9.0 Assessment of Environmental Impacts

9.1 INTRODUCTION

This section of the EA is designed to further explore the proposal and discuss key environmental impacts. The relevant DGRs and other key environmental issues have been addressed as part of this EA.

9.2 ECOLOGICAL CONSIDERATIONS

Eco Logical Australia Pty Ltd (ELA) was commissioned by QR National to prepare an Ecological Assessment for the proposed TSF. The assessment has been carried out on the basis that the proposal is a Part 3A Major Project. The Ecological Assessment is provided within Appendix F of this EA.

9.2.1 Existing Environment

The study area comprises disturbed lands, including evidence of widespread soil disturbance (excavation and filling), interspersed with revegetation and depressions. As already outlined the southern part of the study area has a long history associated with coal stockpiling, loading and unloading and to this day the site contains a significant quantity of coal tailings. The remaining study area contains remnant, albeit highly disturbed, swamp oak forest, salt marsh and freshwater wetland in the south, artificial freshwater wetlands (i.e. drains and ponds) and open pasture. Much of the site is currently subject to pasture improvement and cattle grazing.

The site adjoins NPWS Estate (Hexham Swamp) to the west. Recognised SEPP 14 Coastal Wetlands also adjoins the study area and extends onto the site as identified within Figure 18.

Eco Logical Australia has adopted the proven methodology of Database Review, Literature Review and Flora & Fauna Survey effort to identify potential effects of the proposal on threatened species, population or ecological communities or their habitats.

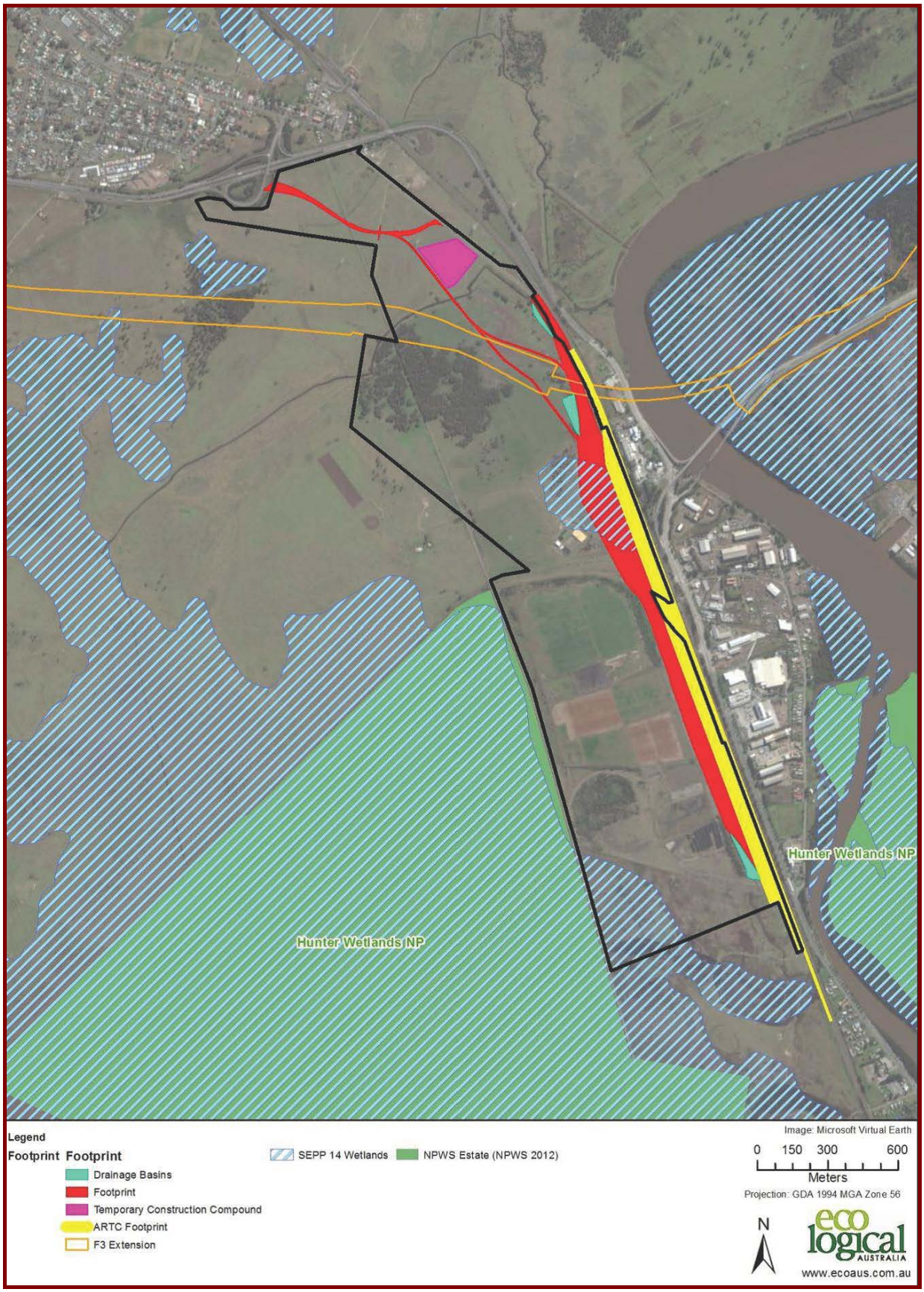

Figure 18: NPWS Estate (Hexham Swamp) & SEPP 14 Coastal Wetlands.

Database Review

The data audit was based on analysis of environmental database searches including the Atlas of NSW Wildlife and the EPBC Act. Searches included a 10km radius around the site, centred on the study area, to determine the local occurrence of threatened flora and fauna in accordance with state and federal statutory requirements. These searches were carried out on 25 February 2011.

An assessment of likelihood of occurrence was made for threatened flora and fauna identified from the database search. This assessment was based on database or other records, presence or absence of suitable habitat within the study area, results of the field investigations and professional judgement.

Literature Review

Three recent studies have compiled ecological information on the study area, including: EcoBioiogical (2008), EcoHub Ecological Consultants (2009), and Parsons Brinckerhoff (2012). Whilst these documents were not finalised and published, the data from EcoBiological (2008) and EcoHub Ecological Consultants (2009) studies have been included in this study.

Flora & Fauna Survey

The survey methods for this project have been designed to supplement the previous surveys to ensure survey effort meets the Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities (DEC 2004); DECCW (2011) Field Survey Guidelines; DECC (2009) Threatened species survey and assessment guidelines field survey methods for fauna - Amphibians; and the Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act) survey guidelines for Nationally Threatened Species.

Survey effort for the study area from this and previous flora and fauna studies are addressed with the Ecological Investigation Report within Appendix F. The survey has met OEH requirements in relation to vegetation community mapping, call playback (owls), bats, birds, nocturnal amphibians (spotlighting and play-back) and di-urnal amphibian and reptiles.

With regard to vegetation plots and fauna trapping, the survey effort was appropriate for the site, but does not strictly meet the guidelines. For example, two rather than three plots were undertaken in the Phragmites Australia / Typha orientalis wetlands due to the homogeneity of the site. With regard to fauna trapping, the total number of trap nights for the entire site exceeded the survey guidelines, however cage and arboreal trapping was not undertaken in the saltmarsh and Phragmites australis wetlands due to a lack of suitable habitat for ground-dwelling mammals. Eco Logical Australia (ELA) believes the survey intensity and location was appropriate for the site and indeed exceeds the survey requirements in a number of cases.

An overview of the consolidated survey effort is addressed within Table 10 below.

Table 10: Consolidated Survey Effort - flora & fauna studies/comparison to guidelines.

Survey Method	Survey Guidelines (DEC 2004; OE&H 2010)	Survey	Timing	Stratification type, area and survey effort per type					Compliance with OE&H Guidelines
				Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner	Coastal floodplain sedgelands, rushlands and forbs of the North Coast	Phragmites Australia and Typha orientalis coastal freshwater wetlands of the Sydney Basin	Saltmarsh in estuaries of Sydney Basin and South East Corner	Disturbed / Cleared Vegetation	
				47.15	9.69	15.66	9.24	172.26	
Rapid Data Points (RDP)	N/A	EcoBiological (2008)	3/12/207 and 9/1/2008	4 points	3 points		1 point		N/A
		ECOHUB (2008) (descriptive quadrats)	December 2007	7 points in total (locations unknown)					
Floristic quadrats	Swamp Oak Forest - 4 quadrats; Coastal floodplain sedgelands - 3 quadrats; Phragmites australis and Typha orientalis freshwater wetlands - 3 quadrats; Saltmarsh - 3 quadrats; Disturbed/cleared - 0 quadrats	EcoBiological (2008)	3/12/207 and 9/1/2008	3 plots					Not all stratification units have been sampled as per the guidelines; however given the homogeneity of stratification units as found during extensive random meanders, the site is considered to have been adequately surveyed.
		ECOHUB (2008)	11-16 June 2008	4 quadrats in total (locations unknown					
		Eco Logical Australia (2011)	January - February 2011	4 quadrats	2 quadrats	2 quadrats	2 quadrats		
Wetland survey	N/A	EcoBiological (2008)	11/1/2008 and 31/3/2008		1 survey				N/A
Floristic searches	N/A	EcoBiological (2008)	3/12/207 and 9/1/2008	1 transect	1 transect			1 transect	N/A
		ECOHUB (2008)	11-16th June 2008	3 transects	1 transects	2 transects	1 transects	1 transects	
		Eco Logical Australia (2011)	January - February 2011	2 transects plus random meander across study area	1 plus random meander across study area	1 plus random meander across study area	1 plus random meander across study area	random meander across study area	
Vegetation community mapping	Stratify the site in to Biometric vegetation types	EcoBiological (2008)	3/12/207 and 9/1/2008	Random meander across the entire site					Yes
		Eco Logical Australia (2011)	January - February 2011	Random meander across the entire site					
		ECOHUB (2008)	June 2008	Random meander across the entire site					
Targeted flora and fauna habitat transects	N/A	EcoBiological (2008)	November 2007 to March 2008	1 transect	1 transect			1 transect	N/A
		ECOHUB (2008)	11-16 June 2008	2 transects	1 transect			1 transect	
		Eco Logical Australia (2011	January - February 2011	Random meander across the entire site					
Elliot A trapping (terrestrial)	100 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	EcoBiological (2008)	19-23/11/2007	72 trap nights					132 trap nights have been sampled on the site. Given the suitability of the habitat on the site (depauperate and long history of disturbance), this level of survey effort is considered adequate.
		ECOHUB (2008)	11th-14th June 2008 and 21-25th June 2008	80 trap nights (western boundary of subject site) plus 80 trap nights (southwest section of subject site). Actual location unknown					

Survey Method	Survey Guidelines (DEC 2004; OE&H 2010)	Survey	Timing	Stratification type, area and survey effort per type					Compliance with OE&H Guidelines
				Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner	Coastal floodplain sedgelands, rushlands and forbs of the North Coast	Phragmites Australia and Typha orientalis coastal freshwater wetlands of the Sydney Basin	Saltmarsh in estuaries of Sydney Basin and South East Corner	Disturbed / Cleared Vegetation	
				47.15	9.69	15.66	9.24	172.26	
Elliot B trapping (terrestrial)	100 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	EcoBiological (2008)	19-23/11/2007	36 trap nights					Due to inadequate location of survey sites, it's difficult to say whether precise guidelines per stratification unit have been met. However, 36 trap nights have been sampled on the site, presumably in more favourable habitats. Given the suitability of the habitat on the site (depauperate and long history of disturbance), this level of survey effort is considered adequate.
Arboreal trapping (ECOHUB arboreal glider traps)	24 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	ECOHUB (2008)	11th-14th June 2008 and 21-25th June 2008	72 trap nights plus 36 trap nights (location unknown)					Given arboreal habitat is confined to the swamp oak forest, the combined arboreal trapping and hair tubing effort by EcoBiological (2008) and ECOHUB (2008) is adequate.
Hair tubes (arboreal)		EcoBiological (2008)	19-23/11/2007	96 trap nights					
Cage trapping	24 trap nights over 3-4 consecutive nights. Effort per stratification unit up to 50ha, plus an additional effort for every additional 100ha	ECOHUB (2008)	11th -14th June and 21st -25th June 2008	16 trap nights (location unknown)					No. However, given the available habitat, past disturbance and the likelihood of encountering threatened fauna targeted by this method, this level of effort is considered adequate.
Spotlighting	2x 1 hour up to 200ha of stratification unit at 1km per hour on 2 separate nights.	EcoBiological (2008)	22/11/2007;	12.5hrs total effort (location unknown)					It is difficult to accurately calculate effort per stratification unit, due to lacking survey location information. However, given the complexity and habitat suitability of the study area, the effort employed is considered adequate.
		Eco Logical Australia (2011)	January - February 2011	1 x 20min transect 3 repeat visits	1 x 20min transect 3 repeat visits	2 x 20min transects 3 repeat visits	1 x 20min transect 3 repeat visits	meander transects	
		ECOHUB (2008)	8th June 2008	2 hours (location unknown)					
Call playback	Sites to be separated by 800m-1km. At least 5 visits on separate nights for Powerful Owl, Barking Owl and Grass Owl. 6 visits for Sooty Owl and 8 visits for Masked Owl.	EcoBiological (2008)	22nd November 2007 - 10th January 2008	3 sites over 4 nights					Yes
		ECOHUB (2008)	8th -12th June 2008	1hr each night for 4 nights (unknown locations)					
Anabat II bat call recorder	2 sound activated devices - effort per 100ha of stratification unit targeting preferred habitat.	EcoBiological (2008)	22nd November 2007 - 10th January 2008	4 sites x 12hrs			1 site x 12hrs	3 sites x 12hrs	Yes
		ECOHUB (2008)	11th -14th June and 21st -25th June 2008	2 sites (nights and hours unknown)	2 sites (nights and hours unknown)	2 sites (nights and hours unknown)		1 sites (nights and hours unknown)	
Bird survey	Species time curve is suggested	EcoBiological (2008)	22nd November 2007 - 10th January 2008	4 transects x 30min each	1 transects x 30min each	1 transects x 30min each	1 transects x 30min each	3 transects x 30min each	Yes
		ECOHUB (2008)	11th -14th June and 21st -25th June 2008	3 transects (12 hours total)	1 transect (12 hours total)	1 transect (12 hours total)		1 transect (12 hours total)	
		Eco Logical Australia (2011	January - February 2011	Opportunistic	Opportunistic	Opportunistic	Opportunistic	Opportunistic	

Survey Method	Survey Guidelines (DEC 2004; OE&H 2010)	Survey	Timing	Stratification type, area and survey effort per type					Compliance with OE&H Guidelines
				Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner	Coastal floodplain sedgelands, rushlands and forbs of the North Coast	Phragmites Australia and Typha orientalis coastal freshwater wetlands of the Sydney Basin	Saltmarsh in estuaries of Sydney Basin and South East Corner	Disturbed / Cleared Vegetation	
				47.15	9.69	15.66	9.24	172.26	
Targeted waterbird survey	A 1 hr census at dawn or duck per wetland	EcoBiological (2008)			2x2hr searches				Yes
Nocturnal amphibian survey (including Green and Golden Bell Frog call playback)	Tadpole surveys, call surveys and active searches (day and night). Small habitat areas 1hr on 3 separate occasions. Large areas 3 separate four-hourly searches. Surveys should be done between Sept - January during wet and humid nights.	EcoBiological (2008)	4 separate days/nights 22nd November 2007 - 10th January 2008	4 survey points (14 hours total effort)	5 survey points x 30min each (14 hours total effort)	4 survey points x 30min each (14 hours total effort)	3 survey points x 30min each (14 hours total effort)	5 survey points x 30min each (14 hours total effort)	Yes
		ECOHUB (2008) (descriptive quadrats)	June 2008; and humid and wet nights 9th, 10th, 14th, 19th and 21st November 2008	5 repeat visits of 2 sites	5 repeat visits of 3 sites	5 repeat visits of 3 sites		5 repeat visits of 1 site (dam)	
		Eco Logical Australia (2011	January - February 2011		1 site 3 repeat visits	4 sites 3 repeat visits	1 site 3 repeat visits	2 sites 3 repeat visits (dam)	
Diurnal reptile and amphibian survey	30-minute search on two separate days targeting specific habitat	EcoBiological (2008)	22nd November 2007 - 10th January 2008	6 person hours within subject site and opportunistic through subject site					Yes
		ECOHUB (2008) (descriptive quadrats)	18th June 2008	2 transects with 5 sub-plots (location unknown)					

Note:

Stratification of the site for field survey was initially based on Biometric Vegetation Type. Where patches of the same BVT were fragmented, survey design ensured a 20m x 20m vegetation plot, rapid data point or random meander was undertaken in each patch. This approach ensured the variability of vegetation community and condition was adequately surveyed.

The following paragraphs describe the supplementary fieldwork undertaken by Eco Logical Australia in 2011.

Vegetation Community Mapping

Vegetation communities within the study area were mapped and defined based on biometric vegetation types.

Field work was carried out in January and February 2011. Random meander traverses were used to validate the vegetation communities, their boundaries and condition classes. There was particular focus on delineating the boundaries of EEC listed under state or federal legislation and investigating SEPP14 wetland within the study area.

Vegetation Community Validation

Four biometric vegetation communities were identified, described and mapped during the field survey and corresponded to three respective EEC's (Table11). Vegetation condition varied across the study area. Swamp Oak Swamp Forest had considerable variation in quality due to past disturbance, with some areas being in moderate condition, areas of rehabilitation that contained Swamp Oak (Casuarina glauca) and other areas consisting of a predominantly native understorey only and a cleared canopy (Derived Grassland). Areas of Swamp Oak Swamp Forest that comprised rehabilitation were not considered to reflect the description of Swamp Oak Floodplain Forest EEC due to modifications/introduced soil and floristic composition. Table 11 below provides the vegetation types, corresponding EEC's and the area of each type.

All remnant native vegetation on the site (excluding the rehabilitation plantings of Swamp Oak Swamp Forest) is considered to meet the definition of Groundwater Dependence Ecosystems as described in NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002) due to the likely interaction of the vegetation with shallow watertables and periodic inundation of floodwater.

Table 11: Biometric Vegetation Types and EECs

Biometric Vegetation Types	EEC	Area (ha)
Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner	*Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.*	28.65
	Nil (planted and not consistent with the EEC definition).	18.50
Coastal floodplain sedgelands, rushlands and forbs of the North Coast	*Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.*	9.69
Phragmites Australia and Typha orientalis coastal freshwater wetlands of the Sydney Basin		15.66
Saltmarsh in estuaries of Sydney Basin and South East Corner	*Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.*	9.24
Disturbed / Cleared Vegetation		172.03
Total		**253.77**

Swamp Oak swamp forest fringing estuaries, Sydney Basin and South East Corner – 47 ha

This vegetation community was present in four variations on the site, including remnant forest, areas containing a scattered canopy, mostly native understorey and absent canopy, and rehabilitation areas containing Swamp Oak.

Remnant patches of this community were detected on poorly drained soils scattered throughout the northern portion of the study area as shown in Figure 19.

The canopy was dominated by Casuarina glauca (Swamp Oak), with occasional Melaleuca styphelioides (Prickly-leaved Tea Tree) also observed. The shrub layer was absent and the dense ground layer was dominated by native and exotic grasses and herbs, including Aster subulatus, Atriplex prostrata, Cirsium vulgare (Spear Thistle), Cynodon dactylon, Pennisetum clandestinum and Persicaria lapathifolia (Pale Knotweed).

The rehabilitation area was dominated by planted Acacia saligna (Golden Wreath Wattle), Melaleuca armillaris (Bracelet Honey-myrtle) and Swamp Oak, as well as a variety of exotic species such as Chloris gayana (Rhodes Grass), Cirsium vulgare (Spear Thistle), Lantana camara (Lantana) and Verbena bonariensis (Purpletop). The rehabilitation variant of Swamp Oak Swamp Forest was in poor condition across its range, due to being planted out with a weedy Western Australian species (Acacia saligna) and mismanagement of the area effectively leading colonisation of exotic species.

All variants of this community were subject to stock grazing and infestation of the weeds mentioned above.

Considering the floristic assemblage, position in the landscape and observations of surface soil, two of the variants (Moderate condition and Scattered Swamp Oak) of this community were considered to align with the EEC Swamp Oak Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner. The remaining variants were not considered to qualify as the EEC due to modifications to soil and/or floristic composition

In a survey undertaken by EcoBiological in 2008 a total of 682 trees bearing potential habitat hollows were identified and mapped and the size class of hollows were recorded. The majority of hollows were small and over 90% of the hollow bearing trees were Swamp Oak.

The following photographs have been taken at locations (Photo Points) as identified on Figure 19.

Photograph 10: Swamp Oak Swamp Forest (Location 2)

Photograph 11: Rehabilitation variant of Swamp Oak Swamp Forest (Location 3)

Coastal floodplain sedgelands, rushlands and forblands of the North Coast - 9.69 ha

This community was scattered throughout the pastures in the northern end of the study area and was also recorded in several constructed drainage lines in the south of the study area as shown on Figure 19. Sections of this community were mapped as Freshwater Wetland Complex (Ephemeral Swamps) by Ecobiological (2008).

The shrub layer was absent, and the ground layer was dominated by a mix of native and exotic species. Common native species included Bolboschoenus caldwellii, Cynodon dactylon (Common Couch), Paspalum distichum (Water Couch) and Phragmites australis (Common Reed), while common exotic species included Aster subulatus (Wild Aster) and Pennisetum clandestinum (Kikuyu).

This community was in moderate condition, being used to graze cattle, and having modified hydrology and simplified floristics.

The floristic and structural elements of remnant patches of this community were consistent with the NSW Scientific Committee's listing Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, an EEC listed under the TSC Act.

Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin – 15.66 ha

Several remnants of this community were detected throughout the study area as shown on Figure 19. It was also present in a large constructed drainage line in the middle of the study area.

Phragmites australis was the dominant species throughout this community, while Bolboschoenus caldwellii and Typha orientalis (Broad-leaved Cumbungi) were also present. Saltmarsh species, including Juncus kraussii (Sea Rush), Paspalum vaginatum (Salt-water Couch) and Sarcocornia quinqueflora (Samphire) were present in the ecotone between the saltmarsh and phragmites rushland communities, making it difficult to determine their precise boundaries. This community was in moderate condition throughout the study area. It was subject to stock grazing and was infested with several exotic species, particularly Juncus acutus (Sharp Rush).

The floristic and structural elements of this community were consistent with the NSW Scientific Committee's listing Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, an EEC listed under the TSC Act.

Photograph 12: Coastal Freshwater Wetland (Location 1)

Saltmarsh in estuaries of the Sydney Basin and South East Corner– 9.24 ha

This community was present in the south of the study area as shown in Figure 19.

Juncus kraussii, Paspalum vaginatum, Sarcocornia quinqueflora and Sporobolus virginicus were the dominant species throughout this community. Bolboschoenus caldwellii and Phragmites australis were common in the ecotone between this community and Phragmites australis and Typha orientalis coastal freshwater wetland, making it difficult to determine the precise community boundaries.

This community was in moderate condition throughout its extent. The area was subject to stock grazing and drainage has been modified by a levy. Common exotic species include Aster prostrata, Cotula coronopifolia (Water Buttons), Juncus acutus and Wild Aster.

The floristic and structural elements of this community were consistent with the NSW Scientific Committee's listing Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions, an EEC listed under the TSC Act.

Photograph 13: Saltmarsh (Location 5)

Floristic Surveys

In January and February 2011 a total of 10 20x20m vegetation plots and five (5) transects were completed. Surveys consisted of recording all flora species present within the plots and encountered along transects.

Vegetation survey proformas were used to collect information, with the data including the date of survey, recorder/s, site number, quadrat size (20 m x 20 m), MGA coordinates (all taken with a GPS using WGS84) and vegetation structure. One or more digital photographs were taken at each site.

Within each 0.04ha plot all vascular plants species were recorded and identified as far as was possible. In some cases a lack of flowering material was a hindrance, with some samples only undergoing identification to the genus level. Samples of unknown species were collected for later identification. Nomenclature followed the Flora of New South Wales (Harden 1992; 1993; 2000; 2002) except where more recent taxonomic changes have taken place.

Biometric data were gathered concurrently with the flora survey quadrats, in accordance with the Biobanking Methodology (DECC 2008) and Biobanking Assessment Methodology and Credit Calculator Operation Manual (DECC 2009), This involved gathering data within a 20mx50m plot/transect on native species richness, over-storey cover, mid-storey cover, native ground cover, exotic cover, number of trees with hollows, over-storey regeneration and length of logs.

For further details of the vegetation plots and transects refer to the Survey Methods identified within Figures 3 & 4 of the Ecological Investigations Report (Appendix F).

Targeted Threatened Flora Surveys

Targeted threatened flora searches were undertaken for those species considered to potentially occur on the site based on database searches in the locality and habitat on site. In terms of seasonally cryptic species, only species whose optimal period of detection corresponded with the survey timing (i.e. January to February) were adequately surveyed for. The following threatened flora species were targeted:

- Callistemon *linearifolius* (Netted Bottlebrush);
- *Melaleuca biconvexa* (Biconvex Paperbark);
- Persicaria elatlor(Tall Knotweed); and
- Zannlchellia palustris.

No threatened flora species were recorded within the study area, though Zannichellia palustris was considered a potential occurrence.

The OEH have indicated that the following additional species should be considered and justification on the adequacy of survey for these species should be provided

- Asperula asthenes (Trailing Woodruff);
- Lindernia alsenoides (Noah's False Chick Weed); and
- Maundia triglochinoides (Small Water Ribbons).

Asperula asthenes grows in damp sites along river banks from Taree to Bulahdelah. This species is best to be surveyed for during spring, which is outside of the survey season applied to this study. However, survey for the ARTC project (Parsons Brinkerhoff, 2012) which included the majority of the TSF subject site and was undertaken in the appropriate season did not identify this species and concluded that the likelihood of it being present on site was low. ELA concurs with this assessment.

Lindernia alsinoides also grows in swampy sites in sclerophyll forest and coastal heath north from Bulahdelah, and is most detectable when flowering in November, which is outside of this study's survey period. Survey of the subject site was undertaken by Parsons Brinkerhoff (2012) during the appropriate season for the ARTC project, however the species was not observed. Given the disturbance history of the study area and the nearest record of these species is over 14km and 66km respectively from the site, these species are not considered potential occurrences. Parsons Brinkerhoff concluded that the likelihood was low and habitat not present.

Maundia triglochinoides has been recorded approximately 3km from the study area and grows in swamps and shallow fresh water on heavy clay and is detectable for most of the year, with distinct leaf form and venation. The species flowers in November – January and would therefore have been flowering during field survey by ELA in 2011. This species was not detected during surveys, nor was it observed by Parsons Brinkerhoff (2012) in their surveys for the ARTC project on the same land. It is therefore highly unlikely that the species is present on this site.

Fauna Surveys

Given the detailed surveys that *were* undertaken as part of EcoBiological (2008) and EcoHub (2009), fauna surveys were limited to targeted amphibian surveys in suitable habitat. Survey timing was preferentially aligned with periods following rainfall, during periods of moderate to high humidity and low wind speed.

Table 12: Weather conditions during the fauna survey.

Date	Rainfall (mm)	Temperature (Max daily C°)
7 January 2011	18.2	Not Recorded
8 January 2011	0.0	28.8
9 January 2011	3.0	29.0
10 January 2011	3.6	29.5
11 January 2011	2.0	27.8
12 January 2011	0.4	30.0
15 February 2011	11.6	25.7
16 February 2011	1.4	27.2
17 February 2011	0.0	32.2
18 February 2011	41.8	Not Recorded

Nocturnal Surveys

Nocturnal amphibian surveys involved 24 person hours searching suitable wetland habitats using 50 watt handheld spotlights, Traverses were generally undertaken on foot, though fauna *were* opportunistically encountered during vehicular movements.

At several locations call playback surveys were undertaken, consisting of green and golden bell frog *(Litoria aurea),* grass owl *(Tylo capensis)* and masked owl *(Tylo novaeho/landiae)* call broadcasting for approximately 5 minutes followed by a 5 minute listening period for each call. Spotlights were then used to detect any cryptic species following each call being played. All fauna species encountered or heard calling were recorded and are included in Table 13.

Diurnal Surveys

Diurnal amphibian surveys involved traverses in areas of suitable habitat for searching for basking individuals.

Traverses are identified on Figures 3 & 4 within the Ecological Investigations Report (Appendix F).

Opportunistic Observations

Opportunistic observations of species were recorded at all times, including reptiles, frogs, mammals and birds. Opportunistic observations included identification of indirect evidence such as scats and tracks.

Figure 19 shows the identified vegetation communities and EECs on the site. It can be seen that much of the site is cleared. No Threatened flora species were recorded within the study area.

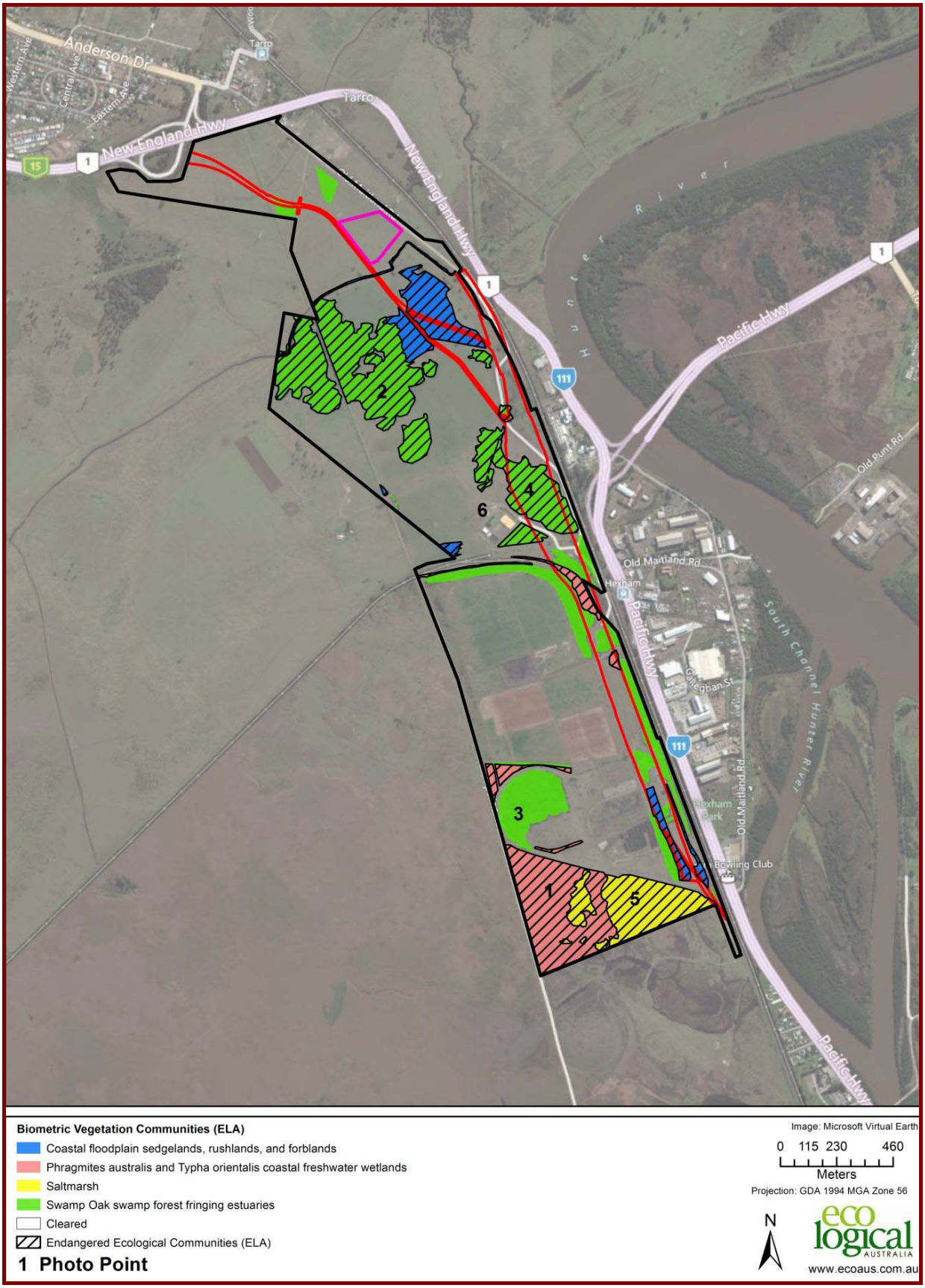

Figure 19: Vegetation Communities, EECs & Threatened Fauna Species.

Table 13 below presents the biodiversity values present within the site, including threatened biodiversity (EEC's, threatened species and migratory species) recorded or considered likely occurrences, a summary of general biodiversity, habitat condition and connectivity values.

Table 13: Summary of Biodiversity Values

Note: Within the table, V refers to vulnerable species and M refers to migratory species under the TSC and EPBC Acts.

BIODIVERSITY VALUE	SUMMARY			
Scientific Name	Common Name	TSC Act	EPBC Act	Likelihood of Occurrence
—	*Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.*	EEC	—	Recorded
—	*Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*	EEC	—	Recorded
—	*Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions*	EEC	—	Recorded
Zannichellia palustris		E	—	Potential
Litoria aurea	Green and Golden Bell Frog	E	V	Potential
Hieraaetus morphnoides	Little Eagle	V	—	Recorded onsite
Anseranas semipalmata	Magpie Goose	V	M	Recorded onsite
Botaurus poiciloptilus	Australasian Bittern	V	—	Recorded onsite
Ephippiorhynchus asiaticus	Black-necked Stork	E	—	Some marginal potential
Rostratula australis (a.k.a. R.benghalensis)	Painted Snipe (Australian subspecies)	E	V	Potential
Tyto capensis	Grass Owl	V	—	Recorded onsite
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Potential
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	—	Recorded onsite
Gallinago hardwickii	Latham's Snipe	—	M	Unlikely
Merops ornatus	Rainbow Bee-eater	—	M	Unlikely
Miniopterus australis	Little Bent-wing Bat	V	—	Recorded onsite
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	—	Recorded onsite
Mormopterus norfolkensis	East Coast Freetail Bat	V	—	Recorded onsite
Myotis adversus	Large-footed Myotis	V	—	Recorded onsite
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Recorded onsite
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	—	Potential
Scoteanax rueppellii	Greater Broad-nosed Bat	V	—	Recorded onsite
Apus pacificus	Fork-tailed Swift	—	M	Potential
Haliaeetus leucogaster	White-bellied Sea-Eagle	—	M	Recorded onsite
Hirundapus caudacutus	White-throated Needletail	—	M	Potential
Ardea alba	Great Egret	—	M	Potential
Ardea ibis	Cattle Egret	—	M	Potential
Biodiversity	Overall a total of 168 fauna species were recorded, including 9 Amphibian species, 128 Avian species, 25 Mammal species and 6 reptile species. 20 threatened or migratory fauna species have either been recorded or are considered potential occurrences (see above) 268 flora species were recorded across each of the three different studies. Of these 86 were introduced species with additional species considered to have been introduced to the study area through vegetation rehabilitation works. One threatened flora species, *Zannichellia palustris*, listed as endangered is considered a potential occurrence on the site but has not been recorded within the study area.			

	The study area contains five broad vegetation types, with four of these considered to be native vegetation communities in variable condition and covering approximately 32% or 81ha of the study area. Each of these vegetation types are considered to represent three respective EEC's listed under the TSC Act (see above). The remaining study area is classed as either disturbed or a vegetation rehabilitation area.
Habitat Condition	The site evidences a long history of industrial and agricultural disturbances, with the spatial representation of the rehabilitation area and disturbed vegetation in Figure 3 depicting the worst affected areas (75% of the site). The central portion of the study area has been subject to coal stockpiling, excavation works and is essentially an artificial landscape. Much of this area is subject to pasture improvement and cattle grazing, with grazing also extending to the north and into areas mapped as having the native vegetation. Despite this level of disturbance, the site does still contain some ecological values, in the form of the three endangered ecological communities associated with wetlands and habitat for threatened species. With the exception of the Green and Golden Bell Frog and hollow roosting bats, the study area generally constitutes foraging or intermittent refuge habitat. Several surveys for Green and Golden Bell Frog have been conducted within the study area over a three year period, with no results indicating the presence of the species. At best, wetland habitats within the study area (i.e. Coastal floodplain sedgelands, rushlands, and forbs; Phragmites australis and Typha orientalis coastal; and the edges of Coastal Saltmarsh in estuaries of the Sydney Basin) potentially support very occasional and intermittent movements and foraging by Green and Golden Bell Frog, although this has not been confirmed with any sightings. In terms of habitat for hollow obligate Microchiropteran bats (e.g. East Coast Freetail Bat, Large-footed Myotis and Greater Broad-nosed Bat), the area of remnant Swamp Oak swamp forest fringing estuaries in the north of the study area contains 682 hollow bearing trees, with the majority of hollows being in the small (<8cm class) (EcoBiological 2008). None of these hollow bearing trees will be affected by the proposed development.
Connectivity	The study area is positioned in a highly fragmented landscape, which has developed through historic agricultural, infrastructure and industrial land uses. The study area itself is highly fragmented, with small patches of isolated remnant vegetation such as the Swamp Oak Forest and areas of wetland occurring within a mostly disturbed/cleared area. The northern railway line, New England Highway, pacific Highway and Hexham industrial area form barriers to movement to the east and north. Cleared pasture interspersed with low lying wetland areas occurs to the west. The primary habitat connection to the study area occurs to the southwest, whereby the study area is connected to wetland habitats within Hexham Swamp Nature Reserve. Habitat within the reserve is generally non-woody freshwater or estuarine wetland and is therefore only suitable for a restricted fauna assemblage (i.e. not suitable for forest/woodland dependant species).

9.2.2 Impact Assessment

The TSF has the potential to have the following impacts:

- Clearing of EEC and habitat for threatened species;
- Fragmentation of habitat; and
- Changes to hydrological environment.

Clearing of Native Vegetation

The subject site is highly disturbed, having had a long history of industrial and agricultural land use. Vegetation communities on the site are therefore in a somewhat degraded state. Approximately 10.64ha of native vegetation will be impacted, of which 7.48ha met the definition of an ECC

(Table 10 and Figure 19). In addition to the impact on 7.48ha of EEC, the adjoining ARTC development will impact on approximately 9.1ha of EEC, giving a total impact of 16.58ha.

The Part 3A Draft Guidelines for Threatened Species Assessment (DECC and DPI 2005) identifies matters which are relevant to the assessment of impacts to EEC, endangered populations and threatened species. Appendix 3 of DECC and DPI (2005) guidelines lists six questions and associated sub-questions that address the impacts of proposed developments on threatened species, populations, or ecological communities. A detailed assessment accounting for the ecological impacts associated with the proposed TSF for ecological communities recorded or considered likely to occur in the study area (see species and EEC's in Table 13). The assessment concludes that due to the degraded nature of the EECs and their distribution in the locality and region, the proposed development will not have a significant impact on these EECs.

The impacts on native vegetation communities associated with the proposed TSF development are provided in Table 14.

Table 14: Extent of impact on biometric vegetation types & corresponding EEC

Biometric Vegetation Type	Area Vegetation Community Impacted (ha)	Corresponding EEC	Area EEC Impacted (ha)
Coastal floodplain sedgelands, rushlands, and forbs	1.49	Freshwater wetland on coastal floodplain	1.49
Phragmites australis and Typha orientalis coastal	1.23	Freshwater wetland on coastal floodplain	1.23
Saltmarsh in estuaries of the Sydney Basin	0.00	Coastal saltmarsh	0.00
Swamp Oak swamp forest fringing estuaries, Sydney Note: approx. half this biometric vegetation type meets definition of the EEC	7.70	Swamp oak forest on coastal floodplain	4.76
Total to be Impacted	**10.64**		**7.48**

Threatened Flora Species

In terms of impacts to threatened flora species, Zannichellia palustris was the only threatened flora species considered a potential occurrence within the study area. Whilst there is some possibility of the species occurring within the study area, the impacts of the proposal are limited to a relatively small area of potential habitat (1.23ha) in which the species has not been located.

The proposed offset strategy will ensure that a vast majority of potential habitat will be retained within the study area and managed for conservation.

Threatened Fauna Species

With regard to threatened fauna species and their habitats, Table 4 within the Ecological Investigations Report (Appendix F) provides a list of those species likely to occur with the study area. The study area generally constitutes foraging or intermittent refuge habitat. Several surveys

for Green and Golden Bell Frog have been conducted within the study area over a three year period, with no results indicating the presence of the species.

A total of 168 fauna species were recorded, including 9 amphibian species, 128 avian species, 25 mammal species and 6 reptile species. 21 threatened or migratory fauna species have either been recorded or are considered potential occurrences including 6 migratory birds, 5 threatened birds, 9 mammals (all of which are bats) and 1 amphibian.

With the exception of the Green and Golden Bell Frog and hollow roosting bats, the study area generally constitutes foraging or intermittent refuge habitat for these species. The quality of such habitat on site is generally poor due to weed invasion, lack of diversity in the vegetation communities and the fragmentation of native vegetation on site. The loss of such habitat is not significant given the presence of the Hexham Swamp Nature reserve which contains higher quality and greater extent of these habitats.

At best, wetland habitats within the study area (i.e. Coastal floodplain sedgelands, rushlands, and forbs; Phragmites australis and Typha orientalis coastal; and the edges of Coastal Saltmarsh in estuaries of the Sydney Basin) potentially support very occasional and intermittent movements and foraging by Green and Golden Bell Frog. With the proposal impacting upon 2.72ha of this marginal habitat for the species and the retention and conservation management of up to 13.41ha, habitat provision will continue and will be improved for the species within the study area, therefore avoiding a significant impact on the species.

In terms of habitat for hollow obligate Microchiropteran bats (e.g. East Coast Firetail Bat, Large-footed Myotis and Greater Broad-nosed Bat), the area of remnant Swamp Oak Swamp Forest Fringing Estuaries in the north of the study area contains 682 hollow bearing trees, with the majority of hollows being in the small (<8cm class) (EcoBiological 2008). None of these hollow bearing trees will be affected by the proposed development (refer to Appendix F) and therefore a significant impact on these species is not likely to occur. Whilst there will be loss of native vegetation and habitat, no threatened species or communities are considered likely to be significantly affected by the proposal.

SEPP 14 Coastal Wetlands

The study area contains approximately 18.88ha of SEPP14 Coastal Wetlands and adjoins Hexham Swamp (Hunter Wetlands National Park). Wetland number 833 is approximately 10.6ha and will have direct impacts of 5.71 ha. The remainder of wetland 833 is likely to be affected by changes in hydrology. Due to historic disturbance regimes, this wetland is considered to be of very low value as a coastal wetland.

The other area of SEPP 14 Coastal Wetlands on the site is in the southern portion where no direct or indirect impacts are expected to occur and indeed this area is proposed for protection via a conservation agreement as described in Section 7.3.13. Given the large extent of wetland in the area and the mitigation measures described in Section 9.2.4 of this document, the development of this site is not considered to have a significant impact on the broader wetland complex of the Lower Hunter.

Connectivity

The proposal is located within the Watagan to Stockton Corridor identified in the LHRS. The corridor represents a broad strategic corridor rather than one designed for a particular species. The proposal will remove disturbed vegetation within the corridor, in a location where the corridor is already significantly broken (for terrestrial species) by the railway line, Maitland Road and the Hunter River. An Offset Strategy will be implemented that will seek to improve the habitat on site and therefore improve the 'stepping stone' opportunities for birds and bats. The offset area provides for significant areas of improved management which would result in a better outcome than the existing information.

Changes to Hydrological Environment

Native vegetation communities on site are considered to be groundwater dependent ecosystems. These occur not only as terrestrial communities, but also within the two main agricultural drains that flow to Hexham Swamp. The drains contain wetland species such as Phragmites australis (dominant), Bolboschoenus caldwellii and Typha orientalis (Broad-leaved Cumbungi). No threatened species listed under the Fisheries Management Act 1994 or Threatened Species Conservation Act 1995 have been recorded in the drains, nor are they considered likely due to poor habitat condition and the presence of Gambusia sp.

Changes to the hydrological and aquatic environment can occur due to:

- Increased rate and volume of run-off from hardstand areas leading to changes in water quality and salinity in estuarine environments;
- Ponding or retention of storm/flood water due to construction of buildings or roads; and
- Changes to ground water levels due to filling.

The SWMP by WorleyParsons (2012) describes the current site hydrology, water quality and changes to these as a result of the development. Stormwater Run-off and quality is discussed in Section 9.4.

Retention and Dissipation of Flood Waters

As all ecosystems on the site are groundwater dependent, proposed changes to flooding regimes as a result of the development need to be assessed. Flood modelling has been completed by BMT WBM and is discussed in Section 9.3.

The assessment has determined that the proposed TSF will have a negligible effect on the retention or dissipation of floodwaters and will therefore not have a significant impact on the current hydrological regime of the Swamp Oak Forest.

Groundwater and Surface Water Interaction

Douglas Partners (2012b) has prepared an investigation into the effects of the proposed development on the groundwater within and adjacent to the subject site. This report indicates that, whilst surface flow and velocity may increase and recharge ground water levels, actual ground water levels are unlikely to change significantly. Douglas Partners (2012b) indicates that groundwater directly adjacent to road and building infrastructure may increase slightly (in the order of <2cm).

The loss of this vegetation is inconsistent with the NSW Groundwater Dependent Ecosystem Policy which provides five policies for the protection and management of GDEs. All of the EECs identified on the site are GDEs. However the GDEs on site are highly disturbed through previous land uses and remain in relatively poor condition through weed invasion. Given the improvement of GDEs within the proposed offset areas, this loss is not significant for GDEs in the Hunter estuary. The location of the EECs/GDEs are identified at Figure 19 and the extent of impact as a result of the proposed TSF is identified within Table 14.

9.2.3 Mitigation Measures

Ecological survey was used to understand the environmental sensitivities of the site prior to design of the TSF. As a result, the TSF is located primarily on the disturbed part of the site and avoids the southern area which contains saltmarsh.

The following onsite practices are to be undertaken during the construction phase and will be contained within a CEMP.

Table 15: Mitigation measures during pre-construction, construction & operation

	Mitigation Measure / Ecological Management Procedure	Timing
1. Site-specific environmental induction	• Ensure that all staff working on the Project undertake a site-specific environmental induction. The induction should include items such as: - Sensitivity of wetlands, particularly saltmarsh; - Site environmental procedures (vegetation management, sediment and erosion control, protective fencing, noxious weeds); - What to do in case of emergency (sediment fence failure, injured fauna); and - Key contacts in case of environmental emergency e.g. WIRES.	Pre-construction and during construction for new staff
2. Identification of clearing limits	• Accurately and clearly mark out the limits of clearing and trees/vegetation to be retained. • Identify trees close to work areas which are at risk during construction and install protective fencing (temporary fluoro orange 'para-web' fencing or similar) to reduce risk of damage during the construction phases of the development. • Do not store materials/vehicles under the drip-line (canopy) of retained vegetation.	Pre-construction
3. Pre clearing survey	• Qualified ecologist to conduct pre-clearing surveys of: - hollow bearing trees; and - freshwater wetlands. • Fauna at risk of injury are to be relocated to suitable habitat a safe distance from the proposed works by a qualified ecologist.	Pre and during construction
4. Clearing of vegetation	• Where trees require felling, retain the timber, particularly sections with hollows - as Coarse Woody Debris for enhancement of the Northern Offset area; and • Cease work immediately if any previously unknown	Construction

	Mitigation Measure / Ecological Management Procedure	Timing
	threatened flora or fauna species are encountered. WIRES should be consulted if any injured fauna are encountered.	
5. Management of erosion and sediment control	• Provide appropriate controls to manage exposed soil surfaces and stockpiles to prevent erosion and subsequent sediment discharge into surrounding wetlands; • Clearly identify stockpile and storage locations and provide erosion and sediment controls around stockpiles; • Stockpiles of topsoil to be stored in windrows no higher than 2m and be maintained free of weeds; and • Undertake dust suppression where required in accordance with the Protection of the Environment Operations Act 1997 (POEO Act) where there is a risk of increased dust outside of acceptable levels.	Pre and during construction
6. Site office and plant storage	• Ensure these areas are located in the nominated compound.	During construction
7. Weed Management	• Establish and implement a hygiene protocol for vehicles entering and leaving the site to minimise spread of weeds and other biological risks such as alligator weed.	Pre, during & post construction
8. Monitoring	• Develop a monitoring program during construction (including a weekly checklist) to ensure that all mitigation measures proposed have been undertaken. The checklist should include items such as fencing and sediment and erosion control.	Pre, during and post construction

9.2.4 Offset Strategy

The DGRs for this project required the ecological assessment to include consideration of o*ffsets for native vegetation clearance consistent with the improve or maintain principle.* This section describes the policy framework for offsets, the offset strategy proposed and an assessment of how the offset is consistent with the policy framework.

Policy framework

The NSW OEH has adopted *Principles for the use of Biodiversity Offsets in NSW*. Details of which are provided in Appendix D of the Ecological Investigations Report.

OEH have also adopted the *Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A Developments* (DECCW 2010). The policy is designed to assist OEH in assessing the adequacy of an offset. To do so, the policy requires the use of the Biobanking Assessment Methodology to calculate the credits required to offset an impact and the credits generated by a proposed offset. The outcome of this assessment is described as meeting one of three outcomes, with a Tier 1 being the preferred outcome (further details are provided in Table 9 of the Ecological Investigations Report, (Appendix F)). The policy notes that proposals assessed as State Significant projects do not have to meet the "improve or maintain" standard which is required under the biobanking scheme as some projects will not be able to achieve "improve or maintain" but, due

to their social or economic benefits, should proceed. The term 'red flag' in the table relates to certain communities or species that are 'red flagged' under the Biobanking Assessment Methodology. This means that the loss and offset of this community or species cannot achieve an improve or maintain outcome. The term 'impacts fully offset' refers to an offset where the credit requirements are fully met.

Offset Required

The project will impact on 10.64ha of native vegetation. The credits required to offset the impacts are described in Table 16 with the full Credit Report provided on page 114 of the Ecological Investigations Report (Appendix F). The credits required are based on the biometric vegetation type being impacted and the habitat for threatened species that uses these communities.

Table 16: Offset Credits Required

Biometric Vegetation Type	Hectares of impact	Credits required to offset impacts of clearing
Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	1.49	13
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin	1.23	17
Saltmarsh in estuaries of the Sydney Basin and South East Corner	0	0
Swamp Oak swamp forest fringing estuaries, Sydney Basin	7.92	231
Total	**10.64**	**261**

Proposed Offset

QR National have committed to the protection and management of 53.63ha of native vegetation and habitat on site. Figures 20 and 21 indicate the lands proposed for offset.

Description of vegetation communities

The Northern Offset (Figure 20) is dominated by Casuarina glauca (Swamp Oak), with occasional Melaleuca styphelioides (Prickly-leaved Tea Tree) also observed. The vegetation contains over 600 hollow-bearing trees, although most of these hollows are less than 8cm. The shrub layer is absent and the dense ground layer is dominated by native and exotic grasses and herbs, including Aster subulatus (Wild Aster), Atriplex prostrata, Cirsium vulgare (Spear Thistle), Cynodon dactylon (Common Couch), Pennisetum clandestinum (Kikuyu) and Persicaria lapathifolia (Pale Knotweed). The area is also heavily grazed. Weed treatment and stock management will therefore be an important management requirement. The Northern offset also contains an area that is currently clear and will require re-establishment of native vegetation to return it to swamp oak swamp forest.

The southern offset area (Figure 21) is a combination of saltmarsh and Phragmites australia and Typha orientalis coastal freshwater wetland. These communities were also subject to stock grazing

and weed infestation and will therefore require management actions addressing these issues in particular.

Management

Management of the offset sites will be undertaken in accordance with a Conservation Management Plan that will address standard management actions such as weed management, feral animal control, management of retained vegetation, fire management, buffer zones, management of edge effects, management of hydrological changes, habitat enhancement (e.g. for Green and Golden Bell Frog) and rehabilitation measures, and monitoring. Of particular relevance for these two sites will be weed management and stock management.

The Conservation Management Plan is to be prepared following confirmation with OEH that the site is suitable for a Conservation Agreement (discussed below). The Northern Offset area will not include the Hunter Water pipeline that runs north-south through the site. The pipeline is on land owned by Hunter Water and is a separate lot to the offset. Access to maintain the pipeline or any other infrastructure should not be inhibited by the Conservation Management Plan.

Security

To meet the NSW Principles for Offsetting, the mechanism or instrument should provide certainty in the long term – i.e. it should 'run with the land' regardless of ownership and should require management in accordance with pre-determined actions.

There are several options available for long term security of offsets:

- Property Vegetation Plans under the Native Vegetation Act;
- Biobanking Agreements under the Threatened Species Conservation Act 1995;
- Covenants under the Conveyancing Act 1919;
- Conservation Agreements under the National Parks and Wildlife (NP&W) Act 1974;
- Trust Agreements under the Nature Conservation Trust Act 2001; and
- Planning Agreement under the EP&A Act 1979.

Each has its merits, however QR National propose to utilise a Conservation Agreement. Preliminary discussions with the OEH have occurred, with OEH advising that a Conservation Agreement under the NP&W Act 1974 is considered an appropriate mechanism for conserving land in perpetuity and is one of OEHs preferred methods. Appendix G of the Ecological Investigations Report (Appendix F) contains OEH correspondence. Conservation Agreements are legally binding and are specifically designed for conservation management. Conservation Agreements typically take 6-12 months to establish. During this time the Conservation Management Plan will be prepared.

Credits generated

The Biobanking Assessment Methodology has been used to calculate the credits generated by the proposal. These are contained in the table below.

Table 17: Credits Generated by Offsets

	Northern Offset		Southern Offset		Combined	
Vegetation Type	Ha	Credits Generated	Ha	Credits Generated	Ha	Credits Generated
Coastal floodplain sedgelands, rushlands, and forbs	0.61	4	-	-	0.61	4
Swamp Oak swamp forest fringing estuaries, Sydney	18.1	139	-	-	18.1	139
Swamp Oak swamp forest fringing estuaries, Sydney – to be rehabilitated	14.6	97	-	-	14.6	97
Phragmites australis and Typha orientalis coastal			12.8	119	12.8	119
Saltmarsh in estuaries of the Sydney Basin			7.52	72	7.52	72
Total	**33.31**	240	20.32	191	**53.63**	**431**

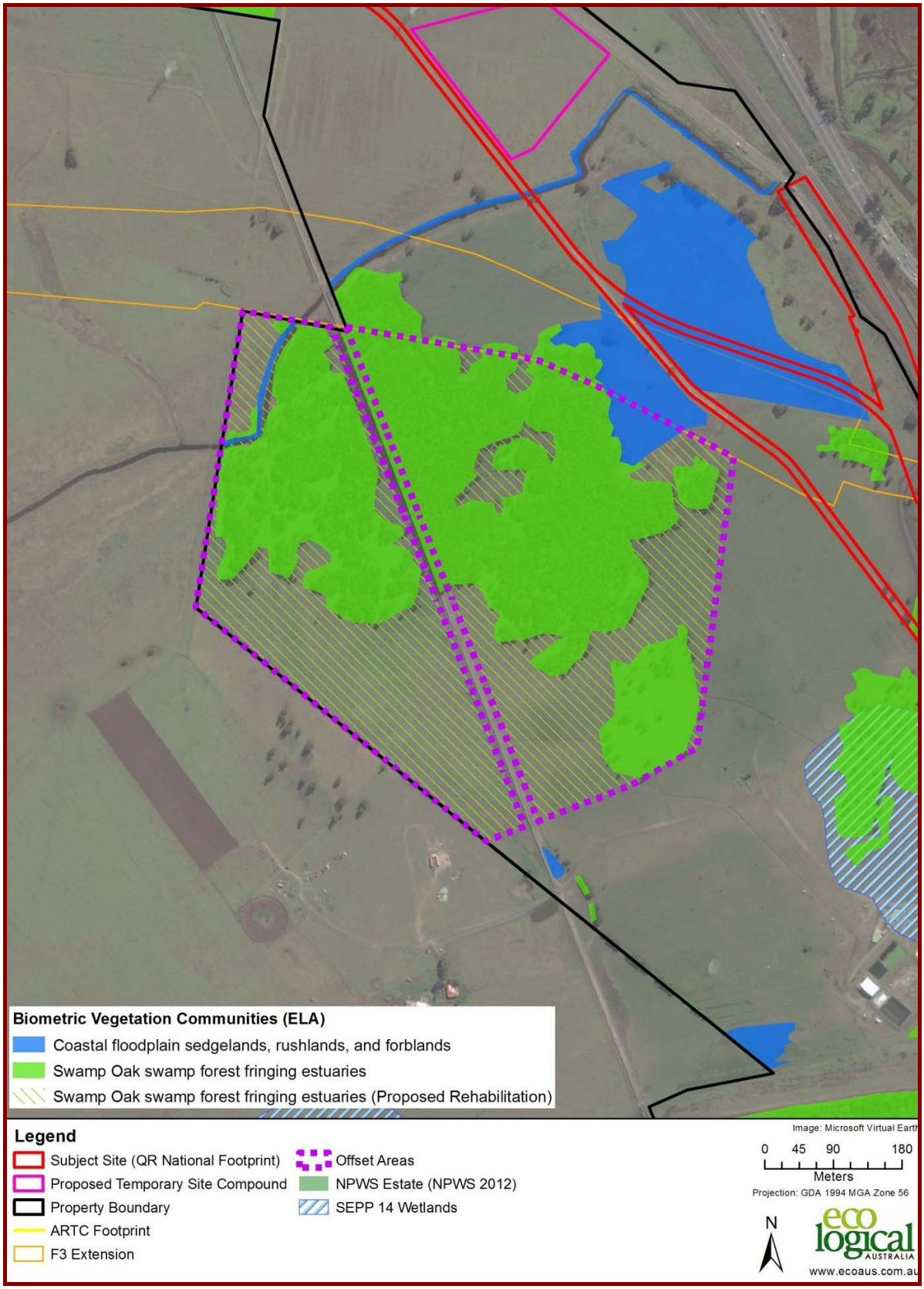

Figure 20: Proposed Northern Offset Area

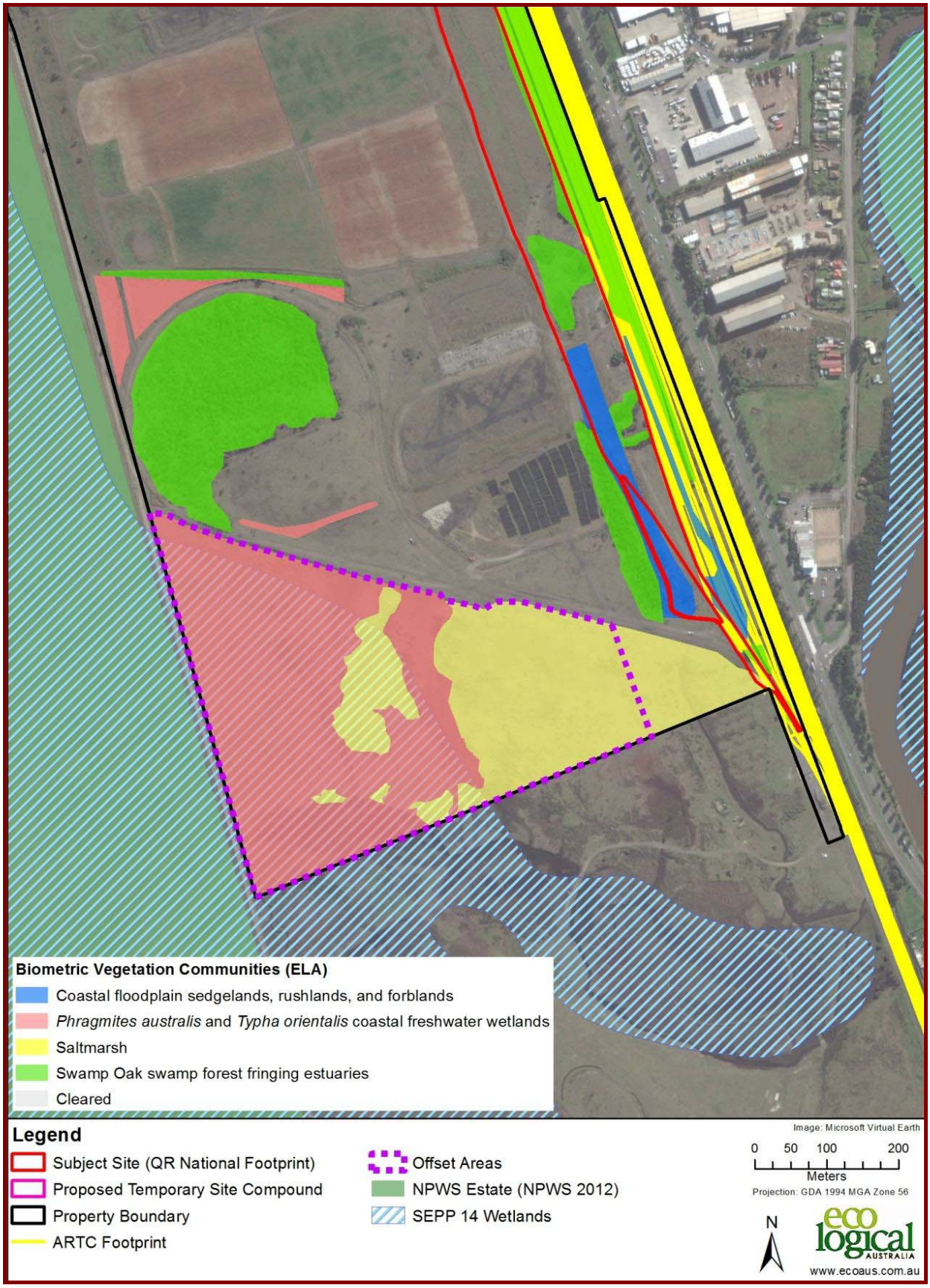

Figure 21: Proposed Southern Offset Area

Evaluation of Offset Strategy

An evaluation of the impacts and offsets has been undertaken using the Biobanking Assessment Methodology (DECC 2008). Table 18 provides a summary of credits required to offset the loss of native vegetation as well as the number of credits generated by the proposed offsets. The outcome is that credit requirements are met for three out of the four communities. The only community to be in deficit is the Coastal floodplain sedgelands, rushlands and forblands, which is 9 credits short. This shortfall cannot be made up on site as there are no other areas of this community to protect. However, this loss is more than made up by the over-all credit surplus of 170. In terms of the OEH Interim Policy on Assessing Impacts and Offsets of Part 3A Development, achieving an 'improve or maintain' outcome by the project is not possible as red-flagged EECs are being impacted. A Tier 2 outcome for three out of four communities is achieved and a Tier 3 outcome is achieved for the Coastal floodplain sedgelands community.

The offsets are also consistent with the OEH Principles for Offsetting as identified in Section 6.3.4 of the Ecological Investigations Report (Appendix F). The Offset Strategy represents a very positive outcome.

Table 18: Credit Balance

Vegetation type	Credits required to offset impacts of clearing	Credits created by onsite conservation management	Balance
Coastal floodplain sedgelands, rushlands, and forblands of the North Coast	13	4	Deficit of 9
Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin	17	119	Surplus of 102
Saltmarsh in estuaries of the Sydney Basin and South East Corner	0	72	Surplus of 72
Swamp Oak swamp forest fringing estuaries, Sydney Basin	231	236	Surplus of 5
Total	**261**	**431**	**Surplus of 170**

9.2.5 Conclusion

Three EEC's occur in the study area: Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions; Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions; and Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

No threatened flora species were recorded within the study area, though Zannichellia palustris was considered a potential occurrence.

Eleven threatened fauna species were recorded within the study area and an additional four threatened fauna species were considered likely to occur. Six migratory species listed under the EPBC Act are also considered likely to occur.

The majority of the area proposed to be affected on the site comprises cleared/disturbed land or rehabilitation, containing both native and non-endemic species. However, there will be some impact on native vegetation and habitat. The magnitude of this impact has been assessed with the result being that no threatened species or communities are considered likely to be significantly affected by the proposal.

A Biobanking Assessment on the proposed development and proposed offset lands was completed to determine if sufficient credits would be generated on the offset lands to achieve the 'improve or maintain' outcome according to the Methodology.

Credit requirements are met for three out of the four biometric vegetation communities, with an over-all credit surplus of 170. The only community to be in deficit is the Coastal floodplain sedgelands, rushlands and forblands, which is 9 credits short. In terms of the OEH Interim Policy on Assessing Impacts and Offsets of Part 3A Development, achieving an "improve or maintain" outcome by the project is not possible as red-flagged EECs are being impacted. A Tier 2 outcome for three out of four communities is achieved and a Tier 3 outcome is achieved for the Coastal floodplain sedgelands community.

Statutory considerations that have been addressed include impacts on SEPP14 Coastal Wetland with approximately 5.69ha of degraded SEPP14 wetland being directly affected.

A referral of the project under the EPBC Act has been made. The project has been determined to not be a controlled action.

9.3 FLOODING

The Flood Impact Assessment for the proposed TSF and other planned developments in the vicinity of the site was undertaken by BMT WBM. The full report is contained in Appendix G.

The Flood Impact Assessment by BMT WBM is an update and supersedes an existing Flood Impact Assessment completed by WorleyParsons, Issue 1, dated 23 August 2011. The updated assessment considers the cumulative impacts of the QR National TSF, ARTC HRR and the access road alignment from the Tarro Interchange.

BMT WBM was engaged to undertake the flood impact assessment of the future F3 proposal on behalf of the RMS. The cumulative impacts of the RMS Pacific Highway upgrade from the F3 to Heatherbrae project has also been assessed cumulatively with the proposed development.

9.3.1 Existing Environment

The Hunter River catchment covers an area of the order of 22,000km^2 which flows into the Tasman Sea through the Port of Newcastle. The lower reaches of the Hunter River system are tidal and forms the Hunter River estuary. Three major rivers discharge into the estuary, namely the Hunter River, the Paterson River and the Williams River. The confluence of the Williams River is at Raymond Terrace and the Paterson River joins the Hunter River further upstream of Raymond Terrace between Morpeth and Hinton.

The site is located adjacent to the Hunter River in the vicinity of the Hexham Bridge. Immediately upstream of Hexham Bridge, the Hunter River changes from a general south-westerly direction to a south-easterly direction. Downstream of Hexham Bridge the main channel splits into two arms,

the North Arm and South Arm separated by Kooragang Island. To the south west of this location is the Hexham Swamp, separated from the Hunter River by industrial development including the New England Highway and the GNR.

The Hunter River has experienced many floods during its recorded history. The largest flood on record was the 1955 flood. This flood has been estimated at approximately 1% AEP event (also known as a 1 in 100 year event).

When floodwaters reach Hexham Bridge, overtopping of the New England Highway will occur at a level equivalent to 5% AEP (1 in 20 year event) peak level of the Hunter River, filling the available flood storage of Hexham Swamp. Flood flows will then return to the Hunter River South Arm in the vicinity of Ironbark Creek, the principal natural drainage channel of Hexham Swamp. The progression of flood flows through Hexham Swamp is controlled by a number of topographical features, including an abandoned railway (Hexham to Minmi) and the Chichester Pipeline.

There is a set of eight flood gates located on Ironbark Creek, near the confluence with the Hunter River South Arm. These gates control flows in and out of Hexham Swamp through Ironbark Creek for lower order flood events, but are overtopped for events above the 5% AEP. The model configuration is representative of the current operation, where three of the gates have been raised open to enable flow into the swamp, while all eight gates are flapped to enable flow out of the swamp.

Ocean water levels, influenced by storm surge and the tide, have an effect on flood levels within the lower estuary, up to Green Rocks (approx. 8km upstream of the Williams River / Hunter River confluence).

In higher frequency low discharge floods, the Hunter River flow is contained within the river banks and levees. As flood magnitude increases, floodwaters overtop the natural and man-made levees and flows across the floodplain.

The site is situated within the broader floodplain area of Hexham Swamp. This floodplain receives flows spilling over the New England Highway and in major flood events will be subject to significant inundation. Major catchment flooding of the Hunter River system is the predominant flooding mechanism at the site.

Existing Hunter River Flood Conditions and Model Calibration

To understand and assess the flood behaviour in the project area, a hydraulic model of the lower Hunter River floodplain was utilised.

There have been a considerable number of flood studies undertaken to understand flood behaviour in the vicinity of the project area, where available these studies have been reviewed, BMT WBM has used their TUFLOW two dimensional model to undertake a project area assessment to understand the impact on flood behaviour for the project individually and cumulatively with both the ARTC HRR Project and the Pacific Highway Upgrade from the F3 to Heatherbrae.

The existing Williams River/Hunter River flood model has been used to simulate design flood conditions for the development assessment. Model simulations for a range of design event magnitudes(10%, 5%, 2% and 1% AEP and probable maximum flood (PMF) events) have been

undertaken to establish existing flooding conditions across the site and to provide baseline conditions for assessing the impact of the TSF and adjacent projects.

The BMT WBM TUFLOW model has simulated the peak flood levels at the proposed development site for a range of design event magnitudes. There is a general flood water level gradient from north to south across the site. Table 19 presents the maximum flood depths at the northern and southern ends of the site.

Table 19: Design Flood Levels (mAHD)

Design Flood Magnitude	Northern End of Site	Southern End of Site
10% AEP	1.0	0.8
5% AEP	1.2	10
2% AEP	2.2	2.1
1% AEP	3.7	3.5
PMF	8.3	7.7

The nature of flooding across the site is similar for a range of design events. This principally originates from floodwaters spilling over the New England Highway from the Hunter River to Hexham Swamp at the northern end of the site. At the 1% AEP event the Hexham Swamp floodplain becomes fully connected, with floodwaters entering over the New England Highway and flowing back to the Hunter River between Hexham Bridge and Ironbark Creek.

The site is not flood affected at the 20% AEP event as the Hunter River remains principally in bank. At the 10%, 5% and 2% AEP events, flood waters spill over the New England Highway into Hexham Swamp at the northern end of the project area, Hexham Swamp is also filled from the southern end by flow from the Hunter River South Arm through Ironbark Creek.

Peak flood velocities are typically less the 0.5m/s, but are locally much higher near the New England Highway, where the initial spilling from the Hunter River occurs. The floodplain flow distribution shows that the major area of conveyance is through the area to the north of the Hexham Swamp. The northern end of the project area is located in this flow path. The majority of the site downstream of Hexham Bridge is sheltered to some degree by the surrounding areas of higher land and is not in the principle flow path.

Local Runoff Events

Flooding in the project area is dominated by Hunter River flood events. Analysis of the local topographic survey and local runoff events shows there are a number of formal, non-formal and swampy areas that store and convey local runoff to the north, west and south of the project area. These channels provide some capacity for flood flows. Due to the size of the Hunter River catchment flood flows in these areas would have dissipated prior to a Hunter River flood reaching the project area and are insignificant compared to the flood flows. Section 9.4 details the management of stormwater runoff from the proposed development.

In addition QR National are undertaking further modelling of the local storm flows as part of detailed design to mitigate any impacts to the broader flood plain, in particular the proposed access road from Tarro Interchange and the northern end of the project will be assessed.

9.3.2 *Impact Assessment*

The development includes regrading of site elevations up to a level of approximately 2.65m AHD. Rail and building infrastructure that is situated at or above this level will remain flood free in the 2% AEP event, which has a peak level of approximately 2.2m AHD. Under the developed conditions the site will be largely flood free at the 2% AEP event, but inundated during a 1% AEP design event. This reduction of flood inundation frequency is only local to the development site itself and does not impact on the flooding frequency of the broader Hexham Swamp system.

Although the highest parts of the site will be located above the 2% AEP flood level, there will be a residual on site flood risk for larger magnitude events such as the 1% AEP and PMF events. The peak flood level at the 1% AEP event is around 3.7m AHD, which will correspond to a flood depth of over 1m across the development site. This has implications for the onsite rail and building infrastructure. Critical infrastructure, such as electrical supply and equipment and administration buildings will be elevated above the 1% AEP flood level.

At the 1% AEP event the velocity depth product for the elevated site area does not exceed 1.0 and is therefore suitable for light building constructions, as recommended by the NSW Floodplain Development Manual. Impacts on the velocity depth product remote from the development site are not significant.

The access road from the Tarro Interchange to the TSF will have a finished surface level (crest level) of approximately 1.1mAHD varying to 2.2mAHD. The adopted culvert size beneath the access road for the creek crossings is 3 x 1.5m coinciding with those below the railway and New England Highway, 3 x 1.5m.

The cumulative impacts of the proposed works, in terms of changes in peak flood water level and peak flood velocity for the 1% AEP, 2% AEP, 5% AEP and 10% AEP are restricted locally to the site and Hexham Swamp. The impact to the Hunter River floodplain beyond Hexham Swamp is negligible. The most significant impacts of the proposed developments are associated with the inclusion of the access road. The impacts from the rail developments are minor in comparison as the rail development is situated within an area of relatively low floodplain conveyance.

Buildings

The TSF will comprise a mix of maintenance and administration buildings. Maintenance and provisioning buildings will be constructed with floor levels that are marginally below the 1% AEP event to match rail levels, administration buildings will be raised above the 1% AEP event. It is recognised that the maintenance buildings could be inundated during a major flood of the order of the 1955 flood and that there is potential for flooding of this magnitude to cause damage to components of the TSF.

Flow velocities across the Hexham floodplain during major flood events are typically low and are therefore unlikely to result in structural damage to components of TSF infrastructure. The TSF will be constructed from flood compatible materials in accordance with the guidelines outlined in the NSW Government's 'Floodplain Development Manual' (2005). This would include the siting of power facilities at a suitable freeboard above the 1% AEP event level.

Given the ample flood warning time, there is time for staff to relocate stock and equipment to higher ground prior to the oncoming flood. There is also opportunity to move rollingstock to higher ground further up the Valley.

Surrounding Land

Upstream of the proposed access road peak flood levels are increased by just under 0.1m (typical flood depths increase from 1.5m to 1.6m) for the 2% AEP flood.

The flood plain flow peaks at around 560m^3/s, with 250m^3/s conveyed through cross drainage and the remainder flowing over the road. For the 1% AEP event the impacts are less than those of the 2% AEP event. The peak flood level impact of the access road is reduced to around 0.05m (with typical flood depths being approximately 3m), as substantial overtopping of the road crest occurs. The road embankment is effectively drowned out, limiting adverse flood impacts. At the 1% AEP flood velocities increase is in the order of 1m/s above the existing velocity of 1m/s. Typical velocities will therefore be over 2m/s and locally higher.

For the 5% and 10% AEP events flood impacts are relatively minor. Peak flood levels upstream of the access road are typically increased by around 0.04m, with some localized increase of up to 0.6m at the 10% AEP event. The impact at the 10% AEP event would be mitigated by the provision of cross drainage through the proposed access road.

The impacts on peak flood velocity for the 2% AEP event are in a similar order to those experienced at the 1% AEP event. The impact on peak velocity is minimal for both the 5% and 10% AEP events.

The rail embankment results in a small redistribution of floodplain flows, pushing more water round to the west through Hexham Swamp. Impacts are restricted to the east of the project in isolated locations where water is trapped behind the rail embankment. Typically peak flood levels are increased by 0.2m, however no cross drainage has been modeled in these areas. There are localised peak velocities in the order of 1m/s where existing velocities are 1m/s. This occurs at the onset of spilling from the Hunter River. Cross drainage structures will be investigated during detailed design to mitigate the impacts in these localized areas.

Local Infrastructure

The most significant impact to local infrastructure occurs at the 2% AEP event for a 1km stretch of the Pacific Highway immediately north of Hexham Bowling Club caused by water spilling from the Hunter River becoming trapped behind the new rail formation. The modeling shows peak flood levels increase in the order of 0.1-0.2m and peak velocities of around 3m^3/s at this location. As noted above no cross drains have been modeled in this area and will be investigated during detailed design to mitigate the impacts.

At the 1% AEP event there is approximately a 0.05m modeled increase in the modeled peak flood level across the New England Highway to the north of Hexham Bridge. This impact is related to the redistribution of flood flows from the rail corridor to Hexham Swamp. There is a corresponding 0.1m decrease in peak levels modeled across the New England Highway to the south of Hexham Bridge.

At Woodlands Close modeled flood level increases are in the order of 0.08m at the 2% AEP event, 0.04m at the 1% AEP event and 0.03m at the 5% AEP event. Impacts in this location are related to both the local redistribution of flood flows and the proposed access road.

Impacts on Local Housing

The flood impacts to local housing are predominantly associated with the access road. The most significant impact on local housing occurs at the 2% AEP event, where a 0.08m peak flood level increase is modelled at the property located on Woodlands Close. The impact on peak flood level at this location for the 1% AEP event is 0.04m and at the 5% AEP event it is 0.03m. These impacts are related to both the local redistribution of flood flows and the proposed access road.

Elsewhere, the only event indicating an impact on local housing is the 1% AEP event. There are three houses located on the New England Highway, to the north of Hexham Bridge and another house situated within Hexham Swamp to the west of the development. These four properties show a 0.03m increase in peak flood level at the 1% AEP event, related to the redistribution of flood flows from the rail corridor to Hexham Swamp. There is a corresponding reduction in peak flood levels of 0.03m indicated for the 30 or so properties located along Old Maitland Road.

The 0.03m peak flood level increase in Hexham Swamp for the 1% AEP event also has implications for properties fringing the swamp in suburbs such as Shortland, Birmingham Gardens, Jesmond and Wallsend. However, this is unlikely to have a significant impact on flooding to houses, but rather a small increase in peak flood levels to low-lying land that is already inundated. Development of the proposed TSF would not result any significant flooding impact to local housing.

Impacts on Local Businesses

The only local businesses that may experience a flood impact resulting from development of the proposed TSF and HRR Project are those located on the former Oak Milk site (Brancourts). At the 5% AEP and 2% AEP events there is a local increase in peak flood levels of around 0.4m. This impact is due to the higher spill level of the proposed development restricting the progression of flood flows through the site. For the 1% AEP event and events of a greater magnitude the local flood impact is negligible as the entire site becomes fully connected with the wider floodplain and is substantially inundated.

At events of a 5% magnitude the flow rate of flood waters spilling through the site is sufficiently small that they can be mitigated through the provision of local cross drainage infrastructure. However, for a narrow range of flood events of greater magnitude (e.g. the 2% AEP), prior to the extensive inundation of the site, the flow rates are large enough to require alternative mitigation works. There are a number of options through which this impact can be mitigated and these are currently being investigated as part of the detailed design.

Impacts on Geomorphology

The proposed development has negligible impact on the flood flows within the Hunter River channel and so will not impact on the Hunter River geomorphology. The impacts of the proposed development are predominantly within the partially disconnected floodplain of Hexham Swamp and are restricted to events of around 5% AEP magnitude and greater. Due to the negligible impact on high frequency flood events no significant geomorphic impacts are anticipated.

Within Purgatory Creek local peak flood velocities are increased to around 2m/s through the access road cross drainage. This impact can be mitigated through the inclusion of appropriate scour protection works in the vicinity of the access road crossing. Impacts to flood velocities in the local flood plain are typically less than 0.2m/s.

Local Flood Impacts

Local rainfall events in the vicinity of the project are not expected to impact the facility and will be managed through the stormwater drainage system which is described further in Section 9.4. Modelling of the proposed stormwater system shows a peak reduction of approximately 15% for the 1 year ARI storm and an increase of approximately 5% for the 2 year ARI storm at the project boundaries. All local stormwater flows would be managed to minimise impact on surrounding catchments.

Cumulative Impacts (Future F3 Upgrade & Hexham Relief Roads)

The investigation considers cumulative impacts of the TSF, access road, ARTC's HRR Project and the F3 Freeway upgrade.

Overall there is no significant increased flood impact resulting from the cumulative consideration of the three proposed developments when compared to the developments in isolation.

During the cumulative impacts assessment, results from the 5% AEP event indicate a peak flood level increase of approximately 0.16m resulting from an uncoordinated approach on culvert alignments. Revising culvert locations for consistency between the proposed developments will minimise the impact.

Climate Change

The impact of climate change, initially addressed in the WorleyParsons report, was based on consideration of the following for a 1% AEP Hunter River flood in the RMA-2 model:

- 10% increase in peak discharges that define the inflow hydrograph at the upstream limit of the model (near Green Rocks) which was considered to reflect an increase in peak rainfall intensity over the entire catchment; and
- An increase of 0.9m in the tidal boundary condition to reflect median sea level rise predictions for 2100. This analysis was undertaken in accordance with recommendations outlined in the DECC Guideline "Floodplain Risk Management Guideline – Practical Considerations of Climate Change' (October 2007).

The peak 1% AEP flood level at the northern end of the site under the above climate change conditions is predicted by this model to increase by 0.32m.

The fill platform to be used as a rail embankment to the TSF will have a finished surface level of approximately 2.65mAHD (top of formation) and rail level of approximately 3.32mAHD. The formation level is approximately 0.45m above the 2% AEP, exceeding the potential increase from climate change of 0.32m.

The BMT WBM Flood Impact Assessment has considered the impact of sea level rise scenarios on the proposed developments. A sensitivity test on the 1% AEP design event has been undertaken incorporating a 0.9m increase in water level conditions at Newcastle Harbour (model boundary).

The cumulative impacts of the proposed TSF, the HRR and the access road (including flood mitigation measures) and the F3 Freeway Upgrade were assessed under the future climate change conditions for the 2100 planning horizon. The flood impacts under future climate change conditions are similar to those modelled under current conditions for the cumulative projects.

9.3.3 Mitigation Measures

For the access road, the flood mitigation to overcome the impact experienced during the 5% AEP storm event is to provide an additional 150m^2 of flow area, represented as 300m by 0.5m high culvert openings. The final configuration of flood relief measures will be refined during the detailed design stage as a combination of lowering the access road elevations to be less than 1.2mAHD and reduce the number of culverts. The flood impact of the final design should then be reassessed (refer to Figure 22).

The cumulative impacts of the TSF, HRR Project and the access road in terms of changes to peak flood water level and peak flood velocity are shown in Figures 4-2 to 4-9, Appendix G of this EA.

Local impacts adjacent to the rail formation to the east of the site will be addressed through the provision of cross drainage structures. A number of mitigation measures exist to address potential flood impacts to the Brancourts site and will be investigated during detailed design.

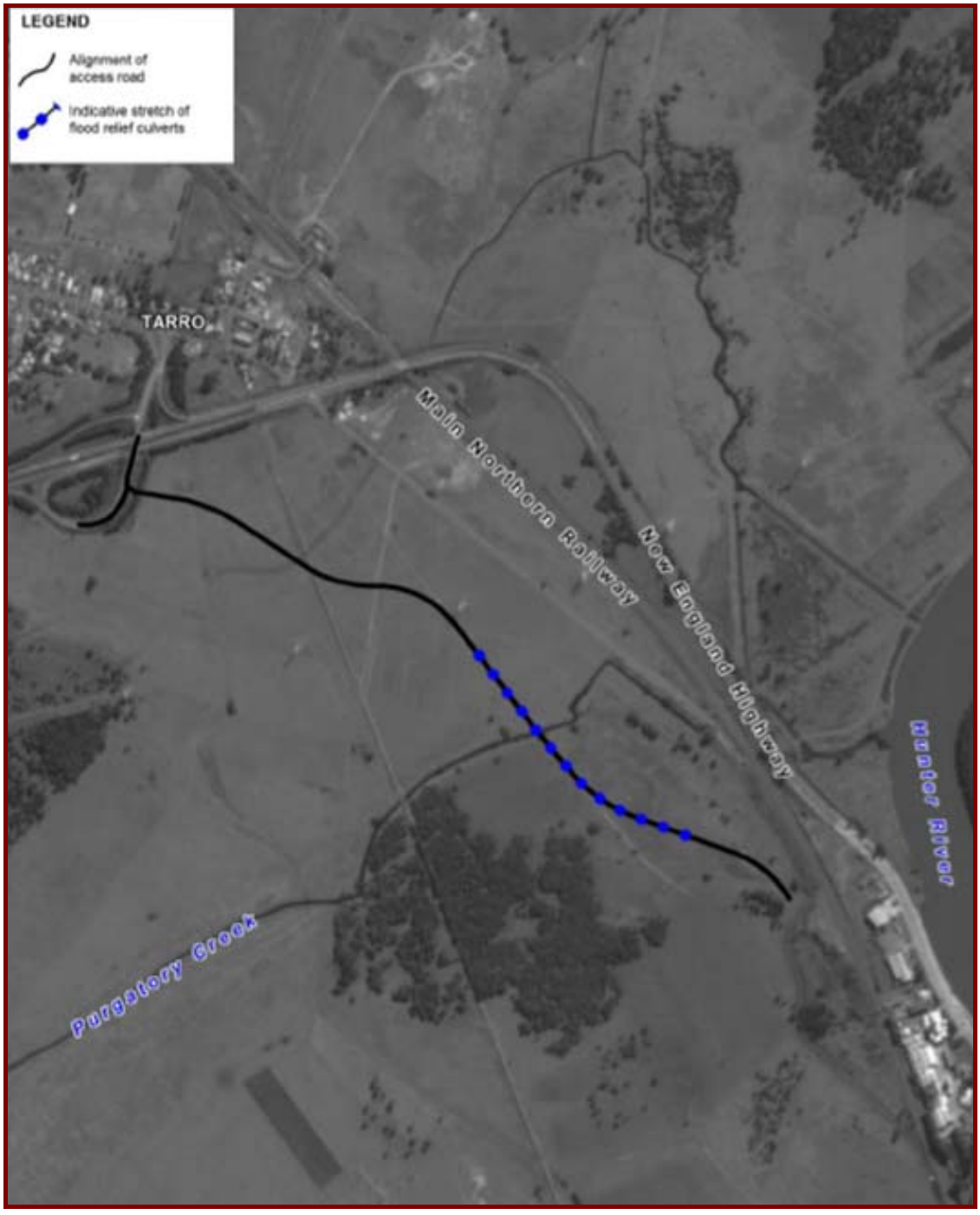

Figure 22: Location of Flood Relief Culverts Distribution.

Evacuation Plan

Depending on the specific rainfall distributions in a given event, it is likely that significant flooding of Hexham Swamp will typically not occur until 2 – 3 days after a major rainfall event. Actual timing of the flood peak is dependent on rainfall location and intensity. This is due to the large catchment size of the Hunter River, with extensive catchment upstream of Singleton. Flood warnings issued by the Bureau of Meteorology (BoM) and the State Emergency Service (SES) are given 24 hours in advance for Singleton and Maitland. This provides sufficient warning a day in advance of when Hexham Swamp is likely to be inundated by Hunter River flood waters. Given the ample flood warning time, there is adequate of time for safe evacuation from the site.

9.3.4 Conclusion

The objective of the study was to undertake a detailed flood impact assessment of the proposed cumulative development on Hunter River flood conditions. Central to this was the application of a two-dimensional hydraulic model of the Hunter River floodplain developed as part of the Williams River Flood Study (BMT WBM, 2009) and updated for the Williamtown / Salt Ash Flood Study Review (BMT WBM, 2011) for Port Stephens Council.

Specifically the modelling undertaken for the proposed cumulative development aimed to:

- Confirm existing flooding conditions across the site including flood levels, flows and velocities to establish baseline conditions for impact assessment;
- Identify the potential flood impacts of the proposed cumulative developments of the Hexham TSF, HRR and access road for a range of design flood magnitudes; and
- Consider the potential cumulative flood impacts of development with the RMS Pacific Highway upgrade from the F3 to Heatherbrae.

The results of the modelling and flood impact assessment have confirmed:

- Peak 1% AEP flood levels for existing conditions are estimated to vary from 3.7m AHD at the northern end of the site to 3.5m AHD at the southern end;
- The majority of the proposed development would be subject to significant inundation in major flood events where typical 1%;
- Corresponding peak flow velocities for the 1% AEP event under existing conditions are typically of the order 0.5m/s, but locally higher;
- The site is to be raised to a level above that of the 2% AEP flood level but largely below the 1% AEP flood level;
- Local increases in peak flood level of up to 0.1m upstream of the proposed access road alignment are simulated for the 2% AEP event with peak flood level increases of less than 0.05m being typical for other design events;
- Elsewhere localised increases in peak flood level can be addressed through adequately designed cross drainage infrastructure;
- Climate change considerations of increased tailwater levels and rainfall intensity increased the 1% AEP flood level by 0.32m;
- The cumulative impacts of the proposed rail developments and access road with the proposed F3 upgrade show no significant additional flood impacts to those when considering the developments in isolation for the 1% AEP event; and
- The cumulative assessment of the proposed access road and F3 upgrade show an increased flood impact for the 5% AEP event. However, there is scope to reduce this by considering the distribution of flood relief culverts for the two developments together, rather than in isolation.
- There is the possibility that the Brancourts site may experience a flood impact resulting from development of the proposed TSF and HRR Project at the 5% AEP and 2% AEP events. WBM BMT have advised that a number of mitigation measures exist to address

potential flood impacts to the Brancourts site which will be investigated during the detailed design phase.

- For the 1% AEP event and events of a greater magnitude the local flood impact is negligible as the entire site becomes fully connected with the wider floodplain and is substantially inundated.

9.4 STORMWATER & WATER QUALITY

WorleyParsons were engaged by QR National to prepare a SWMP for the TSF and the full document is contained in Appendix L.

9.4.1 Existing Environment

The site is dominated by a large coal reject stockpile filled to levels ranging between 3m to 13m AHD surface levels. The natural surface levels are predominantly 0.5 - 2mAHD, generally dominated by disturbed lands used for cattle grazing. Eco Logical's Ecological Investigations Report contained within Appendix F has identified SEPP14 Coastal Wetlands, Coastal Saltmarsh EEC and Swamp Oak Floodplain Forest EEC in parts of the site (refer to Figure 18 within Section 9.2).

All remnant vegetation on the site (excluding the Swamp Oak Swamp forest rehabilitation plantings) is considered to meet the definition of GDEs as described in the NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002) due to the likely interaction of the vegetation with shallow watertables and periodic inundation by floodwater.

Existing Hydrological Conditions

Whilst some flow is toward Hexham Swamp, drainage for the site is predominantly toward the Hunter River via Purgatory Creek in the north and Ironbark Creek beyond the southern boundary. Ironbark Creek is the principal natural drainage channel for Hexham Swamp. Purgatory Creek through the site appears to be an old farm drain excavated to create the pasture lands now used for grazing. Existing and proposed hydrological conditions are shown in Figure 4 in the SWMP in Appendix L.

Existing Water Quality

Existing water quality of groundwater and surface water is reported by Douglas Partners in the Contamination Report in Appendix J to contain elevated heavy metals, hydrocarbons, nutrients and faecal coliforms. Douglas Partners has extensive testing results for groundwater and surface water, site knowledge and inspection for the site and adjacent sites.

9.4.2 Impact Assessment

The proposed stormwater management strategy is summarised as follows:

- Prevention: The following preventative measures would be adopted as development controls to reduce the generation of pollutants under normal conditions as well as provide contingencies in the event of an accidental spill of potentially polluting substances:

- Minimise area of development footprint by providing a compact and efficient design;
- Provision of industry best practice arrangements for the dispensing of fuel and other provisions (sand, lubricating oil, coolant, water, etc) to both locomotives and on-site vehicles and machinery. Management is to be in accordance with all relevant Australian Standards and guidelines; and
- Development and implementation of operational procedures which define how to operate the site in an environmentally responsible manner. Procedures would include, disposal of hazardous and potentially hazardous material and contingencies in the case of a potentially damaging environmental event (such as a fuel spillage).

- Isolation: Operational activities identified as potentially generating significant contamination are to be isolated from the greater stormwater system. These areas include wagon and locomotive wash down bays, maintenance areas and refuelling/provisioning areas. All water generated in these areas would be either disposed of to trade waste or treated onsite and reused;
- Treatment: Runoff would be treated or controlled by a series of stormwater management devices prior to discharge into the environment;
- Contingencies: There is a potential for an accidental spill/leak to occur at any point in the rail yard. Therefore appropriate measures will be in place to isolate an area for clean-up purposes; and
- Monitoring: A comprehensive surface water and groundwater monitoring plan would be undertaken by QR National to establish existing baseline parameters and observe the surface and ground water quality during the construction and operation phases of the TSF development.

The stormwater management system has been designed to segregate potentially contaminated waters from operational areas (which will be directed to a dirty water system for reuse) and divert all other water to on-site storage basins where treatment will occur through the use of several varieties of gross pollutant traps (GPTs).

A GPT will be located at the outlet of each pond as a final barrier to remove suspended solids, remaining floating debris (e.g. plant material) and hydrocarbons. Low flows will pass through the GPT with larger flows discharging over a spillway.

Details relating to flooding at the site are provided within Section 9.3 of this EA.

Hydrology

As the overall site is predominately flat, runoff would currently occur slowly, with the majority of rainfall being stored on site in the lower lying areas. It is likely that runoff would only occur during/after extended periods of rainfall.

Following development there will be an increase in impervious area (shown in Table 20). Due to site constraints, the proposed drainage systems have been designed to fall at absolute minimum gradients (sometimes flat).

The flat grades of the drainage system will act to minimise time of concentration changes and maximise infiltration. As a result, the following potential impacts will need to be addressed:

- Potential changes to the hydrologic response of catchments contributing to sensitive areas during normal wetting and drying cycle events (i.e. events <1 year ARI return period);
- Peak flows from frequent storm events (e.g. 1 to 2 year ARI events) which affect "stream forming" flows in the downstream drains, etc. Note that many of the existing surface drains within the neighbouring properties are recent human constructions; and
- Large return period events (e.g. 10 year ARI) where significant changes in peak flow may cause localised erosion, should controls not be implemented at the point of discharge to the surrounding landscape.

The hydrodynamics within the existing site have been significantly altered by previous land use practices of coal stockpiling, infilling of wetlands, construction of tailings ponds and drainage swales and irrigation of wastewater treated effluent. The resulting landform is considered highly disturbed. The existing hydrology at the site is represented within Figure 3 of Appendix L.

The following discharge locations have been identified including channel realignment of Purgatory Creek and have been used to assess potential impacts from the proposed development:

- Location 1 - Culvert to Hunter River north of the site;
- Location 2 - Swamp Oak Floodplain Forest (EEC) north of the site;
- Location 3 - SEPP14 west of HWC watermain and North of abandoned railway;
- Location 4 - SEPP14 west of HWC watermain within Hexham Swamp and South of abandoned railway; and
- Location 5 – Coastal Saltmarsh (EEC) south of the site.

Given the highly disturbed state as previous coal, rail and agricultural land uses, it is difficult to numerically assess the existing hydrological behaviour of the site. In view of this, a combination of qualitative and quantitative approaches has been used to assess stormwater management measures appropriate to the development. Quantitative modelling was carried out using DRAINS to assess low frequency, high intensity storm events. Qualitative methods were used to assess high frequency, low rainfall and the effects on wetting/drying periods.

Table 20: Composition of Catchment Areas

	Existing			Developed		
Outlet Location	Total Area (Ha)	Impervious Area (Ha)	% Impervious	Total Area (Ha)	Impervious Area (Ha)	% Impervious
Location 1 - Culvert to Hunter River	379.0	2.3	1%	381.1	5.0	1.3%
Location 2 - Swamp Oak Forrest	30.5	0.3	1%	25.5	0.5	1.9%
Location 3 - SEPP14 North	37.2	1.9	5%	52	14.6	28%
Location 4 - SEPP 14 South	66.8	3.9	6%	50.7	2.97	6%
Location 5 - Coastal Saltmarsh	32.6	2.8	9%	39.1	8.3	21%
Total	**546.1**	**11.2**	**2%**	**548.4**	**31.4**	**5.7%**

The SWMP identified two Discharge Locations would be sensitive to changes in low flow events, these being Location 2 - Swamp Oak Floodplain Forest (EEC) and Location 5 – Coastal saltmarsh (EEC).

At Location 2 - Swamp Oak Floodplain Forest there is a minor change in catchment area draining to Location 2. It is concluded that this will not impact minor flow regimes, however it will increase the frequency of inundation from every second year to yearly. As the percentage of the catchment that is impervious doesn't appreciably change, there will be a negligible change to existing wetting and drying periods. The change is negligible on an area and quantitative basis. In view of this, it is concluded that the proposed development will have a negligible impact to the EEC.

At Location 5 – Saltmarsh EEC, there is an increase in the volume of fresh water discharged to this location due to the increase in impervious area. However, due to the proposed detention basins the impact is not considered significant in comparison to the overall size and quantity of water within the estuarine environment. Refer to Part 5.1.2 of the SWMP contained within Appendix L.

Due to the proposed erosion and sediment control mitigations, locations 1, 3 and 4 (Table 20) are not considered sensitive to minor changes in flow rates. This is because these areas are relatively waterlogged and/or semi-permanent submerged environments, in large, flat, open areas where depth changes are negligible, or are within areas where the proposed development represents relatively minor changes to significantly larger catchments. Any incidental ponding, as a result of the access road embankment, will be addressed with piped drainage during detailed design of the access road.

Modelling indicated that there are opportunities for stormwater management on the site to assist in creating favourable conditions for restoration of suitable environments as an offset for the area of the site lost due to the proposed development. This can be achieved by changing the discharge and overflow locations, and frequencies to specific areas as part of the ongoing design.

From the ecological report contained in Appendix G, the Groundwater Dependent Ecosystems (GDEs) are highly disturbed from previous land uses and remain in relatively poor condition due to weed invasion. Given the improvement of GDE's in the offset lands, any possible detrimental effects locally are offset and not significant in terms of the Hunter Estuary.

Water Quality

The construction of the TSF and HRR projects is to involve significant earthworks to achieve required site grading. As a result of the soil disturbances, there is potential for increased sediment loads to occur from the site. If disturbed soils are contaminated from previous land uses, then disturbance of these soils could potentially result in contaminated sediment being exported from the site in surface water runoff

During operation, the following potential contaminant sources have been identified:

- Locomotive Wash: Designated locomotive wash down areas will be protected from weather and bunded to prevent runoff; runoff would be treated (via sediment traps and oil/grease separators) prior to discharge to the proposed wash down recycling system described in Section 6.4.2. These systems are totally separate from the stormwater system;
- Locomotive and Wagon Maintenance Facilities: Locomotive and wagon maintenance facilities will be contained within specifically designed building structures that are protected from all weather, and have separate bunded collection, treatment and disposal systems, such that no contaminates can enter the stormwater system;
- Provisioning and Refuelling Areas: Proposed provisioning and refuelling areas would be covered and bunded so that there is no runoff from these areas into the environment. Hence, it is unlikely that the provisioning/refuelling operation would be a source of hydrocarbon contamination into the environment; and
- Rail Yard: It is likely that the rail yard would have a low coal particulate load, primarily through the coal particulate either falling off wagons or washing off during periods of rainfall. Additionally, there is potential for hydrocarbon and metal contamination resulting from the rail yard operations. Runoff from the rail yard would be treated in gross pollutant traps and constructed wetlands prior to discharge. Monitoring of the discharge quality is required to verify the treatment effectiveness.

A detailed construction stormwater management plan will be included in the CEMP. An overview of the proposed stormwater regime for the construction period is described as follows:

- The proposed water quality ponds would be used as sediment basins during the construction phase. These ponds should be installed before any other works take place on site. All ponds would be inspected following rainfall events to ensure stormwater meets the necessary quality requirements prior to being discharged off site;
- Construction of temporary surface drains to minimise the flow of clean runoff into the construction site. Surface flows should also be directed away from material stockpiles and open trenches;
- Creation of designated no-go areas to minimise site disturbance;
- Silt fences or similar will be required around exposed ground and material stockpiles, including the use of bunding where considered appropriate;
- Provision of shaker pads or other similar devices at all site entry locations to ensure construction vehicles are not tracking material off site;
- Minimise areas of earthworks and trenches under construction at any one time;

- Progressive revegetation of disturbed areas;
- Regular cleaning of public roads which are used by construction traffic;
- Where possible, vegetated filter strips will be provided between construction works and areas of sensitive vegetation;
- Construction plant and materials to be stored and maintained away from watercourses and high water tables; and
- Inspection (on a daily basis) of construction areas, stormwater devices (silt fences, sediment basins, etc) and any other appropriate areas.

For constriction of the access road, road side swales and small temporary sediment ponds could be established to ensure retention of sediment laden runoff prior to discharging into adjacent areas. Where a sufficient width filter strip cannot be located between a natural drainage line and the construction works, sediment fences will be located beyond the available filter strip.

ARTC Relief Roads Project

In terms of ARTC's HRR Project, it is expected that stormwater runoff volume and velocity will not increase as a result of the development. This is due to the fact that train lines formation will be constructed on ballast and gabion rock. The surface roughness of the material is higher than the current bare earth of 0.03 to 0.04 (runoff coefficient) which will help decrease stormwater runoff rates and attenuate the peak flows. The result will be a flattening of the discharge hydrograph profile.

The cumulative impacts of the proposed ARTC HRR Project have been considered in this EA. Modelling incorporating catchments covering both projects concluded that there is no significant effect on overall peak volumes.

9.4.3 Mitigation Measures

Stormwater treatment targets adopted for the SWMP are summarised below:

- Suspended Solids (TSS) - 85% retention of the developed average annual load;
- Total Phosphorous (TP) - 65% retention of the developed average annual load; and
- Total Nitrogen (TN) - 45% retention of the developed average annual load.

Water Quality Control Strategies

Based on the above, the stormwater quality management measures outlined in this EA have been developed. MUSIC modelling was undertaken to determine the treatment efficiencies of the proposed measures. These measures are set out below:

- Areas of high sediment, oil & grease and nutrient loads will be separated from the stormwater system (e.g. wash bays, provisioning sheds, servicing sheds). These areas will be treated separately and discharged to trade waste or for re-use in wash down. This will be achieved by the use of separate drainage systems, bunds, roofing and hardstands in these areas;
- Where possible, runoff will be directed over gravel/ballast areas prior to entering the drainage system to encourage pollutant removal, infiltration and decreased run off

rates. Given the porosity of the ballast, it is considered that reasonably heavy storms would infiltrate through the gravel and eventually drain to the cess drain running the length of the site;

- Gross Pollutant Traps will be utilised to provide primary screening of stormwater. This will comprise formed concrete stilling basins with trash racks located at the outlet to basins. Areas draining directly to the ponds will utilise stormwater GPT's. The GPT's will be located offline to prevent re-suspension of material during larger storm events. A baffled outlet will be provided to trap hydrocarbons and other floating material in the GPT; and
- Water Quality Control Ponds (WQCP) – three ponds are proposed across the site to facilitate removal of suspended solids. The characteristics of these ponds are summarised in Table 21 below.

Table 21: WQCP Details

WQCP	Volume (M^3)	Surface Area	Depth (M)
1	1,230	2,190	0.6m
2	3,900	6,800	0.6m
2	3,800	6,560	0.6m

- Access roads are to be provided with road side swales that will provide treatment throughflow attenuation and sedimentation of suspended sediments;
- Figure 34 in Appendix L illustrates the location and concept layout for the water quality ponds. The characteristics of these ponds would be further developed and refined during the detailed design stage; and
- A further GPT will be located at the outlet of each pond as a final barrier to remove suspended solids, remaining floating debris (e.g. plant material) and hydrocarbons. Low flows will pass through the GPT with larger flows discharging over a spillway.

Modelling indicates that the proposed treatment trains will achieve the adopted stormwater treatment targets for the site. The adopted treatment measures are considered conservative and have not included the significant additional benefits of the removal of grazing from the site.

Water quality monitoring will be undertaken in accordance with Section 7 of Appendix L. The water quality monitoring program consists of establishing the baseline surface and groundwater quality and periodic monitoring against the baseline during construction and operation.

Construction SWMP

A preliminary construction SWMP has been prepared for the site. As part of the SWMP, preliminary Inspections and Test Plans (ITP) have been prepared for the specific activities (relevant to the SWMP) in accordance with the Blue Book (refer Appendix E of the WorleyParsons report in Appendix L).

It is concluded that the construction SWMP demonstrates that the proposed development can be feasibly constructed in accordance with current best practice, and will therefore minimise impacts to the surrounding areas during this phase. Final construction SWMP will be developed as part of the management plan and construction certificate process.

9.4.4 *Conclusion*

Based on the investigation, it is concluded that the proposed TSF can feasibly be developed in accordance with current best practice guidelines, and will not have a significant impact on the adjacent areas.

9.5 EFFLUENT DISPOSAL

An Effluent Disposal Assessment has been completed by Douglas Partners and the full report is contained in Appendix N.

HWC has confirmed that there is no regional sewer connection sufficiently close for connection of the TSF, so onsite effluent disposal will be required. Wastewater flows calculations for the TSF development have been derived by Worley Parsons in accordance with the relevant standards. The water demand and wastewater flow calculations are contained in the Services Investigation Report in Appendix M. The suitability of the land for onsite effluent disposal has been determined by Douglas Partners and their reporting is contained in Appendix N.

9.5.1 *Existing Environment*

The irrigation site area was selected for proximity to the TSF and being elevated above flooding inundation potential. The site is predominantly open, flat grassed area and there is significant space available. Following the assessment guidelines there are number of limitations to the site has localised embankment slopes greater than 20%, moderate to high potential for run on and seepage of Brancourts effluent irrigation at the northern end and presence of intermittent waterways with ponded surface water.

The subsurface conditions comprise fill material combinations of silty gravel, silty sandy gravel, clayey sandy gravel and predominantly coal reject. Potentially existing concrete slabs from the previous buildings of the former site uses may intrude into the selected irrigation areas.

9.5.2 *Impact Assessment*

Water Demand and Availability

The ultimate water demand for the TSF is 32 equivalent tenements (ET). The water supply would be provided for the showers and toilets in the administration block, two maintenance facilities and other facilities within the TSF. Water demand is calculated as follows:

Table 22: Water Demand

Stage	ET	Average Day Demand			Peak Day Demand (KL/day)	Extreme Day Demand (KL/day)	Peak Hour Demand (KL/day)
		Administration (KL/day)	Wash Down Top Up (KL/day)	Total (KL/day)			
Stage 1	11	2.0	0.25	2.6	6.1	7.0	10.8
Stage 2	32	6.0	0.45	7.4	15.5	17.6	27.8

Water connection for the TSF is likely to be made to an existing 200mm water main which in turn is connected to the 900mm diameter Chichester Trunk Gravity Main (CTGM) passing through the QR National site adjacent to the TSF. HWC has previously confirmed that the existing 200mm diameter main for connection has capacity for the demand from the TSF.

Wastewater Management

The TSF would be serviced by reticulated sewer to a package sewage pump station located in the vicinity of the buildings and would transport wastewater up to the package treatment plant. A package wastewater treatment plant would be provided for treatment of domestic effluent, a separate treatment process is proposed for reclamation of wash down water.

The irrigation pump station would comprise two pumps mounted on a concrete slab with an adjacent control cabinet. A buffer storage tank with sufficient storage for 60 days of treated effluent discharge from the TSF would be employed in case of wet weather. A backup irrigation pump has also been provided. During operation, the volume stored will be monitored and in exceptional circumstances, such as prolonged wet weather, pump out and transport by tanker truck would be required to an appropriate discharge point into HWC's system.

The Stage 2 sewer flows will be as follows:

- Average Dry Weather Flow (ADWF) = 0.15L/s; and
- Peak Wet Weather Flow (PWWF) = 1.5L/s

These flows are based on a sewer load of 13.6 ET, which is based on the assumption of 60 people per day using the site, in 2 shifts over 24 hours. A schematic flow diagram of the system is represented in Figure 23.

The wash down water treatment recycle system is for the wash down of locomotives. Gross pollutants, waste traps and oil/grease separators would be used in the return of wash down water for reuse. A pump station with chlorine dosing would be used to manage flow to the reuse header tank. A small proportion, in the order of 250L/day, of wash down water will be disposed to the main wastewater treatment system.

Irrigation Area Requirements for Disposal

The minimum disposal areas were calculated by Douglas Partners. The minimum irrigation area for the Stage 1 average dry weather flow (ADWF) is 13,600m^2, while the Stage 2 footprint size of the irrigation area will be 39,300m^2.

It will be necessary to provide stormwater drainage diversions and bunds adjacent to the irrigation areas to minimise potential for rainfall runoff and run on entering the irrigation areas.

The disposal area will be filled and regraded to meet design standard requirements. There is physical separation from Brancourts irrigation area and the two systems would operate independently. The soil will be improved with lime and gypsum as required. A minimum 250mm thick suitable clay loam fill to form the surface of the irrigation area. This is to improve soil properties and minimise the potential for groundwater pollution. Any existing concrete found during irrigation area construction will be topped with a minimum 500mm thick fill layer or be removed depending on final extent of intrusion.

Approval Process

Following detailed site design and design of the wastewater systems for the TSF, application will be made for approval under Section 68 of the Local Government Act with NCC. The recycle system will be subject to approval from NSW Office of Water/OEH.

9.5.3 Mitigation Measures

Mitigation measures to address effluent disposal impacts are outlined below:

- A wastewater system for effluent disposal and primary and secondary disposal areas have been proposed as identified within Figure 6 (Project Components). Further details are provided within the Effluent Disposal Report (Appendix N);
- A recycle system for wash down water;
- An irrigation area with the following site improvements:
    - Removal of the concrete hardstand and footings in the central portion of the site, or placement of 0.5m of suitable clay loam fill material over concrete;
    - Addition of lime to acidic soils to maintain plant growth;
    - Addition of gypsum to improve the soil structure and reduce dispersion/erosion;
    - Earthworks to re-contour and fill drainage channels and redirect surface water flow around the proposed irrigation area (meeting buffer distance requirements);
    - Where required, placement of suitable fill or earthworks to raise site levels to at least 1m above the permanent groundwater table and/or at least 0.6m between the highest seasonal water table level and the base of the irrigation areas (whichever is the greater);
    - Importation and placement of a suitable clay loam fill to form the surface of the irrigation area to improve soil properties and minimise the potential for the groundwater pollution; and
    - Installation of catch drains/bunds upslope and downslope of the irrigation area to prevent rainfall run-on and runoff;
- Temporary erosion and sediment controls will be required during construction works;
- Dewatering licensing to cover the sewer installation is potentially required;
- Rainwater tank top up of recycle water system; and
- Given that there are two irrigation areas within close proximity and independent to one another, additional targeted sampling of surface waters and groundwater is undertaken up-gradient, within and down gradient of the proposed effluent irrigation area prior to development to confirm baseline surface water and groundwater quality. Groundwater wells should be located to allow for monitoring of groundwater up-gradient, within and down-gradient during operation of the effluent disposal area.

9.5.4 Conclusion

There is sufficient area available for onsite effluent disposal and its independence and separation from the existing irrigation area. Conventional control of design of the system falls under Section 68 of the Local Government Act with NCC as the consent authority. QR National, through the design of the TSF, has proposed an environmentally sound wash down facility of recycling water and rainwater tank top up for reduced water supply.

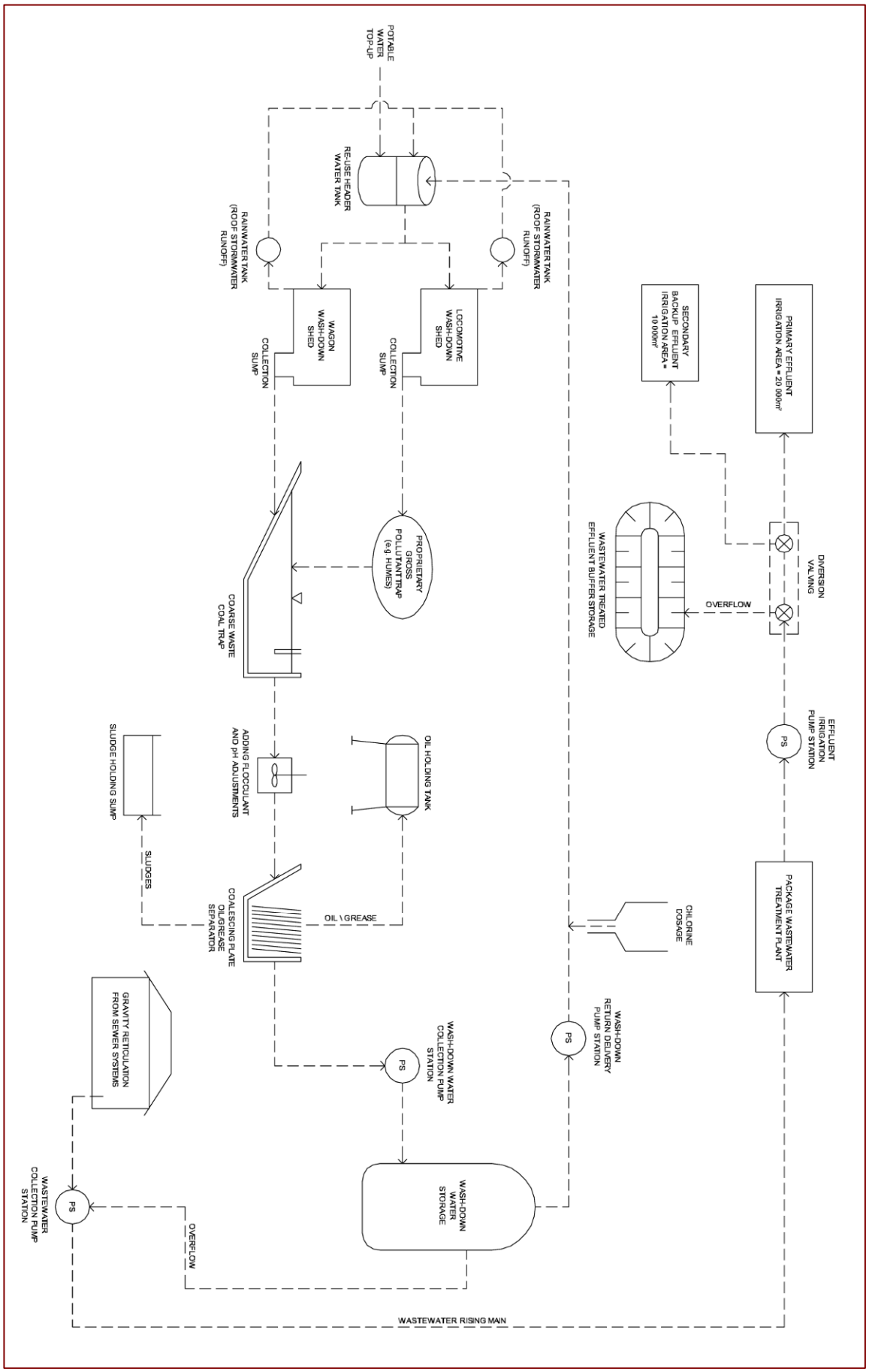

Figure 23: System Schematic Process/Flow Diagram.

9.6 TRAFFIC, ACCESS & CARPARKING

A Traffic Impact Assessment (TIA) has been prepared by Better Transport Futures (BTF) for the proposed TSF and the full report is contained in Appendix O. The TIA includes a review of the impact of the TSF on the local road network during both the construction and operational stages. The TIA also takes into account the ARTC HRR Project and future RMS plans for the proposed F3 Freeway to Heatherbrae Upgrade.

9.6.1 Existing Environment

The site has existing access to the New England Highway via Woodlands Close to the north. The existing intersection at Woodlands Close and the New England Highway provides only for left turn in and left turn out. The New England Highway in the vicinity is a dual carriageway with two lanes of traffic in both directions and a posted speed limit of 90km/h. To the west of Woodlands Close is the Tarro Interchange which provides local access to Tarro and Beresfield from the New England Highway. It is not possible to access Maitland Road (Pacific Highway) from the site at Hexham due to the location of the rail corridor (refer to Figure 24).

Richmond Vale Rail Trail

Consultation with NCC has indicated a potential cycle path along the HWC owned land, which would connect with the potential future Richmond Vale Rail Trail cycle path, and provide a regional link between the Hexham area through to Kurri Kurri and beyond. The design of the internal road network and operations allows for connection for the northern proposed cycle routes.

F3 Freeway Extension

Investigations have commenced into an extension of the F3 Freeway from John Renshaw Drive to the Pacific Highway at Heatherbrae. Consultation with RMS has identified the preferred route of the extension has the potential to significantly reduce traffic flows along the New England Highway in the vicinity of the site. The design of the access road and proposed TSF track has been coordinated with the preliminary proposals for the F3 Freeway to Heatherbrae Upgrade. The location of the future F3 Freeway is identified within Figure 24.

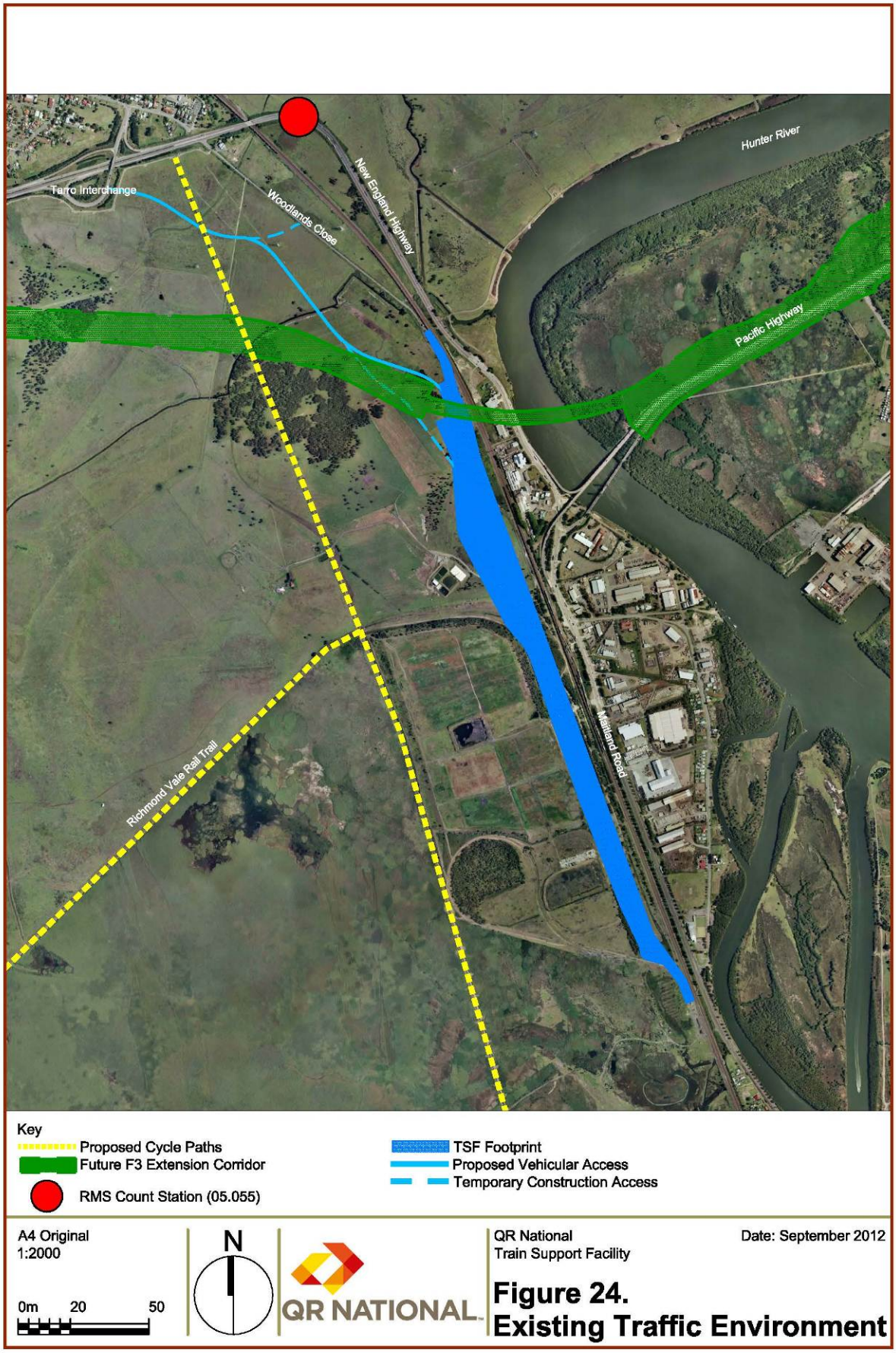

Figure 24: Existing Traffic Environments

Fassifern to Hexham Rail link

Transport for NSW has advised that the design of a Rail Link between Fassifern and Hexham on the GNR Line is under review. The Rail Link would form a rail freight bypass of western Newcastle. Preliminary studies have been carried out on a route which diverges from the existing railway at Fassifern and joins the existing Hunter Valley Line in the vicinity of Hexham.

The Fassifern to Hexham Rail Link would be justified by an increase in coal traffic from south of Fassifern, additional regional container traffic from the north west or the proposed container freight terminal at Beresfield. Additional traffic from these sources has the potential to cause congestion on the bank between Adamstown and Cardiff which would be alleviated by a bypass between Fassifern and Hexham.

During the assessment and design of the TSF, Transport for NSW will be further consulted where any adjustments or amendments are made to the proposed TSF to ensure that changes do not have an impact on the future Rail Link. The proposed TSF has been designed with consideration of the current proposal for the Fassifern to Hexham Rail Link.

Ongoing consultation with Transport for NSW and other relevant agencies will be undertaken via meetings at key milestones throughout the project process, for example; following submission of the Preferred Project Report/Submissions Report. The proponent has agreed to keep Transport for NSW and RMS up to date on project progress and Transport for NSW and RMS will do likewise regarding the progress of future development in the area, in particular the future F3 extension and Fassifern to Hexham Rail Link.

Existing Traffic Volumes

New England Highway – Traffic data provided by RMS from a traffic volume survey station (05.055) located to the north of the site, on the New England Highway (Figure 24) is illustrated in the table below.

Table 23: Recorded AADT on New England Highway, Count Station 05.055

Year	1988	1990	1992	1995	1998	2001	2004	2010	2011
AADT	29551	34451	34523	41052	43337	45783	48879	56430	52116
Growth		4900	72	6529	2285	2446	3096	7551	-4313
% / annum		8.29	0.10	6.30	1.86	1.88	2.25	2.57	-7.64

The last 5 years of data show rate of growth is just on 2.7%, reflecting the growth in traffic between the Upper Hunter and Maitland through to Newcastle.

The New England Highway is classified as an Arterial Road under RMS road classification guidelines and is found to have some spare capacity for increased traffic flows.

Tarro Interchange – BTF traffic surveys completed in July 2011 of the two way combined peak flows on the Tarro Interchange found 350-400 vehicle movements in the morning peak and 450-500 vehicle movements in the afternoon peak. The operation of the Tarro Interchange was observed during the study and delays to vehicles on both roads were observed to be low. Sight distances were found to be acceptable for traffic exiting the New England in both directions.

The intersection of the New England Highway with Woodlands Close operates well with little delay. It is noted however that it does not meet Austroads standards and the traffic flows in and out of Woodlands Close are very low, as there is currently little development off Woodlands Close to create demand. The RMS has indicated that the use of Woodlands Close would not be an appropriate access for the TSF project.

9.6.2 Impact Assessment

To assess the impact of traffic from the proposed TSF, Sidra traffic modelling has been undertaken to analyse the level of service for the proposed intersection (at AM and PM peak periods), the level of queuing and expected delays. The results of the Sidra modelling are contained within the Traffic Impact Assessment in Appendix O.

Construction

It has been proposed that a new intersection be constructed on the Tarro Interchange that provides access to the site during the construction and operational phases of the facility. The proposed intersection off the Tarro Interchange is identified in Figure 25.

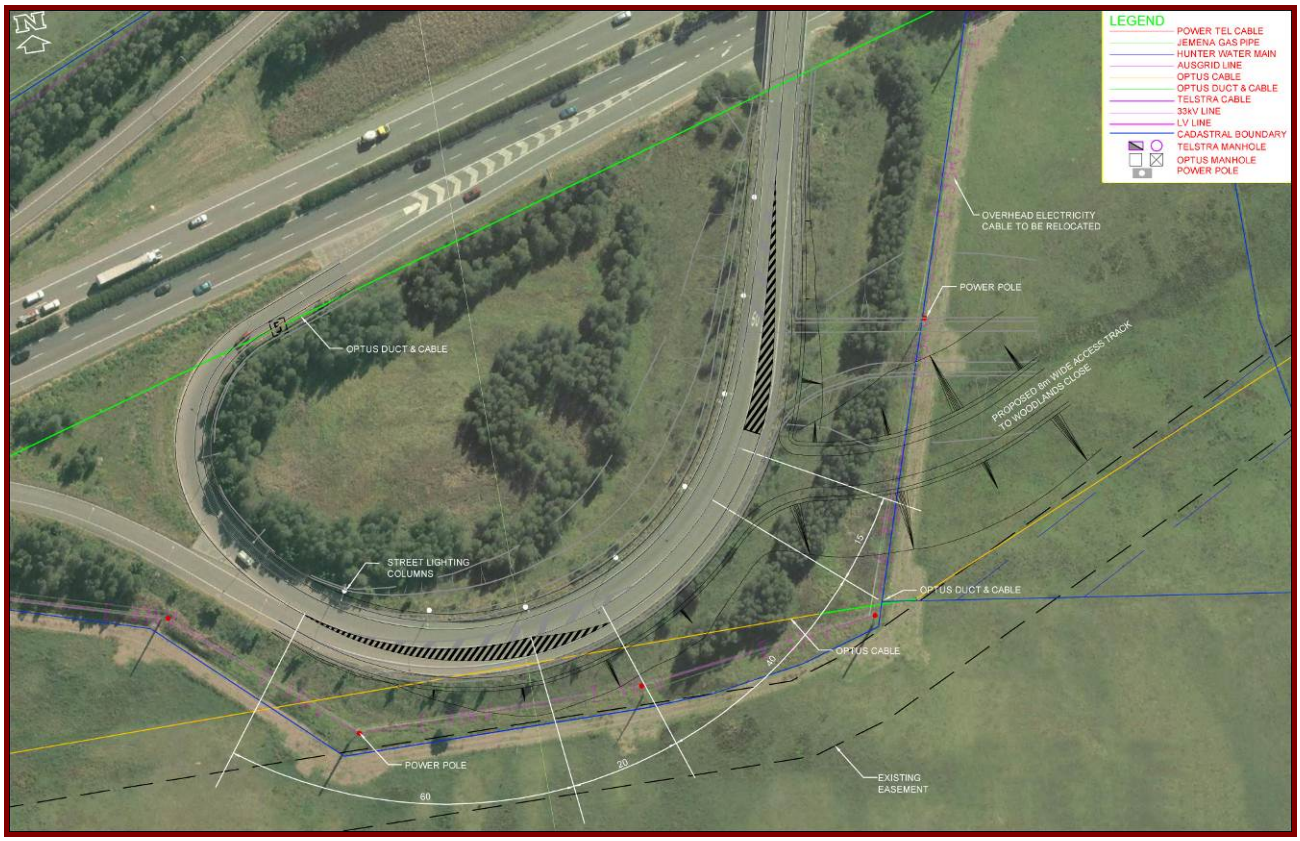

Figure 25: Proposed Intersection of Access Road with Tarro Interchange.

To enable the construction of the intersection with Tarro Interchange, initial access will be required to the site via Woodlands Close, in order to mobilise the heavy machinery and material required for construction. The movement of vehicles in and out of the site via Woodlands Close will require the development of a Traffic Management Plan. It is considered that this would require access to be restricted to night work and potentially the closure of the left hand lane off the New England Highway and an appropriate reduction in the speed limit. This would form part of a separate application to RMS.

Following completion of the access road and Tarro Interchange intersection, construction of the TSF can commence, with workers and materials now able to enter and exit the site safely, without disruption to flow of traffic on the New England Highway.

The proposed working hours for the construction of the TSF are between 7.00am – 6.00pm, with up to 75 construction workers on site during the peak construction period. There will be two distinct peaks in traffic flow, coinciding with construction workers arriving on site and departing at the end of the day, with remaining traffic flows being spread out between 9.00am and 3.00pm. The traffic associated with construction workers will generally impact outside of the traditional peak hours on the New England Highway at this location. Construction of the proposed TSF will result in no impact to the existing rail services. Construction of connecting tracks will be undertaken during scheduled closedowns to ensure that no impact to existing services occurs.

The peak volume of traffic coincides with the civil works to the site. Significantly, this would involve the importation of up to 380,000m^2 of fill to provide a level platform on which to construct the rail formation and buildings. A summary of the quantities associated with the importation of the fill are illustrated in the table below.

Table 24: Fill Quantities

Total Fill Required (Measured on Plan)	Total Tonnage (based on 1.7t/m3)	Total Number of Inbound Movements (Truck & Dog 30t Load)
380,000m^3	646,000	21,533

Construction traffic will peak to around 190 vehicles per day entering the site, during this period. The peak daily traffic volume is predicted to be in the order of 380 vehicle movements per day, which will be spread over a period of 7 – 8 hours. This peak would be temporary, predicted to occur over a 2 – 4 month period of the 18 month construction program.

The peak traffic movement associated with the construction phase of this project are outlined in the table below.

Table 25: TSF Peak Vehicle Movements

	Daily Number of Vehicles	Total Two-Way Movements
Light Vehicles	70	140
Heavy Vehicles	120	240
Total Movements	190	380

The following is a summary of vehicle movement paths for vehicles entering and exiting the site, which has been developed in consultation with RMS:

- Accessing from the south, vehicles will left turn in off the existing slip road to the Tarro Interchange and then turn right into the access road to the subject site;
- Accessing from the north, vehicles would continue along the New England Highway to the signalised turn around area under the Hexham Bridge (opposite Brancourts) then turn right back onto the New England Highway to proceed to the Tarro Interchange as above;

- Exiting movements wishing to head north will turn left onto the Tarro Interchange and then merge onto the New England Highway; and
- Exiting movements wishing to head south will turn left onto the Tarro Interchange and then merge onto the New England Highway, before turning down John Renshaw Drive and making a U-turn at the roundabout controlled intersection of John Renshaw Drive with the F3 Freeway (at the end of Weakleys Drive).

Refer to Figure 26 for the access routes in and out of the subject site.

Figure 26: Vehicular Access Routes

Cumulative Impacts

ARTC Hexham Relief Roads Project

ARTC is planning to undertake construction of their HRR Project on land adjacent to the TSF site with their works commencing in March 2013.

The Parsons Brinkerhoff Traffic Impact Assessment provides traffic numbers associated with construction of the HRR Project. These numbers are similar to the maximum numbers for the TSF project.

Consistent with the TSF project the ARTC peak vehicle rate is primarily associated with bulk material delivery timing spread throughout the day. This would result in cumulative traffic flows during the peak construction period in the order of 720 vehicle movements per day. This is a worst case scenario assessment of both projects experiencing bulk material, peak vehicle movements simultaneously.

The total number of construction workers for both projects is in the order of 150 with the remainder of the traffic flow spread out over the primary delivery period between of 9.00am to 3.00pm.

During the morning and afternoon peak traffic periods, flow on the New England Highway is high, with little capacity for additional traffic movements. However given the construction hours proposed, the peak influx of workers in and out of the site will generally impact outside of the peak traffic flows of the New England Highway.

Peak construction traffic associated with the importation of fill equates to approximately 95 vehicles per hour entering and leaving the site. Outside of the peak periods, the traffic flows are 1 000 or more per hour less than the peak period indicating significant spare capacity for the additional traffic movement.

Overall it is considered that the construction traffic associated with the TSF and ARTC works will have an acceptable impact upon the operation of traffic flows along the New England Highway in this location.

Operational

An assessment of traffic generation has also been undertaken for the operational phase of the TSF and is summarised in the table below.

Table 26: Operational Vehicular Movements

DEMAND	Number per Day	Inbound per Day	Outbound per Day	Total per Day
Staff	30	30	30	60
Fuel Delivery	3	3	3	6
Delivery Vehicles	20	20	20	40
Total	53	53	53	106

The facility will be open 24 hours 7 days a week, with the servicing and maintenance operations occurring between 6.00am and 10.00pm. Staff number approximately 30 and work in shifts, decreasing the peak demands on the road network accordingly.

Delivery of fuel for the facility will require up to three B doubles accessing the site each day. Other delivery vehicles movements will generate 20 inbound and outbound movements per day. Based upon a typical eight hour day for the delivery of supplies it is expected that there would be on average three vehicles inbound and outbound per hour. It is considered that three vehicles inbound and outbound per hour would have a negligible impact upon the operation of the New England Highway at this location, given the construction of the new intersection with the Tarro Interchange.

Car Parking

Dedicated onsite parking will be provided adjacent to the offices and amenities as identified within Figure 7 (Project Components) and on hardstand areas adjacent to main work areas. The facility car park would have 38 parking spaces including two disabled spaces.

9.6.3 Mitigation Measures

The assessment of traffic impacts for the proposed TSF requires a commitment to undertake the following:

- Construction of a new T-intersection on the Tarro Interchange with sheltered right turn lane to accommodate the site access road; and
- Construction of an access road connecting the Tarro Interchange with the TSF.

9.6.4 Conclusion

The access proposal off the Tarro Interchange will provide an appropriate level of service for traffic access to the proposed development site. Whilst traffic flow on the New England Highway is high at peak times, the relatively low number of staff and shift work operation means that there will be little if any impact upon the existing traffic flows along the New England Highway at this location. The future extension of the F3 Freeway to the Pacific Highway at Heatherbrae, will reduce flows along the New England Highway in vicinity of the proposed project.

The peak construction period, anticipated to be over 3-4 months, is only temporary and mitigated by the arrival of site staff prior to the morning peak period and departing after the afternoon peak period. Materials movements will occur after the morning peak period optimising supply movement efficiencies.

9.7 GEOTECHNICAL

A preliminary geotechnical investigation of the proposed TSF site was carried out by Douglas Partners and their full report is contained in Appendix H. This included a field investigation consisting of a number of test bores as well as cone penetration testing. A number of soil samples, including samples from the test bores, were collected for laboratory testing. Preliminary ground improvement methods were considered in the report for construction methodology and costing purposes. Preliminary pavement design advice was provided for costing purposes. Slope stability of the rail embankment and batters of the Tarro Interchange were also assessed in the report.

9.7.1 Existing Environment

The field investigation found that the southern half of the site contains fill typically at a depth of 0.5m to 1.5m with maximum depth of up to 2m. The fill is predominantly coal reject (chitter), from the former Coal Handling Plant, intermixed with sand and clays. Douglas Partners found that the fill may be suitable to act as bridging layer for support of pavements such as access roads, however this application is reliant on import of all fill required for the embankments. Coal reject reuse opportunities are being assessed in parallel with the approval. The use of coal reject will only be proposed as part of the fill solution if the assessment determines that the material is suitable for reuse and all standards are met.

The natural subgrade was found to consist of soft to firm clay at depths typically in the range of 15m to 17m and up to a maximum of 25m thick. As the clay soils have low permeability and are highly compressible, they are subject to long term consolidation when placed under load. The underlying soils are sand with occasional gravel increasing in density with depth with a further clay layer underlying this and weathered bedrock at depths in the range of 25m to 33m. Ground water was identified typically between 0m and 2m below the natural surface. In accordance with AS2870-2011 the site classification is P.

Subsurface Conditions

Table 27 below presents a summary of the subsurface conditions determined from various investigations undertaken on and in the vicinity of the site.

Table 27: Subsurface Conditions

Stratum	Description
Fill	Predominantly comprising coarse coal reject (chitter), and intermixed with sand and clays where spread elsewhere particularly on the southern half of the site in the area of a former Coal Handling Preparation Plant. Over the southern half of the site the fill depth is typically 0.5 m to 1.5 m depth, but up to about 2 m.
Clay (alluvial)	Soft to firm silty clays / clays and clayey silts are present beneath the fill at all CPT test locations. The clay layer is typically 15 m to 17 m thick but up to 25m thick at the southern end of the site. It is this layer which presents issues of poor bearing capacity for footings and pavements, as well as potential long term settlements under load due to its compressibility. The clay profile is interbedded by silty sand / clayey sand, particularly in the upper profile of the unit.
Sand	Sand, clayey sand or silty sand, with occasional gravel, usually loose to medium dense, becoming dense with depth. The thickness and distribution of this layer is quite variable and it is not present at all locations.
Clay (residual)	The deeper clays are generally stiff to very stiff sandy clay, grading to hard clays and weathered rock although weathered rock was not encountered during the current investigation.
Bedrock	Sandstone, siltstone, shale and coal were encountered in previous bores that were taken to rock. The depth to rock varies considerably, from about 25 m (below natural surface) in the south-eastern area (former colliery facilities) to 33 m near the former rail loop, west of the southern end of the site. More generally, it appears that the depth to rock is round 30 m to 35 m over most of the site, probably increasing to the west towards Hexham Swamp.

9.7.2 Impact Assessment

Implications of Site Conditions on Construction

Field testing found that a clay crust is present over the site which is generally about 0.5m to 1m thick. The subgrade significantly reduces in strength below this level. It is recommended where possible that minimal excavation into the surface crust is carried out to avoid exposing underlying softer soils. For any required excavations where a surcharge is created by machinery or for excavations below a depth of approximately 2.5m (without surcharge), the use of sheet piling is recommended to ensure stability and prevent base heave. Dewatering by the use of internal sumps and pumps will also likely be required in any excavations due to the presence of high groundwater.

Due to the relatively low strength of the clay soils and associated long term total settlements Douglas Partners noted the use of high level foundations for buildings would not be appropriate particularly where the structure is sensitive to settlement including buildings with overhead cranes. These buildings will need to be founded on piled foundations with foundations taken to the underlying sand or bedrock. Review of the various piling methods are considered in the report (Appendix H). Ground improvement could also be considered to improve the shear strength and thus bearing capacity of the soils. Any licences required will be sought from NSW Office of Water when necessary.

Slope Stability

The Geotechnical Assessment of Embankment Settlement and Stability has been assessed by Douglas Partners for both the proposed TSF and for the road embankment off the Tarro Interchange.

The geometry of an embankment is controlled by the required height of the embankment, water level and the batter slopes required to provide acceptable factors of safety against slope instability. The slope stability is controlled by the upper soft clay, which varies in strength and thickness across the site. For the purposes of the stability assessment, the stability of the rail embankment was modelled in the area where the clays were weakest and the height of the embankment is greatest.

The slope stability assessment was undertaken using the program Slope/W Ver 2007. The results of the analysis for the TSF indicated that the factor of safety against slope failure during preload is 1.5 which is considered satisfactory for no load at crest.

The stability of the embankment following preload was estimated. The stability of the embankment (with train loads) will be a function of the amount of strength gain the underlying clays have achieved during the partial preload.

Based on the results of the analysis, the degree of consolidation of the upper 3m of soft clay after a period of 1 year was estimated to be about 50%. The strength of the upper 3m of the soft clay due to a fill height of 2m was estimated to be about 10 kPa.

The factor of safety was reassessed after a period of one year when the clays have partially consolidated and using a shear strength of 10 kPa. The analysis was also based on additional load applied at the crest of the embankment due to the load of a train. A value of 60 kPa (positioned at least 1m from the shoulder of the embankment) was assumed in the analysis for the stress applied by the train loads onto the fill embankment.

The results of the analysis for the Tarro Interchange embankment indicate that the factor of safety against slope failure is 1.40 which is slightly below the normally accepted factor of safety of 1.5 for long – term structures. The factor of safety increases to greater than 1.5 for embankment heights of less than 6m. The stability was reanalysed for a batter slope 3H:1V. The results of the analysis indicated a factor of safety of 1.6, which was considered acceptable.

The results of the analysis indicated that for embankments greater than 6m in height, the batter slope should be no steeper than 3H:1V and for embankments less than 6m in height, batters should be no steeper than 2.5H:1V.

A detailed overview of the assessment is described within the Preliminary Geotechnical Assessment contained within Appendix H.

9.7.3 Mitigation Measures

Ground Improvement

A number of possible ground improvement options have been considered in an aim to reduce the post construction settlement for rail embankments, roads and services and possibly building areas. The report noted that the use of preloading would be a suitable technique, however even with the inclusion of wick drains, the settlement time is unacceptable to the delivery timeframes for the project. Deep soil mixing has been used successfully by others recently adjacent to the TSF site and so this is likely to be the preferred ground improvement option. Piling is the likely method to be used to support building footings. The ground improvement method should be monitored by geotechnical instrumentation to measure and verify performance.

Pavements

The use of both an unbound granular pavement and a bound pavement has been considered with a preliminary pavement design presented for both options. Both pavement options require the use of a select subgrade to bridge the existing soft clays thereby providing a working platform.

9.7.4 Conclusion

In summary, the detailed geotechnical analysis undertaken for the proposed TSF has found that the site is suitable for the proposed TSF and associated infrastructure provided that settlement and slope stability issues are addressed.

9.8 GROUNDWATER

An assessment of potential groundwater level impacts has been undertaken by Douglas Partners which is contained in Appendix J, following the Preliminary Contamination Report in Appendix J.

9.8.1 Existing Environment

Douglas Partners completed an assessment of potential groundwater level impacts in 2012 which builds on groundwater investigations in 2008. These investigations included installation of nine groundwater monitoring bores and utilised five existing monitoring wells.

NSW Office of Water records indicate that there are nine registered groundwater wells located around the perimeter of the site and are used for monitoring purposes. The monitoring bores were registered in October 2011 and were installed as part of the current investigations associated with the proposed TSF development.

Groundwater levels were recorded in each of the fourteen wells with levels varying from RL0.3 to RL2.88 AHD (typically within 1.5m of the ground surface). Further monitoring was undertaken of groundwater levels in 2011 in a total of 35 wells. This monitoring found similar groundwater levels to those in the 2008 study.

The regional groundwater flow was identified as being multidirectional due to the height and location of the coal reject stockpile. Site observations and measurements indicated groundwater flows to the west of the site towards Hexham Swamp Nature Reserve, to the east of the site

towards the Hunter River and towards two unlined drainage channels connecting to Purgatory Creek and then the Hunter River.

As the overall site is relatively flat, surface water runoff currently occurs slowly, with the majority of rainfall being stored on site in the lower lying areas, with groundwater/surface water interaction at these lower elevations. It is likely that runoff would only occur during/after extended periods of rainfall.

Due to the likely interaction of the vegetation with shallow water tables and periodic inundation by floodwater, all remnant vegetation on the site, excluding the Swamp Oak swamp forest rehabilitation plantings, is considered to meet the definition of groundwater dependent ecosystems as described in the NSW State Groundwater Dependent Ecosystem Policy (DLWC 2002). Refer to the groundwater contour plan contained within the Preliminary Contamination Assessment in Appendix J.

Extensive review of groundwater quality and contamination has been undertaken over a number of years. Douglas Partners Report May 2012 noted contaminant observations during fieldwork generally indicated the absence of gross contamination within the soil, groundwater and surface water. Laboratory testing of the groundwater and surface water samples found results generally within the adopted criteria, however elevated concentration of heavy metals, nutrients and faecal coliforms were detected in the majority of samples tested. The contamination assessment is dealt with in detail under Section 9.9 of this EA.

The 2012 assessment identified the following with respect to groundwater at the TSF site:

- The site has previously been used for a number of agricultural and commercial/industrial land uses including grazing, wastewater treatment and associated effluent disposal, coal preparation and associated railway lines and sidings;
- A number of potential contamination sources are associated with the current/former land uses at the site, including above ground fuel storage tanks and bowsers, railway lines, coal reject filling, fill material of unknown origin, former cropping, wastewater treatment and associated irrigation, potentially buried wastes, potential acid generation from exposure of ASS during construction of the HWC pipeline;
- Laboratory testing of groundwater and surface water samples has found elevated concentrations of heavy metals, nutrients and faecal coliforms in the majority of samples. Elevated hydrocarbons were also detected in some locations. The groundwater contamination was considered likely to be associated with effluent irrigation onsite, leaching of contaminants from fill materials or localised contaminant sources (i.e. fuel storage); and
- It is noted that existing groundwater impact is widespread and this portion of the Hexham Wetland is in a degraded state.

9.8.2 Impact Assessment

The proposed TSF fill embankment associated with the rail, access roads and buildings may result in a slight rise in groundwater levels in the vicinity of the fill. No significant variation in levels is expected for the remainder of the site.

From the ecological report contained in Appendix F, the GDEs are highly disturbed from previous land uses and remain in relatively poor condition due to weed invasion. Given the improvement of GDE's any possible detrimental effects locally are not significant in terms of the Hunter Estuary.

Potential Impacts to GDEs

The proposed development will be constructed partly over several areas of GDEs, some of which are classified as EECs, and as a consequence the remnant EECs will be left in immediate proximity to the development.

Impacts to water levels due to the development are generally expected to be localised and in the case of construction activities only temporary and recoverable.

During construction there is some risk of lowering of the water table due to localised dewatering estimates, however such drawdowns are not expected to have significant impacts on water levels outside of the development footprint.

Groundwater levels on the majority of the site are at or near the surface and typically controlled by surface water drainage features. The majority of site changes have potential for slightly changed groundwater levels within filled areas (probably slightly higher), increased run-off, and in places increased seepage, to the ground surfaces adjacent to the development.

The increased run-off will have little effect on groundwater levels during wet times as the water levels are controlled by surface water controls. In times of dryer weather the increased run-off is likely lead to certain areas staying wetter for longer than they may have prior to development. There would be some risk of localised pockets receiving less run-off than previously, however the risk of this is limited as the ground is generally low lying with limited fall, encouraging spreading of the run-off.

Impacts to groundwater levels from the development are expected to be limited to close proximity to the TSF development footprint. Impacts on water levels on the western parts of the site in Hexham Swamp to the West and the Hunter River to the east, are expected to be negligible.

Recharge times are not expected to be impacted by the small increase in impervious area provided by the TSF footprint relative to the site area and the flood regimes are not expected to be altered by the development.

Existing Groundwater Uses

There is limited use of groundwater in the vicinity of the site. Registered wells in the vicinity of the site are limited to nine monitoring bores installed in 2011 at the perimeter of the site for the purpose of monitoring groundwater quality and levels. The wells were installed as part of site investigations for the proposed TSF development. It is understood that there are no wells registered

for beneficial use within 3 km of the site. Therefore, no impacts to groundwater levels from the TSF development are expected to occur at such a proximity to the site.

9.8.3 Mitigation Measures

Potential mitigations to reduce the risk of impacts to groundwater levels would include:

- Detailed design of any dewatering to limit impacts on groundwater levels. This may include limiting the depth of excavation as well as the extent of dewatering occurring at any one time, in particular for dewatering in close proximity to GDEs;
- Matching the level of outlet structures from the drainage system to closely match level of existing surface flow controls;
- Permanent sediment basins will be lined or raised above the groundwater level to prevent inception or connection of the stormwater and groundwater systems, this issue however is considered minor as the treated stormwater should not be contaminated;
- Groundwater monitoring during and following construction;
- Any activities requiring licences from the NSW Office of Water will be obtained prior to the commencement of construction.

9.8.4 Conclusion

Groundwater is present at relatively shallow depths over the site. Other than a slight rise in groundwater levels in the vicinity of the fill, no significant variation in levels is expected for the remainder of the site.

The assessment of potential groundwater level impacts from the development of the proposed TSF at Hexham considered possible impacts associated with the following:

- Excavation dewatering;
- Site filling;
- Ground improvement;
- Site capping;
- Site drainage; and
- Irrigation of Effluent.

A conceptual groundwater model was developed for the site on the basis of available background information including site hydrogeology, the proposed TSF development and existing and proposed site hydrology.

In summary, the proposed development and stormwater controls are generally sympathetic to the existing site hydrology. Potential impacts to groundwater levels are likely to be limited to the immediate vicinity of the proposed TSF development, or short term and recoverable.

It is noted that the TSF development area is limited to a corridor of approximately 150 m adjacent to the GNR (excluding the five ARTC train lines) located over the western strip of the greater site area. Potential risks associated with impacts to groundwater levels will be managed through

detailed design, construction and monitoring for the proposed TSF development. All licences required for groundwater monitoring and boreholes, will be gained prior to works occurring.

9.9 CONTAMINATION

A Preliminary Contamination Assessment (PCA) has been carried out by Douglas Partners and their full report is contained in Appendix J. The PCA was undertaken to assess past and present contaminating activities, report on site conditions and provide a preliminary assessment of site contamination. The report has been recently updated to address the issues raised in the DP&I Adequacy Review.

9.9.1 Existing Environment

The desktop review identified the site as having a long history of industrial development. Minmi-Hexham Railway and a Coal Preparation Plant occupied the site closing in 1988. While the majority of infrastructure associated with these uses has been removed, the landscape has been significantly altered and particularly by the placement of the coal reject stockpile. Figure 27 identifies the former coal preparation plant.

At the northern end of the site, rural land uses of cropping and cattle grazing dominated the landscape. Brancourts irrigates treated effluent over northern and southern portions of the site.

Fieldwork and laboratory testing for contaminates was undertaken initially in 2008. Further updates to the reporting have occurred since, including work by ERM from 2010. Douglas Partners was also present on site, during the construction of the HWC's DN900 water main upgrade works.

The results of the above mentioned assessments indicated the following with respect to potential soil, groundwater and surface water contamination:

Proposed TSF Development Area:

- Presence of soil hydrocarbon impact (TRH C_{10}-C_{36}) in Pit 128 from the surface to about 1.5m, considered likely to be associated with a former abandoned UST;
- Presence of localised soil and groundwater hydrocarbon impact (TRH C_{10}-C_{36}) possibly associated with the former fuelling area (Bore 102/0.3-0.5 and BH03/1.3);
- Presence of soil TRH (C_{10}-C_{36}) soil contamination adjacent to former infrastructure;
- Presence of TRH (C_{10}-C_{36}) soil contamination within fill material generally comprising coal fines and coal reject located throughout the southern portion of the site, including the coal tailings stockpile (viz. DP Bore 101/0.8-1.0, Pit 160/4.0, and TP18, BH03, MW08);
- Presence of fibre cement fragments containing asbestos within the former control cabin;
- Presence of dumped filling, building rubble, concrete, bricks, etc., (potential for asbestos contamination);
- Presence of groundwater heavy metal and nutrient impact in all bores;

- Presence of groundwater faecal coliform impact in Bore 109, possibly associated with effluent irrigation;
- Presence of surface water heavy metal and nutrient impact at all surface water sampling locations; and
- Presence of surface water faecal coliform impact at SW201, SW202, SW203, SW205, SW210 and SW211, possibly associated with effluent irrigation.

The available results of previous and current contamination assessments have been collated by GHD and are presented in the GHD Contamination Drawings contained within the Contamination Assessment in Appendix J. Sample locations undertaken by ERM in 2010 are identified within Figure 28.

Site Disturbance

Excavations on site are expected to include:

- Proposed Basins 1 to 3;
- Proposed cess drains;
- Site preparation for proposed access roads and associated culverts; and
- Temporary trench excavations for buried services.

Based on the shallow groundwater levels at site it is anticipated that most excavations will intersect groundwater (refer to GHD Areas of Disturbance Plan in Appendix E of the Preliminary Contamination Assessment in Appendix J). Temporary dewatering may be required to allow construction activities, especially of the access road, culvert and buried service excavations. For the proposed cess drains and detention ponds it may be possible to excavate these without dewatering.

The results of the preliminary contamination assessment have identified soil, groundwater and surface water impacts that will require management due to disturbance (i.e. excavation / dewatering) associated with the development of the TSF.

Soil Contamination

The results of site investigations generally indicated the absence of gross soil contamination associated with the proposed TSF. Soil exceedences were generally associated with non-volatile medium to heavy chain hydrocarbons. Due to the non-volatile nature of the of the localised impacts observed within fill materials during the site investigations it is unlikely that significant odours will be generated if such materials are excavated or disturbed during TSF development.

Based on the site observations and historical information, the potential for widespread soil contamination within the TSF development area is considered to be low.

Minor bonded asbestos containing materials (ACM) were observed in the immediate vicinity of former site buildings (i.e. control cabin). Potential ACM may also be present in localised dumbed piles of filling containing building rubble. The occurrence of asbestos containing materials within the proposed TSF footprint is therefore not likely to be widespread.

Groundwater/Surface Water Contamination

It is noted that the results generally indicate the absence of gross contamination within the soil, groundwater and surface water samples tested. Elevated levels of nutrients and faecal coliforms were encountered in groundwater and surface water samples taken at the site. Based on field observation and laboratory testing, it is considered that the elevated nutrient and faecal coliform concentrations may be attributed to the infiltration of irrigated treated effluent. Refer to the Preliminary Contamination Assessment in Appendix J for additional detail.

In addition, slightly elevated levels of heavy metal contamination were encountered in groundwater and surface water samples taken at the site. Based on field observations and laboratory testing in soils, no apparent impact was observed on the site to suggest gross heavy metal contamination within soils. It is therefore possible that that the slightly elevated heavy metal concentrations in groundwater and surface water are consistent with regional groundwater and surface water quality.

Site observations and measurements indicated that the groundwater flow direction is towards the west of the site towards Hexham Nature Reserve, to the east of the site towards the Hunter River, and to the north towards to unlined drainage channels in the northern portion of the site. Surface water drains in the northern portion of the site flow towards two shallow drainage channels that flow to Purgatory Creek then the Hunter River. A drainage channel around the perimeter of the coal tailings stockpile in the central portion of the site drains in a westerly direction towards Hexham Nature Reserve.

9.9.2 Impact Assessment

Based on the above field and analytical observations, it is considered that there is a potential for offsite migration of groundwater and surface water containing elevated heavy metals, hydrocarbons, nutrients and faecal coliforms. Effluent irrigation activities at the site could be contributing to the impacts on waters at the site. It is understood that effluent irrigation is proposed to continue under Environmental Protection Licence (No 816) for the interim. Additional sampling and laboratory analysis would be required to confirm the source/type and significance of impacts and potential for offsite migration of waters from the site.

Subject to further investigation and appropriate remediation and validation works the site is likely to be suitable for proposed industrial development from a contamination perspective.

Excavations on site are detailed in Section 9.9.1. Excavations on the southern parts of the site will be predominately through existing filling which is typically granular and can be expected to be relatively permeable. Dewatering is likely to be achieved by a combination of sump and pump methods for localised excavations with spear point dewatering in some areas.

On the northern parts of the site excavations will be through the natural clay soils, which are generally of low permeability of these soils flow rates are expected to be relatively low if they are not under surface water.

Localised site remediation is likely to be required to remediate detected hydrocarbon contamination within the fill material in the southern portion of the site and fibro fragments containing asbestos in the former control cabin.

The remedial works likely to be required to render the site suitable for the proposed development includes:

- Localised excavation to remove hydrocarbon impacted soil associated with the former fuel tank (Pit 128) and former fuelling area (Bore 102 and Pit 128);
- Appropriate removal and validation of asbestos within the former control cabin, or on site management of asbestos impacted materials;
- Assessment and classification of numerous fill stockpiles (many of which were not assessed as part of the current assessment) and subsequent re-use or offsite disposal to landfill as required; and
- Preparation of management procedures to minimise impacts of contaminated groundwater/surface water on the proposed development.

9.9.3 Mitigation Measures

An integrated surface water and groundwater monitoring program would be undertaken to establish existing groundwater and surface water conditions at the site. The assessment would consider the potential source of impacts on waters, background quality, potential for offsite migration and significance of elevated contaminant concentrations in waters. Groundwater monitoring would utilise the existing wells, together with additional wells to improve the monitoring network.

Management procedures will be formulated to minimise the potential impacts of groundwater/surface water contamination on the proposed development during and following construction. Monitoring of discharge waters from both operation and construction in accordance with a Water Quality Management Plan discussed in Section 9.4.

Dewatering will be managed in accordance with the general procedures included in the Acid Sulphate Soil Management Plan (ASSMP) detailed in Section 9.10. In addition, site activities including dewatering should be conducted in accordance with the Water Quality Management Plan.

Contaminated soils will be managed in accordance with the ASSMP in Appendix I and the RAP which is contained within Appendix J following the PCA.

The following is recommended to address potential impacts in regard to contamination associated with the proposed TSF development:

- Adherence to the RAP for contaminated soils contained within Appendix J;
- Additional investigations to refine remediation requirements outlined within the RAP for the TSF development;
- Conduct localised remediation and validation of soils impacted by site development (i.e. areas subject to earthworks and ground disturbance); and
- Prepare a Water Quality Management Plan to manage surface water and groundwater contamination during and following TSF development. The WQMP would include the following:
    - Mitigation measures to protect human health and the environment;

- Procedures to minimise the risk of exposure to and potential for migration of impacted waters;
- An integrated surface water and groundwater monitoring strategy; and
- Contingency measures.

Management of soil, surface water and groundwater impacts will be incorporated with the CEMP for the TSF development. The CEMP will address potential impacts through soil and water management (i.e. contaminated soils and waters, acid sulphate soil management, dewatering and drainage, etc.). Measures to minimise exposure of impacted soils and waters will be implemented through staged development, monitoring and contingency procedures.

The development area is therefore considered to be suitable for construction of the TSF, subject to appropriate soil remediation and surface water and groundwater management during and following construction.

9.9.4 Conclusion

The PCA identified soil, surface water and groundwater impacts that will require management to facilitate the development of the TSF.

Management of soil, surface water and groundwater impacts will be incorporated with the CEMP for the TSF development. The CEMP will address potential impacts through soil and water management. Measures to minimise exposure of impacted soils and waters will be implemented through staged development through, monitoring and contingency procedures.

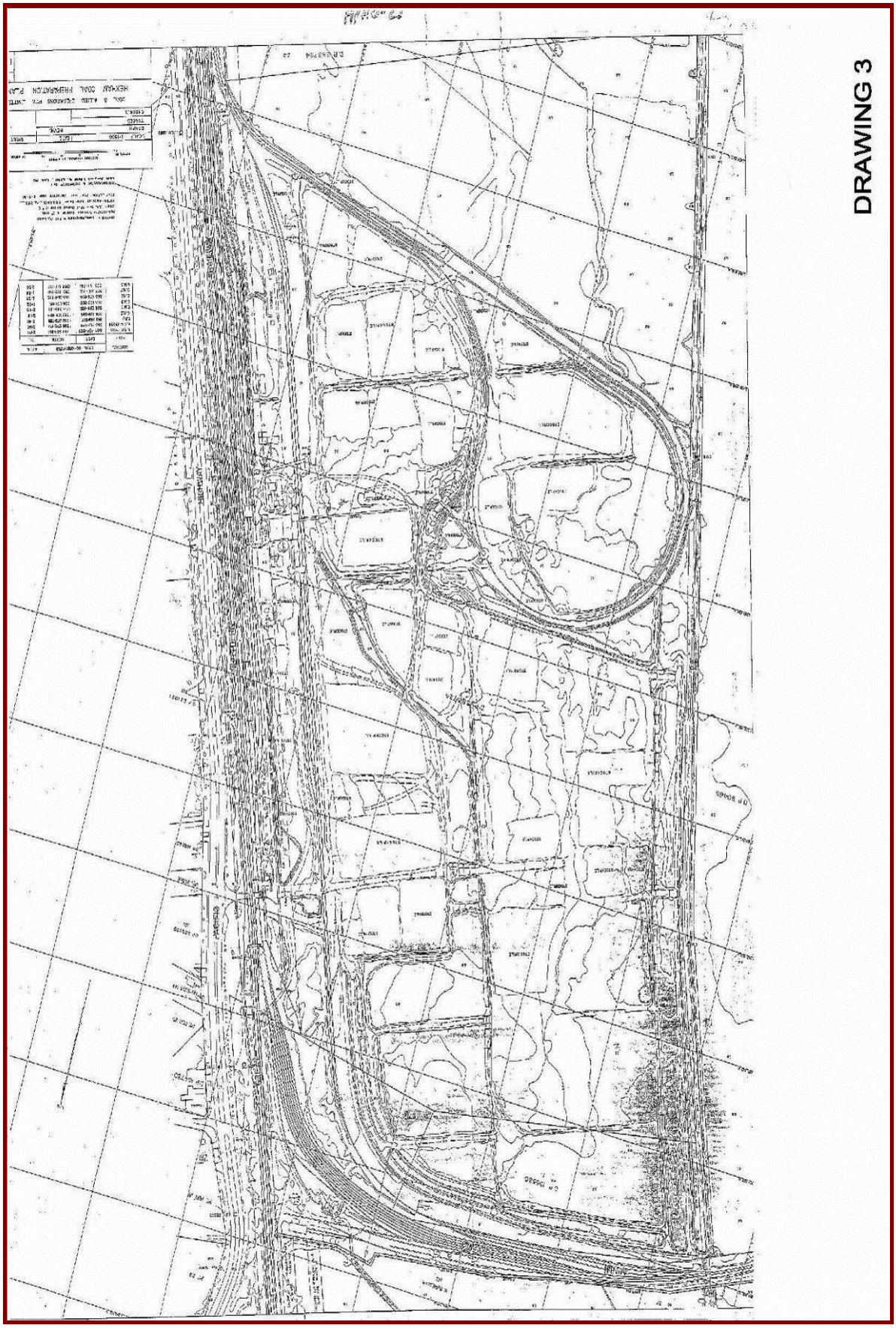

Figure 27: Former Coal Preparation Plant.

Figure 28: Sample Location Map.

9.10 ACID SULPHATE SOILS

An ASSMP of the proposed TSF site was carried out by Douglas Partners and is contained in Appendix I of this EA.

9.10.1 Existing Environment

The TSF site is underlain by quaternary alluvium consisting of unconsolidated sediments deposited in a fluvial or estuarine environment which includes gravel, sand, silt and clay. Groundwater levels typically vary between 0-2m below ground level throughout the site.

The Department of Land and Water Conservations 1:25,000 scale "Acid Sulphate Soil Risk Map for Beresfield" (sheet 9232 N3), indicates a uniform probability of acid sulphate across the site. Douglas Partners investigation of the eastern portion of the site has confirmed the presence of PASS within natural soils. With the exception of the coal reject stockpile, Douglas Partners conclude from the before mentioned maps that the natural subsurface conditions are likely to be across the site and thus PASS will affect the whole site.

9.10.2 Impact Assessment

Acid sulphate screening tests have been conducted with the use of 37 bore/test pits within a 2.5km^2 section of the eastern portion of the site. Acid sulphate screening tests on the samples were then completed by ALS Environment Pty Ltd (ALS). Test results have established that the Acid Sulphate Soils Advisory Management Committees (ASSMAC) action criteria for excavations above and below 1000 tonnes has been exceeded, confirming that PASS are present within the TSF site.

For construction purposes, the disturbance of soils through excavation and dewatering within natural soils (excluding fill) should be treated as having potential for oxidising PASS and thus must be managed under the ASSMP. Construction activities for the TSF for which the ASSMP will apply is water and sewer servicing, gas relocation and roads and stormwater drainage installations.

Summary of Acid Sulphate Soil Conditions

The acid sulphate screening results have been reproduced in Table 28 below. The results of the acid sulphate soil assessment generally indicated the presence of PASS conditions within natural soils.

Table 28: Acid Sulphate Soils Screening Tests

Bore / Test Pit	Sample Depth (m)	Sample RL (mAHD)	Sample Description	Screening Test Results			
				pH			Strength of Reaction [b]
				pH_F	pH_{FOX}	pH_F - pH_{FOX}	
14	2.4	-0.9	Silty Sand – grey	7.2	2.6	4.6	3FH
14	2.9	-1.4	Silty Sand – grey	7.4	5.2	2.2	1
16	2.3	0.0	Silty Clay – grey / brown	7.3	6.1	1.2	1-2
16	2.8	-0.5	Sandy Silty Clay – grey	7.6	6.5	1.1	1
16	3.0-3.45	-0.7 to -1.1	Sandy Silty Clay – grey	7.6	2.3	5.3	1-2
21	0.5-0.95	0.6 to 1.0	Silty Clay – grey brown	7.4	6.2	1.2	1-2
21	1.5-1.95	0.0 to -0.4	Silty Clay – grey brown	7.6	6.9	0.7	1
21	2.4	-0.9	Sandy Silt – grey	7.5	6.9	0.6	1
21	3.0-3.45	-1.5 to -1.9	Clayey Sand – grey	7.6	6.2	1.4	1
22	0.4	0.3	Silty Clay – grey	6.8	5.9	0.9	1H
22	0.9	-0.2	Silty Clay – grey	6.8	6.7	0.1	1H
22	1.4	-0.7	Clayey Silty Sand – grey mottled orange	7.0	6.8	0.2	1
22	1.7	-1.0	Clayey Silty Sand – grey mottled orange	7.1	6.9	0.2	1
22	2.4	-1.7	Clayey Silty Sand – grey mottled orange	7.1	6.9	0.2	1
23	0.7	0.4	Silty Clay – grey	7.4	6.6	0.8	1H
23	0.9	0.2	Silty Clay – grey	7.2	6.6	0.6	1H
23	1.2	-0.1	Clayey Silty Sand – grey	7.1	7.0	0.1	1H
24	0.4	3.1	Silty Clay – grey brown	7.3	6.0	1.3	1
24	0.7	2.8	Silty Sand – grey	6.7	6.3	0.4	1
24	0.9	2.6	Silty Sand – grey	6.7	6.2	0.5	1
24	1.6	1.8	Silty Sand – grey	6.5	5.5	1.0	1
25	0.8-0.95	0.4 to 0.5	Silty Sand - grey	8.4	7.2	1.2	1
25	1.4	-0.1	Silty Sand - brown	8.0	7.5	0.5	1
25	1.5-1.95	-0.2 to -0.6	Silty Sand - brown	8.0	6.4	1.6	1
25	2.4	-1.1	Silty Sand – brown (shells)	8.5	6.9	1.6	1-2
25	3.9	-2.6	Silty Sand - brown	8.3	6.3	2.0	1-2
27	1.5-1.95	0.3 to -0.2	Silty Clay - grey	8.1	5.5	2.6	1
27	2.4	-0.6	Clayey Silty Sand -grey	8.1	6.3	1.7	1
27	2.9	-1.1	Clayey Silty Sand -grey	8.0	6.0	2.0	1-2
27	3.0-3.45	-1.2 to -1.7	Clayey Silty Sand - grey	8.2	7.2	1.0	1-2
28	3.3	-0.3	Silty Clay - grey	7.8	3.9	3.9	1-2
28	4.5-4.95	-1.5 to -1.9	Sandy Silt - grey	7.6	5.6	2.0	1-2
30	0.4	1.4	Sandy Clay - brown	5.9	4.4	1.5	2
30	0.5-0.95	0.8 to 1.3	Sandy Clay -brown	6.3	6.3	0.0	1-2
30	1.4	0.4	Clay -grey	7.2	6.6	0.6	1-2
30	1.5-1.95	0.3 to -0.2	Clay -grey	7.1	6.5	0.6	1

Bore / Test Pit	Sample Depth (m)	Sample RL (mAHD)	Sample Description	Screening Test Results			
				pH			Strength of Reaction [b]
				pH_F	pH_{FOX}	pH_F - pH_{FOX}	
30	2.4	-0.6	Silty Sand – grey mottled orange	7.0	6.6	0.4	1
30	3.0-3.45	-1.2 to -1.7	Clayey Silt – grey (shells)	7.7	2.4	5.3	1-2
30	4.5-4.95	-2.7 to -3.2	Clayey Silt – grey (shells)	7.5	2.6	4.9	4HF
31	1.3	0.0	Silty Clay – grey mottled orange	7.4	6.1	1.3	1H
31	1.5	-0.2	Silty Clay – grey mottled orange	7.0	6.9	0.1	1H
31	1.8	-0.5	Silty Clay – grey mottled orange	7.7	7.6	0.1	1H
34	1.3	-0.7	Silty Clay - grey	7.2	6.4	0.8	1
34	1.4-1.95	-0.8 to -1.35	Silty Clay - grey	7.1	6.5	0.6	1
34	2.4	-1.8	Silty Clay - grey	7.0	6.1	0.9	1
34	3.0-3.45	-2.4 to -2.8	Silty Clay - grey	7.2	4.5	2.7	1
36	0.4	0.8	Silty Sand - brown	6.9	5.4	1.5	1-2
36	0.5-0.95	0.3 to 0.7	Sandy Clay -brown	7.6	7.6	0.0	1
36	1.4	-0.2	Sand -brown	8.0	7.8	0.2	1
36	1.5-1.95	-0.3 to -0.7	Sand -brown	8.1	7.8	0.3	1
36	2.5	-1.3	Silty Sand - grey	8.1	6.6	1.5	1
36	3.0-3.45	-1.8 to -2.2	Silty Sand - grey	8.1	4.8	3.3	1-2
36	4.0	-2.8	Silty Sand - grey	8.2	6.8	1.4	1-2
37	1.4	-0.1	Clay -grey	7.3	5.2	2.1	1
37	2.4	-1.1	Clayey Silt -grey	7.3	2.9	4.4	1
Guideline			Sands to Loamy Sands	<4[c]	<3.5[d]	>1[d]	-
			Sandy Loams to Light Clays				
			Medium to Heavy Clays and Silty Clays				

Notes:

[a] Depth below ground surface

[b] Strength of Reaction

1 denotes no or slight reaction

2 denotes moderate reaction

3 denotes high reaction

4 denotes very vigorous reaction

F denotes bubbling/frothy reaction indicative of organics

H denotes heat generated

[c] For actual Acid Sulphate soils (ASS)

[d] Indicative value only for PASS

Shaded results indicate potential for acid generation upon oxidation (i.e. PASS)

Detailed laboratory testing for TPA, TAA and Chromium Reducible Sulphur content was undertaken on five selected soil samples and results are presented in Table 29 below.

Table 29: Detailed Acid Sulphate Soil Laboratory Testing

Bore / Test Pit	Sample Depth [a] (m)	Sample RL (mAHD)	Sample Description	Laboratory Results			
				pH_{KCL}	Scr %S	TAA (mole H+/t)	TAA (mole H+/t)
14	2.4	-0.9	Silty Sand - grey	5.6	0.65	6	359
16	3.0-3.45	-0.7 to -1.1	Sandy Silty Clay -grey	6.8	0.08	<2	388
27	1.5-1.95	0.3 to -0.2	Silty Clay - grey	5.5	<0.02	21	184
28	3.3	-0.3	Silty Clay - grey	5.9	<0.02	4	<2
30	0.4	1.4	Sandy Clay - brown	5.4	0.04	16	230
Guideline			Sands to Loamy Sands	-	0.03	18	18
			Sandy Loams to Light Clays		0.06[b]/0.03[c]	36[b]/18[c]	36[b]/18[c]
			Medium to Heavy Cays and Silty		0.1[b]/0.03[c]	62[b]/18[c]	62[b]/18[c]

Notes:

[a] Depth below ground surface

[b] ASSMAC Action Criteria for disturbance of 1-1000 tonnes of material

[c] ASSMAC Action Criteria for disturbance of more than 1000 tonnes of material

Shaded results indicate an exceedence of ASSMAC action criteria for 1-1000 tonnes of ASS soil.

The result of the chromium reducible sulphur testing and TPA testing for samples 14/2.4m, 16/3.0-3.45m, 27/1.5-1.95m and 30/0.4m exceed the ASSMAC action criteria (Ref 2) for excavations above and below 1000 tonnes. The results of detailed laboratory analysis therefore confirm that PASS are present within the site.

For construction purposes, disturbance of soils (either by excavation or dewatering) within natural soils (i.e. excluding filling) should be treated as PASS and managed under the guidance of the ASSMP contained within Appendix I.

The preliminary geotechnical investigation contained within Appendix H found subsurface conditions generally comprised filling (typically coarse coal reject and intermixed sand and clays) up to 2 metres depth in the southern portion of the investigation area, overlying alluvial clays, overlying sands, overlying residual clays at depth.

Groundwater levels typically varied between about 0 - 2 metres below ground level. Due to frequent irrigation over the northern portion of the site, combined with flooding, perched water levels within fill and the ground surface may have been present. Additional detail relating to groundwater is contained within the Preliminary Contamination Report, Appendix J,

Groundwater levels measured during the preliminary contamination assessment varied between about 0.3m to 2.6m below ground level (RL 0.2 AHD to 2.9 AHD). It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

9.10.3 Mitigation Measures

The ASSMP outlines management strategies to be implemented for implementation to address PASS which include:

- Soil Treatment – Neutralisation of PASS should be undertaken in accordance with the ASSMAC guidelines;
- Neutralising Leachate - Leachate water collected from the bunded area (in a multi stage sedimentation tank, if required) should be neutralised as necessary before release; and
- Dewatering – A specific dewatering procedure is recommended in order to minimise potential adverse impacts resulting from excavation and dewatering of acid sulphate soils during construction.

A more comprehensive outline of the management strategies is contained within the ASSMP within Appendix I. The key elements of the management measures are presented below as mitigation measures:

- Excavated soils and leachate containing acid sulphate will be appropriately stored within a bunded area with an impermeable base. The spoil and leachate will be appropriately treated prior to authorised disposal according to the acceptance criteria outlined in ASSMP and regulatory requirements. Water produced from excavation will be similarly stored in multi-stage sediment tanks with treatment to regulatory requirements and acceptance criteria before disposal. No excessive amounts of PASS will be disturbed to minimise impact of required dewatering and excavation;
- Stockpiled soil will initially be limed at an average rate of 37kg/m^3 of soil (27kg lime/tonne of soil) for neutralisation as soon as practicably possible;
- Acid sulphate produced from excavated soil and dewatering will be appropriately managed in accordance with the ASSMAC guidelines. Excavated soil, dewatering and leachate will all be treated with suitable neutralising agents of acid sulphate. Treatment agents include agricultural lime ($CaCO_3$), calcined magnesia (MgO or $Mg(OH)_2$) and dolomite ($MgCO_3.CaCO_3$);
- Continuous monitoring of soils, water and leachate will be conducted throughout construction, thus levels and frequency of dosing will be altered accordingly to requirements;
- Records of the treatment of acid sulphate soils on site will be maintained by the contractor with necessary detailed information. A record of contingency measures and additional treatment used shall also be undertaken. A final report upon completion of works will present the monitoring regime and results to confirm that no adverse environmental impact has occurred during construction;
- The contingency plan involves remedial action if the agreed standards or acceptance criteria have not been achieved. Remedial action involves increased lime dosing to treat acid sulphate as well as mitigation actions during rainfall events affecting acid sulphate

soils. Sufficient lime will be stored during construction for the neutralisation of acid sulphate soils and contingency methods; and

- The ASSMP will be adopted directly into the CEMP for the TSF applying to excavation activities.

9.10.4 Conclusion

The ASSMP has identified acid sulphate soils within the TSF site. Analysis has been provided of the acid sulphate soils and appropriate mitigation necessary for excavation activities during construction. This plan will be adopted directly into the CEMP for the TSF applying to excavation activities.

9.11 INFRASTRUCTURE & SERVICES

A servicing report has been prepared by WorleyParsons and is contained in Appendix M. Existing and proposed utilities and protection is described within Section 6.4.4 of this EA and identified within Figure 11.

9.11.1 Existing Environment

Worley Parsons has completed searches of existing service availability surrounding the site. Contact has been made with authorities for preliminary advice on the servicing of the TSF and relocating or protecting utility services over or adjacent to the TSF.

Notable existing infrastructure through the site are transmission lines with steel towers east-west across the northern portion of the site, 33kV sub transmission lines adjacent to Tarro Interchange 33kV and 11kV poles down Woodlands Close, the DN900 Chichester Trunk Gravity Main – water main north south along the western edge of the site and DN500 high pressure gas main.

A description of existing and proposed services and utilities is described below and a detailed description of services and utilities is contained within Section 6.4 of this EA.

9.11.2 Impact Assessment

Water Services

Existing - HWC has recently upgraded their DN900 CTGM to be underground and realigned it parallel to the Western and Southern boundaries of the development site. It has been assumed that the existing DN200 water main has been connected to the new below ground CTGM and this will be confirmed in service requirements advice from HWC.

Proposed - The total average daily demand for the TSF is 2.6kL/day for the initial build up and an ultimate demand of 7.4kL/Day. Preliminary investigations into the capacity of the existing DN200 water main indicate that the TSF demand could be sufficiently supplied without an upgrade. However due to filling works across the site, part of the water main may need to be re-laid to reduce the pipe depth for maintenance. A loop DN150 reticulation water main will service the TSF and provide necessary access for fire fighting. The reticulation main will be located outside road and rail routes.

Relocation/protection of the water supply to Brancourts treatment plant may be required and has been included in this EA. Works crossing or improving Hunter Water easements and access will be confirmed with Hunter Water.

Wastewater Services

Existing - There is currently no HWC wastewater network system nearby in the area available for connection. There is an existing on site effluent disposal operated by Brancourts including a treatment plant and irrigation areas leased from QR National.

Proposed – There are two on site wastewater systems proposed for the TSF. The first wastewater system is for sewage, requiring reticulation, pump station(s), a package treatment plant and an irrigation area for onsite effluent disposal. The effluent disposal is discussed further in Section 9.5 of this EA. Buffer storage for 60 day capacity is maintained on site for extended wet weather or any time when disposal cannot be to the irrigation area. The water level would be monitored and can be tankered for orderly disposal in the HWC network system. Consent authority for this system will be NCC under Section 68 of the Local Government Act.

The second wastewater treatment stream is dedicated to wash down water recycling. In order to recycle the water for use, there will be an oil/grease trap, gross pollutant trap, pH adjustment, pump station and reuse header tank. Initial wash down water allowance is 7.5KL/week for locomotives, subject to recycling. Building roof water is also being captured in rainwater tanks for this system. Waste stream of non-useable wash down water blown down to the sewer system is estimated to be approximately 125L/day, increasing to 250L/day.

The consent authority for this system will be NCC subject to Section 68 of the Local Government Act. It is likely that the OEH may also take a concurrent approval role in the recycling system. Both treatment systems will be owned and managed by QR National.

The proposed effluent irrigation areas, as described above, will be constructed and commissioned following construction of the TSF. Up until this stage the area is proposed to be utilised for stockpiling.

Telecommunications Services

Telstra, Optus and Nextgen telecommunications networks are located within Woodlands Close with Telstra being the relevant telecommunications authority responsible for the proposed development. According to the Telstra's preliminary servicing advice, the size and scale of the network upgrade would be dependent upon amount of services required. The network upgrade would likely involve an underbore of the existing railway.

Correspondence has commenced with Optus on relocation/protection as a result of the access road crossing existing Optus infrastructure near the Tarro Interchange.

Gas Services

The relocation/protection of the gas main is necessary for the construction of the TSF. Correspondence has commenced with the authorities. The EA covers the relocation/protection of the gas main. Jemena's preliminary servicing has also advised that natural gas is available and could be extended for TSF use.

Electrical Services

Power Solutions Pty Ltd has carried out a preliminary estimate of electrical demand based upon the loading of a similar facility. The major areas and items that require electrical supply at the TSF include:

- Office and amenities;
- Locomotive wash area;
- Wagon maintenance building;
- Locomotive maintenance building;
- Provisioning building;
- Turntable;
- Wheel lathe; and
- Yard lighting.

Due to the intermittent nature of the power usage of much of the equipment at the TSF, the diversity factor is expected to be quite low. Based on the above, the estimated maximum electrical load is estimated to be in the vicinity of 500kVA. This load will require the installation of a dedicated kiosk substation with the installation of at least two connection points from Ausgrid's existing 11kV network providing a ring feed. This provides all of the TSF's power needs while the ring feed allows maintenance to be undertaken without disruption.

The initial connection point for the TSF is expected to be the 11kV underground line to the North of the development which currently supplies an industrial wastewater treatment plant. The second connection point will be an existing overhead 11KV line on the Eastern side of the highway creating the ring feed. This connection is likely to require underboring of the Great North Rail Line and Maitland Road (Pacific Highway).

As outlined previously there are substantial existing electrical assets on site including transmission lines, steel towers and Ausgrid 33kV/11kV affecting the site. Relocation of the 33kV Transgrid overhead services adjacent to Tarro Interchange is required for the access road connection. Correspondence is ongoing with Ausgrid on temporary relocation or realignment provisions and permanent realignment. Furthermore there is potential for the 33kV/11kV to be realigned down Woodlands Close. This EA includes the relocation as required.

A visual representation of the services and utilities described above is contained within Figure 11.

9.11.3 Mitigation Measures

- Provide water servicing of the TSF through approvals from HWC;
- Provide an onsite effluent disposal system. Consent authority for this system will be NCC under Section 68 of the Local Government Act;
- Provide a recycled wastewater system for wash down of locomotives. Approval authority for this system will be NCC under Section 68 of the Local Government Act and potentially OEH;
- Provide electrical servicing of the TSF through approvals from Ausgrid;
- Extend telecommunications to service the TSF through approvals from Telstra; and

- Relocation or protection of gas, water, electrical transmission, tele-communication and easement requirements with the relevant authorities.

9.11.4 Conclusion

This services investigation report has identified potential connection to existing water, telecommunications and gas services and conventional wastewater system with onsite effluent disposal can be achieved to service the TSF. Additionally a dedicated recycling system is included to wash down locomotives prior to maintenance. It has been identified that as part of the TSF, relocation/protection of services is required and negotiations have commenced with the relevant authorities. The ARTC HRR Project will not have any impact on water or wastewater servicing for the TSF.

9.12 ABORIGINAL ARCHAEOLOGY

McCardle Cultural Heritage Pty Ltd has been engaged by QR National to carry out a Heritage Impact Assessment of the proposed development. A copy of the report is included at Appendix K. As part of this assessment, consideration has been given to the report prepared by AMBS in 2012, in relation to the adjoining relief road project being undertaken by ARTC.

9.12.1 Existing Environment

A search of the OEH AHIMS register has shown that 93 known Aboriginal sites are currently recorded within a ten kilometre radius of the study area. The recorded sites include 51 open camps, 25 artefact sites, six isolated finds, three grinding grooves, three artefact/PADs, three PADs, one scarred tree and one artefact/PAD/grinding groove site. The location of the sites within the context of the study area are identified within Figure 29.

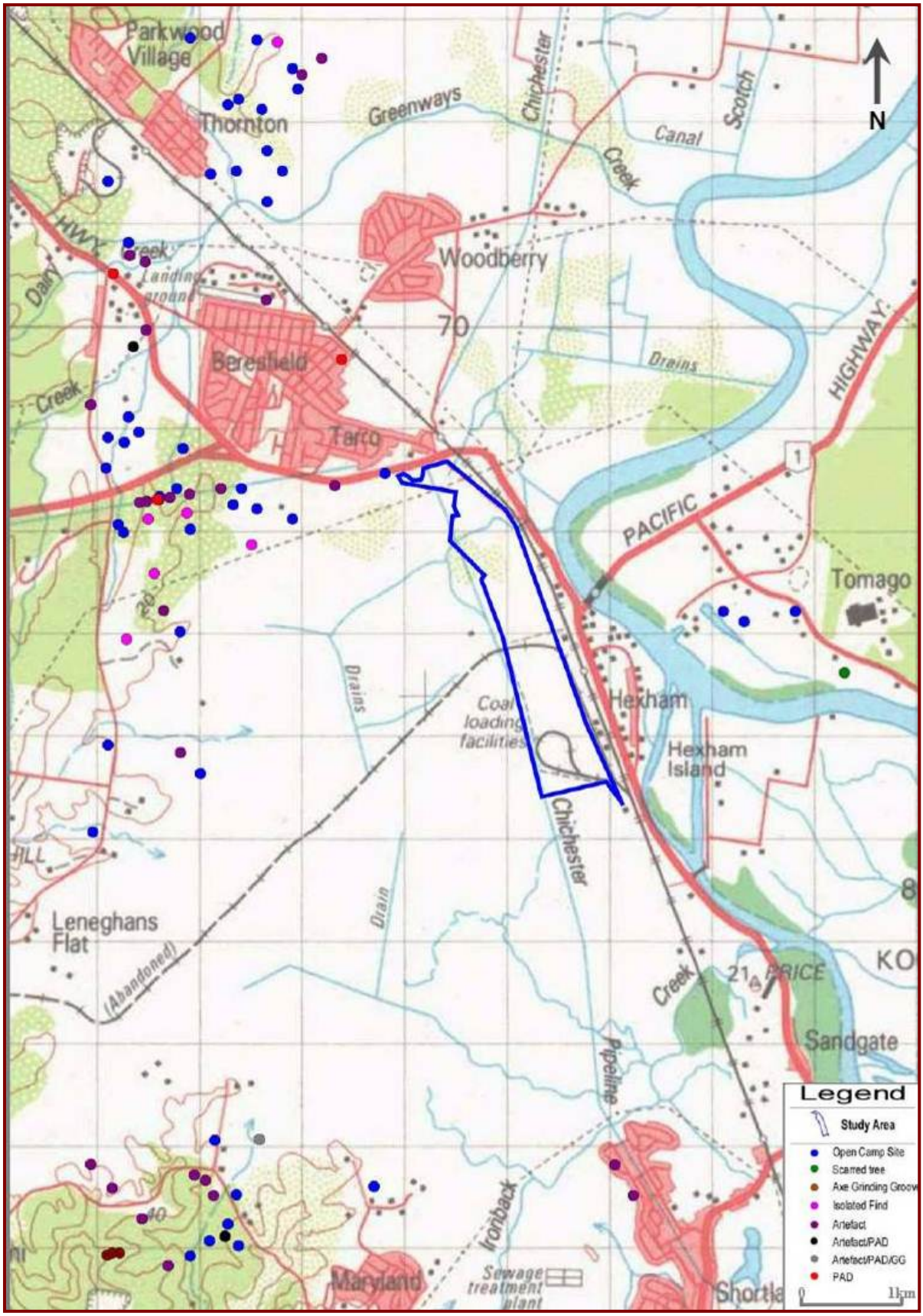

Figure 29: Local Sites Identified from OEH AHIMS Register.

A detailed site survey was carried out by McCardle Cultural Heritage Pty Ltd together with the registered Aboriginal Groups and traditional owners on 9 February 2011. Registered Aboriginal Group representatives that attended the survey were:

- Kerrie Brauer - Awabakal Traditional Owners Aboriginal Corporation; and
- Shane Frost and James Frost – Awabakal Descendants Traditional Owners Aboriginal Corporation.

During the survey, the Aboriginal representatives were also asked of their traditional knowledge and of any areas of cultural significance within the study area and if they felt comfortable in sharing that information. Discussions centred on places associated with ceremonial, spiritual, mythological beliefs, traditions and known sites that date from the precontact period. Sites or places with historical associations and/or significance which date from the post-contact period and that are remembered by people today (e.g. plant and animal resource use areas, known camp sites) were discussed as well as sites or places of contemporary significance (apart from the above) which has acquired significance recently. The Aboriginal stakeholder field representatives made general statements regarding the cultural significance of the Hexham Swamp area to the Awabakal people.

No sites were identified during the survey. This may be due to a number of reasons including poor visibility, disturbances and the low lying flood prone landform that may not have been suitable for continued occupation. While the study area may have been utilised for hunting and gathering, resulting in reduced evidence of occupation, the previous land use in the northern portion would have disturbed that evidence. The disturbances in the southern section would have destroyed any such evidence.

A site was identified by AMBS (HS1) as part of their work in relation to the adjoining ARTC HRR Project, however, this was not identified during a second site visit by MCH. Notwithstanding, this the assessment has assumed that the Site is present. The Site HS1 is identified in Figure 30.

The inferences that can be made about the nature of occupation within the investigation area and the specific sites identified area are limited by the small sample size. However, consistent with the Hunter Valley occupation model (Kuskie and Kamminga 2000), it is inferred from the evidence that:

- Aboriginal people used and occupied the area but generally at a very low intensity within the last 4,000 years. Although occupation of the region extends back to at least 20,000 years ago, the environmental context would have been very different to the present over such an extended period of time;
- Most of the artefact evidence is consistent with transitory movement through the landscape and occasional and short-duration visits by small parties of hunters and/or gatherers for food procurement;
- These activities appear to have occurred more frequently on swamp margins rather that the swamp itself; and
- Evidence is identified as a result of disturbances and exposures.

Notwithstanding the points above, the generally very low density of artefacts within the investigation area and the topography of the area (low lying swamp land) indicates that in the

broader locality focused occupation was more likely to have occurred outside of the direct investigation area in association with those such contexts where more preferential circumstances existed for water, level ground and subsistence resources (such as swamp margins).

The survey results are consistent with, or do not contradict the general model of occupation.

In view of the survey results, the predictive model of site location can be reassessed for the investigation area.

The potential for bora/ceremonial, carved tree, scarred tree, rock engraving and stone arrangement sites to occur within the investigation remains assessed as very low or negligible.

No direct evidence of lithic procurement sites was identified, however the potential for casual, opportunistic procurement of stone, such as quartz, from colluvial gravels within the investigation area cannot be discounted.

No evidence was encountered of burial sites, and although the potential for skeletal remains to occur within the investigation area is considered to be very low, it cannot be discounted.

Sites of traditional cultural significance (such as mythological sites) were not identified by the Aboriginal stakeholders or stakeholder representatives involved in the investigation. The registered Aboriginal stakeholders also did not disclose any specific knowledge of other cultural values/places (for example, historically known places or resource use areas). However, the possibility cannot be excluded that traditional or historical Aboriginal values or associations may exist that were not divulged to McCardle Cultural Heritage by the persons consulted, although this potential is assessed as low.

One artefact scatter was previously identified within the northern portion of the investigation area. There remains a low to moderate potential for additional open artefact evidence to occur in the areas currently obscured by vegetation (swamp/flats to the north), and such evidence is likely to occur in a low density. The artefact evidence may involve a broad range of artefact and stone types. Environmental contexts in which a higher artefact density and potentially deposits of research significance may occur, in association with more focused and/or repeated Aboriginal occupation, are largely absent from the investigation area.

Site location, in relation to landforms and proximity to reliable water is also supported by the evidence.

Significance Assessment

One of the key steps in the process of cultural heritage management is the assessment of significance. Not all sites are equally significant and not all are worthy of equal consideration and management (Sullivan and Bowdler 1984; Pearson and Sullivan 1995: 7). The determination of significance can be a difficult process as the social and scientific context within which these decisions are made is subject to change (Sullivan and Bowdler 1984). This does not lessen the value of the heritage approach, but enriches both the process and the long-term outcomes for future generations as the reasons for, and objectives of, site conservation also change over time.

The significance of indigenous archaeological sites or cultural places can be assessed on the criteria of the Burra Charter, the Australian Heritage Commission Criteria of the National Estate, and the OEH guidelines that are derived from the former two. The NSW NPWS Aboriginal Cultural Heritage Standards and Guidelines Kit (1997) emphasises two realms of significance assessment:

- Aboriginal cultural significance; and
- Archaeological (scientific) significance.

Scientific significance is assessed according to the contents of a site, state of preservation, integrity of deposits, representativeness/rarity of the site type, and potential to answer research questions on past human behaviour (NPWS 1997). The following extract from the McCardle report identifies the determined scientific significance.

Table 30: Identifying the Assessed Scientific Significance

Site	Site Type	Representative	Integrity	Res. Pot	Sci. Sig
PCD	PCD	Unknown	Fair	Unknown	Unknown
HS1 (surface site)	Artefact Scatter	Unknown (may be part of fill)	Poor	Low / Moderate	Low / Moderate
HS1 (PAD)	PAD	Unknown	Unknown	Unknown	Unknown

The PCD and site HS1 are identified in Figure 30 below. Also identified in Figure 30 are the 'cultural sites'. These cultural sites were identified by the registered Aboriginal stakeholders during the AMBS assessment in the far south of the study area. AMBS stated they were not archaeological sites but culturally identified by Aboriginal site officers and as such the site officers would submit a site card to OEH. These objects were not given a designated site name but for the purpose of clarification they have been named COHS/1 (Cultural Objects/Hexham Swamp/1).

While Aboriginal sites and places may have scientific significance, they also have cultural/social significance to the Aboriginal people from that area. Determining cultural/social significance can only be determined by the Aboriginal people from the area in which the sites and/or places were identified. Consultation with the Aboriginal stakeholders has been undertaken in order to document cultural/social significance, all registered stakeholders have stated the Hexham Swamp area is of very high cultural significance.

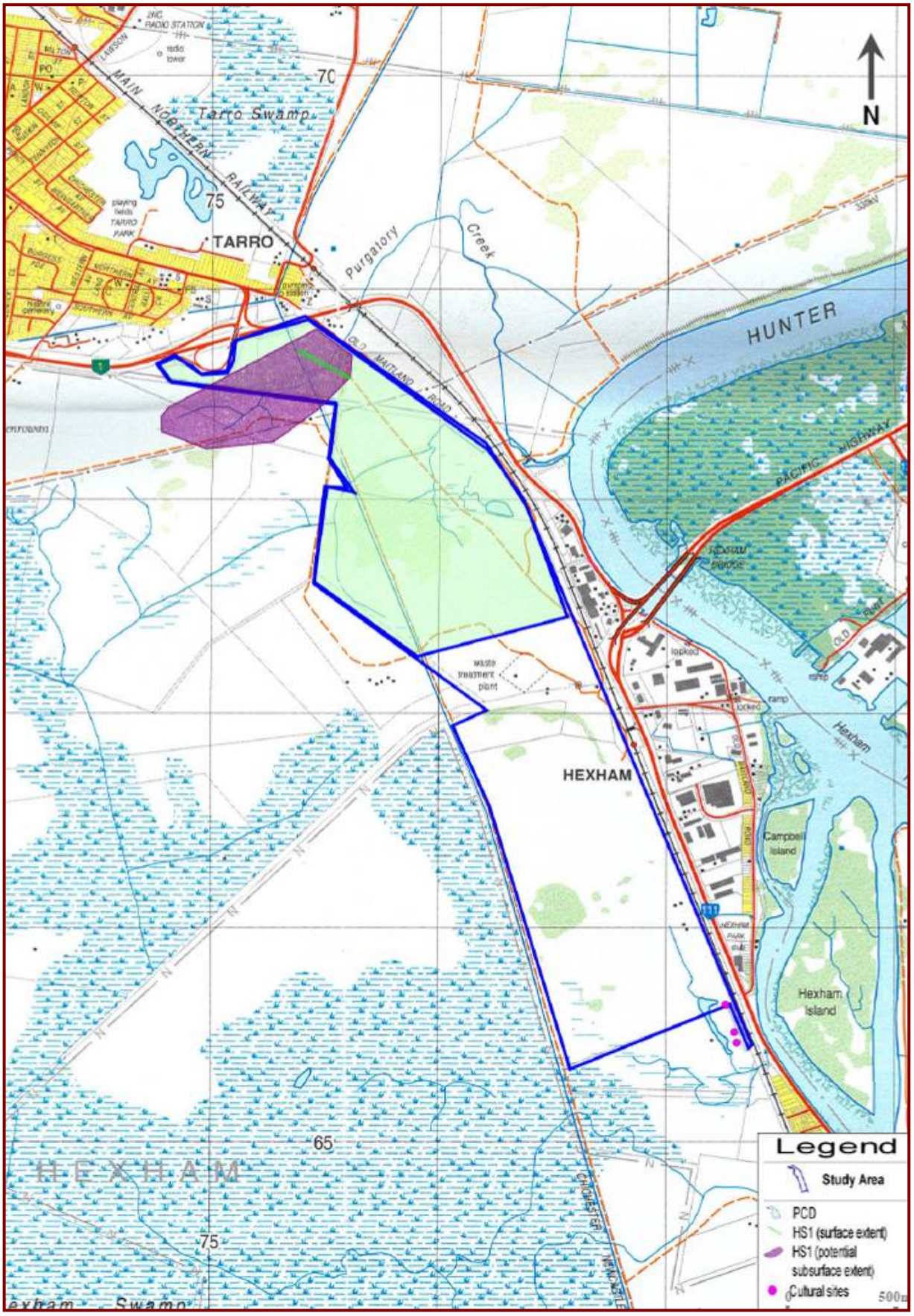

Figure 30: Location of PCD and Sites.

9.12.2 Impact Assessment

The PCD will be impacted through the construction of an access road and a section to the east will be impacted upon by the TSF footprint. A small portion of the PAD will be impacted by the access road but site HS1 (surface expression) will be completely avoided.

The OEH Code of Practice for the Archaeological Investigation of Aboriginal Objects in New South Wales (2010:21) describes impacts to be rated as follows:

1. Type of harm: is either direct, indirect or none.
2. Degree of harm is defined as either total, partial or none.
3. Consequence of harm is defined as either total loss, partial loss, or no loss of value.

The following table identifies the assessed impact of the proposed development on the PCD and HS1.

Table 31: Assessed Impact of the Proposed Development on the PCD & HS1

Site	Site Type	Type Of Harm	Degree Of Harm	Consequence Of Harm	Representative	Integrity	Res. Pot	Sci. Sig
PCD	PCD	Direct	Partial	Partial Loss Of Value	Unknown	Unknown	Unknown	Unknown
HS1 (surfaces site)	Artefact scatter	None	None	No loss of value	Unknown (may be part of fill)	Poor	Low/ Mod	Low/ Mod
HS1 (PAD)	PAD	Direct	Partial	Partial Loss Of Value	Unknown	Unknown	Unknown	Unknown

9.12.3 Mitigation Measures

Specific management strategies are considered below for the management of identified sites and potential archaeological deposits (PAD) or potential cultural deposits (PCD) within the study area.

One of the most important considerations in selecting the most suitable and appropriate strategy is the recognition that Aboriginal cultural heritage is very important to the local Aboriginal stakeholders. Decisions about the management of sites and PAD should be made in consultation with the appropriate local Aboriginal stakeholders.

To summarise the findings of this assessment, the area with the least disturbances is the northern portion which is an identified PCD, site HS1 and HS1PAD are also within the PCD.

The project plans had been altered during this assessment to ensure the least impact on the cultural heritage. Based on the current plans and assessment the following has been determined:

- The surface expression of Site HS1will not be impacted on;
- The majority of the HS1/PAD will not be impacted on. The only portion to be impacted on will be the eastern section where the access road will be placed;
- The majority of the PCD will not be impacted on. The only portion that will be impacted on will be the where the access road will be placed; and
- The cultural site known as COHS/1 is not a registered archaeological site, however the Aboriginal stakeholders will be given the opportunity to collect the objects prior to works.

The following management strategies are discussed in relation to the project, the results of the assessment and discussions with the Aboriginal stakeholders.

Conservation/Protection

Conservation is the first avenue and is suitable for all sites, especially those considered of high archaeological significance and/or cultural significance. Conservation includes the processes of looking after an indigenous site or place so as to retain its cultural significance and are managed in a way that is consistent with the nature of peoples' attachment to them.

As the surface expression of Site HS1 will not be impacted on, this site will be temporarily fenced to ensure its protection during construction.

As the only portion of the HS1/PAD that will be impacted on will be the eastern section where the access road will be placed, the road construction foot print will be temporarily fenced to ensure its protection during construction.

As the only portion of the PCD that will be impacted on will be the access road, the road construction foot print will be temporarily fenced to ensure its protection during construction.

Such measures will ensure the temporary fencing will delineate the development footprint and prevent any access to the remaining areas, thus ensuring the protection of areas not impacted by the proposed development. COHS/1 is in a highly disturbed context and will be impacted on by the development and as such conservation is not justified.

Further Investigations

An Aboriginal Heritage Impact Permit (AHIP) under Section 90 of the NP&W Act 1974 is not required for Part 3A projects to undertake archaeological subsurface test excavations, provided the excavations are carried out in accordance with the Code of Practice and in consultation with the local Aboriginal stakeholders.

Subsurface testing is appropriate when a PAD has been identified, and it can be demonstrated that sub-surface Aboriginal objects with potential conservation value have a high probability of being present, and that the area cannot be substantially avoided by the proposed activity.

Subsurface testing can identify whether subsurface cultural deposits exist, their nature, extent, content, integrity and significance.

As a small part of HS1/PAD may be impacted on, further investigations are required prior to works (HS1 surface expression will not be impacted on and will be avoided). A PCD has also been identified in the northern portion of the study area. The majority of this PCD will be protected by fencing, and it will not be impacted by the project. However, the proposed access road has been planned within this area, and as such further investigations are required prior to works.

Archaeological test excavations will be undertaken as part of the Code of Practice's suggested due diligence approach, to confirm that no harm is caused to Aboriginal objects or places. It is anticipated that no impacts will occur at the surface expression of HS1 and as such it is considered that no further investigations are justified in this area. The registered Aboriginal stakeholders will be provided with the opportunity to collect the cultural objects COHS/1 prior to any works being undertaken.

AHIP

As this project is being assessed under Part 3A, an AHIP is not required for any objects that may be impacted. No impacts will occur at the surface expression of HS1 and as such no further investigations/salvage is justified.

Monitoring

An alternative strategy for areas where archaeological deposits are predicted to occur is was to monitor development works for cultural materials, predominantly during the initial earth moving and soil removal works. This was the main strategy for managing the possible occurrence of Aboriginal skeletal remains.

However, with the legislative changes, monitoring is not an option as if there is even a slight possibility of cultural materials being present this must be addressed through the due diligence process and Code of Practice.

Aboriginal Cultural Heritage Management Plan

QR National is committed to implementing a sustainable Aboriginal Cultural Heritage Management Plan (ACHMP) on site, to facilitate employees and contractors to protect any potential cultural and archaeological deposits on site from harm. The ACHMP will be developed cooperatively with the RAPs, the McCardle archaeologist and QR National.

This ACHMP will cover all activities during the construction and post construction phase of the project. The ongoing sustainable management of the cultural heritage values within the project study area will be the responsibility of QR National. The ACHMP will be an evolving document that will be continuously updated as appropriate at each stage of archaeological investigative works are carried out.

To ensure that all personnel involved in the project, from the initial planning stages through to development, construction and future use of the land, are aware of and implement the appropriate management actions for the protection of Aboriginal cultural heritage values, QR National proposes to prepare an induction program as part of the ACHMP.

The ACHMP will establish the broad framework for achieving sustainable protection of cultural heritage values within the constraints of the project. This section briefly outlines the issues that would be addressed by the ACHMP for the construction phase of the project. The ACHMP will be completed prior to the start of any geotechnical or earth works for the project. The ACHMP will address (but is not necessarily limited to) the following:

- An outline of the project, including archaeological works to date;
- Objectives and targets of the ACHMP;
- Consultation/communications protocol for communications between QR National and the RAPs. This will include ongoing consultation, future archaeological works, ACHMP and the care and control of any cultural materials uncovered. Regular meetings to ensure all parties have a clear understanding of what is feasible and to work constructively together to ensure the best outcomes for the cultural heritage values within the project study area;
- Works schedule that will enable archaeological works to be undertaken in a timely manner;
- Procedures for further investigations, including excavation, site recording, site types uncovered and mitigation options;
- Procedure in the event of unexpected archaeological and/or cultural finds during construction;
- Procedures for skeletal remains if uncovered during construction;
- Care and control agreement for any cultural materials uncovered;
- Artefacts and reporting requirements for all stakeholders including the archaeologist and registered Aboriginal stakeholder;
- Ongoing management of protected areas will include a protocol for the temporary fencing of the boundaries of areas that will be managed for cultural heritage conservation, to ensure that subcontractors do not inadvertently damage those areas and site(s) during the construction of the project. This component of the ACHMP will also examine permanent fencing if required; and
- Cultural heritage awareness training requirements for contractors involved in all earth works during all stages of the project development. Part of the site induction will include an induction on the cultural heritage of the study area. All personnel on site must be inducted and as such are made aware of the cultural heritage values across the study area. The induction package can be included in the EMP and/or ACHMP.

9.12.4 Conclusion

Detailed site investigation relative to the proposed development has identified a potential site HS1, a PCD and PAD in the northern part of the site. Much of the northern part of the site will not be impacted upon by the proposed development, and site HS1 (surface expression) will be completely avoided.

Subject to adoption of the mitigation measures as outlined above the impacts of the proposed development will be appropriately managed.

9.13 EUROPEAN HERITAGE

EJE Heritage has been commissioned by QR National to investigate European Heritage, determine the significance of any European Heritage and to prepare an assessment of the impact. A copy of their report is included in full at Appendix D.

9.13.1 Existing Environment

A detailed overview of the site history is contained in the report prepared by EJE and attached as Appendix D. The whole of the study area has a history of agricultural use and this continues today in respect to the northern part of the site, while the southern part of the site from 1850 has a history associated with the rail industry and coal storage, preparation and loading and unloading.

The following provides a general chronology since 1830.

1830's - The subject site was mostly used for agricultural and dairying purposes.

1850's - The site was first utilised for storage and loading of coal.

1857 - John Eales constructed a railway to carry coal from the Mines at Minmi to loading at Hexham.

1859 - JA Brown purchases the site and will become Australia's largest coal producer.

1927 - Part of the site becomes the headquarters for the Hunter Valley Co-Operative Dairy Company to become known as the Oak.

1930's - Coal preparation was commenced on site and this included the construction of a coal washery in 1955.

1955 - Oak Milk Bar was opened.

1987 - Last Coal delivery to the site and coal washery ceases operation.

1997 - Newcastle Rail Terminals purchased the site with plans to use the site to help alleviate coal transportation problems to the Port of Newcastle.

2001 - Investigations undertaken regarding the establishment of a coal terminal at the Hexham site.

2003 - Coal tailings site rezoned to 4(b) Port and Industry under Newcastle LEP 2003.

2005 - Investigations undertaken to determine if coal tailings could be used in power stations.

2006 - QR National purchases the site.

2006 - Project Approval of the Hexham Swamp Rehabilitation Project on adjacent lands to the south-west.

2007 - Minister for Planning gives notice of receipt of an application to Amend SEPP (Major Projects) 2005 to include the Hexham Redevelopment site as potential State Significant Site.

2008 - State Significant Site Study Requirements and DGRs were released for the Hexham Redevelopment.

2010 - Revised State Significant Site Study Requirements and DGRs were issued for the Hexham Redevelopment.

2011 - Coal tailings site rezoned to IN3 Heavy Industry under Newcastle LEP 2011.

2011 - ARTC submit a project application for the HRR Project.

Figure 31 identifies the rail line structure established by JA Brown, extending from mines through to the subject site. Figure 32 identifies the Brian Andrews, Coal, Railways & Mines.

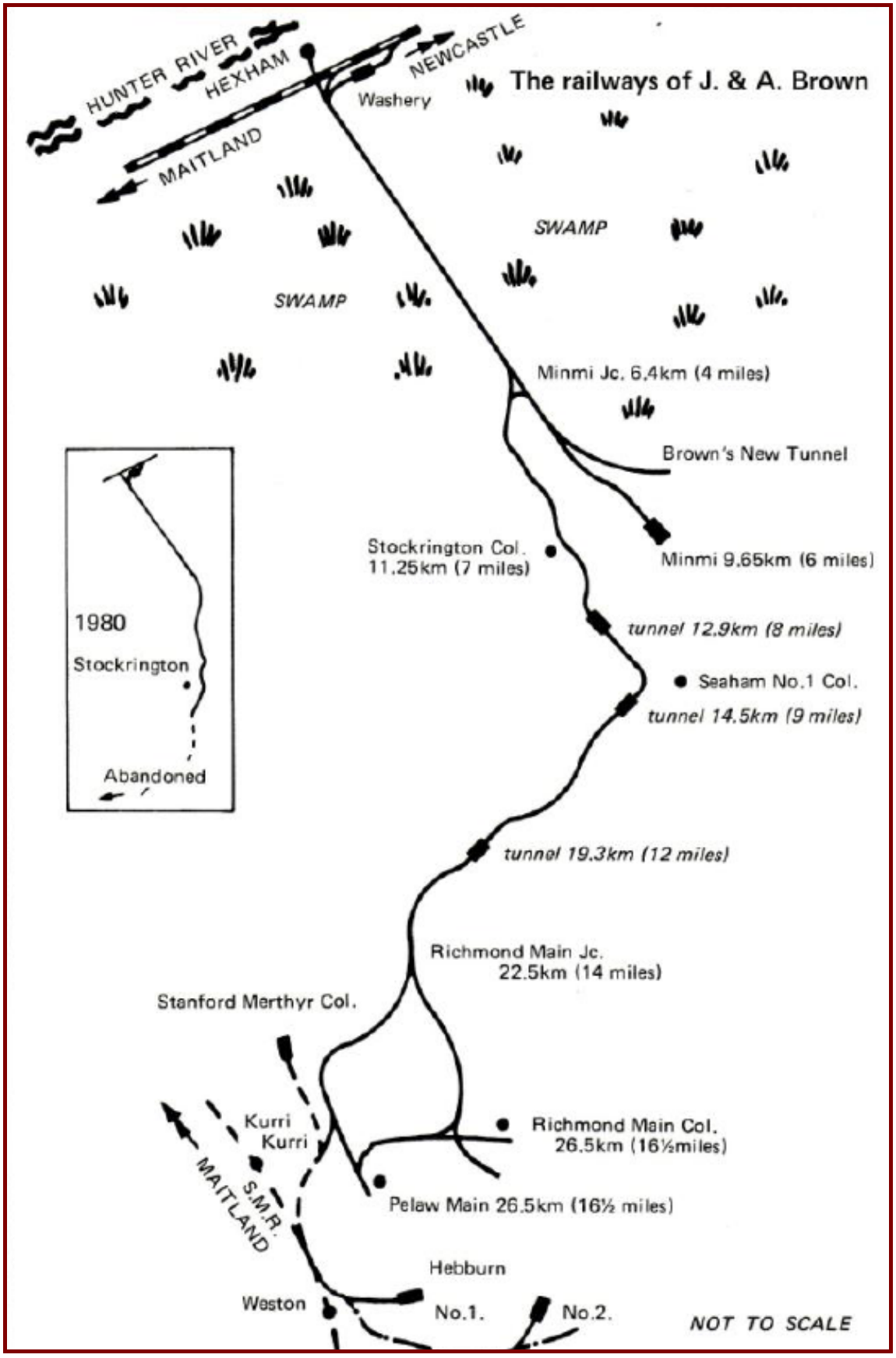

Figure 31: Railways of J. & A. Brown. K. Pearce, Coals to Hexham.

Various track layouts and structures occurred from the early days of site occupation and resulting in the following track layout in 1978:

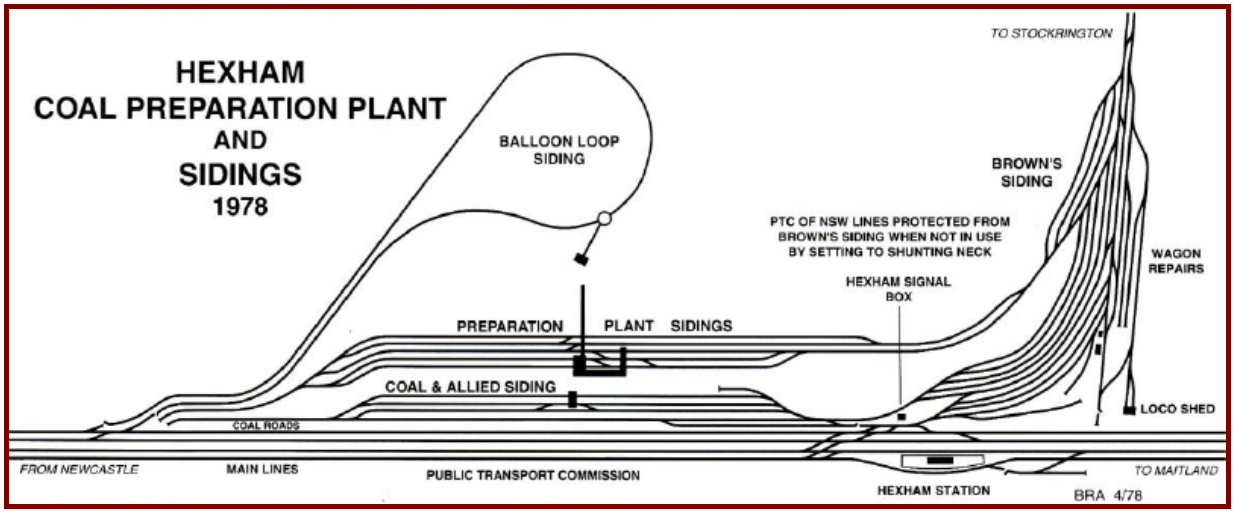

Figure 32: Plan of the site: Brian Andrews, Coal, Railways & Mines.

In May of 1988 the Hexham facility ceased operations, much of the stockpiles that were on site as at this date remain on site and this evident in the levels that can be seen on the site survey included in Appendix D.

The photograph below shows the extent of coal operations on the south part of the site in 1986, not long before operations ceased.

Photograph 14: 1986 Aerial view of the subject Site (NCC Plan Room).

Figure 33 below identifies the site's redundant structures.

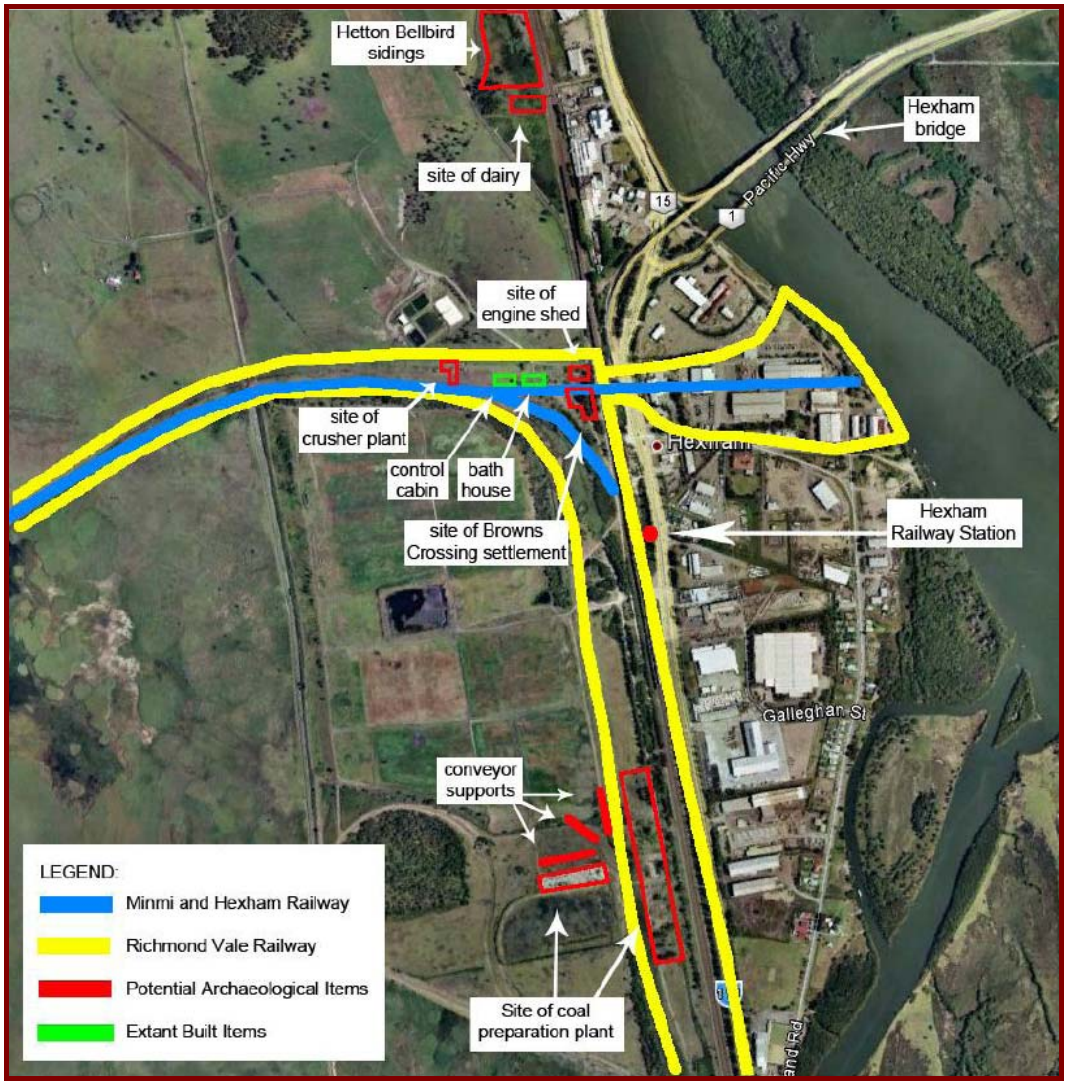

Figure 33: Overlay showing redundant structures.

Significance Assessment

The historical significance of the site lies primarily in its association with the coal and rail industries for in excess of a hundred years. Despite the removal of railway infrastructure, associated buildings and equipment, highly significant evidence relating to the early history of the site remains in the form of a rail corridor and former control cabin and bath house. Activities on the site relating to the transport and treatment of coal link it to the State Heritage Themes of Mining, Transport, Industry and Technology, while association with the coal magnate John Brown links it to the theme of Persons. Although of less historical significance than the coal and rail – related history of the site, agriculture has also played a role, providing an association with the State Heritage Themes of Pastoralism and Agriculture.

Built Items within the Study Area

The Control Cabin

- Built in c. 1909, the control cabin is a two storey structure constructed from bricks made in the J. & A. Brown brick yards. The building consists of brick arched openings and a hipped roof of which only the rafters and some iron sheets remain. Vandalism and neglect, together with the theft of materials has made the building ruinous, with large voids in the brickwork. Floor joists and ceiling rafters have been burned out.
- *Condition* – Ruinous. The control cabin has been burned and robbed of materials and has lost roof covering.

Photograph 15 & Photograph 16: The control cabin.

The Bath House

- Built in 1949, the bath house is a single storey structure with two clear additions to the east and west elevations. The building is ruinous, with vegetation growing within the structure. The bath house consists of tiled interior and a gable roof of which only the timber structure remains.
- *Condition* – Ruinous and has lost roof covering.

Photograph 17: The bath house.

Coal Preparation Plant Conveyor Belt Support Footings & Coal Stockpile

- Coal preparation plant conveyor belt support footings and other coal stockpile buildings remain on site. Thirteen concrete conveyor belt support footings remain as well as those of other coal stockpile buildings.
- *Condition* – The remains are in poor condition.

Photograph 18: Conveyor belt support footings.

Ruins of Dairy Farm Milking Shed, Milking Machine Hut and Silos

- The ruins of a milking shed, including milking machine hut, hay shed and concrete feed silos, are located towards the western end of the study area. The facility was extant by 1944 and anecdotal evidence suggests that it became redundant in the late 1950s.
- *Condition* – The former dairy milking shed, feed shed and milking machine hut are in ruinous condition. The concrete feed silos have resisted flooding and other damage and stand in good condition.

Photograph 19: The ruins of the milking machine hut.

Ruins of the Hetton Bellbird Weighbridge Hut

- The weighbridge hut, which housed the weighing machine showing the weight of each coal hopper shunted across the weighbridge before dumping at the gantry loader, was built at some time after 1935, and was probably demolished during the general clearing of the site in 1976.
- *Condition* – Ruinous. The ruin of the Hetton Bellbird weighbridge hut, together with other remains associated with the Hetton Bellbird (later Peko – Wallsend) sidings and coal loader, is in poor condition.

9.13.2 Impact Assessment

The Statement of Heritage Impact has been written in accordance with the guidelines for Assessing Heritage Significance and Statement of Heritage Impact as issued by the NSW Heritage Office, and the Australia ICOMOS Burra Charter (1999).

The following aspects of the proposal respect or enhance the heritage significance of the item or area for the following reasons:

The significance of the site is directly related to its former use in hauling coal by rail. The proposed TSF, designed to meet the modern requirements of the industry, will reintroduce rail based activities very similar to those that came to an end with the closure of the Richmond Vale Railway in 1987. In cultural terms, it will reactivate what was formerly a busy place of work, in pursuit of innovation and industry best practice in a fashion sympathetic to the efforts of the Brown family. Re – use of the site for railway purposes will increase the meaning and value of the site both for staff, contractors, the people of Hexham, Tarro and Beresfield, and for railway enthusiasts and the wider community.

The following aspects of the proposal could detrimentally impact on the heritage significance of the item or area for the following reasons:

The proposed works necessitate disturbance, concealment or removal of a range of built items including those mentioned above, being the control cabin, bath house and the Hetton Bellbird weighbridge, as well as the dairy, some concrete conveyor belt support footings, coal preparation plant footings and some remnant items of track work which are associated with the Minmi to Hexham Railway which is recognised as a Local Heritage Item within Schedule 5 of the Newcastle LEP 2015.

Whilst these items provide evidence of previous use of the area, none of these items are considered to be of high heritage significance.

There were two extant structures within the study area to which heritage significance might have been assigned. These are the control cabin and the bath house. While these are not listed in statutory planning instruments or Heritage registers, both are within the curtilage of the former Richmond Vale Railway as developed by the Heritage Branch of the DP&I.

9.13.3 Mitigation Measures

The following actions will be undertaken to enhance the interpretation of the abovementioned items:

1. Serviceable bricks from the control cabin will be salvaged and appropriately reused in a symbolic linkage of the past and proposed uses of the site.
    - This will facilitate interpretation of previous uses of the site and also of its heritage significance. For example, clean undamaged bricks may be able to be used for landscaping purposes, paving or within dwarf walls for signage.
2. Appropriate interpretation in the form of a plaque providing details of the site's heritage will be located within the site.
3. The proposed development will be carried out in accordance with the Statement of Heritage Impact prepared by EJE, dated June 2012.

In addition to the above the following measures will be employed to address the potential impacts on the archaeological resources associated with the Minmi to Hexham railway:

Construction Non-Indigenous Management Plan

- The lead contractor for the construction of the TSF will, before commencing site work, prepare a Construction Non-Indigenous Management Plan setting out the mitigation and management strategies that would be implemented to minimise potential impacts to heritage items.

Appointment of an Excavation Director

- An Excavation Director, whose experience complies with the criteria promulgated by the Heritage Branch of the DP&I will be appointed prior to any excavation within the vicinity of the junction of the Minmi to Hexham Railway and the GNR. The Excavation Director will advise on archaeological matters associated with the excavation, and is to ensure compliance with both the procedures to be adopted in the event of unexpected finds and measures for protecting heritage items that are to be conserved;
- The Excavation Director will have the following responsibilities:
    a) Notify the proponent of potentially archaeologically sensitive places;
    b) Closely observe the course and conduct of excavations both in those places and in the entire area of excavations;
    c) Be responsible to the proponent for compliance with the provisions of the Heritage Act 1977 (NSW); and
    d) Advise the proponent as to the level of significance of such relics as may be discovered within the area of excavations. These levels may be Local, State or National.

Excavation Relics

- Should relics be discovered within the area of excavation, and should these, within the opinion of the Excavation Director, have heritage significance, the Excavation Director shall advise the proponent as to practical measures for the protection of those items.

9.13.4 Conclusion

The proposed TSF was found to have very minimal inherent impact on the heritage values of the site. While several items associated with previous uses, such as the dairy ruins, remnant trackwork, coal preparation plant footings and conveyor belt support footings will likely be demolished, these have very restricted level of significance and their loss will not be detrimental.

QR National is committed to interpreting as much of the site's history as possible within the parameters of modern needs. This has been demonstrated by QR National committing to the abovementioned mitigation measures which include salvage of undamaged bricks from the control cabin for reuse and the provision of plaque on site providing details of the site's history.

In heritage terms, the site has been found to be suitable for the proposed TSF. For over 130 years the site has been associated with the coal and rail industries. These associations will be preserved by the revival of the use for which the site was intended, being the transportation of coal.

9.14 NOISE & VIBRATION

SLR Consulting Australia Pty Ltd has been commissioned by QR National to conduct a Noise Impact Assessment for the proposed TSF. A full copy of their report is located at Appendix P and presents the results and findings of the noise assessment including consideration of construction, road traffic and operational noise of the proposed facility.

9.14.1 Existing Environment

An ambient noise monitoring program was conducted by SLR Consulting. Ambient noise levels were monitored at four separate locations, considered to be representative of the nearest potentially affected receivers to the site. The objective of this survey was to measure L_{A90} (15 minute) and L_{Aeq} (15 minute) noise levels at the nearest potentially affected residential locations during the day, for the proposed development in accordance with the NSW Industrial Noise Policy (INP).

Table 32 below and Figure 34 identify the nine locations that have the potential to be affected by the proposed development (sensitive receivers). The sensitive receivers were used for the purpose of survey and assessment. Four monitoring locations have been identified on Figure 34 which are representative of the background noise for the nine sensitive receivers.

Table 32: Noise monitoring locations (sensitive residential receivers).

Residence No.	Description
R1	Hain Property west of site
R2	Lynch property north of site
R3	New England Highway east of site
R4	Old Maitland Road (North) east of site
R5	Old Maitland Road east of site
R6	Old Maitland Road (South) east of site
R7	Maitland Road south-east of site
R8	Church old Maitland Road
R9	Tarro Primary School

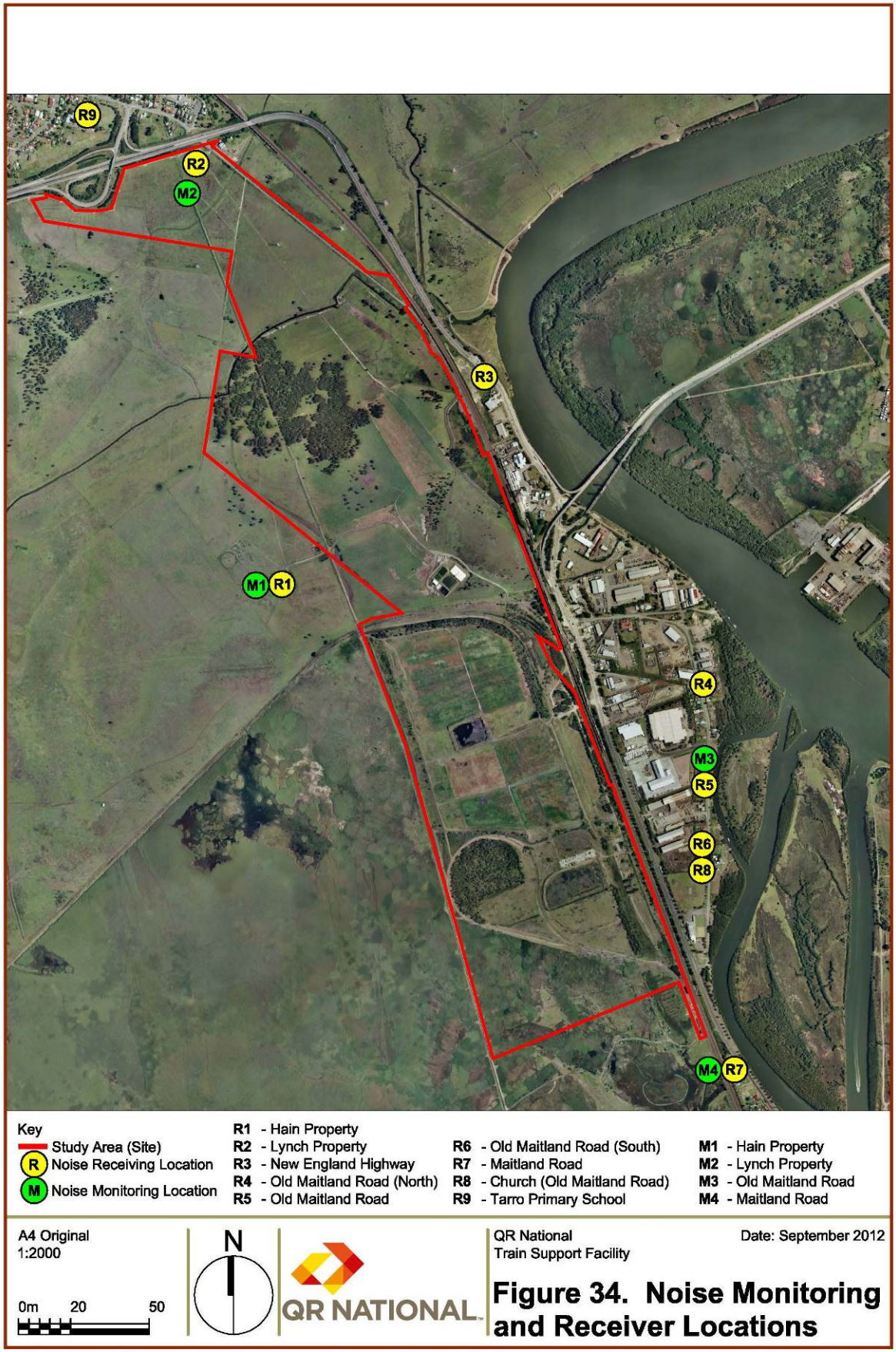

Figure 34: Noise monitoring and Receiver Locations

Continuous unattended noise surveys were carried out at locations M1, M2 and M3 from 17 March 2008 to 27 March 2008 to determine the background levels. In addition operator attended noise surveys were conducted at residential locations M1, M2, M3 and M4 to characterize and quantify the main contributions to ambient noise at these locations. The detailed results of these are shown in Tables 33 and 34 below.

Table 33: Background Noise levels at Sensitive Receivers

Location	Description	Measured Background LA90 Noise Level	Adopted Rating Background Level	Estimated Existing Industrial LAeq Contribution
M1 Hain Property	Daytime	41 dBA	41 dBA	< 44 dBA
	Evening	46 dBA	41 dBA	< 39 dBA
	Night	47 dBA	41 dBA	< 34 dBA
M2 Lynch Property	Daytime	56 dBA	56 dBA	< 54 dBA
	Evening	53 dBA	53 dBA	< 44 dBA
	Night	47 dBA	47 dBA	< 39 dBA
M3 Old Maitland Road	Daytime	40 dBA	40 dBA	< 54 dBA
	Evening	40 dBA	40 dBA	< 44 dBA
	Night	39 dBA	39 dBA	< 39 dBA

Table 34: Operator Attended Noise Surveys

Location	Date/ Start time/ Weather	Primary Noise Descriptor (dBA re 20 μPa)					Description of Noise Emission, Typical Maximum Levels LAmax (dBA) and Estimated Existing LAeq Contribution
		LAmax	LA1	LA10	LA90	LAeq	
M1 Hain Property	17/3/2008 15:25 Day W=2 to 4 m/s NE Temp=25°C	69	61	55	49	53	Wind in trees to 50 Distant traffic 45 to 47 Train passby to 50 Birds 52 to 60 Aircraft 55 to 60
M2 Lynch Property	17/3/2008 07:50 Day W= calm Temp=20°C	78	70	66	58	64	Traffic noise dominant 65 Train passby to 63
M3 Old Maitland Road	17/3/2008 14:17 Day W=2 to 3 m/s NE Temp=25°C	69	66	55	47	54	Truck in industry site to 54 Industrial noise 45 to 46 Distant traffic 47
M4 Maitland Road	17/3/2008 14:44 Day W=2 to 3 m/s NE Temp=24°C	79	74	69	55	65	Traffic noise dominant 73 Some wind in trees Some cicadas

The effects of meteorology on noise levels were considered and in both the case of wind and temperature inversion occurred less than 30% of the time and so are not significant in terms of assessment of noise environment.

Rail Movements

Noise monitoring undertaken as part of the EA for the HRR Project identified the number of rail pass by events on 25 and 26 August 2011 which are presented in Table 35 below:

Table 35: Rail Pass by Events

Location	Date	Rail Pass by Events			
		Freight (inc.Coal)		Passenger	
		Day	Night	Day	Night
Adjacent to rail line off Woodland Close	25/08/11	63	34	43	9
	26/08/11	55	25	40	9

Despite the fact that rail movements at Hexham will increase due to the increase in coal freight movements. There will be no increase in train movements going past the site as a result of the proposed TSF.

9.14.2 Impact Assessment

The noise emission design criteria for the proposed TSF have been established with reference to the INP.

TSF Operations

Operational noise levels from the proposed TSF are predicted to meet the project specific noise criteria at all receiver locations under prevailing weather conditions (calm) during day, evening and night periods as shown in table 36 below.

Table 36 details the sound power levels of relevant plant and equipment considered in the model. Table 37 summarises the operational scenario modelled, a tick indicates that the equipment is in operation during the relevant period, where a number is included in brackets flowing the tick, this represents the number of pieces of equipment considered in the noise model. The operational scenario modelled is likely to represent the acoustically worst case scenario.

Table 36: Predicted Noise Levels TSF Operations

Locality	Period	Predicted Noise Level LAeq(15minute) Calm	Intrusiveness Criteria LAeq(15minute)	Amenity Criteria LAeq(Period)	Project Specific Noise Level (PSNL)
R1 Hain Property	Day	38 dBA	46 dBA	60 dBA	46 dBA
	Evening	38 dBA	46 dBA	50 dBA	46 dBA
	Night	38 dBA	46 dBA	45 dBA	45 dBA
R2 Lynch Property	Day	31 dBA	61 dBA	60 dBA	60 dBA
	Evening	31 dBA	58 dBA	50 dBA	50 dBA
	Night	31 dBA	52 dBA	45 dBA	45 dBA
R3 New England Highway	Day	46 dBA	61 dBA	60 dBA	60 dBA
	Evening	46 dBA	58 dBA	50 dBA	50 dBA
	Night	46 dBA	52 dBA	45 dBA	45 dBA
R4 Old Maitland Road (North)	Day	40 dBA	45 dBA	60 dBA	45 dBA
	Evening	40 dBA	45 dBA	50 dBA	45 dBA
	Night	40 dBA	44 dBA	45 dBA	44 dBA
R5 Old Maitland Road	Day	38 dBA	45 dBA	60 dBA	45 dBA
	Evening	38 dBA	45 dBA	50 dBA	45 dBA
	Night	38 dBA	44 dBA	45 dBA	44 dBA
R6 Old Maitland Road (South)	Day	39 dBA	45 dBA	60 dBA	45 dBA
	Evening	39 dBA	45 dBA	50 dBA	45 dBA
	Night	39 dBA	44 dBA	45 dBA	44 dBA
R7 Maitland Road	Day	31 dBA	61 dBA	60 dBA	60 dBA
	Evening	31 dBA	58 dBA	50 dBA	50 dBA
	Night	31 dBA	52 dBA	45 dBA	45 dBA
R8 Church Old Maitland Road	Day	39 dBA	45 dBA	Internal when in use 40 dBA	Internal when in use 40 dBA
	Evening	39 dBA	45 dBA		
	Night	39 dBA	44 dBA		
R9 Tarro Primary School	Day	<30 dBA	61 dBA	Internal Classroom Noisiest 1-hour period when in use 35 dBA	Internal Classroom 35 dBA
	Evening	<30 dBA	58 dBA	N/A	N/A
	Night	<30 dBA	52 dBA	N/A	N/A

The Tarro Primary School has been assessed within an updated assessment and complies with the noise critera as identfied in Table 36 above.

Table 37: Operational Scenario Considered in Noise Model

Plant and Equipment	Day	Evening	Night
Provisioning Facility			
Loco and Wagons	✓(1)	✓(1)	✓(1)
Compressor	✓(1)	✓(1)	✓(1)
Forklift	✓(1)	✓(1)	✓(1)
Hand Tools as required	✓	✓	✓
Locomotive Maintenance Shed and Wash Bay			
Locomotive wash	✓(1)	✓(1)	✓(1)
Loco	✓(1)	✓(1)	✓(1)
Compressor	✓(1)	✓(1)	✓(1)
Forklift	✓(1)	✓(1)	✓(1)
Hand Tools as required	✓	✓	✓
Wagon Shop			
Loco and Wagons	✓(1)	✓(1)	✓(1)
Wagon Placement tractor	✓(1)	✓(1)	✓(1)
Compressor	✓(1)	✓(1)	✓(1)
Forklift	✓(1)	✓(1)	✓(1)
Hand Tools as required	✓	✓	✓
Train shunting	✓(1)	✓(1)	✓(1)

Operational Road Traffic Noise

The acoustic report determines that the number of traffic movements associated with the proposed development is insignificant in acoustic terms and that compliance with the RNP is predicted to be met.

Sleep Disturbance

The following table shows that sleep disturbance noise levels comply with the criteria at all locations.

Table 38: Sleep Disturbance Noise Levels

Location	Period	Predicted Sleep Disturbance Noise Level	Sleep Disturbance Criteria L1(1minute)
R1 - Hain Property	Night	45 dBA	56 dBA
R2 - Lynch property		35 dBA	62 dBA
R3 - New England Highway		57 dBA	62 dBA
R4 - Old Maitland Road (North)		52 dBA	54 dBA
R5 - Old Maitland Road		48 dBA	54 dBA
R6 - Old Maitland Road (south)		51 dBA	54 dBA
R7 - Maitland Road		38 dBA	62 dBA
R8 - Church Old Maitland Road		N/A	N/A
R9 - Tarro Primary School		N/A	N/A

The resulting sleep disturbance project specific noise criteria for residences receiver locations are based on the night time adopted rating background noise levels plus 15 dBA (as described in the Application Notes to the INP).

The assessment of sleep disturbance has been updated to clearly identify that the worst case maximum night time noise levels from trains shunting on site have been used for the assessment of sleep disturbance from the proposed TSF.

Construction Noise

The acoustic report makes an assessment of construction noise impacts associated with road works at the Tarro Interchange, demolition, clearing and drainage, rail works and building works. In addition the transport route for construction has also been assessed. It has been determined based on all machinery and equipment to be used that construction noise levels are predicted to be below the relevant guidelines at the closest residential receivers.

The additional daily traffic of up to 340 vehicles (worst case) associated with construction activity will result in a negligible change to the existing road traffic noise level generated in the New England Highway and therefore are predicted to meet the requirements of the RNP. Construction traffic volumes have been based on a worst case noise assessment which involves import of 100% of material to site.

The results of construction noise predictions for the proposed TSF are contained within Table 39 and show the worst case impact of all construction phases at each nearest residential receivers for the daytime period only. Noise predictions indicate that the construction of the TSF would comply with construction noise goals for the daytime period at all assessment locations. However, a marginal 2 dBA exceedance of the 'noise affected' management noise level is predicted at location R6 during rail works but is well below the 'highly noise affect' management noise level. The exceedance is caused by the operation of the tamping machine.

Sound power levels for construction are considered within the Noise and Vibration Impact Assessment in Appendix P model.

Table 39: Construction Noise Predictions

Location	Weather Conditions	Predicted Noise Level LAeq (15minute)	Management Level LAeq(15minute) (dBA)	
			Noise Affected	Highly Noise Affected
Road Construction				
R1 - Hain Property	Calm	39 dBA	51 dBA	75 dBA
R2 - Lynch Property		50 dBA	66 dBA	
R3 - New England Highway		56 dBA	66 dBA	
R4 - Old Maitland Road (North)		45 dBA	50 dBA	
R5 - Old Maitland Road		43 dBA	50 dBA	
R6 - Old Maitland Road (South)		49 dBA	50 dBA	
R7 - Maitland Road		39 dBA	66 dBA	
R8 - Church Old Maitland Road		49 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School		54dBA[1]	45 dBA internal	N/A
Demolition Clearing and Drainage				
R1 - Hain Property	Calm	49 dBA	51 dBA	75 dBA
R2 - Lynch Property		35 dBA	66 dBA	
R3 - New England Highway		51 dBA	66 dBA	
R4 - Old Maitland Road (North)		46 dBA	50 dBA	
R5 - Old Maitland Road		43 dBA	50 dBA	
R6 - Old Maitland Road (South)		50 dBA	50 dBA	
R7 - Maitland Road		39 dBA	66 dBA	
R8 - Church Old Maitland Road		50 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School		33 dBA[1]	45 dBA internal	N/A
Rail Works				
R1 - Hain Property	Calm	43 dBA	51 dBA	75 dBA
R2 - Lynch Property		36 dBA	66 dBA	
R3 - New England Highway		61 dBA	66 dBA	
R4 - Old Maitland Road (North)		49 dBA	50 dBA	
R5 - Old Maitland Road		47 dBA	50 dBA	
R6 - Old Maitland Road (South)		**52 dBA**	50 dBA	
R7 - Maitland Road		39 dBA	66 dBA	
R8 - Church Old Maitland Road		52 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School		34 dBA[1]	45 dBA internal	N/A
Building Works				
R1 - Hain Property	Calm	43 dBA	51 dBA	75 dBA
R2 - Lynch Property		32 dBA	66 dBA	
R3 - New England Highway		55 dBA	66 dBA	
R4 - Old Maitland Road (North)		48 dBA	50 dBA	
R5 - Old Maitland Road		45 dBA	50 dBA	
R6 - Old Maitland Road (South)		39 dBA	50 dBA	
R7 - Maitland Road		<30 dBA	66 dBA	
R8 - Church Old Maitland Road		39 dBA[1]	45 dBA internal	N/A
R9 - Tarro Primary School		30 dBA[1]	45 dBA internal	N/A

Note: Construction may only occur between the hours of 7.00 am and 6.00 pm Monday to Friday, and 8.00 am to 1.00 pm Saturdays. No construction work is to take place on Sundays or Public Holidays

1. These are external noise levels. As a conservative estimate, the difference between external to internal noise levels with a dwelling comprising of standard construction and windows open for adequate ventilation is 10 dB. As a result, the internal noise level for receiver R8 and R9 is 39 dBA and 44 dBA during road construction respectively, 40 dBA and <30 dBA during demolition works respectively, 42 dBA and <30 dBA during rail works respectively and <30 dBA during building works at both receiver R8 and R9. These internal noise levels comply with the internal construction noise criteria 45 dBA.

Vibration

The SLR report has reviewed the potential for impacts associated with vibration noting that the distance between both construction and operational sources will means that the proposal is below the criteria for minimal risk of cosmetic damage to residential and commercial properties.

Cumulative Impacts

The acoustic report identifies that the primary potential for cumulative noise impact is during the construction phase of both the ARTC and QR National developments. Even so the cumulative construction works are below the "highly noise affect" management levels at all times.

9.14.3 Mitigation Measures

Operational noise levels are predicted to be below the relevant guidelines at the closest residential receivers and therefore mitigation is not required.

Although noise levels are predicted to be below the relevant guidelines at the closest residential receivers during construction the following measures should be considered to reduce the construction noise impact:

- Site noisy equipment behind structures that act as barriers or at the greatest distance from the noise-sensitive area or orient the equipment so that noise emissions are directed away from any sensitive areas.
- Keep equipment well maintained;
- Employ "quiet" practices when operating equipment (e.g. positioning and unloading of trucks in appropriate areas); and
- A Construction Noise Management Plan should be prepared and implemented prior to commencement of construction works at the site. This should include the following:
    - Construction noise goals,
    - Recommendations regarding specific physical and managerial measures for controlling noise, noise and vibration monitoring programs and reporting procedures, and
    - Measures for dealing with exceedances and mechanisms to provide ongoing community liaison.

With regard to potentially offensive noise events associated with construction activities AS 2436-1981"*Guide to noise control on construction, maintenance and demolition sites"* provides the following:

If noisy operations must be carried out, then a responsible person should maintain liaison between the neighbouring community and the contractor. This person should inform the public at what time to expect noisy operations and also inform the contractor of any special needs of the public. Consultation and cooperation between the contractor and his neighbours and the removal of uncertainty and rumour can help reduce the adverse reaction to noise.

9.14.4 Conclusion

A noise and vibration impact assessment has been carried out and for operational functions of the TSF compliance is achieved with the maximum allowable noise criteria for the INP in all respects. Noise is only predicted to be a potential area of concern during the construction phase and more particularly where the ARTC and QR National project are to be constructed at the same time. Mitigation measures have however been recommended to minimise impacts. Vibration impacts from construction as well as operations are not predicted to have an impact on sensitive receivers or other nearby commercial receivers.

9.15 AIR QUALITY

SLR Consulting Australia has been commissioned by QR National to conduct an Air Quality Impact Assessment of the proposed TSF. The report considers both the construction and operational phase of the proposed development. The report in its entirety is provided in Appendix Q.

9.15.1 Existing Environment

The proposed project site is situated in the Lower Hunter region of NSW. This region has a significant industrial base including primary metallurgical works, fertiliser manufacturing and coal fired power generators. Emissions from a substantial motor vehicle fleet also contribute to pollution levels in the region.

In the absence of site-specific monitoring data, estimates of the existing air quality environment for the project site has been derived using data from the EPA monitoring sites at Beresfield and Newcastle.

The Beresfield monitoring site is located approximately 3km north-northwest of the project site and is classified as semi-rural. It was commissioned in 1993 and is located in the Francis Greenway High School, on Lawson Avenue, Beresfield.

The EPA maintains a monitoring site in Newcastle which is located approximately 13km southeast of the project site. The site was commissioned in 1992 and is located in the Newcastle Sports Ground, off Dumaresq Street, Newcastle.

The parameters that are currently measured at the Beresfield and Newcastle monitoring sites are summarised in Table 40 below.

Table 40: Parameters Measured at the Beresfield and Newcastle Monitoring Sites.

Parameter	Beresfield	Newcastle
Ozone	✓	✓
Oxides of Nitrogen	✓	✓
Sulphur Dioxide	✓	✓
Particulate Matter as PM10	✓	✓
Particulate Matter as PM2.5	✓	✓
Carbon Monoxide	-	✓
Meteorology	✓	✓

For the purpose of this assessment the estimates of background concentrations of criteria pollutants were derived from the Beresfield monitoring site for 2011, with the exception of carbon monoxide for which the Newcastle data was used.

In establishing the existing background air quality consideration has been given to the cumulative impacts relative to the adjoining ARTC HRR Project.

Table 41 represents the complied background air quality and assumes that ARTC five trains sitting idle on the HRR which provides for a conservative background as it is unlikely that less than this number would sit idle in practice.

Table 41: Background Air Quality Environment for Assessment Purposes

Air Quality Parameter	Units	EPA Criteria		Regional Background Levels Assumed
		Averaging Period	Max Allowable (µg/m³)[1]	
PM10	µg/m³	24-hour	50	42.8
	µg/m³	Annual	30	17.2
Nitrogen dioxide	µg/m³	1-hour	246	79.0
	µg/m³	Annual	62	33.6
	µg/m³	1-hour	570	171.6
	µg/m³	24-hour	228	34.3
	µg/m³	Annual	60	4.9
Carbon monoxide	µg/m³	15 minute	100	N/A
	µg/m³	1-hour	30	N/A
	µg/m³	8-hour	10	1.7
Dust deposition	g/m²/month	Annual	4 g/m²/month	2.0

9.15.2 Impact Assessment

For the purpose of assessing the impact of the proposed development both the construction phase and the operational phase has been considered. The following sources have been identified.

Construction Phase

Based on information provided by the Proponent, dust generating construction related activities at the proposed site may include (but may not be limited to):

- Road construction;
- Importing fill (approximately 380,000m^3);
- Loading and unloading of trucks;
- Excavating;
- Use of backhoes;
- Movement of trucks on unpaved roads; and
- Wind erosion of stockpiles and exposed areas.

Due to the irregularity and short duration of the emission sources during this phase, the impact is not expected to have long-term health or ecological impacts beyond the proposed site boundaries. However, as these sources can result in high short-term releases of particulate matter during construction, control measures should be put in place during this phase. The control techniques for fugitive dust sources generally involve watering, chemical stabilisation, wind sheltering and source activity management.

Operational Phase

Air pollutant emission sources associated with the day-to-day operation of the proposed TSF include;

- Refuelling of locomotives with diesel;
- Refilling and emptying of storage tanks;
- Storage of fuels;
- Locomotive exhaust;
- Maintenance operations which includes (but not limited to);
    - Oil and grease removal;
    - Locomotive cleaning; and
    - Wagon and locomotive repairs.
- Vehicles; and,
- Site based equipment including (but not limited to):
    - Wagon placement tractor;
    - Forklift;
    - Compressor;
    - Trucks; and
    - Quad bikes.

In assessing the impacts of the operational phase SLR considered emissions for particulates, nitrogen dioxide (NO_2), sulphur dioxide, carbon monoxide, air toxics and in all cases have determined that all emissions are within acceptable standards. In addition it was determined that it is reasonable to expect that dust deposition resulting from activities associated with the operation of the TSF will not have a significant impact on local amenity.

The incremental increases in 1-hour concentrations of NO_2 are the highest of the particulates considered. The maximum daily maximum 1-hour concentration of NO_2 was 79.0 □g/m^3. The annual average concentration was reported to be 33.6 □g/m^3 in 2011. Table 19 of the Air Quality Impact Assessment (Appendix Q) identifies results of dispersion modelling for Nitrogen Dioxide. As assessed in the Air Quality Impact Assessment, the maximum cumulative results of the dispersion modelling suggest that no exceedences of the relevant NSW EPA goals for ambient concentrations of NO_2 will occur at any of the sensitive receptors locations as a result of activities associated with the operation of the TSF.

Any future increase in train numbers will not be a result of the TSF. Increased train numbers will be a result of growth and expansion of coal mines and the coal industry.

9.15.3 Mitigation Measures

Construction Measures

The following procedures and requirements should be followed during the life of the project to minimise the impact of dust generated in association with the proposed development:

- Watering of roads and sealing of roads will be undertaken during construction;
- Watering of haul roads will be managed for dust suppression during the construction phase;
- Trucks entering and leaving the site should be well maintained in accordance with the manufacturer's specification to comply with all relevant regulations. Fines may be imposed on vehicles which do not comply with smoke emission standards. Truck movement should be controlled on site and restricted to designated roadways. Truck wheel washes or other dust removal procedures (including covering of loads) should be installed to minimise transport of dust offsite if necessary.

The following are general, basic procedures which are designed to control dust and other emissions from construction operations and onsite equipment. The aim of these procedures is to minimise offsite dust nuisance and air quality impacts.

- Activities carried out on site should be such as to ensure that all equipment used and all facilities erected are designed and operated to control the emission of smoke, dust, fume and other objectionable matter into the atmosphere;
- Precautions to be taken include spraying of earthworks, roads and other surfaces as necessary with water or other suitable liquids, providing dust suppression equipment to any onsite materials batching plant, sealing of temporary haul roads and the modification of operations during high or unfavourable wind conditions;
- Working areas and access roads should be stabilised as soon as practicable to prevent or minimise windblown dust;

- All disturbed areas should be stabilised as soon as practicable to prevent or minimise windblown dust;
- All unsealed trafficable areas should be kept sufficiently damp during working hours to minimise windblown traffic generated dust emissions. Continued use of water on dirt roads helps the formation of a crust so that dust is not as easily generated;
- Water sprays, sprinklers and water carts may be employed if needed to adequately dampen stockpiles, work areas and exposed soils to prevent the emissions of dust from the site. Water carts and other equipment will be available to enable watering at least at an hourly rate of 2 litres per square metre;
- Stockpiles and handling areas should be maintained in a condition which minimises windblown or traffic generated dust. Areas that may be inaccessible by water carts should be kept in a condition which minimises windblown or traffic generated dust using other means;
- All equipment for dust control will be kept in good condition. The equipment will be operable at all times with the exception of shutdowns required for maintenance. Construction equipment will be properly maintained to ensure exhaust emissions comply with relevant regulatory requirements;
- If visible smoke can be seen from any equipment (while working on a construction site) for longer than 10 seconds duration, the equipment should be taken out of service and adequately repaired or tuned so that smoke is no longer visible for periods longer than 10 seconds;
- Cleared vegetation, demolition, materials and other combustible waste material should not be burnt on site;
- Silt should be removed from behind filter fences and other erosion control structures on a regular basis, so that collected silt does not become a source of dust;
- No dust, soil or mud should be deposited from any vehicle on public roads. Where wheel washing facilities are provided on construction works area, all drivers of construction vehicles shall utilise the wheel wash prior to leaving the works area and entering public roads;
- Any dust soil or mud deposited on public roads by construction activities and vehicle movements should be removed immediately and disposed of appropriately; and
- Hire agreements should contain provisions to stand down equipment which has excessively smoky exhaust.

Operational Measures

Whilst it has been established that there are no significant air quality impacts from the operational phase the following measures will be adopted to further minimise the potential for impact:

- Minimise any non-essential idling of locomotives;
- Identify and expeditiously repair locomotives with excessive smoke;
- Incorporate the usage of low sulphur diesel fuel where available;
- Minimise fuel spillage; and
- Exhaust emissions associated with low exit velocities have the highest potential for adverse ground-level impacts.

Greenhouse Gas

The proposed TSF will result in a minor increase in the generation of GHGs as a result of operations within the facility, noting that the TSF is designed to service trains that are already on the network.

GHG will be generated for a short period during the construction phase and in general will be relatively insignificant.

A more detailed overview of the proposed development's impact on GHG emissions is outlined within Section 10.2 of this EA.

Construction Mitigation

The primary fuel source for the vehicles operating at the site during construction is diesel. For the purposes of this assessment, and due to the short term nature of construction, a quantitative analysis of GHG emissions from this source has not been conducted. However, the following practises will be adopted to assist in the reduction of GHG emissions during construction:

- Emissions from construction / transport vehicles and onsite machinery will apply with the relevant AS;
- All vehicles and machinery will be regularly maintained to ensure proper and efficient working order and therefore minimise emissions;
- Optimum vehicle / equipment tyre pressures will be maintained; and
- Construction and transport vehicles will be managed to reduce vehicle idling time onsite.

No electricity is proposed to be consumed as a result of the construction of the Train Servicing facility.

9.15.4 Conclusion

An air quality and GHG emissions assessment has been carried out to cover both the construction and operation phase of the proposed development. The proposal has been found to comply with relevant criteria and is predicted to not have an adverse impact on neighbours or the environment.

Dust generation during the construction phase has been identified as the primary source of possible impact and a range of mitigation measures have been proposed. Whilst the operational phase is within the acceptable criteria measures have nonetheless been proposed to further reduce the possibility of impacts.

The operation of the TSF will not generate any additional GHG. During the construction phase, relatively insignificant emissions will be generated for a short period and a number of mitigation measures will be implemented.

9.16 SOCIAL & ECONOMIC

ADW Johnson has been commissioned by QR National to conduct an Economic & Social Impact Assessment for the proposed QR National TSF. A full copy of the report is located at Appendix R.

9.16.1 Existing Environment

Community Profile

A community profile for the project was prepared based on the 2006 Australian Bureau of Statistics Australian Census. The Social and Economic Assessment used the most recently available National census data to undertake the assessment. There has since been the release of the preliminary 2011 census data in July 2012.

During the almost five years since the census there has been little change evidenced in the residential community of the local area. This is consistent with the pattern over the previous census period from 2001 – 2006 where the Hexham population increased by 1, from 148 to 149 persons. Discussions with Newcastle Council confirmed this, revealing that there had been no new housing construction approvals in the Hexham area since 2006.

In a broader sense, the areas to the North and South of Hexham have experienced growth in recent years. The surrounding suburbs of Fletcher and Maryland in the Newcastle LGA, and Thornton, Woodberry and Metford in Maitland LGA, are recognised as strong first and second home buyer areas witnessing growth. The Maitland LGA has experienced in the order of 2.3% growth in population between 2005 and 2010. Projections in the 2011 Maitland Urban Settlement Strategy indicate medium growth forecasts of 2% pa.

Age Profile

Table 42 below displays the number of people in each of the populations within the various age brackets. This data shows the significant differences in populations between the regions, particularly establishing Hexham's small population, contrasted with the large surrounding populations located to the north and south of the site.

Table 42: Age Profile

Age (years)	Surrounding Northern Suburbs	Surrounding Southern Suburbs	Hexham	Newcastle LGA	NSW
0-4	1,344	1,129	*6*	*8,261*	*420,431*
5-9	1,365	1,191	*7*	*7,982*	*431,924*
10-14	1,385	1,223	*19*	*8,076*	*446,561*
15-19	1,253	1,360	*13*	*9,320*	*439,862*
20-24	1,079	1,298	*10*	*12,436*	*431,854*
25-29	1,032	936	*17*	*10,155*	*424,154*
30-34	1,261	1,137	*0*	*9,960*	*466,891*
35-39	1,279	1,161	*0*	*9,608*	*474,684*
40-44	1,271	1,170	*13*	*9,802*	*483,159*
45-49	1,226	1,012	*15*	*9,954*	*475,233*
50-54	1,090	962	*14*	*9,164*	*429,103*
55-59	1,020	809	*14*	*8,125*	*401,921*
60-64	792	599	*6*	*6,498*	*317,625*
65-69	610	440	*0*	*5,353*	*254,424*
70-74	421	380	*0*	*4,831*	*210,901*
75-79	288	298	*5*	*4,859*	*188,091*
80-84	197	232	10	4,103	140,704
85-89	85	123	0	2,178	74,527
90-94	25	40	0	868	29,465
95-99	5	15	0	181	6,606
100+	0	0	0	39	1,057
Total	**17,028**	**15,515**	**149**	**141,753**	**6,549,177**

Figure 35 below shows the proportion of each of the subject populations within the various age brackets. With the exception of Hexham, each population area has a similar age profile from the 30 - 34 years age group onwards. However, within the younger 0 - 29 year age groups, deviations exist between the populations, revealing interesting characteristics of the local populations. Most notably, both 'Surrounding Northern Suburbs' and 'Surrounding Southern Suburbs' maintain a higher population percentage within the 0-19 years age group, than both Newcastle LGA and NSW as a whole.

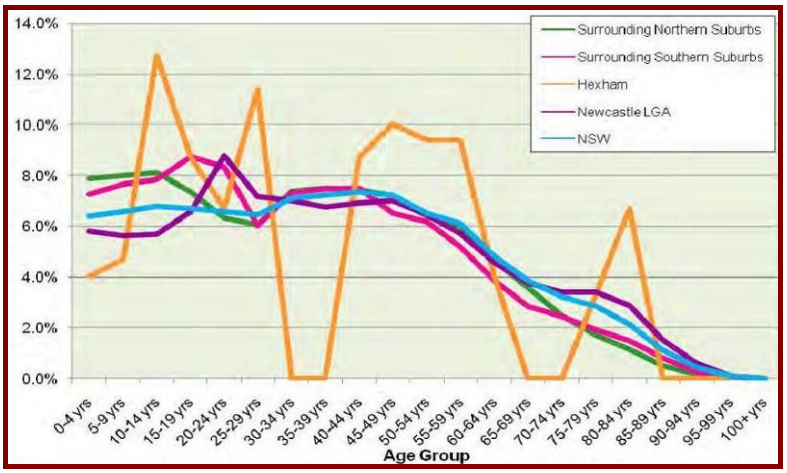

Figure 35: Comparative Age Profile.

The most notable departure from the NSW profile in the older age groups is from 56+ years, where the 'Surrounding Northern and Southern Suburbs' exhibits a smaller population, corresponding to its larger young populations. This is reflective of the local region's recent population increase (discussed in Table 43 below), consisting mainly of working households and families, rather than retirees and pensioners.

Figure 35 above displays high volatility for Hexham, due to its low population total of 149 persons. It can be stated that Hexham's population predominantly falls within the 10 - 29 years, 40 - 59 years and 75 - 84 years age groups.

Table 43 below displays the comparative age profiles of the selected populations for 2001 and 2006. Consistently, all populations have experienced an overall increase. Most notably however, Hexham and its 'surrounding northern and southern suburbs' are shown to have experienced population increases, reflecting the area's strong growth over recent years. The growth of these areas supports the justification for increased infrastructure and employment opportunities within the local area.

Table 43: Comparative 2001 & 2006 Age Profile.

	Surrounding Northern Suburbs		Surrounding Southern Suburbs		Hexham		Newcastle LGA		NSW	
Age (years)	2001	2006	2001	2006	2001	2006	2001	2006	2001	2006
0-4	*	1,344	1,137	1,129	*	*6*	*8,108*	*8,261*	*422,341*	*420,431*
5-9	*	1,365	1,232	1,191	*	*7*	*8,114*	*7,982*	*445,983*	*431,924*
10-14	*	1,385	1,151	1,223	*	*19*	*8,153*	*8,076*	*445,026*	*446,561*
15-19	*	1,253	1,348	1,360	*	*13*	*9,265*	*9,320*	*436,626*	*439,862*
20-24	*	1,079	1,210	1,298	*	*10*	*11,380*	*12,436*	*408,719*	*431,854*
25-29	*	1,032	1,041	936	*	*17*	*10,197*	*10,155*	*446,515*	*424,154*
30-34	*	1,261	1,154	1,137	*	*0*	*9,876*	*9,960*	*468,524*	*466,891*
35-39	*	1,279	1,137	1,161	*	*0*	*9,879*	*9,608*	*483,003*	*474,684*
40-44	*	1,271	1,075	1,170	*	*13*	*9,801*	*9,802*	*482,318*	*483,159*
45-49	*	1,226	974	1,012	*	*15*	*8,999*	*9,954*	*438,277*	*475,233*
50-54	*	1,090	830	962	*	*14*	*8,242*	*9,164*	*412,967*	*429,103*
55-59	*	1,020	634	809	*	*14*	*6,656*	*8,125*	*325,330*	*401,921*
60-64	*	792	421	599	*	*6*	*5,507*	*6,498*	*267,064*	*317,625*
65-69	*	610	416	440	*	*0*	*5,044*	*5,353*	*228,029*	*254,424*
70-74	*	421	403	380	*	*0*	*5,590*	*4,831*	*217,237*	*210,901*
75-79	*	288	305	298	*	*5*	*5,241*	*4,859*	*177,684*	*188,091*
80-84	*	197	211	232	*	10	3,503	4,103	114,764	140,704
85-89	*	85	104	123	*	0	2,024	2,178	61,490	74,527
90-94	*	25	37	40	*	0	638	868	22,667	29,465
95-99	*	5	9	15	*	0	178	181	5,778	6,606
Indigenous										1,057
Total										**6,549,177**

Labour Force Summary

The second release of 2006 Census data provides extensive data relating to the labour force of study populations including basic labour force performance, industry of employment and occupation of employment. The 2006 Census data for NSW captures the dramatic improvements which have occurred across many areas of the labour market over the previous 5 years. The basic labour force characteristics are shown in Table 44 below. In 2006, across NSW, the unemployment rate had fallen to 5.9%, which is down from 7.2% as at the 2001 Census.

Direct comparisons from 2001-2006 for the other populations is difficult, due to the fact that community profiles were not compiled for "Hexham State Suburb" and the state suburbs which create the 'Surrounding Northern Suburbs' for the 2001 Census. However, 2001 unemployment figures for Newcastle LGA and each of the state suburbs included in the 'Surrounding Southern Suburbs' region were all higher than their comparative 2006 unemployment rates (with the exception of Fletcher which maintained its 2001 rate). These were: Newcastle LGA: 11.1%, Surrounding Southern Suburbs: 10.4%.

More recently, unemployment information released for the September Quarter 2007, reflects the ABS data which shows a pattern of decreasing unemployment figures and rates. The Statistical Local Areas of Newcastle (Inner and Remainder), displayed in Table 44 below reveal an ongoing steady decline in unemployment numbers and rates over the past year from September 2006 to September 2007.

Table 44: Newcastle Unemployment; September Quarter 2007.

	Unemployment					Unemployment Rate (%)					Labour Force
Statistical	Sep	Dec	Mar	Jun	Sep	Sep	Dec	Mar	Jun	Sep	Sep
Local Area	2006	2006	2007	2007	2007	2006	2006	2007	2007	2007	2007
Newcastle - Inner	266	264	240	218	194	9.4	9.4	8.6	7.9	7.1	2,744
Newcastle - Remainder	4,606	4,602	4,273	3,919	3,525	6.3	6.4	6	5.6	5	70,496

Below shows the labour force participation rate across the subject populations. Surrounding northern suburbs (such as Beresfield, Tarro, Thornton, Woodberry and Millers Forrest) enjoy a higher participation rate than NSW. The unemployment rate across all local and regional profiles, are higher than the NSW unemployment rate. This gap supports the need for increased employment opportunities throughout the region, which could subsequently be created through the proposed QR National development.

Table 45: Labour Force Characteristics ABS 2006.

	Surrounding Northern Suburbs	Surrounding Southern Suburbs	Hexham	Newcastle LGA	NSW
Persons aged 15 years and over	12,943	11,978	123	117,434	5,250,259
Labour force status:					
Employed, worked full-time	4,721	4,139	38	37,989	1,879,628
Employed, worked part-time	2,341	2,303	16	20,373	842,715
Employed, away from work	515	498	3	4,066	187,104
Unemployed, looking for work	532	469	10	4,889	183,157
Total labour force	*8,109*	*7,409*	*67*	*67,317*	*3,092,604*
Not in the labour force	4,263	4,082	52	43,000	1,801,010
% Unemployment	6.6	6.3	14.9	7.3	5.9
% Labour force participation	61.6	58.2	54.9	57.3	58.9

Economic Overview and Context of TSF Project

In 2007 ARTC, having secured a 60 year lease on NSW and interstate rail lines, produced the Hunter Valley Coal 2007-2012 Capacity Strategy. This was the basis for its investment over the next 5 years.

The Hunter Valley Coal 2007-2012 Capacity Strategy identified the following problems to be resolved:

- Bottlenecks, junction conflicts and reduced headways;
- Conflicts between maintenance and train running;
- Limited capacity (single track sections, wagon capacity, train length limitations);
- Inadequacies in maintenance sidings; and
- The demands of rapid growth.

In 2007 the Hunter rail network had capacity for 85 million tonnes per annum (mtpa) of coal, and growth in demand was predicted to reach up to 177mtpa of coal in 2012.

At that time the need for strategies to increase the network's efficiency, capacity and reliability where in clear focus and the QR National proposal was assessed as being in logical support and continuity with ARTC plans.

QR National's proposal is considered consistent with and supportive of the Hunter Valley Coal Capacity Strategy. The proposed development complements the ARTC's plans to relocate all train maintenance and servicing activities out of the Terminals. QR National's proposal will assist to alleviate congestion at the Terminals and enhance the capacity of the Hunter Valley's rail network.

The ARTC reports annually on its priorities, progress and projects in terms of improving the overall efficiency and effectiveness of the network. The 2011-2020 ARTC report continued to provide the context and in-principle support for the QR National project. The report states "For much of the period since the first strategy, the infrastructure solutions have been comparatively straightforward. The rapid growth in demand meant that the primary focus was on delivery of projects to meet the growth. ARTC believes that it has now reached the point where its ability to deliver projects is comfortably ahead of demand and it is increasingly focussed on optimising the management of the delivery program." It further states that they are turning their attention to examining congestion and disruption planning as the network gets increasingly busier. They confirm there is a need to not only optimize capacity but to optimize operational efficiency. They confirm that relocation of fuelling and other provisioning and inspection activities away from the terminal at Kooragang has long been considered the best solution in this regard.

The report explains that PWCS Kooragang Island facility has six departure roads for its three dump stations, but only one arrival road for each dump station. As a result, trains need to queue on the Mainline before being called forward into the arrival road as the preceding train moves through the dump station. The other critical issue at PWCS Kooragang Island is the use of the departure roads for stabling trains while locomotives are serviced and fuelled and trains are examined, and for holding trains where there is a time delay before their next run. PWCS Kooragang Island plan to increase capacity up to the order of 105mtpa with the construction of a fourth dump station on the existing PWCS Kooragang Island loop. Development of dump station four will exacerbate the existing problems, and poses significant issues in terms of providing adequate and suitably configured arrival and departure capacity. There is concern over congestion issues arising from growth, given the limited availability of arrival roads and the use of the Mainline for queuing which underscores the growing system capacity loss as a result of congestion.

Economic Context

Continuing strong world demand for coal is encouraging major investment across the entire HVCC; this includes the establishment of new mines, increasing investment in the rail system, and initiatives to increase the coal export capacity of the Port. Several major new coal projects and expansions to existing projects have been precipitated by high coal prices and strong demand. The combination of high output from existing mines, the coming online of new mines and extensions to the capacity of existing mines, is set to significantly increase the supply of coal eligible for transport to the Port.

When the QR National TSF project was originally conceived in 2007/8 the ARTC (2007- 12) had identified expenditure of $918.2m over the next five years. This was in addition to $71.1m identified for "minor upgrades" and $156.4m identified for major periodic maintenance/renewal.

The updated 5 year expenditure forecast from 2011-2015 of $854.8m is significantly less than that of previous years. This is due to some major projects being completed, the industry decision to not pursue a multi-user provisioning facility, and lower cost solutions for Nundah Bank and the Liverpool Ranges being identified. The Report in no way indicated a weakening of the coal export market or growth of mining in the region.

However, there may be some confusion around this issue. The ARTC's forecasts of industry demand for export coal capacity from the Hunter Valley identified a decline in demand from 2007 to 2011.

- 2007 Report 2012 demand projection 170mtpa;
- 2009 Report 2012 demand projection 190mtpa;
- 2011 Report 2012 demand projection 163mtpa.

The decline in export coal capacity demand was due to changes in the forecasting methodology. The ARTC Bi-annual Reporting of coal transport demand is now separated based on those estimates which are subject to an indicative contractual nomination and those that are prospective volumes in the planning stage. The 2011 Report has indicative contractual nominations reported, whilst prospective volumes are excluded.

The Annual reports of the Newcastle Port Corporation provide evidence of the strength and growth of the Hunter coal mining industry. In the period from 2006-2007 to 2010-2011 coal shipped through the Newcastle Port had increased from 80.77 million tonnes to 108.26 million tonnes – an increase of 34%. In terms of export value, coal trade was estimated at $5.7b in 2006-2007, increasing to $13.55b in 2010-2011, representing an increase of 138% or an average annual increase of 34%.

The Newcastle Port Corporation anticipated that by 2012 the Port will have a loading capacity of 123.6 million tonnes of coal. Furthermore, export coal supply has the potential to reach 275Mtpa between 2017 and 2025. The Newcastle Port Corporation assert the most significant component to expanding coal chain capacity will be sufficient below rail capacity along with support infrastructure to park, refuel and maintain trains.

Context in the Port of Newcastle

Stage 1 of the NCIG Terminal was completed in May 2010 with a capacity to handle 30Mtpa. As at October 2011, NCIG had loaded 20mtpa onto 300 ships. Output through NCIG has already approached loading capacity. Stage 2AA commenced construction in August 2010 and is expected to have a loading capacity of 53Mtpa when completed.

PWCS is pursuing the development of Terminal 4 (T4) to ensure they maintain the Capacity Framework Arrangements which supports the long term infrastructure for the HVCC. T4 is expected to have a maximum capacity of 70Mtpa in Stage 1, 95Mtpa in Stage 2 and 120mtpa when completed. The project has a 10 year time frame with target commencement in 2013.

The Newcastle Port Corporation has graphed the projected coal export capacity (Figure 36) which is expected to grow at 6% per annum.

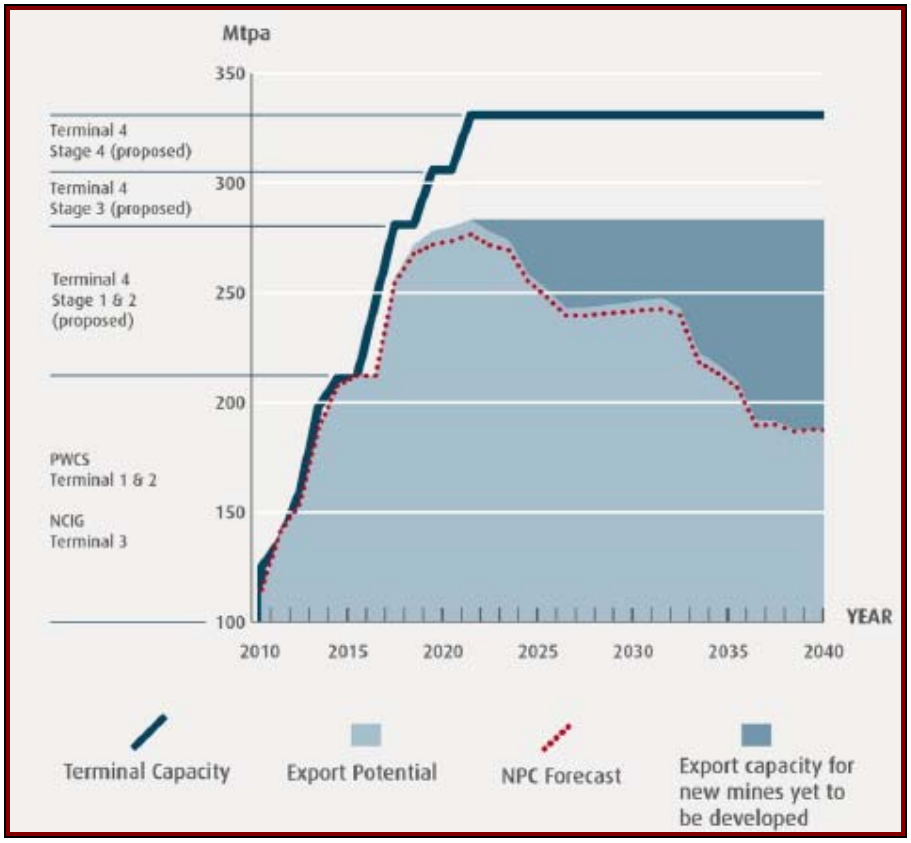

Figure 36: Port Export Capacities.

Global energy consumption is forecast to grow at 53% between 2008 and 2035. Coal will continue to provide a significant proportion of energy needs. Australia is expected to produce 31% of OECD coal production and 7% of total world production by 2035.

In summary there is considerable evidence that HVCC infrastructure needs to be aligned to the future demand for export coal. This is already being addressed by stakeholders who are already undertaking and proposing significant infrastructure investment.

9.16.2 Impact Assessment

Location Considerations

Assessments over the last five years have confirmed the suitability and capability of the Hexham site for the TSF. These locational considerations include:

- The availability of level land immediately adjacent to the existing rail line;
- The ability to keep wagons attached to locomotives during servicing avoiding cost and delays;
- The dimensions of the site to accommodate existing and future train lengths;
- Appropriate industrial zoning and history of industrial/coal related uses;
- The potential for minimal environmental and community conflicts associated with the site;
- The availability of a large scale property in single ownership;

- The adequate depth of the site from the rail line to accommodate the most efficient servicing of rail fleet;
- The ability to amalgamate like and related uses and develop synergistic relationships and activities; and
- The site's close access to a trained and skilled labour force.

Economic Advantages

The opening up of the coal haulage market to competition is the principal benefit of the QR National proposal. The establishment of a TSF will improve QR National's competitiveness by reducing costs, minimising off track time, and improving reliability. This in turn would work to drive down haulage prices. Further, improved efficiency and more competitive pricing would result from becoming self-sufficient, rather than relying on third party facilities and suppliers.

From a broader system perspective, there is a very real need to maximise existing rail network utilisation to support increased capacity of the system and access to the port. Projects such as the QR National TSF have been widely recognised as part of a wider strategy to improve coal chain efficiencies and to ensure continued business viability and market growth.

The proposed TSF aims to improve the efficiency of train time-tabling, maximise haulage time, reduce down time and improve reliability. All these variables will combine to improve competitiveness and at the same time reduce haulage costs which underpin the international competitiveness of the industry.

One of the most significant benefits of the QR National proposal will be the freeing up of land at the Port which is currently used for train servicing. This will enable Kooragang Island to be used for more specific port related functions, thus improving the capacity and efficiency of the existing port facilities.

Employment Considerations

The employment considerations associated with the TSF include the following benefits:

- Ongoing full time equivalent employment of approx. 30 persons;
- Building on and expanding the regions long history and skill base in the rail support sector;
- Skills retention and development;
- Construction employment of up to 20 months of 100 FTE workers; and
- Flow on and multiplier benefits of both the operation of the facility and from increasing the coal chain's overall export capacity.

The most immediate impact will come from the construction phase. Construction investment includes employment and payment of wages, the purchase of construction materials and products. This results in induced consumption and production impacts in the economy. The multiplier effects have been estimated using ABS and Australian National Accounts: Input-Output Tables 1996-97 (ABS Catalogue 5209.0). Tables 46 and 47 identify first round effects, industrial support effects and consumption induced multiplier effects at rates of $0.466, $0.438 and $0.962 respectively to every dollar of construction.

Table 46: Construction Multiplier Effect on Employment - $130m Capital Investment.

Train Support Facility	Effects Direct	Production Induced Effects		Consumption Induced Effects	Total
		First Round Effects	Industrial Support Effects		
Multipliers	1	.33	.45	2.33	4.11
Employment No. per $million	5.59	1.84	2.52	13.02	22.97
Total job years created	727	239	328	1,693	2,986

The proposed development will generate 839 job years directly during construction, with a further 567 to 1,693 positions created from production and consumption induced effects. Therefore, based on an initial construction cost estimate of $130m, the proposed development will generate 2,986 job years in the economy.

Table 47: Contribution to the Economy from Construction of TSF.

Train Support Facility	Direct Effects	Production Induced Effects		Consumption Induced Effects	Total
		First Round Effects	Industrial Support Effects		
Output multipliers	1	0.466	0.438	0.962	2.866
Output ($millions)	$130m	$61m	$57m	$125m	$373m

The multipliers presented above indicate a construction project costing $130m could result in a positive wider multiplier effect factor of 2.86. This is derived from the combined benefit from production induced effects and consumption induced effects. However, it is important to note that multiplier effects tend to impact at a national level and do not necessarily have a local level impact. At this stage of the project, state or local level impacts cannot be precisely quantified because the factors that feed into the assessment of multipliers (such as the origin of materials and construction contracts) have not been determined.

The ABS notes that "Care is needed in interpreting multiplier effects; their theoretical basis produces estimates which somewhat overstate the actual impacts in terms of output and employment. Nevertheless, the estimates illustrate the high flow-on effects of construction activity to the rest of the economy. Clearly, through its multipliers, construction activity has a high impact on the economy."

While the specific direct and indirect employment and economic impacts of the TSF construction are considerable, it is the continuous underpinning and strengthening of the foundations and efficiencies of the coal chain that will secure employment and economic benefits to the region in the longer term.

The ongoing operation of the facility will also have multiplier effects as a result of the payment of wages and from employee's subsequent spending patterns in the local and surrounding economy. As a result, the project will contribute to the New South Wales economy. Table 48 shows the likely contribution of the project to NSW Gross Domestic Product (GDP).

Table 48: Contribution to NSW Gross Domestic Product of TSF.

Effects Direct Production Induced Effects	Consumption Induced Effects Total
	Value
Total Workers (Industrial/Other)	30
Average Salary #	$60,000
Total Wages	$1,800,000
Initial Income Multiplier	2.72
Imputed Turnover (actual + initial multiplier)	$6,700,000
Weighted Avg Direct Value Added Multiplier	0.3333
Direct Value Added	$2,200,000
Direct and Flow-on Value Added PER ANNUM	$8,900,000

Estimated average earnings based on comparative projects, 2006 ABS average weekly earnings for Transport and Storage sector.

The above table indicates that the direct contribution and multiplier (flow on) contribution of workers during the operation of the TSF is expected to result in an annual contribution to the NSW GDP of $8.9m.

Impact Analysis

There will be two levels of impact: firstly, impacts on the neighbouring and adjoining communities and environment; and secondly impacts on the much wider regional community and economy. As is typical, the negative effects are mostly associated with the near neighbour community and the significant positive benefits will flow to the wider regional and state communities.

Potential positive socio-economic impacts include:

- Employment generation associated with the construction and subsequent operation of the TSF;
- Increased efficiency and cost competitiveness in the coal haulage network;
- Enhanced capacity of the coal rail network;
- Increased ability to deliver growth in coal volumes to the Port and subsequent increases in exports;
- Increased capacity of the rail system without increasing the number of tracks through large built up residential communities;
- Development of employment opportunities that build on the region's core competencies and workforce skills and training facilities;
- Freeing up of land within proximity of the Port itself for high value port related activities;
- Multiplier effects associated with increased employment and regional spending; and
- Implementation of strategic planning frameworks which underpin other community and economic objectives for the region.

Potential negative socio-economic impacts include:

- A potential adverse impact on lands of environmental importance both on site and in the adjacent Hexham Swamp; and
- Potential deterioration of the living amenity of near neighbours including visual, traffic and acoustic impacts principally during construction.

It is considered that the potential positive socio-economic impacts outweigh any potential negative impacts on near neighbours. Further that these potential negative impacts can to a significant extent be mitigated with good design, preparation and planning.

To the extent that environmental issues (which are the subject of separate independent reports) also have a socio-economic impact, it is considered that while onsite environmental impacts require the employment mitigation strategies, any potential adverse impacts can be mitigated and managed via approvals conditioning.

This development will represent a strong net socio-economic benefit for the local, regional and national communities.

It is, however, important to appropriately acknowledge and make the distinction between local impacts and wider impacts. It is considered that while potential negative impacts are generally of lower importance or degree, there is a responsibility for QR National to ensure good communications, planning and monitoring to mitigate the local impacts as much as is possible.

9.16.3 Mitigation Measures

The following mitigation measures will be implemented to enhance positive impacts and mitigate negative impacts of the proposed development.

- Adopt recommendations from other expert consultant's reports to enhance amenity and site accessibility, and minimise environmental impacts.
- Develop a 'Near Neighbour Consultation Strategy' for ongoing proactive engagement and communication with surrounding and adjoining residents. Within this strategy, develop and implement policies which aim to increase project knowledge and develop community-staff relations.
- Conduct an open day during the public exhibition period to show and explain the project to interested community members and have technical staff in attendance to answer questions and provide explanations.
- Use existing social structures and venues such as Hexham Bowling Club to disseminate information and receive input.
- Establish an email address for business and community stakeholders to forward questions and make comment during the exhibition of the project proposal.
- Employ ongoing monitoring procedures, including air quality, acoustic and environmental. Incorporate acoustic, pollution and visual mitigation strategies wherever necessary and/or possible throughout the construction and operation phases. Provide open reporting to the community via newsletters.
- Provide local residents, near neighbours and key community stakeholder groups with an information package at the open day on request via email. This could include a finalised site plan, flood management plan, traffic and onsite route overview, timeline

for staged development as well as an artist's impression of the proposed development. This will assist in mitigating community concerns and answer key questions that have been publicly raised.

- Wherever possible utilise regional businesses, resources and materials for construction and operations.
- Where possible promote the employment of local and regional workers to retain and develop the local skills-base.
- Security, design and protocols should ensure the general public do not access the TSF site.
- All safety requirements under WHS guidelines should be employed during design, construction and operational phases.
- Keep near neighbours informed of decisions regarding access arrangements to the development site, any transport arrangements during construction or any one off events that might impact on them.
- Maintain open and direct communications with ARTC and the HVCCC to ensure that potential benefits of the project are maximised and negative impacts minimised; and that as much as possible synergies between the two projects are realised to the widest benefit.
- Ensure clear and appropriate information is provided to key stakeholders regarding regional transport planning.
- Related planning and housing agencies and organisations should be provided with early and adequate information regarding the employment and housing demands of the project to best manage supply issues.

9.16.4 Conclusion

An Economic and Social Impact Assessment has been undertaken in relation to the proposed QR National TSF. Subject to implementation of the above mitigation measures, it has been found that the proposed development will represent a strong net socio-economic benefit for the local, regional and national communities.

9.17 WASTE MANAGEMENT

9.17.1 Existing Environment

The site is partly vacant and filled industrial land, part agriculture and grazing and part used for effluent disposal by the Brancourts' facility. No construction or industrial waste is currently generated on the site.

9.17.2 Impact Assessment

The *NSW Waste and Resource Recovery Strategy 2007* (NSW WARR) aims to maximise the conservation of natural resources and to minimise environmental harm from waste management and disposal of waste.

Inadequate collection, storage and disposal of waste generated during construction and operational activities may have the potential to pollute the surrounding environment, including soil and water.

Relevant waste reduction principles under the NSW WARR are:

- Preventing and avoiding waste;
- Increased recovery and use of secondary materials;
- Reducing toxic substances in products and materials; and
- Reduce litter and illegal dumping.

Waste Generation

Waste would be generated during construction and operation of the proposed TSF.

Potentially waste generating activities would include excavation, construction of buildings, laying hardstands, road and rail infrastructure works, drainage works and equipment operation and maintenance.

Construction Waste

Preparation and excavation works can generate wastes such as spoil, concrete and building rubble which are classified as General Solid Waste (Non-Putrescible) under DECCW's *Waste Classification Guidelines*.

There is the potential for contaminated fill on former industrial areas to be exposed during site excavation works but it will be retained and managed on site.

Construction activities are likely to produce various waste types, including building rubble, concrete, scrap metal, steel, scrap wood and packaging materials. These waste types are classified as General Solid Waste (Non-Putrescibles) under DECCW's *Waste Classification Guidelines*.

The operation and maintenance of construction equipment is expected to produce small quantities of spent solvents, empty containers, used oil, batteries, lighting equipment and engine oil which would be classified as Hazardous Waste under DECCW's *Waste Classification Guidelines*. Construction site office-related activities are likely to generate wastes such as cardboard, paper, plastic and glass.

Operational Waste

Waste types likely to be generated during operation of the TSF include cardboard, paper, plastic, glass, used cartridges, food/organic waste, vegetation/green waste, machinery parts, scrap metal, oils, used rags, spent solvents, empty paint cans, chemical containers, used lubricating oil, batteries, lighting equipment and engine oil.

Office activities during operation are expected to produce cardboard, paper, plastic, glass and used cartridges which are classified as General Solid Waste (Non-Putrescibles) under DECCW's *Waste Classification Guidelines*. Site personnel would also generate food/organic waste which is classified as General Solid Waste (Putrescibles) under DECCW's *Waste Classification Guidelines*.

9.17.3 Mitigation Measures

Construction Waste Management

A Construction Waste Management Plan (CWMP) would be prepared prior to the commencement of construction on the site. The CWMP would form part of the CEMP. These plans would address appropriate waste identification, handling, storage and disposal in accordance with the DECCW Guidelines. The different waste streams would be stored separately, collected and disposed of by licensed waste contractors.

The objective of the CWMP is to minimise waste generation by contractors during construction of the Project and by the operator during the life of the project. The specific objectives of the plan are:

- Identification of the types of waste likely to be generated during construction;
- Appropriate storage of waste on site;
- Measures to minimise the amount of waste produced;
- Measures to increase the potential for waste to be re-used and recycled;
- Appropriate methods to assess if waste can be re-used, recycled or disposed to landfill; and
- Maintaining records of waste re-use, recycling and/or disposal.

Construction activities would be carried out as detailed in the CWMP and CEMP to minimise the potential for exposure to contaminated soils. Storage of hazardous waste would prevent or control accidental releases to the air, soil and water resources of the area. Storage provisions would include:

- Adequately sized and organised storage areas including physical separation such as walls or containment bunds as necessary;
- Protection from weather and sunlight:
- Secondary containment systems to prevent loss to the environment;
- Secondary containment being at least 110% of the largest storage container, or 25% of the total storage capacity (whichever is greater) for liquid hazardous waste; and
- Adequate ventilation where volatile wastes are stored.

Hazardous waste storage activities would be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes. Management actions would include:

- Provision of readily available information on chemical compatibility to employees, including labelling each container to identify its contents;
- Limiting access to hazardous waste storage areas to employees who have received proper training;
- Clearly identifying (label) and demarcating the area, including documentation of its location on a facility map or site plan;

- Conducting periodic inspections of waste storage areas and documenting the findings; and
- Preparing and implementing spill response and emergency plans to address their accidental release.

Operational Waste Management

An operational WMP will be required to address the ongoing handling, storage and disposal of waste. Licensed waste contractors would be made responsible for collection and appropriate disposal of waste.

General waste (putrescibles and non-putrescibles) generated during the operation of the proposed TSF would be stored, reused, recycled or disposed of in the same manner as described for construction waste above.

Hazardous waste management requirements would be as outlined in the construction waste management section above.

Identification of the waste handling strategy is detailed in Table 49 below.

Table 49: Waste Handling Strategy.

Proposed Waste Handling Strategies		
Waste	**Storage Location**	**Disposal Method**
Timber (pallets, wood blocks)	Collected in recycling area.	Remove off site or wood chip for reuse on landscaped areas.
Oiled rags	Collected in dedicated identified bins within the workshops.	Removed by licensed contractor as trade waste.
Coolant	Circulated to waste coolant collection tank after a number of reuses.	Removed by a licensed contractor to an approved facility as trade waste.
Paper	Collected in various recycling areas around the site.	Removed from site by a waste recycling contractor.
Cardboard	Collected in various recycling areas around the site.	Removed from site by a waste recycling contractor.
Scrap metals /Aluminium	Collected in dedicated recycling bins within the workshops.	Removed from site by a waste metal recycling contractor.
Contaminated oily sand	Stored in an impervious concrete bunker.	Potential for insitu treatment within concrete bunker to be later reused on site for landscaping.
Cleaning rags	General waste bins.	Normal waste removal or removed as Trade Waste, depending on the quantity produced.
Waste oil	Circulated to waste oil collection tank.	Removed by a licensed contractor to an approved facility for recycling.
Oil filters	Collected in waste oil area, then drained.	Oil is drained before removal by licensed contractor as trade waste.
Used batteries	Self-bunded pallet storage in store.	Removed by a licensed contractor to an approved facility for recycling.
General waste	General waste bins	Normal rubbish removal
Paint	Small quantity of tinned paint for touch ups. Held in the store.	Pour liquid paint into sand and allow to set. Dispose of into an industrial waste bin. Removed by a licensed contractor as trade waste.
Plastic wrap	General waste bins.	Normal rubbish removal.
Food waste	General waste bins or in-situ compost bin.	Normal rubbish removal or reuse on landscaped areas.
Air conditioning gas	Recovered using approved A/C equipment stored with empty gas cylinders.	Exchanged with licensed contractor.
Glass	Collected in dedicated recycling bins.	Removed by municipal contractor to municipal recycling centre.
Chemical solutions e.g. chlorates, surfactants, resins, glues	Designated chemical storage area within the store.	Removed by a licensed contractor to an approved facility as trade waste.
Oil/grease from separator	Storage tank adjacent equipment.	Removed by a licensed contractor to an approved facility as trade waste.
Clinical waste	Minimal requirement. Will have "sharps" disposal containers and waste bin in first aid room.	Removed by a licensed contractor to an approved facility as trade waste.
Electrical waste	Old computer equipment etc. held in store.	Removed to municipal recycling centre.
Residue from industrial waste treatment or disposal	Storage tank/bin adjacent equipment.	Removed by licensed contractor to an approved facility as trade waste.
Sewage sludge	Tank storage incorporated within package plant.	Removed by a licensed contractor to an approved facility as trade waste.

Transportation of Waste

Transportation of waste would be conducted so as to prevent or minimise spills, releases, and exposures to employees and the public. Specific procedures for waste transport would be included in the WMP.

Monitoring

Waste management would include regular monitoring as detailed in the WMP and include:

- Regular inspection of all waste storage collection and storage areas;
- Verification that wastes are properly labelled and stored;
- A detailed record keeping system;
- Checking of trains, bins and systems documentation; and
- Regular audits.

9.17.4 Conclusion

A range of waste types and quantities will be generated during construction and operation.

Avoidance and management measures would be required in order to prevent potential environmental harm from waste.

Waste will be minimised and managed for reuse onsite where possible and recycling where not. Hazardous waste would be subject to strict storage procedures and would be disposed of via a licensed contractor to approved sites.

A WMP would be required to provide a framework for sound waste management for all project stages and will form part of the CEMP and the OEMP. These documents will ensure that waste is managed in accordance with relevant statutory and policy requirements and that the potential for environmental harm is minimised and all relevant risks have been reduced to acceptable levels.

9.18 VISUAL

9.18.1 Existing Environment

The subject site lies at a low elevation and is of flat topography. Contextually, the site is surrounded by the following land uses (Figure 37):

- The New England Highway to the north and east;
- The Great Northern Rail Line to the north and east;
- The Hexham industrial area to the east and south east. The Hexham rail station is also located within this area;
- The Hunter River is located east of the New England Highway and the Hexham industrial lands;

- Hexham Swamp to the south west; and
- Rural lands to the south and west.

The project area is generally cleared and disturbed. Exotic grassland is the dominant vegetation type. The site displays a semi-rural character with minimal tree cover.

The site is not located in a prominent position or within an important view corridor and public views to the much of the site are screened by an existing row of trees along the western side of Maitland Road (New England Highway) and industrial land to the east of the site (Brancourts facility). Views into the site from the north are limited for passing motorists using the New England Highway.

The site is considered to have a low scenic amenity.

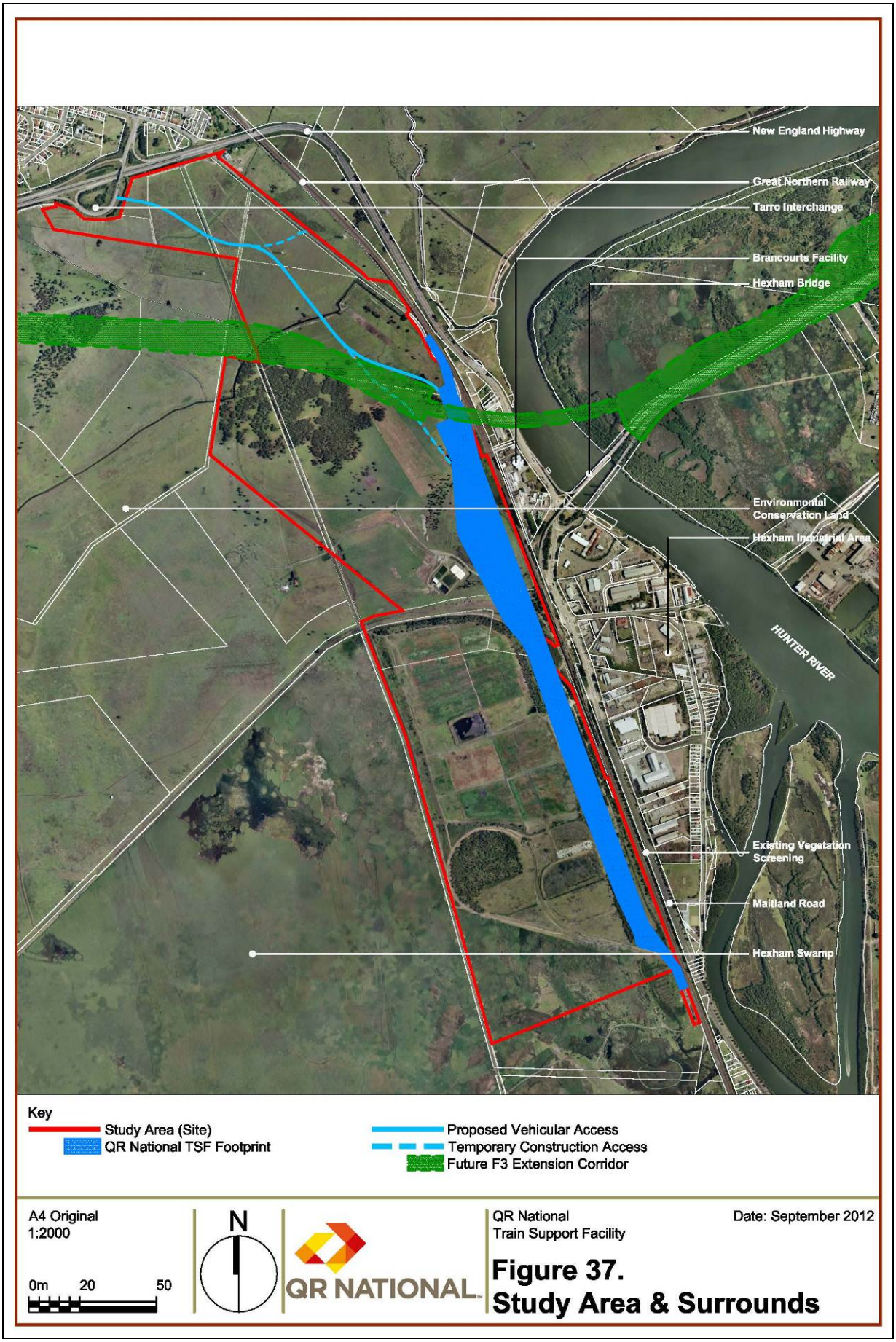

Figure 37: Study Area & Surrounds.

9.18.2 Impact Assessment

The proposed built form on the site does not comprise any tall buildings. The buildings proposed within the TSF are of approximately two storey height. Buildings of this height will not be visually prominent based on the reasons outlined above. The proposal will have no adverse visual impacts.

9.18.3 Mitigation Measures

The following mitigation measures are recommended:

- Following construction, consideration will be given to landscaping treatment throughout the developed area of the site. Appropriate locations will be determined based on environmental, operational and safety considerations; and
- Buildings will be constructed of low reflective materials and colours will be of earth tones.

9.18.4 Conclusion

The subject site is considered to be of low scenic value and is not located within any prominent public view corridor. The site location, topography, existing screening, proposed low level building heights and intended use of low reflective materials will ensure that the TSF has no adverse visual impact.

Figure 6 in Section 6 identifies a visual perspective of the building and track layout of the proposed facility.

9.19 CUMULATIVE IMPACTS

The potential cumulative impacts of the proposal have been assessed. There are both existing and proposed developments in the area sensitive to cumulative effects. The proposed project is likely to be fully operational by 2016. This assessment addresses cumulative impacts likely to arise from the combination of existing development and other recently approved projects.

9.19.1 The Cumulative Impact Context

The proposal is an extension of the NSW rail network capacity and the coal production and transport network of the Hunter region. The cumulative impacts of the proposal sit in the broader context of a more efficient rail network.

The specific context is the site, adjoining development, adjoining infrastructure, the local natural environment and the community.

9.19.2 Future Development Proposals

Future infrastructure development in the vicinity of the site includes:

- An extension of the F3 Freeway will cross the land to the north of the TSF site;
- ARTC are seeking approval for additional tracks in the rail corridor immediately to the east of the site.
- The conceptual Fassifern to Hexham Rail Link may join the Mainline in the vicinity of the TSF site.

9.19.3 Local Sensitivities

There is a range of local land uses with potential sensitivities to cumulative impacts and are listed below. These land uses and the list of uses and sensitivities is:

- The Hexham industrial area east of the site;
- The residential area of Tarro, 1 - 2km to the north of the TSF Site;
- The Hunter River east of the site;
- The location of the site on the Hunter River floodplain;
- An area of SEPP 14 Coastal Wetlands on the site and other areas of vegetation; and
- The Hexham Swamp is an ecologically important area adjoining the site to the west.

Not all would be affected by cumulative impacts linked to the proposal.

9.19.4 Traffic and Transport

Access to the site will be via the New England Highway off the Tarro Interchange. The traffic assessment finds that the additional traffic levels generated by the operation of the proposal are insignificant.

9.19.5 Aboriginal Heritage

The cumulative impact to Aboriginal heritage in the area is limited given that:

- The net development footprint does not affect a high proportion of any particular landform present within the region;
- A comparable suite of landforms (swamps and swamp margins) contain similar archaeological resource occur in multiple contexts within the local area;
- All high density deposits identified to date occur outside the development footprint;
- The placement of the development within the swamplands and within the disturbed context, ensures the cumulative impacts are focused in areas of lower archaeological potential, ensuring impacts are kept to a minimum;
- Plans have been altered to ensure that no part of the surface expression of site HS1 will be impacted upon, thereby retaining a representative archaeological and cultural resource for the study area;

- A small portion of the potential subsurface expression of site HS1 (PAD) may be impacted upon. Test excavations will assist in identifying the nature and extent of any sub-surface materials and allow the proposed development flexibility to plan around such evidence; and
- The PCD has also been subject to long term past land uses (impacts) that have resulted in a disturbed landscape. As a consequence of these disturbances the representative value of the cultural resource is lessened. The majority of the PCD will remain undisturbed, the only disturbance will include the access track, and the remainder will be protected.

9.19.6 Noise and Vibration

There is potential for cumulative noise impacts associated with the project however the only effect is likely to be during construction. Construction noise impacts can be managed using the CEMP.

9.19.7 Air Quality

No significant cumulative effects were identified by the Air Quality Impact Assessment which included GHG.

9.19.8 Hazard and Risk

There is a potential risk to surrounding land use from the proposal. Following implementation of mitigation measures the residual risk is not considered significant. No significant cumulative risk arises from the interaction of the proposed TSF with other development and hazards in the locality.

9.19.9 Flooding

The proposed development and access are located adjacent to the Hunter River. There is the potential for changes that affect flood behaviour and drainage in the locality.

The cumulative flooding impacts, including the future F3 extension and ARTC additional tracks, have been assessed by WBM BMT.

Overall there is no significant cumulative flooding impact from all proposed developments for the 1% AEP (1 in 100 year) flood.

9.19.10 Ecology

The proposal will result in the loss of part of a disturbed SEPP 14 Coastal Wetlands area, some EEC and pasture for access requirements. These are cumulative impacts which have been recognised and mitigated through proposed environmental offsets.

The stormwater from the site has the potential to affect adjoining wetlands through altered wetting and drying cycles and additional runoff from hardstand areas. The proposed stormwater drainage system will manage both the quality and quantity of water coming off the site. This will prevent any cumulative impacts arising from altered drainage.

9.19.11 Infrastructure

The overall additional load on existing infrastructure is minimal due to the project being a new location for an existing enterprise. There are no significant local capacity thresholds that will be exceeded by the proposal.

The proposal will make adequate provision for connection to existing infrastructure as required.

9.19.12 Social and Economic

The cumulative effects are positive for social and economic considerations.

Construction would generate significant direct and indirect employment opportunities for the Lower Hunter Region during this period, as well as in NSW as a whole.

The efficiency of the coal transport chain is of significant importance to coal export and therefore the NSW and Australian economies.

Overall, beneficial cumulative impacts would be expected from the proposed TSF.

9.19.13 Mitigation Measures

The mitigation measures proposed to apply to the project will prevent both direct and cumulative adverse impacts.

9.19.14 Conclusion

Although there is the potential for some adverse cumulative impacts they are addressed by proposed mitigatory measures and project design.

The potential for significant adverse cumulative impacts in combination with the ARTC HRR Project and new development and infrastructure augmentation is unlikely.

Overall the cumulative impacts are likely to be beneficial.