BETTER TRANSPORT FUTURES
MARK WAUGH

Proposed Train Support Facility, Woodlands Close, Hexham, NSW

QR National

Traffic Impact Assessment
September 2012

Mark Waugh Pty Ltd
ABN 67 106 169 180

Document History and Status

Issue	Ver.	Issued To	Qty	Date	Approved
Draft	Ver01.	Queensland Rail / ADW Johnson	1	3rd May 2012	C Thomas
Draft	Ver 2	Queensland Rail / ADW Johnson	1	25th May 2012	C Thomas
Draft	Ver 3	Queensland Rail / ADW Johnson	1	30th May 2012	C Thomas
Draft	Ver04	Queensland Rail	1	20th August 2012	C Thomas
Draft	Ver05	Queensland Rail	1	28th August 2012	C Thomas
Final	Ver06	Queensland Rail	1	31st August 2012	C Thomas
Final	Ver 07	Queensland Rail	1	10th September 2012	C Thomas

Printed:	10 September, 2012
Last Saved:	10 September, 2012
File Name:	M:\MW Pty Ltd\Active Projects\P0458 QR Adew Hexham\Reports\Update Report - April 2012\P0458 QR Hexham Rail Facility TIA Ver07.Docx
Author:	Sean Morgan
Name of Organisation:	Queensland Rail
Name of Project:	Proposed Train Facility Project, Hexham NSW
Name of Document:	Traffic Impact Assessment Report
Document Version:	Final
Project Number:	P0458

Contents

Document History and Status i

1 Introduction 3

2 Existing Situation 4

2.1 Background and Site Location 4
2.2 Local Road System 5
2.3 Traffic Volumes 6
2.4 Road Classification 9
2.5 Intersection Performance 10
2.6 Road Network Improvements 10
2.7 Public Transport, Pedestrians and Cyclists 12
2.8 Existing Accident Data 14

3 Construction Stage 15

3.1 Description of Works for Construction Stage 15
3.2 Site Access 17
3.3 Traffic Distribution 18

4 Impact Assessment – Construction Phase 20

4.1 Site Access Operations 20
4.2 Road Network Performance and Capacity 21
4.3 Road Safety 23
4.4 Internal Road Network 23

5 Impact Assessment – Operational Phase 24

5.1 Impact Assessment – Train Support Facility 24
5.2 Pedestrian Access 24
5.3 Public Transport Facility 24
5.4 Site Operations and Access Arrangements 24
5.5 Parking Requirements 25

6 Assessment of Transport Operations 26

6.1 Site Access Operations 26
6.2 New England eastbound off ramp / Anderson Drive 27
6.3 Predicted Intersection Operation – Tarro Interchange on New England Highway 29
6.4 Proposed Road Works 29
6.5 Richmond Vale Rail Trail 29

7 Summary and Conclusions 30

7.1 Summary 30
7.2 Summary of Road Mitigation Measures 30
7.3 Conclusion 31

Appendix A. Site Plans and Access Proposal 32

Appendix B. Accident Crash Data Summary 43

Appendix C. Sidra Results 48

1 Introduction

Better Transport Futures was commissioned by Queensland Rail to prepare a Traffic Impact Assessment for the proposed Train Support Facility on the vacant land in the vicinity of Woodlands Close, Hexham. The site is located adjacent to the Great Northern Railway and the sole vehicle access route is via Woodlands Close. Concurrently, ARTC are proposing to construct the Relief Roads Project adjacent to the site to relieve rail network congestion.

This report presents the findings of the traffic investigations and assessment of the proposal, based upon the current plans for the development and the updated traffic volumes for the local road network. This update has also taken into account the proposed F3 to Raymond Terrace road link and is structured as follows:

- Chapter 2 outlines the existing situation in the vicinity of the subject site, including discussion on the planned development growth within the vicinity and road network changes to support it.
- Chapter 3 details the traffic operations and access requirements related to the Construction Stage of the Train Support Facility.
- Chapter 4 assesses the traffic impacts during the construction phase of the Train Support Facility together with the concurrent construction of the ARTC Relief Roads project.
- Chapter 5 assesses the impact of the Train Support Facility once operational together with the adjacent ARTC Relief Roads Project.
- Chapter 6 assessment of the traffic operations for the future development of the Train Support Facility together with the ARTC Relief Roads Project and the impact upon the local road network and the site access; and
- Chapter 7 summarises the findings of this investigation, outlining conclusions and recommendations for the traffic operations of the site to support the development application for the various stages of the proposal.

As part of the development of this document, the following guides and publications were used:

- RTA Guide to Traffic Generating Developments, Version 2.2 Dated October 2002;
- City of Newcastle Cycling Strategy and Action Plan adopted March 2012;
- Australian / New Zealand Standard – Parking Facilities Part 1 : off-street car parking (AS2890.1:2004);
- Hexham Relief Road, Traffic Impact Assessment prepared by Parsons Brinkerhoff dated July 2012;
- Accident Data for the locality provided by the RMS (Newcastle office); and
- Austroads Guidelines for Traffic Management and Road Design

2 Existing Situation

2.1 Background and Site Location

The subject site is located at Hexham, NSW between the main northern railway on its eastern boundary and the Chichester Pipeline to its west.

Source: UBD

■ *Figure 2-1-Site Location*

The site has existing access to the New England Highway via Woodlands Close to the north. It is not possible to access the Pacific Highway at Hexham because of the railway and the close proximity of the main road. The site is constrained to the west and south by the Hexham Swamp leaving the only practical land transport access for the site as Woodlands Close to the north.

The existing intersection of Woodlands Close and the New England Highway provides left in left out access only to the west of the main northern railway overbridge. The intersection has limited sight distance for traffic travelling west toward Maitland because of the railway overpass, and is a safety concern for the RMS. The speed environment reflects the important arterial function of this road, posted as 90 km per hour.

To the west of Woodlands Close is the Tarro Interchange, a grade separated interchange which provides local access to Tarro and Beresfield from the New England Highway.

Past uses of the land have been low in traffic generating intensity, either agricultural (grazing) or material storage. This has meant that the low usage of the existing Woodlands Close intersection has been acceptable as the only vehicular access for the site.

2.2 Local Road System

2.2.1 Road Characteristics

New England Highway

New England Highway (H9) in the vicinity of the site provides a dual carriageway with two lanes of travel in both directions to state highway standard. It has a posted speed limit of 80 km/h north of Hexham. This portion of the New England Highway forms part of the State Highway system and carries a high level of interstate and inter-regional traffic. The road is controlled by the RMS with Council being the consent authority for any new works on this road.

The Tarro Interchange was constructed by the RMS to address local access for Tarro and Beresfield. This was necessary with the continued growth in traffic flows on this section of highway which serves as a link around Hexham Swamp for both the New England and Pacific Highways to the F3 Sydney to Newcastle Freeway. The at grade junction serving Tarro was upgraded by the RMS some years ago by providing a grade separated interchange at a point to the west of Woodlands Close. This removed the previous at grade intersection in the vicinity of Woodlands Close and has resulted in a much safer junction for all road users, and allowed the road environment to operate at its current speed limit of 80 kph (recently reduced after RMS review).

Sight line visibilities at the interchange are satisfactory and are in accordance with the requirements of the RTA Road Design Guide for the posted speed limit. A peak hour traffic survey was completed at this intersection during both the morning and afternoon periods (BTF July 2011) and it was noted that the current interchange operates well. Further details are outlined in **Section 2.3 Traffic Volumes**.

Woodlands Close

Woodlands Close is a local road connecting to the New England Highway immediately to the west of the railway overbridge. It serves as the only access to land parcels to the west of the main northern railway line, including the subject site. The existing standard of road is quite low, operating as a low volume two lane two way road serving sites that are currently used predominantly for agricultural purposes. The overall level of traffic generation that utilises the road is minimal.

- *Photo 1-Aerial view of New England Highway south of Tarro, showing the Tarro Interchange, and Woodlands Close in the foreground.*

2.3 Traffic Volumes

Traffic volume data for the project has been collected from the RMS and during a survey of traffic movements at the Tarro Interchange. Peak period surveys were initially completed on Friday 4th August 2006.

The results in Table 2-1 from the traffic surveys completed in 2006 indicate that during the surveyed morning peak period (7.45 to 8.45 AM) the two-way traffic flow along the New England Highway was 4,574 vehicles (to east of Tarro interchange). The directional split of flows was 2,790 vehicles eastbound towards Hexham (61%). The morning flows reflect demand for commuting traffic to Newcastle. The eastbound flow during the peak demonstrates that there is a high demand for through traffic movements along the New England Highway. The majority of observed vehicles were light vehicles, but there were a high number of heavy vehicle (including B-double trucks) of the order of 15 % of total flows.

Whilst these traffic volumes have altered since 2006, this data provides valuable background for directional splits of traffic, daily variation in traffic movements to aid in the identification of peak periods and variation of traffic through the week.

■ *Table 2-1 Peak hour survey results on the New England Highway – August 2006*

		AM Peak 7.45-8.45am		PM Peak 4.30-5.30pm	
New England Highway	Eastbound	2,790	61%	2,210	44%
	Westbound	1,784	39%	2,865	56%

The traffic survey also recorded turning movements in and out of the New England Highway at the Tarro interchange. The surveys show that existing traffic flows along the Tarro Interchange link road are relatively low, with around 298 vehicles two-way observed during the morning peak period. A significant number of these vehicles would be workers travelling to areas of Newcastle to the south and east of the interchange.

The afternoon peak hour surveys show that the peak period is from 4.30 to 5.30 pm- after 5.30 pm the traffic volumes decreased. The two-way traffic flow was 5,075 vehicles per hour, with the predominant movement being westbound, towards Maitland, with some 2,865 vehicles or 56% of the flows. In the order of 9% of vehicles were heavy vehicles, showing a lower percentage than the morning peak period.

In July 2011, BTF completed additional traffic surveys to determine the morning and afternoon peak period traffic flows utilising the Tarro Interchange, excluding the New England Highway. These surveys show that the two-way traffic flow over the bridge are in the order of 450-500 in the afternoon peak period whilst in the morning peak period they are lower at 350-400. The peak directional flow was 318 in the PM peak (from Anderson Drive towards Maitland) with the morning peak directional flow being 260 (from Newcastle turning off towards Anderson Drive). The majority of the vehicles observed were light vehicles.

It was noted during the site visit that there was a high percentage of traffic turning off the eastbound ramp off the New England Highway, turning left onto Anderson Drive and then completing a U-turn at the intersection of Anderson Drive with Woodberry Close. These vehicles then proceed back over the bridge to return to the New England Highway and turn off onto John Renshaw Drive to use the F3Freeway. It would appear that drivers are using this route to avoid the substantial delays experienced by southbound traffic on Weakleys Drive.

■ *Table 2-2 Peak hour survey results – Tarro Interchange July 2011*

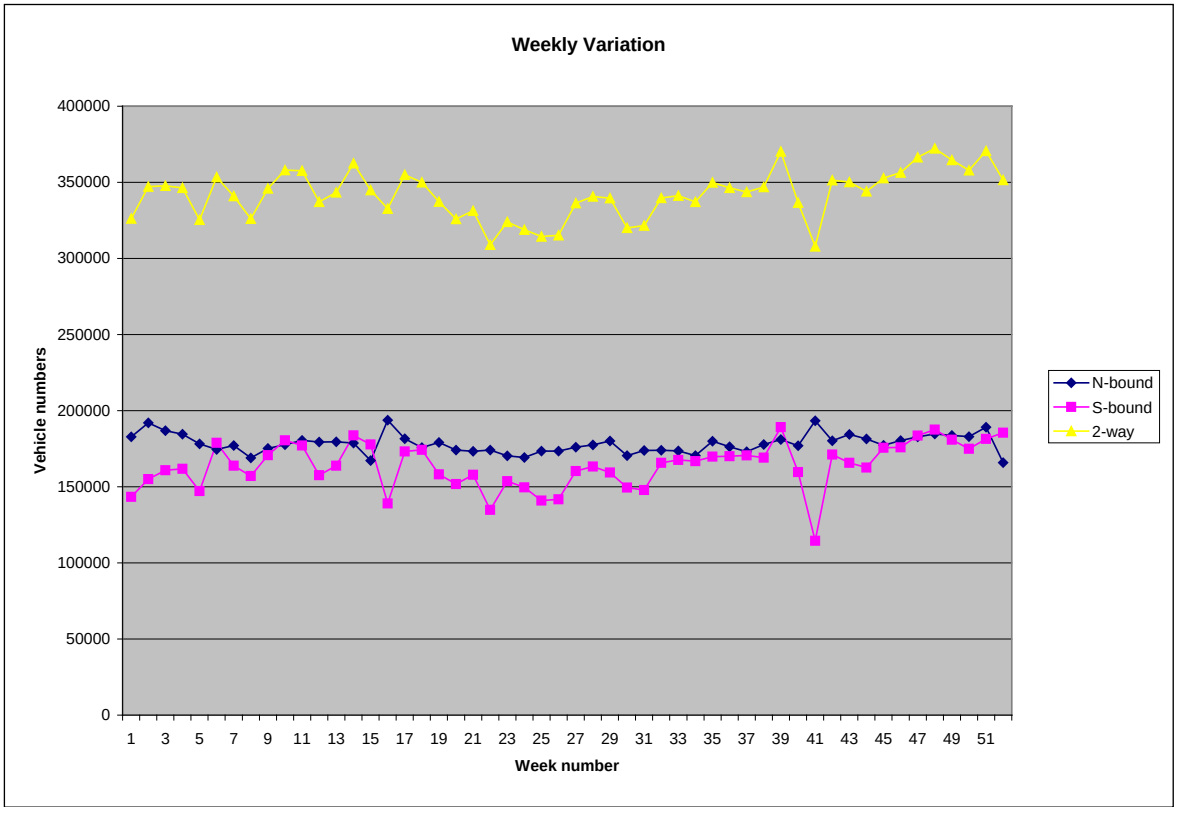
		Peak Movement	
Anderson Drive/Tarro Interchange	From Newcastle on to Anderson Drive	260	AM Peak
	From Anderson Drive towards Maitland	318	PM Peak

2.3.1 RMS Traffic Volume Data

The relevant traffic data provided by the RMS is for the station numbers 05.055, which is located to the north of the site, on the New England Highway, north of the Pacific Highway (SH10) junction. This station provides a wide range of data, including weekly variation in flows along the New England Highway as well as hourly variation in flows, for both northbound and southbound flows.

2.3.2 Weekly variation in traffic flows along the New England Highway

The weekly variation in traffic data for traffic flows along the New England Highway is presented in Figure 2-2 below:

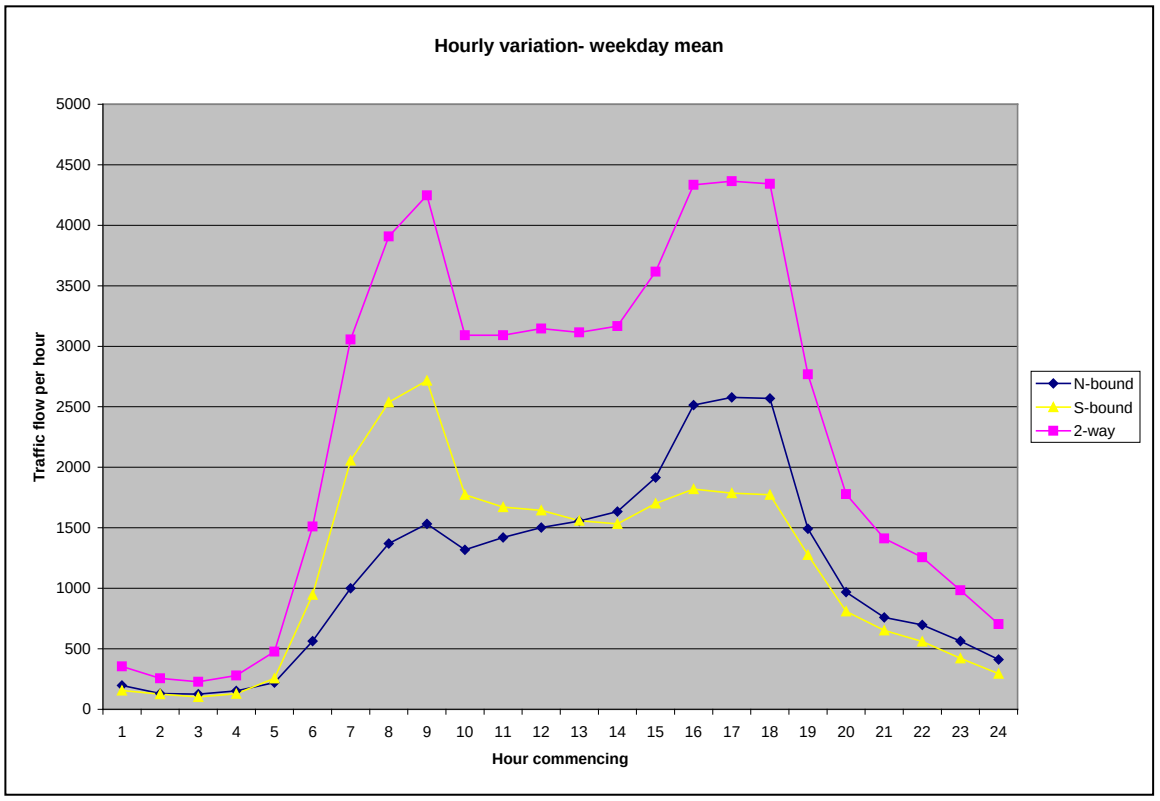


■ *Figure 2-2 Graph showing weekly variation in traffic volumes at Count Station 05.055*

From the graph above, it can be seen that the weekly variation in traffic flows along the New England Highway is very low. There is a slight peak towards the end of the year, when there is heavier flows associated with the Christmas peak period.

2.3.3 Hourly variation in traffic flows along the New England Highway

The weekday hourly variation in traffic data for traffic flows along the New England Highway is presented in Figure 2-3 below:



■ *Figure 2-3 Graph showing hourly variations in traffic volumes at Count Station 05.055*

From the graph above, it can be seen that the southbound traffic flow produces the peak single direction flow, between 8.00 and 9.00 am, which corresponds with the period noted during the traffic survey on site. The graph also shows that the south bound flow is around 2,800 vehicles per hour which is consistent with the observed survey flow of 2,790 vehicles per hour. This RMS data is from 2001, which indicates there has been little growth in the peak period flows in recent years.

2.3.4 Historic Traffic Growth

The traffic data from the RMS automatic counter also provides historic data, providing background traffic growth in traffic volumes along the New England Highway. These are presented in Table 2-3 below:

■ *Table 2-3 Historic Traffic Flows along the New England Highway*

Year	1988	1990	1992	1995	1998	2001	2004	2010	2011
AADT	29,551	34,451	34,523	41,052	43,337	45,783	48,879	56,430	52,116
Growth		4,900	72	6,529	2,285	2,446	3,096	7,551	-4,313
% per annum		8.29%	0.10%	6.30%	1.86%	1.88%	2.25%	2.57%	-7%

Table 2-3 above shows that the rate of growth in traffic flows along the New England Highway has decreased over time. The growth up to 1995 is a reflection of the various connections of the F3 Freeway to the New England and Pacific Highways. Since 1990 the average over the 11 years of data is in the region of 3% per annum. The last 5 years data shows that the rate of growth is just on 2.7% per annum, reflecting growth in traffic demand between the Upper Hunter and Maitland through to Newcastle. The most recent values from 2011 indicate the daily volumes have reduced.

2.4 Road Classification

It is usual to classify roads according to a road hierarchy, in order to determine their functional role within the road network. Changes to traffic flows on the roads can then be assessed within the context of the road hierarchy. Roads are classified according to the role they fulfil and the corresponding volume of traffic they should carry. The Roads and Maritime Services Authority of New South Wales (RMS) has set down the following guidelines for the functional classification of roads.

Arterial Road

Typically a main road carrying over 15,000 vehicles per day and fulfilling a role as a major inter-regional link with over 1,500 vehicles per hour during the peak hours. The New England Highway would be classified as an arterial road.

Sub-arterial Road

Defined as secondary inter-regional links, typically carrying volumes between 5,000 and 20,000 vehicles per day with between 500 and 2,000 vehicles per hour during the peak hours.

Collector Road

Provides a link between local areas and regional roads, typically carrying between 2,000 and 10,000 vehicles per day. At volumes greater than 5,000 vehicles per day, residential amenity begins to decline noticeably. Peak hour flows would be between 250 to 1,000 vehicles per hour. Anderson Drive would be classified as a collector road.

Local Road

Provides access to individual allotments, carrying low volumes, typically less than 2,000 vehicles per day with peak hour flows up to 250 vehicles per hour. Woodbury Road would be classified as a local road.

Peak hour volumes on all types of roads are typically within the range of eight to twelve per cent of the daily flows.

The RMS provides the following advice on levels of service for flows on urban roads.

■ *Table 2-4 Peak hour flow on two-lane urban roads*

Level of service	One Lane (vehs per hour)	Two Lanes (vehs per hour)
A	200	9,00
B	380	1,400
C	600	1,800
D	900	2,200
E	1,400	2,800

Table 2-4 demonstrates that the New England Highway is currently operating within its technical and functional capacity level as an urban highway. Based on the RMS's guidelines for level of service, the New England Highway operates at a level of service of E, assuming a heavy vehicle percentage of up to 15%. This shows that the road has some spare capacity for increased traffic flows although there may be some delays created by merging traffic.

Based on the data observed in surveys presented and discussed above, the existing peak period flows at the Tarro Interchange of 2,790 vehicles per hour south/eastbound and 1,783 vehicles per hour north/westbound during weekday AM periods suggests that for the eastbound movement towards Newcastle, the road is currently operating close to capacity with a level of service of E.

For the corresponding afternoon peak period, the westbound movement is in the order of 2,865 vehicles per hour, again indicating that the current level of service is E. This again shows that during the critical afternoon peak the road is operating within its capacity limits, with some spare capacity for additional traffic movements.

2.5 Intersection Performance

The operation of the Tarro Interchange on the New England Highway was observed during the survey period and the existing delays to turning vehicles were generally low for road users along both roads.

For traffic exiting the New England Highway, visibility in both directions is acceptable, as the interchange has been placed on a straight section of the New England Highway at a distance of approximately 300 metres from the railway overbridge. This provides road users with acceptable visibility in all directions at the interchange.

The analysis of this interchange is considered under the development impact analysis, in terms of the impact potentially on highway levels of service, and the predicted performance of a right turn lane on the Tarro Interchange.

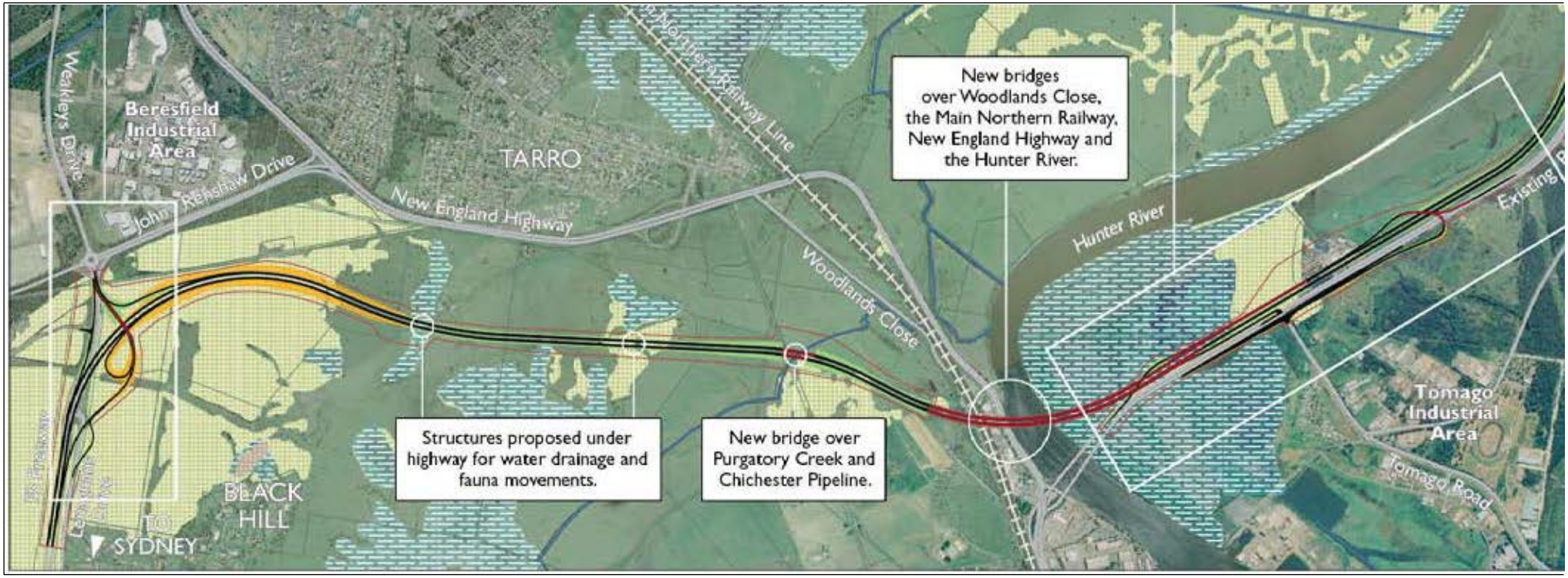
The intersection of the New England Highway with Woodlands Close operates well with little delay, but it is noted that the traffic flows in and out of Woodlands Close are very low, as there is currently little development off Woodlands Close to create a demand.

2.6 Road Network Improvements

The RMS seeks to maintain the operating standard of the state highway system both in terms of movement and safety. This has been recognised by the NSW Government which has commenced investigations into a future high standard connection from the F3 terminus at John Renshaw Drive to the Pacific Highway at Heatherbrae. This future route is planned to bypass the section of New England Highway that would provide the key road connection for the subject site.

The preferred route has now been established by the RMS and was released publicly in July 2008. The major benefit of this proposed upgrade is the removal of a large number of traffic movements from the length of the New England Highway between the end of the F3 and Hexham. As part of the development of the preferred option, a traffic modelling exercise was completed for the RMS. It is understood that this modelling work has indicated that the traffic flows along this length of the New England Highway could potentially reduce by in the order of 20 to 30% of existing flow levels at peak times. This would equate to a traffic reduction of around 600 to 900 vehicles per hour at peak times. There is no timeframe for this construction work and it remains at the planning stage currently.

The preferred option for upgrading this length of the Pacific Highway in the vicinity of the subject site is shown below in Figure 2-4.



Source: RMS web page.

■ *Figure 2-4 Extract from Concept Design for the F3 Freeway to Raymond Terrace upgrade*

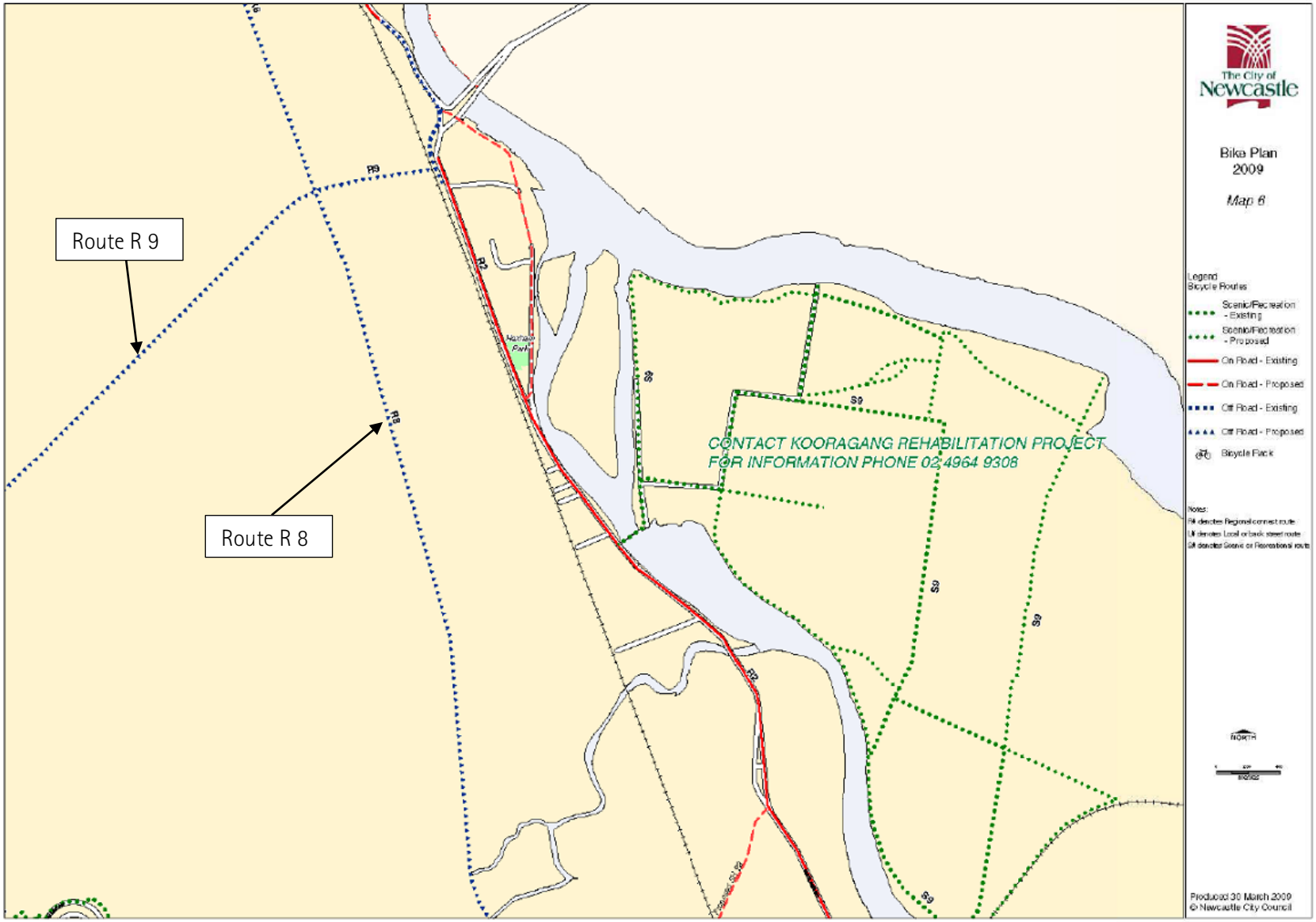
The RMS is currently constructing the F3 to Branxton link (Hunter Expressway) with this project due to open by January 2013. This important road link will provide a more direct route between the F3 and the New England Highway, as well as providing an attractive route for traffic from the Maitland area accessing the centre of Newcastle. This link will potentially decrease the volume of traffic using the New England Highway adjacent to the subject site and allow for improved road operation.

The other road network upgrade that has been completed in the vicinity of the site and has improved the network operation is the upgrade of the intersection of the New England Highway and Weakleys Drive. The work involved the provision of a grade separated interchange at this location to provide priority for the major through traffic movement along the New England Highway.

2.7 Public Transport, Pedestrians and Cyclists

Public transport in the vicinity of the site is available via the regional rail network at Hexham. Pedestrian access is via existing on-road facilities in the general vicinity of the site. There are a number of on-road marked cycle lanes on the New England Highway in the locality of the subject site and the RMS have been gradually upgrading the cycling facilities as other upgrades have occurred. It is understood that the RMS are currently reviewing upgrade options at the rail over pass on the New England Highway to the immediate east of Woodlands Close, with the provision of a dedicated off road cycle path required at this location due to current safety concerns for cyclists.

The City of Newcastle Council has recently updated their Bikeplan and this includes a potential link along Woodlands Close for a cycle path (R8) (See Figure 2-5). This route has no funding or timeframe but has been identified as a desirable future regional link. This link has also been identified to connect with the potential future Richmond Vale Rail Trail (R9) that will provide a regional link between the Hexham area through to Kurri Kurri and beyond. It is noted that the Richmond Vale Rail Trail is a long term project similar to the Fernleigh Bike Path that will take a number of years to develop and fund but has the potential to provide a dedicated off road regional cycling facility.



Source: City of Newcastle Bike Plan 2009

■ *Figure 2-5 Extract from NCC Bike Plan 2009*

2.8 Existing Accident Data

As part of the study work, the accident crash data for the New England Highway and the Tarro interchange have been obtained from Roads and Maritime Services. The data covers 5 years of incidents, dating from July 2006 through to June 2011.

The accident crash data for the locality shows that there have been some 21 reported incidents over the 5 year timeframe, around 4 per annum. There has been a single injury with 20 accidents recording no injuries. The majority of the accidents are rear end type accidents (47%), which typically reflect drivers not reacting in time to vehicles slowing down in front of them.

Since the data has been provided by the RMS, it is noted that there has been a cyclist fatality at the rail overpass. This has prompted renewed planning by the RMS with regards to the provision of an off-road cycle lane over this railway bridge, due to the constrained nature of the road alignment in this location.

A summary of the accident data is provided in Appendix B to this report.

3 Construction Stage

3.1 Description of Works for Construction Stage

The Train Support Facility (TSF) will be a dedicated provisioning and maintenance depot for QR National trains hauling coal between Hunter Valley mines and the Port of Newcastle. The TSF project area, including the access road to the Tarro Interchange, will occupy approximately 38 Ha of land parallel to the Great Northern Railway (GNR) at Hexham. It will consist of a number of rail lines parallel to the GNR with specialised buildings for locomotive and wagon maintenance and refuelling and standing facilities. This construction works will include the construction of the fuel storage area that will provide 4 x 100,000 litre diesel tanks for refuelling of the trains at the facility.

The initial stage of works on site will be to construct an access road to the site, with a new T-intersection off the Tarro Interchange. This access will be constructed in a joint partnership with ARTC who also require an access for their proposed works for the Hexham Relief Roads Project. If the ARTC project has not progressed then the access road off the Tarro Interchange will be built as part of this TSF project.

This new access road will be constructed from the Tarro Interchange to the extent of accommodating access to the crown land parcel within the QR National landholding. The intention would be to retain Woodlands Close as it provides access for local residents and local and State Government authorities such as Hunter Water and the ARTC to adjacent lands and to their infrastructure.

Following construction of the access roads to the site, construction of the main TSF facility can commence. This will involve the importation of up to 380,000 cubic metres (measured on plan) of fill to provide a level platform on which to construct the rail formation and buildings that will form the TSF. Allowing for each cubic metre of fill to weigh approximately 1.7 tonnes this gives a total tonnage in the order of 646,000. Allowing for typically 30 tonnes per truck and dog load, this gives in the order of 21,533 inbound truck movements for fill with a corresponding outbound movement of empty trucks. Note that this is considered a worst case scenario as some fill may be obtained on the site but the value of 12,200 has been applied to this assessment. The construction period is expected to be about 20 months.

■ *Table 3-1 Summary of imported fill requirements for construction works*

Fill Requirement (measured on plan)	Total tonnage (based on 1.7t/m^3)	Number of inbound movements (30t/load)
380,000m^3	646,000	21,537

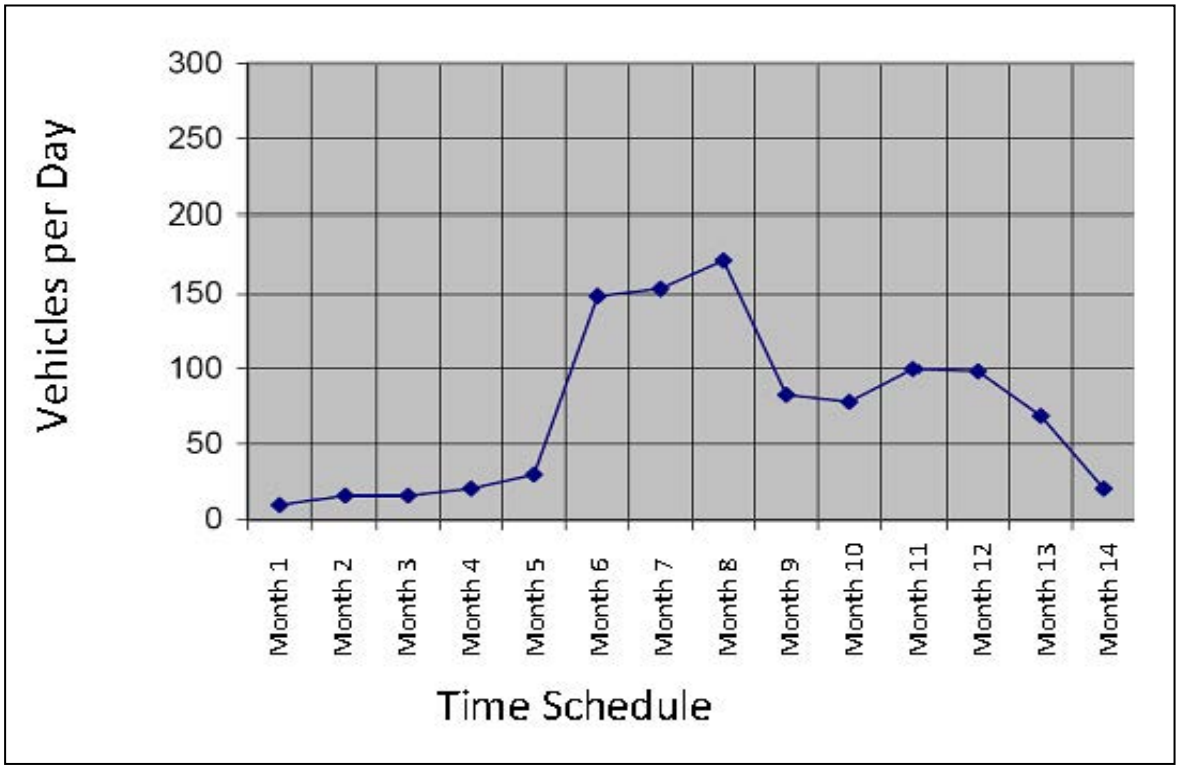
3.1.1 Traffic Generation

When assessing the construction traffic movements, the following assumptions have been made:

1. The access off the Tarro interchange will have been completed at the beginning of the project, either as part of the ARTC project or as the initial stage of the development of this project, allowing access to the subject site to be permitted via this route with NO use of the intersection of the New England Highway and Woodlands Close required for the construction of the Train Support Facility once this access off Tarro interchange is provided.
2. During the initial stage of the construction staff movements associated with the site are anticipated to be approximately 15 vehicles entering for the 7am start and 15 vehicles leaving after the 6pm finish. These movements include site managers and plant operators.
3. Material deliveries are expected to occur primarily during the 9am – 3pm window. The majority are expected to occur during the earlier part of the day. This is to provide maximum construction and supply efficiency with trucks not being delayed during peak hour traffic and plant on site having the optimum opportunity to deal with materials once delivered.
4. Although the majority of activities or material hauls are well known, there will be a small proportion of minor traffic and loads which are unpredictable.

5. The major vehicle movements will occur during the import of fill when potentially up to 12,200 inbound trucks will be required to deposit the fill on the site.

Advice from the study team provides the following estimate of traffic generation during construction stage of the project. These estimates are shown as a worst case scenario over only 14 months (See Figure 3-1). The anticipated time frame for the construction is 19-20 months which will extend the graph and potentially soften the peaks. The busiest stage of the construction for vehicle movements will be during the import of fill, which has the potential be sourced from a number of locations. Due to the haul times to the site (and the return trip) the number of truck movements per day will remain constant, but the number of days that these trucks will need to access the site will potentially vary.



■ *Figure 3-1 Indicative Construction Traffic Vehicle Movements Shown Monthly*

The graph above shows that there will be a distinct peak to the traffic flow patterns associated with the construction works on site. During the initial few months of construction, there will be in the order of 20 to 30 vehicles entering the site per day equating to 40-60 vehicle movements per day two-way, whilst at its peak there could be in the order of 170 vehicles or so entering the site. Allowing for exiting movements, this would indicate some 340 vehicles per day two-way associated with the construction works on site. This peak however is temporary in nature, predicted only to occur over two to three months of the construction period.

This peak period may elongate to 4 month due to the volume of inbound fill that is required on the site. Any material won on site would reduce the inbound material requirements, with associated reduction in truck demands.

These flow rates have been applied in the traffic analysis for these investigations, to ensure robustness of design.

■ *Table 3-2 Summary of Construction Vehicle Movements for Train Support Facility*

	Daily number of vehicles	Total Two-way movements
Initial Phase of Construction	20-30 vehicles	40-60 vehicle movements two-way
Peak Period of Construction (2-4 months)	170 vehicles	340 vehicles movements two-way

3.2 Site Access

Vehicle access to the development will be via a new access road connecting to the Tarro Interchange. Until advised otherwise by the road authority, it is assumed that the Woodlands Close intersection will remain open given this is a public road owned by Council. Construction workers will enter and exit the site via the new access point on the Tarro Interchange as will materials and plant movement. The hours of work will be governed by consent conditions and are anticipated to be between 7am and 6pm. It is expected that peak movements in would generally occur before the morning peak hour on the adjacent road network and in a similar manner the majority of construction staff would leave the site following the afternoon peak on the New England Highway.

It is recognised that the existing intersection of Woodlands Close with the New England Highway is not well laid out due to the combination of poor sight visibility lines and vehicle speeds / volumes along the New England Highway.

It has been assumed that the access off the Tarro interchange will be built at the beginning of the process (and potentially in conjunction with ARTC) prior to work commencing on the Train Support Facility.

As part of the construction of the access off the Tarro interchange, initial access will be required to the site via Woodlands Close, in order to move the heavy machinery onto the site as well as the material required to build the access on the Tarro interchange. The construction of the access to the Tarro interchange will be wholly within the site so that disruption to traffic on the interchange will be minimal. The movement of vehicles in and out of the site via Woodlands Close for this work will need to be discussed and agreed with the road authorities (Council and the RMS) and will require the development and implementation of a Traffic Management Plan in accordance with the RMS "Traffic Control at work sites" manual. It is considered that this TMP will require access to be restricted to use at night and would potentially require the closure of the left hand lane on the New England Highway with an appropriate speed reduction zone. This will be a separate application to Council with a detailed TMP submitted for review and approval.

Once the access can be provided via the connection to the Tarro interchange ramp, all vehicle movements for the construction and operation of the Train Support Facility will use the Tarro ramp access with no further vehicle access via Woodlands Close. This will allow for both construction workers vehicles and all material delivery vehicles to use this new access on the Tarro interchange.

Note that as part of the traffic management for the construction phase, all heavy vehicles will be directed to enter the site off the New England Highway westbound via the off ramp and then to turn right into the site. The traffic management plan will specify that NO heavy vehicle access will be permitted via Tarro along Anderson Drive.

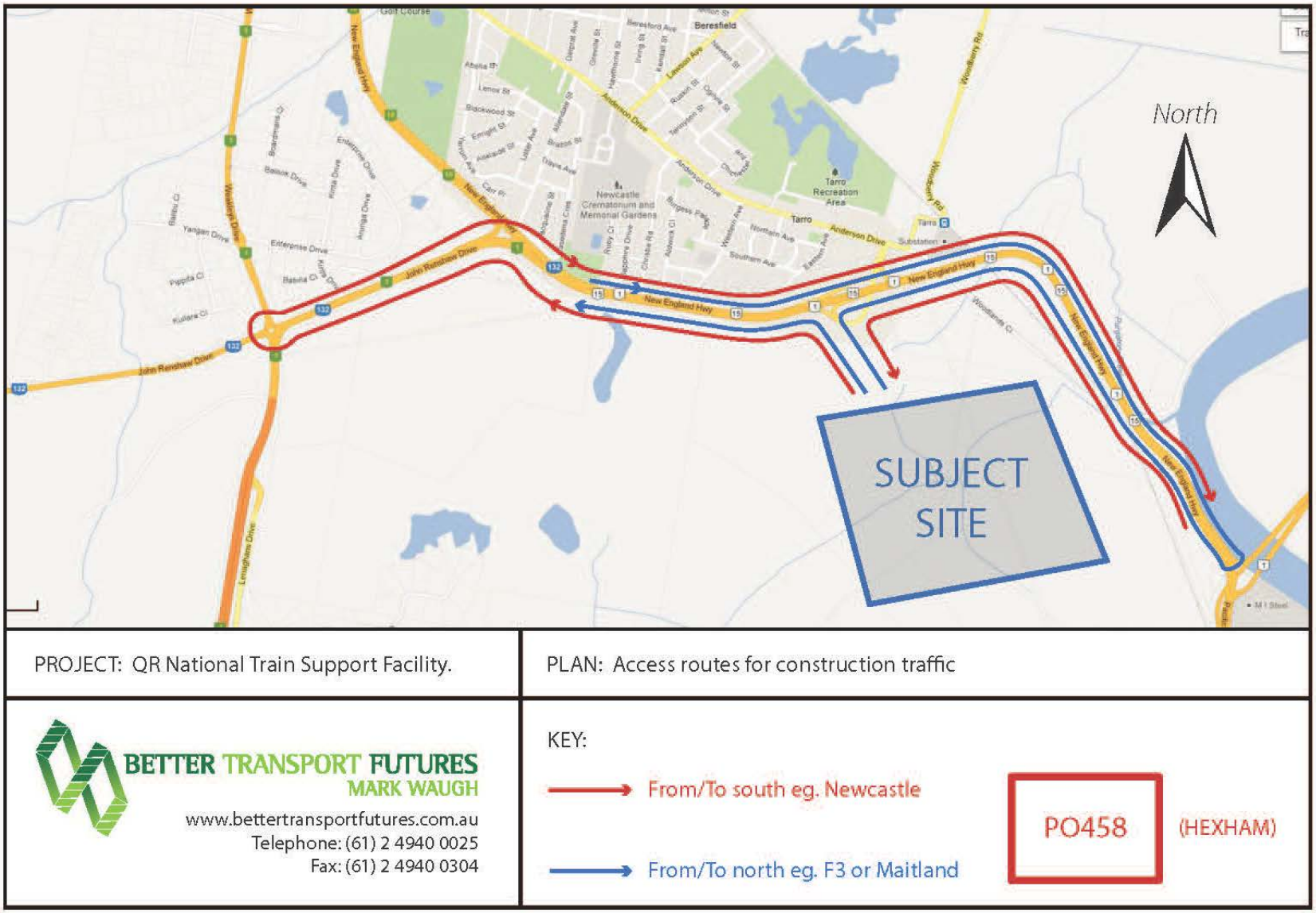
3.3 Traffic Distribution

It is considered that there will be no dominant direction for traffic inbound and outbound of the site for the construction works. For the purposes of this assessment, it has been assumed that traffic will be equally split between origins/destinations to the north and south of the site.

The following is a summary of vehicle movement paths for vehicles entering and exiting the site:

- Accessing from the south, vehicles will left turn in off the existing slip road to the Tarro Interchange and then turn right into the access road to the subject site.
- Accessing from the north, vehicles would continue along the New England Highway to the signalised turn around area under the Hexham Bridge (opposite the Oak factory) then turn right back onto the New England Highway to then proceed to the Tarro Interchange as above.
- Exiting movements to north will turn left onto the existing on ramp to the New England Highway and merge with the northbound movement along the New England Highway.
- Exiting movements wishing to head south will turn left onto the Tarro Interchange and then merge onto the New England Highway, before turning down John Renshaw Drive and making a U-turn at the roundabout controlled intersection of John Renshaw Drive with the F3 Freeway (at the end of Weakleys Drive).

Refer to Figure 3-2 over for the access routes in and out of the subject site.



■ Figure 3-2 Access Routes for Construction Traffic

4 Impact Assessment – Construction Phase

4.1 Site Access Operations

It is proposed to provide all vehicle access to the construction area via the new access off the Tarro Interchange. Construction is due to occur over a 20 month period, with a gradual build up of work on site that will peak over a 3 to 4 month period, with a drop off in work after this intensive period.

The construction start and finish times may be controlled, to avoid traffic movements in and out of the site during peak periods on the adjacent road network. For inbound trips, the majority of trips will occur before 7.00 AM, when the traffic flow on the New England Highway is much lower than during the peaks. For example, before 7.00 AM, the northbound traffic flow on the New England Highway is less than 1,000 vehicles per hour in two lanes.

The proposed construction times are 7am-6pm and as such the outbound movements will occur at the end of the afternoon peak period. From the RMS data, it can be seen that the northbound flow between 2.00 PM and 7.00 PM is over 1,000 vehicles per hour, with the peak flow over 2,500 vehicles per hour over a 2 hour period.

It is important to note that ARTC is planning to undertake the construction of the Hexham Relief Roads Project on land adjacent to the proposed site. This project could potentially be constructed at the same time as the TSF construction, and this assessment has allowed for the traffic movements associated with concurrent construction.

From the review of the report prepared for the Five Relief Roads project by Parsons Brinkerhoff (dated July 2012) the future traffic flows associated with the construction works are 70 light vehicles per day and 120 heavy vehicles per day during the peak construction works (190 vehicles per day, or 380 two-way movements) see Table 4-2. The hours of operation for the construction will be between 7.00 AM and 7.00 PM. There will be 70 inbound light vehicle movements associated with workers arriving on site before 7.00 AM and these same numbers leaving after 7.00 PM. During the working day there will typically be 11 inbound and 11 outbound trucks movements per hour associated with this construction work.

■ *Table 4-1 Fill Truck Movements*

Fill Requirement (measured on plan)	Total tonnage (based on 1.7t/m^3)	Number of inbound movements (30t/load)
380,000m^3	646,000	21,533

■ *Table 4-2 Vehicle Movement*

	Daily number of vehicles	Total Two-way movements
Light Vehicles	70 vehicles	140 vehicle movements two-way
Heavy Vehicles	120 vehicles	240 vehicles movements two-way
Total Movements	190 vehicles	380 vehicle movements two-way

4.2 Road Network Performance and Capacity

It is considered that the overall traffic volumes associated with the construction phase of the TSF development will have an acceptable impact upon the road network. The peak daily traffic volume is predicted to be in the order of 340 vehicle movements per day, which will be spread over a number of hours (7 or 8 hours). There will be distinct peaks in traffic flows at the start of the day and at the end associated with staff arriving and departing, but both of these events will be controlled to occur outside of the peak periods on the adjacent road network.

It is important to note that the construction of the adjacent ARTC Relief Roads project could potentially be occurring at the same time and this construction work will require some 380 vehicle movements per day (maximum). Thus the cumulative traffic flows during this concurrent construction activity could be in the order of 720 vehicle movements per day. The ARTC construction work will require a peak of 70 construction workers on site.

The construction traffic will have two distinct peaks with inbound movements during the morning associated with construction workers arriving on site and outbound movements during the afternoon period associated with construction workers exiting the site at the end of the day. The total number of construction workers for the two sites would be in the order of 1 50 giving 1 50 inbound trips in the morning peak period and a similar value departing in the afternoon/early evening. The remaining traffic flows for both of these sites would be spread out over the primary delivery period between 9am and 3pm hour day, giving some 95 vehicle or less per hour on average (or 48 vehicles entering and 4 8 vehicles exiting per hour). These represent the movements for the peak construction phase which is anticipated to be for three months.

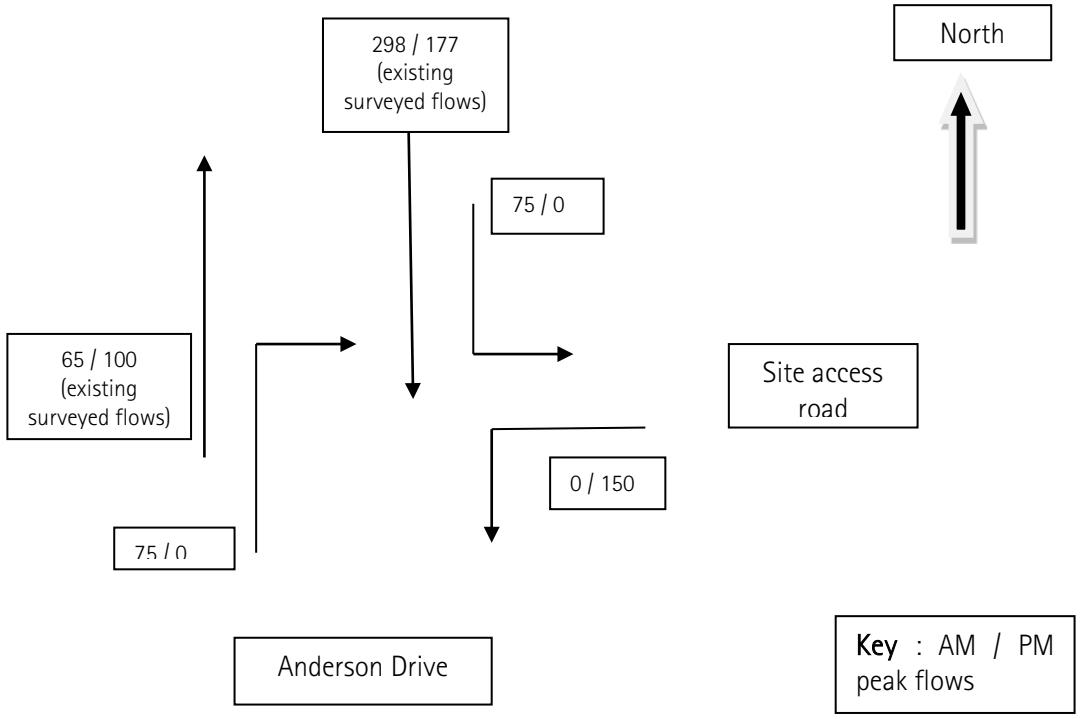
It can be seen that outside of the peak periods of use along the New England Highway, this volume of traffic will have an acceptable impact upon the operation of the road network at this location. Outside of the peak hours, the traffic flows on the New England Highway at this location are 1,000 or more per hour less than the flows during the peak periods, indicating significant spare capacity for additional traffic movements. Whilst the flows will increase with the construction activities, the total flows will be much lower than during the peak periods and the additional delays / congestion for existing road users will be minimal.

An important element will be the management of traffic movements during the traditional peak periods on the New England Highway. During these peak periods (AM and PM) the two way traffic flow on the highway is high and there is very little spare capacity for additional traffic movements. However, the construction works will require staff to arrive on site before 7.00 AM to commence work and construction will be completed by 6.00 PM. Thus the traffic associated with construction workers will generally impact outside of the traditional peak hours on the New England Highway at this location. Materials delivery is predicted to occur after the AM peak to maximise the supply efficiencies.

Once the access on the Tarro interchange has been constructed, all vehicle access will be via this new access with no access required via Woodlands Close. The preliminary design for the access on the Tarro interchange has been prepared by ARTC and this access allow for right movements in for heavy and light vehicles as well as light vehicles to turn left into the site off the Tarro interchange. The design does not allow for heavy vehicles to turn left into the site off the Tarro interchange and all exit movements will be a left hand turn only.

This design will ensure that no heavy vehicles will have to access the site via Beresfield and Tarro. No right turn out will be permitted from this access to ensure road safety is maintained and to reduce the traffic impacts within Beresfield and Tarro.

The future traffic volumes at this intersection, during the construction phase of the TSF site and the ARTC project are shown in Figure 4-1 below.



■ *Figure 4-1 Turning Volumes, site access on Tarro interchange during concurrent construction.*

These volumes have been assessed with Sidra and the results of this Sidra assessment are presented in Table 4-3 below:

■ *Table 4-3 Sidra results, site access on Tarro Interchange for concurrent construction phase*

Approach	Level of Service	Delay (seconds)	Queue (95th percentile metres)
Anderson Drive (off ramp)	A / A	5.9 / 0.5	2.6 / 0.1
Site access road	B / B	13.4 / 12.4	0.4 / 5.1
Anderson Drive (Beresfield)	A / A	1.7 / 0.2	0.0 / 0.0

Note: results are for AM / PM peak periods

The above Sidra results show that the proposed intersection on the Tarro interchange will operate well with minimal delays for all road users during the intense use of this access for concurrent construction activities.

Overall, it is considered that the construction traffic associated with the TSF together with the potential concurrent ARTC Relief Roads project will have an acceptable impact upon the operation of the traffic flows along the New England Highway in this location and specifically the proposed access on the Tarro interchange.

4.3 Road Safety

Road safety plays an important role for the project and in particular the intersection of Woodlands Close and the New England Highway has been identified as a safety risk, both from a technical view point and as assessed by QR National staff. For these reasons, the access to the site will be provided via the new access road off the Tarro Interchange.

The movement of vehicles on and off the New England Highway will be controlled via the existing on and off ramps to the Tarro Interchange. These ramps have been designed in accordance with the RTA Road Design Guide and as such offer an appropriate and safe access point for vehicle movements.

The connection for the site access road on to the Tarro Interchange has been design in accordance with the RTA Road Design Guide. The design of the layout has taken into account the future users of the site, both for the construction stage and the ultimate development. This includes the swept path requirements for B doubles.

The location of the T-intersection on the ramp to the Tarro Interchange has been designed to ensure forward visibility requirements are met as per normal road design. The intersection will be lit to ensure users during inclement weather or in hours of darkness will be able to safely see the layout of the interchange.

It is considered that the proposed T-intersection access and approach road to the Tarro Interchange can safely accommodate the traffic movements associated with the construction traffic for the Train Support Facility.

As discussed in Section 3.2 above, during the initial site set up and construction for the connection to the Tarro interchange, access will have to be accommodated at the Woodlands Close interchange and an appropriate Traffic Management Plan for this to occur in a safe and appropriate manner will be prepared in consultation with the road authorities.

4.4 Internal Road Network

The internal roads associated with the project will be designed in accordance with Council requirements taking into consideration the specific requirements of the future operators on the site. This will include accommodating the swept path movements of B- doubles. All roads will operate under a posted speed limit of 60 km/h to the site access to the TSF and will then reduce speed internally, in accordance with site specific requirements. The majority of roads will allow for two way traffic movements, with some roads within the TSF providing one-way movements for the Train Support Facility to simplify the road layout.

5 Impact Assessment – Operational Phase

The Train Support Facility (TSF) will provide a low key centre, with staff numbers of 30 on site associated with work at the facility. In addition, there will be up to 3 to 4 B-doubles required to access the site per day associated with fuel delivery. There will be other delivery vehicles e.g. sand, with the expected volume of traffic amounting to 20 inbound and 20 outbound movements per day maximum.

The vehicle movements during the operation stage of the TSF facility are summarised below in Table 5-1:

■ *Table 5-1 Traffic flows associated with the proposed operational phase of the TSF*

Demand	Number per day	Inbound per day	Outbound per day	Total per day
Staff	30	30	30	60
Fuel	3	3	3	6
Delivery vehicles	20	20	20	40
TOTAL	53	53	53	106

All access will be via the new link road connecting to the Tarro grade separated intersection on the New England Highway.

5.1 Impact Assessment – Train Support Facility

It can be seen that the impact of the traffic associated with the Train Support Facility will be minor, with some 53 inbound and 53 outbound movements per day. The traffic will have a minimal impact upon the overall road network and can safely access the major road network via the new link to connect with the Tarro Interchange.

The facility will be open 24 hours a day 7 days a week, with servicing of locomotives and wagons predominantly occurring between 6.00 AM and 10.00 PM i.e. over 16 hour day. Staff will work shift work on the site decreasing the peak demands on the adjacent road networks accordingly. Deliveries can occur throughout the normal working day and with 23 inbound movements per day (and a similar value outbound) it is expected that on average there would be 3 vehicles per hour on average (based upon typical 8 hour days for delivery of supplies). It is considered that 3 vehicles inbound and outbound per hour would have a negligible impact upon the operation of the New England Highway at this location.

For the adjacent ARTC Relief Road project, the operational traffic flows will be negligible, with the only traffic being that associated with occasional maintenance work. It can thus be seen that the cumulative impact will be acceptable upon the adjacent road network.

5.2 Pedestrian Access

There are no pedestrian facilities provided within the general locality of the site. It is expected that there will be no pedestrian access required to the site given its location. Internal pedestrian movements will be managed along designated paths between the various buildings on the site.

5.3 Public Transport Facility

The site is located adjacent to the Hexham railway station. Hexham station provides access to trains to the centre of Newcastle as well as trains up the Hunter Valley to Scone along the Hunter Line. There are regular services and with reasonably high frequency during peak periods in the week. However, there is no pedestrian access from the subject site available to the station. Given that the majority of construction workers will need to transport tools etc. to the site, it is considered that there will be no demand for access to the railway station for the construction stage of the development. The operational staff demands are low and given the shift work operations the demand for public transport use is considered unlikely from this development.

5.4 Site Operations and Access Arrangements

The site plans for the proposed development application are presented in Appendix A to this report. Overall access geometry meets the requisite standards. The internal road layout has been designed in accordance with Council's industrial subdivision code taking into account intersection controls, pedestrian requirements as well as road geometry requirements such as carriageway width etc.

5.5 Parking Requirements

It can be seen that the new development will require parking for the construction workers etc. Given the size of the site, it is considered that all vehicles will be able to park off the public highway and as such this has not been given further consideration.

For the future Train Support Facility, dedicated on-site parking will be provided adjacent to the main work area, adjacent to the offices, loco shop and loco wash building. The parking in this location will be a sealed surface with marked parking bays provided in accordance with Australian Standards. The plans for the project indicate 38 parking spaces will be provided. Additional hardstand areas will be provided to allow for standing over of vehicles such as the fuel delivery trucks adjacent to the fuel storage area.

There is no advice provided within the Council DCP or the RTA Guide to Traffic Generating Developments for parking for this type of facility. The TSF will have a total staffing level of 30 spread over a number of shift hours, giving a total parking demand of less than 30, assuming all staff drives to the site. With 38 spaces provided on site these parking demands can be managed on site.

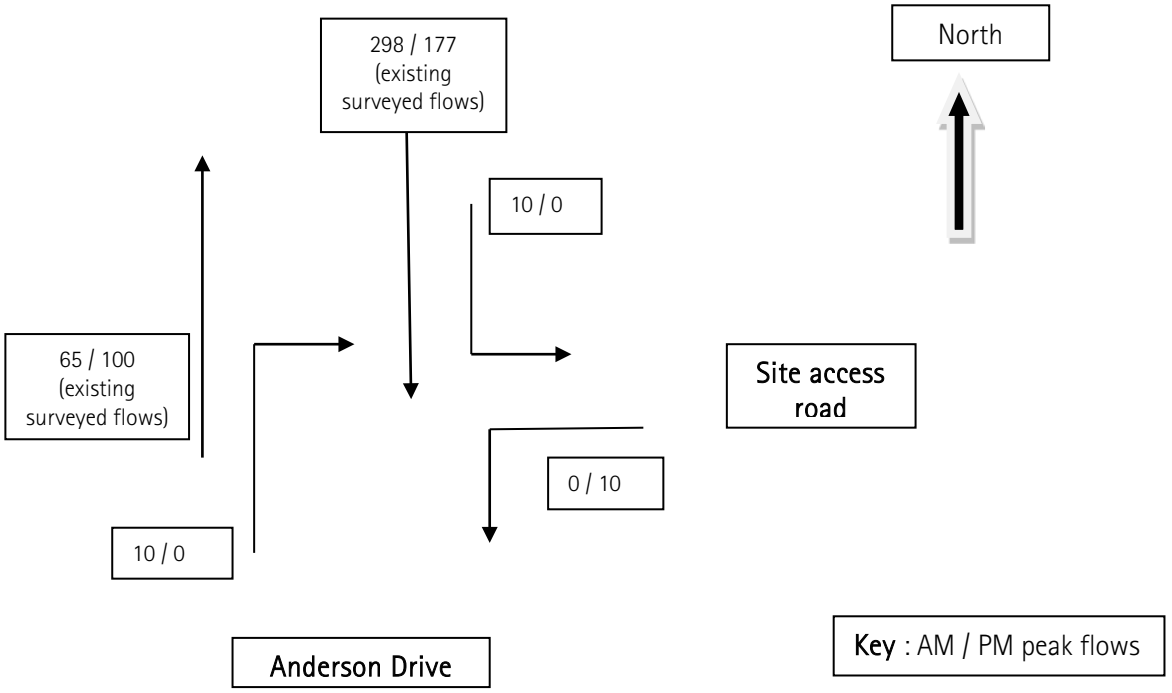
6 Assessment of Transport Operations

6.1 Site Access Operations

The access to the subject site is via a link road connection to the Tarro interchange which takes advantage of the grade separation of movements at the interchange. In this way the main highway flows are not compromised by additional at grade movements at Woodlands Close. This is considered important given that the proposed land use activity for the subject site would include heavy vehicles and potentially B-Double access. Discussion with the road authority has highlighted safety concerns at this intersection and the provision of access via the Tarro interchange removes the requirement for this project to use this intersection.

A preliminary design for the access to the site via Tarro Interchange and Woodland Close has been prepared, a copy of which is included as Appendix B.

A summary of the predicted traffic numbers at the site access on the Tarro intersection are provided below in Table 6-1.



■ *Figure 6-1 Predicted traffic movements at site access on Tarro interchange, operational phase*

The following table may be used as an initial guide to determine the need for a detailed traffic analysis in accordance with the procedure provided in Part 3 of the Guide to Traffic Management. When the volumes at an intersection are less than those shown, a detailed analysis to demonstrate that adequate capacity is available is unlikely to be necessary. Furthermore, flaring of the approaches is unlikely to be needed based on capacity.

Table 6-1 from Part 3 "Traffic Studies and Analysis" Austroads Guide to Traffic Management, Intersection volumes below capacity analysis is unnecessary.

■ *Table 6-1 Extract from Austroads Guide to Traffic Management Part 3*

Major road type [1]	Major road flow (vph) [2]	Minor road flow (vph) [3]
Two-lane	400	250
	500	200
	650	100
Four-lane	1,000	100
	1,500	50
	2,000	25

Notes:

1. Major road is through road (i.e. has priority)
2. Major over flow includes all major road traffic with priority over minor road traffic
3. Minor road design volumes include through and turning volumes

To confirm the operation of the intersection, a Sidra analysis has been prepared and the results are presented in Table 6-2 below.

■ *Table 6-2 – Site access operation on Tarro interchange, operational phase*

Approach	Level of Service	Delay (seconds)	Queue (95th percentile metres)
Anderson Drive(off ramp)	A / A	1.4 / 0.9	0.3 / 0.3
Site access road	B / B	13.1 / 12.2	0.3 / 0.3
Anderson Drive (Beresfield)	A / A	0.3 / 0.5	0.0 / 0.0

Note: results are for AM / PM peak periods

The analysis above confirms the advice from the Austroads Guide to Traffic Management Part 3.

The layout of this intersection has been assessed by Parsons Brinkerhoff and the basic layout has been determined and a sketch has been prepared for this intersection. The review of the design work and the plan confirms the following key requirements for this intersection:

- A sheltered right turn is required for the vehicles turning right off the ramp into the site. Whilst the Sidra modelling above indicates minimal delays and associated queuing, the length of the sheltered right turn lane has been maximised to ensure road safety is not compromised and to ensure a heavy vehicle such as a truck and dog trailer combination can be accommodated in this lane without effecting the through traffic movement.
- The intersection should operate as a Stop type intersection control, to ensure drivers exiting the site stop and ensure there is an adequate gap in the traffic movements for exit movement.
- Road markings and signage shall be installed in accordance with Austroads Guidelines to the satisfaction of The City of Newcastle (the road authority) and the RMS, who are required to provide concurrence for this access due to the proximity to the New England Highway.

Accident data for this locality indicates that there have been a number of accidents on the ramp in the vicinity of the proposed access to the site. However, the majority of these are no injury accidents with just a single injury over a 5 year period. This would indicate that the design and alignment of the ramp helps contain vehicle speeds and as such reduces the severity of accidents. The proposed access to the site off these ramps to the Tarro interchange should not have a major impact upon the road safety at this location, as the intersection must be designed and constructed in accordance with Austroad Guidelines. Using these guidelines the intersection shall provide adequate sight distance for all vehicles, provide a sheltered right turn lane and allow for the swept path movement of vehicles.

Road safety should be enhanced during the intense construction phase with the provision of a Traffic Control Plan (TCP) at this location. This TCP will be designed in accordance with the RMS publication "Traffic Controls at Worksites" and allow for the following:

- Reduced travel speed of 40 km/h during construction phase;
- "Trucks Turning Ahead" signage;
- Manual control of traffic movements with Stop / Go signs when large machinery is entering or exiting the site; and
- Covering of all signage outside of work hours to allow for normal traffic movements / speeds.

Once the construction phase is complete, the volume of traffic using this intersection will be considerably reduced. The Hexham Relief Roads project will require little if any vehicle access as all operation on site are rail based. For the Train Support Facility, the volume of traffic will be in the order of 53 inbound and 53 outbound vehicle movements per day, including an average of 3 delivery vehicles per hour.

At this stage of operations, the intersection will continue to operate at a level of service of A with minimal delays and congestion. Again the critical issue will be the right turn into the site off the Tarro access ramp. The design of the access has ensured that maximum visibility is available for traffic propped waiting to turn right into the site off the ramp with visibility along and over the bridge over the New England Highway in this location.

6.2 New England eastbound off ramp / Anderson Drive

The intersection of the New England Highway with Anderson Drive has been reviewed on site during the morning and afternoon peak periods and it can be seen that currently this intersection performs very well with minimal delays for road users. The intersection layout currently restricts all traffic exiting the ramp to turn left only onto Anderson Drive, with signage and a raised median on Anderson Drive restricting the right turn out.

This intersection currently operates well with minimal delays for road users, due to the minimal conflict in traffic movements. However observations on site show that the existing intersection is poorly laid out, with limited sight visibility available to the right over the bridge for drivers exiting the off-ramp. Visibility is blocked by the safety barrier which is located just behind the painted kerb line at this location. This barrier is provided to protect errant vehicles from falling down the embankment onto the New England Highway below.

■ *Photo 2 – View to right for drivers exiting the off-ramp.*

A number of options have been reviewed for allowing right turn movements at this location for construction including:

- Modifying safety barrier to improve visibility;
- Manual control of traffic movements with Stop / Go boards; and
- Installation of temporary traffic signals.

These measures have been dismissed on road safety grounds, due to the lack of space to provide signals or personnel to manage traffic movements and the physical constraints of the intersection. As part of this project, there will be no vehicles turning right off the eastbound off ramp onto Tarro interchange.

The traffic assessment and the access routes shown in Figure 3-2 above do not require this right hand turn to be made and it is this layout that has been adopted for this assessment.

6.3 Predicted Intersection Operation – Tarro Interchange on New England Highway

The Tarro Interchange is a full grade separated interchange allowing for priority for the major traffic flow along the New England Highway. This intersection currently operates well with minimal delays for traffic entering and exiting the main highway. It can be seen that during construction, there is potential for increased traffic delays created by the construction works, but these will be relatively minor and will be over a limited timeframe. Whilst the construction will occur over a 20 month period, there will be a ramp up and ramp down of activities as well as a daily variation in flows that reduces the impacts during the peak periods.

For the operational side of the project, it can be seen that the project will have very little impact, as the operational traffic movements are very low. It is considered that there will be little if any impact upon the operation of the intersection of the Tarro grade separated intersection.

6.4 Proposed Road Works

The Access proposal consists of the following road and intersection improvements:

1. Construction of a local access road connecting to the Tarro Interchange;
2. Construction of a new T-intersection with sheltered right turn lane to accommodate the site access road linking to the Tarro Interchange; and
3. New road construction of a link to the TSF.

Note that the above road works will be required specifically for this project but will also be required for the ARTC project which could be constructed concurrently. ARTC are currently in discussion with the RMS for the Works Authorisation Deed (WAD) for the road works on the Tarro interchange.

6.5 Richmond Vale Rail Trail

The proposed works will not impact upon the future provision of the Richmond Vale Rail Trail (R9) in the locality. The design of the internal road network and operations allow for connection between this proposed route and the proposed future route along Woodlands Close alignment (R8). The proposed connection to the Tarro interchange will also potentially improve connectivity for this route, as it will be possible to direct cyclists away from the at-grade connection of Woodlands Close and the New England Highway.

7 Summary and Conclusions

7.1 Summary

From the study work into the proposed Hexham Train Servicing Facility in the vicinity of Woodlands Close, Hexham, the following summary is provided:

1. The proposal is to develop a Train Support Facility on the vacant land off Woodlands Close, Hexham. The site is located adjacent to the Great Northern Railways and the current sole vehicle access route is via Woodlands Close. Concurrently, ARTC are proposing to construct the Hexham Relief Roads Project adjacent to the site to relieve rail network congestion.
2. Whilst access to the subject site is currently available via the intersection of Woodlands Close and the New England Highway, discussion with the RMS and an on-site review by the study team including the proponent has indicated that access via Woodlands Close is not desirable on safety grounds. Whilst this access is currently used by a number of land owners along Woodlands Close, the planned volume of traffic during construction in particular together with the vehicle type means that a higher level of intersection control and access is required.
3. The initial stage of works on site will be the construction of the new site access road that connects to the grade separated Tarro Interchange. The link will connect with the Tarro Interchange via T-intersection with a sheltered right turn lane. This access will be required for the Hexham Relief Roads project currently being developed by ARTC and this access can be jointly constructed with ARTC prior to the commence of work on the Train Support Facility.
4. The construction work will involve the construction of the Train Support Facility, at the southern end of the site. Advice from the study team indicates that a maximum of 340 vehicles movements are expected for the construction phase of the works per day, with a peak demand of 70 vehicles entering and exiting the site at the start and finish of the day respectively. Normal construction activity means that the vast majority of these movements will occur outside of the peak periods on the adjacent road network, with staff traffic entering before 7.00
5. AM and then leaving the site after 6.00 PM whilst materials delivery will tend to occur early in the work period but after the morning peak.
6. The adjacent Hexham Relief Roads project will be constructed concurrently to the subject development and will generate in the order of 380 vehicle movements per day, with the usual reduction in flows at the beginning and end of the construction works. There would be a similar flow to the QR project, in the order of 70 inbound and outbound movements during the morning and afternoon peak periods.
7. The predicted future traffic flows for the concurrent construction work have been reviewed to assess acceptability of the proposed access arrangements for the subject site. Results from Sidra analysis indicate the additional traffic generated by the development can be accommodated on the local road network and at the Tarro Interchange with the roads and intersection remaining within their road capacity limits.
8. The Train Support Facility operations will be very low, with a maximum of 53 inbound and 53 outbound vehicle movements per full day, which includes staff movements, deliveries and fuel supplies. This will have a negligible impact upon the operation of the road network and the Tarro Interchange. The adjacent Five Relief Roads project will requirement minimal vehicle access for the majority of the time.

9. Once these two sites are operational, the traffic movements are low, with less than 10 vehicle movements expected during the critical peak periods. The Hexham Relief Roads Project will require little if any traffic to access the site whilst the Train Support Facility will generate 106 traffic movements per day, spread-out over the 24 hour operations of the site. The Sidra analysis confirms the delays at the site access on the Tarro interchange will be negligible.

10. The new T-intersection on the Tarro Interchange will allow for safe and efficient entry and exit to the site, with the provision of a right turn lane reducing any delays for the through traffic movements as well as maintain road safety. A concept design has been prepared for this intersection and this will be refined through the detailed design process with the road authority to ensure compliance with Austroads Guidelines and RMS Road Design requirements.

11. Site access roads would be required to be built to Council industrial standards and take into account the specific requirement of the future operations. All vehicles, including service vehicles, will enter and leave the site in a forward direction. The site layout can adequately cater for these movements.

7.2 Summary of Road Mitigation Measures

The assessment of traffic impacts for the proposed Train Support Facility requires a commitment to undertake the following:

1. Construction of a new T-intersection with sheltered right turn lane to accommodate the site access road linking to the Tarro Interchange. This intersection and access can be built in conjunction with ARTC for the Hexham Relief Roads Project; and

2. Construction of a local access road connecting to the Tarro Interchange and providing access to the TSF.

7.3 Conclusion

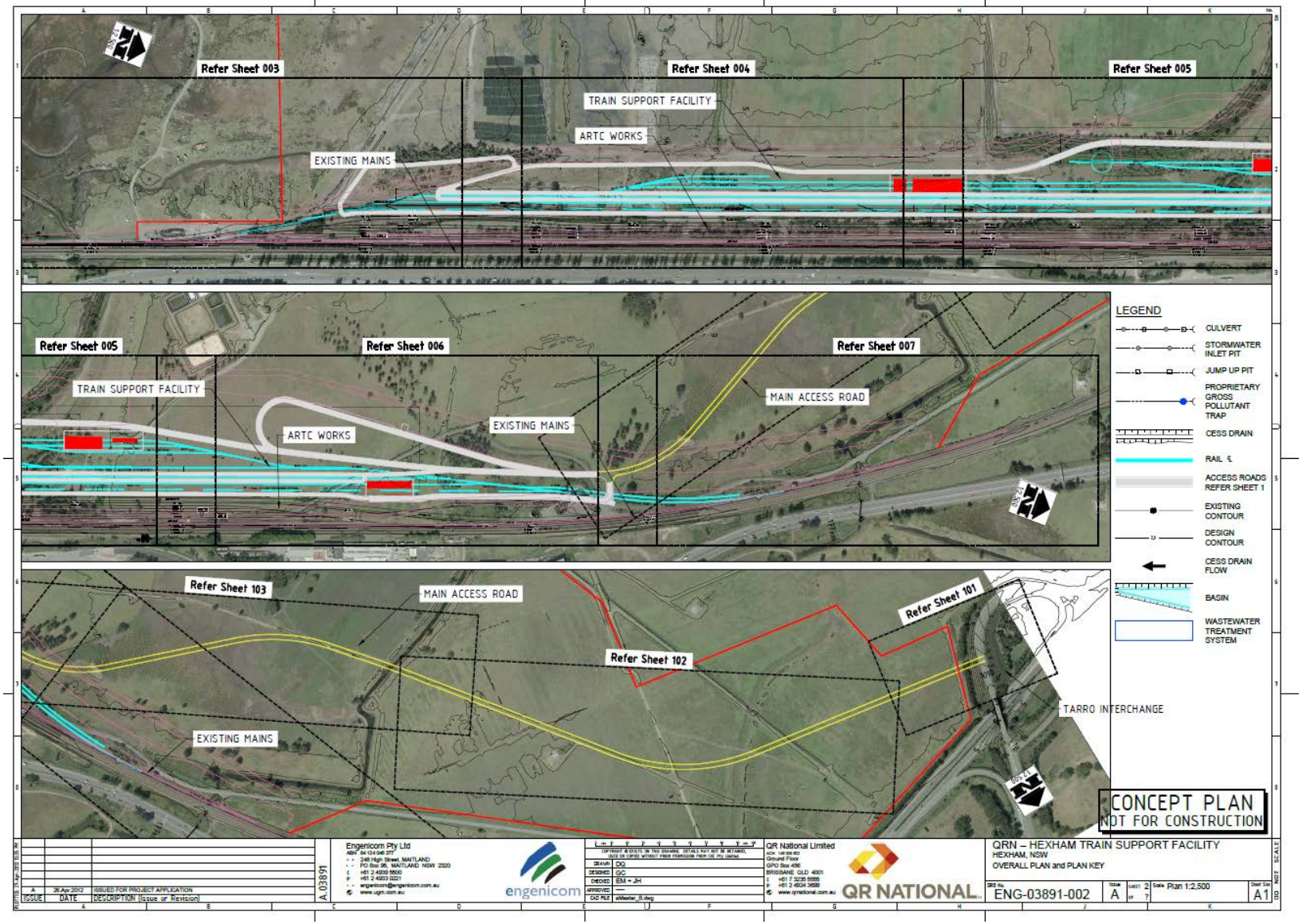
From the study, it is concluded that the access proposal off the Tarro Interchange, and along the abandoned pipeline easement, is sound and will provide a good level of service for traffic access to the proposed development site. Whilst traffic flows on the New England Highway are high at peak times, the proposed development (and its associated shift work operations) means that there will be little if any impact upon the existing traffic movements along the New England Highway at this location.

The peak period of construction, anticipated to be over three to four months, is only temporary in nature and can be mitigated through the arrival of site staff before the morning peak and departing after the afternoon peak. Materials movements will occur after the AM peak optimising supply movement efficiencies.

Long term the future connection of the F3 Sydney to Newcastle Freeway to the Pacific Highway at Heatherbrae will improve the situation, as traffic flows along this section of the arterial road network will decrease. Similarly the Hunter Expressway will reduce flows along this section of the regional road network and allow for improved road operations in this location.

It is recommended the development proposal be approved in terms of its traffic and access arrangements, subject to detailed design of the proposed T-intersection on the Tarro Interchange together with the design for the internal road network.

Appendix A. Site Plans and Access Proposal



ARTC

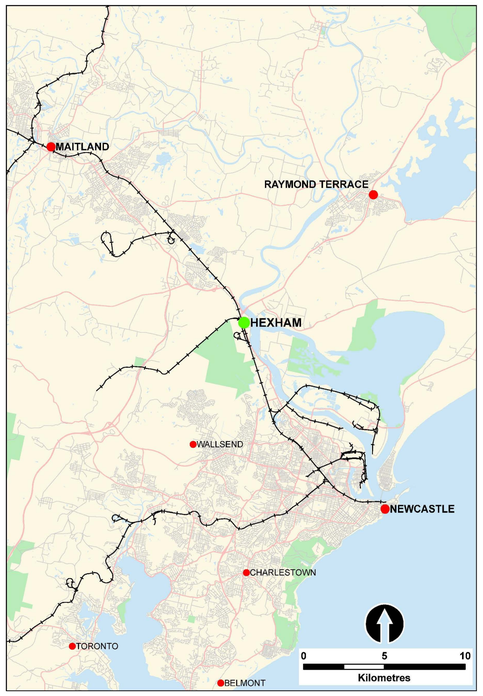
UHVA

JULY 2012

PROJECT:

HEXHAM RELIEF ROADS
TARRO INTERCHANGE - JOINT SITE ACCESS
WORKS AUTHORISATION DEED
CONCEPT DESIGN

PREPARED FOR:
RMS AND AUSTRALIAN RAIL TRACK CORPORATION LTD



LOCALITY PLAN

DRAWING SCHEDULE:

CIVIL

HR-CIV-0387701-03-00	**RMS WORKS AUTHORISATION DEED COVER PAGE AND DRAWING SCHEDULE**
HR-CIV-0387702-03-00	RMS WORKS AUTHORISATION DEED GENERAL NOTES
HR-CIV-0387705-03-00	**RMS WORKS AUTHORISATION DEED KEY PLAN**
HR-CIV-0387710-03-00	RMS WORKS AUTHORISATION DEED TYPICAL CROSS SECTIONS
HR-CIV-0387715-03-00	**RMS WORKS AUTHORISATION DEED GENERAL ARRANGEMENT - SHEET 1**
HR-CIV-0387716-03-00	**RMS WORKS AUTHORISATION DEED GENERAL ARRANGEMENT - SHEET 2**
HR-CIV-0387721-03-00	RMS WORKS AUTHORISATION DEED LONGITUDINAL SECTIONS - MC20
HR-CIV-0387722-03-00	RMS WORKS AUTHORISATION DEED LONGITUDINAL SECTIONS - MC20
HR-CIV-0387725-03-00	RMS WORKS AUTHORISATION DEED LONGITUDINAL SECTIONS - MC10
HR-CIV-0387730-03-00	RMS WORKS AUTHORISATION DEED CROSS SECTIONS - MC20
HR-CIV-0387731-03-00	RMS WORKS AUTHORISATION DEED CROSS SECTIONS - MC20
HR-CIV-0387732-03-00	RMS WORKS AUTHORISATION DEED CROSS SECTIONS - MC20
HR-CIV-0387735-03-00	RMS WORKS AUTHORISATION DEED CROSS SECTIONS - MC10
HR-CIV-0387741-03-00	RMS WORKS AUTHORISATION DEED ALIGNMENT PLAN - SHEET 1
HR-CIV-0387742-03-00	RMS WORKS AUTHORISATION DEED ALIGNMENT PLAN - SHEET 2
HR-CIV-0387745-03-00	RMS WORKS AUTHORISATION DEED KERB RETURN
HR-CIV-0387746-03-00	RMS WORKS AUTHORISATION DEED KERB RETURN
HR-CIV-0387751-03-00	**RMS WORKS AUTHORISATION DEED PAVEMENT PLAN - SHEET 1**
HR-CIV-0387752-03-00	**RMS WORKS AUTHORISATION DEED PAVEMENT PLAN - SHEET 2**
HR-CIV-0387761-03-00	**RMS WORKS AUTHORISATION DEED SIGNAGE AND LINEMARKING PLAN - SHEET 1**
HR-CIV-0387762-03-00	**RMS WORKS AUTHORISATION DEED SIGNAGE AND LINEMARKING PLAN - SHEET 2**
HR-CIV-0387771-03-00	**RMS WORKS AUTHORISATION DEED TURNING MOVEMENTS - SHEET 1**
HR-CIV-0387772-03-00	**RMS WORKS AUTHORISATION DEED TURNING MOVEMENTS - SHEET 2**
HR-CIV-0387775-03-00	RMS WORKS AUTHORISATION DEED UTILITIES PLAN
HR-CIV-0387776-03-00	RMS WORKS AUTHORISATION DEED UTILITIES PLAN

RMS PLAN REGISTRATION NUMBER:

Plotted By: wrightmo Plot Date: 31/07/12 - 10:56 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387701-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387701-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

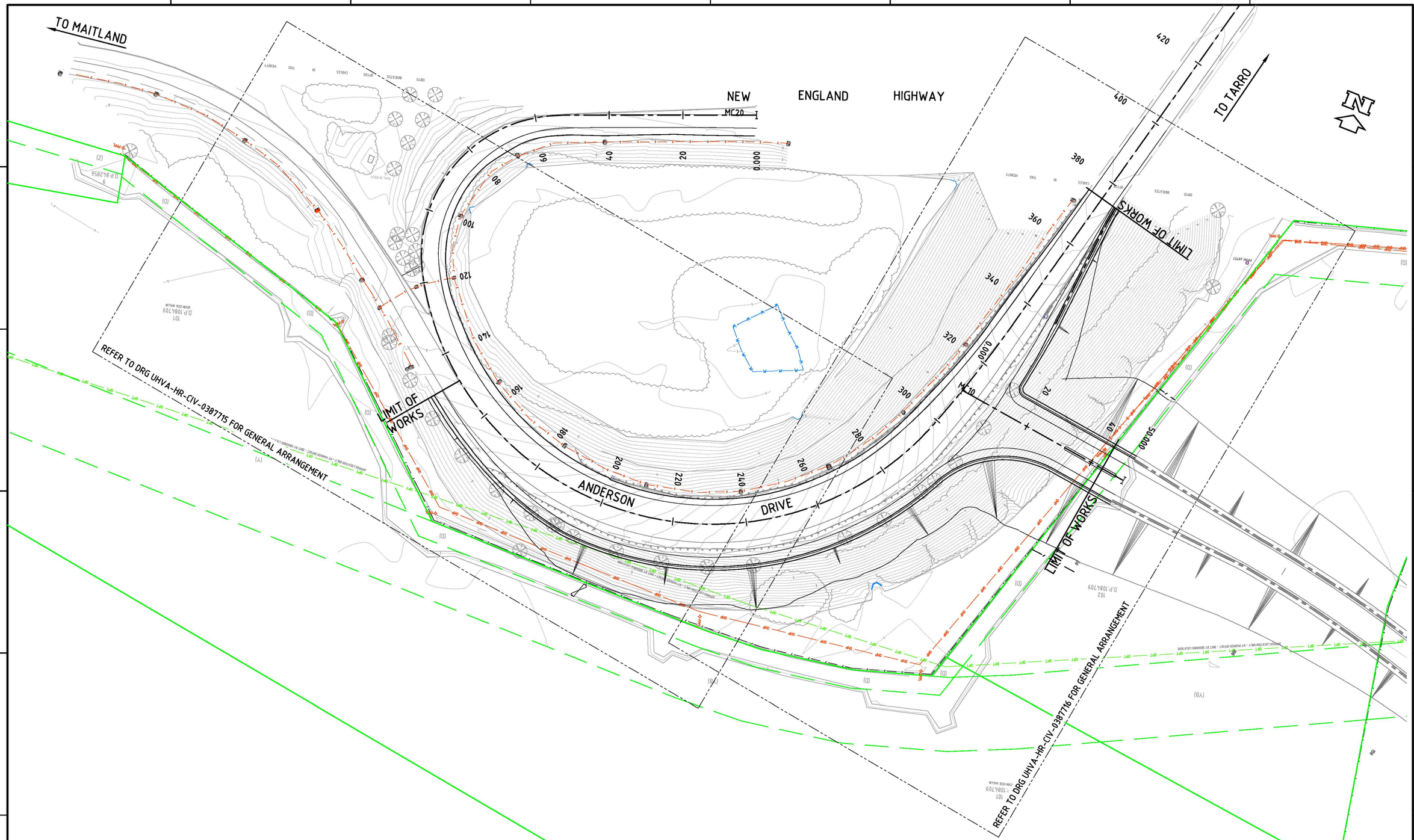
00 ---- ---- ---- ---- ---- ---- ----

HR-CIV-0387701-03-00

RMS Works Authorisation Deed
Cover Page and Drawing Schedule

Sheet No. -

Scale:



KEY PLAN
SCALE 1:500 AT A1

RMS PLAN REGISTRATION NUMBER:

0 5 10 20 30
Full Size 1:500 ; Half Reduction 1:1000
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:53 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387705-03.dwg

Drawing standard in accordance with PP-117.4.3

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387705-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

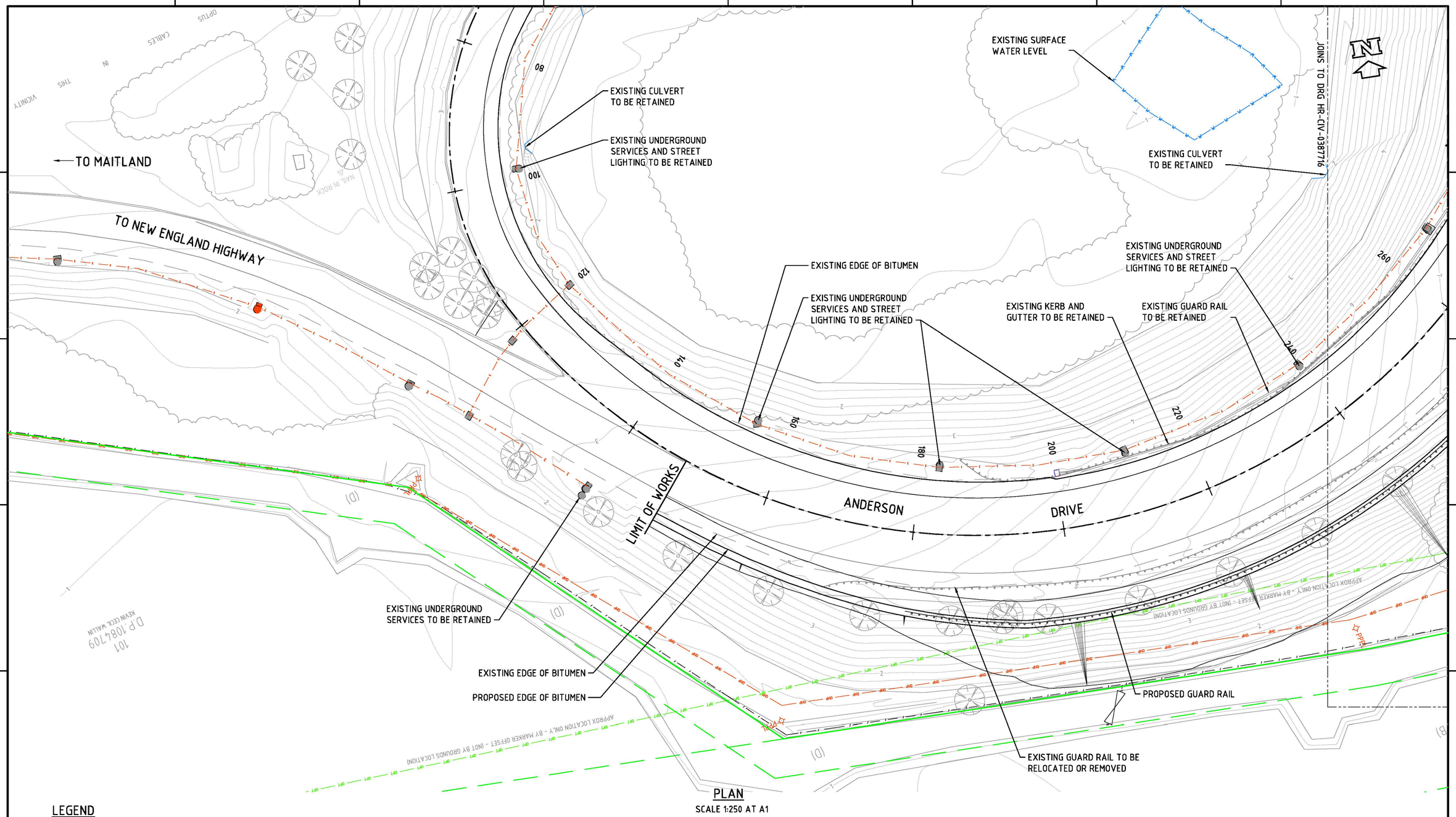
ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387705-03-00

RMS Works Authorisation Deed
Key Plan

Sheet No. 1 of 1
Scale: 1:500



PLAN
SCALE 1:250 AT A1

LEGEND

- PROPERTY EASEMENT
- EXISTING PROPERTY BOUNDARY
- WATER SURFACE / NATURAL FLOW
- UNDERGROUND ELECTRICAL CABLE
- EXISTING FIBRE OPTIC CABLE / SIGNALLING
- TELSTRA
- OVER HEAD POWER LINE
- STREET LIGHT

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:54 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387715-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387715-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

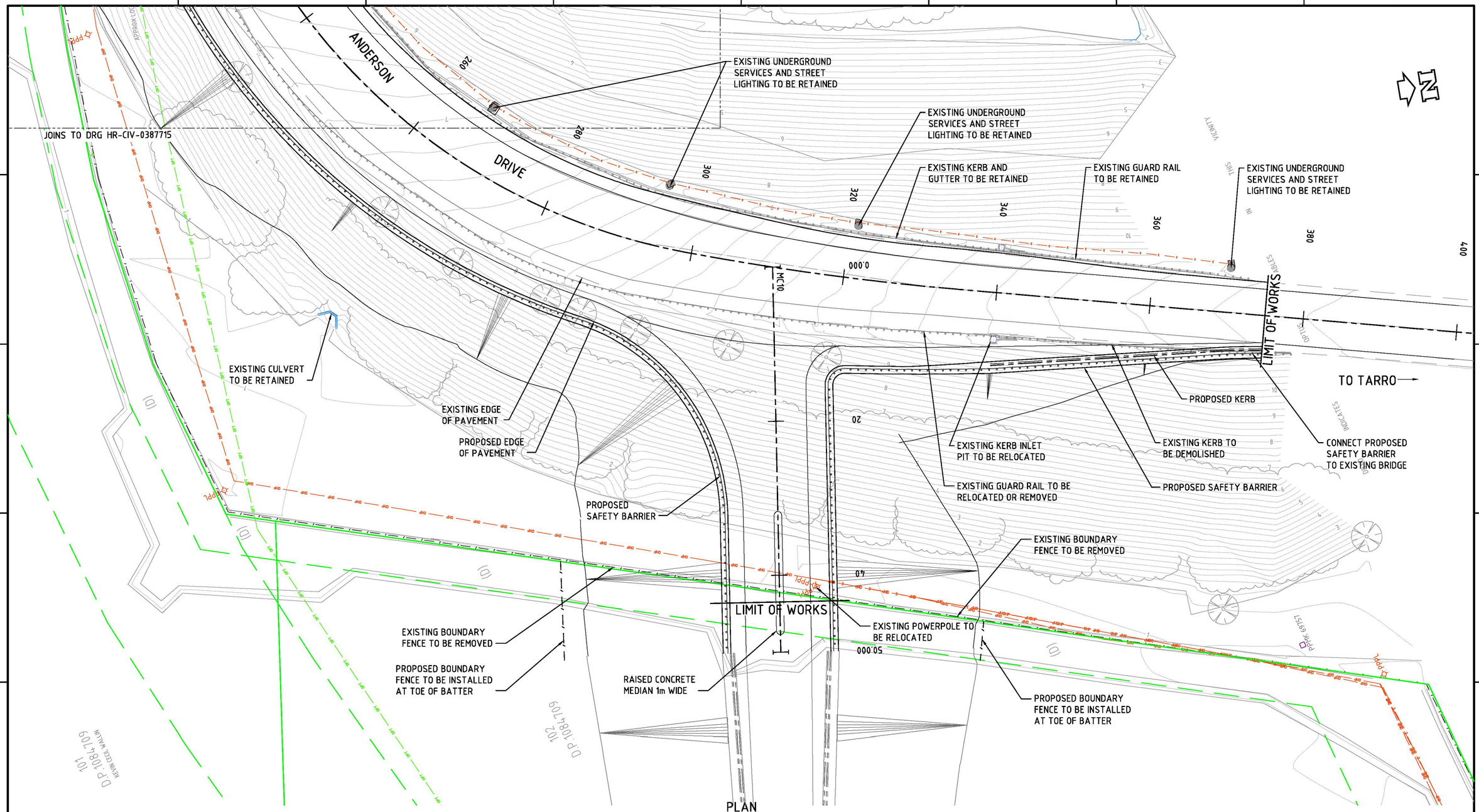
ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387715-03-00

RMS Works Authorisation Deed General Arrangement

Sheet No. 1 of 2
Scale: 1:250



PLAN
SCALE 1:250 AT A1

LEGEND

- PROPERTY EASEMENT
- EXISTING PROPERTY BOUNDARY
- WATER SURFACE / NATURAL FLOW
- UNDERGROUND ELECTRICAL CABLE
- EXISTING FIBRE OPTIC CABLE / SIGNALLING
- TELSTRA
- OVER HEAD POWER LINE
- STREET LIGHT

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:54 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387716-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387716-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

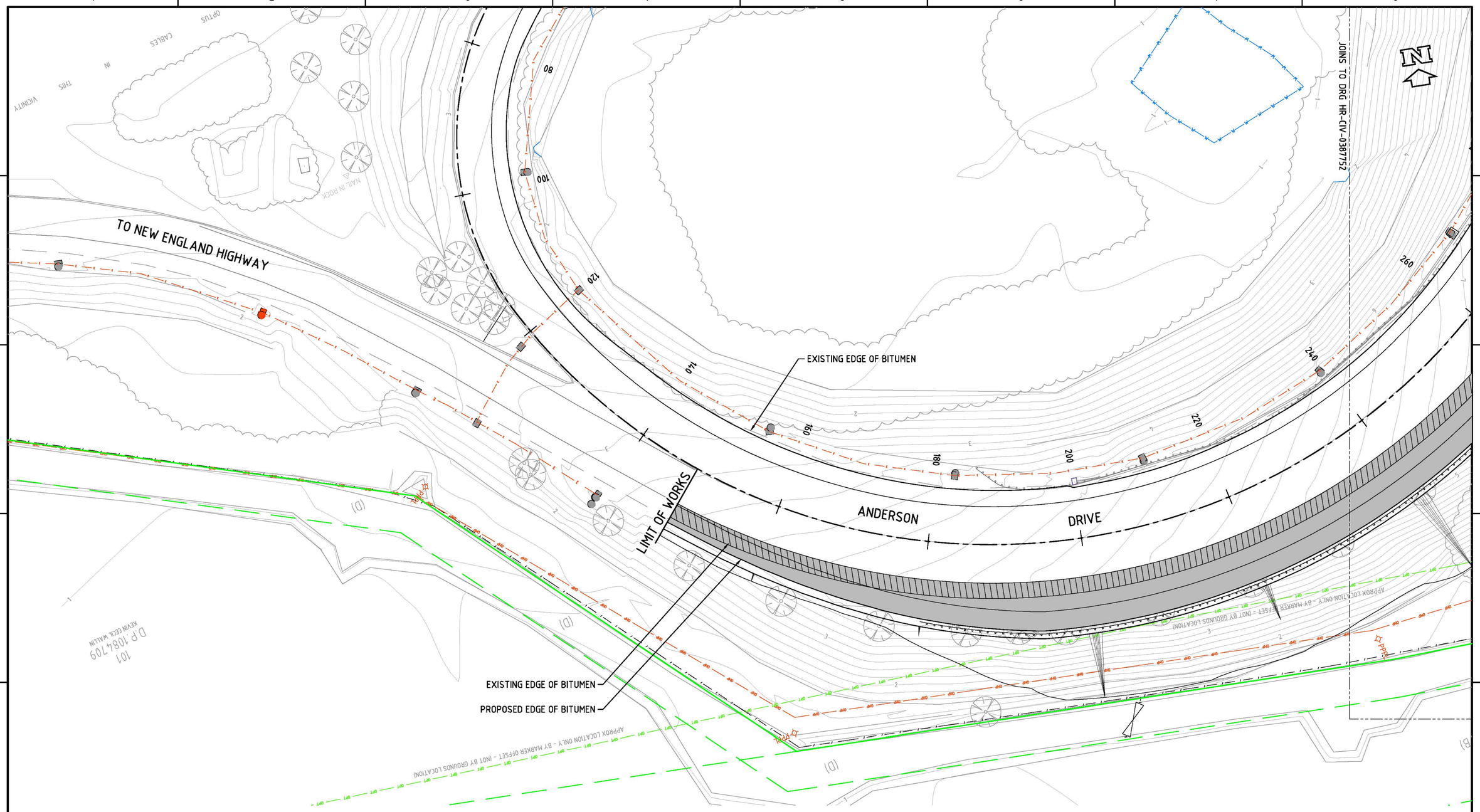
ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387716-03-00

RMS Works Authorisation Deed General Arrangement

Sheet No. 2 of 2
Scale: 1:250



LEGEND

NEW PAVEMENT (PROPOSED)

MILL AND RESURFACE 40mm
AC WEARING COURSE

PLAN

SCALE 1:250 AT A1

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:52 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387751-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387751-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

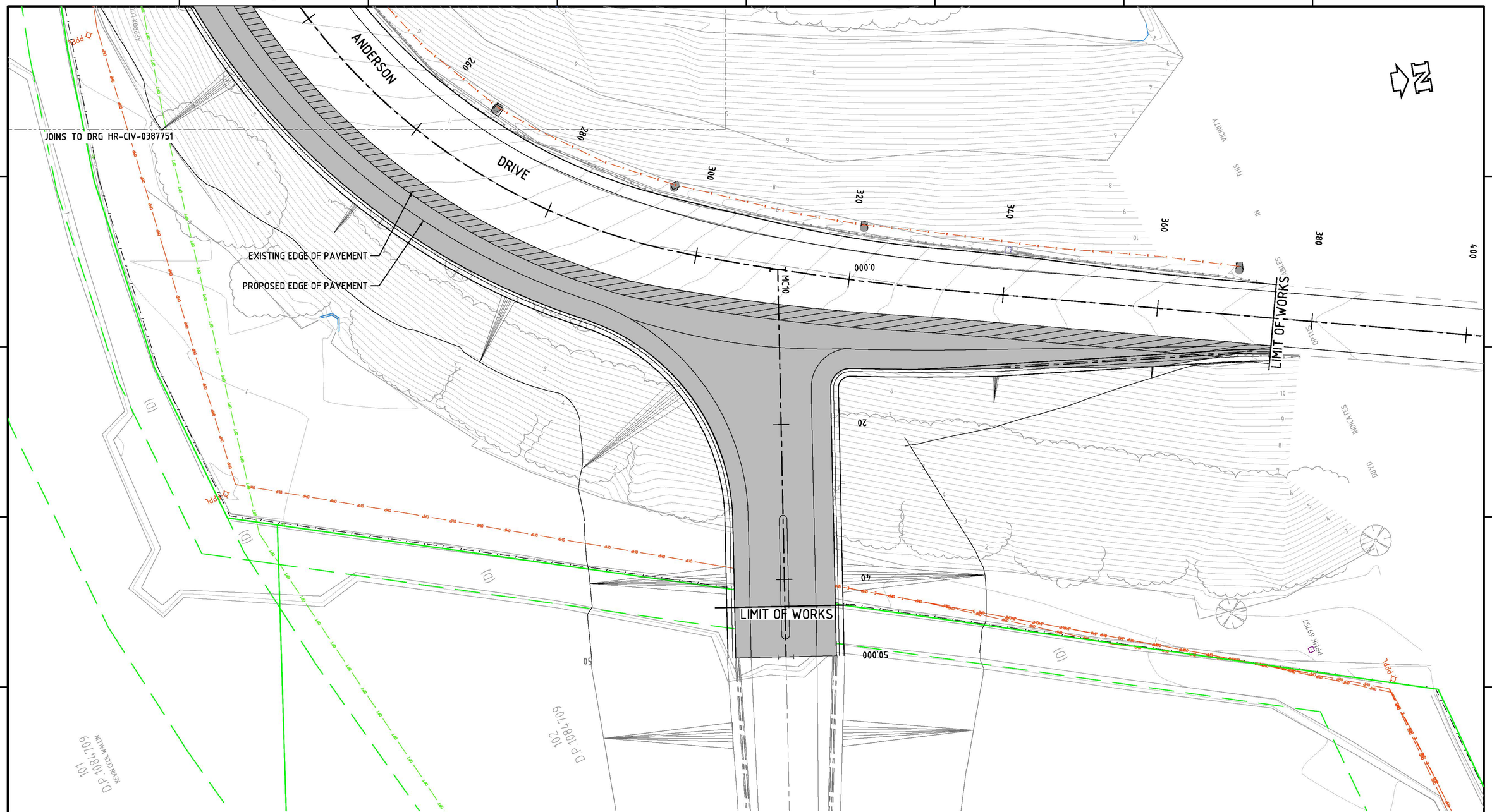
ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387751-03-00

RMS Works Authorisation Deed Pavement Plan

Sheet No. 1 of 2

Scale: 1:250



PLAN
SCALE 1:250 AT A1

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:52 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387752-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387752-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed
Checked
Ind.Rev. Company
Ind.Rev. Name
Review Signature

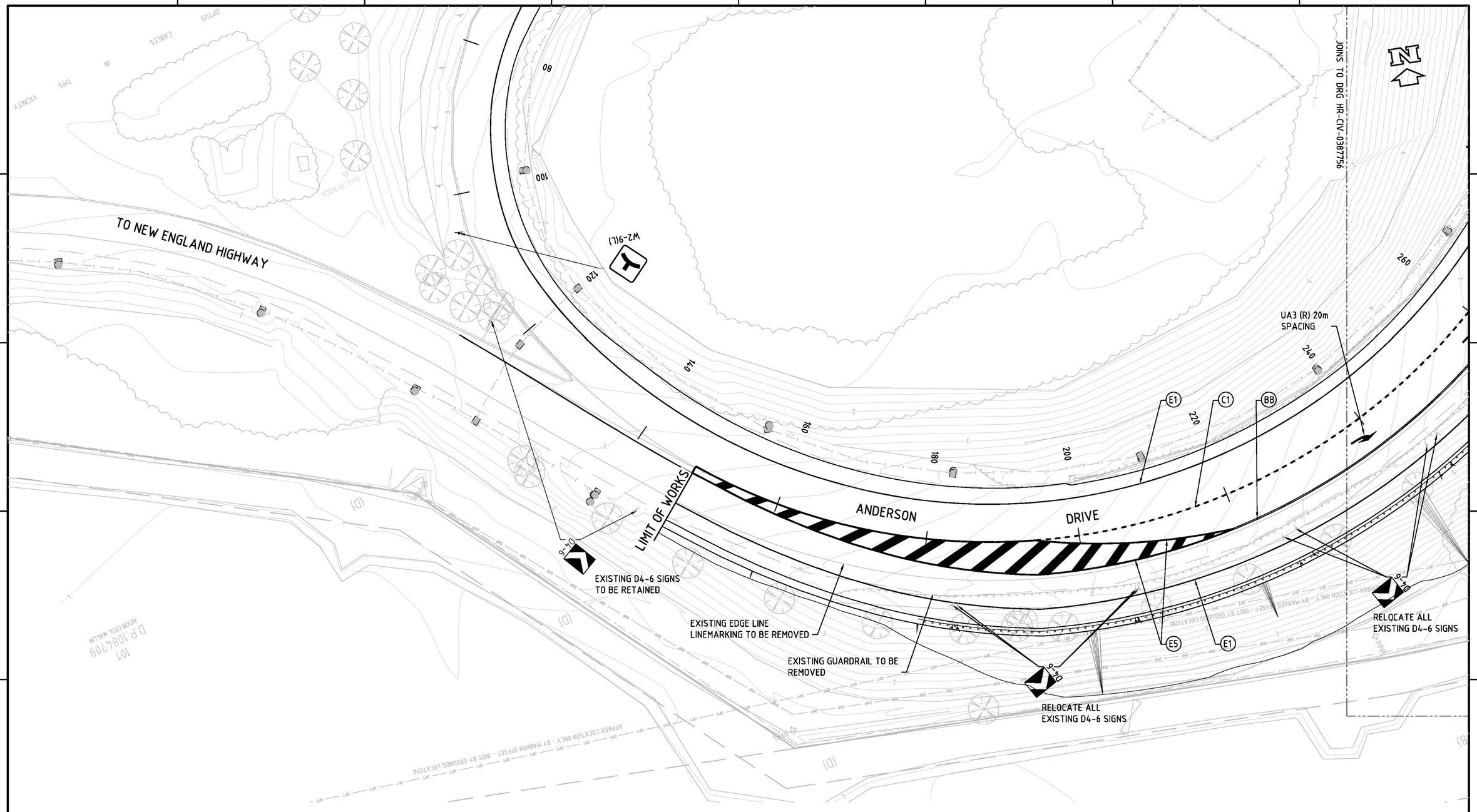
ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387752-03-00

RMS Works Authorisation Deed
Pavement Plan

Sheet No. 2 of 2
Scale: 1:250



NOTES:

GUIDE POSTS AND DELINEATORS ON GUARD RAIL SAFETY BARRIER TO BE INSTALLED AS PER RMS DELINEATION GUIDE LINES

PLAN

SCALE 1:250 AT A1

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:52 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387755-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387755-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

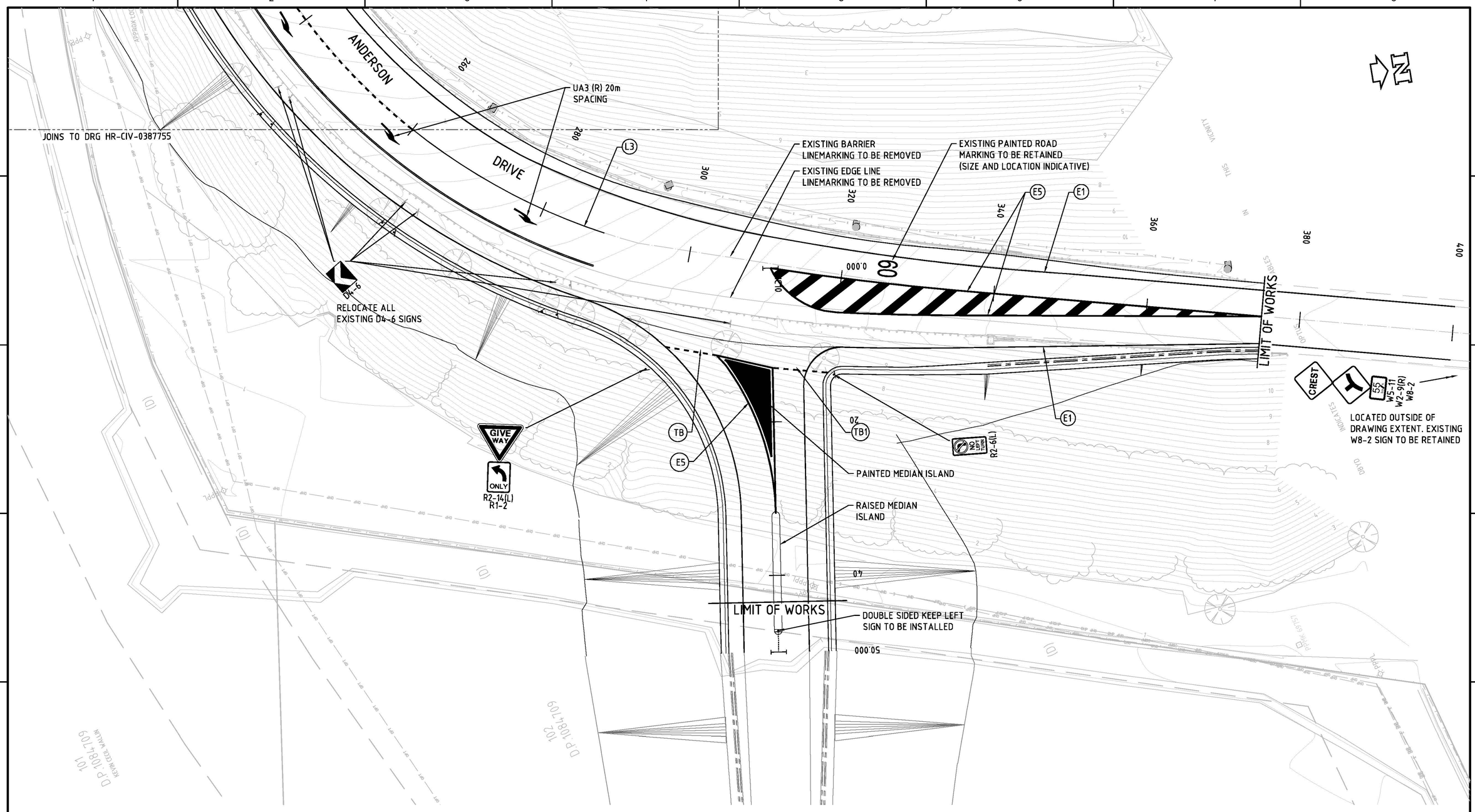
ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387755-03-00

RMS Works Authorisation Deed Signage and Linemarking Plan

Sheet No. 1 of 2

Scale: 1:250



NOTES:

GUIDE POSTS AND DELINEATORS ON GUARD RAIL SAFETY BARRIER TO BE INSTALLED AS PER RMS DELINEATION GUIDE LINES

PLAN

SCALE 1:250 AT A1

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:53 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387756-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387756-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

AUSTRALIAN RAIL TRACK CORPORATION LTD

RMS Works Authorisation Deed Signage and Linemarking Plan

00 HR-CIV-0387756-03-00

Sheet No. 2 of 2

Scale: 1:250

TO NEW ENGLAND HIGHWAY

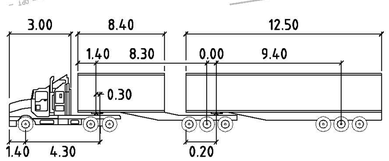
LIMIT OF WORKS

JOINS TO DRG HR-CIV-0387762

N

B-DOUBLE 26M

TRACTOR WIDTH :	2.50m	LOCK TO LOCK TIME :	6.0
TRAILER WIDTH :	2.50m	STEERING ANGLE :	22.2
TRACTOR TRACK :	2.50m	ARTICULATING ANGLE :	70.0
TRAILER TRACK :	2.50m	SPEED :	15km/h



PLAN

SCALE 1:250 AT A1

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:53 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387761-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387761-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed

Checked

Ind.Rev. Company

Ind.Rev. Name

Review Signature

ARTC ACCEPTANCE
Accepted By

Signed:

Accepted Date

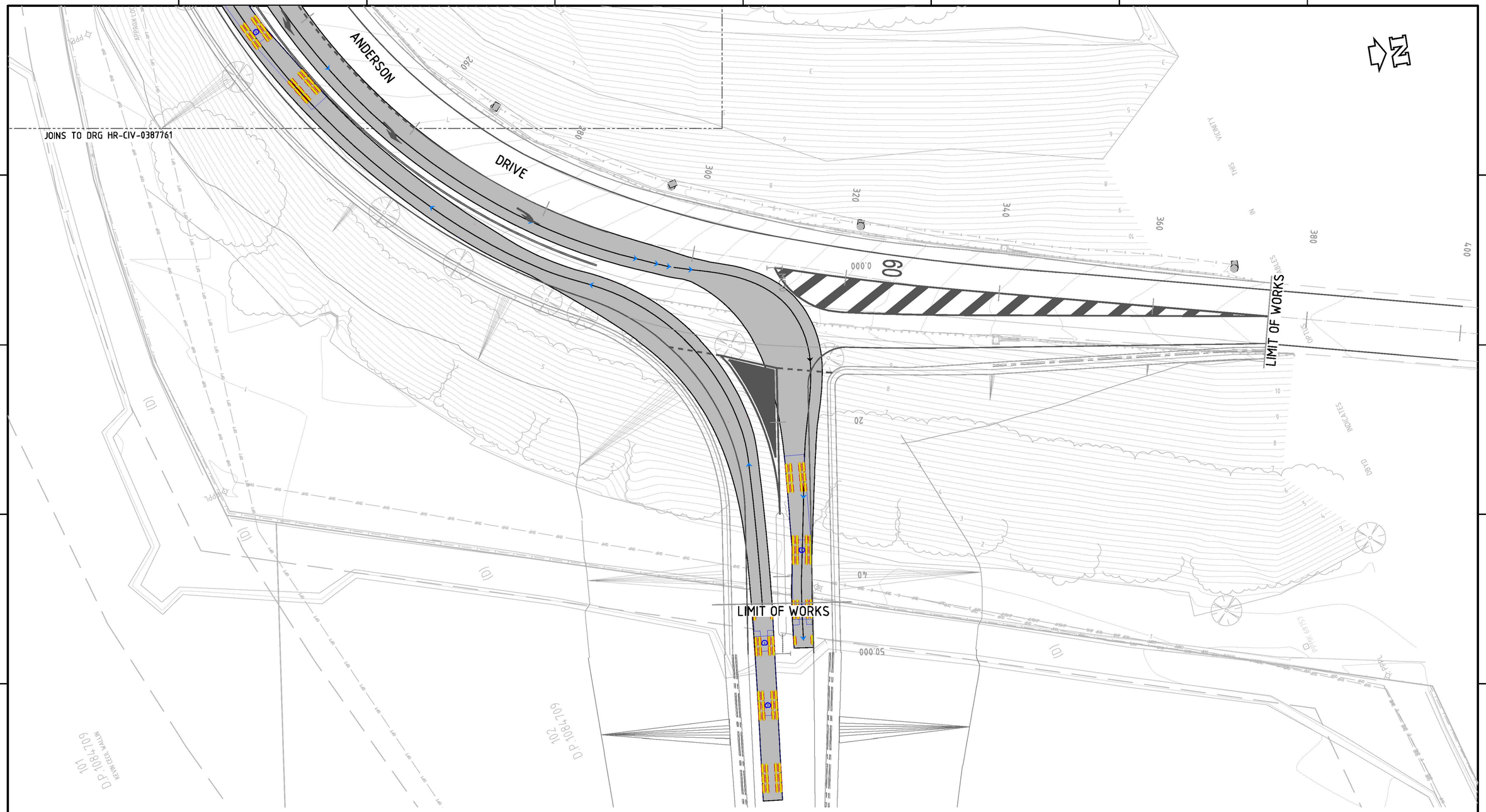
ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387761-03-00

RMS Works Authorisation Deed Turning Movements

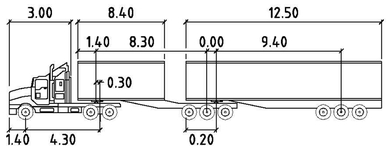
Sheet No. 1 of 2

Scale: 1:250



B-DOUBLE 26M

TRACTOR WIDTH	: 2.50m	LOCK TO LOCK TIME	: 6.0
TRAILER WIDTH	: 2.50m	STEERING ANGLE	: 22.2
TRACTOR TRACK	: 2.50m	ARTICULATING ANGLE	: 70.0
TRAILER TRACK	: 2.50m	SPEED	: 15km/h



PLAN
SCALE 1:250 AT A1

RMS PLAN REGISTRATION NUMBER:

0 2.5 5 10 15
Full Size 1:250 ; Half Reduction 1:500
SCALE (m)

Plotted By: wrightmo Plot Date: 31/07/12 - 10:53 Cad File: U:\HR - Hexham Relief Roads\DE_Design\DE06_Design_Doc\Phase_3\Drafting\Drawings\RMS\UHVA-HR-CIV-0387762-03.dwg

Used on / Next higher assembly:

Filename: UHVA-HR-CIV-0387762-03.dwg

Alternate DMS number:

Rev	Date	Revision Description	Designed	Checked	Ind. Rev.	Approv.
00	not issued	PRELIMINARY ISSUE				

Designing Company: UHVA

Designed | Checked | Ind.Rev. Company | Ind.Rev. Name | Review Signature

ARTC ACCEPTANCE
Accepted By
Signed:
Accepted Date

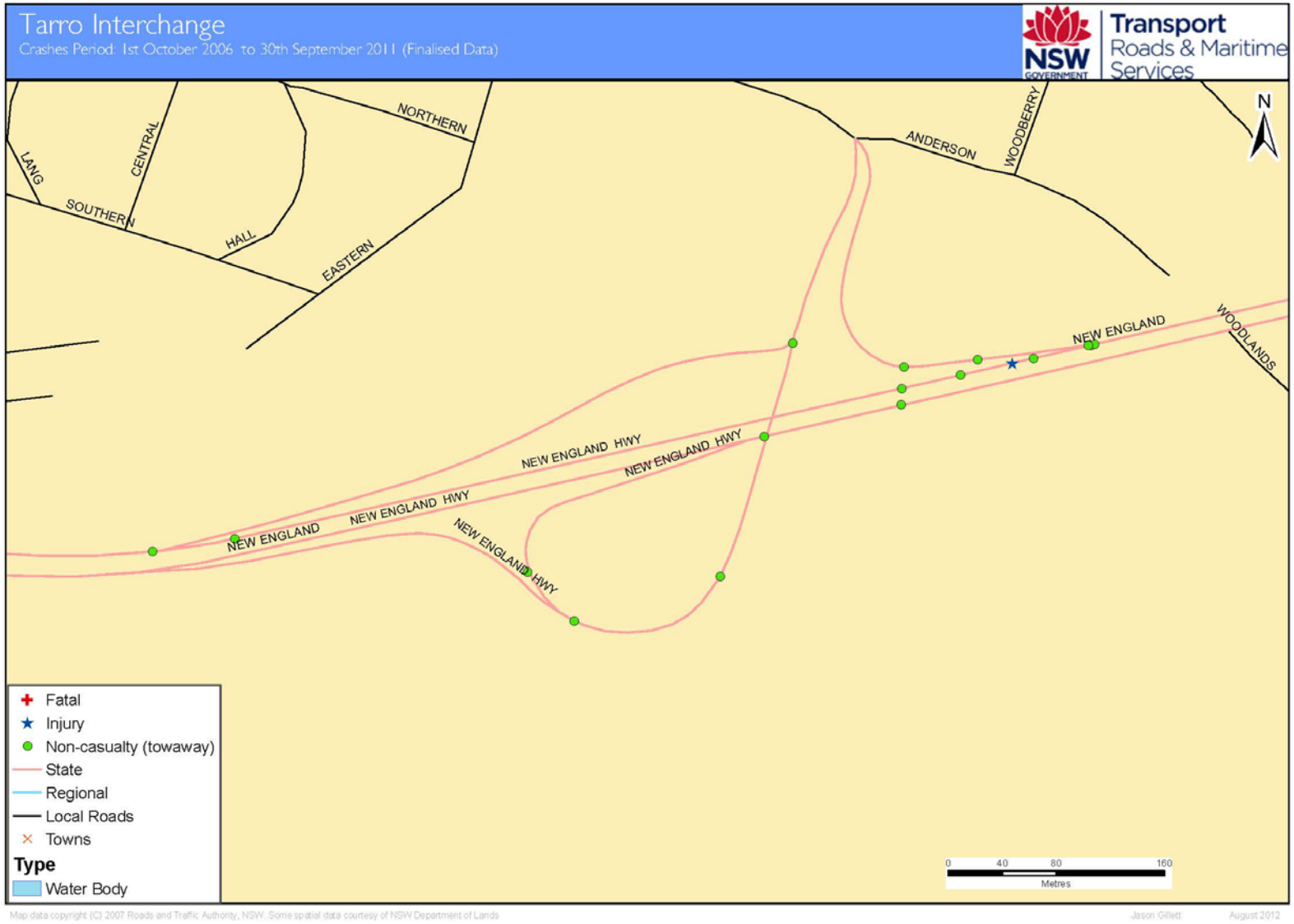
ARTC AUSTRALIAN RAIL TRACK CORPORATION LTD

00 HR-CIV-0387762-03-00

RMS Works Authorisation Deed Turning Movements

Sheet No. 2 of 2
Scale: 1:250

Appendix B. Accident Crash Data Summary



Summary Crash Report

Transport Centre for Road Safety — NSW GOVERNMENT

# Crash Type		
Car Crash	14	77.8%
Light Truck Crash	4	22.2%
Rigid Truck Crash	1	5.6%
Articulated Truck Crash	2	11.1%
'Heavy Truck Crash	(3)	(16.7%)
Bus Crash	0	0.0%
"Heavy Vehicle Crash	(3)	(16.7%)
Emergency Vehicle Crash	0	0.0%
Motorcycle Crash	0	0.0%
Pedal Cycle Crash	0	0.0%
Pedestrian Crash	0	0.0%

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

Location Type		
*Intersection	2	11.1%
Non intersection	16	88.9%

* Up to 10 metres from an intersection
~ 07:30-09:30 or 14:30-17:00 on school days

Collision Type		
Single Vehicle	6	33.3%
Multi Vehicle	12	66.7%

Road Classification		
Freeway/Motorway	0	0.0%
State Highway	15	83.3%
Other Classified Road	0	0.0%
Unclassified Road	3	16.7%

Contributing Factors		
Speeding	7	38.9%
Fatigue	1	5.6%

Weather		
Fine	12	66.7%
Rain	6	33.3%
Overcast	0	0.0%
Fog or mist	0	0.0%
Other	0	0.0%

Road Surface Condition		
Wet	7	38.9%
Dry	11	61.1%
Snow or ice	0	0.0%

Natural Lighting		
Dawn	0	0.0%
Daylight	15	83.3%
Dusk	0	0.0%
Darkness	3	16.7%

Crash Movement		
Intersection, adjacent approaches	1	5.6%
Head-on (not overtaking)	1	5.6%
Opposing vehicles; turning	0	0.0%
U-turn	0	0.0%
Rear-end	9	50.0%
Lane change	1	5.6%
Parallel lanes; turning	0	0.0%
Vehicle leaving driveway	0	0.0%
Overtaking; same direction	0	0.0%
Hit parked vehicle	0	0.0%
Hit railway train	0	0.0%
Hit pedestrian	0	0.0%
Permanent obstruction on road	0	0.0%
Hit animal	0	0.0%
Off road, on straight	0	0.0%
Off road on straight, hit object	1	5.6%
Out of control on straight	0	0.0%
Off road, on curve	1	5.6%
Off road on curve, hit object	3	16.7%
Out of control on curve	0	0.0%
Other crash type	1	5.6%

Speed Limit					
			~ 40km/h or less	0	0.0%
40 km/h or less	0	0.0%	80 km/h zone	1	5.6%
50 km/h zone	3	16.7%	90 km/h zone	11	61.1%
60 km/h zone	3	16.7%	100 km/h zone	0	0.0%
70 km/h zone	0	0.0%	110 km/h zone	0	0.0%

CRASHES	18	
Fatal crash	0	0.0%
Injury crash	1	5.6%
Non-casualty crash	17	94.4%

CASUALTIES	2	
Killed	0	0.0%
Injured	2	100.0%
^ Unrestrained	0	0.0%

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

Time Group		% of Day
00:01 - 02:59	0	0.0% 12.5%
03:00 - 04:59	0	0.0% 8.3%
05:00 - 05:59	1	5.6% 4.2%
06:00 - 06:59	0	0.0% 4.2%
07:00 - 07:59	1	5.6% 4.2%
08:00 - 08:59	2	11.1% 4.2%
09:00 - 09:59	2	11.1% 4.2%
10:00 - 10:59	2	11.1% 4.2%
11:00 - 11:59	1	5.6% 4.2%
12:00 - 12:59	0	0.0% 4.2%
13:00 - 13:59	1	5.6% 4.2%
14:00 - 14:59	0	0.0% 4.2%
15:00 - 15:59	3	16.7% 4.2%
16:00 - 16:59	3	16.7% 4.2%
17:00 - 17:59	0	0.0% 4.2%
18:00 - 18:59	0	0.0% 4.2%
19:00 - 19:59	1	5.6% 4.2%
20:00 - 21:59	0	0.0% 8.3%
22:00 - 24:00	1	5.6% 8.3%

Street Lighting Off/Nil		% of Dark
1	of 3 in Dark	33.3%

Crashes		Casualties
4	2011	0
7	2010	0
1	2009	0
3	2008	0
2	2007	2
1	2006	0

~ School Travel Time		
Involvement	8	44.4%

McLean Periods			% Week
A	4	22.2%	17.9%
B	0	0.0%	7.1%
C	5	27.8%	17.9%
D	1	5.6%	3.5%
E	0	0.0%	3.6%
F	2	11.1%	10.7%
G	5	27.8%	7.1%
H	0	0.0%	7.1%
I	1	5.6%	12.5%
J	0	0.0%	10.7%

Day of the Week						# Holiday Periods					
Monday	4	22.2%	Thursday	3	16.7%	Sunday	0	0.0%	New Year	1	5.6%
Tuesday	4	22.2%	Friday	4	22.2%	WEEKDAY	17	94.4%	Aust. Day	0	0.0%
Wednesday	2	11.1%	Saturday	1	5.6%	WEEKEND	1	5.6%	Easter	0	0.0%
									Anzac Day	1	5.6%

Queen's BD	0	0.0%	Easter SH	1	5.6%
Labour Day	1	5.6%	June/July SH	0	0.0%
Christmas	1	5.6%	Sept./Oct. SH	2	11.1%
January SH	1	5.6%	December SH	1	5.6%

Crashid dataset Tarro Interchange - 1/10/2006 to 30/9/2011

Percentages are percentages of all crashes. Unknown values for each category are not shown on this report.

Rep ID: REG01 **Office:** Hunter **User ID:** gillettj

Page 1 of 1

Generated: 31/08/2012 11:42

Detailed Crash Report - sorted

Transport Centre for Road Safety — NSW GOVERNMENT

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
					Natural Lighting															S F
Hunter Region				**Newcastle City LGA**	**Tarro**				**Anderson Dr**											
582145	21/11/2006	Tue	23:45	200 m S	NEW ENGLAND HWY	OTH	CRV	Fine	Dry	90	1	SEM	M42	W in ANDERSON DR	30 Proceeding in lane		N	0	0	S F
E29806408					Darkness	DCA : 802 R		Off cway left bend												
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
576948	30/04/2007	Mon	09:10	185 m E	ANDERSON DRIVE OP	DIV	STR	Fine	Dry	90	3	CAR	M26	E in NEW ENGLAND HWY	Unk Proceeding in lane		I	0	2	
E32374881					Daylight	DCA : 301		Same - Rear end				CAR	F54	E in NEW ENGLAND HWY	Unk Proceeding in lane					
												CAR	M49	E in NEW ENGLAND HWY	Unk Proceeding in lane					
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
604265	29/12/2007	Sat	11:00	200 m E	ANDERSON DR	D F	STR	Fine	Dry	90	3	CAR	M58	E in NEW ENGLAND HWY	20 Proceeding in lane		N	0	0	
E32317376					Daylight	DCA : 301		Same - Rear end				OMV	U U	E in NEW ENGLAND HWY	Unk Proceeding in lane					
												CAR	M26	E in NEW ENGLAND HWY	0 Stationary					
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
609912	13/02/2008	Wed	07:55	100 m E	TARRO OP	DIV	STR	Fine	Dry	80	2	TRK	M45	S in NEW ENGLAND HWY	85 Proceeding in lane		N	0	0	S
E33038457					Daylight	DCA : 301		Same - Rear end				TRK	M27	S in NEW ENGLAND HWY	65 Proceeding in lane					
Hunter Region				**Newcastle City LGA**	**Tarro**				**Anderson Dr**											
619261	16/04/2008	Wed	16:45	at	NEW ENGLAND HI OP	2WY	CRV	Raining	Wet	60	1	CAR	M17	N in ANDERSON DR	50 Proceeding in lane		N	0	0	S
E33895007					Daylight	DCA : 804 R		Off left bend into obj				Fence								
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
642291	02/10/2008	Thu	19:00	500 m E	QUARTER SESSIO RD	DIV	STR	Fine	Dry	90	2	SEM	M42	E in NEW ENGLAND HWY	90 Proceeding in lane		N	0	0	
E35481529					Darkness	DCA : 305		Same - Lane side swipe				CAR	F37	E in NEW ENGLAND HWY	90 Proceeding in lane					
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
689190	06/11/2009	Fri	08:30	470 m S	ANDERSON DR	OTH	CRV	Raining	Wet	50	2	UTE	U U	S in NEW ENGLAND HWY	Unk Proceeding in lane		N	0	0	
E39279649					Daylight	DCA : 301		Same - Rear end				CAR	M27	S in NEW ENGLAND HWY	10 Proceeding in lane					
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
700869	01/03/2010	Mon	05:00	470 m W	ANDERSON DRIVE OP	DIV	STR	Fine	Dry	60	1	LOR	M70	E in NEW ENGLAND HWY	60 Proceeding in lane		N	0	0	
E131185697					Darkness	DCA : 703		Left off cway into object				Fence								
Hunter Region				**Newcastle City LGA**	**Tarro**				**New England Hwy**											
704152	30/03/2010	Tue	10:30	240 m E	ANDERSON DRIVE OP	DIV	STR	Raining	Wet	90	2	TRK	M23	E in NEW ENGLAND HWY	80 Proceeding in lane		N	0	0	
E43003186					Daylight	DCA : 301		Same - Rear end				OMV	U U	E in NEW ENGLAND HWY	Unk Veering right					

Rep ID: DCR02 **Office:** Hunter **User ID:** gillettj

Generated: 31/08/2012 11:42

Detailed Crash Report - sorted

NSW GOVERNMENT Transport Centre for Road Safety

Crash No.	Date	Day of Week	Time	Distance	ID Feature	Loc Type	Alignment	Weather	Surface Condition	Speed Limit	No. of Tus	Tu Type/Obj	Age/Sex	Street Travelling	Speed Travelling	Manoeuvre	Degree of Crash	Killed	Injured	Factors
Natural Lighting																				**S F**
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
713260	23/04/2010	Fri	16:00	at	NEW ENGLAND HWY	TJN	STR	Fine	Dry	50	2	CAR	M33	E in NEW ENGLAND HWY	15 Turning right		N	0	0	
E40908303				Daylight		DCA : 104	Adj - Right-thru from right					TRK	M22	N in NEW ENGLAND HWY	50 Proceeding in lane					
Hunter Region			**Newcastle City LGA**		**Tarro**				**Anderson Dr**											
708294	30/04/2010	Fri	15:40	110 m S	NEW ENGLAND HI OP	OTH	CRV	Raining	Wet	50	2	CAR	F48	S in ANDERSON DR	Unk Incorrect side		N	0	0	S
E40560775				Daylight		DCA : 201	Opp - Head on					CAR	F32	N in ANDERSON DR	Unk Proceeding in lane					
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
711600	17/05/2010	Mon	16:00	200 m E	ANDERSON DR	OTH	CRV	Raining	Wet	60	1	CAR	M31	E in NEW ENGLAND HWY	50 Proceeding in lane		N	0	0	S
E43092984				Daylight		DCA : 804 L	Off left bend into obj					Utility pole								
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
721624	03/08/2010	Tue	10:00	255 m E	ANDERSON DR	OTH	CRV	Raining	Wet	90	1	WAG	M19	E in NEW ENGLAND HWY	32 Proceeding in lane		N	0	0	S
E42149574				Daylight		DCA : 804 L	Off left bend into obj					Signpost								
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
727960	01/10/2010	Fri	15:45	245 m E	ANDERSON DRIVE OP	DIV	STR	Fine	Dry	90	2	CAR	F37	N in NEW ENGLAND HWY	50 Proceeding in lane		N	0	0	
E43035139				Daylight		DCA : 301	Same - Rear end					CAR	M23	N in NEW ENGLAND HWY	0 Stationary					
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
740675	03/01/2011	Mon	13:00	100 m E	ANDERSON DRIVE OP	DIV	STR	Fine	Wet	90	3	4WD	F20	W in NEW ENGLAND HWY	70 Proceeding in lane		N	0	0	
E43344019				Daylight		DCA : 301	Same - Rear end					CAR	M43	W in NEW ENGLAND HWY	0 Stationary					
												WAG	M44	W in NEW ENGLAND HWY	0 Stationary					
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
744617	08/03/2011	Tue	08:45	200 m W	WOODLANDS CL	DIV	STR	Fine	Dry	90	2	CAR	F21	E in NEW ENGLAND HWY	Unk Proceeding in lane		N	0	0	
E43416237				Daylight		DCA : 301	Same - Rear end					4WD	F45	E in NEW ENGLAND HWY	0 Stationary					
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
767213	28/07/2011	Thu	15:45	at	NEW ENGLAND HWY	TJN	CRV	Fine	Dry	90	1	CAR	F18	E in NEW ENGLAND HWY	90 Turning left		N	0	0	S
E45974978				Daylight		DCA : 706 R	Left turn					Signpost								
Hunter Region			**Newcastle City LGA**		**Tarro**				**New England Hwy**											
767740	15/09/2011	Thu	09:00	335 m E	ANDERSON DR	OTH	STR	Fine	Dry	90	2	CAR	F43	N in NEW ENGLAND HWY	80 Proceeding in lane		N	0	0	
E46254367				Daylight		DCA : 301	Same - Rear end					TRK	F18	N in NEW ENGLAND HWY	5 Proceeding in lane					

Report Totals: Total Crashes: 18 Fatal Crashes: 0 Injury Crashes: 1 Killed: 0 Injured: 2

Rep ID: DCR02 **Office:** Hunter **User ID:** gillettj

Generated: 31/08/2012 11:42

Detailed Crash Report - sorted

Crashid dataset Tarro Interchange - 1/10/2006 to 30/9/2011
Note: Ordered by: Crash Date.

Appendix C. Sidra Results

Criteria for interpreting results of SIDRA

1-Level of Service (LoS)

LoS	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Good	Good
B	Good, with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	Satisfactory	Satisfactory, but requires accident study
D	Operating near capacity	Near capacity and requires accident study
E	At capacity, excessive delay: roundabout requires other control method	At capacity, requires other control mode
F	Unsatisfactory, requires other control mode or additional capacity	Unsatisfactory, requires other control mode

2-Average Vehicle Delay (AVD)

The AVD is a measure of operational performance of an intersection relating to its LoS. The average delay should be taken as a guide only for an average intersection. Longer delays may be tolerated at some intersections where delays are expected by motorists (e.g. those in inner city areas or major arterial roads).

LoS	Average Delay / Vehicle (secs)	Traffic Signals and Roundabouts	Give Way and Stop Signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	28 to 42	Satisfactory	Satisfactory but accident study required
D	42 to 56	Operating near capacity	Near capacity, accident study required
E	56 to 70	At capacity, excessive delays: roundabout requires other control mode	At capacity; requires other control mode
F	Exceeding 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode

3-Degree of Saturation (D/S)

The D/S of an intersection is usually taken as the highest ratio of traffic volumes on an approach to an intersection compared with the theoretical capacity, and is a measure of the utilisation of available green time. For intersections controlled by traffic signals, both queues and delays increase rapidly as DS approaches 1.0. An intersection operates satisfactorily when its D/S is kept below 0.75. When D/S exceeds 0.9, queues are expected.

INTERSECTION SUMMARY

Site: AM peak concurrent construction

Site access on Tarro interchange
AM peak concurrent construction
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	Vehicles		Persons	
Demand Flows (Total)	551	veh/h	661	pers/h
Percent Heavy Vehicles	6.5	%		
Degree of Saturation	0.212			
Practical Spare Capacity	278.0	%		
Effective Intersection Capacity	2601	veh/h		
Control Delay (Total)	0.47	veh-h/h	0.56	pers-h/h
Control Delay (Average)	3.1	sec	3.1	sec
Control Delay (Worst Lane)	13.4	sec		
Control Delay (Worst Movement)	13.4	sec	13.4	sec
Geometric Delay (Average)	P	sec		
Stop-Line Delay (Average)	P	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.3	veh		
95% Back of Queue - Distance (Worst Lane)	2.6	m		
Total Effective Stops	145	veh/h	174	pers/h
Effective Stop Rate	0.26	per veh	0.26	per pers
Proportion Queued	0.07		0.07	
Performance Index	7.0		7.0	
Travel Distance (Total)	333.2	veh-km/h	399.9	pers-km/h
Travel Distance (Average)	605	m	605	m
Travel Time (Total)	6.0	veh-h/h	7.2	pers-h/h
Travel Time (Average)	39.2	sec	39.2	sec
Travel Speed	55.5	km/h	55.5	km/h
Cost (Total)	217.66	$/h	217.66	$/h
Fuel Consumption (Total)	33.2	L/h		
Carbon Dioxide (Total)	83.2	kg/h		
Hydrocarbons (Total)	0.115	kg/h		
Carbon Monoxide (Total)	4.37	kg/h		
NOx (Total)	0.169	kg/h		

P: You need to Process this Site (F9) for this variable to be computed.

Level of Service (LOS) Method: Delay (HCM 2000).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: AM peak concurrent construction

Site access on Tarro interchange
AM peak concurrent construction
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Anderson Drive (off ramp)											
2	T	68	5.0	0.036	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	79	10.0	0.090	11.0	LOS B	0.3	2.6	0.46	0.75	46.4
Approach		147	7.7	0.090	5.9	NA	0.3	2.6	0.25	0.40	51.9
East: Site access road											
4	L	11	10.0	0.014	13.4	LOS B	0.0	0.4	0.42	0.86	45.2
Approach		11	10.0	0.014	13.4	LOS B	0.0	0.4	0.42	0.86	45.2
North: Anderson Drive (Beresfield)											
7	L	79	10.0	0.212	8.6	LOS A	0.0	0.0	0.00	0.98	49.0
8	T	314	5.0	0.212	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		393	6.0	0.212	1.7	NA	0.0	0.0	0.00	0.20	57.4
All Vehicles		551	6.5	0.212	3.1	NA	0.3	2.6	0.07	0.26	55.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Project: M:\MW Pty Ltd\Active Projects\P0458 QR AdeW Hexham\P0458 QR Sidra.sip
8000290, MARK WAUGH PTY LTD, SINGLE

INTERSECTION SUMMARY

Site: PM peak concurrent construction

Site access on Tarro interchange
PM peak concurrent construction
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	460	veh/h	552	pers/h
Percent Heavy Vehicles	6.8	%		
Degree of Saturation	0.171			
Practical Spare Capacity	368.9	%		
Effective Intersection Capacity	2696	veh/h		
Control Delay (Total)	0.57	veh-h/h	0.69	pers-h/h
Control Delay (Average)	4.5	sec	4.5	sec
Control Delay (Worst Lane)	12.4	sec		
Control Delay (Worst Movement)	12.4	sec	12.4	sec
Geometric Delay (Average)	P	sec		
Stop-Line Delay (Average)	P	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.7	veh		
95% Back of Queue - Distance (Worst Lane)	5.1	m		
Total Effective Stops	150	veh/h	180	pers/h
Effective Stop Rate	0.33	per veh	0.33	per pers
Proportion Queued	0.12		0.12	
Performance Index	6.3		6.3	
Travel Distance (Total)	278.6	veh-km/h	334.3	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	5.2	veh-h/h	6.2	pers-h/h
Travel Time (Average)	40.4	sec	40.4	sec
Travel Speed	54.0	km/h	54.0	km/h
Cost (Total)	189.01	$/h	189.01	$/h
Fuel Consumption (Total)	29.4	L/h		
Carbon Dioxide (Total)	73.6	kg/h		
Hydrocarbons (Total)	0.104	kg/h		
Carbon Monoxide (Total)	4.24	kg/h		
NOx (Total)	0.155	kg/h		

P: You need to Process this Site (F9) for this variable to be computed.

Level of Service (LOS) Method: Delay (HCM 2000).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: PM peak concurrent construction

Site access on Tarro interchange
PM peak concurrent construction
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Anderson Drive (off ramp)											
2	T	105	5.0	0.056	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	5	10.0	0.005	9.6	LOS A	0.0	0.1	0.29	0.63	47.5
Approach		111	5.2	0.056	0.5	NA	0.0	0.1	0.01	0.03	59.3
East: Site access road											
4	L	158	10.0	0.171	12.4	LOS B	0.7	5.1	0.33	0.89	45.9
Approach		158	10.0	0.171	12.4	LOS B	0.7	5.1	0.33	0.89	45.9
North: Anderson Drive (Beresfield)											
7	L	5	10.0	0.102	8.6	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	186	5.0	0.102	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		192	5.1	0.102	0.2	NA	0.0	0.0	0.00	0.03	59.6
All Vehicles		460	6.8	0.171	4.5	NA	0.7	5.1	0.12	0.33	54.0

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Project: M:\MW Pty Ltd\Active Projects\P0458 QR AdeW Hexham\P0458 QR Sidra.sip
8000290, MARK WAUGH PTY LTD, SINGLE

INTERSECTION SUMMARY

Site: AM peak operational

Site access on Tarro interchange
AM peak operational phase
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	414	veh/h	496	pers/h
Percent Heavy Vehicles	5.4	%		
Degree of Saturation	0.172			
Practical Spare Capacity	364.7	%		
Effective Intersection Capacity	2403	veh/h		
Control Delay (Total)	0.09	veh-h/h	0.11	pers-h/h
Control Delay (Average)	0.8	sec	0.8	sec
Control Delay (Worst Lane)	13.1	sec		
Control Delay (Worst Movement)	13.1	sec	13.1	sec
Geometric Delay (Average)	P	sec		
Stop-Line Delay (Average)	P	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.0	veh		
95% Back of Queue - Distance (Worst Lane)	0.3	m		
Total Effective Stops	27	veh/h	33	pers/h
Effective Stop Rate	0.07	per veh	0.07	per pers
Proportion Queued	0.02		0.02	
Performance Index	4.5		4.5	
Travel Distance (Total)	250.8	veh-km/h	300.9	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	4.3	veh-h/h	5.1	pers-h/h
Travel Time (Average)	37.1	sec	37.1	sec
Travel Speed	58.8	km/h	58.8	km/h
Cost (Total)	149.67	$/h	149.67	$/h
Fuel Consumption (Total)	21.2	L/h		
Carbon Dioxide (Total)	53.0	kg/h		
Hydrocarbons (Total)	0.068	kg/h		
Carbon Monoxide (Total)	1.81	kg/h		
NOx (Total)	0.093	kg/h		

P: You need to Process this Site (F9) for this variable to be computed.

Level of Service (LOS) Method: Delay (HCM 2000).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: AM peak operational

Site access on Tarro interchange
AM peak operational phase
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Anderson Drive (off ramp)											
2	T	68	5.0	0.036	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	11	10.0	0.011	10.3	LOS B	0.0	0.3	0.40	0.66	47.0
Approach		79	5.7	0.036	1.4	NA	0.0	0.3	0.05	0.09	57.9
East: Site access road											
4	L	11	10.0	0.013	13.1	LOS B	0.0	0.3	0.40	0.86	45.4
Approach		11	10.0	0.013	13.1	LOS B	0.0	0.3	0.40	0.86	45.4
North: Anderson Drive (Beresfield)											
7	L	11	10.0	0.172	8.6	LOS A	0.0	0.0	0.00	1.09	49.0
8	T	314	5.0	0.172	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		324	5.2	0.172	0.3	NA	0.0	0.0	0.00	0.04	59.6
All Vehicles		414	5.4	0.172	0.8	NA	0.0	0.3	0.02	0.07	58.8

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Project: M:\MW Pty Ltd\Active Projects\P0458 QR AdeW Hexham\P0458 QR Sidra.sip
8000290, MARK WAUGH PTY LTD, SINGLE

INTERSECTION SUMMARY

Site: PM peak operational

Site access on Tarro interchange
PM peak operational
Stop (Two-Way)

Intersection Performance - Hourly Values				
Performance Measure	**Vehicles**		**Persons**	
Demand Flows (Total)	323	veh/h	388	pers/h
Percent Heavy Vehicles	5.5	%		
Degree of Saturation	0.105			
Practical Spare Capacity	663.9	%		
Effective Intersection Capacity	3086	veh/h		
Control Delay (Total)	0.09	veh-h/h	0.11	pers-h/h
Control Delay (Average)	1.0	sec	1.0	sec
Control Delay (Worst Lane)	12.2	sec		
Control Delay (Worst Movement)	12.2	sec	12.2	sec
Geometric Delay (Average)	P	sec		
Stop-Line Delay (Average)	P	sec		
Intersection Level of Service (LOS)	NA			
95% Back of Queue - Vehicles (Worst Lane)	0.0	veh		
95% Back of Queue - Distance (Worst Lane)	0.3	m		
Total Effective Stops	27	veh/h	32	pers/h
Effective Stop Rate	0.08	per veh	0.08	per pers
Proportion Queued	0.02		0.02	
Performance Index	3.5		3.5	
Travel Distance (Total)	195.9	veh-km/h	235.0	pers-km/h
Travel Distance (Average)	606	m	606	m
Travel Time (Total)	3.3	veh-h/h	4.0	pers-h/h
Travel Time (Average)	37.3	sec	37.3	sec
Travel Speed	58.5	km/h	58.5	km/h
Cost (Total)	117.88	$/h	117.88	$/h
Fuel Consumption (Total)	16.8	L/h		
Carbon Dioxide (Total)	42.1	kg/h		
Hydrocarbons (Total)	0.055	kg/h		
Carbon Monoxide (Total)	1.52	kg/h		
NOx (Total)	0.075	kg/h		

P: You need to Process this Site (F9) for this variable to be computed.

Level of Service (LOS) Method: Delay (HCM 2000).
NA: Intersection LOS for Vehicles is Not Applicable for two-way sign control since the average intersection delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

MOVEMENT SUMMARY

Site: PM peak operational

Site access on Tarro interchange
PM peak operational
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue		Prop. Queued	Effective Stop Rate	Average Speed
							Vehicles	Distance			
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Anderson Drive (off ramp)											
2	T	105	5.0	0.056	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
3	R	11	10.0	0.009	9.7	LOS A	0.0	0.3	0.30	0.64	47.5
Approach		116	5.5	0.056	0.9	NA	0.0	0.3	0.03	0.06	58.6
East: Site access road											
4	L	11	10.0	0.011	12.2	LOS B	0.0	0.3	0.30	0.86	46.0
Approach		11	10.0	0.011	12.2	LOS B	0.0	0.3	0.30	0.86	46.0
North: Anderson Drive (Beresfield)											
7	L	11	10.0	0.105	8.6	LOS A	0.0	0.0	0.00	1.07	49.0
8	T	186	5.0	0.105	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		197	5.3	0.105	0.5	NA	0.0	0.0	0.00	0.06	59.3
All Vehicles		323	5.5	0.105	1.0	NA	0.0	0.3	0.02	0.08	58.5

Level of Service (LOS) Method: Delay (HCM 2000).
Vehicle movement LOS values are based on average delay per movement
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model used.

Project: M:\MW Pty Ltd\Active Projects\P0458 QR AdeW Hexham\P0458 QR Sidra.sip
8000290, MARK WAUGH PTY LTD, SINGLE