

5. Stakeholder Consultation

This chapter summarises the community and stakeholder involvement activities and feedback received during the development of the Project. Table 5a outlines the DGRs relating to consultation and where they have been addressed.

Table 5a Director General's Environmental Assessment Requirements – Consultation

Director General's Environmental Assessment Requirements	Where addressed
Consultation	
<i>During the preparation of the EIS, you should undertake an appropriate and justified level of consultation with relevant parties, including (but not limited to):</i> <i>local, State or Commonwealth government authorities, including the:</i> <i>Department of Planning and Infrastructure (Hunter Regional Office);</i> <i>Office of Environment and Heritage;</i> <i>NSW Office of Water;</i> <i>Hunter Central Rivers Catchment Management Authority;</i> <i>Transport for NSW;</i> <i>Department of Trade and Investment (Primary Industries and Mineral Resources); and</i> <i>Newcastle City Council.</i> <i>service and infrastructure providers such as:</i> <i>Roads and Maritime Services;</i> <i>RailCorp;</i> <i>Hunter Water; and</i> <i>Hunter Energy.</i> <i>specialist interest groups, including Local Aboriginal Land Councils; and</i> <i>the public, including community groups and adjoining and affected landowners.</i> <i>The EIS must describe the consultation process and the issues raised, and identify where the design of the development has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.</i>	Sections 5.1 to 5.7 of this chapter

5.1. Introduction

The UHVA Overarching Community and Issues Management Strategy, was developed to provide a comprehensive approach that considered consultation issues, protocols and strategies for delivery of the Alliance consultation components from planning through to construction.

A detailed Community Consultation Strategy (CCS), which formed a sub plan to the overarching plan, was established for the proposed development at the environmental assessment phase. The strategy was implemented throughout the course of the environmental assessment phase. It was designed to clearly articulate the objectives of the project, and stakeholders and the community were informed and included during the environmental assessment process.

The strategy outlined the process for the flow of information and feedback between the project team, stakeholders and the community. Specifically, the strategy outlined communication objectives for the proposed Project:

- to ensure Government, stakeholders and the community were informed about the project, had the opportunity to provide input and understand the outcomes on completion of each phase of the project's development;
- liaise with government agencies and discuss the scope for the technical investigations and consider the outcomes of investigations prior to adequacy review;
- inform the community about the commencement of the environmental assessment process;
- seek feedback from stakeholders and community members on the Project; and

- inform the community about opportunities for engaging in the consultation process and providing a submission during EIS preparation and exhibition.

5.2. Stakeholders

The Community Consultation Strategy aimed to ensure that all relevant environmental, social and economic issues raised by stakeholders and the community were considered and addressed by the project team within the Environmental Impact Statement report.

Stakeholder and community members consulted as a part of the environmental assessment process included:

- special interest groups and local businesses including Hunter Estuary Technical Working Party, Newcastle Coal Infrastructure Group, Hunter Community Environment Centre, Hunter Bird Observers Club, Rising Tide and Hunter Bird Observers Club;
- State and Local representatives including councillors from Newcastle City Council, Port Stephens Council, Member for Cessnock, Member for Port Stephens and Member for Wallsend;
- State and local government authorities including Office of Environment and Heritage, Office of Water, RailCorp, Roads and Maritime Services, Hunter Water and Hunter Central Rivers Catchment Management Authority;
- local community of Hexham and Tarro;
- landowners identified as directly adjacent to the proposal; and
- utility providers including Ausgrid, Jemena, Telstra, Hunter Water Corporation, Optus and Vision Stream.

5.3. Community and Stakeholder Consultation Activities

Throughout the development and exhibition phases of the EIS a number of consultation activities have been implemented.

Table 5.3 summarises the consultation activities used to engage with stakeholders and community members.

Table 5.3 Consultation tools and activities

Consultation activity	Stakeholders			
	Federal and State government agencies	Local community groups and businesses	Property owners and residents adjacent to the Proposal area	Emergency services and utility providers
UHVA 1800 telephone number	✓	✓	✓	✓
Email	✓	✓	✓	✓
Letters		✓	✓	✓
Advertisement	✓	✓	✓	✓
Newsletters		✓	✓	✓
One on one meetings	✓		✓	✓

Consultation activity	Stakeholders			
	Federal and State government agencies	Local community groups and businesses	Property owners and residents adjacent to the Proposal area	Emergency services and utility providers
Static displays	✓	✓	✓	✓
Community Information Session (PEA)	✓	✓	✓	✓
*Exhibition display (EIS Community Information Session)	✓	✓	✓	✓
*Submissions	✓	✓	✓	✓

* To be completed as a component of the exhibition period

The following section provides a detailed outline of the community and stakeholder consultation activities conducted over the course of the project's development. This also includes activities which will be undertaken as part of the EIS Exhibition period.

5.4. Overarching Consultation Tools

The overarching consultation tools were established and maintained to ensure that project information was continuously being collected, exchanged and distributed. The consultation tools used, provided an open line of communication between the community, stakeholders and the project team and the variety of avenues provided, ensured inclusion regardless of technological availability or capability.

Project 1800 Information Line

A toll free 1800 number was established for all UHVA projects and was provided on all consultation materials distributed. Details of community members and stakeholders who made contact with the project team were recorded in the project contact and issues database. At the time of writing this report, a total of five phone calls were received in relation to the project during the environmental assessment process. Issues raised are presented below.

Project Email

A project email address was established and provided on all consultation materials distributed. Details of community members and stakeholders who made contact with the project team were recorded in the project contact and issues database. A total of two emails were received in relation to the project during the consultation period prior to the submission of the EIS. Issues raised are presented below.

5.5. Preliminary Environmental Assessment Consultation Activities

During the preparation of the Environmental Assessment, the Government, stakeholder and community engagement program comprised the following tasks:

- letters to property owners and residents adjacent to the proposal, advising of the PEA commencement;
- public notification, including newspaper advertisement to inform community of the exhibition of the PEA;
- newsletter, providing project specific information, the EIS process and dates for the exhibition of the PEA;
- one on one meetings with property owners and residents adjacent to the proposal; and
- PEA exhibition community information session.

Planning Focus Meeting

A planning focus meeting was not required by the DP&I for the project as it was deemed unnecessary given that key agencies were able to provide written comments on issues to be addressed within the EIS using their existing knowledge. Key agencies were also considered to have familiarity with the Proponent and with the scope of the Project from other ongoing ARTC capital upgrade projects recently approved or currently underway.

Stakeholder Meetings

Individual stakeholder meetings were held throughout the EIS process to gauge interest in the Project and gain a better understanding of specific issues concerning potentially affected landowners and stakeholders. Stakeholder meetings were offered to all adjacent landowners. A total of five meetings were held with adjacent landowners. Feedback was recorded and is summarised below.

Letters to Stakeholders – November 2011

In accordance with Clause 193(4)(a) of the Environmental Planning and Assessment Regulation 2000, eight letters were sent to identified property owners and residents adjacent to the proposal and four to key government agencies. The letters advised of the PEA lodgement, the next steps in the environmental assessment process and provided project contact details.

Public Notification (Newspaper Advertisement) – March 2012

An advertisement was placed within the Newcastle Herald on Saturday 10 March, to provide a brief project update and encourage attendance at the PEA community information session. A copy of the advertisement can be found in **Appendix A DGRs, Consultation and Risk Analysis**.

Newsletter – March 2012

The PEA newsletter outlined the proposed project, provided project milestones, explained the environmental assessment process, provided project contact details and advertised the PEA community information session. Approximately 31 newsletters and invitation letters were distributed on 19 March 2012 to stakeholder groups, local government agencies and community members. Additionally, 1,150 newsletters were distributed via a letter box drop, to members of the community within the suburbs of Hexham and Tarro. A copy of the newsletter can be found in **Appendix A DGRs, Consultation and Risk Analysis**.

PEA Community Information Session – March 2012

A community information session was held on Saturday 24 March at the Hexham Bowling Club to provide members of the community with the opportunity to learn more about the project, meet with the project team, ask questions and raise any issues or concerns that they might have. 21 members of the community attended the information session, the issues raised are presented below.

Feedback Forms – March 2012

Feedback forms were available at the community information session to provide stakeholders and community members an additional avenue through which to provide feedback and comment on the project and register to receive ongoing project updates. The feedback forms requested information about the effectiveness of the session itself, sought to determine general attitudes towards the project and allowed for the identification of issues and concerns. A total of 11 feedback forms were received. Analysis of the issues and concerns raised is provided below.

5.6. Environmental Impact Statement Public Exhibition

Various consultation materials and activities are currently being prepared and facilitated in preparation for the Project's exhibition period. Once the proposal has been lodged, the activities outlined below would be undertaken.

EIS Public Notification (Newspaper Advertisement)

An advertisement would be placed within the Newcastle Herald to advise of the EIS completion and advertise and encourage attendance at the EIS community information session.

EIS Project Newsletter

The project newsletter will outline the proposed project, outcomes of the environmental investigations, the submissions process and provide details on how to make a submission. Also included would be details of the upcoming community information session location and times. Approximately 1,000 newsletters would be distributed to members of the community surrounding the project area within the suburbs of Hexham and Tarro.

EIS Exhibition Notification Letter

Prior to the exhibition period, letters would be distributed to all identified property owners, residents adjacent to the proposal, key stakeholders and interested parties registered in the project Consultation database. Letters would provide a project update, information about the outcome of environmental investigations, community consultation and how to make a submission. The letter would also advise of EIS exhibition locations and community information session.

EIS Exhibition Static Display

Details on consultation activities, display of the EIS opportunities to provide feedback and outcomes of environmental assessment will be provided at number of public locations. This is to ensure community members without access to the internet have an opportunity to access to copies of the EIS and reports.

Static displays will include:

- a copy of the EIS and reports;
- poster, incorporating details of the proposed project and upcoming consultation activities; and
- project fact sheets, including information detailing how to make submission.

Static displays are proposed for the following locations, upon approval by the relevant authority:

- Newcastle City Council chambers, Newcastle;
- Newcastle City library branch, Beresfield;
- Hexham Bowling Club, Hexham;
- Hunter Wetlands Centre, Shortland; and
- Tarro Post Office, Tarro.

EIS Community Information Session

A community information session will take place during the public exhibition period. The information session would provide members of the community with the opportunity to engage with members of the project team, learn about the project and seek advice on how to make a submission. The community information session is proposed to be held at the Hexham Bowling Club. The community information session would be staffed by members of the project team and copies of the EIS and additional materials will be made available to stimulate conversation and assist members of the community to develop a greater understanding of the project.

5.7. Community and Stakeholder Issues and Concerns

Feedback provided by stakeholders and members of the community during the preparation of the EIS have played a valuable role in the documents development. Table 5.7 below provides a summary of the issues raised by stakeholders and members of the community and references where they have been addressed within the EIS. Issues raised within the DGRs and associated Government Agency letters are provided in **Appendix A DGRs, Consultation and Risk Analysis**.

Table 5.7 Summary of issues raised by stakeholders during the Environmental Impact Statement

Stakeholder	Comment	Where addressed
Department of Planning and Infrastructure (including the Hunter Regional Office)	ARTC and QR National have been cooperating on the development of the Hexham Relief Roads and Train Support Facility projects. Joint presentations have been provided to a number of key stakeholders, including the Department of Planning and Infrastructure in Sydney on 19 December 2011 and the Hunter Region Office on 4 April 2012. EIS to include Cumulative Impacts of the QR National Proposal and the ARTC Hexham Relief Roads (HRR) project, including ancillary facilities (e.g. parking, site compounds, etc.). ARTC to use the QR National EIS from 2008 to assess cumulative impacts where later data is not available. 3rd May 2012: meeting to provide update on projects and EIS submission schedule.	Chapter 24 Cumulative Impacts Chapter 2 Planning Framework
Office of Environment and Heritage	Meeting held 28 March 2012 outline and discussion of the location of the cultural PAD identified by McCardle Cultural Heritage, HS1 (indigenous site registered by AMBS), the possible extent of HS1 and the proposed geotechnical test locations and types. Included in these discussions was the proposed access route for construction traffic to the project site via the Tarro Interchange to Woodlands Close. 7th May 2012: meeting to present ecology assessments and discuss key issues including off-set strategy.	Chapter 14 Indigenous Heritage Chapter 10 Traffic and Transport Chapter 8 Ecology
Department of Sustainability, Environment, Water, Population and Communities;	Project presentation given to SEWPAC on 14 December 2011 in conjunction with QR National to cover the combined impacts of the HRR and TSF projects. EPBC referral determined as non-controlled action. PB has liaised with SEWPAC on 22 March regarding the EPBC referral and to request additional information regarding the Grey Headed Flying Fox and wetlands.	Chapter 8 Ecology
Transport for NSW	ARTC and QR National provided a joint presentation on the HRR and TSF projects to Transport for NSW on 15 December 2011.	Chapter 10 Traffic and Transport
Department of Trade & Investment, Regional Infrastructure and Services	13 th April 2012: meeting to present the Project and discuss key issues.	Chapter 3 Strategic Need and Justification
Newcastle City Council	Preliminary discussions with Council Officers in regard to site access from Woodlands Close. Letter sent on 19 March 2012. No response received to date. Phone calls offering to provide a presentation to Senior Council staff were not returned. 11th May 2012: meeting to present the Project and discuss key issues including interaction with Council infrastructure.	Chapter 10 Traffic and Transport
Roads & Maritime Services	Extensive consultation regarding access for construction traffic to the project site – access via the intersection of the New England Highway and Woodlands Close was not supported; a construction access road from the Tarro Interchange to Woodlands Close was proposed to resolve this issue.	Chapter 10 Traffic and Transport
QR National	Ongoing consultation between QR National and ARTC throughout the EIS process regarding both projects, particularly traffic access routes (including consideration of options), and cumulative Impacts of the Proposals.	Chapters 7 – 22 and Chapter 24 Cumulative Impacts
Hunter Water Corporation	ARTC and QR National provided a joint presentation on the HRR and TSF projects on 20 December 2012. Discussions have been ongoing re property issues associated with access and crossing Hunter Water Corporation (HWC) easements. HWC advised of a potential capital works project to construct a new 1200mm diameter water pipeline in its easement parallel to the New England Highway, commencing in July 2013.	Chapter 18 Groundwater

Stakeholder	Comment	Where addressed
Community	Drainage & Flooding: Concerned about current drainage issues in the area and increased risk of flooding due to construction works. The area already experiences issues with drainage and flooding so this is a concern to nearby residents. Air quality: Have issues with dust coming off coal trains. Concerned about existing and potential increase in dust as a result of increased traffic on the line. Traffic & Transport: Concerned about increase in traffic on local roads during construction, particularly from residents in the Tarro locality, issues concerning traffic access and haulage routes and increased noise levels. Noise & Vibration: Concerned about vibration impacts to nearby residents, already having problems from previous projects in the area with effects from vibration. Concerned about the increase in noise from construction traffic and increase in train movements once operational. Project components: Concerned about adjoining QR National Project (proposed Train Servicing Facility) and cumulative effects of both projects. Also some concerns about future expansion of the project limited by the QR National proposal. Property: Concerned about access to private property and potential property devaluation. Integrity of investigations: Indicated that original noise and vibration assessments were undertaken when track works were being completed, as such concerned about the validity of the results. Social benefit/cost: Concerns that the area is experiencing significant increases in infrastructure and that the benefits are not being experienced by the local community. Land use and planning Property owners identified that land where temporary access route is proposed, is currently used for stock. As such, installation of appropriate fencing prior to the construction of the temporary access route was requested.	Chapter 7 Flood and Chapter 17 Fluvial Geomorphology Chapter 13 Air Quality Chapter 10 Traffic and Transport Chapter 9 Noise and Vibration Chapter 24 Cumulative Impacts Chapter 20 Land Use and Planning Chapter 9 Noise and Vibration Chapter 16 Socioeconomic Chapter 20 Land use and Planning

A total of 11 feedback forms were received during the community information session. Figure 5.7 below provides a summary of the main issues raised.

Over 50% of respondents were supportive of the proposal's progression, with only 2 respondents indicating opposition. The main issues raised included cumulative impacts (8 respondents) with particular reference to the QR National TSF, specifically relating to potential impacts on residents. (refer **Chapter 24 Cumulative Impacts**). In addition, over 50% of the total number of respondents identified noise and vibration during both construction and operation and general concerns of the potential impacts to residents during construction as key issues (refer to **Chapter 9 Noise and Vibration**). Given the small sample size, figures should not be deemed indicative of the general attitudes of the Hexham and Tarro populations.

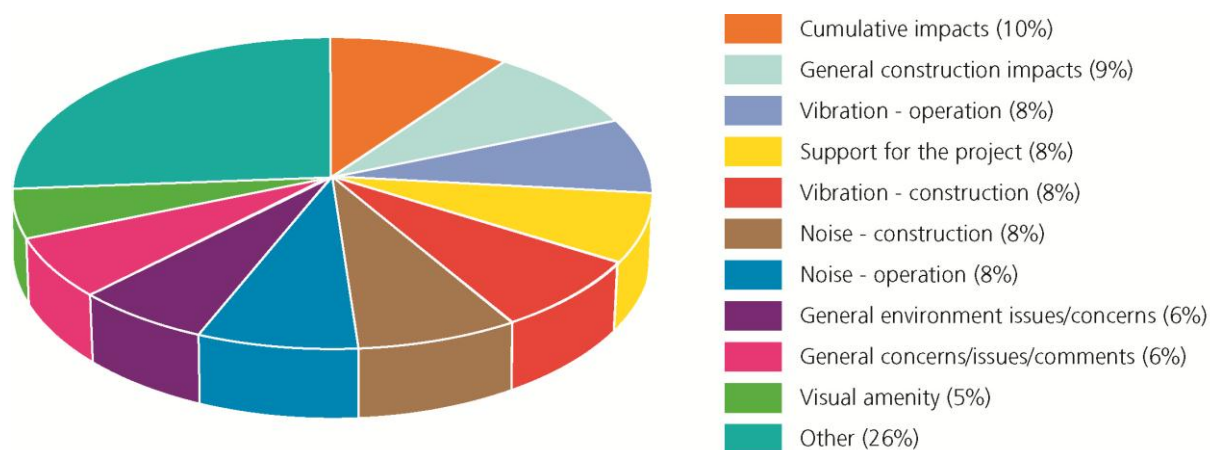


Figure 5.7 Issues identified in feedback forms

5.8. Project Changes and Community Comments

The preparation of the design for the Project and this EIS has had consideration to the comments and concerns raised by all stakeholders (refer to Table 5.7). The surrounding community and stakeholders have been consulted on a number of occasions to discuss the Project and the potential impacts that it may have. The key concerns raised by the community have regard to impact assessment of the Project. To address this, EIS reports have included additional studies to determine key environmental impacts for the Project and mitigate where necessary.

Comments raised by the community have been taken into consideration as part of the design development. A number of comments received have resulted in additional time and effort spent in a number of areas. Examples include increased interaction with QR National, the development of a number of integrated strategies (drainage and access, refer **Chapter 4 Project Description**) to further address potential cumulative impact and additional consideration of surface water flows, drainage and run-off from the Project Area. The majority of issues raised would be addressed through the implementation of mitigation measures during the construction and operation of the Project. UHVA will continue to discuss the Project with the community and have consideration to any concerns raised as the Project progresses.

6. Environmental Risk Analysis

This chapter details the approach to and provides a summary of the environmental risk analysis. The complete risk analysis can be found in **Appendix A DGRs, Consultation and Risk Analysis**.

Table 6a provides the DGRs relating to environmental risk analysis.

Table 6a Director-General's Environmental Impact Statement Requirements – Environmental Risk Analysis

Director General's Environmental Impact Statement Requirement	Where addressed
Environmental risk analysis	
<i>Notwithstanding the key assessment requirements, the Environmental Impact Statement must include an environmental risk analysis to identify:</i> • <i>Potential environmental impacts associated with the proposed Project (construction and operation);</i> • <i>Proposed mitigation measures; and</i> • <i>Potentially significant residual environmental impacts after the application of proposed mitigation measures.</i> <i>Where additional key environmental impacts are identified through this risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the Environmental Impact Statement.</i>	Sections 6.1 – 6.4 of this chapter and Appendix A DGRs, Consultation and Risk Analysis

6.1. Objective

During the Project Application and Preliminary Environmental Assessment phase, a Project Environmental Risk Analysis was conducted.

The environmental risk analysis was reviewed and updated as part of the EIS process in order to achieve the following objectives:

- Identify and confirm key environmental impacts of the Proposed Project and assist stakeholders to focus on the issues for assessment.
- Identify any additional key issues not specified in the DGRs that would require investigation. This includes an analysis of environmental impacts and potential residual environmental impacts after the application of proposed mitigation measures.
- Verification of the key environmental risks following any changes to the concept design and as the scope of the Proposed Project develops throughout the EIS phase.
- Encourage a level of investigation that is commensurate with the risk of the potential environmental impacts which may result from the Proposed Project.

6.2. Methodology

An environmental risk rating was assigned to each environmental issue based on the likelihood (refer Table 6.2a) and consequence (refer Table 6.2b) of the risk occurring and the ability of the project team to manage these risks through environmental mitigation measures. This allowed any additional key issues, not identified in the DGRs, to be identified and appropriately assessed. A risk rating matrix was used to give each risk a rating on the following scale:

- Very high threat;
- High threat;
- Moderate threat;
- Minor threat; and
- Low Threat.

Table 6.2a Risk category definitions

Likelihood	Description	Probability
Almost certain	This threat can be expected to occur	>75%
Likely	This threat will quite commonly occur	51% - 75%
Possible	This threat may occur occasionally	26% - 50%
Unlikely	This threat could infrequently occur	10% - 25%
Rare	This threat may occur in exceptional circumstances	<10%

Table 6.2b Risk category definitions

Consequence	Environmental Impact
Substantial	Permanent widespread damage
Major	Heavy damage, costly restoration
Medium	Major but recoverable damage
Minor	Limited but medium term negative damage
Negligible	Short-term damage

6.3. Risk Analysis

The environmental risk analysis was conducted on 13 July 2011 in a workshop held in Sydney with the EIS authors.

Each environmental issue was systematically reviewed by the group with reference to the current scope of the Proposed Project, the findings of the specialist studies conducted as well as input and issues raised by the community and stakeholders. The proposed scope and extent of mitigation was also discussed, along with potential residual impacts and a residual risk category (i.e. post mitigation) assigned.

The issues that were addressed in the risk analysis were:

- Hydrology and groundwater;
- Water quality;
- Flora and fauna;
- Traffic/access;
- Topography, geology and soil;
- Air emissions and dust generation;
- Noise and vibration;
- Infrastructure, land use and property;
- Non-Indigenous heritage;
- Indigenous heritage;
- Visual;
- Hazards and risks;
- Flood;
- Contamination;
- Community;
- Social;
- Regulatory approvals;
- Resource and energy use;

- Waste generation; and
- Cumulative impacts.

6.4. Conclusion

The environmental risk analysis did not identify any key environmental issues in addition to those already identified in the Preliminary Environmental Assessment and DGRs.

The complete risk analysis can be found in **Appendix A DGRs, Consultation and Risk Analysis**.

7. Flood

The DGRs identify hydrology, including effects of flood, as a key issue. This chapter presents a summary of the flood assessment undertaken by BMT WBM (refer **Appendix B Flood**). Table 7a outlines the DGRs relevant to hydrology and effects of flood and where they have been addressed.

Table 7a Director-General's Environmental Assessment Requirements – Hydrology

Director-General's Environmental Assessment requirements	Location addressed
Hydrology – including but not limited to: - effects of floods on the project (including access); and project effects on flood characteristics (including on surrounding land, infrastructure, housing and businesses for a range of flood events up to and including the PMF), and taking into account potential for flood characteristic changes resulting from climate change and sea level rise; - surface water and stormwater management, including consideration of water quality (sedimentation and acid sulphate soils); hydrological regimes, watercourses (including ephemeral), riparian and receiving areas (including Hexham Swamp Nature Reserve); - groundwater hydrology, groundwater dependent ecosystems, and groundwater users and licences (as applicable); and - taking into account the Managing Urban Stormwater: Soils and Construction (Landcom) guidelines and the Acid Sulfate Soil Manual (ASSMAC), and Upgrading of Lower Hunter Flood Model at Hexham (DHI, 2008).	Sections 7.1 – 7.4 of this chapter Chapter 19 Water Quality Chapter 18 Groundwater Chapter 12 Soil and Water Management Section 7.1.1 of this chapter

7.1. Methodology

The Project Area is located in the southern portion of the Lower Hunter River floodplain. The Hunter River has a long history of flooding; floods in the river have been reported as far back as 1818. The largest flood on record occurred in 1955 which was estimated to have an annual exceedance probability (AEP) of around 1% (which is also referred to as a 1 in 100 year flood) and resulted in multiple fatalities and widespread damage. The most recent major flood events in the region occurred in February 1990 and June 2007.

During large floods, there is the potential for floodwaters to overtop the banks of the Hunter River and inundate the Project Area, Hexham Swamp and adjoining land. Therefore an understanding of flood behaviour at the Project Area is required to minimise the risks to the proposed Project and to minimise the changes to flood behaviour as a result of the proposed Project.

In addition to consideration of design flood behaviour, predicted changes to rainfall and sea levels have been considered. Design flood behaviour is a collective term used to describe the flood levels, flood depths and velocities that are predicted for a particular design rainfall event.

7.1.1. Flood Model

In order to understand and assess flood behaviour in the Project Area, a hydraulic modelling study of the lower Hunter River floodplain was considered necessary.

There have been a considerable number of studies completed to understand the behaviour of flooding in the vicinity of the Project Area. Where available these studies have been reviewed; however, it was considered important from a catchment wide perspective to undertake a Project Area specific investigation to understand the impact on flood behaviour of the proposed Project individually and the proposed Project in combination with all the nearby proposed significant transportation infrastructure developments. These proposed developments include the Train Support Facility (TSF) for QR National and the proposed Pacific Highway Upgrade from the F3 to Heatherbrae.

BMT WBM was engaged to re-establish the Williams River TUFLOW flood model which included the extended modelled floodplain from Fullerton Cove through to Port Stephens (part of the Williamstown/Salt Ash Flood Study Review, BMT WBM 2011). In addition, the model was linked to the Hunter River flood model which was developed to investigate a new Pacific Highway crossing of the Hunter River in the vicinity of Hexham for the F3 to Heatherbrae Upgrade.

The model establishes the existing flood affected areas in the Project Area and assesses the proposed Project Area flood affectation for the 10%, 5%, 2% and 1% AEP and the probable maximum flood (PMF) events. The model assesses cumulative impacts and therefore includes the Hexham Relief Roads, the F3 Upgrade and the QR National TSF. The inputs to the flood model also consider the change in flood affectation as a result of climate change predictions of an increase in sea levels and rainfall.

The model includes the Hexham Relief Roads as described in **Chapter 4 Project Description**. It includes construction of the access road off the Tarro Interchange for UHVA site access purposes. The upgraded area is typically elevated at between 3 to 4m AHD and ties into the existing rail elevation of around 2m AHD at either end. This formation represents a conservative scenario and the final formation levels would be determined during detailed design.

This model represents only a small portion of the Hunter River floodplain. For consistency the existing conditions model results were compared against the results of a valley wide model, documented in "Upgrading of Lower Hunter Flood Model at Hexham (DHI 2008, prepared for Newcastle Council)". The models generally show a good level of consistency, with peak flood levels being typically within 0.3m of each other for most locations. The main area of difference between the models is in the vicinity of Kooragang Island where the DHI 2008 model has a 1dimensional representation of this area which is not as accurate as the 2dimensional representation included in this model. Should the project proceed then it is anticipated that the DHI model for Newcastle Council will need to be upgraded to include the Project Area.

7.2. Existing Environment

The area within which the Relief Roads would be established extends for approximately 2km parallel to the main Hunter River channel. This relatively long boundary alongside the river therefore means that flood levels at the northern end of the Project Area are different to flood levels at the southern (downstream) end of the Project Area.

The BMT WBM TUFLOW flood model predicted design flood levels for a range of events as indicated above and these are presented in Table 7.2 below. These peak water levels represent the maximums at the northern and southern ends of the site. These flood levels correlate to water depths across the Project Area of the order of 1.5 to 3m for the 1% AEP flood event.

Table 7.2 Design flood levels (mAHD)

Design Flood Magnitude	Northern end of site	Southern end of site
10%	1.0	0.9
5%	1.2	1.1
2%	2.2	2.1
1%	3.7	3.5
PMF	8.3	7.7

The flood model predicts that the flooding process across the proposed development site is similar for a range of design events. Flooding of the site is predicted to originate from floodwaters spilling over the New England Highway from the Hunter River at the northern end of the Project Area, crossing the Project Area and flowing in a south westerly direction into the Hexham Swamp. For the 1% AEP event

and larger the Hexham Swamp floodplain becomes fully connected, with flood waters entering the area over the New England Highway, to the north and flowing back to the Hunter River between Hexham Bridge and Ironbark Creek at the southern end of the project area. Refer to Figure 7.2 which shows the existing conditions 1% AEP peak flood velocities and velocity vectors.

The site is not flood affected in the 20% AEP design event, with floodwaters mainly confined to the main Hunter River channel. At the 10%, 5% and 2% AEP events flood waters spill into Hexham Swamp over the New England Highway at the northern end of the project area. Hexham Swamp is also filled in these events from the south by backwater flow from the Hunter River South Arm through Ironbark Creek.

7.2.1. Local Runoff Events

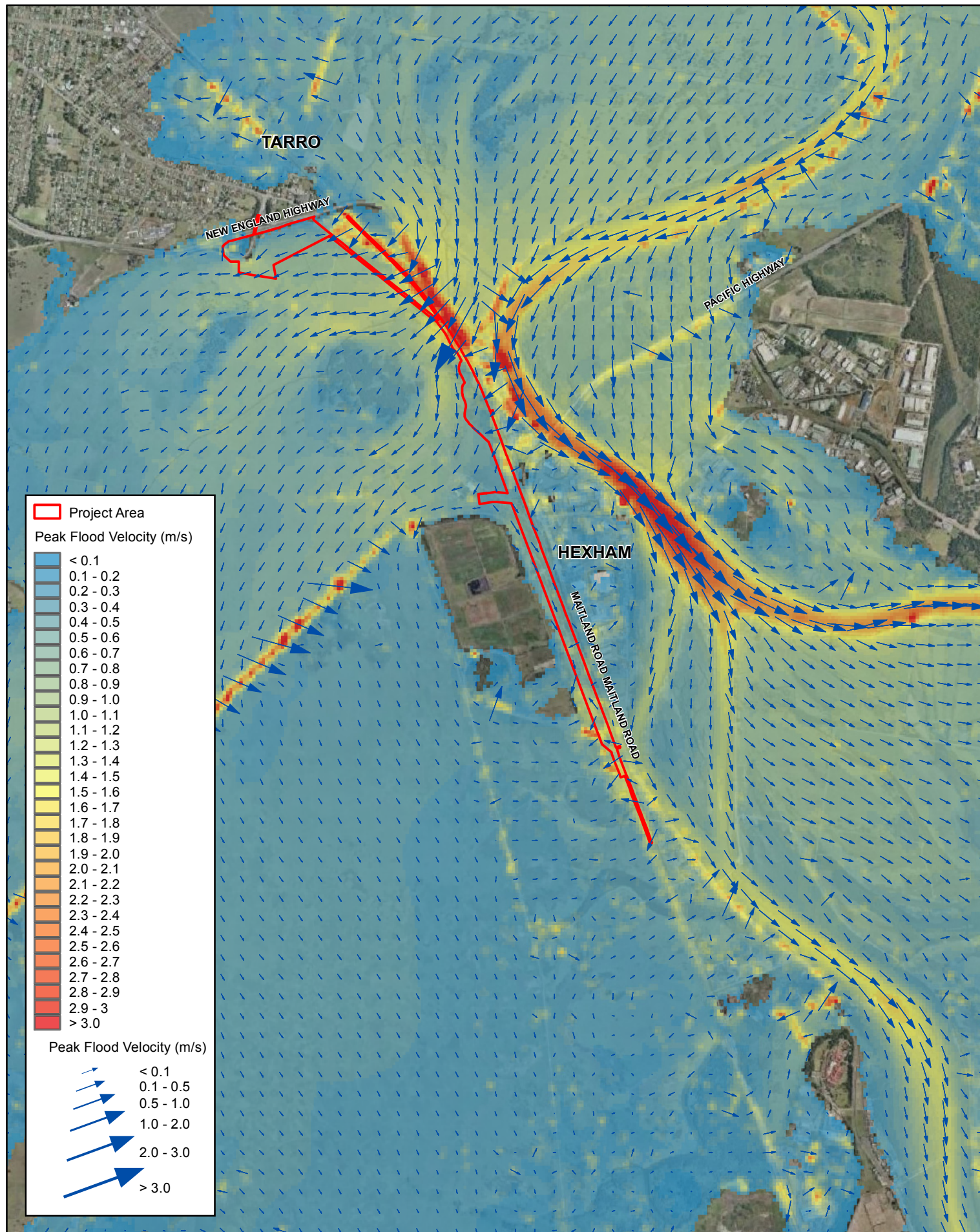
Flooding in the Project Area is dominated by Hunter River flood events. From observations of the site during a rainfall event and analysis of the local topographic survey local rainfall runoff events would result in water ponding around the Project Area and is understood to not inundate the existing rail formation but does cause some inundation of access roads adjacent to the rail formation due to their low elevation. On the eastern side, the Project Area is currently drained via a channel running north to south. On the western side of the existing formation there are several non-formalised channels and swampy areas that store and convey local runoff to the north, west and south of the Project Area. These channels provide very little capacity for flood flows, however local runoff in these channels would have dissipated once a Hunter River flood reaches the Project Area or is insignificant compared to flood flows.

7.3. Potential Impacts

The proposed earthworks to create the track formations and associated services within the Project Area reduce the capacity of the Project Area to convey flood flows between the Hunter River and the Hexham Swamp floodplain. The earthworks result in a small redistribution of floodplain flows, pushing more water at the northern end of the Project Area around to the west and through to Hexham Swamp. However, the impact on flood levels in Hexham Swamp is relatively minor, at around 0.03m in the 1% AEP event. This minor impact in Hexham Swamp is also experienced in the Ramsar listed Shortland Wetlands to the south east of Hexham Swamp but is not significant as there is no change to the duration of inundation nor to the extent of inundation and therefore a flood event in the Shortland Wetlands will be no different to what is currently experienced. There are locally high increases in peak flood levels of up to 0.1m, but these are restricted to the rail corridor immediately to the west. There is also a corresponding reduction in peak flood levels to the east of the Project Area, in the Hexham Industrial area. In terms of the surrounding area, there is no impact to flood levels for the Hunter River main channel and floodplain upstream of the Hexham Bridge and downstream from Kooragang Island on the eastern side of the existing main northern railway line. Figure 7.3a presents the afflux predicted for the 1% AEP.

The changes in peak velocities for the 1% AEP event as a result of the proposed Project are typically less than 0.2m/s. However, there are some localised areas where the velocities increase. One location is at the northern end of the proposed Project where flows from the Hunter River overtop the upgraded rail embankment. Existing peak velocities are around 1m/s and the proposed works result in an increase of 1m/s due to flood flows being re-directed around the northern end of the upgrade towards the west. Another area of increased velocity occurs in the vicinity of the proposed access road off the Tarro Interchange to the north of the Relief Roads area. The increase in velocity in this area is of the order of 0.3m/s above the existing velocity of 0.8m/s. However, the increase in flood depth is less than 0.2m and therefore the change in flood hazard is insignificant. While both these instances are local, management of these velocities would be considered as part of detailed design with the mitigation measures proposed below taken into consideration.

For the 2% AEP and 5% AEP events the impacts on peak flood levels are locally restricted to the east of the upgrade. It is noted that the proposed formation levels for the project are above the 2% AEP flood level, but largely below the 1% AEP flood level. For these events, water spills from the Hunter



A4 Original

0 250 500 750
Metres
GDA 1994 MGA Zone 56

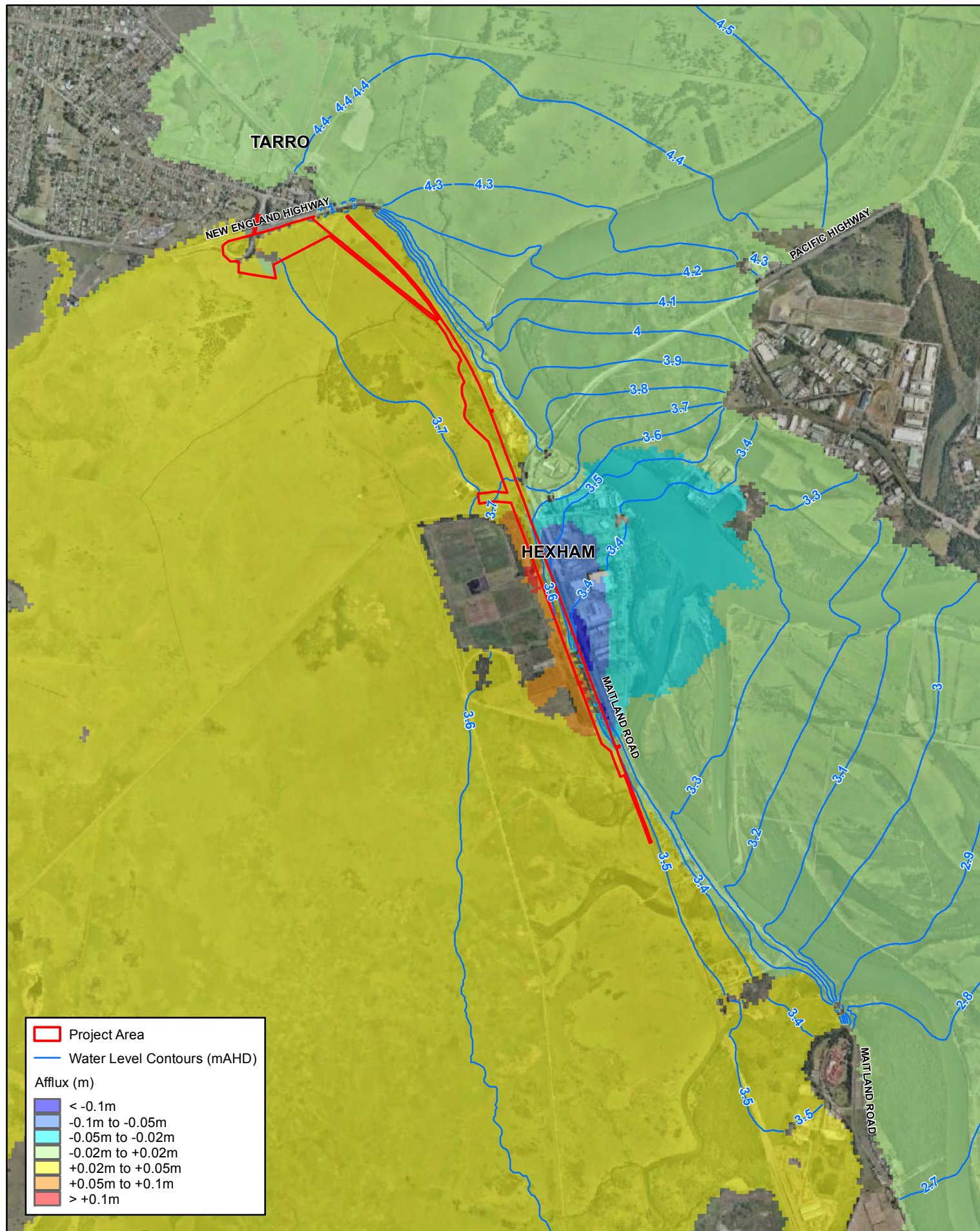


ARTC
Hexham Relief Roads

**1% AEP Peak
Flood Velocities**

Job Number	2110501B
Revision	A2
Date	27.03.2012
Scale	1:30,000

Figure 7.2



A4 Original

0 0.25 0.5 0.75 1
Kilometres
GDA 1994 MGA Zone 56



ARTC
Hexham Relief Roads

**Impact on
1% AEP Flood Level**

Job Number 2110501B
Revision A2
Date 27.03.2012
Scale 1:30,000

Figure 7.3a

River to fill the available flood storage. With the proposed earthworks for the site, this water is detained behind the raised rail formation raising the peak flood level, typically in the order of 0.2m. It should be noted that the model assumes there are no existing or proposed cross drainage structures that may affect the detention of floodwaters behind the rail embankment. This is a conservative assumption and appropriate for assessing flood affectation because all cross drainage features will be inundated due to elevated Hunter River levels and therefore not operate during flood events. For the 10% AEP event there is no impact on peak flood levels as the Project Area is not inundated.

At the 2% AEP event there is only a localised increase in velocity, again at the northern end of the rail upgrade where some water is spilling over the rail embankment. Although the depth of water over the rail embankment is less than 0.2m at the northern end and is very localised for the 2% event. This increase is around 1m/s over the existing peak velocities of around 0.5m/s. The impact on peak velocity is minimal for both the 5% AEP and 10% AEP events.

The flood impacts associated with the PMF event show some localised redistribution of peak velocities and localised peak flood depth increases of over 0.05m. However, this impact occurs in an area already flooded to a depth of over 4m and therefore can be regarded as an insignificant increase because the impact will not change the flood behaviour at the site. These increases occur near the access road at the New England Highway.

7.3.1. Local Flood Impacts

As mention above, a local rainfall event in the vicinity of the project is not expected to impact on the rail formation as it will be managed through the local stormwater drainage system. The Relief Roads would be constructed on material that is less pervious than existing soils and the proposed stormwater drainage system would be designed to cater for the resulting increased flows. The modelling of the proposed drainage system estimated increased peak flows at the project boundaries of approximately 10-15% as a result of the increase in impervious surfaces. However, it is proposed that all local stormwater runoff flows would be managed to minimise impact on surrounding catchments.

7.3.2. Ironbark Creek Floodgates

Floodgates were installed to reduce the tidal flows in Ironbark Creek and its tributaries in Hexham Swamp in the 1970s. In 2006, approval was given by the Minister for Planning to permanently open the floodgates under the Hexham Swamp Rehabilitation project (Department of Planning & Infrastructure ref 05_0193). However, the proposed opening of the gates is for non-flood times only with the Department of Environment and Heritage responsible for management of the flood gates during times of flooding in the Hunter River in accordance with the Flood Procedures Manual (DLWC 2000).

Previous studies have assessed the impact of local and tidal flooding resulting from the opening of all the floodgates. The Hexham Swamp EIS (WBM 2005) concluded that opening the flood gates would result in relatively little impact on water levels in the Hexham Swamp for local 100% AEP and a 5% AEP design storm over a 2-day event duration coinciding with Spring tides. The current model has three gates open to allow flow into Hexham Swamp and eight gates open to allow flow out of the swamp. For the larger Hunter River catchment flood events, the volume of water in the Swamp from the flood event overtops the floodgates for events greater than a 10% AEP design flood and therefore the proposed Hexham Relief roads project will have no impact on the proposed non-flood operation of the flood gates.

7.3.3. Regional Flood Behaviour Impacts

Regional flood behaviour impacts include consideration of changes in flood behaviour impacts to nearby infrastructure, buildings and emergency management procedures. The results of the modelling as presented above indicate very localised changes to flood levels (and subsequent flood depths) and flood velocities. These changes are mainly restricted to the road width of the Pacific Highway adjacent to the project area. Some land and buildings adjacent to the Highway may also experience increased water levels for all events above the 2% event but the resolution of the model grid is not fine enough to

individually identify changes to individual properties. All of the land in the vicinity of the Project area is located in a high hazard floodway area so the localised increase in flood levels on the Pacific Highway will not change this classification. Flood planning controls would already apply to all land and building near the project area and since the changes are localised there will be no noticeable change to the timing or duration of the flood events so there will be no change in risk to local infrastructure, buildings, people or emergency procedures.

7.3.4. Climate Change Considerations

The flood model was amended to simulate sea level rise predictions of an increase of 0.4m and 0.9m for 2050 and 2100 respectively and increased rainfall intensities of 10% and 30% (DECC 2007a and DECCW 2009b). The modelling indicated that the increase in sea level resulted in an increase in the 1% AEP peak flood level of around 0.1m for the 2050 scenario and 0.2m for the 2100 scenario at the Project Area. The potential increase in rainfall has a much greater impact, with the 10% increase in rainfall resulting in a 0.3m increase in peak flood level and the 30% increased rainfall resulting in around a 0.8m increase in peak flood level. However, it is noted that these increases will occur irrespective of the development.

7.3.5. Cumulative Impacts

As indicated above, an assessment of the cumulative impacts associated with the proposed relief roads, QR National TSF and the F3 upgrade was undertaken. The flood modelling predicted no significant increased flood impact resulting from the cumulative consideration of the three proposed developments when compared to consideration of the developments in isolation. For the proposed Project and QR National TSF the impacts both magnitude and location are similar to those described above for the proposed Project in isolation. That is an increase of around 0.03m to peak flood levels in Hexham Swamp. For all three projects, the most significant area of impact is the area bounded by the F3 upgrade to the south and the New England Highway to the north. In this area, peak flood level increases of just over 0.1m are predicted. However, this is a similar order of magnitude to the impacts predicted for this Project in isolation and therefore needs to be managed by the design of the F3 upgrade. Results of the F3 modelling in isolation are presented in the Pacific Highway Upgrade F3 to Heatherbrae: Flooding, Drainage and Water Quality Impact Assessment (BMT WBM 2011). The cumulative impacts for the 1% AEP are presented in Figure 7.3b.

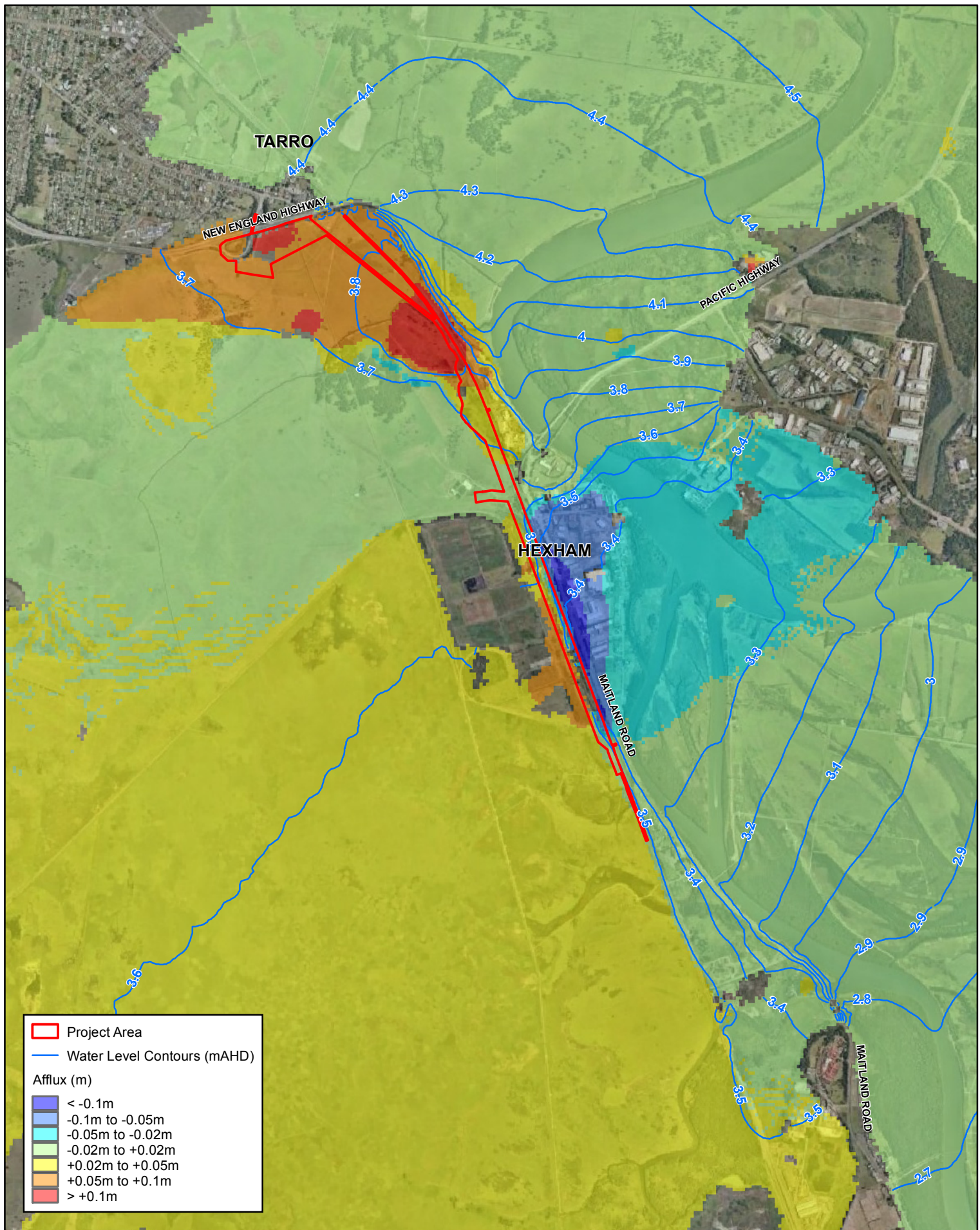
In terms of velocity impacts, there are noticeable changes to velocities in the vicinity of the F3 upgrade. These changes are localised and correspond to the redistribution of flood flows through the flood relief cross drainage structures and bridge openings proposed for the F3 upgrade. The predicted velocities at the local level are around 3m/s and would therefore require mitigation measures to reduce the velocities and subsequently prevent scour and erosion of the land upstream and downstream of the structures. It is assumed that appropriate measures would be provided as part of the road upgrade works.

Given that the predicted impacts to both flood levels and velocities are not significant in terms of the wider Hunter River floodplain, there is unlikely to be any noticeable change to the timing of the flood peak experienced at the Project Area. The localised velocity changes may result in a slightly earlier flood peak but given that the duration of inundation is in the order of days the change in timing would not be noticeable.

7.4. Mitigation Measures

As presented above the predicted impacts as a result of the proposed Project and the culmination of all the local significant projects, namely the QR National TSF and the F3 upgrade are generally localised and are not predicted to impact flooding within the wider Hunter River floodplain.

There are minor impacts (up to 0.03m) to flood depths within Hexham Swamp but there would be no significant change to existing flood behaviour, including timing and magnitude of peak depths and as such no mitigation measures are proposed to mitigate these minor impacts in the swamp.



A4 Original

0 0.25 0.5 0.75 1



Kilometres

GDA 1994 MGA Zone 56



ARTC
Hexham Relief Roads
**1% AEP Impact
for Cumulative
Development Assessment**

Job Number	2110501B
Revision	A2
Date	27.03.2012
Scale	1:30,000

Figure 7.3b

Measures proposed to mitigate the localised impacts and are discussed further below.

7.4.1. Construction

During the construction, the project would be vulnerable to damage if a Hunter River flood event greater than the 10% AEP event occurs. The following temporary mitigation measures for duration of the construction period would be undertaken:

- Compounds, and where practicable, stockpiles would be placed above 10% AEP flood level. The proposed site compound near the Tarro Interchange is in an area currently subject to inundation in the 10% AEP flood event. This site would have buildings elevated above the 10% AEP flood level of 1.0mAHD to prevent inundation of the buildings and information regarding the flood affectation of the site clearly displayed.
- Controlled capture and conveyance of sediment laden runoff from works areas via a network of dirty water channels connecting to suitable sediment controls. To be designed with a 50% to 20% AEP design flood flow capacity.
- A construction flood emergency management plan would be prepared to provide information on flooding at the site, such as expected peak flood levels, expected times of inundation and information on how to reduce the risks to people and property during a flood event.

7.4.2. Operation

Proposed mitigation measures focus on management of increased velocities at specific locations across the project site. These measures or similar can be incorporated during the detailed design. The proposed mitigation measure would include:

- A drainage master plan would be prepared.

It is noted that the site is not inundated for events less than the 2% AEP event, however inundation of land for lower events outside of the project site can impact the operations at the site and therefore the full range of flood events needs to be addressed when considering how the site would operate in the long term.

Subsequently safe management of the site before, during and after a flood emergency would be the key flood impact mitigation measure. The following proposed measure would be implemented to minimise risks to the proposed development as a result of flooding.

- Maintenance of stormwater drainage system in accordance with ARTC annual maintenance.

8. Ecology

8.1. Introduction

A detailed assessment of flora and fauna has been carried out and is summarised in this chapter and provided in full in **Appendix C Ecology**. Table 8.1 outlines the DGRs relevant to ecology and where they have been addressed.

Table 8.1 Director-General's Environmental Assessment Requirements - Ecology

Director-General's Environmental Assessment Requirements	Location addressed
Key Issues	
Ecology – including but not limited to: - flora, fauna and habitat (including rare, threatened and endangered species, populations and ecological communities, migratory birds and wetlands) and consideration of local, regional, state and corridor impacts (including consideration of the Hunter-Central Rivers Catchment Action Plan and the Watagan Ranges to Port Stephens conservation corridor identified in the Lower Hunter Regional Conservation Plan (DECCW, 2009); - flora and fauna surveys including targeted surveys of potentially occurring threatened species; - vegetation clearing (and resultant foraging, roosting, habitat loss, fragmentation, connectivity and edge effects) and operational impacts (such as increase in rail movements); - demonstration that the project can be managed to minimise impacts on the Hexham Swamp Rehabilitation Project; - offsets for ecological impacts and native vegetation clearance consistent with the "improve and maintain" principle, taking into account the OEH BioBanking Assessment Methodology or a detailed biodiversity assessment; and - taking into account the Draft Guidelines for Threatened Species Assessment (DEC and DPI, 2005), and the Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC, 2004). Guidelines for Developments Adjoining Land and Water Managed by the Department of Environment, Climate Change and Water (DECCW, 2010).	Sections 8.3 and 8.4 of this chapter Section 8.2 of the chapter Section 8.4 of this chapter Sections 8.3, 8.4 and 8.5, Chapter 12 Soil and Water Management and Chapter 25 Compilation of Mitigation and Management Measures Section 8.6 of this chapter Section 8.3 of this chapter

8.2. Assessment Methodology

The ecological assessment included both desk-based assessment of literature and relevant databases, as well as field surveys of the Study Area and surrounding landscape. Records of threatened species known or predicted to occur within the locality were obtained from the following:

- Atlas of NSW Wildlife (OEH);
- Threatened species, populations and communities database (OEH);
- NSW DPI Threatened Aquatic Fauna Database (DII);
- PlantNet (RBG); and
- The EPBC protected matters search tool.

Field surveys were undertaken from 15-22 June, 5-6 September, 4 November and 7-8 November 2011 inclusive. The survey methods, effort and assessments were undertaken in accordance with the following guidelines:

- Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Working Draft) (Department of Environment and Conservation 2004);
- Survey guidelines for Australia's threatened frogs (Department of Environment, Water, Heritage and the Arts 2010);
- Significant impact guidelines for the vulnerable Green and Golden Bell Frog (*Litoria aurea*) (Department of the Environment, Water, Heritage and the Arts 2009); and
- Threatened Species Survey and Assessment Guidelines: Field Survey and Methods for Fauna-Amphibians (DECC, 2009b).

8.2.1. Flora Surveys

The floristic diversity and possible presence of threatened species was assessed using a combination of random meander and plot-based (quadrat) surveys. Due to the linear nature of the proposed Project, random meander surveys were completed along the entire length of the Project Area.

Sixteen quantitative (quadrat/transect) site surveys were undertaken as outlined in the methodology contained within *BioBanking Operation Manual* (Seidel & Briggs 2008). The following site attributes were recorded at each site:

- Location;
- Vegetation structure and dominant species and vegetation condition;
- Native and exotic species richness;
- Number of trees with hollows;
- Total length of fallen logs;
- Native overstorey cover;
- Native mid-storey cover;
- Ground cover (grasses, shrubs, other, exotics); and
- Evaluation of regeneration.

The condition of vegetation was assessed through general observation and comparison against this benchmark data as well as using parameters such as intactness, diversity, history of disturbance, weed invasion and health. Three categories were used to describe the condition of vegetation communities: good, moderate and low.

8.2.2. Fauna Surveys

The fauna surveys included habitat assessment and targeted fauna surveys. In addition, opportunistic recordings of species were made through incidental sightings, aural recognition of calls and observations of indirect evidence of species' presence (i.e. Yellow-bellied Glider chews, Glossy-black Cockatoo chew cones, nests/dreys, whitewash, burrows and scats).

The following survey techniques were employed:

- Habitat assessment;
- Targeted surveys, including for Green and Golden Bell Frog;
- Microchiropteran bat surveys;
- Spotlighting;
- Call playback;
- Diurnal bird surveys; and
- Herpetofauna active searches.

A full description of the flora and fauna survey methods and locations is provided in **Appendix C Ecology**.

8.2.3. Estuarine and Aquatic Assessment

Surveys involved habitat assessments of estuarine and freshwater habitats including: intertidal mangrove, saltmarsh, wetland and creek systems and targeted flora and fauna surveys. The site surveys included: water quality recordings, quadrat and transect surveys of flora communities, quadrat surveys for epibenthic fauna and trapping for fish species.

8.3. Existing Environment

8.3.1. Regional Conservation Planning

Lower Hunter Regional Strategy (LHRS): The LHRS strategy identifies a number of 'Green corridor' areas marked for protection between the Watagan Ranges and Stockton Bight. The majority of the Study Area is identified as existing employment land with the adjacent Hexham Swamp identified as a part of the green corridor. The existing vegetation within the Project Area that will be impacted upon is already fragmented and highly disturbed. Furthermore, as the rail design is a small widening of the existing rail corridor with industrial land use and the New England Highway adjacent, impacts are considered minimal, and will not further fragment any areas of existing remnant vegetation.

Lower Hunter Regional Conservation Plan: This Plan sets out a 25 year program to direct and drive conservation planning and efforts in the Lower Hunter Valley. In 2006, approximately 20,000 ha of various high conservation value government lands were set aside which included a new green corridor stretching from the Watagan ranges, through Hexham Swamp to Port Stephens. The corridor is of relevance to the Study Area that lies between the Hexham Swamp, the Hunter River and the Kooragang Wetland Rehabilitation Project on Ash Island, which are key components of the green corridor. The Project Area consists of a small widening of the existing highly disturbed rail corridor, which lies adjacent to industrial developments and a major road (Maitland Road). Thus, the proposed Project is not likely to have any significant effect on habitat connectivity, genetic exchange and dispersal capabilities of any threat-listed species, populations or endangered ecological communities.

The Hunter Central Rivers Catchment Action Plan (CAP): The CAP aims to maintain or improve aquatic habitat and maintain or improve riparian vegetation. The Hunter Estuary Wetlands that are located adjacent to the Study Area are identified as high priority wetlands in the CAP. The proposed Project will require the removal of 7.53 ha of native vegetation; however, if the mitigation measures recommended in Section 6 are adhered to then the proposed Project is likely to have a minimal impact upon the remaining aquatic habitat and wetland vegetation within the locality.

Kooragang Wetland Rehabilitation Project (KWRP): The vision of the KWRP is for an estuary in which healthy, restored fisheries, shorebird, threatened species and other wildlife habitat is in balance with the thriving port, providing opportunities for research, education and recreation. The nearest rehabilitation projects to the current proposal are the Hexham Swamp rehabilitation project located to the South, and the Kooragang wetland rehabilitation project located on Ash Island to the South east beyond the Pacific Highway and the Hexham industrial area. Given the distance, and nature of the works proposed, the actions do not have a significant impact on the aims and restoration objectives of the KWRP.

8.3.2. Vegetation Communities

The majority of the vegetation within the site has been previously cleared and extensively modified as a result of:

- Historic and current grazing;
- Rail construction in the current and former locations; and
- A coal loader, remnant coal stockpiles and former associated rail lines which have since been removed.

Where the landscape and soil profile has not been significantly modified, the original vegetation is regenerating from a soil stored seed bank. There is some regeneration in areas where the soil profile has been disturbed/removed through dispersal of seeds from isolated mature trees and colonising species (such as *Acacia* spp.) as well as planted garden trees.

Figures 8.3a-c illustrate the vegetation communities within the Study Area. The distinct vegetation types are:

- Swamp Oak Swamp Forest Fringing Estuaries;
- Swamp Mahogany Swamp Forest on Coastal Lowlands;
- *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands;
- Coastal Saltmarsh in Estuaries;
- Exotic Grassland/Disturbed;
- Exotic Herbfield; and
- Planted Vegetation.

8.3.3. Swamp Oak Swamp Forest Fringing Estuaries

Previous vegetation mapping of the Study Area had identified the presence of Swamp Oak Rushland Forest. This was confirmed during the site surveys. A comparison of the quadrat data against biometric benchmark data (DEC, 2007) suggests that within the Study Area, this community was degraded with many of the vegetation characteristics below benchmark condition. The majority of this community had been previously cleared. It occurred as fragmented patches and is subject to ongoing disturbance from grazing or edge effects from the existing unformed roads and the railway. Its condition was described as 'moderate'; the canopy was generally regrowth with a dense understorey of exotic species (Figure 8.3a), particularly *Lantana camara*.

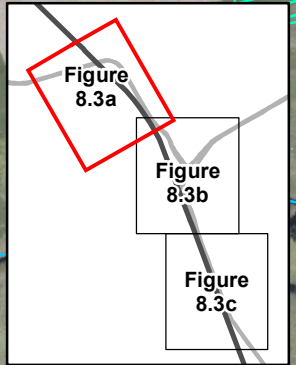
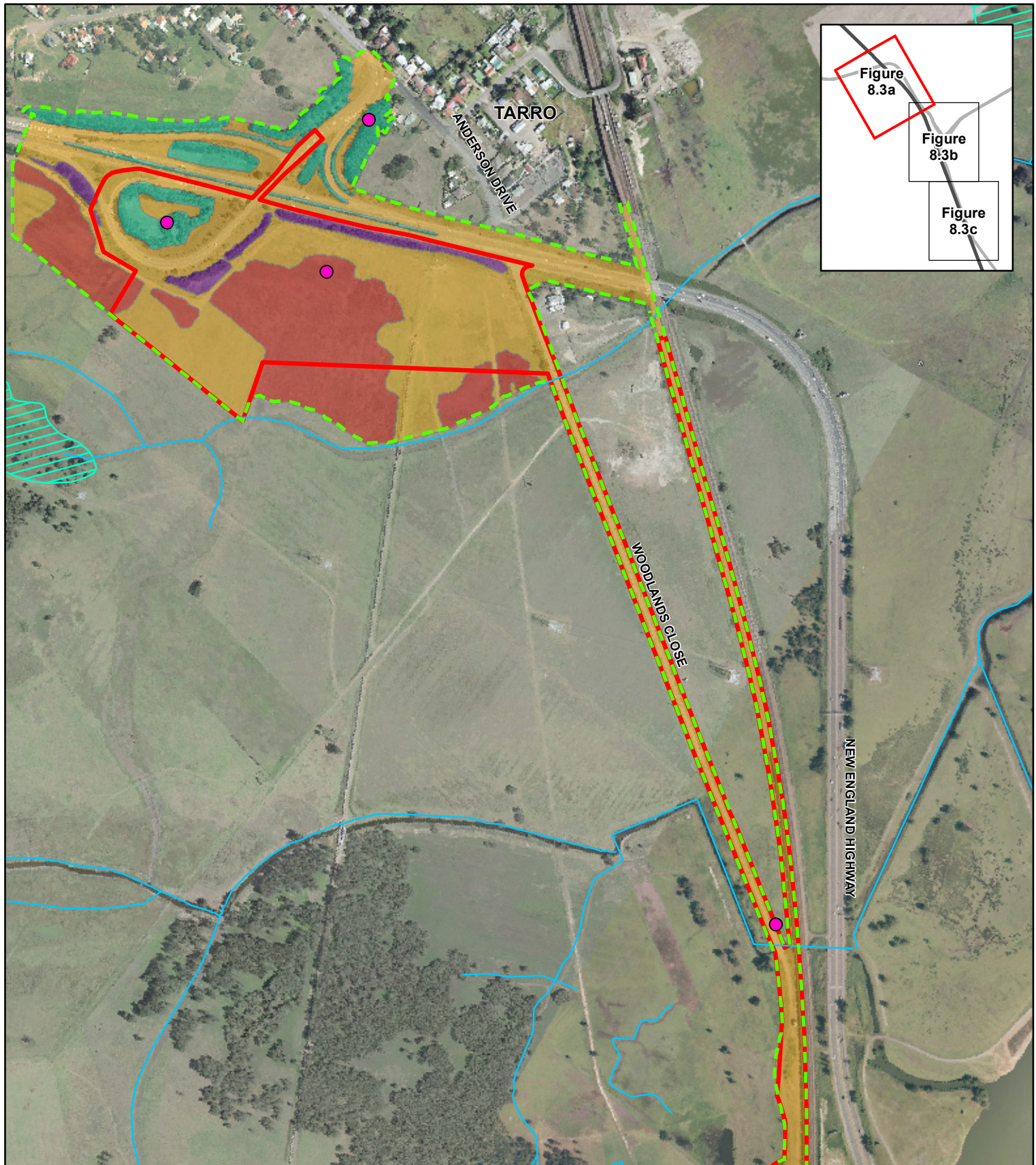


Source: Appendix C Ecological Assessment

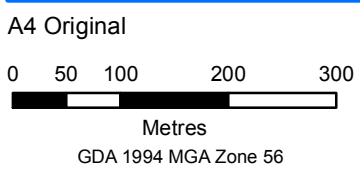
Photo 8.3a Swamp Oak Swamp Forest Fringing Estuaries

8.3.4. Swamp Mahogany Swamp Forest on Coastal Lowlands

Vegetation mapping identified the presence of Swamp Mahogany Paperbark Swamp Forest (MU37) within the Study Area. This was confirmed during the site surveys. A comparison of the quadrat data against biometric benchmark data (DEC, 2007) suggests that within the Study Area, this community was degraded with many of the vegetation characteristics below benchmark condition. The majority of this community had been previously cleared. It occurred as fragmented patches and was subject to ongoing disturbance from grazing or edge effects from the existing unformed roads and the railway. Its condition was described as 'moderate'. The canopy was generally regrowth native trees with a dense shrublayer of the exotic species, *Lantana camara* (Photo 8.3b).



- | | | |
|---|---|---|
| ● Flora Survey | Coastal Saltmarsh in Estuaries | <i>Phragmites australis</i> and <i>Typha orientalis</i>
Coastal Freshwater Wetlands |
| — Drainage | Exotic Grassland / Disturbed | Swamp Mahogany Swamp Forest
on Coastal Lowlands |
| Study Area | Exotic Herbfield | Swamp Oak Swamp Forest |
| Project Area | Planted Vegetation | Fringing Estuaries |
| SEPP14 Wetland | Water | |

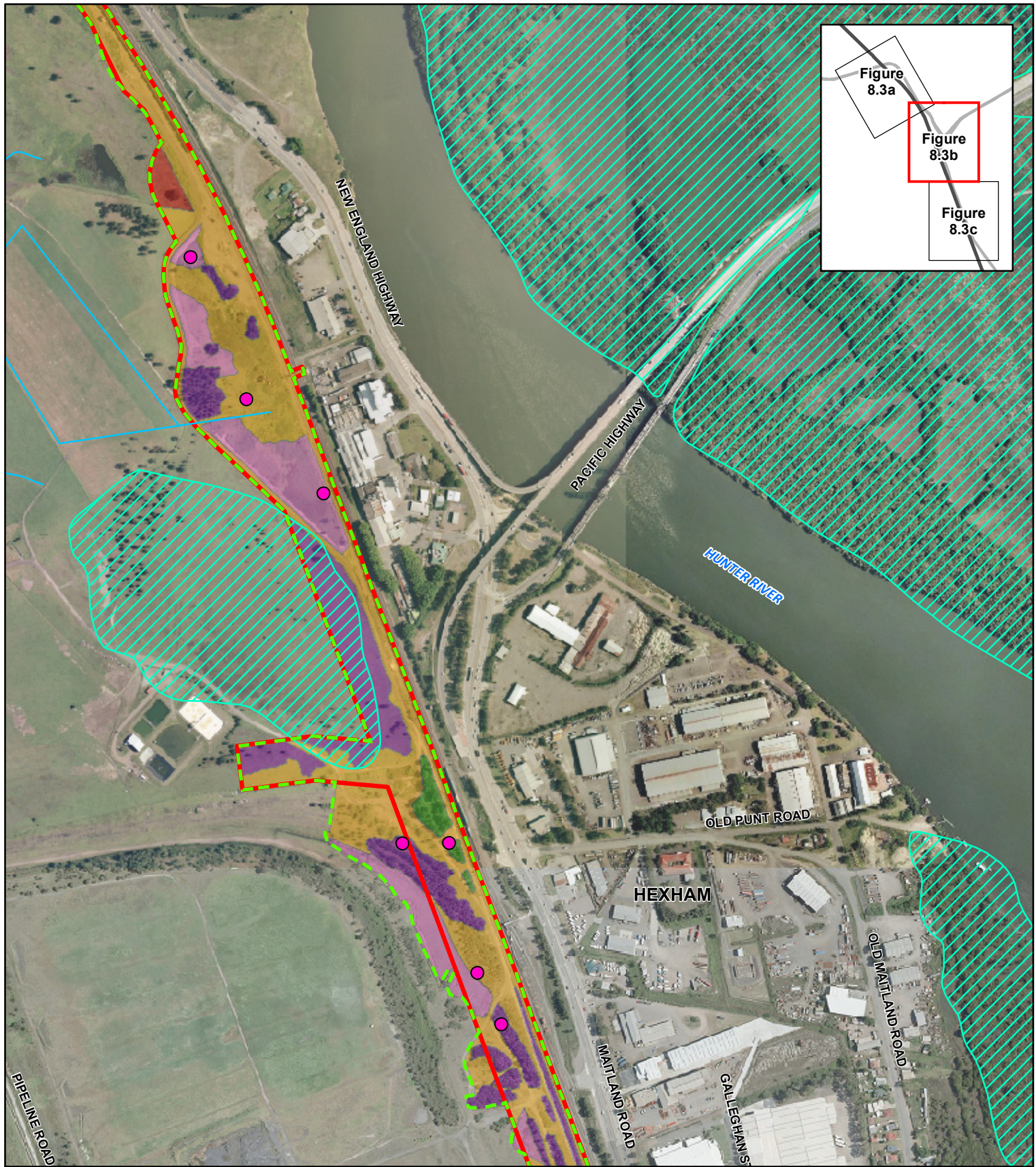


ARTC
Hexham Relief Roads

**Vegetation
Communities**

Job Number	2110501A
Revision	A3
Date	30.04.2012
Scale	1:7,000

Figure 8.3a



- | | | |
|------------------|--------------------------------|---|
| ● Flora Survey | Coastal Saltmarsh in Estuaries | <i>Phragmites australis</i> and <i>Typha orientalis</i> Coastal Freshwater Wetlands |
| — Drainage | Exotic Grassland / Disturbed | Swamp Mahogany Swamp Forest on Coastal Lowlands |
| --- Study Area | Exotic Herbfield | Swamp Oak Swamp Forest Fringing Estuaries |
| ▭ Project Area | Planted Vegetation | |
| ▨ SEPP14 Wetland | Water | |

A4 Original

0 50 100 200 300
Metres
GDA 1994 MGA Zone 56

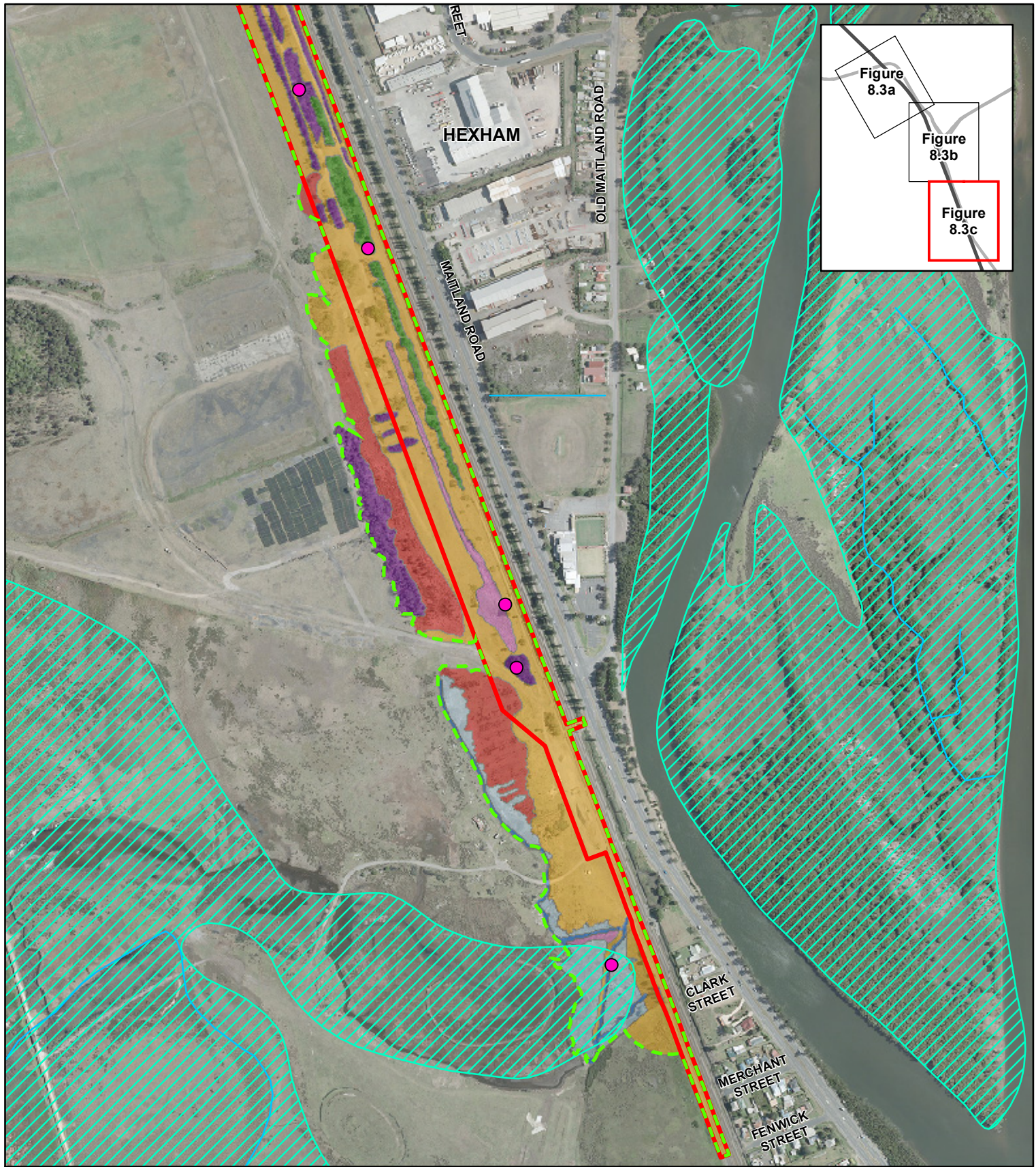


ARTC
Hexham Relief Roads

**Vegetation
Communities**

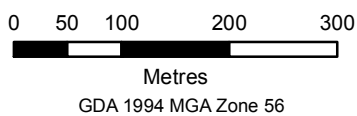
Job Number	2110501A
Revision	A3
Date	30.04.2012
Scale	1:7,000

Figure 8.3b



- | | | |
|---|--|--|
| ● Flora Survey | Coastal Saltmarsh in Estuaries | <i>Phragmites australis</i> and <i>Typha orientalis</i> Coastal Freshwater Wetlands |
| — Drainage | Exotic Grassland / Disturbed | Swamp Mahogany Swamp Forest on Coastal Lowlands |
| Study Area | Exotic Herbfield | Swamp Oak Swamp Forest Fringing Estuaries |
| Project Area | Planted Vegetation | |
| SEPP14 Wetland | Water | |

A4 Original



ARTC
Hexham Relief Roads

Vegetation Communities

Job Number	2110501A
Revision	A3
Date	30.04.2012
Scale	1:7,000

Figure 8.3c



Source: Appendix C Ecological Assessment
Photo 8.3b Swamp Mahogany Swamp Forest on Coastal Lowlands

8.3.5. Coastal Saltmarsh in Estuaries

The site survey identified Coastal Saltmarsh in Estuaries as occurring within the Study Area (Photo 8.3c). This community occurs in the south of the Study Area where an inlet is present that is subject to tidal influences from the South Arm of the Hunter River. Therefore Coastal Saltmarsh is present along with isolated stands of *Avicennia marina* (Mangroves) and *Casuarina glauca*. A comparison of the quadrat data against biometric benchmark data (DEC, 2007) suggests that within the Study Area, this community is in good condition with the vegetation characteristics either at or above benchmark for Coastal Saltmarsh. A high diversity of native species was present with weeds incursions restricted to the edges of the Saltmarsh areas.



Source: Appendix C Ecological Assessment

Photo 8.3c Coastal Saltmarsh in Estuaries Mapped as SEPP 14 Wetland No. 840

8.3.6. *Phragmites Australis* and *Typha Orientalis* Coastal Freshwater Wetlands

Vegetation mapping identified large areas of Freshwater Wetland Complex (MU46) within the Study Area that is associated with Hexham Swamp (Photos 8.3d and 8.3e). This was confirmed during the site surveys. These wetlands have been modified and are likely to have formed as a result of clearing of swamp forest. Two variants of these freshwater wetlands occur, being the *Phragmites australis* dominated wetlands and wetlands that have open water. A comparison of the quadrat data against biometric benchmark data suggests that within the Study Area, this community was of 'moderate' condition as most of the vegetation characteristics are at or below benchmark condition. There was a moderate diversity of native species, with some invasion of exotic species.



Source: Appendix C Ecological Assessment

Photo 8.3d *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands Dominated by *P. australis* and *T. orientalis*



Source: Appendix C Ecological Assessment

Photo 8.3e *Phragmites australis* and *Typha orientalis* Coastal Freshwater Wetlands Dominated with Open Water

8.3.7. Exotic Grassland / Disturbed

Exotic grassland/disturbed vegetation (Photo 8.3f) is the most common vegetation within the rail corridor. This vegetation is not consistent with a native vegetation community and is unlikely to regenerate due to modification of soil profile. Areas of the grassland have been invaded by the weeds *Arundo donax* and *Lantana camara*. The condition of this community was described as 'low'. It had less than 25% of benchmark canopy cover and less than 50% native ground cover. It is unlikely to regenerate due to disturbance of soil profile and native seedbank. Native species recorded were colonising species are likely to have germinated as a result of wind-dispersed seed.



Source: Appendix C Ecological Assessment

Photo 8.3f Exotic grassland / disturbed vegetation adjoining the rail line

8.3.8. Exotic Herbfield

Exotic herbfield vegetation community (Photo 8.3g) is a modified wetland that has been dominated by exotic pasture weeds and occurs in the north of Study Area adjoining the New England Highway and in the south of the Study Area. This vegetation is not consistent with a native vegetation community and is unlikely to regenerate due to modification of the soil profile and previous grazing regimes. The condition of the community was described as 'low'. It had less than 25% of benchmark canopy cover and has less than 50% native ground cover. Areas of this community were dominated by Alligator Weed that is classified as a noxious weed at a state and federal level.



Source: Appendix C Ecological Assessment

Photo 8.3g Exotic herbfield showing infestation of Alligator Weed

8.3.9. Planted Vegetation

This vegetation community is the result of rehabilitation works conducted by the RTA for the on and off ramps for Anderson Road. This vegetation is not consistent with a native vegetation community and contains planted areas of *Callistemon* sp., *Casuarina glauca* and sediment detention basins constructed to receive runoff from the road. The *Casuarina glauca* area differs from the endangered ecological community of Swamp Oak Floodplain Forest as it does not occur on a coastal floodplain. It is elevated on embankments built as part of the road works. The condition of this community was described as 'low'. It had less than 25% of benchmark canopy cover and has less than 50% native ground cover. It is unlikely to regenerate due to the disturbance of soil profile and native seedbank. Native species recorded are a result of previous rehabilitation works undertaken as part of road works. Photo 8.3.h shows an indicative picture of this type of community.



Source: Appendix C Ecological Assessment

Photo 8.3h Planted *Casuarina glauca* with an exotic understorey

8.3.10. Plant Species Recorded

A total of 158 plant species were recorded in the Study Area of which 71 species (45%) were native. Of the 87 exotic species of plant recorded, seven are listed under the *Noxious Weeds Act 1993* for the Newcastle City Council Noxious Weed Control Area. These were: *Alternanthera philoxeroides* (Alligator Weed), *Cestrum parqui* (Green Cestrum), *Ageratina adenophora* (Crofton Weed), *Cortaderia selloana* (Pampas Grass), *Echium plantagineum* (Paterson's Curse), *Lantana camara* (Lantana) and *Rubus fruticosus* aggregate species (*Rubus ulmifolius*) (Blackberry).

8.3.11. Fauna Habitats

The suitability, size and configuration of the fauna habitats correlated broadly with the vegetation communities. These areas provided habitat for a range of birds, mammals and herpetofauna, and were in moderate to poor condition. Specific habitat attributes of each community type are described in further detail in **Appendix C Ecology**.

8.3.12. Species of Animal Recorded

Seventy-seven vertebrate fauna species were recorded during the field surveys including two threatened species of animal: Grey-headed Flying-fox and White-fronted Chat. A further two threatened species were also recorded more distantly from the Study Area: the Black-necked Stork and Spotted Harrier. Eight introduced species were also recorded during surveys, including Fox,

Brown Hare, Rabbit, and Common Myna. Table 8.3 details the number of each of these species surveyed.

Table 8.3 Fauna Species Recorded

Group	Introduced	Native	Total
Birds	4	53	57
Mammals	4	3	7
Frogs	-	8	8
Reptiles	-	3	3
Fish	1	1	2
Total	9	68	77

Source: Appendix C Ecological Assessment

8.3.13. Threatened Biodiversity and Migratory Species

Threatened Ecological Communities

Seventeen threatened ecological communities listed under the TSC Act and/or EPBC Act have been identified as having potential to occur within the locality. No threatened ecological communities listed under the *Fisheries Management Act 1994* (FM Act) have the potential to occur within the locality. Four threatened ecological communities listed under the TSC Act were recorded within the Study Area: Coastal Saltmarsh, Freshwater Wetlands, Swamp Oak Floodplain Forest and Swamp Sclerophyll Forest. No threatened ecological community listed under the EPBC Act or FM Act is present within the Study Area.

Endangered Populations

No Endangered populations listed under the TSC Act or FM Act occur within the Study Area.

Threatened Flora Species

A total of 20 threatened flora species listed under the TSC Act and/or EPBC Act are known or predicted to occur in the locality. While no threatened plant species were recorded in the Study Area, three threatened species of plant are considered moderately likely to occur based on the presence of potential habitat. These are:

- *Maundia triglochinoides* (Small Water Ribbons) is listed as Vulnerable under the TSC Act.
- *Persicaria elatior* (Tall Knotweed) is listed as Vulnerable under the both the TSC Act and the EPBC Act.
- *Zannichellia palustris* is listed as Endangered under the TSC Act.

The field surveys completed for the *Ecological Assessment (EA)* (PB 2011), were completed in accordance with *Draft Guidelines for Threatened Species Assessment* (DEC, 2005b), *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC, 2004) and *Principles for the Use of Biodiversity Offsets in NSW* (DECCW, 2008b). The timing of these surveys were specifically targeted to optimally cover the majority of threatened species' seasonal requirements, with surveys conducted during winter, mid- and late spring (5-6 September and 7-8 November) 2011, coinciding with access arrangements and environmental conditions following a wet winter. There is potential habitat for these species at the site.

Despite the fact that *Maundia triglochinoides*, *Persicaria elatior* and *Zannichellia palustris* were not recorded within the Study Area the EA used a precautionary approach in the assessment of these species, which were identified as having "moderate likelihood of occurrence" based on potential

habitat within the subject site. This assessment determined the project would not constitute a significant impact on the habitat of any of the three species.

Other threatened species known or predicted to occur in the locality are considered unlikely to occur in the Study Area for one or more of the following reasons:

- Preferred habitat not present;
- Outside known range of the species and habitat marginal; and
- Species is not cryptic and based on survey effort, would have been recorded if present.

Threatened Fauna Species

A total of 64 threatened species of animal listed under the TSC Act, FM Act and/or the EPBC Act have been recorded, or are predicted to have habitat in the locality. Two threatened species of animal, the Grey-headed Flying Fox and White-fronted Chat, were recorded in the Study Area during field surveys. A further two threatened species, the Black-necked Stork and Spotted Harrier, were also recorded during field surveys, although more distantly from the Study Area.

It is not likely, however, that all 64 species would be affected by the Proposal. Thirty-seven threatened species are considered to have a low likelihood of occurrence based on the availability of habitat.

Migratory Species

Three species of migratory bird; Eastern Great Egret, Cattle Egret and White-bellied Sea Eagle, were recorded in the Study Area during field surveys. A further 34 migratory species have the potential to occur in the locality based on the EPBC Protected Matters search, other database searches and experience and knowledge of the area.

Under the EPBC Act, an action is likely to have a significant impact on a migratory species if it substantially modifies, destroys or isolates an area of important habitat for the species. The Study Area encompasses two SEPP 14 wetlands, and impacts to these wetlands may affect the 25 migratory species that may potentially use this habitat. However, the proposed Project is not likely to modify, destroy or isolate an area of important habitat. As such, impacts of the proposed Project on Migratory species are not considered further.

Ramsar Wetlands

One Internationally important wetland, Hunter Estuary Wetlands (Ramsar site) is mapped in two areas in close proximity to the proposed Project Area. Kooragang Nature Reserve is mapped approximately 4 km to the east across the South Arm of the Hunter River, and the Shortland Wetlands occur approximately 5 km to the south of the proposed Project Area. This wetland is a 'declared Ramsar wetland' due to its significance to international migratory birds. The proposed Project is not likely to impact (including indirect impacts) these two areas due to their distance from the proposed Project Area.

The impact on Hunter Estuary Wetlands is not likely to be significant; however, given the proposed Project's proximity a referral to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) has been made.

SEPP 14 Wetlands

Two SEPP 14 wetlands have been mapped as occurring in the Study Area:

- Wetland 833 – located at approximate chainage 176,100 km in the north of the Study Area. This wetland occurs in an adjoining property and is part of the effluent treatment works. Historically, the wetland has been subjected to heavy grazing in the past and this is a disturbance that is ongoing. A portion of this wetland will be filled to accommodate the proposed rail lines and an access track.
- Wetland 840 – located at approximate chainage 173,800 km in the south of the Study Area. That portion of the wetland which occurs in the Study Area does not form part of the Hexham Swamp Nature Reserve. However, a large portion of this wetland (outside the Study Area) does

form part of the Hexham Swamp Nature Reserve. The proposed Project is not likely to significantly impact this SEPP 14 wetland; however, it is likely to change the surface and overland flows to a limited area of it.

8.4. Construction and Operational Impact Assessment

The proposed Project would have both direct and indirect impacts on biodiversity during both the construction and operation phases. Table 8.4a summarises these impacts.

Table 8.4a Potential Impacts on Biodiversity

Impacts	Construction	Operation
Vegetation/habitat clearing (including estuarine and aquatic habitats)	•	
Migratory species	•	•
Fragmentation and connectivity	•	
Noise impacts on fauna	•	•
Weed invasion	•	•
Increase in edge effects	•	
Hydrological changes	•	•
Fish passage	•	
Increased presence of Mosquitofish		•
Aquatic disturbance	•	•
Increase in fauna mortality	•	•
Increase in key threatening processes	•	•

Source: Appendix C Ecological Assessment

8.4.1. Vegetation and Habitat Clearing

Construction of the proposed Project would require the clearing of vegetation and habitats as summarised in Table 8.4b. This includes a loss of habitat features, although this would only be minor due to a general lack of fauna microhabitats recorded in the proposed Project Area.

Table 8.4b Potential loss of vegetation within the Proposal area

Vegetation community/fauna habitat	Extent within Study Area (ha)	Vegetation clearing (ha)
Vegetation		
Swamp Oak Swamp Forest Fringing Estuaries ¹	6.18	5.28
Swamp Mahogany Swamp Forest on Coastal Lowlands ¹	1.12	1.12
<i>Phragmites australis</i> and <i>Typha orientalis</i> Coastal Freshwater Wetlands ¹	3.46	2.70
Coastal Saltmarsh in Estuaries ¹	1.62	0
Exotic Grassland/Disturbed	35.56	25.55

Vegetation community/fauna habitat	Extent within Study Area (ha)	Vegetation clearing (ha)
Exotic Herbfield	9.29	3.70
Planted Vegetation	2.72	0.69
Total area of EEC clearing	12.37	9.10
Fauna habitats		
Swamp forest	10.01	7.10
Saltmarsh	1.62	0
Aquatic habitat	3.46	2.70
Cleared land	47.57	29.25

Notes: 1 - Endangered Ecological Community as listed under the *Threatened Species Conservation Act 1995*
Source: Appendix C Ecological Assessment

8.4.2. Fragmentation and Habitat Clearing

The proposed Project would result in the removal of approximately 7.10 ha of forest (including 6.40 ha of Swamp Forest EEC) occurring in the Project Area. Due to the linear nature of the proposed Project, the proposed Project Area would essentially encroach on vegetation at the interface of existing clearing and easements.

The vegetation in the Study Area is largely isolated and disturbed due to existing infrastructure such as the existing rail corridor, Pacific Highway and industrial developments. Patches of vegetation are also separated from other larger tracts by the south arm of the Hunter River. The proposed Project would not fragment or sever connectivity of habitats in the locality: rather, the proposed Project would add incrementally to those processes, which have previously fragmented the surrounding landscape. Over the full extent of the proposed Project Area, the proposed Project is not likely to further fragment or isolate vegetation any more than that currently occurring in the Study Area.

Although the Green and Golden Bell Frog was not recorded in the Study Area during field surveys, potential habitat was recorded therein, and this species has the potential to be affected by the incremental isolation of small wetlands in the proposed Project Area if it was found to be present.

8.4.3. Noise and Vibration Impacts on Fauna

While the construction phase may cause temporary disturbance to animals, the impacts from noise emissions are likely to be localised close to the proposed Project (up to 100 metres) and are not likely to have a significant, long-term impact on wildlife populations. During possessions, there would be additional noise during night time hours for the length of the possession which usually last for a few days. Operational noise in the proposed Project Area would be around the clock, although most would occur during the day. Regardless, very few nocturnal species are likely to use the area. The Study Area is already affected by train noise and industrial noise and the proposed Project would not add significantly to this.

Furthermore, it is considered likely that most animal species would habituate to periodic noise disturbance from regular maintenance activities and it is likely that surrounding industrial operations and existing rail operations would already have an impact on background levels of noise due to 24 hour operations.

8.4.4. Weeds

The proposed Project has the potential to further disperse weeds into areas of native vegetation within the Study Area, particularly adjacent to cleared areas. The existing rail corridor has a high level of weed invasion, particularly exotic grasses.

The most likely causes of weed dispersal associated with the proposed Project would include earthworks, movement of soil and attachment of seed (and other propagules) to vehicles and machinery.

Existing disturbed vegetation within the Study Area, however, has considerable weed growth already; therefore, the overall extent of weed invasion is not likely to increase significantly.

8.4.5. Edge Effects

Swamp forest vegetation occurring in the Study Area has been extensively cleared and is already highly fragmented and isolated from other areas of substantial vegetation. Due to the small size of native vegetation patches, the majority are likely to be completely subject to edge effects.

Estuarine and aquatic wetland communities occurring in the Study Area (including SEPP 14 Wetlands) are relatively well connected to similar habitat occurring in the Hexham Swamp Nature Reserve and floodplain. However these communities are highly disturbed and impacted upon by constructed channels and grazing. The sections of wetland that will be disturbed by the proposed Project do not hold intrinsically high environmental values due to disturbance. Thus, removal of these sections of the wetlands is not likely to result in a significant increase in edge effects to the wider wetland complexes.

As such the Proposal is unlikely to result in a significant increase in edge effects.

8.4.6. Hydrological Changes

While a number of freshwater wetlands occurred in the Study Area, most of these and their associated drainage lines have been modified as a result of agricultural practices and existing rail infrastructure. However, several of the freshwater wetlands, including SEPP 14 wetlands, will require infilling to accommodate the proposed rail infrastructure and access tracks. Any such works will require assessment of the drainage channels that have previously been constructed across the wetland complex and erosion and sediment control measures to minimise the impacts to the remaining wetlands and drainage lines within the vicinity of the works.

8.4.7. Aquatic Disturbance and Impacts on Fish Passage

The proposed Project will extend the existing box culvert approximately 70 m in length. The distance fish will be required to travel to enter the drainage line west of the proposed Project Area will increase greatly. However, this is unlikely to impact upon fish entering the culvert during tidal events. If the existing box culvert design is retained for the proposed Project it is unlikely that the assemblages of fish travelling through the culvert to the Study Area will change dramatically.

During construction, impacts from changes to the existing culvert structure could include short-term blockage to fish passage or long term blockage if fish-friendly design is not incorporated. Additionally, run-off from disturbed surfaces could potentially affect water quality in permanent and ephemeral wetlands due to sedimentation.

8.4.8. Increased Presence of Mosquitofish

Changes to the nature of drainage in the proposed Project Area have the potential to allow the Mosquitofish to extend its range further into the Hexham Swamp Reserve complex if flows from the proposed Project Area are not directed away from the wetland. The Swamp supports a number of native gudgeon species that have potential to be greatly impacted upon if the Mosquitofish were to widen its infiltration into the complex as a result of the proposed Project.

8.4.9. Potential Impacts on Groundwater Dependent Ecosystems

The proposed Project will not require extraction of groundwater from existing alluvial aquifers; however, the proposed Project will require the infilling of areas of *Phragmites australis* and *Typha australis* Coastal Freshwater Wetlands and removal of the Swamp Oak Swamp Forest Fringing Wetlands and Swamp Mahogany Swamp Forest on Coastal Lowlands which are all groundwater dependent ecosystems.

The proposed Project will result in the removal of 9.10 ha of groundwater dependent ecosystems (GDEs) within the Study Area, which is not in keeping with the five management principles of the NSW Groundwater Dependant Policy (Department of Land and Water Conservation, 2002). However, these ecosystems are highly disturbed, with the entire Study Area having previously been cleared in the early 1970s and a coal loader being operated at the site. The soil profile has been significantly altered due to the addition of fill from building sites and the existing rail corridor. The existing GDEs are highly disturbed and likely to be regrowth from previous clearing. Therefore the removal of a small area of these communities is unlikely to have significant impacts upon the GDEs in the locality or the wider region.

8.4.10. Direct Fauna Mortality

Fauna injury or death could occur as a result of the construction phase, when vegetation and habitats are being cleared. Fauna injury or mortality also have the potential to occur during operation of the rail corridor as a result of collision with survey/maintenance vehicles and through increased rail movements.

While some mobile species, such as birds, have the potential to move away from the path of clearing, other species that are less mobile, or those that are nocturnal, may have difficulty moving over relatively large distances. Threat-listed species that may be affected by vegetation clearing include microchiropteran bats and Green and Golden Bell Frog.

The proposed Project would increase the width of an existing linear rail corridor that effectively traverses a modified landscape. This would increase the distance and area for animals to cross and negotiate, increasing the risk of vehicle strikes.

In summary, it is unlikely that the Project would significantly increase direct fauna mortality, above that which would currently occur in the existing rail corridor.

8.4.11. Regional Conservation Planning

The Project, due to its location and the nature of the works proposed, will be consistent with, and not adversely impact on the LHRS, Lower Hunter Conservation Plan, CAP or the KWRP which includes the Hexham Swamp Rehabilitation Project. In particular, the Project includes a number of mitigation measures to address the Project's potential impacts to wetlands, including water quality, fish passage, erosion, pest species, weed species, etc (refer Section 8.5 of this EIS and Section 7 of **Appendix C Ecology**). These mitigation measures will further manage potential impacts of the Project on these rehabilitation projects, in particular the surrounding Hexham Swamp.

8.4.12. Key Threatening Processes

Key threatening processes are listed under Schedule 3 of the NSW TSC Act, NSW FM Act and also under the Commonwealth EPBC Act. Key threatening processes relevant to the Proposal are:

- Predation by the Plague Minnow (*Gambusia holbrooki*);
- Invasion, establishment and spread of *Lantana camara*;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants;
- Clearing of native vegetation;
- Human-caused climate change;

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands; and
- The degradation of native riparian vegetation along New South Wales water courses.

These are discussed on more detail in **Appendix C Ecology**.

8.4.13. Impact Assessment Guidelines

This section summarises the assessment of significance of the potential impacts following the requirements of the Section 5A of the EP&A Act 1979 and the EPBC Act.

For threat-listed biodiversity listed under the TSC Act, the DGRs have requested that impacts on threat-listed species, populations and communities be assessed against Section 5A of the EP&A Act with guidance from the *Threatened Species Assessment Guideline – The Assessment of Significance* (DEWHA, 2009b).

Significance assessments for these threat-listed ecological communities and threat-listed species concluded that the proposed Project is not likely to result in any significant impact due to the relatively small area (9.10 ha) of native vegetation communities likely to be affected and the existing disturbed nature of the proposed Project Area. A summary of the likely impacts on threatened biodiversity is presented in Table 8.4c.

Table 8.4c Summary of likely impacts to threatened biodiversity

Threatened biodiversity		TSC Act	EPBC Act	Threat-listed biodiversity recorded within the Study Area (Y/N)	Impacts	Fragmentation	Affect the lifecycle	Weeds/pest s/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
Threatened ecological communities											
Freshwater Wetlands		E	-	Yes	Yes, 2.70 ha would be cleared	Unlikely. Study Area already highly fragmented. Proposed Project unlikely to increase fragmentation.	N/A	Potential impact, however, mitigation measures will likelihood of weed spread.	N/A	No	No
Coastal Saltmarsh		E	-	Yes	No area will be cleared	No	N/A		N/A	No	No
Swamp Oak Floodplain Forest		E	-	Yes, dominant community within Study Area	Yes. 5.28 ha would be cleared	Unlikely. Study Area already highly fragmented. Proposed Project unlikely to increase fragmentation.	N/A	Potential impact, however, mitigation measures will likelihood of weed spread.	N/A	No	No
Swamp Sclerophyll Forest		E	-	Yes	Yes, 1.12 ha would be cleared	Unlikely. Study Area already highly fragmented. Proposed Project unlikely to increase fragmentation.	N/A	Potential impact, however, mitigation measures will likelihood of weed spread.	N/A	No	No
Flora											
Maundia triglochinoxides	Small Water	V		No	Yes, 2.70 ha potential habitat would be	Unlikely. Study Area already	No	Potential impact,	N/A	No	No

Threatened biodiversity		TSC Act	EPBC Act	Threat-listed biodiversity recorded within the Study Area (Y/N)	Impacts	Fragmentation	Affect the lifecycle	Weeds/pest s/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
	Ribbons				cleared. No critical habitat would be cleared.	highly fragmented. Proposed Project unlikely to increase fragmentation.		however, mitigation measures will decrease likelihood of weed spread.			
<i>Persicaria elatior</i>	Tall Knotweed	V	V	No	Yes, 3.82 ha potential habitat would be cleared. No critical habitat would be cleared.	Unlikely. Study Area already highly fragmented. Proposed Project unlikely to increase fragmentation.	No	Potential impact, however, mitigation measures would reduce likelihood of weed spread.	N/A	No	No
<i>Zannichellia palustris</i>	Horned Pondweed	V	-	No	Yes, 2.70 ha potential habitat would be cleared. No critical habitat would be cleared.	Unlikely. Study Area already highly fragmented. Proposed Project unlikely to increase fragmentation.	No	Potential impact, however, mitigation measures would reduce likelihood of weed spread.	N/A	No	No
Fauna											
Green and Golden Bell Frog		E	E	No	Yes, 2.70 ha of potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an	No	No	No	No	No

Threatened biodiversity		TSC Act	EPBC Act	Threat-listed biodiversity recorded within the Study Area (Y/N)	Impacts	Fragmentation	Affect the lifecycle	Weeds/pest s/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
						existing rail easement and will not fragment any new areas of habitat. The Study Area is already highly fragmented from important populations on Ash Island.					
Threat-listed aquatic birds (Australian Painted Snipe, Australasian Bittern, Black Bittern, Black-necked Stork and Magpie Goose)		E/V	E/V	Yes. Black-necked Stork	Yes, 9.10 ha of known and potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat.	No	No	Yes. Increased rail traffic likely to increase timing and duration of noise impacts.	No	No
Threat-listed raptors (Little Eagle and Spotted Harrier)		V	-	Yes. Spotted Harrier	Yes, 9.10 ha of known and potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat.	No	No	Yes. Increased rail traffic likely to increase timing and duration of noise impacts.	No	No
Grass Owl		V	-	No	Yes, 9.10 ha of potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any	No	No	Yes. Increased rail traffic likely to increase timing and duration of noise	No	No

Threatened biodiversity		TSC Act	EPBC Act	Threat-listed biodiversity recorded within the Study Area (Y/N)	Impacts	Fragmentation	Affect the lifecycle	Weeds/pest s/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
						new areas of habitat.			impacts.		
Threat-listed opportunistic blossom nomads (Swift Parrot, Little Lorikeet and Grey-headed Flying-fox)		E/V	E/V	Yes. Grey-headed Flying-fox	Yes, 1.12 ha of known and potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat.	No	No	No	No	No
Microchiropteran bats (Eastern False Pipistrelle, East-coast Freetail Bat, Yellow-bellied Sheath-tail Bat, Greater Broad-nosed Bat, Little Bent-wing Bat, Eastern Bent-wing Bat, Large-footed Myotis)		V	-	No	Yes, 9.10 ha of potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat.	No	No	No	No	No
Varied Sittella		V	-	No	Yes, 6.40 ha of potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat.	No	No	No	No	No
White-fronted Chat		V	-	Yes	Yes, 9.10 ha of known habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will	No	No	Yes. Increased rail traffic likely to increase timing and duration of	No	No

Threatened biodiversity		TSC Act	EPBC Act	Threat-listed biodiversity recorded within the Study Area (Y/N)	Impacts	Fragmentation	Affect the lifecycle	Weeds/pest s/disease	Noise	Change to current disturbance regimes	Likely to be significantly affected
Scientific name	Common name				Habitat clearing						
						not fragment any new areas of habitat.			noise impacts.		
Waders (Great Knot, Greater Sand Plover, Lesser Sand Plover, Broad-billed Sandpiper and Black-tailed Godwit)		V	-	No	Yes, 2.70 ha of potential habitat would be impacted.	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat	No	No	Yes. Increased rail traffic likely to increase timing and duration of noise impacts.	No	No
Red-backed Button Quail		V	-	No	Yes	No. The Proposed Project will effectively add incrementally to the width of an existing rail easement and will not fragment any new areas of habitat	No	No	Yes. Increased rail traffic likely to increase timing and duration of noise impacts.	No	No

Notes:

1) TSC Act - *Threatened Species and Conservation Act 1995*. CE = Critically Endangered, E1 = Endangered V = Vulnerable E2= Endangered Population.

2) EPBC Act - *Environmental Protection and Biodiversity Conservation Act 1999*. CE = Critically Endangered, E = Endangered V = Vulnerable.

8.5. Mitigation and Management Measures

Table 8.5 summarises the mitigation and management measures which would be implemented to reduce the identified impacts on ecology.

Table 8.5 Summary of ecological mitigation and management measures

Impact	Mitigation
General	- Provide all workers with environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity, and penalties for breaches. - Prepare a flora and fauna management plan as part of the CEMP.
Vegetation and Habitat Loss	- Limit disturbance of vegetation to the minimum necessary to construct works. - Implement clearing protocols, including: - Marking trees to be removed and preparing an inventory of trees and hollows (if observed) to be removed. - Pre-clearance surveys to be completed by an appropriately qualified ecologist, particularly for the Green and Golden Bell Frog. - Check trees for the presence of bird nests and potentially arboreal mammals, prior to felling. - As far as practicable, animals found to be occupying trees would be allowed to leave before clearing. - Where practicable, restrict equipment storage and stockpiling of resources to designated areas in cleared land.
Weeds	- Develop weed management actions to manage weeds during the construction phase of the proposed Project. This will include the management of exotic perennial grasses, such as <i>Chloris gayana</i>*, <i>Melinis repens</i> * that were recorded abundantly within the existing rail corridor and adjacent lands, and the seven noxious weeds of <i>Alternanthera philoxeroides</i>*, <i>Ageratina adenophora</i>*, <i>Cestrum parqui</i>*, <i>Cortaderia selloana</i>*, <i>Echium plantagineum</i>*, <i>Rubus fruticosus</i>* and <i>Lantana camara</i>* as per the Noxious Weeds Act 1993. - Where practicable, vehicles and other equipment to be used during clearing phases in the construction zone and general construction equipment (such as excavators, graders etc.) are to be visibly free of soil, seeds and plant material before entering the site to prevent the introduction of further exotic plant species and pathogens.
Aquatic Disturbance	- Minimise the clearing of freshwater wetlands, coastal saltmarsh and mangroves to that which is absolutely necessary for the safe construction and operation of the proposed Project. - Incorporate existing drainage channels into design of proposed Project drainage channels where practicable. - Where required, install high visibility signs at freshwater wetland and coastal saltmarsh sites occurring outside the proposed Project Area, to inform workers of no go areas. This is particularly important during spring and summer when migratory shorebirds and waders use such habitats. - Erosion and sediment controls should be implemented in accordance with the Blue Book (Department of Environment and Climate Change 2008c). - Where practicable undertake channel works affected by tidal flow during low or ebb tides. - Develop an Acid Sulfate Soils Management Plan for construction works. - Should additional waterway crossings be required, design in accordance with the DPI's fish passage requirements (Fairfull & Witheridge 2003). Retain the double box culvert design of the existing culvert. - Control and manage potential contaminants (fuels, oils, lubricants) from construction activities.
Residual Impacts	Develop an offset strategies to mitigate the residual impacts. This will fulfill the need to improve or maintain as required in the <i>Principles for the use of biodiversity offsets in NSW</i>.

Impact	Mitigation
Cumulative Impacts from proposed Project and QR National Project	- Erosion and sediment control measures including erosion and sediment control plans. - Control and management of contaminants (fuels, oils and chemicals) during construction and throughout life of the proposed Project. - Pre-clearance surveys to be undertaken by an ecologist- particularly for endangered species such as Green and Golden Bell Frogs. - All workers to complete an environmental induction prior to work commencement. - Limit disturbance and implement clearing protocols. - Minimise clearing of habitats aquatic and terrestrial, where possible. - All discharges to be guided by ANZECC/ARMCANZ guidelines. - Develop offset strategies to mitigate residual effects.

8.6. Approach to Achieving the Biodiversity Offset

Potential offsets for the proposed Project are being investigated. These would be developed in accordance with the *Principles for the use of biodiversity offsets in NSW* (DECC 2008b) provided at **Appendix C Ecology**.

8.7. Cumulative Assessment

One other known rail expansion project is proposed to occur in the vicinity of the proposed Project which will result in a larger area of cleared vegetation and contribute to habitat fragmentation. This project immediately adjoins the proposed Project and comprises a train support facility. As part of this cumulative impact assessment, the QR National 2008 Environmental Assessment Report (ADW Johnson Pty Limited 2008) has been reviewed so that the impacts of the proposed rail expansion project can be assessed with the proposed Project.

The cumulative impact of the two projects is examined in Table 8.7 which compares the extent of clearing and the expected impact to the surrounding environment.

Table 8.7 Cumulative potential loss of vegetation for QR National project and the proposed Project

Vegetation community/Fauna habitat	Hexham Relief Roads (HRR) Project clearing (ha)	QR National Train Support Facility (TSF) project impacted area (ha)	Cumulative area cleared (ha)	Area of vegetation within locality- 10km radius ² (ha)	Cumulative impact within locality (%)
Vegetation					
Swamp Oak Swamp Forest Fringing Estuaries ¹	5.28	5.52	10.80	582.91	1.9
Swamp Mahogany Swamp Forest on Coastal Lowlands ¹	1.12		1.12	569.61	0.19
<i>Phragmites australis</i> and <i>Typha orientalis</i> Coastal Freshwater Wetlands ¹	2.70	8.1	10.80	2984.48	0.36
Coastal Saltmarsh in Estuaries ¹	0	0.03	0.03	2091.01	>0.00
Exotic Grassland/Disturbed	25.55		25.55		

Vegetation community/Fauna habitat	Hexham Relief Roads (HRR) Project clearing (ha)	QR National Train Support Facility (TSF) project impacted area (ha)	Cumulative area cleared (ha)	Area of vegetation within locality-10km radius ² (ha)	Cumulative impact within locality (%)
Exotic Herbfield	3.70		3.70		
Planted Vegetation	0.69		0.69		
Total	39.05	13.65	52.70	6228.01	8.46
Total area of EEC	9.10	13.65	22.75	6228.01	3.65

Notes: 1 - Endangered Ecological Community as listed under the *Threatened Species Conservation Act 1995*

2 - According to the LHCCREMS regional vegetation mapping {Lower Hunter and Central Coast Regional Environmental Management Strategy, 2000 #344}

The cumulative impact of the proposed Project and the proposed QR National project is expected to have a negligible impact on the region's biodiversity. Less than 4 % of the localities' total EEC area is expected to be removed cumulatively as a result of the two projects assessed.

Additional mitigation measures are listed in Section 8.5.

9. Noise and Vibration

A detailed assessment of noise and vibration has been carried out and is summarised in this chapter and provided in full in **Appendix D Noise and Vibration**. Table 9a outlines the DGRs relevant to noise and vibration and where they have been addressed.

Table 9a Director-General's Environmental Assessment Requirements - Noise and Vibration

Director-General's Environmental Assessment Requirements	Location address
Noise and Vibration – including but not limited to: - noise and vibration from activities and sources on and off site (including to adjacent settlements), and the nature, sensitivity and impacts to potentially affected receivers and structures; - the noise assessment must consider the impact from the project in isolation and in a cumulative context; and - taking into account the Interim Construction Noise Guideline (DECC, 2009), Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects (DECCW, 2007), and Assessing Vibration: a Technical Guideline (DEC, 2006).	Sections 9.2 and 9.3 of this chapter Sections 9.3 and 9.4 of this chapter Section 9.1 of this chapter

9.1. Methodology

The assessment was undertaken in accordance with the following NSW Government guidelines:

- Interim Guidelines for the Assessment of Noise from Rail Infrastructure Projects (IGANRIP);
- Interim Construction Noise Guidelines (ICNG);
- Assessing Vibration: A Technical Guideline; and
- Environmental Criteria for Road Traffic Noise (ECRTN).

The scope of the noise and vibration study was to assess potential noise impacts associated with the operation and construction of the proposed Project. The assessment included:

- a baseline noise survey to quantify the existing noise environment at nearest residential and other noise sensitive receivers in Hexham;
- measurement of existing rail noise from passenger and freight operations on the Main Line at Hexham;
- establishing conservative noise and vibration goals for the assessment of potential impacts during the construction and operation of the proposed Project;
- assessment of potential noise and ground vibration impacts from the operation of the proposed Project for the year of opening in 2014 and for the year 2024 indicative of typical future rail traffic usage;
- assessment of potential airborne noise and ground vibration impacts from the construction of the proposed Project;
- the recommendation of a range of feasible, reasonable and practicable measures to reduce and control potential noise and vibration levels where predicted impacts trigger the adopted noise and vibration goals; and
- consideration of cumulative noise and vibration impacts where the proposed Project is constructed and operated simultaneous with adjacent QR National TSF development.

9.1.1. Noise Criteria

Construction Noise

Construction noise is assessed with consideration to DECCW's Interim Construction Noise Guidelines (ICNG) (DECC, 2009a). The ICNG recommends the following standard hours for construction:

- Monday to Friday 7am to 6pm;
- Saturday 8am to 1pm; and
- No works on Sundays or public holidays with the exception of works indicated in Section 4.5.4.

Table 9.1a provides the ICNG criteria for construction noise at residential receivers. The criteria are determined based on the existing at nearby residential locations. As discussed in Section 9.2.2, the L_{A90} is used to derive the RBL for this assessment.

Table 9.1a ICNG construction noise criteria at residential receivers

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

Note: All noise levels in dB(A), to nearest 1 dB(A)

RBL = Rating Background Noise Level dB(A)

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Referencing the long term RBL's (Table 9.2b), measured at nearest residences to the Proposal, construction Noise Management Levels (NML's) shown in bold in Table 9.1b have been established for standard day time works and outside of standard day time construction hours.

Table 9.1b Adopted construction noise management levels for residences

Receiver Locations	RBL L_{A90} dB(A)		Management level $L_{Aeq}(15 \text{ min})$	
	Standard daytime hours (7am-6pm)	Outside of standard hours (6pm-7am)	Standard daytime hours (7am-6pm)	Outside of standard hours (6pm-7am)
Old Maitland Road Monitoring Location A	43	47	53	52
Woodlands Close Monitoring Location B	61	50	71	55
Clark Street, Merchant Street, Fenwick Street Monitoring Location C	48	42	58	47
All residences	-	-	75	75

Note: All noise levels in dB(A), to nearest 1 dB(A)

RBL = Rating Background Noise Level dB(A)

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

L_{A90} = A-weighted sound pressure level exceeded for 90% of the time (background)

Construction NML's have been established for the following non-residential noise sensitive land use in Hexham:

- Church on Old Maitland Road – 45 dB(A) $L_{Aeq, 15min}$ (internal);
- Foreshore Reserve and Hexham Park – 60 dB(A) $L_{Aeq, 15min}$;
- Hexham Bowling Club - 65 dB(A) $L_{Aeq, 15min}$; and
- Commercial premises – 70 dB(A) $L_{Aeq, 15min}$.

Operational Noise

DECCW's *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (IGANRIP) (DECCW, 2007b) provides guidance for the assessment of noise from rail infrastructure. IGANRIP specifies 'trigger levels', which are "non mandatory targets that can be used to initiate an assessment of noise impacts and consideration of feasible and reasonable mitigation measures". The noise triggers do not apply to noise impacts from existing rail operations.

Nearest residential receivers in the proposed Project are currently exposed to rail noise levels greater than the new rail line development noise triggers in Table 9.1d. The Proposed Project will be assessed as a redeveloped rail line with the exception of those residences where existing rail noise levels are below the new rail development triggers; these receivers will be assessed as a new rail development.

Table 9.1c details adopted residential receiver day time and night time airborne rail noise triggers for all rail traffic.

Exceedance of these trigger levels must occur to initiate an assessment of rail noise impacts and the investigation of mitigation measures.

Table 9.1c IGANRIP noise trigger levels for residential land uses

Type of Development	Noise trigger levels dB(A)		Comment
	Day (0700-2200)	Night (2200-0700)	
New rail development	Development increases existing rail noise and resulting noise levels exceed:		These numbers represent external levels of noise that trigger the need for an assessment of the potential noise impacts from a rail infrastructure project.
	60 $L_{Aeq(15h)}$	55 $L_{Aeq(9h)}$	
	80 L_{Amax}	80 L_{Amax}	
Redevelopment of existing rail line	Development increases existing rail noise and resulting noise levels exceed:		An 'increase' in existing rail noise levels is taken to be an increase of 2 dB(A) or more in L_{Aeq} in any hour or an increase of 3 dB(A) or more in L_{Amax} .
	65 $L_{Aeq(15h)}$	60 $L_{Aeq(9h)}$	
	85 L_{Amax}	85 L_{Amax}	

Source: Extract of Table 1, DECCW, 2007

Based on a desktop review of local land use, rail noise triggers have been adopted for the following non-residential noise sensitive land uses in Hexham:

- Church on Old Maitland Road – 45 dB(A) $L_{Aeq, 1hr}$ (internal);
- Foreshore Reserve and Hexham Park – 65 dB(A) $L_{Aeq, 15hr}$; and
- Hexham Bowling Club - 65 dB(A) $L_{Aeq, 15hr}$.

The IGANRIP does not provide noise goals for commercial receivers; a noise goal of 65dB(A) L_{Aeq} has been applied for the assessment of rail noise impacts at the nearest commercial land use.

Road Traffic Noise

The DGRs for the Hexham Relief Roads Project require road traffic noise to be assessed in accordance with the NSW OEH (formerly Environmental Protection Authority) *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999).

Proposed light and heavy vehicle movements during construction and operation phases would arrive/depart on a new road connecting Woodlands Close to the Tarro Interchange.

At the nearest residence on Woodlands Close, noise monitoring Location B, existing day time noise levels of 70 dB(A) L_{Aeq} are dominated by road traffic noise from the New England Highway. The road traffic noise level exceeds the ECRTN day time noise goal of 60 dB(A) $L_{Aeq,15hr}$ for developments with potential to increase noise on existing freeways.

Therefore, consistent with ECRTN guidance, the Proposed Project should not increase road traffic noise by greater than 2 dB(A); a 67 dB(A) L_{Aeq} road traffic noise goal applies for the influence of the Proposed Project to control total road traffic noise on the New England Highway.

Adopting ECRTN guidance for developments with potential to create additional traffic on local road; noise from traffic on the access road on Tarro Interchange and Woodlands Close should not exceed an ECRTN noise goal of 55 dB(A) $L_{Aeq,1hour}$ at nearest residences.

Vibration for Construction and Operation

Vibration during rail pass-by and construction works are considered intermittent sources associated with two main types of impact; disturbance at receivers and potential cosmetic structural damage to buildings. Generally, if disturbance issues are controlled, there is limited potential for structural damage to buildings.

The IGANRIP and ICNG guidelines adopt the OEH (formerly Department of Environment and Conservation) *Environmental Noise Management Assessing Vibration: a technical guideline* (ENM) (DEC, 2006) for the assessment of ground vibration. The guideline references annoyance Vibration Dose Value (VDV) goals for residential receivers from British Standard 6472.

The VDV goals for intermittent vibration are detailed in Table 9.1d.

Table 9.1d Adopted annoyance vibration goals for construction and rail pass-by

Receiver	Day time annoyance VDV goal $m/s^{1.75}$		Night time annoyance VDV goal $m/s^{1.75}$	
	Preferred	Maximum	Preferred	Maximum
Residential	0.2	0.4	0.13	0.26
Schools, educational institutions and places of worship	0.4	0.8	0.4	0.8
Workshops, commercial premises	0.8	1.6	0.8	1.6

Note: VDV = vibration dose value
Day time = 7am to 10pm,
Night time = 10pm to 7am

The structural Peak Particle Velocity (PPV) vibration goals for residential and other vibration sensitive land use are detailed in Table 9.1e and referenced from German Standard DIN 4150. The existing Hexham Station is defined as a structure particularly sensitive to vibration. It is of historical value.

Table 9.1e Adopted structural vibration goals for construction and rail pass-by

Type of Structure	Peak Particle Velocity in mm/s		
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz
Residential property and buildings of similar occupancy	5	5 at 10 Hz 15 at 50 Hz	15 at 50 Hz 20 at 100 Hz
Buildings used for commercial purposes, industrial buildings	20	20 at 10 Hz 40 at 50 Hz	40 at 50 Hz 50 at 100 Hz
Structures particular sensitivity to vibration and are of intrinsic value	3	3 at 10 Hz 8 at 50 Hz	8 at 50 Hz 10 at 100 Hz

Note: Vibration levels are assessed at the foundation of the building or structure

9.2. Existing Environment

9.2.1. Sensitive Receiver Locations

The environment surrounding the rail corridor and proposed Project site is mixed residential, commercial and agricultural/green field (unoccupied) land uses.

The nearest residential properties to the proposed Project are located off the Pacific Highway on Clark Street, Merchant Street and Fenwick Street. To the east of the Pacific Highway residential receivers and a church are located on Old Maitland Road and there are discrete residences on Woodlands Close.

Commercial and light industrial premises, including operations for refrigerated storage and scrap metal handling are located on the New England Highway and off Old Maitland Road.

Recreational land is located at Hexham Park and Foreshore Reserve with the Hexham Bowling Club located off the New England Highway.

A summary of sensitive receivers and their distance from the proposed Project is provided in table 9.2a.

Table 9.2a Nearest noise sensitive receivers to the proposed Project

Receiver Location	Separation Distance from the Proposal to Nearest Receivers
Clark Street	30 metres to residences
Merchant Street	205 metres to residences
Fenwick Street	320 metres to residences
Woodlands Close	750 meters to receivers on Woodlands Close. The site access road from the Tarro Interchange will be 30 metres from nearest residences on Woodlands Close
Old Maitland Road	290 meters to nearest residences 225 meters to the church at 61 Old Maitland Road 90 meters to Hexham Bowling Club
Pacific Highway	50 metres to nearest commercial land use

Note: Noise sensitive receivers include residential dwellings, places of worship, education institutions, child care centres, aged care homes and hospitals

9.2.2. Ambient Noise

Baseline surveys of ambient noise levels were undertaken in August 2011 and April 2012 to characterise the noise environment and determine existing rail noise levels at the nearest receivers to the Proposed Project.

Monitoring of ambient noise levels was conducted at locations shown in Figure 9.2a. These locations are considered to be representative of the surrounding residential and commercial receivers (receivers assessed are shown in Figure 9.2b). The monitoring sites were selected after an initial site inspection to determine locations where background noise levels were conservative (lowest) and a monitoring site where Main Line noise was clearly audible.

The unattended noise levels measured at each monitoring location are detailed in Table 9.2b. Attended noise level results and daily logged noise levels can be found in **Appendix D Noise and Vibration**.

The measured L_{Aeq} noise levels are a statistically averaged noise level accounting for all noise events at the noise monitoring location.

The Rating Background Noise Level (RBL) is the median measured L_{A90} noise level for each period. The L_{A90} noise descriptor is less sensitive to short term and peak noise events than the L_{Aeq} and is applied as a conservative measurement of the existing noise environment.

Table 9.2b Unattended noise monitoring results

Location	Median measured noise level, dB(A)					
	Day 7am-6pm		Evening 6pm-10pm		Night 10pm-7am	
	RBL	L_{Aeq}	RBL	L_{Aeq}	RBL	L_{Aeq}
A 65 Old Maitland Road	43	60	47	64	48	65
B 1 Woodlands Close	61	70	58	68	50	67
C Clark Street	48	65	46	64	42	64
D Adjacent to rail line off Woodlands Close	54	68	54	67	45	67

Note: All noise levels in dB(A) to nearest decibel

RBL = noise level is representative of the average minimum L_{A90}

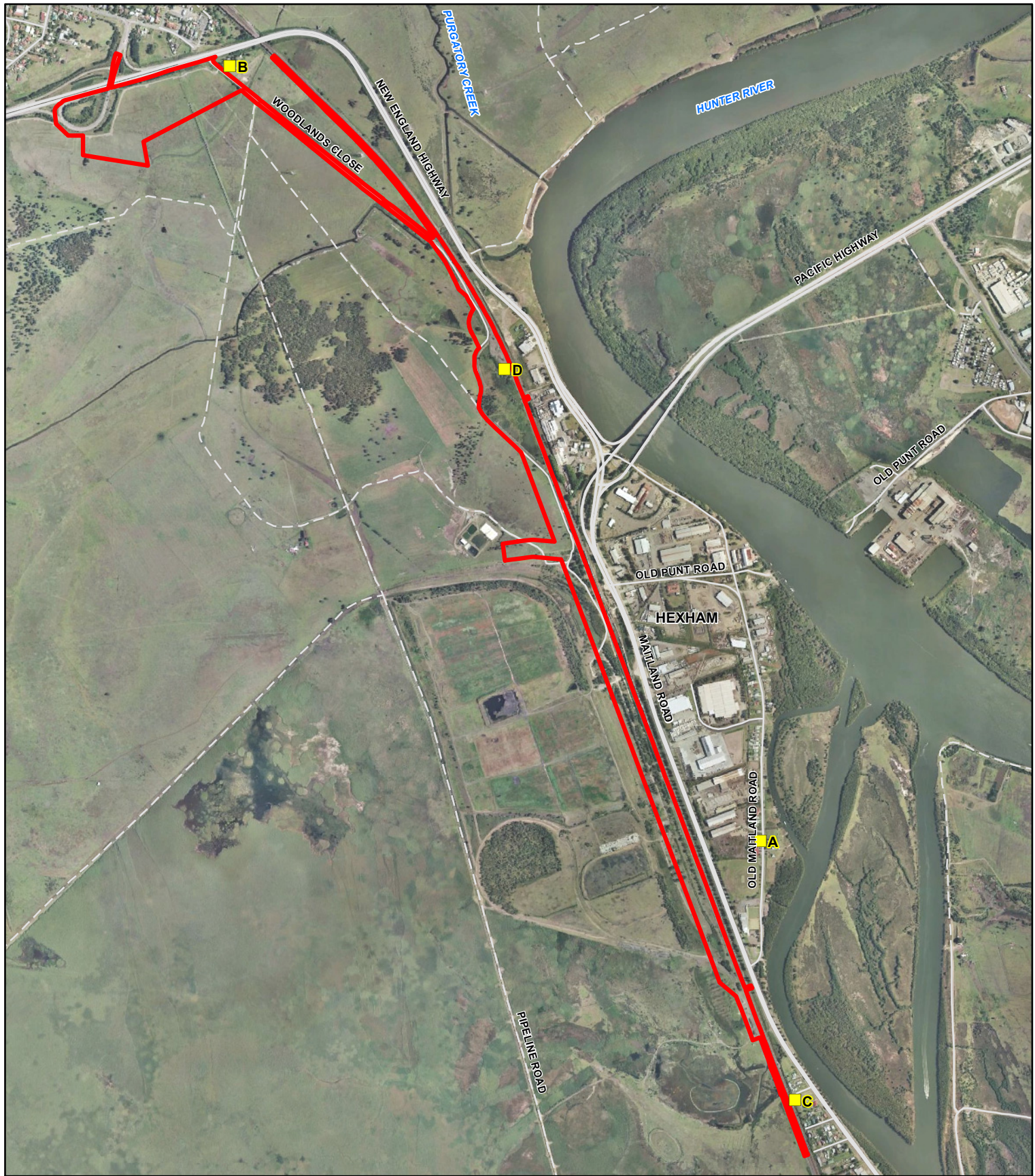
L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

The measured noise levels at Old Maitland Road (Location A) were influenced by local road traffic noise and distant rail noise operations. Based on site observations, road traffic on Old Maitland Road was increased from the day time during the evening, accounting for the higher measured evening noise levels. Night time period noise levels are likely to have been influenced by fauna within the surrounding bushland and marshland.

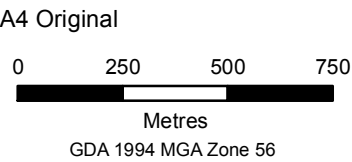
At Woodlands Close (Location B), the noise environment was influenced by road traffic noise from the Pacific Highway and passenger and freight rail operations.

At Clark Street (Location C), measured noise levels were influenced by the New England Highway and followed typical diurnal patterns where noise levels are reduced during the evening and night time.

The monitoring location at Woodlands Close (Location D) is adjacent to the rail line and established to quantify existing rail noise levels. The measured noise levels were dominated by existing freight and passenger rail operations.

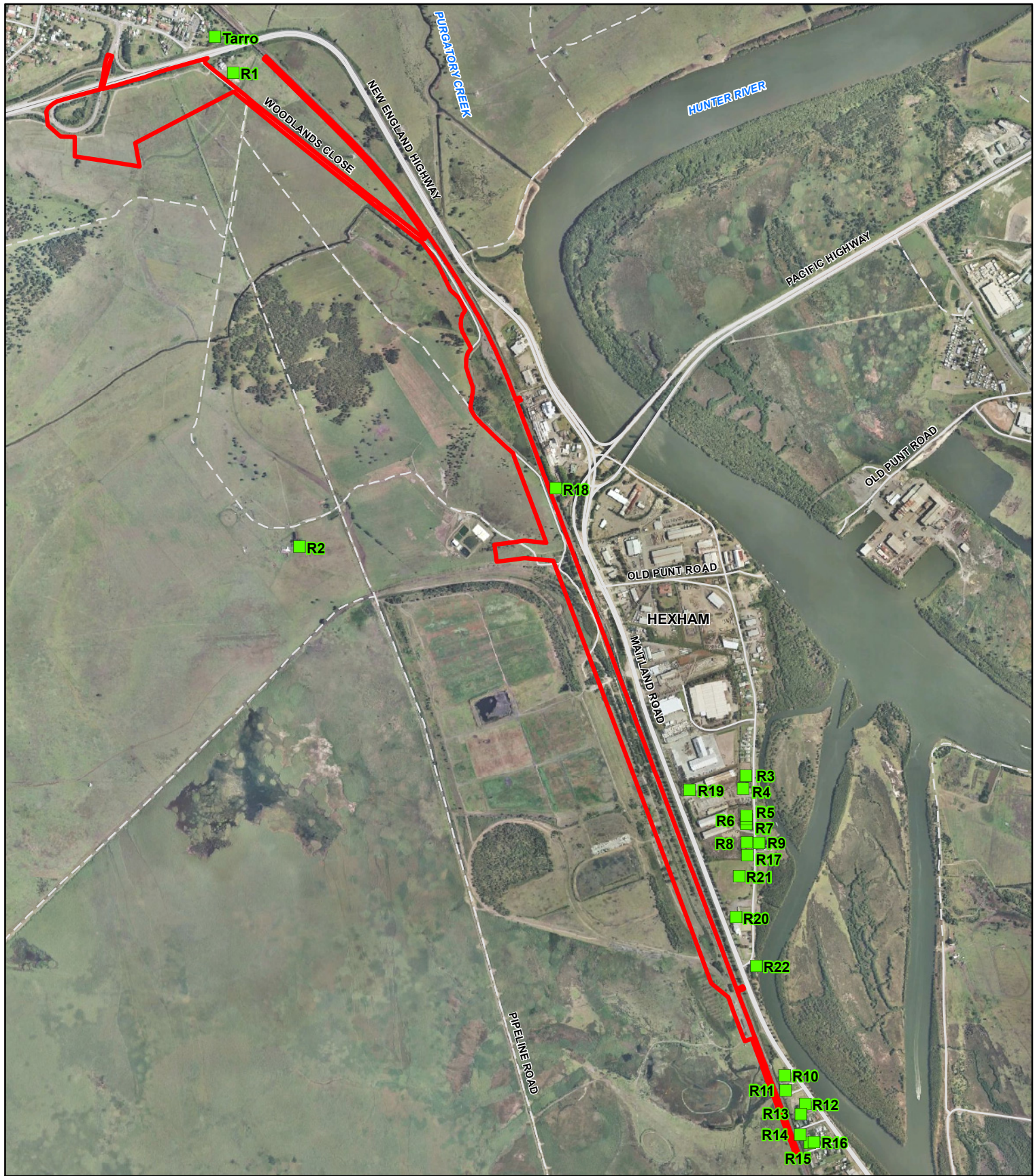


- Noise Monitoring Location
- Major Road
- Local Road
- Minor Road
- Project Area

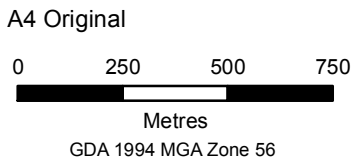


ARTC Hexham Relief Roads Noise Monitoring Locations	Job Number	2110501B
	Revision	A1
	Date	01.05.2012
	Scale	1:18,000

Figure 9.2a



- Assessed Receiver Location
- Major Road
- Local Road
- Minor Road
- ▬ Project Area



ARTC
Hexham Relief Roads

Assessed Receiver Location

Job Number	2110501B
Revision	A2
Date	01.05.2012
Scale	1:18,000

Figure 9.2b

The RBLs at Location A, Location B and Location C have been applied to establish construction noise management levels for residential and other noise sensitive receivers.

9.2.3. Existing Rail Noise Levels at Hexham

At Location D, off Woodlands Close (refer Figure 9.2a) the Sound Acquisition Logger was located 10 metres from the rail corridor to continuously measure rail noise levels over 1 second intervals and recorded actual noise levels.

ARTC operational rail movements were reviewed to confirm the adopted monitoring period was representative of normal daily passenger and freight operations at Hexham.

Table 9.2c details the measured daytime and night time L_{Aeq} total rail noise levels (passenger and freight) on the rail lines, as well as the measured 95th percentile maximum (L_{Amax}) rail noise levels.

The measured noise levels are representative of all rail noise events from locomotives, acceleration and deceleration, wheel squeal, horn blast, wagon bunching and wheel flat spots/ rail corrugation during pass through and stopping rail services. All non-rail noise events have been excluded from the noise levels.

Table 9.2c Measured existing and maximum rail noise levels at Hexham

Location	Date	Rail Pass by Events				Rail L_{Aeq} Period dB(A)		L_{Amax} Noise Level dB(A)	
		Freight (inc. Coal)		Passenger		Day	Night	Day	Night
		Day	Night	Day	Night				
D Adjacent to rail line off Woodlands Close	25/08/11	63	34	43	9	69	65	88	96
	26/08/11	55	25	40	9	66	65	87	91

Notes: Values expressed as A-weighted decibel and rounded to nearest decibel

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

L_{Amax} = maximum rail noise event during the monitoring period

Day = 7am to 10pm

Night = 10pm to 7am

9.3. Potential Impacts

9.3.1. Operational Noise Assessment

Operational noise from the Proposal has been assessed in accordance with IGANRIP (DECCW, 2007). The first stage of this assessment is to determine if the IGANRIP trigger levels outlined in Table 9.1c have been exceeded. If these levels are exceeded, it is then necessary to conduct a full assessment of reasonable and feasible mitigation measures.

Figure 9.2a details the receivers adopted in the predictive assessment of potential worst case (highest) rail noise impacts from the proposed Project.

The prediction of rail noise levels has applied the NORDIC Rail Prediction Method as recommended by IGANRIP. The Nordic model calculates L_{Aeq} and L_{Amax} rail noise levels, required for the assessment of rail noise planning objectives.

The receiver locations are representative of the nearest residences, places of worship, recreational land use and commercial premises to the proposed Project. Where predicted noise impacts at the assessed receivers comply with the adopted noise goals, compliance would be expected at all other receivers in Hexham.

Table 9.3a details the total passenger and freight movements on the Up and Down lines at Hexham for year of operation (2014) and 10 years post Project opening (2024).

The train movements have been directly applied in the assessment of existing and future rail noise from the proposed Project and the Main Line.

Table 9.3a Day and night time rail movements for 2014 and 2024

Train Type	2014 (year of operation)			2024 (10 years post operation)		
	Day	Night	Total	Day	Night	Total
Coal freight	59	39	98	140	84	224
Non-coal freight	10	7	17	18	11	29
Passenger	63	42	105	66	39	105

Note: Source ARTC April 2012
Day = 7am to 10pm;
Night = 10pm to 7am

Predicted Noise Impacts from the Proposed Project

Potential rail noise levels have been predicted for the proposed Project in 2014 (year of operation) and in 2024 (future operations).

To determine potential changes in rail noise levels with the proposed Project, predicted noise levels have also been assessed to existing (2012) and future existing (2024) rail noise levels which assume the proposed Project is not built.

Main Line noise levels include passenger and non-coal freight operations on the Up and Down Main Lines. Coal line noise levels include Up and Down Coal Line operations. Relief Road predictions are for idling trains on four relief roads and a manoeuvring train on the remaining relief road.

Based on the predicted existing rail noise levels receivers R1 to R9 (inclusive) and receiver R16 have been assessed to the new rail development noise trigger. All other residences have been assessed for a redeveloped rail line.

Predicted rail noise levels for the proposed Project opening in 2014 are detailed in Table 9.3b day time (7am – 10pm), Table 9.3c night time (10pm – 7am) and Table 9.3d (maximum). Predicted rail noise levels for the proposed Project future operation 2024 are detailed in Table 9.3e day time (7am – 10pm), Table 9.3f night time (10pm – 7am) and Table 9.3d (maximum).

Table 9.3b Predicted day time 15-hour LAeq noise levels for proposed Project opening (2014)

Receiver	Existing rail	With the Relief Roads Project				IGANRIP noise triggers	
		Main lines	Coal lines	Relief Roads	Total	Base trigger	Change from existing
Residential IGANRIP triggers; 60 dB(A) $L_{Aeq,15hr}$ at R2, 65 dB(A) $L_{Aeq,15hr}$ at all other residences							
R1 Woodlands Close	55	49	53	36	54	No	-1
R2 off Woodlands Close	47	42	45	43	49	No	2
R3 Old Maitland Road	50	45	48	46	51	No	1
R4 Old Maitland Road	53	48	50	47	53	No	0
R5 Old Maitland Road	52	47	49	49	53	No	1
R6 Old Maitland Road	52	47	49	49	53	No	1
R7 Old Maitland Road	52	47	50	50	54	No	2
R8 Old Maitland Road	54	49	51	54	56	No	2
R9 Old Maitland Road	52	46	49	50	54	No	2
R10 Clark Street	62	56	59	41	61	No	-1
R11 Clark Street	63	57	60	40	62	No	-1
R12 Merchant Street	58	51	55	39	56	No	-2
R13 Merchant Street	60	53	57	39	59	No	-1
R14 Merchant Street	64	59	61	38	63	No	-1
R15 Fenwick Street	57	51	55	38	56	No	-1
R16 Fenwick Street	55	49	53	41	55	No	0
Other noise sensitive IGANRIP external noise triggers; Place of worship 55 dB(A) $L_{Aeq,1hr}$; Commercial, passive and active recreation areas 65 dB(A) $L_{Aeq,15hr}$							
R17 Old Church on Maitland Road	54	49	52	54	57	Yes	3
R18 Commercial	67	64	62	62	67	Yes	0
R19 Commercial	59	55	56	51	59	No	0
R20 Hexham Bowling Club	59	54	55	56	60	No	1
R21 Hexham Park	56	51	53	59	60	No	4
R22 Foreshore Reserve	56	51	53	49	56	No	0

Notes: Values expressed as A-weighted dB and rounded to nearest dB(A);

 L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Table 9.3c Predicted night time 9-hour L_{Aeq} noise levels for proposed Project opening (2014)

Receiver	Existing rail	With the Relief Roads Project				IGANRIP noise triggers	
		Main lines	Coal lines	Relief Roads	Total	Base trigger	Change from existing
Residential IGANRIP triggers; 55 dB(A) $L_{Aeq,15hr}$ at R2, 60 dB(A) $L_{Aeq,15hr}$ at all other residences							
R1 Woodlands Close	54	48	53	36	54	No	0
R2 off Woodlands Close	46	42	45	43	48	No	2
R3 Old Maitland Road	49	44	46	46	50	No	1
R4 Old Maitland Road	52	47	49	47	52	No	0
R5 Old Maitland Road	51	46	48	49	53	No	2
R6 Old Maitland Road	51	46	48	49	53	No	2
R7 Old Maitland Road	51	47	49	50	53	No	2
R8 Old Maitland Road	53	48	50	53	55	No	2
R9 Old Maitland Road	51	46	48	50	53	No	2
R10 Clark Street	61	55	58	41	60	No	-1
R11 Clark Street	62	56	59	40	61	Yes	-1
R12 Merchant Street	57	50	54	39	55	No	-2
R13 Merchant Street	59	53	56	39	58	No	-1
R14 Merchant Street	63	58	60	38	62	Yes	-1
R15 Fenwick Street	56	50	54	38	55	No	-1
R16 Fenwick Street	54	49	52	41	54	No	0
Other noise sensitive IGANRIP external noise triggers; Place of worship 55 dB(A) $L_{Aeq,1hr}$; Commercial, passive and active recreation areas 60 dB(A) $L_{Aeq,15hr}$							
R17 Old Church on Maitland Road	53	48	51	54	56	Yes	3
R18 Commercial	66	63	61	62	67	Yes	1
R19 Commercial	58	54	55	51	58	No	0
R20 Hexham Bowling Club	58	53	54	56	59	No	1
R21 Hexham Park	55	50	52	59	60	No	5
R22 Foreshore Reserve	55	50	52	49	55	No	0

Notes: Values expressed as A-weighted dB and rounded to nearest dB(A);

 L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Table 9.3d Predicted maximum rail noise levels for the day time and night time (2014 and 2024)

Receiver	Existing rail	With the Relief Roads Project				IGANRIP noise triggers	
		Main lines	Coal lines	Relief Roads	Total	Base trigger	Change from existing
Residential IGANRIP triggers; 80 dB(A) $L_{Aeq,15hr}$ at R2, 85 dB(A) $L_{Aeq,15hr}$ at all other residences							
R1 Woodlands Close	72	67	72	46	73	No	1
R2 off Woodlands Close	63	59	62	52	64	No	1
R3 Old Maitland Road	67	64	67	54	68	No	1
R4 Old Maitland Road	70	66	69	56	71	No	1
R5 Old Maitland Road	69	65	68	57	70	No	1
R6 Old Maitland Road	70	66	68	58	70	No	0
R7 Old Maitland Road	70	66	69	58	71	No	1
R8 Old Maitland Road	71	68	70	62	72	No	1
R9 Old Maitland Road	69	65	68	59	70	No	1
R10 Clark Street	80	75	77	49	79	No	-1
R11 Clark Street	81	76	78	49	80	No	-1
R12 Merchant Street	76	70	72	48	74	No	-2
R13 Merchant Street	79	72	75	48	77	No	-2
R14 Merchant Street	78	77	78	47	81	No	3
R15 Fenwick Street	74	69	73	47	75	No	1
R16 Fenwick Street	71	66	71	49	72	No	1

Notes Values expressed as A-weighted dB and rounded to nearest dB(A);

L_{Amax} = maximum noise level exceeded for 95% of rail pass-by noise events

Table 9.3e Predicted day time 15-hour L_{Aeq} noise levels for proposed Project operation (2024)

Receiver	Existing rail	With the Relief Roads Project				IGANRIP noise triggers	
		Main lines	Coal lines	Relief Roads	Total	Base trigger	Change from existing
Residential IGANRIP triggers; 60 dB(A) $L_{Aeq,15hr}$ at R2, 65 dB(A) $L_{Aeq,15hr}$ at all other residences							
R1 Woodlands Close	58	50	56	36	57	No	-1
R2 off Woodlands Close	50	43	49	43	51	No	1
R3 Old Maitland Road	53	46	51	46	53	No	0
R4 Old Maitland Road	55	48	54	47	56	No	1
R5 Old Maitland Road	55	48	53	49	55	No	0
R6 Old Maitland Road	55	48	53	49	55	No	0
R7 Old Maitland Road	55	48	54	50	56	No	1
R8 Old Maitland Road	57	50	55	54	58	No	1
R9 Old Maitland Road	55	47	53	50	55	No	0
R10 Clark Street	65	57	62	41	63	No	-2
R11 Clark Street	66	58	64	40	65	No	-1
R12 Merchant Street	61	52	58	39	59	No	-2
R13 Merchant Street	63	54	61	39	62	No	-1
R14 Merchant Street	66	60	65	38	66	Yes	0
R15 Fenwick Street	60	52	59	38	59	No	-1
R16 Fenwick Street	58	50	57	41	58	No	0
Other noise sensitive IGANRIP external noise triggers; Place of worship 55 dB(A) $L_{Aeq,1hr}$; Commercial, passive and active recreation areas 65 dB(A) $L_{Aeq,15hr}$							
R17 Old Church on Maitland Road	57	50	55	54	58	Yes	1
R18 Commercial	69	64	66	62	69	Yes	1
R19 Commercial	62	56	60	51	62	No	0
R20 Hexham Bowling Club	62	55	55	59	62	No	0
R21 Hexham Park	59	52	57	59	61	No	2
R22 Foreshore Reserve	59	52	57	49	59	No	0

Notes: Values expressed as A-weighted dB and rounded to nearest dB(A);

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Table 9.3f Predicted night time 9-hour L_{Aeq} noise levels for proposed Project operation (2024)

Receiver	Existing rail	With the Relief Roads Project				IGANRIP noise triggers	
		Main lines	Coal lines	Relief Roads	Total	Base trigger	Change from existing
Residential IGANRIP triggers; 55 dB(A) $L_{Aeq,15hr}$ at R2, 60 dB(A) $L_{Aeq,15hr}$ at all other residences							
R1 Woodlands Close	57	48	56	36	57	No	0
R2 off Woodlands Close	49	42	48	43	50	No	1
R3 Old Maitland Road	51	44	50	46	52	No	1
R4 Old Maitland Road	54	47	52	47	54	No	0
R5 Old Maitland Road	53	46	51	49	54	No	1
R6 Old Maitland Road	53	46	52	49	54	No	1
R7 Old Maitland Road	54	47	52	50	55	No	1
R8 Old Maitland Road	55	48	53	54	57	No	2
R9 Old Maitland Road	53	46	51	50	54	No	2
R10 Clark Street	63	55	61	41	62	Yes	-1
R11 Clark Street	64	56	62	40	63	Yes	-1
R12 Merchant Street	59	51	57	39	58	No	-1
R13 Merchant Street	62	53	59	39	60	No	-2
R14 Merchant Street	65	58	63	38	64	Yes	-1
R15 Fenwick Street	58	51	57	38	58	No	0
R16 Fenwick Street	57	49	55	41	56	No	-1
Other noise sensitive IGANRIP external noise triggers; Place of worship 55 dB(A) $L_{Aeq,1hr}$; Commercial, passive and active recreation areas 60 dB(A) $L_{Aeq,15hr}$							
R17 Old Church on Maitland Road	56	48	54	54	58	Yes	2
R18 Commercial	68	63	64	62	68	Yes	0
R19 Commercial	61	54	58	51	60	No	-1
R20 Hexham Bowling Club	60	53	57	56	61	No	1
R21 Hexham Park	57	50	55	59	61	No	4
R22 Foreshore Reserve	58	51	55	49	57	No	-1

Notes: Values expressed as A-weighted dB and rounded to nearest dB(A);

 L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Predicted rail noise impacts of up to 66 dB(A) $L_{Aeq,15hr}$ day time, 64 dB(A) $L_{Aeq,9hr}$ night time and 81 dB(A) L_{AMax} at residential receivers do not trigger IGANRIP.

There is a predicted reduction in future existing rail noise levels at a total of 7 residential receivers at Clark Street, Merchant Street, Fenwick Street and Woodlands Close.

Based on the predicted compliance, no noise management or mitigation measures are required to reduce and control rail noise impacts to residences at the opening of the proposed Project in 2014.

Compliance with the IGANRIP noise goals is achieved at all commercial and recreational (passive and active) receivers and land use.

Rail noise impacts of 58 dB(A) $L_{Aeq,9hr}$ night time trigger the IGANRIP at the church on Old Maitland Road. A noise reduction of 2 dB(A) L_{Aeq} day time and night time would be required to comply with IGANRIP. Discussion of reasonable noise management and mitigation for the church has been provided in Section 9.5.

9.3.2. Operational Vibration Assessment

Based on vibration levels measured at 15 metres for coal and non-coal freight pass-by events (refer to **Appendix D Noise and Vibration**), potential ground vibration levels from the realigned Up and Down Coal Lines are expected to comply with the adopted perceptible (disturbance) VDV goals of 0.2 – 0.4 $m/s^{-1.75}$ at nearest residences at least 30 metres from the proposed Project.

Ground vibration impacts are expected to be less than 5 mm/s (PPV) at 10 metres. No structural damage impacts are expected at nearest residences.

The Hexham Station structure is located <5 metres from the existing Main Line. Based on a PPV level of 1.14mm/s at 10 metres, potential vibration levels at Hexham Station, located within 10m of the realigned Up and Down Coal Line with the proposed Project, are not expected to trigger the 3mm/s sensitive structure vibration goal.

Based on the predicted compliance with the ground vibration goals, disturbance issues and structural damage (cosmetic) are not anticipated with the proposed Project. The proposed Project will increase the separation distance between receivers and the Up and Down Coal Lines which may result in a reduction to any existing ground vibration levels from coal train operations.

No section of the rail line in at cutting or tunnel minimising likelihood of ground-borne (reradiated) noise. No assessment of potential ground-borne noise was required.

9.3.3. Construction Noise Impact Assessment

An assessment of potential noise impacts from the construction of the Relief Roads at Hexham has been undertaken in consideration to the OEH ICNG.

The proposed construction of the Relief Roads would include the following work stages:

- site clearance and establishment of a site compound to facilitate the construction activities;
- construction of new access road around the Relief Roads and a new access to the Tarro Interchange;
- bulk earthworks including filling and cutting; and
- the installation of ballast and new tracks, turnout and signalling infrastructures along the Relief Roads.

Construction hours

Standard day time construction hours would be:

- 7am to 6pm Monday to Friday; and
- 8am to 1pm Saturdays.

Works may be required to be undertaken outside of standard day time construction hours for utility service providers and oversized deliveries and unloading.

Rail possession works would be on a 24 hour roster with the aim of completing works and the railway handed back to the ARTC in time for resumption of normal train operations.

Predicted Impacts – Standard Day Time Hours

To provide an assessment of potential worst case noise impacts, sound power levels (SWL) for dominant noise generating plant detailed in **Appendix D Noise and Vibration** have been directly applied in the noise model. Individual SWL for construction plant have been referenced from Parsons Brinckerhoff database of noise sources (also discussed in **Appendix D Noise and Vibration**).

Noise impacts have been predicted at locations adjacent to nearest receivers where fixed and mobile plant would be in simultaneous operation. Potential construction noise impacts at nearest receivers will be variable dependent upon the work location and the number of plant and machinery in operation.

Predicted construction noise impacts within standard day time construction hours are detailed in Table 9.3g.

Based on the predicted construction noise impacts at the assessed receivers, the following works are likely to trigger the residential NMLs:

- Vegetation removal works trigger the 58 dB(A) $L_{Aeq,15min}$ NML by 1 dB(A) L_{Aeq} at 2 of the assessed residences (R10 and R11) on Clark Street and the 53 dB(A) $L_{Aeq,15min}$ NML by 6 dB(A) L_{Aeq} at 2 of the assessed residences (R8 and R9) on Old Maitland Road; and
- Rail tamping works marginally trigger the 53 dB(A) $L_{Aeq,15min}$ by 1 dB(A) L_{Aeq} at 1 of the assessed residences (R8) on Old Maitland Road.

Compliance with the NMLs at the assessed residential receivers is predicted during the other assessed work stages.

Predicted noise impacts of 61 dB(A) $L_{Aeq, 15min}$ at Foreshore Reserve trigger the 60 dB(A) $L_{Aeq,15min}$ NML by 1 dB(A). Noise impacts are predicted to comply with the NMLs during all other assessed construction works at the recreational land use.

Predicted noise impacts of up to 76 dB(A) $L_{Aeq,15min}$ and 86 dB(A) $L_{Aeq,15min}$ at the assessed commercial premises (R18 and R19), during the site clearing works, trigger the 70 dB(A) $L_{Aeq,15min}$ NML for commercial land use by up to 16 dB(A) L_{Aeq} .

During track work installation predicted noise impacts of 78 dB(A) $L_{Aeq, 15min}$ trigger the commercial receiver NML at 2 commercial properties (R18 and R19) by up to 8 dB(A) L_{Aeq} .

Compliance with the NMLs is predicted at commercial and recreation receivers for the other assessed work stages.

Table 9.3g Predicted worst case construction noise impacts during standard day time construction hours

Construction Stage		Predicted L _{Aeq,15min} Construction Noise Level, dB(A)						
		Woodlands Close		Clark St, Merchant St, Fenwick St	Old Maitland Road		Recreational Use	Commercial
		R1	R2	R10 to R16	Residential (R3 to R9)	Church (R17)	(R20, R21, R22)	(R18, R19)
RBL monitoring location		Location B	Location A	Location C	Location A	-	-	-
NML LAeq, 15min dB(A)		71	53	58	53	55	Passive 60 Active 65	70
Site clearing	Clearing / Stripping	27	35	45-47	38-49	49	28-53	60-76
	Vegetation removal	37	45	57-59	48-59	59	37-61	70-86
Site setup	Compound / deliveries	29	32	10-19	18-25	<10	22-24	39-52
	Utility works	62-68	32-38	<20	<20	<20	<20	<30
Access road	Temporary roads	70	45	10-18	14-22	<10	20-32	37-44
Bulk earthworks	Excavation	28	36	47-49	42-50	47	30-53	54-65
	Material handling	19	27	39-40	29-41	41	28-45	34-44
Trackwork installation	Installation	27	35	46-48	43-50	51	44-55	62-77
	Tamping	30	38	51-58	52-54	54	46-56	63-78

Notes: Values expressed as A-weighted dB and rounded to nearest dB(A)

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Predicted impacts – Outside of Standard Day Time Hours

A number of works will be undertaken outside of the standard day time construction hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturdays (refer to Section 4.5.4 of this EIS).

Noise impacts have been predicted for works outside of standard day time construction hours at locations adjacent to nearest receivers. These noise impacts have been assessed based on existing lowest RBLs at the nearest residential receivers which is considered indicative of the sensitive of the evening and night time periods.

Predicted construction noise impacts outside of standard day time construction hours are detailed in Table 9.3h.

Based on the predicted construction noise impacts at the assessed residential receivers, the following works trigger the residential NMLs for outside of standard day time hours works:

- Utilities works trigger the 55 dB(A) $L_{Aeq,15min}$ NML by 13 dB(A) L_{Aeq} at R1 on Woodlands Close.
- At 2 of the nearest receivers on Old Maitland Road (R8, R9) vegetation removal works trigger the 52 dB(A) $L_{Aeq,15min}$ NML by up to 9 dB(A) L_{Aeq} and rail tamping works trigger the NML by up to 2 dB(A) L_{Aeq} .
- At 4 of the nearest receivers (R10, R11, R12 and R13) on Clark Street, Merchant Street and Fenwick Street the vegetation removal works are predicted to trigger the 47 dB(A) $L_{Aeq,15min}$ by up to 12 dB(A), excavation works are predicted to trigger the NML by 2 dB(A) L_{Aeq} and rail installation and tamping works trigger by up to 11 dB(A) L_{Aeq} .

Compliance with the NMLs at the assessed residential receivers is predicted during the other assessed work stages outside of standard day time construction hours.

Where Foreshore Reserve is occupied on Saturday's between 1pm and 6pm and the day time on Sundays, predicted noise impacts of 61 dB(A) $L_{Aeq,15min}$ trigger the 60 dB(A) $L_{Aeq,15min}$ NML by 1 dB(A). Noise impacts are predicted to comply with the NMLs during all other assessed construction works at the recreational land use.

Where normal operations at commercial premises (R18 and R19) occur on Saturday's between 1pm and 6pm and the day time on Sundays, predicted noise impacts of up to 76 dB(A) $L_{Aeq,15min}$ and 86 dB(A) $L_{Aeq,15min}$ during the site clearing works, trigger the 70 dB(A) $L_{Aeq,15min}$ NML for commercial land use by up to 16 dB(A) L_{Aeq} .

During track work installation predicted noise impacts of 78 dB(A) $L_{Aeq,15min}$ trigger the commercial receiver NML by up to 8 dB(A) L_{Aeq} . Compliance with the NMLs is predicted at all other assessed commercial receivers for the other assessed work stages.

Where the Church on Old Maitland Road is in use outside of the standard day time hours, such as services on Saturday afternoons and Sundays, predicted noise impacts for vegetation clearance trigger the 55 dB(A) $L_{Aeq,15min}$ NML by 4 dB(A), all other assessed works comply with the NML.

Sleep disturbance impacts

The ICNG does not include any sleep disturbance criteria and therefore the predicted impacts, for night time construction works to affect the sleep of residents, have been assessed based on the existing background noise environment. The relevant NMLs for outside of standard construction hours has been established through the addition of 5 dB(A) to the measured RBLs, in that a noise event of this type can be clearly audible above the existing noise criteria.

Based on this assessment of construction noise impacts (shown in Table 9.3h) there is the potential for the nearest residents on Woodlands Close, Old Maitland Road, Clark Street, Merchant Street and Fenwick Street to experience audible construction noise during the following works occurrences:

- Vegetation clearance;
- Utility works;
- Excavation works;

- Track installation; and
- Rail tamping.

Notwithstanding this, it should be noted that the reaction to audible noise is a subjective response that varies between people and therefore, even if above criteria this construction noise may not necessarily result in sleep disturbance. Further, sleep disturbance has the potential to occur when audible noise is below the criteria, particularly where noise has discernible characteristics such as tonality, low frequency, or impulsive noise.

In consideration of the predictions of this assessment a range of mitigation measures have been prepared to reduce and control potential construction noise impacts during works outside of standard construction hours (refer to Section 9.5 of this EIS).

Table 9.3h Predicted worst case construction noise impacts outside of standard day time construction hours

Construction Stage		Predicted L _{Aeq,15min} Construction Noise Level, dB(A)						
		Woodlands Close		Clark St, Merchant St, Fenwick St	Old Maitland Road		Recreational Use	Commercial
		R1	R2	R10 to R16	Residential (R3 to R9)	Church (R17)	(R20, R21, R22)	(R18, R19)
RBL monitoring location		Location B	Location A	Location C	Location A	-	-	-
NML LAeq, 15min dB(A)		55	52	47	52	55	Passive 60 Active 65	70
Site clearing	Clearing / Stripping	27	35	45-47	38-49	49	28-53	60-76
	Vegetation removal	37	45	57-59	48-59	59	37-61	70-86
Site setup	Compound / deliveries	29	32	10-19	18-25	<10	22-24	39-52
	Utility works	62-68	32-38	<20	<20	<20	<20	<30
Access road	Temporary roads	70	45	10-18	14-22	<10	20-32	37-44
Bulk earthworks	Excavation	28	36	47-49	42-50	47	30-53	54-65
	Material handling	19	27	39-40	29-41	41	28-45	34-44
Trackwork installation	Installation	27	35	46-48	43-50	51	44-55	62-77
	Tamping	30	38	51-58	52-54	54	46-56	63-78

Notes: Values expressed as A-weighted dB and rounded to nearest dB(A)

L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

9.3.4. Construction Vibration

To assess received vibration impacts at nearest receivers, typical ground vibration levels for dominant vibration generating plant (**Appendix D Noise and Vibration**) have been referenced from previous measurements and assessments of construction works for transportation projects.

Nearest residential receivers are greater than 30 metres from construction works; based on the vibration levels, potential ground vibration impacts are expected to be within human exposure goals of $0.2 - 0.4 \text{ m/s}^{1.75}$ during the day time and $0.13 - 0.26 \text{ m/s}^{1.75}$ during the night time, limiting potential for annoyance or disturbance issues.

Vibratory roller operations within 30 metres of nearest residences may trigger the day time and night time PPV vibration goals. Where vibration management measures in Section 9.5 are implemented the potential for disturbance issues during vibratory roller operations would be minimised.

Potential PPV vibration levels at nearest residences are expected to be within structural damage goals of $5 - 15 \text{ mm/s}$. No disturbance or structural damage issues are expected at the Hexham Bowling Club, the church on Old Maitland Road or Hexham Station, which are located at least 120 metres from the proposed works.

Nearest commercial receivers are located to the east of the Main Line greater than 30 metres from construction locations. Potential construction vibration impacts are expected to be within the adopted $0.4 - 0.8 \text{ m/s}^{1.75}$ human exposure commercial land use vibration goals. No cosmetic structural damage impacts are expected.

Construction Traffic Noise Impacts

To accommodate the construction traffic on Woodlands Close the Tarro Interchange will be upgraded and a connecting road to Woodlands Close constructed.

Estimated construction traffic movements on Woodlands Close, detailed in Table 9.3i, have been referenced from the *Hexham Relief Roads Traffic Impact Assessment* (**Appendix E Traffic and Transport**). Traffic movements are the total vehicle arrivals and departures.

Peak light vehicle movements would occur between 6am and 7am for staff mobilisation and 6pm and 7pm for staff departure with heavy vehicles operating between 7am and 6pm.

Table 9.3i Total construction hourly road traffic movements

Peak Traffic Period	Construction Activity	Hourly Traffic Movements	
		Light Vehicles	Heavy Vehicles
6am – 7am	Staff arrival prior to commencement of construction works	70	0
7am – 6pm	Delivery and departure of materials	10	22
6pm – 7pm	Staff departure at end of day time works	70	0

Note: Construction traffic movements referenced from Hexham Relief Roads Traffic Impact Assessment, 2012

Construction traffic noise impacts were assessed at Receiver 1 Woodlands Close, the nearest residential receiver on Woodlands Close, 30 metres from the construction traffic route.

Potential construction traffic noise impacts in Table 9.3j have been predicted applying the *Calculation of Road Traffic Noise* (Department of Transport Welsh Office, 1988).

Table 9.3j Predicted construction traffic noise impacts

Nearest Receiver	Construction Stage	Predicted 1-hour L_{Aeq} noise dB(A)
Receiver 1, Woodlands Close	Staff arrival 6am to 7am	33
	Delivery and departure of materials 7am to 6pm	50
	Staff departure 6pm to 7pm	33

Note: Values expressed as A-weighted dB and rounded to nearest dB(A)
 L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

During standard day time construction hours the predicted construction traffic noise impacts at Receiver 1 Woodlands Close comply with the 55 dB(A) $L_{Aeq,1hour}$ construction traffic noise goal.

The predicted construction traffic noise impacts comply with the 50 dB(A) $L_{Aeq,1hour}$ construction traffic noise goal for periods outside the standard daytime construction hours.

Adopting a 110 dB(A) L_{Amax} source noise level for air braking and tailgates, predicted noise impacts of 73 dB(A) L_{Aeq} at Receiver R1 from individual heavy vehicles may be audible above an existing measured day time ambient noise level of 70 dB(A) L_{Aeq} .

A range of feasible noise management measures for construction road traffic have been recommended in Section 9.5.

Operational Traffic

During the operation of the Relief Roads one or two light vehicles per day on the Tarro Interchange or Woodlands Close may access the site for maintenance activity.

Road traffic noise from light vehicles on Woodlands Close would comply with the adopted 55 dB(A) $L_{Aeq,1hour}$ road traffic noise goal. Based on the high road traffic volumes on the New England Highway, potential maintenance traffic will not influence day time road traffic noise levels in Hexham.

Traffic Vibration Impacts

Potential road traffic vibration would be minimised by all vehicles adhering to sign-posted traffic speeds and implementing responsible driving practices to minimise unnecessary acceleration and braking events.

Based on a separation distance of at least 30 metres to the Receiver R1 on Woodlands Close, construction and operational road traffic movements are not expected to result in an exceedance of the perceptible and cosmetic damage criteria.

9.4. Cumulative Impact

QR National is currently preparing plans for a TSF and adjoining industrial development located immediately to the west of the Relief Roads. The layout and key features of both projects are discussed in **Chapter 4 Project Description**. QR National is liaising with ARTC to co-ordinate the detailed design and approval processes.

9.4.1. Potential Noise Impacts from Simultaneous Construction Works with Train Support Facility

Potential cumulative noise impacts have been estimated in Table 9.4a based on worse case (highest) predicted noise impacts. The highlighted cells show where NMLs are triggered at nearest residential receivers.

Table 9.4a Predicted cumulative construction noise impacts with TSF

Construction Works	Predicted Daytime Rail Noise, $L_{Aeq,15min}$ dB(A)			
	Haine Residence (R2)	Old Maitland Road (R5)	Woodlands Close (R1)	Off Pacific Highway (R12)
Rail construction				
Hexham Relief Roads	45	59	37	59
QR National TSF	39	38	38	38
Cumulative	46	59	41	59
Building works				
Hexham Relief Roads	45	50	28	49
QR National TSF	38	39	38	38
Cumulative	46	50	38	49
Road construction				
Hexham Relief Roads	45	22	70	18
QR National TSF	57	57	58	57
Cumulative	57	57	70	57
Rail construction				
Hexham Relief Roads	38	54	30	58
QR National TSF	58	58	58	59
Cumulative	58	60	58	62

Notes Values expressed as A-weighted dB and rounded to nearest dB(A)
 L_{Aeq} = equivalent continuous (energy average) A-weighted sound pressure level

Standard Day Time Construction Works

Potential cumulative construction works during standard day time hours are predicted to trigger the NMLs at up to 3 residential receivers during initial rail construction works and site set up, road construction and final rail construction.

The proposed building construction works are predicted to comply with the NMLs at all of the assessed receivers.

Depending on the work locations and the nearest receivers the proposed Project and the QR National TSF project would be a dominant influence to received cumulative impacts throughout the construction programme and both projects will need to manage cumulative noise impacts.

Outside of Standard Day Time Construction Works

At all assessed receivers the potential impacts the receiver specific NMLs of 47 dB(A) $L_{Aeq,15min}$, 52 dB(A) $L_{Aeq,15min}$ and 55 dB(A) $L_{Aeq,15min}$ are likely to be triggered during cumulative construction works outside the day time hours of 7am to 6pm Monday to Friday and 8am to 1pm Saturdays.

Depending on the work locations and the nearest receivers the proposed Project and the QR National TSF project would be a dominant influence to received cumulative impacts throughout the construction programme and both projects will need to manage cumulative noise impacts.

9.4.2. Potential Noise Impacts from Cumulative Operations with Train Support Facility

Table 9.4b day time, Table 9.4c night time and Table 9.4d maximum, detail estimated cumulative noise levels assuming the predicted impacts from the QR National TSF are indicative of continuous operation during a 24 hour period.

Table 9.4b Potential cumulative day time operational noise impacts with TSF

Residential Receiver	Predicted Daytime Rail Noise, $L_{Aeq,15hr}$ dB(A)		
	Hexham Relief Roads	QR National TSF	Cumulative
R1 Woodlands Close	54	<30	54
R2 Hain Residence	49	31	49
R5 Old Maitland Rd	53	38	53
R11 Clark Street	62	32	62

Notes Values expressed as A-weighted dB and rounded to nearest dB(A)

Table 9.4c Potential cumulative night time operational noise impacts with TSF

Residential Receiver	Predicted Daytime Rail Noise, $L_{Aeq,9hr}$ dB(A)		
	Hexham Relief Roads	QR National TSF	Cumulative
R1 Woodlands Close	54	<30	54
R2 Hain Residence	48	31	48
R5 Old Maitland Rd	53	38	53
R12 Clark Street	61	32	61

Notes Values expressed as A-weighted dB and rounded to nearest dB(A)

Table 9.4d Potential cumulative maximum operational noise impacts with TSF

Residential Receiver	Predicted day time rail noise, L_{Amax} dB(A)		
	Hexham Relief Roads	QR National TSF	Cumulative
R1 Woodlands Close	73	36	73
R2 Hain Residence	64	44	64
R5 Old Maitland Rd	70	50	70
R12 Clark Street	80	56	80

Notes Values expressed as A-weighted dB and rounded to nearest dB(A)

L_{Amax} = maximum noise level

Based on the predicted noise levels the proposed Project would be the dominant influence to received noise levels. The influence of the TSF operations is predicted to not result in cumulative noise levels being greater than the day time, night time or maximum noise from the proposed Project.

This is primarily due to the proximity of proposed Project operations to the nearest receivers. The increased separation distance between the TSF project site and nearest residences provides additional attenuation to operational noise.

Perception of Cumulative Noise

The characteristics of noise from rail operations (proposed Project) and industrial noise (TSF) are noticeably different. Rail operations are short term events with potential for instantaneous maximum events such as wagon bunching, wheel squeal and horn blasts. Industrial noise is often continuous and can be characterised by low frequency or tonal noise emissions.

Existing receivers are already exposed to rail noise from Main Line operations which can result in familiarity with specific rail noise characteristics. Where the recommendations in Section 9.5 are implemented the potential for annoyance is expected to be minimised.

Currently there are no industrial developments of similar nature to the proposed TSF project at Hexham. Audible operational noise from the TSF may be more readily discernible as a new noise characteristic in the ambient environment.

9.4.3. Potential Cumulative Road Traffic Noise Impacts with Train Support Facility

The proposed Project would have minimal road traffic operations; as such, road traffic noise during operations would not be a cumulative noise issue. Operational road traffic noise would be managed specific to individual projects.

During the construction program both proposed Projects would access the New England Highway from an access road that joins Woodlands Close via the Tarro Interchange. Cumulative construction road traffic is predicted to be 54 dB(A), which complies with the 55 dB(A) $L_{Aeq,1hr}$ road traffic noise goal at nearest residences on Woodlands Close.

9.4.4. Potential Cumulative Ground Vibration Impacts with Train Support Facility

Due to the requirements for safe working practice of individual construction activity it is unlikely that vibration generating construction plant such as rock breakers and bulldozers would be in simultaneous operation within 30 metres of nearest receivers. The likelihood of cumulative vibration levels triggering the disturbance and structural damage goals is low.

Potential vibration from operations of both projects is predicted to comply with disturbance and structural damage goals. The separation distance from operations of each proposed Project to nearest receivers (>100 metres) is expected to be sufficient to limit the likelihood of perceptible vibration, and comply with the disturbance and structural goals.

9.5. Mitigation and Management Measures

9.5.1. Construction

- A Project Construction Environmental Management Plan (PCEMP) would be prepared prior to commencement of works and be implemented through all phases of construction.
- Standard construction working hours would be restricted to 7 am and 6 pm (Monday to Friday) and Saturdays 8 am and 1 pm, with no works on Sundays or public holidays, unless health and safety or site conditions such as delivery of oversized loads expressly require works outside these times.
- All site workers (including subcontractors and temporary workforce) would be made aware of the potential for noise and vibration impacts upon local residents and encouraged to take practical, feasible and reasonable measures to minimise noise during the course of their activities.
- Where measured construction noise levels trigger the residential and non-residential noise NMLs identified in this report; dominant noise generating mechanical plant would be fitted with feasible noise mitigation controls such as exhaust mufflers and engine shrouds.
- Quieter and less vibration emitting construction methods would be applied where feasible and reasonable. For example, when piling is required, bored piles rather than impact-driven piles will minimise noise and vibration impacts.

- The construction site would be arranged to minimise noise impacts by locating potentially noisy activities away from the nearest receivers wherever possible.
- Where work is proposed in the vicinity of residences, potentially affected residents would be advised in advance of the proposed construction period at least 2 weeks prior to the commencement of works.
- Fixed equipment (i.e. pumps, generators, compressors) would be located to maximise the practical separation distance away from nearest residences.
- Temporary stockpiles would be located away from the nearest residences.
- Whenever possible, loading and unloading areas would be located away from the nearest residences.
- Broadband reversing alarms should be used instead of tonal reversing alarms, in particular outside standard working hours (night-time track possession works). Sub-contractors would also be notified of this requirement and where possible (particularly for night works) this would be included as a contractual requirement.
- Equipment which is used intermittently should be shut down when not in use.
- All engine covers should be kept close while equipment is operating.
- Specific work method statements and directives will be prepared to prohibit unnecessary dropping of materials from heights in/out of vehicles.
- Where possible, trucks associated with the work should not be left standing with their engine operating in a street adjacent to a residential area.
- Where practicable simultaneous operations of loader, Bobcat, 30T excavator, rail tamper and ballast regulator plant would not occur in the same local area.
- Sign-posted traffic speeds would be adhered to and all drivers would implement responsible driving practices to minimise unnecessary acceleration and braking events. Traffic movements would be scheduled to minimise continuous traffic flows (convoy).
- At the commencement of works ground vibration monitoring would determine safe working distances for all vibration generating plant to minimise potential for disturbance and cosmetic issues at all receivers and property.
- The planning and scheduling of vibration generating works would include safe working distances to minimise potential disturbance and cosmetic structural damage impacts. Table 9.5a provides recommended safe working distances for vibration generating plant.

Table 9.5a Safe working distances for construction plant

Plant Item	Description	Safe working distances, metres	
		Cosmetic Damage	Human Disturbance
Vibratory roller	1-2 T	5	15-20
	2-4 T	6	20
	4-6 T	12	40
	7-13 T	15	100
	13-18 T	20	100
	>18 T	25	100
Small hydraulic hammer	5-12 T excavator	2	7
Medium hydraulic hammer	12-18 T excavator	7	23
Large hydraulic hammer	18-34 T excavator	22	73
Vibratory pile driver	Sheet piles	2-20	20
Pile boring	≤800mm diameter	2	-
Jackhammer	Hand held	1	Avoid contact with structure

Source: Transport Construction Authority – Construction Noise Strategy (Rail Projects) October 2010

- Prior to the commencement of construction, condition surveys of residences on Clark Street, Fenwick Street, Merchant Street and at/ off Woodlands Close and the Hexham Station are to be undertaken to determine the current integrity and visible damage. The surveys are to be used to manage vibration through safe working practices to prevent further or new cosmetic damage.
- All plant on site should be operated in accordance with the manufacturer's instructions.
- The constructor (as appropriate) would establish contact with the local residents and communicate, particularly when noisy or vibration generating activities are planned.
- The constructor or site developer (as appropriate) is to provide a community liaison phone number and permanent site contact so that noise and/or vibration related complaints, if any, can be received and addressed in a timely manner.
- Consultation and cooperation between the site(s) and neighbours to the site(s) would assist in limiting uncertainty, misconceptions and adverse reactions to noise and vibration.
- Where measured construction noise levels from the Proposed Project at nearest residences are greater than 75 dB(A) $L_{Aeq,15min}$ the following would be considered:
 - Respite periods of 1 hour are recommended for every continuous 3 hour period of work.
 - Works should be scheduled between 9 am – 12 pm and 2 pm – 5 pm.
- Attended noise and ground vibration measurements are to be undertaken at monthly intervals and upon receipt of adverse comment/ complaints during the construction programme to confirm the noise and vibration levels at adjacent communities and receivers are consistent with the prediction in this assessment and any approval and/or licence conditions.
- All noise measurements are to be undertaken at the most exposed/ affected receivers and be carried out consistent with Australian Standard AS1055.1-1997 Acoustics - Description and Measurement of Environmental Noise - General Procedures.

- Vibration measurements shall be undertaken in accordance with the procedures documented in the DECCW's Assessing Vibration - a technical guideline (2006) and BS7385 Part 2-1993 Evaluation and measurement for vibration in buildings.
- In the event of any non-conformance to the project objectives and/or conditions, the current noise and vibration management measures would be reviewed and additional feasible and reasonable control implemented to reduce impacts where it is practical.

Consistent with the ICNG, where the above measures are implemented the noise and vibration impacts from construction are considered acceptable and typical of construction activities in close proximity to receivers.

Construction works out of standard day time working

Where construction works are required outside of the standard day time construction hours the following additional noise mitigation measures are to be implemented.

- All works undertaken during rail possession are to be managed in accordance with EPL for the Project where feasible.
- Where feasible high noise generating works would be avoided during morning, evening and night time services at the Church on Old Maitland Road.
- Where feasible consideration would be given to a mass loaded absorptive acoustic curtain being installed on localised wire fencing around noise generating plant and machinery.
- High noise generating works for vegetation clearance with chainsaw and chipper would not be undertaken during the 10pm to 7am night time period.
- Where feasible noise generating works for the project would be scheduled to be completed outside of the 10pm to 7am night time period.

9.5.2. Operation

Based on the predicted rail noise levels at the assessed receivers for project opening in 2014 and future network operation in 2024; no noise management or mitigation measures are required to control potential noise impacts of the Proposed Project at residential, commercial or recreational receivers and land use in Hexham in accordance with IGANRIP.

The predicted day time and night time rail noise levels exceed the noise objectives for a place of worship at the Church on Old Maitland Road. To comply with the noise trigger levels a noise reduction of 2 dB(A) L_{Aeq} to the day time and night time noise levels would be required.

Noise mitigation management and mitigation measures such as rail noise barriers, noise bunds, reducing daily train operations or reducing train speeds are not reasonable or practical for the control of noise at one receiver located 225 metres from the Project.

Architectural acoustic treatments to the Church building façade is not reasonable to reduce worst-case noise levels by 2 dB(A) L_{Aeq} . Architectural treatment is typically only feasible where a noise reduction of at least 5 to 10 dB(A) L_{Aeq} is required.

9.5.3. Cumulative for Construction of Train Support Facility

The proposed Hexham Relief Roads project would have minimal road traffic operations; as such road traffic noise during operations would not be a cumulative noise issue. Operational road traffic noise would be managed specific to individual projects.

During the construction program both Proposed Projects will access the New England Highway from Woodlands Close via the Tarro Interchange. Table 9.5 in **Appendix D Noise and Vibration** details estimated worst case cumulative noise impacts from construction road traffic.

10. Traffic and Transport

A detailed assessment of traffic and transport has been carried out and is summarised in this chapter and provided in full in **Appendix E Traffic and Transport**. Table 10a outlines the DGRs relevant to traffic and transport and where they have been addressed.

Table 10a Director-General's Environmental Assessment Requirements – Access and infrastructure

Director-General's Environmental Assessment Requirements	Location addressed
Access and Infrastructure – including but not limited to: - access to the site and associated property severance and access restrictions, including access across the project to the adjacent National Park, to existing and proposed Hunter Water infrastructure, and from Hexham Railway Station to the proposed QR National Project and adjoining lands; - preparation of a Traffic Study, taking into account the Guide to Traffic Generating Developments (RTA, 2002), including construction and operational traffic impacts to the local and regional road network, including impacts of access onto the New England Highway, and in particular at Woodlands Close (including intersection analysis); - impacts to passenger rail services and operation of Hexham Station; - interaction and integration with existing and planned transport infrastructure (eg. F3 to Raymond Terrace Pacific Highway Upgrade, Richmond Rail Trail) and services. Consideration should be given to safety, capacity, efficiency and any required augmentations (eg. Tarro interchange); and - interaction with existing and proposed utilities infrastructure, including the Hunter Water Trunk Main upgrade.	Sections 10.5.6 and 10.5.7 of this chapter Sections 10.5.1 and 10.5.2 of this chapter for traffic impacts on local road network; Section 10.5.8 of this chapter for regional road network Sections 10.5.4 and 10.5.7 of this chapter Section 10.2.2 of this chapter Section 10.5.7 of this Chapter and Chapter 4 Project Description

10.1. Methodology

An assessment was undertaken to investigate the potential traffic impacts of the construction of the proposed Project and other approved projects nearby the Study Area. The report was developed in accordance to the Roads and Traffic Authority's *Guide to Traffic Generating Developments 2002*.

The traffic impact assessment scope of works includes:

- an assessment of the existing road network performance in the Study Area;
- a review of existing public transport services, pedestrian and cyclist amenity;
- a review of the Project Area layout, access and haulage routes;
- an assessment of the future road network performance with and without construction activity from the proposed Project including proposed intersection upgrades, taking into account the nearby approved development;
- an assessment of potential road safety issues associated with the proposed Project; and
- development of mitigation measures to alleviate the identified traffic, safety and operational impacts.

10.2. Existing Environment

10.2.1. Adjoining Lands and Infrastructure

Hexham Swamp Nature Reserve is located to the south and west of the Project Area. Access to the nature reserve is via Woodlands Close through private property. Vehicle access within the nature reserve is by tracks for authorised vehicles only, for maintaining facility such as the water pipeline and power lines.

Hexham railway station is located on the western side of Maitland Road (Pacific Highway). Access to the station is via its eastern side off Maitland Road (New England Highway) only.

Hunter Water Infrastructure has the Chichester Trunk Gravity Main runs alongside the Hunter Rail Line and crosses the Hexham Swamp Nature Reserve. Recently new underground pipeline has replaced the above ground facility and would be operational in 2012. Access to the pipeline is via the Woodlands Close.

10.2.2. Integration with Planned Transport Infrastructure

A number of approved transport infrastructure projects are planned in close proximity to the Project Area. Table 10.2a provides a summary of these projects, their planned construction timing and how the Project interacts and integrates with each.

Table 10.2a Planned transport infrastructure projects and Project integration

Project	Details of Project	Status	Project integration
ARTC Hexham Crossing Loop	Delivered by ARTC, in conjunction with Transport for NSW, as part of the Northern Sydney Freight Corridor to improve freight transport North of Sydney.	Construction of the crossing loop is complete, Commissioning occurred on the 24 June 2012.	Both projects are important to the rail network and fulfil different purposes. The projects are on opposite sides of the rail corridor and hence will not have direct interaction. This is with the exception of cable route requirements, where consideration has been given to identify opportunities for combined infrastructure.
F3 Freeway to Raymond Terrace Pacific Highway Upgrade	To be delivered by RMS. Includes upgrade of the Pacific Highway between the F3 Freeway and Raymond Terrace involves including a bypassing of Heatherbrae.	The Project is in preliminary design stage and subject to funding and planning approval. Construction is anticipated after the Project completion.	ARTC has met with RMS on multiple occasions to ensure the projects suitably integrate. In particular, the Projects access construction road alignment has been modified to allow for the piers of the RMS Hunter River Viaduct.
Richmond Rail Trail and Newcastle Bike Plan 2009	To be delivered by Newcastle City Council, Includes potential cycleway routes that traverse the northern part of the Project Area.	Neither of the projects have been identified by Council as to be undertaken in the near future.	ARTC has discussed the proposed bike paths in meetings with Newcastle City Council. The rail lines included in the Project will not impact on the planned route of the bike paths.
QR National TSF	Refer to Section 4.7 of this EIS.	Awaiting planning approval however construction expected to be undertaken in similar timing to the Project.	Refer to Section 4.7 of this EIS.

10.2.3. Surrounding Road Network

Table 10.2b lists the key roads relevant to the proposed Project and Table 10.2c lists the intersections relevant to the proposed Project. A description of each road and intersection is also provided.

Table 10.2b Key roads within the Study Area

Road	Description
Anderson Drive at the Tarro Interchange	The Tarro Interchange is a grade separated intersection between the New England Highway and Anderson Drive. It consists of four one-way ramps connecting with the New England Highway. Anderson Drive is a two-lane two-way undivided road at the Tarro Interchange. The posted speed limit on Anderson Drive at this location is 60 km/h.
New England Highway	The New England Highway (State Highway SH9) is part of the Auslink Sydney-Brisbane inland highway. Within the Study Area, it is in general a four-lane divided road, with two traffic lanes in each direction separated by a raised concrete central median. The speed limit on the New England Highway at the Tarro Interchange is 90 km/h. The eastbound off-ramp from the New England Highway to the Tarro Interchange is 60 km/h and the southbound on-ramp has an advisory speed limit of 55 km/h.
Maitland Road (Pacific Highway)	Maitland Road (Pacific Highway (State Highway SH1)) in the Study Area is generally a four lane divided road, with two traffic lanes in each direction separated by a raised concrete central median. The speed limit on this section of Maitland Road (Pacific Highway) is 80 km/h. Dedicated on-road cycle facilities are provided within the shoulders.
Woodlands Close	Woodlands Close is two-lane, two-way local no-through road. Woodlands Close consists of sealed and unsealed sections. A sealed section of approximately 1 km length is provided from the intersection with the New England Highway. No speed limit signage is provided therefore the default speed limit is 50 km/h. An unsealed section of Woodlands Close is signed with a 20 km/h speed limit.

Table 10.2c Key intersections within the Study Area

Intersection	Description
Maitland Road (Pacific Highway)/Shamrock Street	Maitland Road (Pacific Highway)/Shamrock Street is a signalised T-junction with adequate sight distance provided on all approaches in all directions with the following features: - an auxiliary left turn lane on Maitland Road (Pacific Highway) for vehicles to turn left from Maitland Road (Pacific Highway) onto Shamrock Street; and - a designated right turn lane on Maitland Road (Pacific Highway) for vehicles turning onto Shamrock Road.
New England Highway/Woodlands Close	The New England Highway/Woodlands Close intersection is a Give Way priority controlled T-junction. Despite an opening in the central concrete median on the New England Highway, the right turn is banned from the New England Highway onto Woodlands Close as well as from Woodlands Close onto the New England Highway.
Tarro Interchange	The Tarro Interchange is a grade separated intersection between the New England Highway and Anderson Drive, located in Tarro. It consists of four one-way ramps connecting with the New England Highway. An off-ramp and on-ramp are provided in both the eastbound and westbound directions. The right turn from the northbound off ramp is banned as all traffic is to turn left onto Anderson Drive.
New England Highway/Vehicle turnaround intersection	Vehicles travelling from Sydney or Maitland via John Renshaw Drive wanting to access Woodlands Close are required to make a looping movement at a speciality built vehicle turnaround intersection. The turnaround intersects with the New England Highway under Hexham Bridge. From here, vehicles can travel in the northbound direction on the New England Highway to access Woodlands Close.
F3 Freeway/John Renshaw Drive Roundabout	Vehicles travelling to Newcastle or Raymond Terrace exiting Woodlands Close are required to make a U-turn movement at the F3 Freeway/John Renshaw Drive

Intersection	Description
	roundabout and travel eastbound along John Renshaw Drive and then onto New England Highway.

10.2.4. Public Transport

The following public transport services are provided:

- bus services provided by Hunter Valley Buses between Raymond Terrace and Newcastle via Hexham (Route 140). The route is served by up to two buses per hour during the commuter peak periods, with one service per hour during off peak periods and weekends. The closest bus stop near the construction site is on Maitland Road (Pacific Highway) near Shamrock Road; and
- passenger rail services provided on the Hunter Line between Newcastle and Scone via Hexham.

10.2.5. Pedestrian and Cyclists' Facilities

Dedicated and shared on-road cycle lanes are provided on the New England Highway and Maitland Road (Pacific Highway), between the Tarro Interchange and Shamrock Street.

There is no formal provision of pedestrian facilities at the Tarro Interchange, Woodlands Close, Maitland Road (Pacific Highway) and the New England Highway.

10.2.6. Existing Traffic Conditions and Volumes

The existing traffic volumes and the turning movements were identified from the following sources:

- RMS count stations on the New England Highway east of Woodlands Close (count station 05.055) and the Pacific Highway at Hexham Bridge (count station 05.001). These were used to establish regional traffic growth;
- turning movement traffic counts at the Anderson Drive (south)/Anderson Drive (west) intersection were used to determine heavy vehicle percentage on Anderson Drive (south); and
- mid-block traffic counts at the Tarro Interchange based on Better Transport Future's Proposed Train Facility and Industrial Estate Traffic Impact Assessment (2011). These were used to establish traffic volume on the New England Highway southbound on- and off-ramps.

The location of traffic counts and surveys is shown in Figure 10.2a.



Source: Hexham Traffic Impact Assessment 2012

Figure 10.2a Location of traffic survey and traffic count data stations

In order to determine the future traffic growth rate on the New England Highway, the average annual daily traffic (AADT) data provided from RMS count station 05.055 was utilised, located east of Woodlands Close (its location is shown in Figure 10.3a). A summary of AADT at this count station is provided in Table 10.2d.

Table 10.2d Recorded AADT on the New England Highway, count station 05.055

Year	2001	2004	2005	2006	2007	2008
AADT Growth	45,783	48,879	51,523	51,003	52,806	52,976
		(+2.2%)	(+2.9%)	(+2.2%)	(+2.4%)	(+2.1%)

Source: Hexham Traffic Impact Assessment 2012

Table 10.3d indicates that traffic on the New England Highway (just east of Woodlands Close) has increased over the period of 7 years (from 2001 to 2008) with a compound growth rate of approximately 2% per annum applied to the base year of 2001. The proportion of heavy vehicles at this location is approximately 15%.

In order to determine the future traffic growth rate on the Pacific Highway, the average annual daily traffic (AADT) data from RMS count station 05.001 was utilised, located at Hexham Bridge (its location is shown in Figure 10.3a). A summary of AADT at this count station is provided in Table 10.2e.

Table 10.2e Recorded AADT on the Pacific Highway, count station 05.001

Year	2001	2004	2005	2006	2007	2008
AADT Growth	33,275	37,781	38,099	38,242	38,913	38,411
		(+4.3%)	(+3.4%)	(+2.8%)	(+2.6%)	(+2.0%)

Source: Hexham Traffic Impact Assessment 2012

Table 10.2e indicates that traffic on the Pacific Highway (at Hexham Bridge) has increased over the period of 7 years (from 2001 to 2008) with a compound growth rate of approximately 2% per annum. For the purpose of this study, a traffic growth of 2% was applied to estimate future traffic volumes on both the New England Highway and the Pacific Highway.

10.2.7. Heavy Vehicle Percentage

Turning movement surveys were undertaken between 6.00 am and 8.00 pm on 28 June 2011 at the Anderson Drive (south)/Anderson Drive (west) intersection.

The turning traffic surveys indicated that the traffic peak hours occurred between 7.30 am and 8.30 am and between 3.30 pm and 4.30 pm, at the Anderson Drive intersection.

Table 10.2f shows a summary of the total number and percentage of light vehicle and heavy vehicle on the southern leg of the intersection during the peak hours.

Table 10.2f Existing intersection traffic volumes

Peak hour	Road	Light vehicles (total)	Heavy vehicles (total)	Light vehicles (%)	Heavy vehicles (%)
7:30am – 8:30am	Anderson Drive (south) northbound	466	23	95%	5%
	Anderson Drive (south) southbound	149	14	91%	9%
3:30pm – 4:30pm	Anderson Drive (south) northbound	380	18	95%	5%
	Anderson Drive (south) southbound	392	23	94%	6%

Table 10.2f indicates that heavy vehicle on the Anderson Drive (south) made up 5% to 9% of the total traffic flow.

10.2.8. Mid-block Level of Service

The Roads and Traffic Authority 2002 *Guide to Traffic Generating Developments* sets out the hourly urban road capacities for two-lane roads for different levels of service (LoS). The definitions and descriptions of each LoS are provided in **Appendix L Traffic and Transport**. Mid-block relates to traffic at the mid-block location (not intersection).

Table 10.2g shows the existing LoS based on the surveyed traffic volumes on Anderson Drive at the Tarro Interchange. The two-way two-lane road is currently operating at LoS B or better.

Table 10.2g Existing mid-block LoS

Peak hour	Road	Direction	Total traffic volume (veh/hr)	LoS
7:30am – 8:30am	Anderson Drive (New England Highway westbound off ramp)	Northbound	65	A
	Anderson Drive (New England Highway westbound on ramp)	Southbound	298	B
3:30pm – 4:30pm	Anderson Drive (New England Highway westbound off ramp)	Northbound	100	A
	Anderson Drive (New England Highway westbound on ramp)	Southbound	177	A

10.3. Traffic Associated with the Proposal

10.3.1. Traffic Generation and Distribution

Program and schedule

The proposed typical working hours are:

- between 7.00 am and 6.00 pm, Monday to Friday; and
- between 8.00 am and 1.00 pm, Saturday.

No works are proposed to be carried out on Sunday or public holidays with the exception of works undertaken during track possessions, when rail services are discontinued.

Exemption to the above working hours would be required during:

- rail possessions;
- works required by utility service providers; and
- delivery of oversize equipment and materials, which may be required to travel at non-disruptive times by the RMS or NSW Police.

10.3.2. Haulage Route

The preferred access option involves the construction of an access road connecting Anderson Drive (Tarro Interchange) and Woodlands Close (Figure 10.3a). The unsealed temporary construction access would be approximately 10m wide. The proposed speed limit on the access road would be 60km/h.

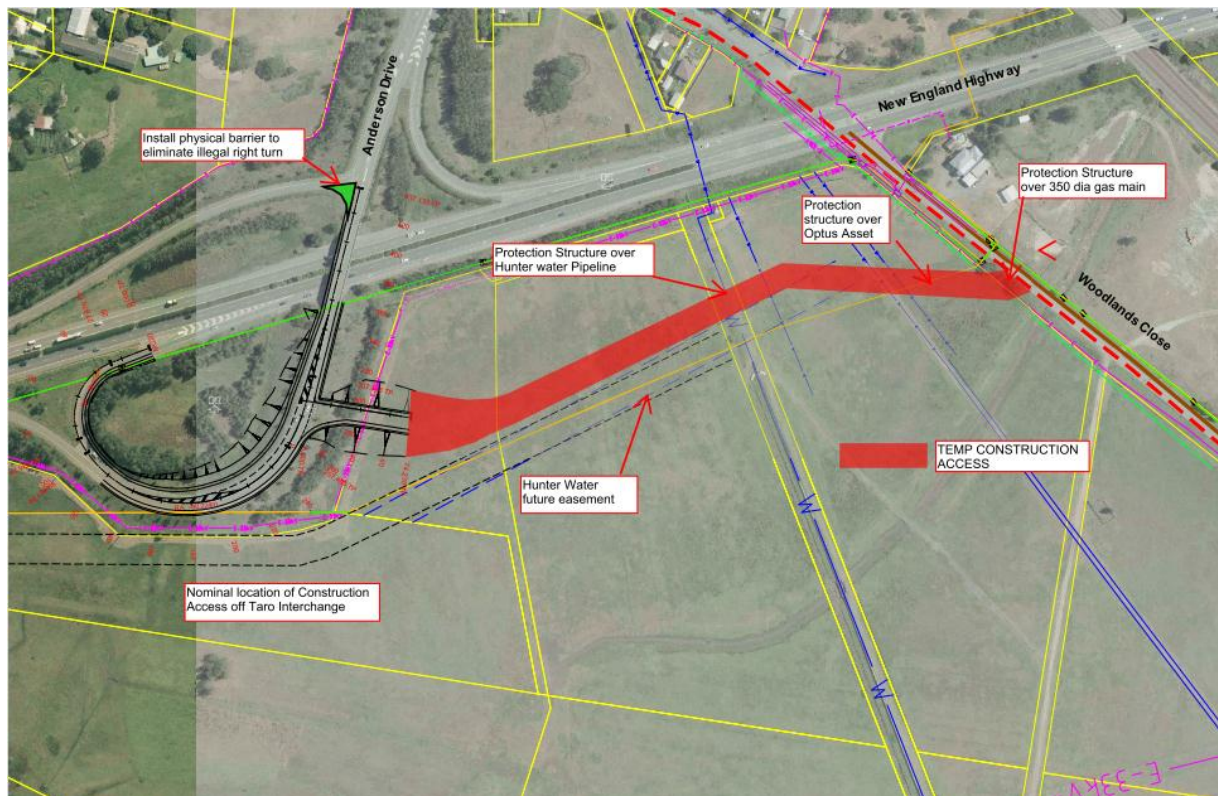


Figure 10.3a Proposed temporary construction access connecting with the Tarro Interchange and a median barrier on Anderson Drive

All construction access would be via the Tarro Interchange at the temporary construction access intersection. This newly created Anderson Drive/temporary construction access intersection would be a Type AU auxiliary intersection with a separate right turn bay. Though traffic lanes would be provided in both directions at that intersection.

The temporary construction access would allow right-in, left-in and left-out movements at the intersection with Anderson Drive. No right-out movement would be permitted from the temporary construction access.

As part of this proposed intersection construction, a concrete median barrier would be constructed to prevent illegal right turn movements from the Tarro Interchange eastbound off-ramp toward Anderson Drive.

Vehicles travelling from Sydney or Maitland via John Renshaw Drive and the New England Highway would enter the temporary construction access and Woodlands Close via the following route (refer to the blue line on Figure 10.3b):

- travel eastbound on John Renshaw Drive;
- John Renshaw Drive becomes the New England Highway;
- turn left into the Vehicle turnaround on the New England Highway via the signalised intersection (under Hexham Bridge);
- loop around turnaround Area and return to signalised intersection (under Hexham Bridge);
- turn right onto the New England Highway;
- leave the New England Highway at the Anderson Drive exit;
- turn right onto the temporary construction access; and
- turn right onto Woodlands Close.

Vehicles travelling to Sydney or Maitland would exit Woodlands Close and the temporary construction access, via the following route (refer to the blue line on Figure 10.3b):

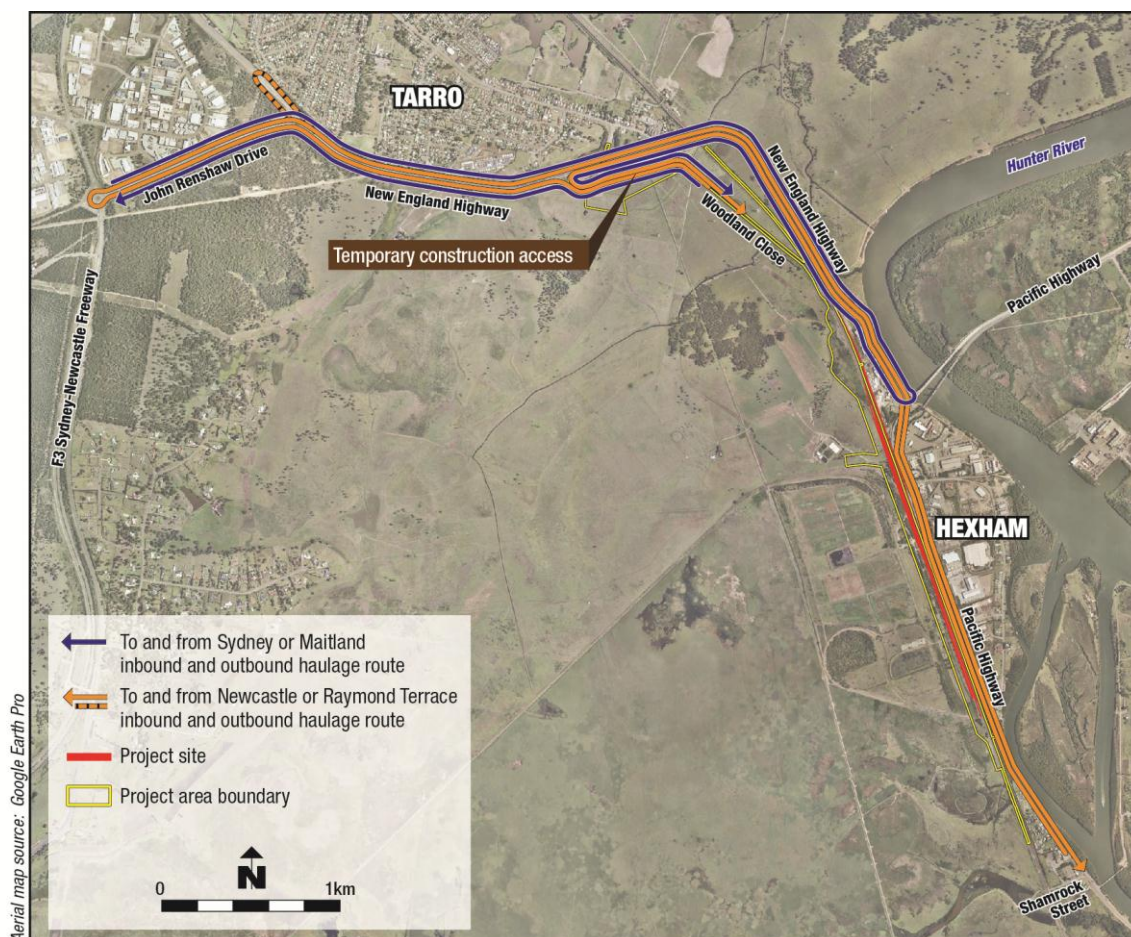
- turn left from the temporary construction access onto Anderson Drive;
- enter the New England Highway via the southbound on-ramp; and
- travel westbound along the New England Highway and John Renshaw Drive.

Vehicles travelling from Newcastle or Raymond Terrace via Maitland Road (Pacific Highway) would enter Woodlands Close via the following route (refer to the orange line on Figure 10.3b):

- travel northbound on Maitland Road (Pacific Highway);
- Maitland Road (Pacific Highway) becomes the New England Highway;
- Leave the New England Highway at the Anderson Drive exit;
- Turn right onto the temporary construction access; and
- turn right onto Woodlands Close.

Vehicles travelling to Newcastle or Raymond Terrace would exit Woodlands Close and the temporary construction access road, via the following route (refer to the blue line on Figure 10.3b):

- travel westbound along the New England Highway and John Renshaw Drive;
- make a U-turn at the F3 Freeway/John Renshaw Drive roundabout or at the U-turn Bay on the New England Highway just north of John Renshaw Drive; and
- travel along the New England Highway toward Newcastle.



Source: Hexham Traffic Impact Assessment 2012

Figure 10.3b Proposed haulage routes

10.3.3. Daily Traffic Generation

The anticipated daily maximum number of light and heavy vehicles entering and exiting the Project Area has been broken down as follows:

Table 10.3a Estimated maximum daily construction traffic generation (light and heavy vehicles)

Vehicle type	Estimated number of vehicles per day	Estimated number of trips per day
Light vehicles	70	140
Heavy vehicles	120	240
Total	190	380

Source: Hexham Traffic Impact Assessment 2012

Based on estimates from Table 10.3a, there would be a maximum of up to 70 inbound light vehicle trips before the start of the shift and 70 outbound light vehicle trips after the shift. During working hours, with the inclusion of heavy vehicles, up to 190 inbound and 190 outbound movements would be generated by the site.

Heavy vehicles coming to the site would include floats, rigid trucks, truck and dog trailers, semi-trailers, cranes, concrete agitators, reinforcement deliveries, toilet pump out trucks, sucker trucks and miscellaneous deliveries. Truck and dog trailers make up the majority of truck movements expected to access the compound site.

On completion of the Project works, road traffic to the site would cease, with the exception of occasional rail corridor maintenance vehicles.

10.3.4. Hourly Traffic Generation

Traffic generated by construction personnel travelling to and from the site would consist of up to 70 light vehicles between 6.00 am and 7.00 am when the personnel arrive at work, as well as personnel leaving the compound between 6.00 pm and 7.00pm at the end of the shift.

Assuming the 120 heavy vehicles for material delivery are distributed throughout the working hours (between 7.00 am and 6.00 pm), there would be 11 trucks per hour arriving and 11 trucks per hour departing from the site in a peak hour.

The traffic peak on the surrounding road network occurs at a different time to the construction peak traffic for the proposed Project. The traffic peak occurs between 7.15 am and 8.15 am and 4.00 pm and 5.00 pm which differ to the construction peak traffic period expected between 6.00 am and 7.00 am and 6.00 pm and 7.00 pm. The light vehicle trips made by construction personnel would occur outside of the traffic peaks, with only heavy vehicle trips being made during traffic peak periods.

Table 10.3b shows the number of hourly trips generated by the Project Area during the day.

Table 10.3b Estimated maximum daily construction traffic generation (light and heavy vehicles)

Working hours	Direction of traffic	Vehicle type	Time	Contributors
Between 7.00am and 7.00pm	Inbound traffic	Construction personnel trip	6.00am – 7.00am	70 construction personnel trips by light vehicles at the start of their work shift
	Inbound and outbound traffic	Construction vehicle trip	Throughout the day between 7.00am and 6.00pm	11 inbound and 11 outbound trips per hour for delivery by heavy vehicles throughout the working hours
	Outbound traffic	Construction personnel trip	6.00pm – 7.00pm	70 construction personnel trips by light vehicles at the end of their work shift

Source: Hexham Traffic Impact Assessment 2012

10.3.5. Traffic distribution

Parsons Brinckerhoff has assumed the traffic distribution for the construction activity related traffic would comprise:

- 50% of trips to/from the Newcastle and Raymond Terrace direction; and
- 50% of trips to/from the Maitland and Sydney direction.

10.4. Potential Impacts – Proposed Project

A traffic impact assessment has been undertaken and the following future scenarios analysed:

- Scenario 1: the proposed Project construction phase without the traffic associated with the construction of QR National TSF (2013); and
- Scenario 2: the proposed Project construction phase plus traffic associated with the construction of QR National TSF (2013).

10.4.1. Intersection Performance

The performance of the road network has been assessed at the new intersection (intersection of Anderson Drive (Tarro Interchange) and the proposed construction access road) using the predicted 2013 traffic volumes, which include additional traffic associated with the construction activities of the proposed Project.

Due to the variance in the proposed Project's traffic generation peak and the background road traffic peak periods, two peak periods were analysed for the construction period:

- Proposed Project peak: 6:00am – 7:00am and 6:00pm – 7:00pm; and
- Background road traffic peak: 7:30am – 8:30am and 3:30pm – 4:30pm.

The results of these analyses show the volumes by direction and the percentage of light and heavy vehicles at the intersection and are presented in **Appendix L Traffic and Transport**.

Tables 10.4a and 10.4b show the intersection summary during the peak hours when construction is at its peak in 2013 with the newly created Anderson Drive/temporary construction access intersection.

Table 10.4a Intersection summary results 2013 (Scenario 1) – Proposed Project traffic generation peak

Intersection	Peak period	DoS*	Average delay (s)	LoS	95 th % Queue (m)
Anderson Drive/temporary construction access intersection	AM (6:00am – 7:00am)	0.18	9	A	1
	PM (6:00pm – 7:00pm)	0.07	8	A	2

*DoS = Degree of Saturation

Table 10.4b Intersection summary results 2013 (Scenario 1) - Background road traffic peak

Intersection	Peak period	DoS*	Average delay (s)	LoS	95 th % Queue (m)
Anderson Drive/temporary construction access intersection	AM (7:30am – 8:30am)	0.18	17	B	3
	PM (3:30pm – 4:30pm)	0.11	13	A	2

*DoS = Degree of Saturation

The analysis indicates that the proposed Anderson Drive/temporary construction access road intersection would operate at an acceptable LoS B or better during the AM and PM peak hours for both the proposed Project traffic generation peak and the background road traffic peak, with short delays and virtually no queuing. The intersection would operate within its design capacity. The results tabled for the intersection performance relate to the worst performing vehicle movements for this intersection:

- for the AM peak hour, this is the left-turn movement from the temporary construction access onto Anderson Drive; and
- for the PM peak hour, these are the left and through movements on Anderson Drive's northern approach.

Based on the model result, the right turning motorists from Anderson Drive onto the construction access road would experience minimal delay during the peak hours, indicating there would be sufficient gaps in Anderson Drive southbound traffic. The proposed 50m short right turn lane would be sufficient to accommodate the traffic waiting to turn right from Anderson Drive onto the temporary construction access road, without interrupting traffic on the adjacent lane (northbound through lane on Anderson Drive).

10.4.2. Mid-block Level of Service

The mid-block LoS was assessed based on the expected construction traffic volumes for Anderson Drive at the Tarro Interchange as compared with the base case mid-block LoS (refer to Table 10.2f).

Table 10.4c 2013 mid-block LoS (Scenario 1) – Proposed Project traffic generation peak

Peak hour	Road	Location	Total traffic volume (veh/hr)	LoS
6:00am – 7:00am	Anderson Drive, north of temporary construction access	Northbound	21	A
		Southbound	316	B
	Anderson Drive, south of temporary construction access	Northbound	56	A
		Southbound	281	B
	Temporary construction access	Eastbound	70	B
		Westbound	0	A
6:00pm – 7:00pm	Anderson Drive, north of temporary construction access	Northbound	35	A
		Southbound	126	A
	Anderson Drive, south of temporary construction access	Northbound	35	A
		Southbound	196	A
	Temporary construction access	Eastbound	0	A
		Westbound	70	A

Table 10.4d 2013 mid-block LoS (Scenario 1) – Background road traffic peak

Peak hour	Road	Location	Total traffic volume (veh/hr)	LoS
7:30am – 8:30am	Anderson Drive, north of temporary construction access	Northbound	68	A
		Southbound	310	B
	Anderson Drive, south of temporary construction access	Northbound	79	A
		Southbound	321	B
	Temporary construction access	Eastbound	11	A
		Westbound	11	A
3:30pm – 4:30pm	Anderson Drive, north of temporary construction access	Northbound	104	A
		Southbound	184	A
	Anderson Drive, south of temporary construction access	Northbound	115	A
		Southbound	195	A
	Temporary construction access	Eastbound	11	A
		Westbound	11	A

Tables 10.4c and 10.4d show that Anderson Drive would operate at LoS B or better during both the proposed Project traffic generation peak and the background road traffic peak.

10.4.3. Sight Distance

A review of Safe Intersection Sight Distance (SISD), Approach Sight Distance (ASD) and Minimum Gap Sight Distance (MGSD) was undertaken using Austroads guidelines for the proposed access intersection on the Tarro Interchange. The results are shown in Table 10.4e.

Table 10.4e SISD, ASD and MGSD for intersection at Tarro Interchange

Intersection	Direction	SISD (m)	Minimum Requirement	ASD (m)	Minimum Requirement	MGSD (m)	Minimum Requirement	Compliance
Anderson Drive/ temporary construction access intersection	Westbound	130	123	130	73			Yes
	Eastbound	100	73	100	40			Yes
	Left turn movement out of access road	-	-	-	-	130	83	Yes
	Right turn movement into access road	-	-	-	-	100	83	Yes

In summary, the SISD, ASD and MGSD for this proposed intersection location comply with the Austroads guideline requirements. Motorists would have sufficient sight distance along Anderson Drive when negotiating the intersection.

10.4.4. Public Transport

The proposed Project would connect to the rail lines in Hexham dedicated to the coal network (i.e. the Up Coal and Down Coal) and not the main line (Main North Line). The main line (i.e. the Up Main and Down Main) in Hexham include trains for public transport and freight rail services. The operation of the proposed Project would therefore not impact upon other rail (public transport or freight) services through Hexham or in the region.

Construction works within the rail corridor would be undertaken during scheduled possessions. These possessions are scheduled for maintenance purposes but are also used for the construction of new rail facilities. Possessions impact upon all rail services and as such the proposed Project would not on its own impact upon existing rail services during the construction phase.

10.4.5. Pedestrians and Cyclists

Although the existing level of pedestrian and cycling activities is considered low, the safety of pedestrians and cyclists that may use the haulage route would be considered in a construction traffic management plan.

The proposed Project is unlikely to impose any adverse impacts on the existing pedestrian and cycling facilities available.

10.4.6. Impacts on Local Access on Woodlands Close

Access to Woodlands Close via New England Highway would be maintained for local residents and local and State Government authorities such as Hunter Water, Hunter-Central Rivers Catchment Management Authority and the Australian Rail Track Corporation to adjacent lands and to their infrastructure.

Construction traffic would use the southern section of Woodlands Close and the temporary construction access road as part of the proposed haulage routes. Therefore, construction traffic would not impose significant impact on the local access to Woodlands Close via the New England Highway.

10.4.7. Impacts on the Access to Adjoining Lands and Infrastructure

Hexham Swamp Nature Reserve: access to the nature reserve via Woodlands Close would be maintained for authorised vehicles at all times. Signage would be provided to warn road users of the turning construction trucks at the Woodlands Close/access road intersection.

Hexham Railway Station: construction activities would not affect vehicular and pedestrian access to the Hexham railway station as its access is via Maitland Road (Pacific Highway) located on the other side of the rail line.

Hunter Water Infrastructure: access to Woodlands Close via New England Highway would be maintained for Hunter Water for their infrastructure.

10.4.8. Impacts on the Regional Road Network

Throughout the working day, it is expected that up to 22 additional heavy vehicle trips per hour would be assigned to Anderson Drive and the temporary construction access for the proposed Project. The intersection that would be immediately affected is the newly created Anderson Drive/temporary construction access road intersection.

The number of heavy vehicles for the proposed Project, when assigned to the New England Highway, is a very small increase on top of the existing heavy vehicle traffic that this road normally experiences. The proposed Project heavy vehicle traffic would equate to 0.4% of the total vehicle traffic on the New England Highway at this location. The existing heavy vehicle traffic at this location accounts for approximately 15% of the total vehicle traffic. Given the temporary nature of the increase (one year construction duration), and the fact that the New England Highway is designated for heavy vehicle traffic, the potential impacts of the additional vehicle movements associated with the works are anticipated to be insignificant.

Delivery vehicles would travel on a designated route along the New England Highway. It is proposed that no heavy vehicles would use Anderson Drive north of the New England Highway, thus it is expected that no impact would be imposed on local residents of Tarro.

Potential impacts would therefore be limited to a possible temporary and mild disruption of users of the New England Highway when equipment and materials are being delivered to the Project Area. The low magnitude would not impose adverse impacts on the regional road network.

10.5. Potential Impacts – Cumulative

A cumulative traffic impact assessment has been undertaken taking into consideration that the construction of both the proposed Project and QR National TSF overlapping for a period of three months in 2013.

10.5.1. Intersection Performance - Cumulative

Tables 10.5a and 10.5b show the intersection summary during the peak hours when construction is at its peak in 2013 with the newly created Anderson Drive/temporary construction access road intersection. This is when the construction of the QR National TSF would occur.

Table 10.5a Intersection summary results 2013 (Scenario 2) – Proposed Project + QR National traffic generation peak

Intersection	Peak period	DoS*	Average delay (s)	LoS	95 th % Queue (m)
Anderson Drive/temporary construction access intersection	AM (6:00am – 7:00am)	0.23	9	A	4
	PM (6:00pm – 7:00pm)	0.20	9	A	7

*DoS = Degree of Saturation

Table 10.5b Intersection summary results 2013 (Scenario 2) - Background road traffic peak

Intersection	Peak period	DoS*	Average delay (s)	LoS	95 th % Queue (m)
Anderson Drive/temporary construction access intersection	AM (7:30am – 8:30am)	0.18	17	B	3
	PM (3:30pm – 4:30pm)	0.11	13	A	2

*DoS = Degree of Saturation

When compared to the Scenario 1 results in Tables 10.5a and 10.5b, the performance of the intersection is similar in that it is forecast to operate at LoS B or better during the AM and PM peak hours for both the proposed Project traffic generation peak and the background road traffic peak, with short delays and virtually no queuing. The intersection would operate within its design capacity. The results tabled for the intersection performance relate to the worst performing vehicle movement for this intersection which is the left-turn movement from the temporary construction access onto Anderson Drive.

Based on the model result, the right turning motorists from Anderson Drive onto the construction access road would experience minimal delay during the peak hours, indicating there would be sufficient gap in Anderson Drive southbound traffic. The proposed 50 m right turn lane would be sufficient to accommodate the traffic waiting to turn right from the Anderson Drive onto the temporary construction access road, without interrupting traffic on the adjacent lane (northbound through lane on Anderson Drive).

10.5.2. Mid-block Level of Service

The mid-block LoS was assessed based on the expected construction traffic volumes for Anderson Drive at the Tarro Interchange as compared with the base case mid-block LoS (refer to Table 10.2f).

Table 10.5c 2013 mid-block LoS (Scenario 2) – Proposed Project + QR National traffic generation peak

Peak hour	Road	Location	Total traffic volume (veh/hr)	LoS
6:00am – 7:00am	Anderson Drive, north of temporary construction access	Northbound	21	A
		Southbound	401	C
	Anderson Drive, south of temporary construction access	Northbound	141	A
		Southbound	281	B
	Temporary construction access	Eastbound	240	B
		Westbound	0	A

Peak hour	Road	Location	Total traffic volume (veh/hr)	LoS
6:00pm – 7:00pm	Anderson Drive, north of temporary construction access	Northbound	35	A
		Southbound	126	A
	Anderson Drive, south of temporary construction access	Northbound	35	A
		Southbound	366	B
	Temporary construction access	Eastbound	0	A
		Westbound	240	B

Table 10.5c 2013 mid-block LoS (Scenario 1) – Background road traffic peak

Peak hour	Road	Location	Total traffic volume (veh/hr)	LoS
7:30am – 8:30am	Anderson Drive, north of temporary construction access	Northbound	68	A
		Southbound	310	B
	Anderson Drive, south of temporary construction access	Northbound	84	A
		Southbound	326	B
	Temporary construction access	Eastbound	16	A
		Westbound	16	A
3:30pm – 4:30pm	Anderson Drive, north of temporary construction access	Northbound	104	A
		Southbound	184	A
	Anderson Drive, south of temporary construction access	Northbound	120	A
		Southbound	200	A
	Temporary construction access	Eastbound	16	A
		Westbound	16	A

Tables 10.5b and 10.5c show that Anderson Drive would operate at LoS C or better during the proposed Project and QR National TSF traffic generation peak, and at LoS B or better during the background road traffic peak.

10.6. Operation

Maintenance works would be required in the rail corridor following the commissioning of the Relief Roads. The amount of operational activities and the associated number of maintenance vehicles would vary depending on what work needs to be undertaken. Maintenance works would be undertaken on an as needs basis.

The temporary construction access would no longer be used by ARTC following construction. Maintenance vehicles' access to the rail corridor would be via the New England Highway and Woodlands Close. However, QR National would likely continue to utilise the access road and may upgrade it to become a permanent access subject to approval.

The amount of operational activities would be significantly less than the construction activities that have been considered in the traffic impact assessment. It is anticipated that the traffic generated by the operational activities is unlikely to impose adverse traffic impacts to the local and regional road network.

10.7. Mitigation Measures

Construction Traffic Management

Prior to any construction commencing, a construction traffic management plan (TMP) would be prepared as part of the pre-construction planning. The plan would detail how the traffic associated with construction would be managed in accordance with the Roads and Traffic Authority 2010 Traffic Control at Work Sites, as well as relevant Australian Standards including AS1742.

The construction traffic management plan would make particular consideration of:

- provide a swept path analysis to ascertain that sufficient manoeuvring space is provided for all vehicles at intersections along the haulage routes;
- traffic management signs to advise road users in advance of work zones and surrounding intersections, and advanced warning signs to be erected in advance of the works commencing; and
- emphasis on banned right turn movements on the Anderson Drive/temporary construction access intersection and the documentation of suitable U-turn facilities elsewhere.

Traffic control plans would be prepared as part of the construction traffic management plan for specific stages of work or locations as required. A review of temporary road work traffic control measures, signage and speed limits in areas of potential risk would also be undertaken.

The construction traffic management plan would also outline procedures to audit implementation of the plan and particularly to aim to ensure that safety aspects are being observed.

The following recommendations are made to minimise the safety and operational impact as a result of the construction activity:

- provide advanced T-junction warning signs to warn motorists of the upcoming intersection on Anderson Drive;
- provide suitable signage to prohibit non-construction vehicles from entering the temporary construction access;
- provide suitable signage to prohibit large vehicles from turning left from Anderson Drive onto the temporary construction access;
- provide Project personnel with information on site access as well as locations where vehicle turnaround intersections are provided; and
- Establish a site rule that entry and exit to/from the site must be from the newly created Anderson Drive/temporary construction access road intersection and vehicular access to the New England Highway via Woodlands Close is banned after the temporary construction access road is constructed.

11. Contamination

The DGRs identify soil and land contamination as a key issue for the EIS. A Contamination Assessment (CA) was undertaken and is provided in **Appendix F Contamination**. This Chapter presents the results of that assessment and includes a summary of identified contamination issues and the way in which they would be managed.

Table 11.1a outlines the DGRs relevant to land contamination and where the DGR is addressed.

Table 11.1a Director-General's Environmental Assessment Requirements – Soils and Land Contamination

Director-General's Environmental Assessment Requirements	Where Addressed
Soils and Land Contamination – including but not limited to: - land contamination and identification of the need for remediation of contaminated land, having regard to the ecological and human health risks posed by the contamination in the context of past, existing and future land uses; - where remediation of contaminated land is required, presentation of a Remedial Action Plan in accordance with relevant OEH (EPA) guidelines; - geological and soil characteristics (physical and chemical) that may impact on land stability and geological integrity; - quantification of bulk earthworks and spoil balance and disposal of excess spoil; - a strategy for managing earthworks with a particular focus on those works that have the greatest potential to disturb soils that are contaminated, have a high erosion and run off hazard; and - management of waste including handling, stockpiling and transportation, and the classification of waste taking into account the Waste Classification Guidelines (DECCW 2009).	Sections 11.3 and 11.4 of this Chapter Appendix F Contamination Chapter 12 Soils and Water Management Chapter 12 Soils and Water Management Chapter 12 Soils and Water Management Sections 11.1 and 11.4 of this Chapter

11.1. Assessment Methodology

The objectives of the CA were to:

- identify potentially contaminating activities that are currently being performed within the Project Area and that may have been performed in the Project Area in the past;
- assess potential Areas of Environmental Concern (AECs) and Chemicals of Concern (COCs) within the Project Area;
- assess the soil, groundwater and surface water contamination status of the Project Area through sampling and laboratory analysis;
- provide an assessment of the suitability of soil and fill to be re-used within the Project Area;
- provide a preliminary in-situ waste classification of soil and fill that may be taken off site; and
- provide recommendations for further investigations, remediation and/or management (if required).

The following scope of works was undertaken:

- review of previous reports carried out on this site and adjacent sites, including review of the Douglas Partners Pty Ltd *Preliminary Contamination Assessment, Proposed Hexham Redevelopment, Maitland Road and Woodlands Close, Hexham* (Douglas Partners, 2011);

- a site history assessment including a review of historical aerial photographs and land title documents;
- a walkover of the Project Area to assess current site conditions;
- excavation of 28 test pits and collection of soil samples from the test pits;
- collection of 37 surface soil samples and 20 rail ballast samples;
- drilling of 8 hand auger boreholes and collection of soil samples;
- installation of 10 groundwater wells and collection of 12 groundwater samples from newly installed wells and two wells previously installed by Douglas Partners;
- collection of 20 surface water samples;
- laboratory analysis of selected soil, ballast and groundwater samples for a suite of potential Chemicals Of Concern; and
- data assessment and preparation of Contamination Assessment report.

Investigation levels for soil and ballast were established based on the following references:

- NSW DEC *Guidelines for the NSW Auditor Scheme* (Second Edition) (DEC, 2006);
- NSW EPA, *Guidelines for Assessing Service Station Sites* (NSW EPA, 1994); and
- National Environmental Protection Council (NEPC) *National Environmental Protection (Assessment of Site Contamination) Measure* (NEPM) (NEPC, 1999).

In order to provide an in-situ waste classification for the material assessed, the results of the laboratory analysis were compared to assessment criteria for *General Solid Waste and Restricted Solid Waste in the NSW: Waste Classification Guidelines* (DECCW, 2009a).

The surface water and groundwater at the site was assessed against the following criteria:

- *Protection of Aquatic Ecosystems* (ANZECC (2000)) - Proposes a low reliability trigger value for Total Petroleum Hydrocarbons (TPH) of 7 µg/L. This guideline is generally considered by industry to be overly conservative and is also well below the TPH detection limit that most laboratories can achieve; therefore, no guideline concentration has been adopted for TPH in groundwater at this site; and
- *Australian Drinking Water Guidelines* - The NSW DECC (2009) 'Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997' provide trigger values for the duty to report. These trigger values are based on health criteria in *the Australian Drinking Water Guidelines* (NHMRC, 2004). The assessment criteria for surface water and groundwater are included in **Appendix F Contamination**.

11.1.1. Sampling plan

Field work for the CA was undertaken from 12 December 2011 to 27 April 2012. The sampling and analysis plan was designed to target the AECs identified. The following samples were collected:

- soil samples from test pits at approximately 100m intervals along the length of the Study Area;
- surface soil samples and fragments of potential asbestos containing materials (PACM) collected in an area of former coal preparation plant buildings to assess potential contamination from hazardous building materials;
- surface soil samples collected at approximately 250m intervals adjacent to the rail corridor to assess potential contamination on surface soils from the rail corridor;
- surface samples were collected adjacent to a hydrocarbon hotspot to assess the horizontal extent of contamination at that location;
- surface samples were collected along Woodlands Close to assess contamination in this area;
- rail ballast samples at approximately 200m to 300m intervals along the length of the rail corridor to assess potential contamination in the rail ballast;
- hand auger boreholes drilled at approximately 100m intervals between chainage 175.900km and 176.100km;
- hand auger boreholes adjacent to the Jemena high pressure gas pipeline to assess contamination in this area;

- a fragment of PACM collected from a stockpile of fibro-board to assess if the fibro-board contained asbestos;
- two fragments of PACM were collected adjacent to a dilapidated building near the high pressure gas main to assess if they contained asbestos;
- two samples of soil were collected from stockpiles of illegally dumped material to assess potential contamination;
- a hand auger borehole into what appeared to be a backfilled excavation;
- two test pits were excavated from suspected former fuel storage area to assess whether hydrocarbon contamination was present within the backfill materials;
- surface water samples collected from surface water ponds within and adjacent to the Project Area;
- groundwater wells with the monitoring well installed to a depth of 4.0m; and
- groundwater samples collected from groundwater wells.

The sampling locations are shown on Figures 3A to 3D and 4A to 4D of the CA (refer **Appendix F Contamination**).

11.1.2. Sampling analysis

The selected soil samples were analysed for the following:

- Asbestos – 96 samples;
- Polycyclic Aromatic Hydrocarbons (PAH) – 84 samples;
- Organochlorine Pesticides (OCP) – 53 samples;
- Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) – 47 samples;
- Total Petroleum Hydrocarbons (TPH) – 57 samples;
- Polychlorinated Biphenyls (PCB) – 29 samples; and
- Lead – 16 samples.

The method above was also used to provide a waste classification for the material assessed. Based on the results of the initial analysis, 13 samples were submitted for leachability testing using the Toxicity Characteristic Leaching Procedure (TCLP) for arsenic, lead, nickel and benzo(a)pyrene.

Selected groundwater samples were analysed for the following:

- Total Petroleum Hydrocarbons (TPH) – 12 samples;
- Benzene, toluene, ethylbenzene, xylenes (BTEX) – 12 samples;
- Polycyclic Aromatic Hydrocarbons (PAH) – 12 samples;
- Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) – 12 samples;
- Major cations (Na, K, Ca, Mg, Fe) and major anions (Cl, HCO₃, CO₃, SO₄) – 12 samples;
- Nitrogen – 12 samples;
- Phosphorous – 12 samples;
- Ammonia – 12 samples; and
- Faecal coliforms and E. Coli – 7 samples.

Selected surface water samples were analysed for the following:

- Total Petroleum Hydrocarbons (TPH) – 12 samples;
- Benzene, toluene, ethylbenzene, xylenes (BTEX) – 12 samples;
- Polycyclic Aromatic Hydrocarbons (PAH) – 12 samples;
- Heavy Metals (As, Cd, Cr, Cu, Pb, Hg, Ni, Zn) – 12 samples;
- pH and electrical conductivity – 12 samples;
- Biological oxygen demand (BOD) – 12 samples;
- Nitrogen – 12 samples;
- Phosphorous – 12 samples;
- Ammonia – 12 samples; and
- Faecal coliforms and E. Coli – 20 samples.

11.2. Existing Environment

The information obtained from the site review is summarised below and in Figures 11.2a-c.

- It appears that the rail corridor has been present on the eastern portion of the Project Area for approximately 150 years. The existing railway lines are situated on ballast of up to approximately 1.5m above the natural ground surface level.
- The northern portion of Lot 100 DP 1044020 currently appears to be used for rural residential purposes. Based on information from the titles search it has likely been used for dairy cattle grazing, and motor vehicle repairs in the past.
- Parts of Lot 113 DP 755232 have been used for effluent treatment purposes. Effluent irrigation is still undertaken on the lot. The lot has a common boundary with the Project Area from about chainage 175.900km to chainage 176.500km.
- The western portion of the Project Area (non-railway corridor) appears to have been used for dairy cattle grazing in the past. The majority of the Project Area is currently undeveloped, and still used for cattle grazing. Some former buildings were present in scattered locations.
- The southern-middle part of the Project Area appears to have been used for farming (dairy cattle grazing). The Hexham Coal Preparation Plant was constructed in this area in 1955 and operated until 1988.
- The Hexham Coal Preparation Plant included several buildings, many of which were partially located on the Project Area. The remnants of the buildings are present on and adjacent to the Project Area. An area where former abandoned fuel tanks were used is located in the Project Area at about chainage 174.785km. Stockpiling of coal was associated with the Coal Preparation Plant, generally to the west of the Project Area.
- Waste materials appear to have been illegally dumped by the general public from time to time. These materials may include waste hazardous building materials (i.e. asbestos).
- The surrounding land uses over the last 50 years appear to be a combination of vacant land, residential properties and commercial/industrial businesses.
- Surface water drainage and groundwater flow has been altered by the placement of the rail corridor and fill and the historical industrialisation of the western portion of Hexham Wetland.
- The timing of the fill placement on the Project Area is not known. Based on the past uses of the site, it is likely the majority of the fill was placed at the time of the Hexham-Minmi Railway (about 1850's), and coal processing and stockpiling (about 1950's to 1980's).

A search of NSW OEH notices issued under the *Contaminated Land Management Act 1997* revealed two properties in the general Hexham area listed as having contamination notices. The properties are located 0.5km and 1.2km from the Project Area. Based on these distances it is not expected that either property would affect the Project Area.

11.2.1. Subsurface conditions

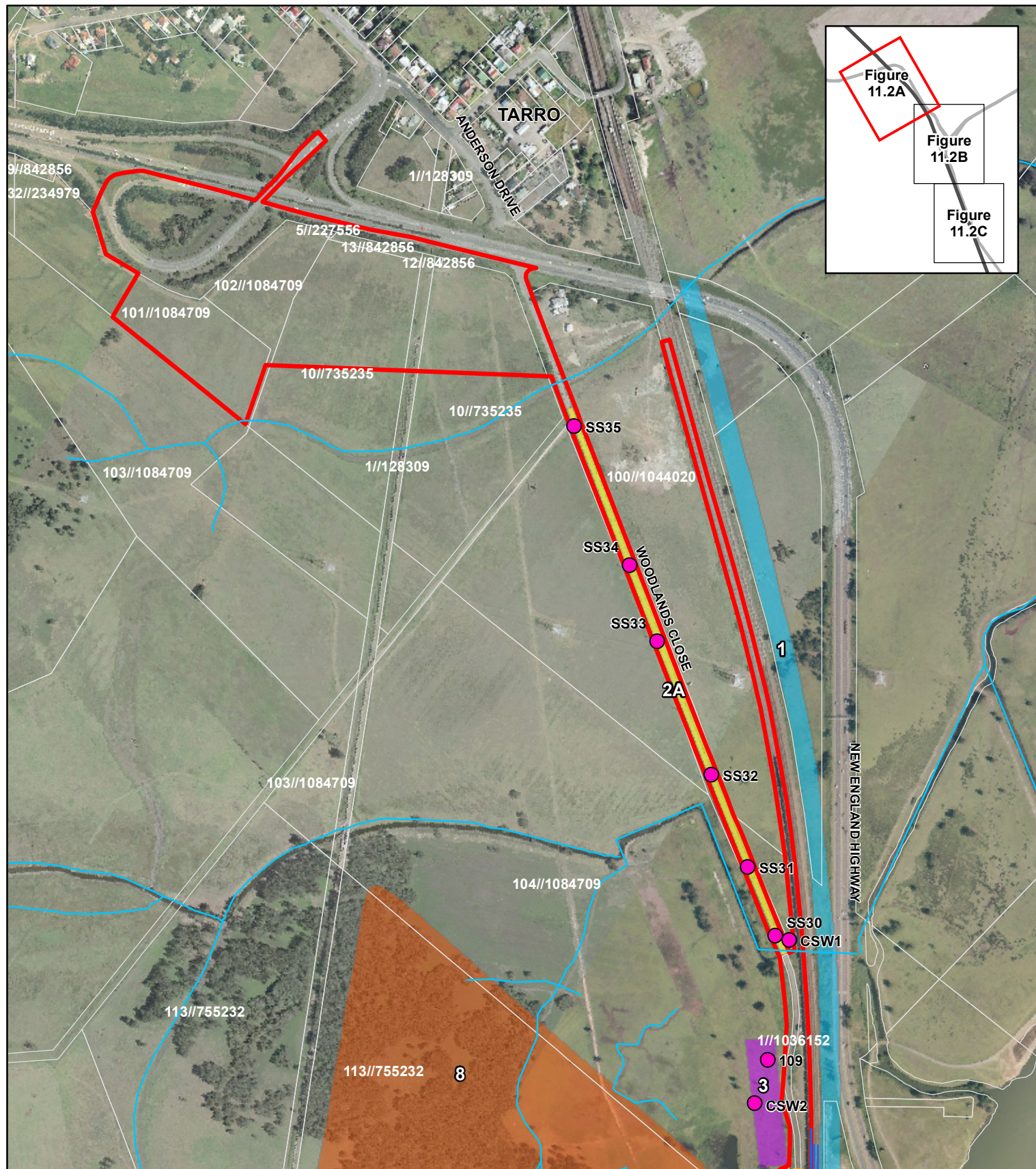
The general subsurface conditions are detailed in Table 11.2a.

Table 11.2a General Subsurface Conditions

Material	Depth (m bgs)
Fill (ballast, import, coal, ash, topsoil)	0.45 - 2.6
Topsoil/Alluvial soil	0.8 - 2.1
Alluvial soil	1.5 – 3.0*

*Depth to base of alluvial soil is the depth of investigation for the majority of test pits.

No staining or odours were observed in the test pits. Coal reject and ash were observed in numerous test pits. Waste materials (other than coal reject and ash) were observed in test pits: one test pit had approximately 60% slag from 0.0m to 0.15m depth, another had several bricks, a glass bottle and a



- Concentrations Above Adopted Criteria
- Drainage
- Relief Roads
- Project Area
- Geotechnical Study Area (Coffey)

- AEC 1
- AEC 2A
- AEC 3
- AEC 4
- AEC 6
- AEC 8
- AEC 9

A4 Original

0 50 100 200 300

Metres

GDA 1994 MGA Zone 56

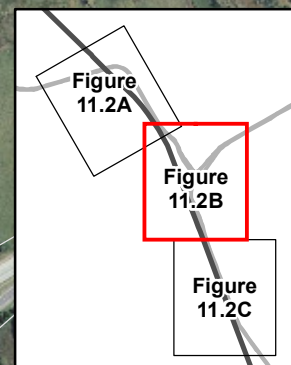
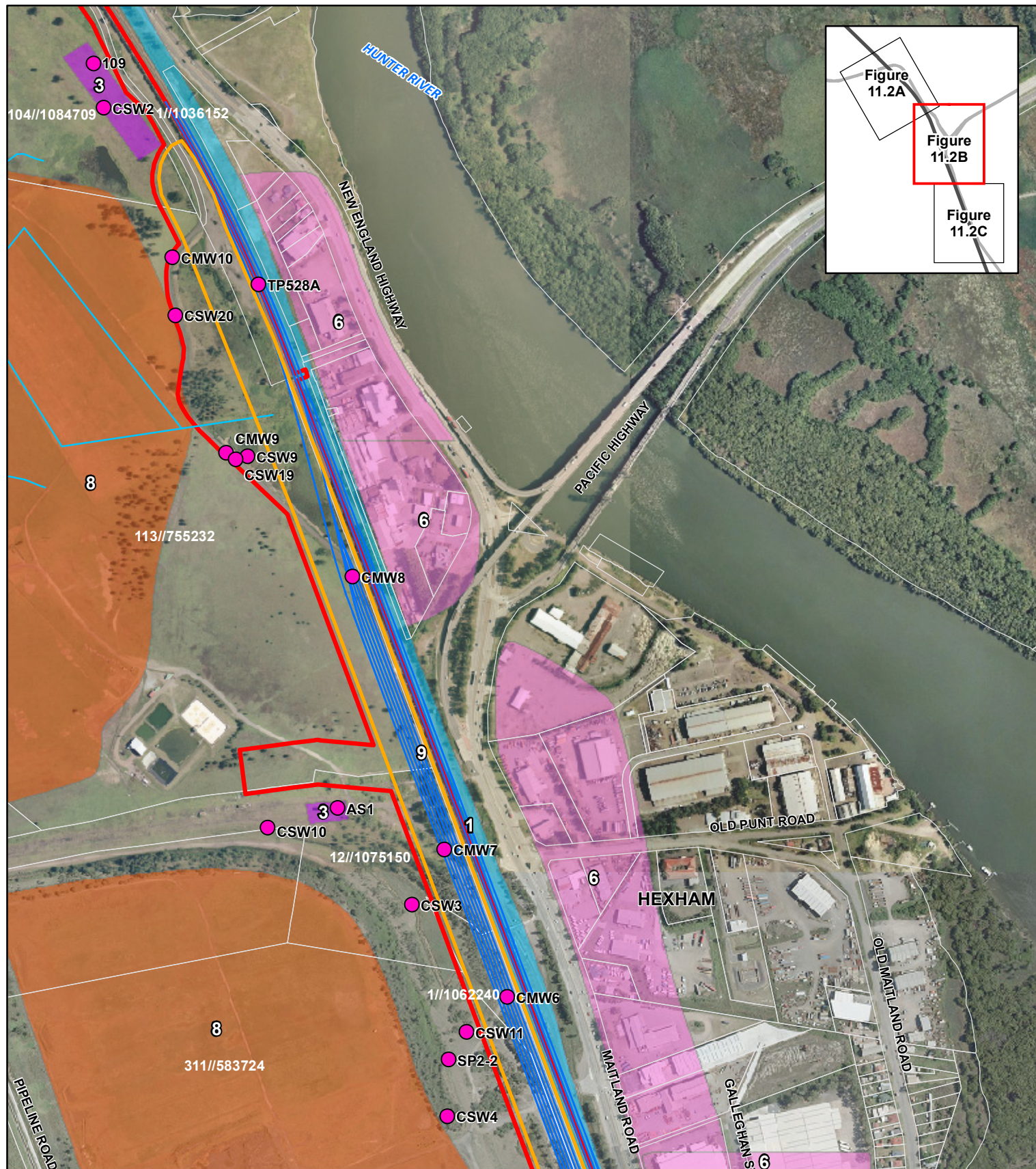


ARTC
Hexham Relief Roads

**Contamination
Assessment Results**

Job Number | 2110501A
Revision | A3
Date | 11.05.2012
Scale | 1:7,000

Figure 11.2a



- Concentrations Above Adopted Criteria
- Drainage
- Relief Roads
- Project Area
- Geotechnical Study Area (Coffey)

- | | |
|---|---|
| AEC 1 | AEC 6 |
| AEC 2A | AEC 8 |
| AEC 3 | AEC 9 |
| AEC 4 | |

A4 Original

0 50 100 200 300

Metres

GDA 1994 MGA Zone 56

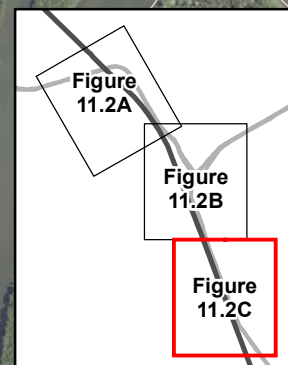
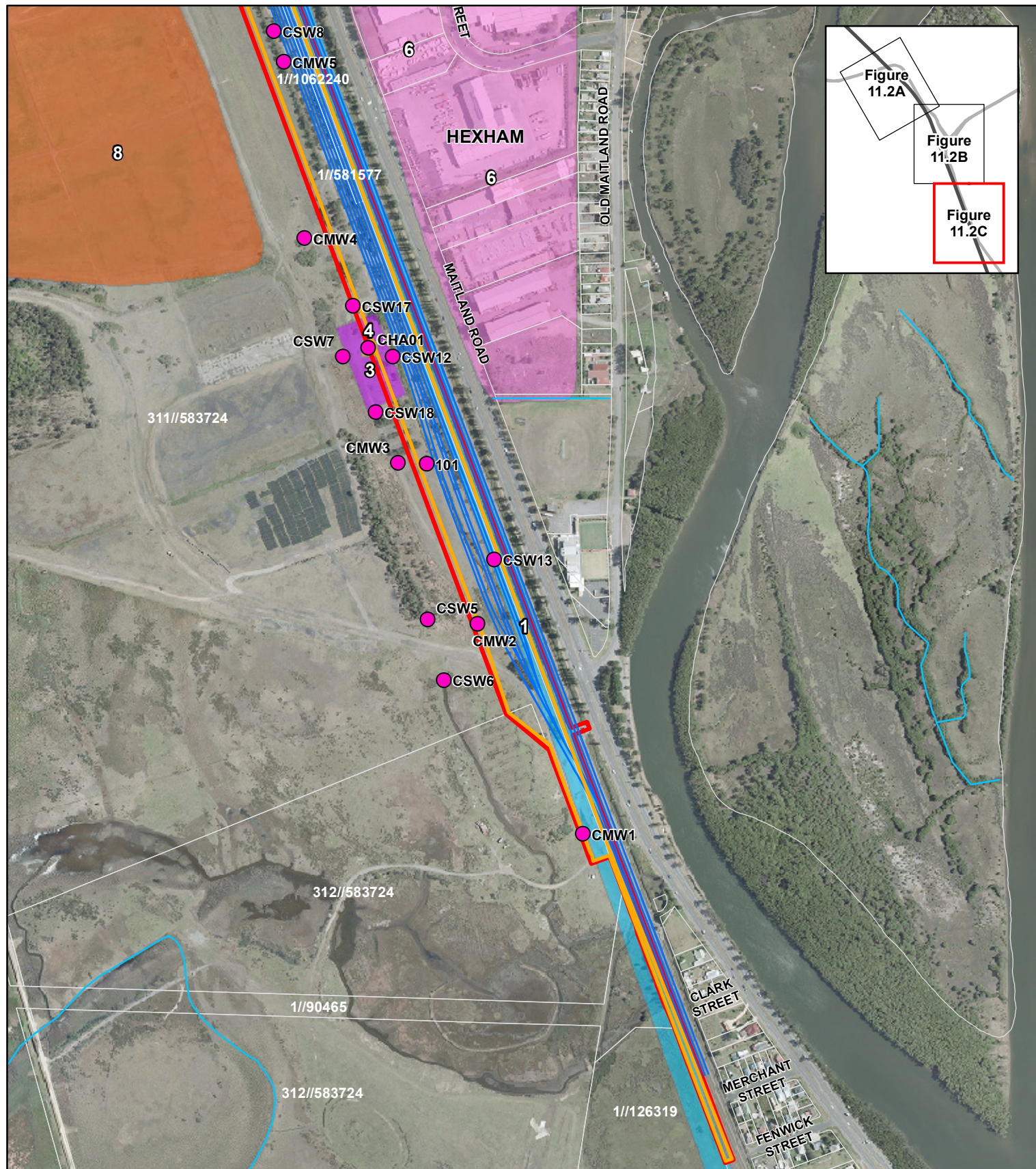


ARTC
Hexham Relief Roads

**Contamination
Assessment Results**

Job Number	2110501A
Revision	A3
Date	11.05.2012
Scale	1:7,000

Figure 11.2b



- Concentrations Above Adopted Criteria
- Drainage
- Relief Roads
- Project Area
- Geotechnical Study Area (Coffey)

- | | |
|---|--|
| AEC 1 | AEC 6 |
| AEC 2A | AEC 8 |
| AEC 3 | AEC 9 |
| AEC 4 | |

A4 Original

0 50 100 200 300

Metres

GDA 1994 MGA Zone 56



ARTC
Hexham Relief Roads

**Contamination
Assessment Results**

Job Number	2110501A
Revision	A3
Date	11.05.2012
Scale	1:7,000

Figure 11.2c

piece of rusted metal at 0.9m to 1.6m depth, and a 1m long piece of rail, pieces of wood and a tree root at 0.8m to 1.7m depth were found.

Groundwater was encountered during test pitting at depths of between 0.25m and 1.90m below ground surface. The groundwater inflows were within fill materials, except for an inflow in one test pit at 1.40m bgs. The inflows may represent localised perched water within fill, rather than the regional groundwater table. Variations in groundwater depth may occur due to factors such as rainfall and climatic conditions.

11.2.2. Soil contamination and waste classification

Ten AECs were identified: rail ballast, fill materials of unknown origin and quality, former building footprints, former abandoned fuel tanks, historical rail use, adjacent industrial land use, groundwater, effluent irrigation, and northern end of Woodlands Close. Figures 11.2a-c show the location of the AECs.

The laboratory results for soil contamination showed concentrations below the assessment criteria for commercial/industrial land use under the *General Solid Waste and Restricted Solid Waste in the NSW: Waste Classification Guidelines* (DECCW, 2009a) with the following exceptions:

- Test Pit Holes (TPH C10-C36) above the criteria (1,000mg/kg) in samples TP505B 0.5-0.6m (1,640mg/kg), TP506B 1.1-1.2m (1,880mg/kg), TP509A 0.2-0.3m (1,190mg/kg), TP514B 0.1-0.2m (1,040mg/kg), TP528A 0.2-0.3m (3,200mg/kg), TP529A 0.3-0.4m (1,660mg/kg), HA3 0.0-0.1m (2,363mg/kg), TP531 0.4-0.5m (1,720mg/kg), TP532 0.4-0.5m (4,732mg/kg), SS30 (1,334mg/kg), SS31 (1,040mg/kg), SS35 (1,100mg/kg) and SP2-2 (1,180mg/kg);
- Benzo(a)pyrene above the criteria (5mg/kg) in samples TP532 0.4-0.5m (110mg/kg) SS30 (5.6mg/kg), SS31 (7.1mg/kg), SS32 (21mg/kg), SS33 (9.1mg/kg), SS34 (15mg/kg), and SS35 (28mg/kg);
- Total PAHs above the criteria (100mg/kg) in samples TP532 0.4-0.5m (1,300mg/kg), SS32 (200mg/kg), SS34 (150mg/kg), and SS35 (270mg/kg); and
- Lead above the criteria in sample TP516B 0.2-0.3m (1,900mg/kg).

Contamination in the form of TPH C10-C36 was identified at greater than 2.5 times the adopted criteria in TP528A 0.2-0.3m and TP532 0.4-0.5m. Benzo(a)pyrene and total PAHs were also identified in TP532 0.4-0.5m as greater than 2.5 times the adopted criteria. This is within ballast and coal reject fill material within the ARTC compound area.

Contamination in the form of TPH C10-C36, benzo(a)pyrene, and total PAHs was identified in samples SS30 to SS35. This was in material that was likely imported for construction of Woodlands Close.

A former abandoned fuel tank area, AEC 4, was identified during the site history assessment. Observations in the area indicated there may be a backfilled excavation. No evidence of tanks was observed to a depth of 1.1m bgs. Testing of hydrocarbons in this area identified elevated TPH C10-C36 concentrations from 0.0m to 1.1m bgs (471mg/kg to 995mg/kg).

Based on the results of the site history assessment and the soil sampling and analysis, the potential for widespread soil contamination within the fill and natural materials in the Project Area is considered low.

The results for waste classification showed that the fill material is general solid waste, with the exception of:

- Localised area around TP516B 0.2-0.3m (lead at 1,900mg/kg) which classifies as restricted solid waste. The potential volume of this material is 2,500m³;
- Localised area around TP532 0.4-0.5m (benzo(a)pyrene 110mg/kg, PAHs 1,300mg/kg) which classifies as hazardous waste. The potential volume of this is estimated to be about 1,500m³;
- Woodlands Close, where benzo(a)pyrene and total PAH concentrations classify soils around SS31, SS32 and SS34 as restricted solid waste, and around SS35 as hazardous waste. The potential volume of restricted solid waste is estimated to be about 3,500m³, and hazardous

waste is estimated to be about 900m³. These volumes are based on a fill depth of about 0.2m; and

- A stockpile of fibre-board in the location of sample AS1 classified as asbestos waste. This stockpile has been removed from the site.

Natural material does not meet the definition of VENM due to the potential presence of acid sulfate soils. Therefore, natural soils also classify as general solid waste. Should acid sulfate soils be disposed to landfill, then it will require lime to be added prior to disposal.

Depending on the volumes of material to be excavated, and the proposed re-use, it may be appropriate to apply for site specific exemptions for re-use of natural or fill materials on other properties. This would be assessed once the volumes and types of material to be excavated are known.

11.2.3. Surface and groundwater contamination

Surface water and groundwater samples have been collected to target AEC 6 to AEC 8. Widespread contamination of surface water, in the form of faecal coliforms, E. Coli, nutrients and metals, was identified both on site and immediately off-site. Widespread contamination of groundwater in the form of metals and nutrients was also identified.

It is considered that the surface water contamination identified is likely to be associated with either grazing of cattle or effluent irrigation (AEC9) that occurs to the west of the Project Area. The long history of industrialisation in this part of the Hexham Wetland has resulted in a degraded wetland system. The concentrations of faecal coliforms and E. Coli in surface water, and nutrients and metals in surface water and groundwater, confirm that the Hexham Wetland is in a degraded state.

The surface water and groundwater contamination is considered to present a potential risk to human health for construction workers and appropriate management procedures would be implemented during construction (refer below).

Laboratory results for surface and groundwater are provided in **Appendix F Contamination**.

11.3. Potential Impacts

Mobilisation of contaminants has the potential to occur during construction activities and result in off-site contamination via stormwater runoff or emissions to air.

The majority of potential impacts would be likely to occur during the construction phase through the excavation and handling of potentially contaminated and hazardous materials. A summary of the impacts from water contamination on both the humans and ecology is provided below:

- **Human health risk:** both surface and groundwater have the potential to migrate off-site and therefore has the potential to pose harm to humans. Screening levels for human health risk have been considered as part of this assessment having regard to trigger values in ANZECC (2000) for recreational water use and comparisons of faecal coliform testing with NSW EPA guidelines. This assessment has identified that concentration of some contaminants exceeded the trigger values for human health.
- **Ecological health risk:** surface water and groundwater have the potential to impact on the ecological health of some aquatic ecosystems. Sampling and results taken from the Project Area were compared to trigger values in ANZECC (2000). It is understood that the existing aquatic environments are highly degraded due to past and present agricultural uses. It was identified that existing concentrations exceed the trigger values for ecological health.

The existing water (surface water and groundwater) on site are at levels above relevant standards and therefore have the potential to pose impacts on human and ecological health. The mitigation measures provided below have been prepared to reduce this risk to workers and the environment.

While there would be potential for contamination of the railway corridor resulting from maintenance works and operational activities, potential impacts would be reduced by continued training and

awareness of railway workers, providing appropriate work methods and ensuring maintenance of locomotives and wagons is carried out routinely.

11.4. Cumulative Impact Assessment

The QR National 2008 Environmental Assessment Report (EAR) has been reviewed along with the Douglas Partners Pty Ltd's *Preliminary Contamination Assessment, Proposed Hexham Redevelopment, Maitland Road ad Woodlands Close, Hexham (Douglas Partners, August 2011)*.

Contamination has been identified within the Project Area (addressed in **Appendix F Contamination**) and within the area investigated by Douglas Partners Pty Ltd for the QR National TSF. The contamination identified is considered to be related to historical activities (i.e. former abandoned fuel tanks, and fill materials and effluent irrigation).

At this stage the management and remediation options at the QR National site are in the process of being developed. To prevent cumulative impacts (e.g. contamination that had been capped by one party being excavated by another party during construction), the remediation/management methods and responsibilities would be agreed upon by both ARTC and QR National. Personnel working on both developments would be made aware of the location and proposed remediation/management of contaminated areas.

The proposed developments are unlikely to cause routine soil and groundwater contamination in the future, unless accidents occur (i.e. spill of fuel). In addition it is considered unlikely that existing groundwater contamination would be exacerbated.

It is assumed that both developments would have up to date, industry standard environmental management procedures in place, in the event of an accidental spill, which would be implemented immediately. Based on this it is considered that potential cumulative impacts during the operational phase of both projects are likely to be negligible.

11.5. Mitigation and Management Measures

The following measures would be implemented to make the Project Area suitable for the development:

- preparation of a site specific Remedial Action Plan (RAP) by a suitably qualified contaminated land consultant. The RAP would discuss potential remediation and/or management options for the identified contaminated soils and present the preferred remediation option(s) based on the final design and construction details for the proposed Project. The Final RAP has been prepared and is presented in **Appendix F Contamination**;
- implementation of the RAP in order to remediate and validate affected areas;
- remediation could comprise excavation and disposal of the waste materials, including restricted solid waste to appropriately licensed landfill. Hazardous waste would require treatment prior to disposal. Alternatively, remediation could comprise pre-treatment, capping of contamination in combination with a risk assessment and site management plan. The remediation options will be further considered in the RAP; and
- preparation of a validation report and/or site management plan(s), depending on the remediation/management option chosen.

It is also noted that prior to construction, a Construction Environmental Management Plan (CEMP) would be prepared and would include measures to protect workers' health during construction. The CEMP would include information on how to recognise, handle and manage contamination (including asbestos) in soil and fill materials.

A Water Quality Management Plan would also be prepared as part of the CEMP to manage the surface water and groundwater contamination, and would include, but not be limited to:

- Measures to ensure that the existing contamination in surface and groundwater is not exacerbated during construction of the Project;
- Management measures for the protection of human health and the environment;

- Monitoring protocols, including frequency of monitoring, the analytes to be tested, and the adopted assessment criteria to demonstrate that contamination is not being exacerbated; and
- Contingency plans.

Different waste types would require different procedures for handling and transport to appropriately licensed facilities. General procedures that would apply to all waste types are:

- waste to be classified before loaded for transport to disposal location;
- if waste quantities are large, the disposal facility would be contacted prior to loading to check when they can accept waste;
- waste would be covered during transport to prevent loss of waste between Project Area and disposal location;
- dockets, or other documentation, would be maintained to demonstrate appropriate disposal of waste; and
- Waste must be notified to OEH and tracked in accordance with the *Protection of the Environment Operations Act 1997* and the *Protection of the Environment Operations (Waste) regulation 2005*.

In order to ensure waste is appropriately disposed to lawful facilities, licensed to accept the waste, a material tracking register, containing the following information would be kept:

- the material type and volume;
- the classification of the waste;
- where it was re-used, i.e. location on the Project site or property address if re-used off-site (if re used);
- where it was disposed, i.e. landfill name and address (if disposed); and
- reference number of relevant documentation, (i.e. waste dockets, waste classification letters), if applicable.

