	Timing
SC65	Community consultation and feedback	Contact would be established with the local residents and the construction program and progress communicated on a regular basis, particularly when noisy or vibration-generating activities are planned. The Community Relations Team would provide a community liaison phone number and permanent site contact so that noise and/or vibration related complaints, if any, can be received and addressed in a timely manner. Specific strategies are provided in Chapter 17 (Noise and Vibration) of this Environmental Assessment.	Construction
SC66	Minimise operational noise impacts.	An Operation Noise Management Plan for the Project would include the following procedures: ◗ A noise barrier to be constructed between chainages 194.340 and 194.880 kilometres to attenuate the urban residences at Telarah. ◗ A noise monitoring program would be implemented for those rural residential locations predicted to trigger IGANRIP trigger levels in 2012. In the event that monitoring confirms that IGANRIP would be triggered at these rural residential locations in 2012, the following attenuation options are available and applicable: – Noise barriers. – Architectural treatment. ◗ The actual attenuation measure would be selected through an assessment of reasonable and feasible noise attenuation measures at the effected locations where noise monitoring confirms exceedence of the IGANRIP trigger levels. This assessment and selection process would depend on a number of issues, including: – Level of exceedence of the IGANRIP trigger. – Outcomes of consultation with affected land holders and residents. – Ongoing Project detailed design. – Cost of construction and ongoing maintenance. – The potential environmental, visual and social impacts of the proposed attenuation measure..	Detailed design and Operation

Ref No.	Objective	Commitment	Timing
		– Consultation with other stakeholders, including DECCW, train operators and ARTC Maintenance and Operations. ◗ A noise monitoring program to confirm the level of noise reduction provided by the attenuation measures. ◗ A similar noise monitoring program and assessment and selection of reasonable and feasible noise attenuation measures would be implemented for those locations predicted to trigger IGANRIP trigger levels in 2022.	
SC67	Noise and vibration controls upon design finalisation	◗ Review the noise model to accommodate design changes. ◗ Confirm noise and vibration attenuation requirements. ◗ Evaluate mitigation options against cost, practicality, reasonableness and community preferences. ◗ Establish final noise and vibration control strategy for implementation.	Detailed design and Operation
Surface Water			
SC68	Minimise water quality impacts.	A Spoil and Fill Management Plan (SFMP) would be prepared and implemented to minimise potential impacts on water quality during construction of the Project. This plan would incorporate the design and installation of erosion and sediment controls in accordance with *Managing Urban Stormwater, Soils and Construction Volume 2D Main road construction* (DECC 2008).	Construction and detailed design
		Project team members involved in the construction of the Project would be made aware of their environmental responsibilities and the measures to minimise impacts.	Pre-construction and Construction
SC69	Management of vegetation clearance	At the vegetation clearing stage, the vegetation would be stockpiled and then mulched and spread over disturbed areas to provide a natural erosion barrier and assist during rehabilitation upon completion of construction.	Construction

Ref No.	Objective	Commitment	Timing
SC70	Minimise potential earthworks impacts	Prior to commencement of earthworks there would be a range of erosion and sediment controls implemented which would include but would not be limited to: ◗ Establishment of sediment filters, such as hay bales and sediment fences, sediment traps and/or sediment basins to capture sediment and prevent sediment laden water discharge to the downstream environment. ◗ Construction of temporary catch and diversion drains to reduce erosion hazard and prevent clean water from upstream of the corridor flowing onto disturbed areas and hence become dirty water. ◗ Stabilisation of exposed surfaces as soon as practicable following completion of construction in the vicinity of the works, including the stabilisation of disturbed soils through progressive revegetation.	Construction
SC71	Controls outside the specific work area	Refuelling of plant and machinery either by fuel trucks with spill trays or within bunded areas or off-site in appropriate locations wherever possible.	Construction
		Minimisation of disturbed areas for the safe completion of construction activities so that the potential export of sediment is minimised.	Construction
		Location of stockpiles clear of flood prone areas, stream banks, channels and stormwater drainage areas, and stabilisation of stockpiles that would be in place for longer than 10 days.	Construction
		Diversion of flows around stockpiles by bunds and/or diversion drains, and around work areas where practicable.	Construction
		Establishment of temporary creek crossings with a lower section for higher flows to pass with culverts extending beyond the toe of fill embankments.	Construction
		Rehabilitation of the waterway once temporary creek crossings have been removed.	Construction
		Establishment and maintenance of a limited number of construction compounds to reduce the areas of overall disturbance for the Project.	Construction
		Establishment of construction compounds, including machinery, fuel and chemical storage areas with bunded areas away from drainage lines.	Construction
		Appropriate storage of construction materials on site so as to prevent leaching, leaking or other transfer of material into waterways or onto land.	

Ref No.	Objective	Commitment	Timing
SC72	Spill containment	An appropriate spill kit would be kept on site at all times and any spillage would be immediately and appropriately cleaned up. In the event of a large or hazardous spill, the Fire Brigade, Police, Ambulance and the Department of Environment, Climate Change and Water would be contacted as appropriate.	Construction
SC73	Monitoring	A surface water-monitoring program would be established prior to commencement of construction. This would enable the compilation of background data over potentially a range of climatic conditions. Surface water quality monitoring would continue for the construction period to monitor water discharged from the construction site, and water quality upstream and downstream of the construction areas.	Pre-construction and Construction
SC74	Erosion and sediment control measures	Permanent catch and diversion drains to divert runoff from upslope and reduce erosion hazard.	Operation
		Permanent diversions to outlet to stable discharge areas.	Operation
		Revegetation of disturbed areas to encourage infiltration.	Construction and Operation
		Permanent areas of spoil to be located clear of flood prone areas, stream banks, channels and stormwater drainage areas.	Construction and Operation
		Permanent areas of spoil to have maximum batter slopes of one vertical to two horizontal and be stabilised by vegetation.	Construction and Operation
		Flows to be diverted around spoil areas and quarries by bunds/diversion drains.	Construction and Operation
SC75	Increase Existing Flood Levels	During the detail design process, review of the extent of encroachment into existing waterway areas would need to occur.	Pre-construction
SC76	Fish Passage through Culverts	Guidelines of both NSW Fisheries and the Queensland Department of Primary Industries would be considered when establishing fish passage. Culverts at perennial waterways or waterways where there is evidence of regular flows would be designed to provide suitable conditions for fish habitat. Specific details for culverts are provided in Chapter 18 (Surface Water) of this Environmental Assessment.	Pre-construction and Construction

Ref No.	Objective	Commitment	Timing
SC77	Minimise impacts on Sawyers Creek	The proposed realignment of Sawyers Creek would maintain (where possible) the existing stream length, grade and power to minimise any impacts on the creek.	Pre-construction and Construction
Topography, Soils and Geology			
SC78	Minimise potential disturbance of soil erosion, sedimentation, PASS, reactive soils or dispersive soils	Develop and implement a Spoil and Fill Management Plan which details erosion and sediment control measures including areas of higher risk. Detail appropriate procedures for the handling, stockpiling and assessment of materials during the works. The Plan would also include a contingency plan for unexpected hazards that may be encountered during site works.	Pre-construction
		Adoption of appropriate moisture and compaction controls where reactive soils are placed as general fill in embankments.	Pre-construction and Construction
		Assessing site reactivity in accordance with AS2870 Residential Slabs and Footings for proposed small to medium scale structures.	Construction
		Widen cuttings where appropriate to provide a buffer from the track to manage sediment issues.	Pre-construction and Construction
		Flattening back cut batter gradients where possible to promote vegetative cover and adoption of selective batter treatments as appropriate.	Pre-construction and Construction
		Treatment of soils with gypsum or similar to inhibit dispersive characteristics.	Construction
		Implement of an Acid Sulfate Soil Management Plan as part of the CEMP including procedures consistent with Remediation Guidelines from DECCW.	Pre-construction and Construction
SC79	Maintenance Activities	Undertake general geotechnical maintenance relating to culvert clean out and repairs, top drains, subsoil drainage and general earthworks.	Operation

Ref No.	Objective	Commitment	Timing
Contamination			
SC80	Develop and Implement Spoil and Fill Management Plan	Develop and implement a Spoil and Fill Management Plan (SFMP) as part of the Construction Environmental Management Plan (CEMP) for managing possible contaminated materials not encountered and assessed during this investigation. The SFMP for the Project would detail appropriate procedures for the handling, stockpiling and assessing potentially contaminated materials during the works. The SFMP would also include a contingency plan for unexpected hazards that may be encountered during site works.	Pre-construction
SC81	Minimise waste	Waste would be managed in accordance with relevant legislation.	Pre-construction, Construction and Post-construction
SC82	Management of Asbestos	Should any signal huts or structures within the site area be scheduled for removal, a hazardous material survey would be undertaken prior to demolition. In the event that asbestos is identified in these structures, an Asbestos Management Plan would be developed and implemented.	Pre-construction and construction
SC83	Management of acid sulfate soils	Implementation of an Acid Sulfate Soil Management Plan as part of the CEMP.	Pre-construction and Construction
Groundwater			
SC84	Minimise groundwater quality impacts through monitoring	Conduct groundwater monitoring (levels and quality), prior to the start of construction to establish baseline groundwater conditions at selected locations adjacent to the Project alignment to confirm groundwater quality and level action criteria against which to monitor conditions during construction.	Pre-construction and Construction
		Conduct groundwater monitoring to monitor groundwater levels and quality of shallow groundwater adjacent to the Project alignment at selected locations, to monitor any groundwater impacts during the construction phase.	Construction
		Assess groundwater monitoring results against baseline groundwater conditions during construction and review mitigation measures and monitoring program if necessary.	Construction
SC85	Implementation of storage areas	Storage areas for vehicles, machinery, equipment and chemicals during construction would have appropriate facilities to contain spills, leaks and surface water runoff to reduce the potential for contamination of groundwater through infiltration.	Construction and Operation

Ref No.	Objective	Commitment	Timing
SC86	Develop a response plan	A response plan to deal with accidental spills and leaks would be included as part of the CEMP.	Construction
Energy and Greenhouse			
SC87	Reduce impacts of greenhouse gases	Use hierarchical approach to minimise greenhouse gas emissions: ◗ Avoid emissions source. ◗ Reduce consumption. ◗ Improve energy efficiency. ◗ Replace with low emissions alternative. ◗ Offset. Further details outlining greenhouse mitigation measures are provided in Chapter 19.4 (Energy and Greenhouse Gas Emissions) of this Environmental Assessment.	Construction
Social and Economic			
SC88	Land acquisitions	Negotiate land acquisitions and implement appropriate compensations measures. Further details outlining landuse mitigation measures are provided in Chapter 14 (Land Use) of this Environmental Assessment.	Detailed design and Pre-Construction
SC89	Minimise noise and vibration	Provide the relevant stakeholders with sufficient information to enable them to understand the likely nature, extent and duration of noise and vibration impacts. Further details outlining noise and vibration mitigation measures are provided in Chapter 17 (Noise and Vibration) of this Environmental Assessment.	Detailed design, Construction and Operation
SC90	Minimise property damage	◗ Measures to avoid and minimise property damage to be included in the CEMP. ◗ Implement ARTC and contractor conduct protocols. ◗ Monitor construction contractors' performance. ◗ Act swiftly to address any stakeholder complaint regarding property damage.	Construction
SC91	Reduce/manage construction dust	Provide relevant stakeholders with sufficient information to enable them to understand the likely nature, extent and duration of dust impacts. Specific control measures for construction dust are provided in Chapter 16 (Air Quality) of this Environmental Assessment.	Construction and operation

Ref No.	Objective	Commitment	Timing
SC92	Minimise impacts on residents	Communicate localised construction activities and timeframes to relevant stakeholders so they can take measures to minimise impacts on themselves and their properties if required.	Construction
SC93	Reduce visual impacts	Communicate future changes (such as via Project newsletter/updates, advertisements) to help ensure the community understands what the proposal site would look like after construction activities. Specific mitigation measures for visual impacts are provided in Chapter 19.6 (Visual) of this Environmental Assessment.	Construction and Operation
SC94	Manage increased light pollution	Where light impacts are severe implement attenuation measures, such as screening of sensitive receptors. If the impact of operational light pollution is severe, consider the implementation of attenuation measures, such as landscaping or barriers, to screen sensitive receptors.	Construction and Operation
SC95	Manage changes to property infrastructure	Implement measures to compensate/offset significant impacts on private infrastructure (such as dams and buildings). Measures to be developed in consultation with affected landholders.	Pre-construction and Construction
SC96	Minimise impacts to private property access	Communicate construction related road changes to relevant local residents to ensure awareness of changed access arrangements. Implement measures to maintain safe access to residential properties. Maintain property access points where appropriate. Where exiting access points need to close, consideration would be given to alternative access arrangements. Further details outlining access mitigation measures are provided in Section 15 (Traffic and Access) of this Environmental Assessment.	Construction and Operation
SC97	Manage security and privacy	Implement ARTC and contractor conduct protocols. Where impacts are severe, consider the implementation of attenuation measures to screen sensitive receptors.	Construction

Ref No.	Objective	Commitment	Timing
SC98	Minimise impacts on road safety, access and traffic mobility	Implement ARTC and contractor OH&S procedures and develop a traffic management plan to: ◗ Instruct drivers to reduce speeds and demonstrate extra caution in the vicinity of sensitive receptors. ◗ Implement appropriate signage near Project site and along haul routes. ◗ Record any incidents involving accidents or near misses with pedestrians and cars on local roads, and report in an OH&S register. ◗ Define traffic movement areas during construction, including the use of signage onsite and along transport routes, to ensure awareness of increased heavy traffic along transport routes. ◗ If the impact of dirt and mud carried out onto local roads is severe, street cleaning would be undertaken to remove potentially hazardous debris and/or consideration can be given to sealing driveways, or establishing cattle grids or ballast beds to construction sites to reduce material carried onto the road. ◗ Further details outlining access mitigation measures are provided in Section 15 (Traffic and Access) of this Environmental Assessment.	Construction
SC99	Maintain rail access	Maintain access to all operational rail stations.	Construction
SC100	Reduce impacts on community values	Implement a public information program that addresses community values. Implement complaint monitoring and response measures.	Construction
SC101	Impacts on local and regional employment	Include local employment in ARTC and construction contactor recruitment, where suitable.	Construction
SC102	Impacts to local businesses	Minimise any disruption to local businesses.	Construction
SC103	Inform community of progress and key activities	Provide regular updates to the community on construction activities and program. Maintain communication lines between ARTC and the community.	Construction Operation

Ref No.	Objective	Commitment	Timing
Visual Amenity			
SC104	Minimise visual disruption to receptors	Minimise loss or damage to vegetation within the rail corridor and adjacent road reserves and private property including the protection of trees prior to construction and/or trimming of vegetation to avoid total removal.	Detailed design and construction
		Minimise light spillage through designing the construction and operation lighting to reduce the likelihood of the sites being over-lit and to minimise additional light spillage from the rail corridor into adjacent visually sensitive properties.	Construction and Operation
		Temporary hoardings, barriers, traffic management and signage to be removed when no longer required.	Construction
		Materials and machinery to be stored tidily during the works.	Construction and Operation
		Roads providing access to the rail corridor and work sites to be maintained free of dust and mud as far as reasonably practicable.	Construction
SC105	Integration of infrastructure	Integration of infrastructure (such as structures, embankments/cuttings and bridges) into the surrounding environment.	Detailed design, Construction and Operation
SC106	Manage changes to landscape	Minimisation of vegetation clearance in sensitive environmental areas, where possible.	Construction and Operation
		Minimisation of vegetation clearance in areas where the vegetation provides screening of the rail corridor to sensitive receptors, where possible.	Construction and Operation
		An integrated and consultative design process and interface amongst specialist disciplines resulting in optimal design solutions.	Detailed design, Construction and Operation
		Landscape solutions would be buildable within the site boundary from the outset unless agreed by adjoining landholders.	Detailed design, Construction and Operation
		Demonstrate that environmental, landscape and urban design issues have been adequately considered as part of an integrated design process resulting in a positive legacy for the Project.	Detailed design, Construction and Operation
		Early identification of landscape 'hot spots' and integration of mitigation strategies to minimise landscape and visual impacts.	Detailed design, Construction and Operation
		Development of a Landscape Rehabilitation Strategy and Landscape Strategy that draws together the outcomes of the above integrated design and assessment process.	Construction and Operation

Ref No.	Objective	Commitment	Timing
		Consultation with affected residents on desired screening.	Construction and Operation
		Maintenance of screening planting following the establishment phase to ensure continual / improved visual screening.	Construction and Operation
Waste Management			
SC107	Minimise waste impacts of the Project	To determine waste management options, waste would be classified according to the DECC's *Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes* (1999) into the following categories: ◗ Inert – including virgin excavated material, vegetation, building and demolition waste, concrete and asphalt. ◗ Solid – such as food waste and litter. ◗ Industrial – such as asbestos. ◗ Hazardous – such as flammable liquids. ◗ Liquid – such as sewage. A Waste Management Plan would be prepared and provide details of the requirements for handling, stockpiling and disposal of wastes.	Construction and Operation
SC108	Manage waste from rail maintenance and repair activities	The Resource Management Hierarchy principles of the *Waste Avoidance and Resource Recovery Act* 2001 would be implemented as follows: ◗ Unnecessary resource consumption would be avoided. ◗ Avoidance would be followed by resource recovery (including reuse of materials, reprocessing, recycling and energy recovery). ◗ Disposal would only be undertaken as a last resort.	Operation
SC109	Recycling	Where feasible, suitable waste would be recycled. Items for recycling would be sorted, collected and taken to a recycling depot in the region. Non-recyclable materials would be disposed of at licensed disposal facilities.	Construction and Operation

Ref No.	Objective	Commitment	Timing
Hazards			
SC110	Minimise the risk of an incident during construction in regards to human health, safety and the environment.	A site specific Safety Management Plan would be developed along with Activity Method Statements and Task Risk Assessments prepared and implemented for construction activities. The Plan would identify hazards associated with work on the site and the hazard control to be implemented so that people are adequately protected from risk of injury or illness, including: ◗ Procedures to comply with all legislative and industry standard requirements for the safe handling and storage of hazardous substances and dangerous goods. ◗ Procedures for manual handling of heavy loads. ◗ Procedures for blasting activities. ◗ Procedures for operation and maintenance of site plant, including mobile plants.	Pre-construction and Construction
		The Construction Environmental Management Plan and the supporting sub plans would address the relevant environmental risks and hazards. This would include: ◗ Details of the hazards and risks associated with the activity. ◗ Mitigation Measures and plans including those identified in this Environmental Assessment and environmental risk analysis sections. ◗ Contingency plans as required.	Pre-construction and Construction
Environmental Management			
SC111	Implementation of Construction Environmental Management Plan (CEMP)	The Hunter 8 Alliance would prepare a CEMP prior to the commencement of construction. The CEMP would address the potential impacts referred to in this EA and would outline the environmental management practices and procedures to be followed during the site preparation and construction of the Project: ◗ A summary of all the potential environmental aspects and impacts outlined in this Environmental Assessment. ◗ A description of all major activities to be undertaken on the site during site preparation and construction. ◗ Statutory approvals and other obligations that would be fulfilled during site preparation and construction, including all approvals, consultations and agreements required from authorities and other stakeholders, and key legislation and policies.	Pre-construction and Construction

Ref No.	Objective	Commitment	Timing
		◗ Details of how the environmental performance of the site preparation and construction works would be monitored, and what actions would be taken to address identified adverse environmental impacts. ◗ A description of the roles and responsibilities for all relevant employees. ◗ Complaints handling procedures. ◗ Compliance with ARTC's Environmental Protection Licence.	
SC112	Development of Construction Environmental Management Sub-Plans	Concise environmental management sub-plans would be developed. These would link to the CEMP. The sub-plans would include the following: ◗ Traffic Management Sub-Plan. ◗ Noise, Vibration and Blasting Management Sub-Plan. ◗ Spoil and Fill Management Plan (includes Erosion and Sedimentation, Soil and Water Management and Contaminated Soils Management). ◗ Flora and Fauna Management Sub-Plan. ◗ Aboriginal Heritage Management Sub-Plan. ◗ Non-Indigenous Heritage Management Sub-Plan.	Pre-construction and Construction
SC113	Manage potential environmental impacts	Hunter 8 Alliance would: ◗ Implement the CEMP in accordance with this statement of commitments and all relevant acts and regulations. ◗ Periodically review the CEMP with the aim of continuous improvement.	Pre-construction and Construction
		There would be continuing consultation with the community during the construction and operation phase of the Project.	Pre-construction, Construction and Operation

21.2 Construction Environmental Management Plan

The Hunter 8 Alliance would prepare a Construction Environmental Management Plan (CEMP) prior to the commencement of construction. The CEMP would address the potential impacts referred to in this Environmental Assessment and would outline the environmental management practices and procedures to be followed during the site preparation and construction of the Project.

Table 21-2 provides the indicative Table of Contents for the CEMP and an outline of what each section would address.

It is envisaged that an independent Environmental Representative would be commissioned to oversee construction of the Project on behalf of the Department of Planning. The independent

Environmental Representative would undertake a number of activities, including review of the CEMP and supporting sub-plans, and monitoring its application and effectiveness in maintaining environmental performance in accordance with the Ministerial Conditions of Approval and legislative requirements.

Table 21-2 CEMP Outline

CEMP Section	Section Outline
Introduction	A general introduction to the CEMP and table listing the applicable Ministerial Conditions of Approval (MCoA)
Project Background	A general discussion about the Project and its context.
Description and Location of the Project	A general description of the Project and the locality. A Project Plan would be included.
CEMP Context	Outline the relationship of the CEMP to the EA and the Project Approval.
Purpose of the CEMP	Outline the purpose of the CEMP in managing environmental performance during construction of the Project.
CEMP Objectives	The Project's environmental objectives regarding environmental management and impact mitigation. The key management objectives listed in Section 1.2.1 would form the basis of this section.
Management Plans and Environmental Procedures	The relationship of the CEMP to the sub-plans described in Section 1.2.2, and the specific environmental procedures developed to implement the specific actions in the CEMP and the sub-plans.
Environmental Policy	Refers to the Hunter 8 Environmental Policy that would be provided as an Appendix to the CEMP and posted in the construction office.
Planning	
Outline of Construction Works and Timeframes	Details of the key construction activities, the proposed construction program and discussion of the construction hours, including the process required for works outside the standard construction hours.
Ancillary Construction Facilities	Details on the location and components of key ancillary facilities, including construction compounds, fuel storage facilities, stockpile areas, spoil disposal areas and borrow pits.
Applicable Environmental Legislation	A table of the applicable environmental legislation and its application during the construction activities

CEMP Section	Section Outline
Approvals and Licensing Requirements	A table of the approvals and licences required by the listed legislation or applicable Ministerial Conditions of Approval.
Statement of Commitments	A table of the finalised Statement of Commitments, when they would be implemented (prior to, during, or upon completion of construction) and the appropriate management document (the CEMP or sub-plan).
Environmental Aspects, Impacts and Risks	Outline of the Construction Environmental Risk Assessment prepared for the Project, and the process for development of Environmental Work Method Statements for those key environmental aspects identified through the risk assessment.
Project Management Structure	
Environmental Management Structure and Responsibility	An organisational chart would be provided. A table would also be provided identifying the key personnel and their responsibilities in implementing the CEMP and overall environmental performance.
Subcontractors	An outline of the environmental responsibilities of subcontractors, and the responsibility of Hunter 8 to monitor subcontractors' environmental performance.
Environmental Management	
Resources and Training	Identifies the resources required to implement the CEMP, particularly monitoring and inspections; development of sub plans, environmental procedures, and Environmental Work Method Statements; document control of compliance; and auditing of environmental practices and controls. Discussion of the environmental training and assessment program that would be implemented for all personnel working on the Project, and the associated environmental inductions.
Communications	A table of the key communication activities with external parties (such as agencies, landholders), who is responsible
Environmental Records and Document Control	A list the range of environmental records to be collated and maintained during and after the construction activities, and the document control procedures to be implemented to maintain quality and current data.
Emergency Response	Details of relevant emergency agencies and their contact details.

CEMP Section	Section Outline
Implementation	
Establishment/Commencement	A program is to be developed at the commencement of the Project that lists the activities to be implemented throughout Project, and the need to maintain and update this list as required ◗ The communication systems to be in place to allow community enquiries to be submitted during construction. ◗ Development and activation of a Project website. ◗ Environmental requirements for suppliers and subcontractors. ◗ Appropriate location of material storage. ◗ Appropriate selection of construction plant and equipment (checked for serviceability).
Environmental Management Activities and Controls	A table of environmental activities and controls (including implementation of the sub plans), the person/s responsible, and the timing and/ or frequency of implementation.
Monitoring and Review	
Monitoring	Lists the qualitative and quantitative environmental monitoring requirements, the frequency, the parameters and targets, and the person/s responsible.
Environmental Auditing	The internal and external audit schedule for monitoring environmental compliance. An outline of the contents of the Weekly/ Fortnightly Environmental Inspection Checklist and the requirements for its implementation. Internal management review of the overall environmental performance of the Project. Compliance Status Review, to track compliance against the Project Approval, Statement of Commitments and other relevant management documents. The process for reporting of non-conformances and implementing corrective actions.
Review and Improvement	A process for regular Environment System reviews would be defined and the actions to be implemented in response to the findings of that review.

CEMP Section	Section Outline
Project Completion and Demobilisation	The procedures to be implemented upon completion of construction and during the demobilisation process.
Reporting	
Environmental Reporting	The process and contents of the monthly environmental reports, daily diaries and weekly reports, and compliance tracking reporting.
Environmental Incidents	The process for investigation, documentation and responding to environmental incidents, including the process for notification of such incidents to external agencies, including the contents for such notifications.
Complaints	The requirements for a Construction Complaints Management System, and the process for recording and addressing received complaints.

21.2.1 Key Management Objectives and Strategies

The Construction Environmental Management Plan would focus on the mitigation of impacts from the following key construction activities and aspects:

- Construction Compounds and Ancillary Facilities.
- Noise, Vibration and Blasting.
- Traffic and Access.
- Earthworks.

Table 21-3 identifies the management objectives in addressing these activities and aspects, and the overarching strategies that would be implemented to allow the Hunter 8 Alliance to meet these objectives: A number of the commitments listed in Table 21-1 would be implemented as appropriate as part of these strategies.

Table 21-3 Key CEMP Management Objectives and Strategies

Activity or Aspect	Management Objectives	Proposed Strategies
Construction Compounds and Ancillary Facilities	Locate, construct and operate construction compounds and ancillary facilities so they minimise impacts upon adjoining landholders Locate and construct construction compounds and ancillary facilities so they avoid native vegetation clearance where possible. Locate, construct and operate construction compounds and ancillary facilities so that they minimise potential for pollution of watercourses and contamination of soil and groundwater. Locate, construct and operate construction compounds and ancillary facilities to avoid disturbance of Aboriginal and non-indigenous heritage artefacts.	Implementation of relevant sections of CEMP and Sub-Plans. Implementation of construction compounds and ancillary facilities site selection criteria: ◗ Within or adjacent to the Project. ◗ Ready access to the road network. ◗ Minimise heavy vehicle travel through residential areas. ◗ Relatively flat land. ◗ A minimum of 150 metres from the nearest residence. ◗ Land already cleared of native vegetation. ◗ Avoids impacts on Aboriginal and non-indigenous heritage artefacts where possible. ◗ Avoids impacts on adjoining land uses.
Noise, Vibration and Blasting .	Minimise construction noise and vibration impacts upon adjoining landholders and structures. Manage construction noise so that it does not exceed the background L_{A90} noise level by more than 5dB(A), or 10dB(A) for tonal or impulsive noise. Minimise vibration impacts on adjacent infrastructure and services. Undertake works in accordance with the *Protection of the Environment Operations Act* 1997. Inform adjacent properties and the general community of key construction activities and general construction progress.	Implementation of the Construction Noise, Vibration and Blasting Management Plan. Development and implementation of Noise, Vibration and Blasting Impact Statements for specific construction activities and/ or specific locations. Undertake dilapidation surveys of adjacent properties and infrastructure prior to and following construction. Development and implementation of a Consultation Strategy. Undertake noise monitoring throughout the construction phase. Comply with consultation requirements of the Environment Protection Licence for works outside normal construction hours.

Activity or Aspect	Management Objectives	Proposed Strategies
Traffic and Access	Minimise potential safety risks to general motorists and construction personnel. Minimise impacts on traffic flow and delays on public roads adjacent to the Project. Minimise construction vehicle use of public roads. Minimise environmental impacts due to construction traffic. Inform adjacent properties and the general community of key construction activities and general construction progress.	Implementation of Construction Traffic Management Plan Development and Implementation of Traffic Control Plans Maximise location of access roads within the construction zone. Ongoing consultation with the Roads and Traffic Authority on management of construction traffic from the Hunter Expressway and maintenance works on their road network to be used by the Project. Ongoing consultation with relevant councils on the construction program and maintenance works on their road network to be used by the Project.
Earthworks	Minimise erosion and sediment loss from the construction zone. Minimise sediment pollution of surrounding watercourses. Minimise dust impacts on surrounding landholders. Undertake works in accordance with the *Protection of the Environment Operations Act* 1997.	Implementation of the CEMP (including air quality) and relevant Sub-Plans: ◗ Spoil and Fill Management ◗ Flora and Fauna Management.

21.2.2 Construction Environmental Management Sub-Plans

This Environmental Assessment has identified the need for specific environmental management measures to mitigate environmental impacts for the identified key environmental issues. To better facilitate implementation of these measures during construction, concise environmental management sub-plans would be developed. These would link to the CEMP and be the management action identified in the CEMP for addressing the specific environmental aspect.

The sub-plans would include the following:

- Traffic Management.
- Noise, Vibration and Blasting Management.
- Spoil and Fill Management.
- Flora and Fauna Management.
- Aboriginal Heritage Management.
- Non-Indigenous Heritage Management.

The Spoil and Fill Management Plan would include the mitigation measures associated with:

- Erosion and Sedimentation.
- Soil and Water Management.
- Contaminated Soils Management.

These plans would be based on the management measures, the Statement of Commitments and Ministerial Conditions of Approval relevant to their specific environmental aspect. The sub-plans would be developed in coordination with relevant government agencies where appropriate.

The resourcing, implementation responsibilities, monitoring and review and reporting requirements for the sub-plans would be consistent with and incorporated into that for the CEMP.

22. Project Justification and Conclusion

22.1 Achieving Objectives

The key objective of the Project is to increase rail capacity and reliability between the Hunter Valley and the Port of Newcastle. In addition to providing increased track capacity, the Project aims to improve operational performance along the route. These improved efficiencies would be created through reduced impacts on train traffic due to track maintenance activities, reduced loss of train paths (delays) due to shadow path effects from passenger services and the reduced loss of available train paths due to train breakdowns.

To meet this overall objective, the ARTC has developed a set of core and non-core objectives for the Project (refer to Section 5.2). Through the design process and the development of management measures and safeguards in this environmental assessment the core and non-core objectives would be achieved.

22.2 Consequences of Not Proceeding

The current constraint of the Hunter Valley rail network for transporting coal from mine to ship is the Port of Newcastle's ability to load the quantity of coal transported by rail into export vessels. With the commissioning of the new coal loader at the Port of Newcastle in early 2010 additional pressure has been placed on the Hunter Valley rail network. Restricting the export capacity of the Port of Newcastle would limit the associated economic development and employment opportunities in the Hunter Valley.

22.3 Project Justification Having Regard to the Objects of the *Environmental Planning and Assessment Act 1979*

In accordance with the Director General's Environmental Assessment Requirements, consideration has been given to the objects of the EP&A Act as outlined in Table 22-1.

Table 22-1 Objects of the Environmental Planning and Assessment Act 1979

EP&A Act Object	How Addressed
i. To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The Project would facilitate the proper development of natural resources, particularly coal, by improving the efficiency of the coal transportation system. The preferred route selection process and the development of the concept design have sought to minimise environmental and social impacts where feasible. Impacts of the Project on flora and aquatic ecology have been avoided or minimised where possible through the planning and design process. Locating the Project on the Up side adjacent to the existing line has a comparatively lower ecological impact than on a separate alignment. The Project has been developed to minimise impacts to local biodiversity and ecological integrity. Where impacts would be imposed, mitigation measures have been developed in the track design to reduce the scale and intensity of those impacts.
ii. To encourage the promotion and coordination of the orderly and economic use and development of land.	The development of improved infrastructure for the movement of freight and coal would assist with the orderly use and development of land in the locality. The Project would not significantly affect the future orderly use or development of land, however consideration to the potential impacts of increased train movements would need to be made for any future use of adjoining land.
iii. To encourage the provision of land for public purposes.	The Project would not directly result in the provision of land for public purposes, other than an improved rail infrastructure development, which indirectly benefits the wider community, including public transport commuters.
iv. To encourage the provision and coordination of community services and facilities.	The ARTC Strategy identified a number of works that could be undertaken to improve the Main Northern Railway between Maitland and Minimbah, in addition to the Project. These works include upgrading of roads, providing overpasses to replace level crossings and station upgrades. Access and safety for the community would be improved as a result of these works. The Project would not adversely impact on the provision of existing community services and facilities.

EP&A Act Object	How Addressed
v. To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	The concept design was developed with the inclusion of environmental management and mitigation measures. These measures are designed to limit the Project's impact on native flora and fauna species, with particular regard to threatened species, populations and ecological communities and their habitats. Impacts of the Project on flora and aquatic ecology have been avoided or minimised where possible through the planning and design process. Route selection was undertaken with the aim of minimising disturbance of areas containing threatened ecological communities, populations, species and their habitats.
vi. To encourage ecologically sustainable development.	Ecologically sustainable development is addressed in Section 22.4.
vii. To encourage the provision and maintenance of affordable housing.	The Project would not have any impact on the provision or maintenance of affordable housing.
viii. To promote the sharing of the responsibility for environmental planning between the different levels of government in the State.	The Project is to be assessed under Part 3A of the EP&A Act. The State Minister for Planning assesses Part 3A project applications. Input into the Director-General's Environmental Assessment Requirements, in the form of Environmental Assessment Requirements, is obtained from the relevant NSW Government departments and agencies at the time of the lodgement of the proponent's Project Application. Maitland City Council, Cessnock City Council and Singleton Council have been involved in the Project consultation process from the time of the route options phase (refer to Chapter 6). An assessment was undertaken that determined that the Project constitutes a controlled action under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.
ix. To provide increased opportunity for public involvement and participation in environmental planning and assessment.	The ARTC has undertaken a range of consultation activities to inform and receive feedback from the public, affected landowners and government agencies of the progress of the Project. Further details on this consultation are provided in Chapter 4. The Environmental Assessment would be placed on public exhibition by the NSW Department of Planning for a minimum of 30 days. In accordance with the requirements of the EP&A Act, stakeholders and the public would be invited to make submissions. This process provides opportunity for public involvement and participation in environmental planning and assessment of the Project.

22.4 Principles of Ecologically Sustainable Development

According to the *Protection of the Environment Administration Act 1991* (PEA Act), ecologically sustainable development (ESD) requires the effective integration of economic and environmental considerations in decision-making processes. Ecologically sustainable development can be achieved through the consideration of the following four principles:

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

The options development and design process has included the consideration of ESD principles.

22.4.1 The Precautionary Principle

Definition

The PEA Act defines the precautionary principle as "*if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation*".

Further, the PEA Act states that, in applying the precautionary principle, decisions should be guided by:

(i) *Careful evaluation to, wherever practicable, avoid serious or irreversible damage to the environment;*

(ii) *An assessment of the risk-weighted consequences of various options.*

Discussion

The precautionary principle has played a key role in the development of the Project. From route option identification through to the concept design and Environmental Assessment, the precautionary principle has been applied. An assessment of the consequences of various options was undertaken as part of the route options identification process. In identifying the preferred options for the third track and the various associated elements (refer to Chapter 6), a number of stages were implemented to select the most appropriate option.

During the Environmental Assessment sufficient information has been gathered to allow an informed process to be implemented. Careful evaluation of collected information was undertaken to avoid, wherever practicable, serious or irreversible damage to the environment. This has allowed the development of appropriate mitigation measures to limit the potential for both long and short-term impacts on the surrounding environment.

Intergenerational Equity

Definition

The PEA Act defines intergenerational equity as "*the present generation ensuring that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations"*.

Discussion

The Project has been developed to anticipate the needs of future generations, by developing and improving infrastructure for the coal industry and in turn, the economic conditions in the area. This would have long-term benefits and is supported and encouraged by the State Plan and the State Infrastructure Strategy (refer to Chapter 5).

Additionally, the construction and operation of the Project would involve the implementation of mitigation measures to respond to potential adverse impacts on the environment. Measures have been formulated to minimise potential impacts on existing residential properties and other existing land uses, while also taking into consideration potential impacts on proposed future land use activities. These measures would assist with achieving the principle of intergenerational equity.

Conservation of Biological Diversity and Ecological Integrity

Definition

The PEA Act states *"conservation of biological diversity and ecological integrity should be a fundamental consideration"*.

Biological diversity is defined by the Threatened Species Conservation Act 1995 as "the diversity of life and is made up of the following three components:

(a) genetic diversity - the variety of genes (or units of heredity) in any population,

(b) species diversity - the variety of species,

(c) ecosystem diversity - the variety of communities of ecosystems."

Ecological integrity is not defined by any Australian legislation. However, ecological integrity is defined by the *Canada National Parks Act 2000,* as "a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change and supporting processes".

Discussion

The preferred option selection process and the development of the concept design have sought to minimise disturbance to native vegetation and habitat where feasible. The preferred option for the third track and associated elements was chosen in preference to other options as they have comparatively lower ecological impacts, with a lesser extent of native vegetation to be removed.

The Project has been developed to minimise impacts to local biodiversity and ecological integrity. Where potential impacts have been identified, mitigation measures in the concept design have been developed to reduce the scale and intensity of those impacts.

The mitigation measures identified in this Environmental Assessment to be implemented prior to, during and following construction, and continuing in the operation phase, have the purpose of minimising impacts on native fauna species, and therefore maintaining biological diversity. A range of mitigation measures to minimise the potential impact on a range of environmental aspects, including noise, air quality, water and waste, would also play a role in the protection of biological diversity.

Improved Valuation, Pricing and Incentive Mechanisms

Definition

The PEA Act states that environmental factors should be included in the valuation of assets and services. The PEA Act identifies the following methods to achieve this:

> *"Polluter pays: those who generate pollution and waste should bear the cost of containment, avoidance or abatement;*
>
> *The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste; and*
>
> *Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems".*

Discussion

The economic value of the environmental resources affected by the Project has been considered throughout the option selection process, the concept design development and the Environmental Assessment phase. This has included:

- Consideration of environmental issues in the route selection process.
- A number of the measures required to minimise potential impacts on the environment, such as avoidance of sensitive ecological areas and measures for safe fauna movement, have been incorporated into the concept design and are key elements of the Project and its overall cost.
- Measures have been identified throughout the Environmental Assessment for the mitigation of potential environmental impacts, including the containment, avoidance and control of pollution associated with the construction and operation phases.
- Detailed investigations have been undertaken using a number of environmental parameters throughout the option selection process, the concept design development and the Environmental Assessment phase. This has been developed so that potential issues requiring remediation or clean-up tasks, and their associated potential high costs, can be addressed early and at likely lower cost.

22.5 Conclusion

This Environmental Assessment has addressed the key issues and general requirements identified in the Director-General's Environmental Assessment Requirements under Part 3A of the EP&A Act. The objects of the EP&A Act have also been considered together with the Project's consistency with the aims and objectives of the NSW State Plan and State Infrastructure Strategy.

The Project would produce some adverse impacts, which are unavoidable for a development of this scale. The Project's design has considered reduction of environment impact throughout the process, while the Environmental Risk Assessment process and the investigations undertaken as part of this environmental assessment have identified appropriate and targeted environmental measures to be applied during the construction and operation phases. As a result, the potential effect of any adverse impacts has been substantially mitigated. These environmental management measures are identified in this Environmental Assessment and in the draft Statement of Commitments (refer to Section 21.1).

The Project is a key component in meeting the objectives and ARTC's strategy of line improvements endeavouring to keep system capacity ahead of industry demands. In achieving this objective the Project would be expected to produce economic and transportation benefits to the coal industry on a local, regional, national and international scale that would, in turn, provide flow-on economic benefits to the Hunter Region.

22.5.1 Next Steps

The next steps for the Project are as follows:

- The Environmental Assessment would be placed on public exhibition by the NSW Department of Planning for a minimum of 30 days. Stakeholders and the public would be invited to make submissions.
- The Hunter 8 Alliance would prepare a Submissions Report detailing the key subjects of the submissions received. If required, The Hunter 8 Alliance would prepare a Preferred Project Report and a final statement of commitments.
- The Director-General of the NSW DoP would provide an Assessment Report to the NSW Minister of Planning who would then make a decision on the Project. If the Minister approves the Project, a set of approval conditions would be sent to the Hunter 8 Alliance, who would then be required to comply with these conditions for the construction and operation of the Project.

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